Aerojet-General Corporation

PART 1 - Appendix E Perimeter Groundwater Operable Unit (OU-5) Remedial Investigation/ Feasibility Study

Baseline Risk Assessment for Groundwater

Aerojet Superfund Site
Sacramento, California

June 2009

Project No. 0020648.03

Document Control No. SR10130445

AEROJET
A GenCorp Company

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LIST OF ACRONYMS

µg/dL	Micrograms per deciliter
µg/L	Micrograms per liter
atm-m^3/mole	Atmosphere-cubic meter per mole
ACWS	Arden-Cordova Water Service
ADD	Average daily doses
AF	Attenuation factors
ATSDR	Agency for Toxic Substances and Disease Registry
BDCM	Bromodichloromethane
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
BLRA	Baseline Risk Assessment
BMI	Benthic macroinvertebrate
BTEX	Benzene, toluene, ethylbenzene, and xylenes
Cal-EPA	California Environmental Protection Agency
CCL	Carbon tetrachloride
CDFG	California Department of Fish and Game
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CF	Chloroform
cm^2	Square centimeters
CNDDB	California Natural Diversity Database
COPC	Constituent of potential concern
CSBP	California Stream Bioassessment Protocol
CSF	Cancer slope factor
CVEI	Central Valley Environmental, Inc.
DCA	Dichloroethane
DCB	Dichlorobenzene
DCE	Dichloroethene
DTSC	Department of Toxic Substances Control

dL	Deciliter
DQI	Data quality indicators
EMSI	Engineering Management Support, Inc.
ERA	Ecological Risk Assessment
ERM	ERM-West, Inc.
FOD	Frequency of detection
Freon 11	Trichlorofluoromethane
Freon 12	Dichlorodifluoromethane
FS	Feasibility study
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HI	Hazard index
HQ	Hazard quotient
IEUBK	Integrated Exposure Uptake Biokinetic
ILCR	Incremental (excess) lifetime cancer risks
IRCTS	Inactive Rancho Cordova Test Site
IRIS	Integrated Risk Information System
J&E	Johnson & Ettinger
kg	Kilogram
K_{oc}	Low organic carbon adsorption coefficient
L/day	Liter per day
L/m3	Liter per cubic meter
LADD	Lifetime average daily dose
LMS	Linearized multi-stage
LOAEL	Lowest-observed-adverse-effect-level
m^3	Cubic meter
MDEP	Massachusetts Department of Environmental Protection
mg/day	Milligrams per day
NCEA	National Center for Environmental Assessment
NDMA	N-Nitrosodimethylamine
NOAA	National Oceanic and Atmospheric Administration

NOAEL	No-observable-adverse-effect-level
OEHHA	Office of Environmental Health Hazard Assessment
OU	Operable Unit
PAH	Polynuclear aromatic hydrocarbons
PCA	Tetrachloroethane
PCD	Partial Consent Decree
PCE	Tetrachloroethene
PGOU	Perimeter Groundwater Operable Unit
PHQ	Physical Habitat Quality
RBP	Rapid bioassessment protocol
RfD	Reference dose
RI	Remedial investigation
RPD	Relative percent difference
RWQCB	Regional Water Quality Control Board, Central Valley Region
SC	Substrate Complexity
SLERA	Screening Level Ecological Risk Assessment
SMDP	Scientific/Management Decision Point
SVOC	Semivolatile organic compound
SVRA	State Vehicle Recreation Area
TCA	Trichloroethane
TCE	Trichloroethene
TIC	Tentatively identified compounds
TPH	Total petroleum hydrocarbons
TRV	Toxicity Reference Value
USEPA	United States Environmental Protection Agency – Region IX
VC	Vinyl chloride
VOC	Volatile organic compound
WGOU	Western Groundwater Operable Unit

1.0 INTRODUCTION

On behalf of Aerojet-General Corporation (Aerojet), ERM-West, Inc. (ERM) presents this Baseline Risk Assessment (BLRA) for the Perimeter Groundwater Operable Unit (PGOU) (OU-5) at the Aerojet Superfund Site (site) in Sacramento County, California. This BLRA has been prepared as part of a remedial investigation (RI)/feasibility study (FS), in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 as amended by the Superfund Amendments and Reauthorization Act of 1986 and Exhibit II of the Partial Consent Decree (PCD). The CERCLA Information System Identification Number for the Aerojet site is CAD 980358832. Government oversight for the Aerojet Superfund site is shared by the United States Environmental Protection Agency – Region IX (USEPA) and the California Environmental Protection Agency (Cal-EPA) through the Central Valley Regional Water Quality Control Board (RWQCB) and the Department of Toxic Substances Control (DTSC), hereinafter "the agencies."

This report incorporates comments from the agencies, as well as ERM/Aerojet's responses as noted below. The agency comments and respective responses from ERM and Aerojet are included as Appendices A, C, D, and E of Part 2 Final PGOU Remedial Investigation/Feasibility Study (RI/FS) Report.

- USEPA comment letter dated 28 October 2003 regarding the *Draft Baseline Risk Assessment for the Perimeter Groundwater Operable Unit (OU-5)* (Draft BLRA) (ERM, 2003b). Aerojet's comment response letter dated 9 July 2004 and USEPA's subsequent comment letter dated 29 August 2004.
- Agencies comment letter dated 14 April 2005 regarding the *Final Perimeter Groundwater Operable Unit Remedial Investigation/Feasibility Study* (Final PGOU RI/FS) (ERM and CVEI, February 2005) and Aerojet's Preliminary Responses letter dated 2 August 2005.
- Agency comments on Aerojet's Preliminary Responses to Agency Comments on the Final PGOU RI/FS provided in a letter dated 24 October 2005 and responses from ERM and Aerojet in a letter dated 16 December 2005.
- Additional agency comments on the Final PGOU RI/FS provided in a letter dated 20 January 2006 and responses from ERM and Aerojet in a letter dated 15 March 2006.

This report also incorporates modifications based on subsequent agreements with the agencies regarding vapor migration based on the work by Geosyntec (*Updated PGOU Vapor Intrusion Screening Assessment, Aerojet Superfund Site* [Geosyntec, 2008]) and those based on discussions/agreements with the agencies regarding the Boundary Operable Unit (OU-6).

This BLRA is included as Appendix E of Part I of the PGOU RI/FS and consists of a Human Health Risk Assessment (HHRA) and a Screening Level Ecological Risk Assessment (SLERA). The objective of this assessment is to evaluate potential risks to human and ecological populations who may be exposed to chemicals present in groundwater within the PGOU under both current and future conditions. The HHRA presented in Section 2 of this BLRA presents an evaluation of the hypothetical use of untreated groundwater for residential supply and the potential for migration of volatile organic compounds (VOCs) from groundwater into indoor air. The SLERA presented in Section 3 of this BLRA provides a preliminary characterization of potential risks to ecological receptors that may be exposed to chemicals in groundwater.

This BLRA used groundwater data presented in Appendix A (Zone 1 PGOU RI), Appendix B (Zone 2 PGOU RI), Appendix C (Zone 3 PGOU RI), and Appendix D (Zone 4 PGOU RI) of Part 1 of the PGOU RI/FS to assess the potential risks to human and ecological receptors. The following subsection presents a brief summary of background information related to the PGOU, including the site setting and history of investigations. The final portion of this introduction describes the organization of the remaining sections of this BLRA report.

1.1 BACKGROUND INFORMATION

The Aerojet site (Figure 1-1) has been used to develop rocket propulsion systems in support of national defense, space exploration, and satellite deployment since the 1950s. Industrial activities supporting this work include solid rocket motor manufacturing, testing, and rehabilitation (hogout); liquid rocket engine manufacturing and testing; and chemical manufacturing. A variety of chemicals has been manufactured and used at the site, including solvents, propellants, fuels, oxidizers, metals, and various other chemicals produced to support industrial operations.

The following sections describe the site setting and history of investigations at the Aerojet site.

1.1.1 *Site Setting*

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

Land use surrounding the Aerojet site includes residential, commercial, industrial, agricultural, and recreational, as well as undeveloped areas. The greatest amount of development exists north and northwest of the site in the communities of Rancho Cordova and Gold River. These communities have a combined population of approximately 60,000. The southern and eastern areas around the site boundaries are primarily undeveloped. The State Vehicle Recreation Area (SVRA), which encompasses Aerojet Area 39, is mainly undeveloped and used for off-road recreation. Aggregate mining is conducted northeast of the SVRA, south of the former Ehnisz property, on privately owned property and on the Inactive Rancho Cordova Test Site (IRCTS) owned by Aerojet. Portions of the lands south of White Rock Road are used for cattle grazing and small farming operations and there are a few ranchettes and houses, including the Clark Cattle Company.

Groundwater within the PGOU is designated for municipal use as a potential drinking water source in the RWQCB Basin Plan (RWQCB, 1998). However, groundwater on site is not used for any purpose, and future groundwater use on lands removed from the Superfund Site boundary is governed by environmental restrictions included in the PCD and recorded against title to the land.

Future additional use of groundwater off site is currently restricted by the Sacramento County Ordinance. The Sacramento County Environmental Management Department manages a "Consultation Zone," which requires all parties to consult with DTSC and RWQCB prior to issuing a well permit within a 2,500-foot distance from chemicals in groundwater at the Aerojet site.

As discussed in Section 1, Part 1, of the PGOU RI/FS report, Aerojet has updated its private water supply well survey (Well Survey) for the PGOU.

The Well Survey identified municipal and domestic water supply wells within 1 mile of the PGOU boundaries. Domestic water supply wells include those used by private citizens or businesses to produce water for irrigation and/or consumption. A list of wells identified during the survey, their Aerojet and/or State well numbers, and the status of each well as of August 2005 is presented in Table 1-1. The location of each active well is shown on Figure 1-2a. Active municipal and domestic wells within the boundary of the PGOU and within 1 mile of the PGOU boundary are discussed below. The locations of inactive, abandoned, or destroyed wells are shown on Figure 1-2b.

1.1.1.1 *Wells within the PGOU Boundary*

Two active municipal water supply wells (1049 and 2066) are within the PGOU boundary (Figure 1-2a). Well 1049 is currently monitored by Aerojet in accordance with the provisions of the PCD Exhibit IV (Sitewide Groundwater Monitoring Plan). Well 2066 is currently monitored by Aerojet in accordance with the provisions of the Western Groundwater Operable Unit (WGOU) Monitoring Plan. No additional active municipal water supply wells were identified within the boundaries of Zone 1 PGOU, Zone 2 PGOU, Zone 3 PGOU, and Zone 4 PGOU.

Four active domestic wells (1024, 1045, 1154, and 1156) were identified within Zone 1 PGOU. In addition, one active domestic well (1059) was identified within Zone 3 PGOU. No active domestic wells were identified within the boundaries of Zone 2 PGOU and Zone 4 PGOU. The status of the five active domestic wells located within PGOU boundaries is presented below.

- Well 1024 is used for irrigation purposes and was added to the Aerojet 2005–2006 Exhibit IV Monitoring Program.
- Well 1045 is located in the California State University – Sacramento Aquatic Center building near Lake Natoma and is used for irrigation. This well was historically monitored by Aerojet and was added to the Aerojet 2005–2006 Exhibit IV Monitoring Program.
- Well 1059 is located in the Prairie City State Off-Highway Vehicle Park and is used for irrigation purposes. This well is monitored by Aerojet under the Exhibit IV monitoring program.
- Well 1154 is located in the Nimbus Flat Park and is used for irrigation purposes. This well is monitored by Aerojet under the Exhibit IV monitoring program.

- Well 1156 is located at Sailor Bar, which is operated by the County Parks and Recreation Department. This well is in use with wellhead treatment provided and monitored by Aerojet.

1.1.1.2 *Wells within 1 Mile of the PGOU Boundary*

Eight municipal water supply wells were identified within 1 mile of the PGOU boundary (1047, 1098, 1366, 1871, 1943/AKT-1, 2065, 2067, and 2069) (Figure 1-2a). The status of these wells is presented below.

- Wells 1098, 2065, 2067, and 2069 were included in the WGOU (OU-3) well survey and not included within the PGOU evaluation.
- Well 1366 is an active public water supply well operated by Fair Oaks Water District and monitored under the Exhibit IV and Aerojet Sitewide Groundwater Monitoring Program.
- Well 1047 was a public water supply well, operated by Fair Oaks Water District until Summer 2008 when the well and associated property were purchased by Aerojet. Since that time the pump was removed from the well and the well is no longer operational.
- Well 1871 is located at a business along Prairie City Road, north of the Zone 4 PGOU boundary. The owner indicated that Well 1871 is only used as a source of industrial water in case of an emergency.
- Well 1943/AKT-1 is used by the Teichert Aggregate Plant. This well is in use with wellhead treatment provided and monitored by Aerojet under the Zone 1 PGOU Groundwater Monitoring Program.

Fourteen active domestic wells were identified within 1 mile of the PGOU boundary (1028, 1029, 1031, 1159, 1221, 1298, 1299, 1301, 1816, 1864, 1893, 1917, 1929, and 1933) (Figure 1-2a). The status of these wells is presented below.

- Three domestic wells (1893, 1929, and 1933) are located north of the American River and near the northern edge of the 1-mile boundary line for Zone 1 PGOU (Figure 1-2a). The three wells are upgradient to the flow of groundwater within Zone 1 outside the identified extent of chemical groundwater plumes in that zone.
- Well 1221 is located just north of the Zone 1 PGOU boundary. This well is operated by Parks and Recreation and used for irrigation. This well is monitored by Aerojet under the Exhibit IV monitoring program.

- Two active domestic wells (1028 and 1029) are located south of the Zone 2 PGOU boundary within the IRCTS property. Well 1028 is used for watering stock and well 1029 is used for dust control and process water. Both wells have historically been monitored by Aerojet.
- Four private domestic wells (1159, 1299, 1816, and 1864) are located south of the Zone 3 PGOU boundary (Figure 1-2a). The wells are monitored by Aerojet under the Exhibit IV monitoring program.
- Four private domestic wells (1031, 1298, 1301, and 1917) are also located south of the Zone 3 PGOU boundary (Figure 1-2a) in an area of planned development. In 2004, the wells were reportedly used by the residents for domestic and irrigation purposes. Wells 1031, 1301, and 1917 are currently monitored under the Aerojet 2005 – 2006 Exhibit IV Monitoring Program. The property owner of Well 1298 indicated that this well is available for irrigation and domestic used, if needed. If the owner elects to use the well, Aerojet will conduct monitoring in accordance with Exhibit IV Monitoring Program.

1.1.2 History of Investigations

The Operable Unit RI/FS Program Plan (Exhibit II) for the Aerojet site is administered through the PCD, initially entered by the Court in June 1989 and modified in December 1989, June 1990, June 1998, and April 2002. The PCD defines the PGOU as follows:

> *All remaining plumes of chemicals in groundwater at and beyond the Aerojet site that are not addressed by the Western Groundwater OU, the Area 41 soil and groundwater OU, or the remedial program for the Inactive Rancho Cordova Test Site (IRCTS) under DTSC Order No. I&/SE93/94/016 and Regional Board CAO 97-093. This OU shall include, without limitation, the plumes of chemicals in the groundwater at Areas 39 and 40 and the remaining plumes of chemicals in the groundwater migrating from the Aerojet General Operating Plan beneath the Inactive Rancho Cordova Test Site (IRCTS). The American River Study Area is included in this OU...*

Characterization of soil and groundwater beneath the Aerojet site has been ongoing since the early 1980s. Since that time, many investigations have been conducted to define the nature and extent of contamination, pilot test potential remedial technologies, and evaluate the effectiveness of existing remedial systems. The following list summarizes significant RI/FS efforts that have been conducted in and around the PGOU:

- ***1993:*** The Stage 1 RI Reports (ICF Kaiser Engineers) contain the results of comprehensive, site-wide soil, soil vapor, and groundwater sampling.
- **1995 through 2000**: The Stage 2 Sampling and Analysis Work Plans (GenCorp Aerojet) were prepared to complete RI/FS activities at source areas throughout the Aerojet site, including those within the PGOU. Additionally, the Stage 2 Sampling and Analysis Work Plans include groundwater monitoring conducted as part of the PGOU RI/FS.
- **1993 through present**: The Annual Groundwater Monitoring Plans (GenCorp Aerojet) contain the locations, chemical analyses, and sampling frequencies for monitoring the downgradient extent of chemical plumes, the effectiveness of the groundwater extraction and treatment systems, and public water supply wells.
- **2000**: The WGOU RI/FS addressed groundwater along the western perimeter of the Aerojet site and groundwater that had migrated off site to the west and northwest. The USEPA Region IX issued a Record of Decision in July 2001 and a Unilateral Administrative Order (USEPA, 2002a) requiring that Aerojet implement a groundwater pump-and-treat remedy to contain chemicals in groundwater at the western site perimeter and restore groundwater to below cleanup standards off site with multiple lines of groundwater extraction wells.
- **2004 through 2008:** Aerojet conducted a site-specific investigation and analysis of the vapor intrusion pathway to support the use of the Johnson and Ettinger (J&E) 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 and values needed for vapor intrusion model. The results of this evaluation are presented in the *Updated PGOU Vapor Intrusion Screening Assessment, Aerojet Superfund Site* (Geosyntec, 2008).

The Aerojet site was divided into four management zones (Zones 1 through 4) during negotiations over the PCD and the site has been historically divided into seven sectors (Sectors A through G) based on groundwater flow directions. These designations have been retained in this BLRA to ensure consistency with other RI/FS analyses. Detailed discussion of the types of chemicals identified in groundwater in each zone is presented in Section 2 of this BLRA.

1.2 REPORT ORGANIZATION

Following this introduction, the remaining sections of this BLRA report are organized as follows:

- Section 2 presents the HHRA;
- Section 3 presents the SLERA; and
- Section 4 lists references used to develop this BLRA.

2.0 HUMAN HEALTH BASELINE RISK ASSESSMENT

This HHRA was conducted in accordance with the risk assessment methodologies and assumptions developed by USEPA and DTSC, following the scope of work outlined in the *Final Perimeter Groundwater Operable Unit Remedial Investigation/Feasibility Study Workplan* (Engineering Management Support, Inc. [EMSI] et al., 2002).

Regulatory guidance used to develop this HHRA included the following:

- *Superfund Exposure Assessment Manual* (USEPA, 1988);
- *Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual, Part A* (USEPA, 1989);
- *Preliminary Endangerment Assessment Guidance Manual* (DTSC, 1994);
- *Supplemental Guidance for Human Health Multimedia Risk Assessment of Hazardous Waste Sites and Permitted Facilities* (DTSC, 1996);
- *Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual, Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments* (USEPA, 2001b);
- *Draft Guidance for Evaluating the Vapor Intrusion into Indoor Air Pathway from Groundwater and Soils* (Vapor Intrusion Guidance; USEPA, 2002b);
- *Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment* (USEPA, 2004a);
- *Region 9 Preliminary Remediation Goals (PRGs) 2004 Update* (USEPA, 2004b); and
- *Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties* (Cal/EPA, 2005a).

Consistent with current risk assessment guidance developed by USEPA and DTSC, this HHRA involves the following steps:

- Selection of Constituents of Potential Concern (COPCs);
- Exposure Assessment;
- Toxicity Assessment; and
- Risk Characterization.

These steps are discussed in the following subsections. A discussion of the uncertainties associated with the risk assessment process and with this HHRA is also presented. This section concludes with a summary of the HHRA results.

2.1 *DATA EVALUATION*

This section presents a brief evaluation of the data used in the selection of COPCs. This selection process follows the methodologies developed by USEPA and DTSC (USEPA, 1989; DTSC, 1994). Constituents selected as COPCs were carried through the remaining steps of the HHRA; eliminated constituents were excluded from further analysis in the HHRA.

2.1.1 *Data Compilation*

The HHRA used data collected from the permanent groundwater monitoring well network within the boundaries of PGOU, which is routinely monitored under the *Aerojet Site Draft 2008-2009 Groundwater Monitoring Plan* (Aerojet, 2008). The HHRA considered analytical results for all groundwater monitoring well samples collected from January 2000 through June 2004. In addition, supplemental data collected after June 2004 from Zone 2 PGOU and Zone 4 PGOU were also included. This date range is consistent with the timeframe for the data collection activities presented in the RIs (Appendices A through D). The data set used within this HHRA will be referred to as RI Reporting Period for the remainder of this document.

Solvents and rocket fuel components are the most widely distributed chemicals in groundwater. The following is a list of the most common chemicals detected in groundwater within the PGOU:

- **VOCs:** Trichloroethene (TCE); tetrachloroethene (PCE); 1,2-dichloroethene (DCE) (total); 1,1-DCE; 1,1-dichloroethane (DCA); 1,2-DCA; Freon 113; vinyl chloride (VC); carbon tetrachloride (CCL); and methylene chloride.
- **Metals:** Aluminum, arsenic, barium, hexavalent chromium, iron, lead, manganese, silver, vanadium, and zinc.
- **Rocket Fuel-Related Compounds:** N-Nitrosodimethylamine (NDMA), perchlorate, and nitrate.
- **Petroleum-Related Compounds:** Diesel fuel, kerosene, and benzene.

Of these, TCE, perchlorate, and NDMA are the most common and widely distributed compounds in groundwater within the PGOU.

As noted in Section 1, the PGOU is divided into four management zones: Zone 1 PGOU, Zone 2 PGOU, Zone 3 PGOU, and Zone 4 PGOU. Wells associated with each management zone are listed in Attachment A and shown on Figures 2-1 through 2-4.

Saturated sediments beneath each of the four management zones are divided into six primary hydrostratigraphic layers (Layers A through F), to the extent they are present, in descending order based on lithologic descriptions, water levels, geophysical data, pump test data, chemical data, and relative depths and thickness (Table 2-1). In addition to the six hydrostratigraphic layers, Zone 4 PGOU also includes a shallow, dredged layer and a bedrock layer. The following text briefly describes the chemicals detected in perimeter groundwater in each of the study areas. In addition, a description of the surface water data is provided.

2.1.1.1 Zone 1 PGOU

The Zone 1 PGOU is in the northern portion of the Aerojet site and incorporates the American River Study Area and overlaps with the WGOU.

Constituents reported in one or more groundwater samples collected from Zone 1 PGOU wells include:

- **VOCs:** 1,1,1-trichloroethane (TCA); 1,1,2,2-tetrachloroethane (PCA); 1,1,2-TCA; 1,1-DCA; 1,1-DCE; 1,2-DCA; 1,2-DCE (total); acetone; benzene; bromodichloromethane (BDCM); bromoform; CCL; chloroform (CF); chloromethane; cis-1,2-DCE; dibromochloromethane; dichlorodifluoromethane (Freon 12); Freon 113; methylene chloride; PCE; toluene; trans-1,2-DCE; TCE; trichlorofluoromethane (Freon 11); and VC.
- **Semivolatile organic compounds (SVOCs):** 1,4-dioxane; N-Butylbenzenesulfonamide; NDMA; and phenol.
- **Inorganic Non-Metals:** Nitrate, nitrite, and perchlorate.
- **Essential Nutrients:** Calcium, magnesium, potassium, and sodium.
- **Metals:** Aluminum, barium, boron, chromium, cobalt, copper, hexavalent chromium, iron, manganese, molybdenum, nickel, silver, vanadium, and zinc.

In addition, the following tentatively identified compounds (TICs) were detected in one or more groundwater samples collected from Zone 1 PGOU: 1-ethyl-2,3-dimethylcyclohexane; 1-indanone; 1,2-dichlorocyclohexane; 1-(4-methylphenyl)ethanone; 2-ethyl-1-hexanol; 2-ethylhexanoic acid; 2,6-di-tert-butyl-4-methylphenol; acetophenone; bezothiazole; butyrolacetone; cadmium stearate; dimexano; diphenyl sulfone; drometrizole; iridomyrmecin; N-butyl-4-methylbenzen-sulfonamide; palmitic acid; salicylaldehyde; salicylic acid; m-toluic acid; o-toluic acid; stearic acid; triethyl phosphate; and unknown compounds.

TCE and perchlorate were the most commonly detected compounds and were distributed over the largest area within the Zone 1 PGOU.

2.1.1.2 *Zone 2 PGOU*

Zone 2 PGOU is located along the southern portion of the Aerojet site adjacent to the IRCTS and only includes land within the property boundary of the Aerojet Superfund site. Constituents reported in one or more groundwater samples collected from Zone 2 PGOU wells include:

- **VOCs:** 1,2-DCA; 1,2-DCE (total); CF; PCE; and TCE.
- **Inorganic Non-Metals:** Nitrate and perchlorate.
- **Essential Nutrients:** Calcium, magnesium, potassium, and sodium.
- **Metals:** Barium, copper, iron, manganese, and vanadium.

TCE and perchlorate were the most commonly detected compounds and were distributed over the largest area.

2.1.1.3 *Zone 3 PGOU*

Zone 3 PGOU is southeast and east of the Aerojet site. Constituents reported in one or more groundwater samples collected from Zone 3 PGOU wells include:

- **VOCs:** 1,1-DCA; 1,1-DCE; 1,2-DCA; 1,2-DCE (total); CCL; CF; cis-1,2-DCE; Freon 12; Freon 113; methylene chloride; TCE; PCE; Freon 11; and VC.
- **SVOCs:** 1-methyl-2pyrrolidinone; dimethyl phthalate; 1,4-dioxane; and NDMA.
- **Inorganic Non-Metals:** Nitrate, nitrite, and perchlorate.
- **Essential Nutrients:** Calcium, magnesium, potassium, and sodium.

- **Metals:** Aluminum, barium, boron, chromium, copper, iron, manganese, silver, vanadium, and zinc.
- **Total petroleum hydrocarbons (TPH):** Diesel.

In addition, the following TICs were in one or more groundwater samples collected from Zone 3 PGOU wells: 2-ethyl-1-hexanol; dimexano; and unknown compounds.

TCE, perchlorate, and NDMA were the most commonly detected compounds and were distributed over the largest area in Zone 3 PGOU.

2.1.1.4 *Zone 4 PGOU*

Zone 4 PGOU is located along the northern side of the Aerojet site. Constituents reported in one or more groundwater samples collected from Zone 4 PGOU wells include:

- **VOCs:** 1,1-DCA; 1,1-DCE; 1,2-DCA; 1,2-DCE (total); BDCM; methyl bromide; CCL; CF; chloromethane; cis-1,2-DCE; Freon 12; Freon 113; methylene chloride; trans-1,2-DCE; TCE; Freon 11; and VC.
- **SVOCs:** 1,4-dioxane; 1,3-dichlorobenzene (DCB); 1,4-DCB; and NDMA.
- **Inorganic Non-Metals:** Nitrate and perchlorate.
- **Essential Nutrients:** Calcium, magnesium, potassium, and sodium.
- **Metals:** Aluminum, barium, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, selenium, vanadium, and zinc.

TCE and NDMA were the most commonly detected compounds and were distributed over the largest area within Zone 4 PGOU.

2.1.1.5 *Surface Water*

The RIs (Appendices A through D) identified the following surface water bodies in the PGOU:

- Zone 1 PGOU: American River, Lake Natoma, the Folsom South Canal, the former Valley Ditch, Buffalo Creek, the Westlake Storm Water Retention Cells, and the Area 20 Administration Ditches;
- Zone 2 PGOU: Rebel Hill Ditch, Buffalo Creek, and the Westlake Storm Water Retention Cells;

- Zone 3 PGOU: Buffalo Creek, the headwaters of Morrison and Coyote Creeks, and Rebel Hill Ditch; and
- Zone 4 PGOU: Alder Creek and surface seeps observed on the hillside south of Alder Creek.

Surface water runoff on site in Zone 1 is either discharged to low areas or channeled into a system of man-made ditches that eventually discharge into the Westlake Storm Water Retention Cells (Figures 2-1 and 2-4). Water is temporarily stored in the Westlake Storm Water Retention Cells where it infiltrates into the soil or, on rare occasion, is discharged to Buffalo Creek, and ultimately to the American River.

Discharges to Buffalo Creek from the Westlake Storm Water Retention Cells are regulated through the *Revised Waste Discharge Requirements for Aerojet-General Corporation and Aerojet Fine Chemicals* (National Pollutant Discharge Elimination System [NPDES] Permit No. CA0004111) (RWQCB Order No. R5-1999-0016-R01, revised 2001) and analytical sampling is conducted prior to discharges. As part of the NPDES permit process, surface water samples are collected from Station S-2.

Based on the data and cross-sections presented in the groundwater RIs (Appendices A through D), with the exception of Zone 4 PGOU, there is an overall downward vertical gradient within the PGOU. In addition, the hydrostratigraphic data presented in the Zone 1 PGOU RI (Appendix A) indicate that surface water from the American River infiltrates into the underlying groundwater units. The infiltration of surface water from the American River prevents the discharge of perimeter groundwater into the American River. Therefore, the groundwater discharge to surface water pathway is not complete for the Zone 1 PGOU, Zone 2 PGOU, and Zone 3 PGOU surface water bodies.

The hydrostratigraphic data presented in the Zone 4 PGOU RI (Appendix D) report do indicate, however, that groundwater could potentially discharge to Alder Creek. Water quality in Alder Creek is monitored by Aerojet on a semiannual basis through the collection and analysis of surface water samples at two locations (S-5 and S-6). Sampling station S-5 is situated along Alder Creek as it enters the east side of the Aerojet site and station S-6 is at the west end of Alder Creek where it exits the property (Figure 2-4). The historical detections of two COPCs (NDMA and perchlorate) in surface water samples collected from Station S-6 along Alder Creek that are also present in the uppermost groundwater unit in Zone 4 PGOU indicate that groundwater in Zone 4 PGOU discharges to

Alder Creek. Based on the hydrostratigraphic data and the detection of the COPCs, the discharge of groundwater to surface water in Alder Creek is considered a potentially complete pathway in this HHRA. However, exposures to constituents in Alder Creek are expected to be negligible for the following reasons: constituents (i.e., NDMA, perchlorate, acetone, chloromethane, and naphthalene) were only detected sporadically in surface water samples; constituents were detected at very low levels; and the opportunity for exposure to constituents in Alder Creek is expected to be limited to occasional dermal contact under a recreational scenario. The HHRA also evaluated the three Alder Creek samples collected in 2004 for the macroinvertebrate study (Alder Creek #1, #2, and #3).

2.1.2 *Evaluation of Analytical Methods*

The primary objective of the data review and usability evaluation was to identify appropriate data for use in the risk assessment. The analytical data were reviewed for applicability and usability following procedures in the *Guidance for Data Usability in Risk Assessment (Part A)* (USEPA, 1992 and USEPA, 1989). According to the USEPA Data Usability Guidance, there are six principal evaluation criteria by which data are judged for usability in risk assessment. The six criteria are:

- Availability of information associated with site data;
- Documentation;
- Data sources;
- Analytical methods and quantitation limits;
- Data review; and
- Data quality indicators (DQIs), including precision, accuracy, representativeness, comparability, and completeness.

A summary of these six criteria for determining data usability in the HHRA is provided below. These criteria are evaluated as a function of the standard operating procedure for the data validation process applied to data for the PGOU RI, as outlined in the *Quality Assurance Project Plan* (Aerojet, 2003a). The HHRA used data collected from the permanent groundwater monitoring well network, which is routinely monitored under the *Aerojet Site Draft 2008-2009 Groundwater Monitoring Plan* (Aerojet, 2008).

2.1.2.1 *Criterion I – Availability of Information Associated with Site Data*

The usability analysis of the site characterization data requires the availability of sufficient data for review. The required information is available from documentation associated with the site data and data collection efforts. The following lists the information sources and the availability of such information for the data usability process associated with this HHRA:

- A site description provided in the RI Report and summarized in Section 2.1.1 of this report identifies the locations and features of the source areas and site-specific characteristics; and
- Site maps with sample locations are provided in the RI Report.

2.1.2.2 *Criterion II – Documentation Review*

The objective of the documentation review is to confirm that the analytical results provided are associated with a specific sample location and collection procedure, using available documentation. As part of the data validation process, the chain-of-custody forms prepared in the field were reviewed and compared to the analytical data results provided by the laboratory to 1) ensure completeness of the data set, and 2) that all samples analyzed by the laboratory were correlated to the correct geographic location at the site(s). Sample collection forms were also reviewed to ensure field procedures included documentation of sample times, dates, and locations; and other sample-specific information such as depth below ground surface (bgs) were also recorded. Information from field forms generated during sample collection activities was imported into the project database.

2.1.2.3 *Criterion III – Data Sources*

As part of the data validation process, the review of data sources was performed to determine whether the analytical techniques used in the site characterization process are appropriate to identify the COPCs in the HHRA.

2.1.2.4 *Criterion IV – Analytical Methods and Quantitation Limits*

In addition to the appropriateness of the analytical techniques evaluated as part of Criterion III, it is necessary to evaluate whether the analytical methods used appropriately identify COPCs and whether the quantitation limits are low enough to allow adequate characterization of risks. At a

minimum, this data usability criterion can be met through the determination that routine USEPA reference analytical methods were used in analyzing samples collected from the site. Elevated quantitation limits are evaluated in the uncertainty section.

2.1.2.5 *Criterion V – Data Review*

The data review portion of the data usability process focuses primarily on the quality of the analytical data received from the laboratory. All site data that are used in the HHRA must be evaluated on the basis of completeness, precision (based on duplicates), and accuracy (based on laboratory spikes). In addition, the laboratory results data are reviewed for blank contamination.

Sample results were validated in accordance with the Quality Assurance Project Plans (17 August 1999, 13 May 2000, 31 May 2001, and 29 May 2003). Rejected data were not used in the HHRA. Where applicable, laboratory and data assessment qualifiers are included on the HHRA tables. The following table presents a list of the qualifiers included within the database.

Qualifier	Description
A	Suspected aldol condensation product
B	Analyte found in associated blank
C	Spiked Sample recovery not within control limits
D	Analyte from secondary dilution analysis
E	Analyte exceeds calibration range
F	Estimated concentration due to an interference
G	Duplicate analysis not within control limits
H	Correlation coefficient for MSA less than 0.995
J	Estimated concentration
M	Duplicate precision not met

N	Presumptive evidence of a compound
S	Concentration determined by method of standard additions
U	Not detected above the method detection limit

2.1.2.6 *Criterion VI – Data Quality Indicators*

DQIs are used to verify that sampling and analytical systems used in support of project activities are in control and the quality of the data generated for the project is appropriate for making decisions affecting future activities. The DQIs address the field and analytical data quality aspects as they affect uncertainties in the data collected for site characterization and the HHRA. The DQIs include precision, accuracy, representativeness, comparability, and completeness. Each of these factors is described below.

Precision - Precision is a measure of the degree of agreement between replicate measurements of the same source or sample. Precision is expressed by the relative percent difference (RPD) between replicate measurements. Replicate measurements can be made on the same sample or on two samples from the same source. Precision is generally assessed using a subset of the measurements made.

Accuracy - Accuracy measures the level of bias that an analytical method or measurement exhibits. To measure accuracy, a standard or reference material containing a known concentration is analyzed or measured and the result is compared to the known value. The following quality control parameters are used to evaluate the accuracy of reported analytical results:

- Holding times and sample temperatures;
- Laboratory control spike percent recovery;
- Matrix spike/matrix spike duplicate percent recovery (organics);
- Spike sample recovery (inorganics);
- Surrogate spike recovery; and
- Blank sample results.

Representativeness - Representativeness is the degree to which data accurately and precisely represent a characteristic of the population at a

sampling point or an environmental condition. There is no standard method or formula for evaluating representativeness, which is a qualitative term. Representativeness is achieved through selection of sampling locations that are appropriate relative to the objective of the specific sampling task, and by collection of an adequate number of samples from the relevant types of locations. As discussed in Section 2, the Workplan was developed to allow collection of samples that are representative of the media to which the receptors may be exposed at the site.

Completeness - Completeness is commonly expressed as a percentage of measurements that are valid and usable relative to the total number of measurements made. Analytical completeness is a measure of the number of overall accepted analytical results, including estimated values, compared to the total number of analytical results requested on samples submitted for analysis after review of the analytical data. All of the analytical data collected during the reporting period were used in this HHRA.

Comparability - Comparability is a qualitative characteristic expressing the confidence with which one data set can be compared with another. The analytical methods are generally consistent with those used in previous investigations of the site. The comparability goal is achieved through using standard techniques to collect and analyze representative samples and reporting analytical results in appropriate units.

2.1.3 *Constituents of Potential Concern Screening*

COPCs are site-related constituents that may adversely affect receptors of concern. COPCs do not necessarily signify a risk; rather, they are merely constituents that have been identified for advancement to further analyses. In accordance with USEPA requirements (2001b), all groundwater data collected within the RI Reporting Period were compiled, and the occurrence and distribution of each constituent was assessed.

COPCs were identified for the following media of interest:

- Groundwater; and
- Surface water.

The classes of chemicals identified in groundwater and surface water within the PGOU include the following:

- VOCs;
- Metals;
- SVOCs);
- Polychlorinated biphenyls (PCBs)/Aroclors;
- Pesticides; and
- Other constituents (e.g., perchlorate, NDMA).

To screen for COPCs in a particular medium of interest, all samples for that medium were considered and the maximum concentration for each constituent was identified.

2.1.3.1 *Essential Nutrient Evaluation*

Consistent with the *Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual, Part A* (USEPA RAGS, Part A; USEPA, 1989) essential human nutrients were not quantitatively addressed in this HHRA. Calcium, magnesium, potassium, and sodium naturally occur in Aerojet soils and are considered essential nutrients for human health.

2.1.3.2 *Concentration-Toxicity Evaluation*

In this screening step, maximum detected concentrations were compared with toxicity-based values developed by USEPA and Cal/EPA. For groundwater and surface water, one tenth of the lowest of either the tap water PRG or the California Public Health Goal was used for the comparison. The human health water screening levels are presented on Table 2-2.

For metals, it should be noted that the HHRA included review of both filtered and unfiltered data for both surface water and groundwater. According to USEPA guidance (USEPA, 2001b), only unfiltered groundwater data should be used in the screening for COPCs. For surface water, filtered and unfiltered data were collected at the same locations. Therefore, this HHRA used the total metal concentrations in this analysis. However, filtered and unfiltered data were not consistently analyzed at the same locations. Since COPC selection was based only on the maximum detected constituents, this HHRA retained the filtered groundwater data in that analysis. Appendices A through D to Part 1 of the RI/FS discuss the differences in the filtered and unfiltered groundwater data.

Organic chemicals present at concentrations below screening levels were additionally evaluated through a frequency of detection (FOD) analysis described below. Detected constituents for which no screening values were available are also identified as COPCs. COPCs lacking screening values are discussed as part of the Uncertainty Section.

As agreed upon with agencies during a teleconference meeting on 12 February 2004, TICs were not considered as COPCs in this HHRA because of the uncertainty surrounding their identification and concentrations. The rationale for exclusion of the TICs is based on the following:

- TIC detections have not been confirmed at the site (i.e., results are only a tentative identification and additional sampling was unable to reproduce results);
- In many cases, TIC identification involves only a general class of compounds (i.e., unknown hydrocarbons); and
- Aerojet has done considerable work to develop appropriate analyses for compounds whose presence has been confirmed.

2.1.3.3 *Frequency of Detection Evaluation*

The final step for organic COPC selection is to evaluate the FOD of each organic compound. Chemicals having maximum concentrations less than screening levels and FOD less than 5 percent in a medium are excluded as COPCs.

2.1.4 *Constituents of Potential Concern*

Tables 2-3, 2-4, 2-5, and 2-6 present the details of the summary analysis, including the range of each detected constituent and its frequency of detection in groundwater for Zone 1, Zone 2, Zone 3, and Zone 4, respectively. Table 2-7 presents the details of the summary analysis, including the range of each detected constituent and its frequency of detection in surface water.

2.1.4.1 *Zone 1 Groundwater*

The results of the Zone 1 groundwater COPC selection for human health are presented on Table 2-3. Two of the organic chemicals had maximum detected concentrations that were less than the screening level (one-tenth of a health-based level), but had detection frequencies greater than

5 percent. Results of the concentration/toxicity screen and FOD analyses indicated that the following analytes were COPCs for groundwater in Zone 1:

- **VOCs:** 1,1,2,2-PCA; 1,1,2-TCA; 1,1-DCA; 1,1-DCE; 1,2-DCA; 1,2-DCE (total); BDCM; CCL; CF; cis-1,2-DCE; dibromochloromethane; Freon 113; methylene chloride; PCE; toluene; TCE; and VC.
- **SVOCs:** 1,4-Dioxane; n-buytlbenzenesulfonamide; and NDMA.
- **Other Organics:** Nitrate, nitrite, and perchlorate.
- **Metals:** Aluminum, barium, boron, hexavalent chromium, copper, iron, molybdenum, silver, and vanadium.

2.1.4.2 *Zone 2 Groundwater*

The results of the Zone 2 groundwater COPC selection for human health are presented on Table 2-4. Results of the concentration/toxicity screen and FOD analyses indicated that the following analytes were COPCs for Zone 2 groundwater:

- **VOCs:** 1,2-DCA; 1,2-DCE (total); CF; PCE; TCE; and VC.
- **Other Organics:** Nitrate and perchlorate.
- **Metals:** Copper, iron, manganese, and vanadium.

2.1.4.3 *Zone 3 Groundwater*

The results of the Zone 3 groundwater COPC selection for human health are presented on Table 2-5. Two of the organic chemicals had maximum detected concentrations that were less than the screening level (one-tenth of a health-based level), but had detection frequencies greater than 5 percent. Results of the concentration/toxicity screen and FOD analyses indicated that the following analytes were COPCs for groundwater in Zone 3:

- **VOCs:** 1,1-DCA; 1,1-DCE; 1,2-DCA; 1,2-DCE (total); carbon tetrachloride; CF; cis-1,2-DCE; Freon 113; methylene chloride; PCE; TCE; and VC.
- **SVOCs:** 1,4-Dioxane; 1-methyl-2-pyrrolidinone; dimethyl phthalate; and NDMA.
- **Other Organics:** Nitrate, nitrite, and perchlorate.
- **Metals:** Aluminum, iron, manganese, silver, vanadium, and zinc.

Petroleum mixtures are complex and the toxic constituents are being evaluated individually. Therefore, although they are relevant for site characterization purposes, diesel-range organics and kerosene were not identified as COPCs.

2.1.4.4 *Zone 4 Groundwater*

The results of the Zone 4 groundwater COPC selection for human health are presented on Table 2-6. Three organic chemicals had a maximum detected concentration that were less than the screening level (one-tenth of a health-based level), but a detection frequency greater than 5 percent. Results of the concentration/toxicity screen and FOD analyses indicated that the following analytes were COPCs for Zone 4 groundwater:

- **VOCs:** 1,1-DCA; 1,1-DCE; 1,2-DCA; 1,2-DCE (total); BDCM; carbon tetrachloride; CF; chloromethane; cis-1,2-DCE; Freon 113; methylene chloride; trans-1,2-DCE; Freon 11; PCE; TCE; Freon 11; and VC.
- **SVOCs:** 1,4-Dichlorobenzene; 1,4-Dioxane; and NDMA.
- **Other Organics:** Nitrate, and perchlorate.
- **Metals:** Aluminum, barium, cadmium, cobalt, iron, lead, manganese, nickel, vanadium, and zinc.

Petroleum mixtures are complex and the toxic constituents are being evaluated individually. Therefore, although they are relevant for site characterization purposes, diesel-range and motor oil organics were not identified as COPCs.

2.1.4.3 *Surface Water*

The results of the surface water COPC selection for human health are presented on Table 2-7. Results of the concentration/toxicity screen and FOD analyses indicated that the following analytes were COPCs for surface water:

- **Metals/Inorganics:** Aluminum, arsenic, ammonia as nitrogen, cadmium, iron, lead, molybdenum, nitrate as nitrogen, selenium, and vanadium.
- **Organics:** Chloroform, naphthalene, and perchlorate.

Petroleum mixtures are complex and the toxic constituents are being evaluated individually. Therefore, although they are relevant for site

characterization purposes, diesel-range and motor oil organics were not identified as COPCs.

2.1.4.4 *Additional Groundwater and Soil Vapor Evaluation*

At a meeting on 9 June 2004, the agencies indicated that they believed soil vapor data provide a more accurate assessment of the indoor pathway than the groundwater data. In addition, the *Draft Guidance for Evaluating the Vapor Intrusion into Indoor Air Pathway* (USEPA Vapor Intrusion Guidance, USEPA, 2002b) recommends soil gas sample collection if groundwater concentrations exceed Tier 2 generic screening evaluation. Accordingly, soil vapor samples were collected at three locations in November 2003 where groundwater was impacted at a minimum depth of 50 feet bgs. The samples were collected at 5 feet bgs within 10 to 15 feet of the following monitoring well locations: 1469 (Zone 1 PGOU), 3179 (Zone 1 PGOU), and 145 (Zone 3 PGOU).

Based on review of this data, the agencies requested additional evaluation of the vapor intrusion pathway. Therefore, between 2004 and 2008, Aerojet conducted a detailed site-specific investigation and analysis of the vapor intrusion pathway to support the use of the J&E 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 and values needed for the vapor intrusion model. The results of this evaluation are presented in the *Updated PGOU Vapor Intrusion Screening Assessment, Aerojet Superfund Site* (Geosyntec, 2008). This HHRA used the conservative soil physical property input parameters (i.e., 95 percent upper confidence limit porosity and 95 percent lower confidence limit soil moisture content) developed for the Aerojet site as the result of the investigation.

In addition, during the site-specific investigation, Aerojet evaluated the existing monitoring wells within the PGOU to determine those completed within the uppermost (first encountered) aquifer. This HHRA evaluated the potential risk for vapor intrusion using the same well list.

2.2 *EXPOSURE ASSESSMENT*

The objective of this exposure assessment is to evaluate potential human exposures to the constituents in perimeter groundwater and surface

water. The development of the exposure assessment included the following tasks:

- Potential human health exposure pathways associated with groundwater were identified;
- Potentially exposed populations were identified and exposure scenarios were defined, considering both current and future use conditions of the site;
- Exposure point concentrations were estimated; and
- Chemical intakes were estimated for the defined populations, using conservative assumptions to characterize the defined exposures.

These analyses are described in the following subsections.

2.2.1 *Identification of Potential Exposure Pathways*

A complete exposure pathway is made up of the following elements:

- A source of chemical constituents;
- A point of potential human contact; and
- An exposure route (i.e., ingestion, dermal contact, or inhalation) at the contact point.

An exposure pathway may also include a mechanism of chemical release (e.g., volatilization of chemicals from groundwater) and a transport medium (e.g., indoor air).

General exposure pathways that may be associated with groundwater and surface water include the following:

- Use of groundwater for residential water supply;
- Use of groundwater for industrial or agricultural water supply;
- Discharge of groundwater to surface water;
- Uptake of groundwater by food crops;
- Migration of VOCs from groundwater through the unsaturated zone into either indoor or ambient air;
- Contact with groundwater during excavation or other intrusive activities; and
- Direct contact with surface water.

Each of these pathways is discussed below. Exposure pathway information is summarized in Table 2-8 and on Figures 2-5 and 2-6 (Conceptual Site Model).

Use of groundwater for residential water supply: As discussed in Section 1.1.1.1, groundwater from existing municipal wells and domestic wells within the PGOU boundaries is used for residential supply. However, active wells are currently monitored in accordance with the requirements of the PCD monitoring program. Thus, there is no known current use of groundwater for residential supply from unmonitored or untreated wells either at or beyond the property boundary. Additionally, the future use of groundwater beyond the property boundary is restricted by the Sacramento County Consultation Zone, which requires special permission be granted for wells installed within 2,500 feet downgradient of identified plumes.

However, recognizing the RWQCB's designation of the PGOU as a potential future source of drinking water, this HHRA included analysis of the hypothetical use of untreated groundwater for residential water supply. This analysis considered hypothetical exposure to groundwater constituents via the following routes: ingestion, dermal contact, and inhalation of VOCs released during household non-ingestion use (i.e., showering, cooking, laundering, and dishwashing).

Use of groundwater for industrial or agricultural water supply: Under current conditions, there are no known uses of groundwater from untreated or unmonitored wells for industrial or agricultural supply either on site, at the property boundary, or beyond the property boundary.[1] The future use of groundwater beyond the property boundary is restricted by the Sacramento County Consultation Zone. Therefore, this pathway is not quantitatively evaluated in this HHRA.

Discharge of groundwater to receiving surface water bodies: The RIs (Appendices A through D) identified the following surface water bodies in the PGOU: Zone 1 PGOU: American River, Lake Natoma, the Folsom South Canal, the former Valley Ditch, Buffalo Creek, the Westlake Storm Water Retention Cells, the Area 20 Administration Ditches, Rebel Hill

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1 It should be noted that a number of wells are currently used for household irrigation. However, as described in the Well Survey (Section 1.1.1 of Part 1 of the PGOU Groundwater RI/FS), these wells are currently monitored.

Ditch, the headwaters of Morrison and Coyote Creeks, Alder Creek, and surface seeps observed on the hillside south of Alder Creek.

Based on the hydrostratigraphic data and the detection of COPCs, the discharge of groundwater to surface water in Alder Creek and Administration Ditches is considered a potentially complete pathway in this HHRA. However, exposures to constituents in Alder Creek and Administration Ditches are expected to be negligible for the following reasons: constituents were only detected sporadically in surface water samples; constituents were detected at very low levels; and the opportunity for exposure to constituents in Alder Creek is expected to be limited to occasional dermal contact under a recreational scenario. Therefore, this HHRA evaluated the potential dermal contact to surface water (i.e., potential wading scenario).

In addition, because surface water levels and detected concentrations of chemicals therein are ephemeral, accumulation of constituents in tissues of fish that could theoretically be consumed (recreationally) is minimal. In addition, as discussed below, most surface water features are not perennial, and once the planned land transfers occur, swimming will not be possible in the on-site features because they will be drained. Consequently, these exposure pathways are not quantitatively addressed in this risk assessment.

As discussed below, inhalation of vapors from surface water reflects a transitory pathway. In addition, while flux from these shallow water bodies is considered likely to be minimal, dispersion into outdoor air from these shallow water bodies will further reduce any potential exposures to VOCs to negligible levels. Therefore, this exposure pathway is not quantitatively addressed in this risk assessment.

Uptake of groundwater by crops: Exposure via this pathway is considered unlikely under both current and future use conditions because depth to groundwater is typically greater than 45 feet bgs in all zones, except for Zone 4 PGOU, but is still well below the root zone depth for crops. In Zone 4 PGOU, groundwater may occur at depths less than 45 feet, but only within the floodplain of Alder Creek. No crops are currently under cultivation in the floodplain of Alder Creek and the future anticipated land use for Alder Creek and its floodplain is recreational (greenbelt). Therefore, the cultivation of food crops within the floodplain of Alder Creek in the future is considered unlikely.

Migration of VOCs from groundwater to ambient air: Exposure via this pathway is limited by depth to groundwater and by the opportunity for VOCs from groundwater to mix with large volumes of ambient air. However, as shown on Table 2-1, the minimum depth to groundwater is less than 100 feet bgs for all but Zone 3 PGOU beyond property boundary. The potential risks with the potential, modeled concentration of VOCs migration into ambient air from groundwater are negligible compared to indoor air. In addition, potential contributions of VOCs from bulk soil and from groundwater to ambient air are represented by the soil vapor to ambient air calculation presented in the PGOU Lands HHRA. Therefore, VOC migration into ambient air from groundwater was not evaluated quantitatively in this HHRA.

Migration of VOCs from groundwater into indoor air: Exposure via this pathway is limited by depth to groundwater. The agencies have requested an estimation of the potential risks associated with the potential, modeled concentrations of VOCs migrating from groundwater at depths less than 100 feet. The theoretical risks associated with the modeled migration of VOCs into indoor air from groundwater present at depths less than 100 feet are therefore evaluated quantitatively in this HHRA.

Migration of VOCs from groundwater to trench air: Exposures via this pathway are limited by several factors including depth to ground water (as discussed in the "migration of VOCs from groundwater to ambient air" section above); the need to dewater or remove any groundwater (including perched groundwater) that may be present in a trench or other excavation to allow construction activities to proceed; and the limited opportunity for exposure (i.e., trench workers are usually only present in trenches for short periods of time; such work does not typically involve frequent, routine, or extended exposure). Subsequently, the migration of VOCs from groundwater to trench air was not assessed quantitatively in this HHRA.

Contact with groundwater during construction activities: The depth to groundwater (as discussed above) makes exposure via this pathway highly unlikely. In addition, potential exposures associated with this pathway would be limited because the logistics of construction activities typically require excavations to be kept free of water (i.e., dewatered if necessary). Dewatering activities during construction on lands removed from the Superfund Site are governed through environmental restrictions and must be conducted in an approved manner. Therefore, exposure to groundwater containing COPCs in many cases not be considered a

complete pathway, and in rare instances should be minimal in nature. Subsequently, this pathway is not evaluated quantitatively in the HHRA.

Contact with surface water: As discussed previously, exposures to constituents in Alder Creek and Administration Ditches are expected to be negligible for the following reasons: constituents were only detected sporadically in surface water samples; constituents were detected at very low levels as compared to screening levels; and the opportunity for exposure to constituents is expected to be limited to occasional dermal contact as described below.

Except for Alder Creek, surface water features are not perennial, which effectively limits exposure potential. Also, once the planned land transfers occur, swimming will not be possible in any of the on-site surface water features (e.g., Westlakes ponds will be drained). Since swimming is not a potentially complete pathway, dermal contact (wading) represents the only theoretically complete exposure pathway.

The theoretical wading exposure scenario potentially includes exposure to the feet, legs, hands, and arms; however, default exposure assumptions have not been developed by USEPA or Cal/EPA for the "wading" scenario. Therefore, dermal contact exposure values for swimming are used. However, because wading is less contact intensive than the approach used by USEPA (1997a) for swimming, incidental ingestion of surface water would be very minor or incomplete, and is not evaluated quantitatively in the HHRA.

Inhalation of vapors from surface water reflects an ephemeral, insignificant pathway. In addition, while flux from these shallow water bodies is considered likely to be minimal, dispersion into outdoor air from these shallow water bodies will further reduce any potential exposures to VOCs to negligible levels. Therefore, this exposure pathway was not quantitatively addressed in this risk assessment.

Based on this evaluation of potential exposure pathways, the hypothetical future use of untreated groundwater for residential water supply; migration of VOCs into indoor air; and dermal contact during wading in surface water represent the primary pathways requiring analysis in this HHRA.

2.2.2 *Identification of Populations and Exposure Scenarios*

As described in Section 1.1, the Aerojet site is currently used for industrial purposes, and activities are confined to specific manufacturing areas within the property. With the exception of these well-defined manufacturing areas, large parcels of the property serve as buffer lands and are not currently used. The PGOU includes buffer lands recently removed from the Superfund Site boundary. Future use of these areas may involve either residential or industrial activities depending on existing or future potential environmental restrictions.

Adjacent to the Aerojet site, the land use is mixed. Areas north of the site are characterized by both residential development (in the vicinity of the Gold River community) and commercial development (along Folsom Boulevard). To the south and east, the Aerojet site is bordered largely by undeveloped land. These areas could be developed in the future for either residential or industrial purposes.

Under current and realistic future use conditions, on- and off-site populations may include industrial workers, construction workers, maintenance/utility workers, residents (adults and children), commercial workers, and patrons of commercial establishments (e.g., shoppers or other visitors). Of these populations, residents are likely to have the greatest theoretical exposure potential. Therefore, this HHRA focused on the evaluation of potential risks for that population. However, this HHRA also included evaluation of volatilization of VOCs from groundwater and migration of vapors through the vadose zone into indoor air for commercial workers. Additionally, dermal contact with surface water during recreational use was assessed.

Additional rationale for the selection of receptor populations and exposure scenarios for inclusion in this HHRA is provided in Table 2-8. In summary, the following scenarios were selected for evaluation in this HHRA:

Population	Applicable Exposures
Residents (adult and child)	• Ingestion of groundwater as a potable water source; • Dermal contact with groundwater during domestic use (e.g., showering); • Inhalation of VOCs from groundwater during domestic use; and • Volatilization of VOCs from groundwater and

Population	Applicable Exposures
	migration of vapors through the vadose zone into indoor air.
Commercial Workers	• Volatilization of VOCs from groundwater and migration of vapors through the vadose zone into indoor air.
Recreator (adult and child)	• Dermal contact with constituents in surface water.

2.2.3 *Estimation of Exposure Point Concentrations*

Because the goal of the risk assessment is to understand the areal extent of potential risk and to create maps of these potential risks, part of this HHRA methodology was to calculate risk estimates based on the chemical results at each sampling location. This was conducted because there is high potential variability in the exposure units by which future receptors could be exposed, since a development plan has not yet been formally established for the site. Therefore, grouping sample locations into manageable and predictable exposure units would not be realistic or defensible.

To facilitate these point-by-point calculations, "unit concentrations" [i.e., 1 microgram per liter (µg/L)] were applied to the risk paradigm (equations, models, toxicity assessment, and risk characterization models) to develop a quantitative estimate of risk and hazard associated with this unit concentration, called "unit hazards" and "unit risks," for each COPC. By applying these COPC-specific unit risks and hazards to location measurements for each COPC, one can calculate location-specific hazard indices (HIs) and incremental (excess) lifetime cancer risks (ILCRs).

Additional descriptions of the estimation of exposure point concentrations for groundwater, surface water, and fate and transport modeling are described in the following sections.

2.2.3.1 *Groundwater*

To support remedial decision-making in the FS, exposures were considered separately in each PGOU zone. Risk estimates associated with direct contact with groundwater, and model inputs associated with estimating indirect exposures to groundwater were calculated on a sample-by-sample basis by using the individual sample results for each location as an input concentration. For each selected COPC, the

maximum detected concentration at each location during the reporting period (i.e. January 2000 through June 2004 and supplemental data collected after June 2004 from Zone 2 PGOU and Zone 4 PGOU) was used in the quantitative calculations.

Direct contact was assessed for all layers, including the deeper groundwater zones. Where chemicals are present in a deeper water-bearing zone and a shallow water-bearing zone is present, passive volatilization was not evaluated for the deeper zones. The shallower zones are considered potential barriers to vapor contributions from deeper zones, and potential contributions from the deeper zones are captured by evaluation of soil vapor samples. Also, it is not appropriate to use the same attenuation factor (AF) for groundwater at substantial depth (e.g., greater than 80 feet bgs) as is assumed for shallower zones (e.g., 20 feet bgs).

Indoor Air

Concentrations in indoor air were based upon modeling of individual location-depth concentrations from soil vapor measurements (discussed below).

2.2.3.2 *Surface Water*

Risk estimates associated with dermal contact with surface water were calculated on a sample–by-sample basis by using the individual sample results for each location as an input concentration. For each selected COPC, the maximum detected concentration at each location during 2004 was used for the quantitative calculations.

2.2.3.3 *Fate and Transport Modeling*

Fate and transport models used to estimate the inhalation of the volatilization of VOCs from groundwater into indoor and outdoor air are described below.

For the purposes of modeling releases and inhalation exposures to volatile constituents released from groundwater, the USEPA definition of a volatile constituent was applied. The USEPA (2004b) defines a volatile constituent as "having a Henry's Law Constant greater than 10^{-5} atmospheres-cubic meter per mole (atm-m^3/mole) and a molecular weight less than 200 grams/mole."

Vapor Intrusion into Indoor Air. The indoor air AF represents the ratio of the indoor air concentration (Cbuilding) to the source concentration (Csource). That is,

AF = Cbuilding/Csource.

Indoor air concentrations were estimated using conservative, but site-specific, AFs derived for groundwater based upon work completed for the Aerojet site (Geosyntec, 2008). These conservative values were developed for groundwater using Cal/EPA's *Vapor Intrusion Guidance Document* (2005b) and running the model with site-specific parameters for depth to source, water-filled and air-filled porosity, and default assumptions for all other inputs. The parameters and assumptions used in the models for the residential and commercial worker scenarios are presented on Tables 2-10a and 2-10b, respectively. Electronic copies of the models used in this HHRA are included in Attachment B.

The AFs for indoor air inhalation are dependent on the depth to groundwater. The minimum depth to groundwater in each zone is included in Table 2-1 and summarized below. The depths to groundwater were determined based on a review of the hydrostratigraphic data presented in Appendices A through D of Part 1 of the PGOU RI/FS and on data collected through soil borings presented in Sections 4 and 5 of Part 2 of the PGOU RI/FS. Data reviewed included hydrogeological cross-sections showing hydrostratigraphic layers and piezometric groundwater elevations measured in groundwater monitoring wells completed within each layer.

Zone 1 PGOU

Minimum depth to groundwater in the Zone 1 PGOU based on data presented on Figures A-10 and A-11 of Appendix A, Part 1, of the PGOU RI/FS is summarized below.

With the exception of perched groundwater identified at soil sites addressed in Section 5, Part 2, of the PGOU RI/FS, the minimum depth to groundwater in Zone 1 PGOU on site is approximately 40 feet bgs. Due to topographic relief, minimum depth to groundwater in Zone 1 PGOU ranges from a minimum depth of 40 feet to well over 100 feet bgs. Between the northern boundary of the Aerojet site and the American River, the minimum depth to groundwater is approximately 40 feet bgs. North of the American River and beyond the floodplain, the minimum

depth to groundwater is typically greater than 100 feet bgs. A conservative value of 40 feet bgs was assumed for Zone 1 PGOU.

Zone 2 - PGOU

The minimum depth to groundwater in Zone 2 PGOU is approximately 50 feet bgs, based on data presented on Figures B-4 and B-5 in Appendix A, Part 1, of the PGOU RI/FS. It should be noted that this minimum depth to groundwater is based on potentiometric groundwater levels, which are often higher than actual depth to groundwater for semi-confined and confined groundwater units. Based on the data presented on Figures B-4 and B-5, depth to the top of the first saturated groundwater layer (Layer B) is approximately 100 feet bgs. The minimum depth to groundwater of 50 feet bgs based on the potentiometric levels is therefore considered to be conservative.

Zone 3 PGOU

The minimum depth to groundwater in Zone 3 PGOU, based on data presented on Figures C-4 and C-5 of Appendix C, Part 1, of the PGOU RI/FS, is summarized below. The minimum depth to groundwater in Zone 3 PGOU is greater than 100 feet bgs. Therefore, vapor intrusion pathway was not evaluated for Zone 3 PGOU.

Zone 4 PGOU

Based on the potentiometric groundwater data presented on Figure D-5 of Appendix D, Part 1, of the PGOU RI/FS, the minimum depth to groundwater in Zone 4 PGOU is 40 feet bgs. Although data indicate that groundwater may discharge to Alder Creek within Zone 4 PGOU, the minimum depth to groundwater of 40 feet bgs represents the depth at which confined groundwater would likely be encountered in areas where future land use is anticipated to be residential or commercial. The future anticipated land use for Alder Creek and its floodplain, where minimum depth to groundwater may be less than 40 feet bgs, is recreational (greenbelt). A depth to groundwater of 30 feet bgs was used for the dredged layer of Zone 4.

2.2.4 *Exposure Assumptions and Intake Calculations*

The concentrations of COPCs at the points of potential human exposure are combined with assumptions about the behavior of the populations potentially at risk to estimate the average daily dose (intake). Later, in the

risk characterization step of the assessment, the estimated doses are combined with toxicity parameters for COPCs to estimate whether the calculated intake levels pose a threat to human health.

To estimate the intake of chemicals, exposure equations and (generally) conservative exposure parameters were selected for the resident (adult and child), commercial worker, and recreator receptors. Under the USEPA RAGS (1989) paradigm, exposure (or intake/dose) is defined as the mass of the chemical taken in by a receptor per unit body weight per unit time. The general equation for intake is:

Intake (milligrams per kilogram [mg/kg]-day) = CW x CR x EF x ED x CV x (1/BW) x (1/AT)

where:

CW = Exposure point concentration (µg/L)

CR = Contact rate (L/day, m^3/day)

EF = Exposure frequency (day/yr)

ED = Exposure duration (yr)

CV = Conversion factors (mg/µg, for example)

BW = Body weight (kg)

AT = Averaging time (days)

For this HHRA, the general equation was modified specifically for each pathway (i.e., ingestion, dermal contact, inhalation from household non-ingestion use, and inhalation of indoor air). The equations used to estimate exposures incorporated age-adjusted intake factors consistent with USEPA guidance for carcinogenic ingestion and inhalation intakes (USEPA, 2004b), and for dermal carcinogenic intakes (*Risk Assessment Guidance for Superfund:Volume I, Human Health Evaluation Manual -Part E* [USEPA, 2004a]). The complete equations and input parameters are presented on Tables 2-9a and 2-9b for each of the exposure scenarios.

As presented in these tables, the contact rate is more specifically defined for each exposure pathway. Exposure parameters for the intake calculations were selected from the Region IX PRG User's Guide (USEPA, 2004b), *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (USEPA, 2002c), *Superfund Exposure Assessment Manual* (USEPA, 1988), and *Risk Assessment Guidance for Superfund Part E* (USEPA, 2004a).

The following subsections describe the exposure assumptions for each exposure scenario.

2.2.4.1 *Residential Scenario*

Specific standard exposure assumptions for each exposure route for the residential scenario are provided below:

- Exposure Frequency: The exposure frequency was based on USEPA guidance (USEPA, 2004a) and assumed to be 350 days per year. Where intakes were calculated solely for the child resident, the exposure duration was 6 years. Otherwise, intakes for the residential scenario were based on exposure durations of 6 years for a child and 30 years for an adult.
- Body Weight: Body weights for the resident were based on USEPA guidance (USEPA, 2004a). Body weights of 15 and 70 kilograms (kg) were used for the child and adult, respectively.
- Ingestion Rates: Ingestion rates for the resident were based on USEPA guidance (USEPA, 2004a). Ingestion rates of 1 and 2 liters per day (L/day) were used for the child and adult, respectively. The age-adjusted ingestion rate of water value used was 1.1 liter-year per kilogram-day (L-yr/kg-day).
- Dermal Contact: Skin surface areas of 18,000 and 6,600 square centimeters (cm^2) were used for the adult and child resident, respectively (USEPA, 2004a). Exposure times of 0.58 and 1 hour per event for the adult and child, respectively, assuming 1 event per day were used (USEPA, 2004a). In accordance with USEPA, chemical-specific skin absorption factors were used and are presented on Table 2-11 (USEPA, 2004a).
- Inhalation: Inhalation rates of 20 and 10 cubic meters per day (m^3/day) were used for the adult and child residents, respectively (USEPA, 2004a). An age-adjusted inhalation rate of 11 cubic meters-year per kilogram day (m^3-yrs/kg-d) was used for carcinogenic risks (USEPA, 2004a).
- Inhalation of Volatiles During Non-Ingestion Household Use: A volatilization factor of 0.5 liter per cubic meter (L/m^3) was used (USEPA, 2004a).

2.2.4.2 *Commercial Scenario*

Specific standard exposure assumptions for each exposure route for the commercial scenario are provided below:

- Exposure Frequency: The exposure frequency was assumed to be 250 days per year for 25 years based on USEPA guidance (USEPA, 2004a).
- Body Weight: Body weight of 70 kg for the commercial worker based on USEPA guidance (USEPA, 2004a).
- Inhalation: Inhalation rate of 20 m^3/day was used for the commercial worker (USEPA, 2004a).

2.2.4.3 *Recreational Scenario*

Specific standard exposure assumptions for the dermal exposure to surface water under the recreational scenario are provided below:

- Exposure Frequency: The exposure frequency was based on USEPA guidance (USEPA, 2004a) and assumed to be 350 days per year. Where intakes were calculated solely for the child, the exposure duration was 6 years. Otherwise, intakes for the recreator scenario were based on combined exposure durations of 6 years for a child and 30 years for an adult.
- Body Weight: Body weights of 15 and 70 kg were used for the child and adult, respectively.
- Dermal Contact: Skin surface areas of 18,000 and 6,600 cm^2 were used for the adult and child resident, respectively (USEPA, 2004a). Exposure times of 0.58 and 1 hour per event for the adult and child, respectively, assuming 1 event per day were used (USEPA, 2004a). In accordance with USEPA, chemical-specific skin absorption factors were used and are presented on Table 2-11 (USEPA, 2004a).

2.2.4.4 *Lead-Specific Considerations*

Quantifying lead exposure is done differently than for other COPCs. Unlike for other chemicals, substantial evidence has been compiled allowing correlation of cause-and-effect relationships in humans with blood concentrations of lead. Therefore, estimation of human blood lead concentrations associated with an exposure situation is currently the preferred risk assessment approach for lead. Several approaches are available for estimating blood lead levels, including USEPA's Integrated

Exposure Uptake Biokinetic (IEUBK) model for children (USEPA, 1994) and DTSC's Lead Risk Assessment Spreadsheet model for both children and adults (Cal/EPA, 1999).

DTSC's Lead Risk Assessment Spreadsheet model (Version 7) was incorporated into this assessment. The Lead Risk Assessment Spreadsheet model is a spreadsheet-based blood lead program that combines DTSC's blood lead slope factors, which relates levels of lead intake with blood levels for various environmental media (e.g., soil, air). The model also incorporates assumptions about background lead levels in air, water, and food to which receptors are simultaneously exposed in order to develop a total blood lead level estimate from all exposure pathways. Default lead spreadsheet model exposure parameters (e.g., soil ingestion, skin surface area) were changed to reflect the exposure assessment for other chemicals as presented on Tables 2-9a and 2-9b. Examples of the DTSC's Lead Risk Assessment Spreadsheet model for each exposure scenario are included in Attachment B.

2.3 *TOXICITY ASSESSMENT*

This section describes the toxicity information used in the HHRA. Consistent with USEPA and DTSC guidance, this HHRA evaluates non-carcinogenic and carcinogenic risks separately, with each evaluation requiring different measures of toxicity. Specifically, the evaluation of non-carcinogenic risk relies on reference doses (RfDs) developed by USEPA, and the evaluation of carcinogenic risk uses cancer slope factors (CSF) developed by USEPA and the Cal/EPA (OEHHA).

Toxicity values, when available, are published by the USEPA in the on-line *Integrated Risk Information System* (IRIS; USEPA 2009) and the *Health Effects Assessment Summary Tables* (HEAST; USEPA 1997a). CSFs are also published by the Cal/EPA (2008). CSFs are chemical-specific, experimentally derived potency values used to calculate the risk of cancer resulting from exposure to carcinogenic chemicals. A higher value implies a more potent carcinogen. RfDs are experimentally derived "no effect" values used to quantify the extent of adverse non-cancer health effects from exposure to chemicals. Here, a lower RfD implies a more potent toxicant. These criteria are generally developed by USEPA risk assessment work groups and listed in USEPA risk assessment guidance documents and databases. The following sources were used for selecting toxicity criteria and the USEPA (2003b) hierarchy was generally followed:

1. Cal/EPA OEHHA Toxicity Criteria Database;
2. IRIS;
3. USEPA's Provisional Peer Reviewed Toxicity Values;
4. National Center for Environmental Assessment (NCEA), or other current USEPA sources);
5. HEAST;
6. USEPA criteria documents (e.g., drinking water criteria documents, drinking water Health Advisory summaries, ambient water quality criteria documents, and air quality criteria documents);
7. Agency for Toxic Substances and Disease Registry (ATSDR) toxicological profiles;
8. USEPA's Environmental Criteria and Assessment Office; and
9. Peer-reviewed scientific literature.

The toxicological profiles for the COPCs available on ATSDR webpage are included in Attachment C. Where both Cal/EPA and USEPA toxicity criteria exist for a given COPC, the most conservative value was used, with the exception of TCE. Based on agreement with the agencies, this HHRA used the OEHHA slope factor for TCE (Cal/EPA, 2008). However, the resultant risk based on use of the USEPA's provisional slope factor is discussed in the uncertainty section.

Although USEPA has developed toxicity criteria for the oral and inhalation routes of exposure, it has not developed toxicity criteria for the dermal route of exposure. USEPA has proposed a method for extrapolating oral toxicity criteria to the dermal route in the recently released *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual* (Part E, Supplemental Guidance for Dermal Risk Assessment) (USEPA, 2004a). USEPA stated that the adjustment of the oral toxicity factor for dermal exposures is necessary only when the oral-gastrointestinal absorption efficiency of the chemical of interest is less than 50 percent (due to the variability inherent in absorption studies).

2.3.1 Non-Carcinogenic Health Effects

For non-carcinogenic health effects, USEPA assumes that a dose threshold exists, below which adverse effects are not expected to occur. A chronic RfD of a chemical is an estimate of a lifetime daily dose to humans that is likely to be without appreciable deleterious non-carcinogenic health

effects. To derive an RfD, a series of professional judgments are made to assess the quality and relevance of the human or animal data and to identify the critical study and the most critical toxic effect. Data typically used in developing the RfD are the highest no-observable-adverse-effect-levels (NOAELs) for the critical studies and effects of the non-carcinogen. For each factor representing a specific area of uncertainty inherent in the extrapolation from the available data, an uncertainty factor is applied. Uncertainty factors generally consist of multiples of 10, although values less than 10 are sometimes used.

Four major types of uncertainty factors are typically applied to NOAELs in the derivation of RfDs. Uncertainty factors of 10 are used to (1) account for the variability between humans; (2) extrapolate from animals to humans; (3) account for a NOAEL based on a subchronic study instead of a chronic study; and (4) extrapolate from a lowest-observed-adverse-effect-level (LOAEL) to a NOAEL, if necessary. In addition, a modifying factor can be used to account for adequacy of the database. Typically, the modifying factor is set equal to one.

To obtain the RfD, all uncertainty factors associated with the NOAEL are multiplied together, and the NOAEL is divided by the total uncertainty factor. Therefore, each uncertainty factor adds a degree of conservatism (usually one order of magnitude) to the RfD. An understanding of the uncertainties associated with RfDs is important in evaluating the significance of the HIs calculated in the risk characterization portion of the risk assessment. While it is reasonable to use available sub-chronic RfDs to evaluate construction worker exposures, as a conservative assessment tool, only chronic RfDs were used. The COPCs in this assessment with USEPA-established oral/dermal and inhalation RfDs are presented on Tables 2-12a and 2-12b.

2.3.2 *Carcinogenic Risks*

USEPA and Cal/EPA develop CSFs from chronic animal studies or, where possible, epidemiological data. Because animal studies use much higher doses over shorter periods of time than the exposures generally expected for humans, the data from these studies are adjusted, typically using a linearized multi-stage (LMS) mathematical model. To ensure protectiveness, CSFs are typically derived from the upper 95th percentile confidence limit of the slope, and thus the actual risks are unlikely to be higher than those predicted using the CSF, and may be considerably lower. The COPCs in this assessment with USEPA-established oral/dermal and inhalation CSFs are presented on Tables 2-13a and 2-13b.

2.3.3 *Toxicological Effects of Petroleum Hydrocarbon Mixtures*

There is currently no single, widely accepted method for addressing risks posed by petroleum hydrocarbon mixtures in soil, due to the numerous difficulties associated with evaluating the toxicity of hydrocarbon mixtures. Despite their technical deficiencies, risk assessments of petroleum mixtures in the environment typically use a "whole-product" approach, an "indicator-chemical" approach, or a combination of these two approaches.

This HHRA evaluated petroleum hydrocarbon mixtures through quantitative evaluation of the risks associated with exposure to petroleum constituents such as benzene, toluene, ethylbenzene, and xylenes (BTEX) and polynuclear aromatic hydrocarbons (PAHs).

2.3.4 *Lead-Specific Considerations*

Extensive information regarding the health effects of exposure to lead is available. There is convincing evidence that lead exposure resulting in blood lead levels greater than 30 micrograms of lead per deciliter of blood (µg lead/dL blood) can result in toxic effects on the nervous system, the cardio-vascular system, and the kidneys. Evidence also suggests that children and infants are more susceptible than adults to lead, and that deleterious effects may be caused by blood lead levels upwards of 10 to 15 micrograms per deciliter (µg/dL). In addition, children frequently exhibit behavioral patterns that facilitate the intake of environmental lead (for example, pica, the craving for unnatural food, such as soil; ATSDR 1999; USEPA 1986, 1990a). Severe lead toxicity is characterized by symptoms of irritability, short attention span, loss of memory, headaches, muscle tremor, peripheral neuropathy, abdominal pain, and hallucinations. In adults, these symptoms may occur at blood lead levels in the range of 40 to 60 µg/dL (USEPA 1986, 1990a).

Lead has consistently tested negative for mutagenicity in microbial systems, although the USEPA has concluded that these systems are not sufficiently developed to demonstrate mutagenicity for metals that are known carcinogens. There is some evidence that lead has an effect on chromosomes in human and other mammalian species. The USEPA has concluded that lead is clearly carcinogenic in animals, but that the data are insufficient for quantitative assessment. Epidemiological data at present do not allow for an assessment of the carcinogenicity of lead in humans (ATSDR, 1999).

As applied to toxicity criteria, neither USEPA nor Cal/EPA has developed traditional RfD toxicity criteria for lead for risk assessment purposes. The primary reason is that a threshold for toxic effects in mammals has not been established. In the absence of RfDs, USEPA and Cal/EPA apply a blood lead level of 10 µg/dL as a basis for risk-based decision making. For example, 10 µg/dL has been used by USEPA for setting lead standards in paint, dust, and soil (USEPA, 2001a).

2.4 *RISK CHARACTERIZATION*

Consistent with regulatory guidance, this HHRA estimated both carcinogenic and non-carcinogenic risks associated with conditions at the site. To assess non-carcinogenic risks, average daily doses (ADDs) were compared to RfDs for each chemical in a ratio called a hazard quotient (HQ). Compounds considered to be non-carcinogens and potential carcinogens known to exhibit non-carcinogenic effects were treated in this manner.

In accordance with USEPA guidance (1989), HQs were summed across exposure pathways for the same chemical. In addition, chemicals that have similar toxic endpoints were summed. The sum of HQs is called the HI. If the HI exceeds one, the chemicals were subdivided according to their toxicological effects, and the risk for each endpoint was considered separately (USEPA, 1989). An HI was calculated using the following equations:

$$HQ = \frac{ADD}{RfD}$$

where:

ADD = Average daily dose (mg/kg-day)

RfD = Reference dose (mg/kg-day)

$$\textit{Hazard Index} = \sum \textit{Hazard Quotients}$$

An HI equal to or less than 1 indicates that adverse health effects are unlikely to occur as a result of the defined conditions of exposure.

It should be noted that a total HI is most appropriately calculated only for a group of constituents that all have the same target organ or endpoint. However, USEPA guidance (1989) suggests that the initial calculation of the HI should be made by considering exposure to all constituents,

regardless of target organ, as was done in this HHRA. Under USEPA guidance (1989), subsequent segregation of detections by target organ can be made if further evaluation is warranted.

For chemicals that have the potential to cause cancer, upper-bound ILCRs were estimated. The lifetime average daily dose (LADD) of a carcinogen was taken to be the cumulative dose received during the period of exposure, averaged over the lifetime of the exposed individual. The following equations were used to calculate chemical-specific and total risk:

$$\text{Chemical - Specific Risk} = \text{LADD} \times \text{CSF}$$

where:

LADD = Lifetime average daily dose (mg/kg-d)

CSF = Cancer slope factor $(\text{mg/kg d})^{-1}$

$$\textit{Total Carcinogenic Risk} = \sum \textit{Chemical Specific Risk}$$

It was assumed for this HHRA that cancer risks from various exposure routes and from simultaneous exposure to all chemicals are additive.

Risk estimates are values that have associated uncertainties. These uncertainties, which arise at every step of a risk assessment, have been evaluated to provide an indication of the relative degree of uncertainty associated with the risk estimates. Consistent with USEPA (1989) guidance, a qualitative discussion of the uncertainties associated with the estimation of risks for the site is presented in Section 2.6. The uncertainty analysis discusses uncertainties associated with each step of the risk assessment, including site characterization data, data usability, selection of COPCs, exposure point concentrations, fate and transport modeling, exposure assessment, toxicity assessment, and risk characterization.

Cancer risks are expressed as a unitless probability of a carcinogenic response occurring over the course of a lifetime as a result of the defined conditions of exposure. Thus, an estimated cancer risk of 1×10^{-6} (1E-06 or 0.000001) indicates that there is an upper bound probability of 1 in 1 million that an excess carcinogenic response will occur during an individual's lifetime as a result of the defined exposure.

USEPA and Cal/EPA have both defined a range of acceptable risk as 1×10^{-6} to 1×10^{-4}, in accordance with the requirements of the *National Oil and Hazardous Substances Pollution Contingency Plan* (USEPA, 1990b). This

range of acceptable risk was used in this HHRA to assess the significance of the potential cancer risks estimated herein. For sites where the estimated lifetime cancer risk is between 10^{-4} to 10^{-6}, the need for active remediation or risk management will be evaluated on a site-specific basis (i.e., risks within this range are "potentially acceptable" depending on site-specific considerations).

2.5 *RISK SUMMARY*

The HHRA risk results under commercial, residential, construction, and recreational land use scenarios for each PGOU Zone are presented below. The groundwater HHRA unit hazard/risk results for each PGOU zone and surface water are presented in Attachment B.

As agreed upon with the agencies, this HHRA includes example calculations using the USEPA RAGS Part D (USEPA, 2001b) Planning Tables. Attachment D includes example calculations using the groundwater sample locations with the greatest risk estimates. Planning Table 7: Calculation Chemical Cancer Risks and Non-Cancer Hazards and Planning Table 9: Summary of Receptor Risk and Hazards for COPCs are included for the residential scenario.

2.5.1 *Zone 1 PGOU*

Risk characterization results for residential ingestion, dermal contact, and inhalation for individual sampling locations with chemicals greater than screening levels at Zone 1 PGOU are provided on Table 2-14a. The HIs and total estimated ILCRs at individual sampling locations for the vapor intrusion pathways are presented on Tables 2-14b and 2-14c for residents and commercial workers. HIs (child only for residential scenario) and total estimated ILCRs at individual soil sampling locations are presented in Figures 2-7a and 2-7b for the residential scenario and Figures 2-7c and 2-7d for the commercial scenario.

A summary of risks for each receptor assessed in Zone 1 PGOU groundwater is presented on Table 2-19a.

2.5.1.1 *Residential*

The results of the residential HHRA for Zone 1 PGOU groundwater are presented below.

Vapor Intrusion

The range of residential child receptor estimated HIs included a minimum of 1.0×10^{-4}, a median of 7.0×10^{-3}, and a maximum of 6.2×10^{-1}, which are all less than the HI of 1.0.

The range of residential adult receptor estimated HIs included a minimum of $<1.0 \times 10^{-4}$, a median of 3.0×10^{-3}, and a maximum of 2.6×10^{-1}, which are all less than the HI of 1.0.

The estimated residential ILCRs ranged from a minimum of 3×10^{-8}, a median of 6×10^{-7}, and a maximum of 5×10^{-5}. Estimated ILCRs were greater than the *de minimus* risk of 1×10^{-6} for 15 of the 48 locations. While a number of chemicals contributed to these estimates, 1,1,1-TCA, chloroform, PCE, and TCE are the primary contributors to the ILCRs greater than the *de minimus* risk of 1×10^{-6}.

Domestic Use

The following table presents the range of risks estimated for the domestic use of groundwater in Zone 1 PGOU. A list of the primary constituent contributors to the risk estimates above the regulatory thresholds is provided below.

	Minimum	**Median**	**Maximum**	**Percent Above Threshold**	**Number Above Threshold**	**Number of Samples**
Layer B						
Child HI	4.0×10^{-1}	6.6×10^{1}	9.3×10^{-1}	0%	0	4
Adult HI	1.7×10^{-1}	2.9×10^{-1}	4.0×10^{-1}	0%	0	4
ILCR	1×10^{-6}	2×10^{-6}	3×10^{-6}	25%	1	4
Layer C						
Child HI	3.5×10^{-2}	7.6×10^{0}	9.5×10^{2}	54%	37	69
Adult HI	1.5×10^{-2}	3.3×10^{0}	4.1×10^{2}	48%	33	69
ILCR	4×10^{-7}	3×10^{-5}	4×10^{-3}	68%	47	69
Layer D						
Child HI	2.5×10^{-1}	2.6×10^{1}	5.7×10^{2}	80%	49	61
Adult HI	1.1×10^{-1}	1.1×10^{1}	2.4×10^{2}	79%	48	61
ILCR	7×10^{-7}	1×10^{-4}	2×10^{-3}	80%	49	61
Layer E						
Child HI	1.0×10^{-3}	1.6×10^{1}	3.5×10^{2}	58%	30	52
Adult HI	4.0×10^{-4}	6.8×10^{0}	1.5×10^{2}	58%	30	52

ILCR	3×10^{-7}	7×10^{-5}	2×10^{-3}	62%	32	52
Layer F						
Child HI	5.3×10^{-2}	2.4×10^{0}	9.8×10^{0}	50%	4	8
Adult HI	2.3×10^{-2}	9.9×10^{-1}	4.2×10^{0}	38%	3	8
ILCR	2×10^{-6}	2×10^{-5}	3×10^{-4}	63%	5	8

Notes:

Thresholds are 1.0 for Non-Carcinogenic Effects and 1×10^{-6} for Cancer Risks.

As can be seen from the above table, the estimated ILCRs exceed USEPA guidelines (1×10^{-4} to 1×10^{-6}) for groundwater in all exposure pathways. The maximum estimated HIs for children exceed 1.0 with the exception of Layer B. The primary contributors of risk above the regulatory thresholds for each layer are described below.

Layer B –*ILCR*: TCE.

Layer C – *Adult and Child HI*: 1,1,2-TCA; 1,2-DCA; 1,2-DCE (total); cis-1,2-DCE; hexavalent chromium; molybdenum; perchlorate; TCE; and zinc. ***Additional Child HI:*** Hexavalent chromium; and PCE. ***ILCR:*** 1,1,2-TCA; 1,4-dioxane; 1,1-DCA; 1,2-DCA; bromodichloromethane; CCL; CF; dichloromethane; NDMA; PCE; TCE; and VC.

Layer D – *Adult and Child HI*: 1,1,2-TCA; 1,2-DCA; 1,2-DCE (total); perchlorate; and TCE. ***Additional Child HI:*** 1,1-DCE; PCE; and cis-1,2-DCE. ***ILCR:*** 1,1,2,2-PCA; 1,1,2-TCA; 1,4-dioxane; 1,1-DCA; 1,2-DCA; bromodichloromethane; CCL; CF; PCE; TCE; and VC.

Layer E – *Adult and Child HI*: 1,2-DCA; 1,2-DCE (total); perchlorate; and TCE. ***Additional Child HI:*** 1,1-DCE; cis-1,2-DCE; and PCE;. ***ILCR:*** 1,1,2-TCA; 1,4-dioxane; 1,1-DCA; 1,2-DCA; bromodichloromethane; CCL; CF; dibromochloromethane; dichloromethane; PCE; TCE; and VC.

Layer F – *Adult and Child HI*: TCE and vanadium. ***Additional Child HI:*** Chloroform. ***ILCR:*** 1,2-DCA; bromodichloromethane; CF; dibromochloromethane; and TCE.

2.5.1.2 *Commercial*

The results of the commercial HHRA for Zone 1 PGOU groundwater are presented below.

Vapor Intrusion

The range of commercial receptor estimated HIs included a minimum of <1.0×10^{-4}, a median of 1.1×10^{-3}, and a maximum of 9.4×10^{-2}, which are all less than the HI of 1.0.

The estimated commercial ILCRs ranged from a minimum of 7×10^{-9}, a median of 1×10^{-7}, and a maximum of 1×10^{-5}. Estimated ILCRs were greater than the *de minimus* risk of 1×10^{-6} for 10 of the 48 locations. TCE is the primary contributor to the ILCRs greater than the *de minimus* risk of 1×10^{-6}.

2.5.2 *Zone 2 PGOU*

Risk characterization results for residential ingestion, dermal contact, and inhalation for individual sampling locations with chemicals greater than screening levels at Zone 2 PGOU are provided on Table 2-15a. The HIs and total estimated ILCRs at individual sampling locations for the vapor intrusion pathways are presented on Tables 2-15b and 2-15c for residents and commercial workers. HIs (child only for residential scenario) and total estimated ILCRs at individual soil sampling locations are presented in Figures 2-8a and 2-8b for the residential scenario and Figures 2-8c and 2-8d for the commercial scenario.

A summary of risks for each receptor assessed in Zone 2 PGOU groundwater is presented on Table 2-19b.

2.5.2.1 *Residential*

The results of the residential HHRA for Zone 2 PGOU groundwater are presented below.

Vapor Intrusion

The range of residential child receptor estimated HIs included a minimum of <1×10^{-4}, a median of 2.6×10^{-3}, and a maximum of 1.2×10^{-1}, which are all less than the HI of 1.0.

The range of residential adult receptor estimated HIs included a minimum of <1.0×10^{-4}, a median of 1.0×10^{-3}, and a maximum of 5.0×10^{-2}, which are all less than the HI of 1.0.

The estimated residential ILCRs ranged from a minimum of 2×10^{-8}, a median of 3×10^{-7}, and a maximum of 2×10^{-5}. Estimated ILCRs were greater than the *de minimus* risk of 1×10^{-6} for 1 of the 11 locations. TCE is the primary contributor to the ILCR greater than the *de minimus* risk of 1×10^{-6}.

Domestic Use

The following table presents the range of risks estimated for the domestic use of groundwater in Zone 2 PGOU. A list of the primary constituent contributors to the risk estimates above the regulatory thresholds is presented below.

	Minimum	**Median**	**Maximum**	**Percent Above Threshold**	**Number Above Threshold**	**Number of Samples**
Layer A						
Child HI	5.6×10^{-2}	1.5×10^{0}	1.6×10^{2}	50%	4	13
Adult HI	2.4×10^{-2}	6.4×10^{-1}	6.8×10^{1}	38%	3	13
ILCR	4×10^{-7}	8×10^{-6}	3×10^{-4}	80%	4	13
Layer B						
Child HI	1.9×10^{-2}	4.5×10^{1}	1.9×10^{2}	71%	5	7
Adult HI	8.0×10^{-3}	1.9×10^{1}	8.2×10^{1}	71%	5	7
ILCR	4×10^{-6}	4×10^{-5}	3×10^{-4}	86%	6	7
Layer C						
Child HI	2.0×10^{-2}	1.1×10^{1}	2.6×10^{1}	29%	2	7
Adult HI	8.5×10^{-3}	4.6×10^{0}	1.1×10^{1}	29%	2	7
ILCR	6×10^{-7}	5×10^{-6}	6×10^{-6}	43%	3	7
Layer D						
Child HI	6.7×10^{1}	6.7×10^{1}	6.7×10^{1}	33%	1	3
Adult HI	2.8×10^{1}	2.8×10^{1}	2.8×10^{1}	33%	1	3
ILCR	1×10^{-5}	1×10^{-5}	1×10^{-5}	33%	1	3

Notes: Thresholds are 1.0 for Non-Carcinogenic Effects and 1×10^{-6} for Cancer Risks.

Layer E did not have any constituents above the screening levels. As can be seen from the above table, the estimated ILCR exceeds USEPA guidelines (1×10^{-4} to 1×10^{-6}) for groundwater in all layers with COPCs (i.e., Layers A, B, C, and D). The maximum estimated HIs for children exceed 1.0 in those layers as well. The primary contributors of risk above the regulatory thresholds for each layer are described below.

Layer A – *Adult and Child HI:* Perchlorate and TCE. ***Additional Child HI:*** 1,2-DCE (total). ***ILCR:*** 1,2-DCA, PCE and TCE.

Layer B – *Adult and Child HI*: Perchlorate; and TCE. ***ILCR:*** CF; and TCE.

Layer C – *Adult and Child HI*: CF; perchlorate; and TCE. ***ILCR:*** CF and TCE.

Layer D – *Adult and Child HI*: Perchlorate and TCE. ***ILCR:*** TCE.

2.5.1.2 Commercial

The results of the commercial HHRA for Zone 2 PGOU groundwater are presented below.

Vapor Intrusion

The range of commercial receptor estimated HIs included a minimum of $<1.0 \times 10^{-4}$, a median of 4.0×10^{-4}, and a maximum of 1.9×10^{-2}, which are all less than the HI of 1.0.

The estimated commercial ILCRs ranged from a minimum of 6×10^{-9}, a median of 6×10^{-8}, and a maximum of 5×10^{-6}. Estimated ILCRs were greater than the *de minimus* risk of 1×10^{-6} for 1 of the 11 locations. TCE is the primary contributor to the ILCRs greater than the *de minimus* risk of 1×10^{-6}.

2.5.3 Zone 3 PGOU

Risk characterization results for residential ingestion, dermal contact, and inhalation for individual sampling locations with chemicals greater than screening levels at Zone 3 PGOU are provided on Table 2-16. As described previously, the minimum depth to groundwater in Zone 3 PGOU is greater than 100 feet bgs. Therefore, vapor intrusion pathway was not evaluated for Zone 3 PGOU.

A summary of risks for each receptor assessed in Zone 3 PGOU groundwater is presented on Table 2-19c.

2.5.3.1 *Residential*

The results of the residential HHRA for Zone 3 PGOU groundwater are presented below.

Domestic Use

The following table presents the range of risks estimated for the domestic use of groundwater in Zone 3 PGOU. A list of the primary constituent contributors to the risk estimates above the regulatory thresholds is presented after the table.

	Minimum	Median	Maximum	Percent Above Threshold	Number Above Threshold	Number of Samples
Layer B						
Child HI	1.3×10^{1}	2.7×10^{1}	4.1×10^{1}	67%	2	3
Adult HI	5.7×10^{0}	1.2×10^{1}	1.8×10^{1}	67%	2	3
ILCR	6×10^{-4}	2×10^{-3}	3×10^{-3}	67%	2	3
Layer C						
Child HI	4.5×10^{-1}	4.9×10^{1}	1.5×10^{3}	84%	49	58
Adult HI	1.9×10^{-1}	2.1×10^{1}	6.6×10^{2}	83%	48	58
ILCR	4×10^{-7}	3×10^{-3}	1×10^{-1}	88%	51	58
Layer D						
Child HI	7.1×10^{-1}	3.5×10^{1}	1.2×10^{3}	90%	45	50
Adult HI	3.0×10^{-1}	1.5×10^{1}	4.9×10^{2}	86%	43	50
ILCR	4×10^{-7}	1×10^{-3}	1×10^{-1}	88%	44	50
Layer E						
Child HI	1.3×10^{-2}	1.4×10^{-1}	5.5×10^{2}	14%	2	14
Adult HI	5.6×10^{-3}	6.0×10^{-2}	2.4×10^{2}	14%	2	14
ILCR	1×10^{-6}	1×10^{-5}	5×10^{-2}	29%	4	14
Layer F						
Child HI	1.7×10^{-2}	1.4×10^{2}	7.0×10^{2}	36%	4	11
Adult HI	7.0×10^{-3}	6.0×10^{1}	3.0×10^{2}	27%	3	11
ILCR	1×10^{-6}	1×10^{-2}	7×10^{-2}	45%	5	11

Notes: Thresholds are 1.0 for Non-Carcinogenic Effects and 1×10^{-6} for Cancer Risks.
-- = No carcinogenic constituents above screening levels

Layer A did not have any constituents above the screening levels. As can be seen from the above table, the estimated ILCR exceeds USEPA guidelines (1×10^{-4} to 1×10^{-6}) for groundwater in all layers with carcinogenic COPCs (i.e., Layers B, C, D, E, and F). The maximum estimated HIs for children exceed 1.0 in those layers as well. The primary contributors of risk above the regulatory thresholds for each layer are described below.

Layer B – ***Adult and Child HI***: NDMA; perchlorate; and TCE. ***ILCR:*** 1,2-DCA; CF; NDMA; PCE; and TCE.

Layer C – ***Adult and Child HI***: 1,2-DCA; NDMA; perchlorate; silver; TCE; and vanadium. ***Additional Child HI:*** 1,1-DCE and CCL. ***ILCR:*** 1,1-DCA; 1,2-DCA; 1,4-dioxane; CCL; CF; NDMA; PCE; TCE; and VC.

Layer D – ***Adult and Child HI***: 1,2-DCA; NDMA; perchlorate; and TCE. ***Additional Child HI:*** 1,1-DCE and vanadium. ***ILCR:*** 1,1-DCA; 1,2-DCA; 1,4-dioxane; CCL; CF; NDMA; PCE; TCE; and VC.

Layer E – ***Adult and Child HI***: NDMA; perchlorate; and TCE. ***ILCR:*** 1,2-DCA; CCL; CF; NDMA; and TCE.

Layer F – ***Adult and Child HI***: NDMA; perchlorate; and TCE. ***Additional Child HI:*** 1,2-DCA. ***ILCR:*** 1,1-DCA; 1,2-DCA; CF; NDMA; and TCE.

2.5.4 Zone 4 PGOU

Risk characterization results for residential ingestion, dermal contact, and inhalation for individual sampling locations with chemicals greater than screening levels at Zone 1 PGOU are provided on Table 2-17a. The HIs and total estimated ILCRs at individual sampling locations for the vapor intrusion pathways are presented on Tables 2-17b and 2-17c for residents and commercial workers. HIs (child only for residential scenario) and total estimated ILCRs at individual soil sampling locations are presented in Figures 2-10a and 2-10b for the residential scenario and Figures 2-10c and 2-10d for the commercial scenario.

A summary of risks for each receptor assessed in Zone 1 PGOU groundwater is presented on Table 2-19d.

2.5.4.1 *Residential*

The results of the residential HHRA for Zone 4 PGOU groundwater are presented below.

Vapor Intrusion

The range of residential child receptor estimated HIs included a minimum of <1 x 10^{-4}, a median of 1.4 x 10^{-2}, and a maximum of 4.5 x 10^{-1}, which are all less than HI of 1.0.

The range of residential adult receptor estimated HIs included a minimum of <1 x 10^{-4}, a median of 3.0 x 10^{-3}, and a maximum of 1.9 x 10^{-1}, which are all less than the HI of 1.0.

The estimated residential ILCRs ranged from a minimum of 3 x 10^{-8}, a median of 3 x 10^{-7}, and a maximum of 2 x 10^{-4}. Estimated ILCRs were greater than the *de minimus* risk of 1 x 10^{-6} for 5 of the 28 locations. While a number of chemicals contributed to these estimates, 1,2-DCA, CCL, CF, TCE, and VC are the primary contributors to the ILCRs greater than the *de minimus* risk of 1 x 10^{-6}.

Domestic Use

The following table presents the range of risks estimated for the domestic use of groundwater in Zone 4 PGOU. A list of the primary constituent contributors to the risk estimates above the regulatory thresholds is presented below.

	Minimum	**Median**	**Maximum**	**Percent Above Threshold**	**Number Above Threshold**	**Number of Samples**
Layer A						
Child HI	5.6 x 10^{-3}	8.5 x 10^{0}	4.7 x 10^{2}	51%	19	37
Adult HI	2.4 x 10^{-3}	3.7 x 10^{0}	2.0 x 10^{2}	46%	17	37
ILCR	5 x 10^{-7}	1 x 10^{-4}	4 x 10^{-2}	59%	22	37
Layer C						
Child HI	1.8 x 10^{0}	2.5 x 10^{0}	3.3 x 10^{0}	29%	2	7
Adult HI	7.5 x 10^{-1}	1.1 x 10^{0}	1.4 x 10^{0}	14%	1	7
ILCR	8 x 10^{-5}	2 x 10^{-4}	2 x 10^{-4}	29%	2	7
Dredged						
Child HI	2.8 x 10^{0}	2.8 x 10^{0}	2.8 x 10^{0}	50%	1	2

	Minimum	Median	Maximum	Percent Above Threshold	Number Above Threshold	Number of Samples
Adult HI	1.2×10^{0}	1.2×10^{0}	1.2×10^{0}	50%	1	2
ILCR	7×10^{-6}	7×10^{-6}	7×10^{-6}	50%	1	2

Notes: Thresholds are 1.0 for Non-Carcinogenic Effects and 1×10^{-6} for Cancer Risks.

The bedrock layer in Zone 4 PGOU did not have any constituents above screening levels. As can be seen from the above table, the estimated ILCRs exceed USEPA guidelines (1×10^{-4} to 1×10^{-6}) for groundwater in all layers. The maximum estimated HIs for children exceed 1.0 in those layers as well. The primary contributors of risk above the regulatory thresholds for each layer are described below.

In addition, one sample of lead was analyzed in Zone 4 PGOU, Layer A. The estimated residential blood lead level of 20 µg/dL for children and 10 µg/dL for adults.

Layer A – ***Adult and Child HI:*** 1,2-DCE (total); cis-1,2-DCE; cadmium; iron; NDMA; perchlorate; TCE; and vanadium. ***Additional Child HI:*** Manganese and VC. ***ILCR***: 1,1-DCA; 1,2-DCA; 1,4-dichlorobenzene; 1,4-dioxane; bromodichloromethane; CCL; CF; NDMA; PCE; TCE; and VC.

Layer C – ***Adult and Child HI***: NDMA. ***ILCR:*** NDMA.

Dredged Layer –***Child HI***: TCE. ***ILCR:*** TCE.

2.5.4.2 Commercial

The results of the commercial HHRA for Zone 4 PGOU groundwater are presented below.

Vapor Intrusion

The range of commercial receptor estimated HIs included a minimum of $<1.0 \times 10^{-4}$, a median of 2.0×10^{-3}, and a maximum of 7.0×10^{-2}, which are all less than the HI of 1.0.

The estimated commercial ILCRs ranged from a minimum of 9×10^{-9}, a median of 7×10^{-8}, and a maximum of 6×10^{-5}. Estimated ILCRs were greater than the *de minimus* risk of 1×10^{-6} for 3 of the 28 locations. TCE is the primary contributor to the ILCRs greater than the *de minimus* risk of 1×10^{-6}.

2.5.5 *Surface Water*

The surface water HHRA unit hazard/risk results for the recreational scenario are presented in Attachment B.

Risk characterization results for individual sampling locations with chemicals greater than screening levels in surface water are provided on Table 2-18 and summarized below.

The range of residential child receptor estimated HIs included a minimum of 8.2×10^{-5}, a median of 2.3×10^{-4}, and a maximum of 7.2×10^{-4}, which are all less than the HI of 1.0. The range of residential adult receptor estimated HIs included a minimum of $<2.8 \times 10^{-5}$, a median of 7.8×10^{-5}, and a maximum of 2.8×10^{-4}, which are all less than the HI of 1.0.

The estimated residential ILCRs ranged from a minimum of 2×10^{-8}, a median of 7×10^{-8}, and a maximum of 1×10^{-7}, which are all less than the *de minimus* risk of 1×10^{-6}.

2.6 *UNCERTAINTY ANALYSIS*

Risk estimates are values that have uncertainties associated with them. These uncertainties, which arise at every step of a risk assessment, are evaluated to provide an indication of the relative degree of uncertainty associated with a risk estimate. This section presents a qualitative discussion of the uncertainties associated with the risk assessment for the PGOU.

Risk assessments are not intended to estimate actual risks to a receptor associated with exposure to chemicals in the environment. In fact, estimating actual risks is impossible because of the variability in the exposed or potentially exposed populations. Therefore, risk assessment is a means of estimating the probability that an adverse health effect (e.g., cancer, impaired reproduction) will occur in a receptor. The multitude of conservative assumptions used in risk assessments guard against underestimation of risks.

Risk estimates are calculated by combining site data, assumptions about an individual receptor's exposures to media, and toxicity data. The uncertainties in this risk assessment can be grouped into four main categories associated with performing these steps:

- Uncertainties in environmental sampling and analysis;
- Uncertainties in fate and transport modeling;
- Uncertainties in assumptions concerning exposure scenarios; and
- Uncertainties in toxicity data and dose response extrapolations.

The uncertainties associated with each of the four categories are discussed below and summarized in Table 2-20. Table 2-20 provides a summary of the expected magnitude of uncertainty, as well as whether the risks presented in this report are over- or underestimated. In Table 2-20, "Low," "Moderate," and "High" are qualitative indicators as to whether the source of uncertainty will likely have a small, medium, or large effect on the risk calculations, respectively.

2.6.1 Environmental Sampling and Analysis

Environmental sampling typically focuses on areas of known or suspected impacts. As a result, exposure point concentrations derived from such sampling data tend to be biased high. That is, these data result in the overestimation of potential risks.

Uncertainty surrounding TICs could lead to an underestimation of potential risk. However, because the occurrence of the compounds was not confirmed in subsequent sampling and because these compounds occur with other COPCs that have associated risks, any underestimation of potential risk is not expected to significantly alter the overall conclusions of this HHRA.

Furthermore, data were used that were collected over time. Older samples may no longer be reflective of concentrations of chemicals that may be degraded (TPH and related compounds) or decrease with time (e.g., VOCs). This may have resulted in overestimation of associated risks.

2.6.1.1 Detection Limits

As described in earlier sections, screening for COPCs was conducted utilizing conservative screening metrics. However, a number of chemicals were not selected as COPCs but had analytical results that were "non-detect" with the maximum quantitation limit greater than the screening level. Evaluation of chemicals that were not detected or had maximum quantitation limits greater than the screening level is discussed below.

Zone 1 PGOU Groundwater Detection Limits. Over one hundred chemicals were excluded as COPCs because they were not detected. Of these, approximately 74 had detection limits greater than the health-based level used to establish the screening criteria. Given the range of estimated risks for the COPCs selected, it is relevant to note that only a handful of chemicals have detection limits above concentrations that represent the upper end of the acceptable risk range assuming domestic use. Even if present, those chemicals are unlikely to change the risk estimates sufficiently enough to alter risk-based decisions made using the current results. The dataset used also contains a combination of older and newer data, and the newer data contains detection limits that are below the health-based limits. Therefore, although the groundwater dataset contains elevated detection limits for some constituents, these are considered unlikely to adversely affect the location-specific risk estimates enough to change decisions made based upon the results.

Zone 2 PGOU Groundwater Detection Limits. Fifty chemicals were excluded as COPCs because they were not detected. Of these, approximately 23 had detection limits greater than the health-based level used to establish the screening criteria. Given the range of estimated risks for the COPCs selected, it is relevant to note that only a handful of chemicals have detection limits above concentrations that represent the upper end of the acceptable risk range assuming domestic use. Even if present, those chemicals are unlikely to change the risk estimates sufficiently enough to alter risk-based decisions made using the current results. The dataset used also contains a combination of older and newer data, and the newer data contain detection limits that are below the health-based limits. Therefore, although the groundwater dataset contains elevated detection limits for some constituents, these are considered unlikely to adversely affect the location-specific risk estimates enough to change decisions made based upon the results.

Zone 3 PGOU Groundwater Detection Limits. Over one hundred chemicals were excluded as COPCs because they were not detected. Of these, approximately 62 had detection limits greater than the health-based level used to establish the screening criteria. Given the range of estimated risks for the COPCs selected, it is relevant to note that only a handful of chemicals have detection limits above concentrations that represent the upper end of the acceptable risk range assuming domestic use. Even if present, those chemicals are unlikely to change the risk estimates sufficiently enough to alter risk-based decisions made using the current results. The dataset used also contains a combination of older and newer data, and the newer data contain detection limits that are below the

health-based limits. Therefore, although the groundwater dataset contains elevated detection limits for some constituents, these are considered unlikely to adversely affect the location-specific risk estimates enough to change decisions made based upon the results.

Zone 4 PGOU Groundwater Detection Limits. Over one hundred chemicals were excluded as COPCs because they were not detected. Of these, approximately 72 had detection limits greater than the health-based level used to establish the screening criteria. Given the range of estimated risks for the COPCs selected, it is relevant to note that only a handful of chemicals have detection limits above concentrations that represent the upper end of the acceptable risk range assuming domestic use. Even if present, those chemicals are unlikely to change the risk estimates sufficiently enough to alter risk-based decisions made using the current results. The dataset used also contains a combination of older and newer data, and the newer data contain detection limits that are below the health-based limits. Therefore, although the groundwater dataset contains elevated detection limits for some constituents, these are considered unlikely to adversely affect the location-specific risk estimates enough to change decisions made based upon the results.

Surface Water Detection Limits. COPC selection was conducted for surface water chemical measurements conservatively using domestic use groundwater screening criteria. Approximately 66 chemicals were excluded as COPCs because they were not detected, but had one or more detection limits that exceeded these conservative criteria. However, use of domestic-use criteria for surface water screening is highly conservative, as surface water incidental contact is substantially less intensive than domestic use. This is evidenced by the fact that the maximum detected arsenic concentration in surface water was four orders of magnitude greater than the domestic-use screening criteria (at 10^{-6}), but the maximum estimated residential/recreational contact risk for arsenic was 10 times less than the *de minimus* risk level of 10^{-6}. Reviewing the maximum detection limits against this differential, most of the detection limits are sufficient to have captured concentrations of chemicals not selected as COPCs that, if present in surface water, could potentially change a location-specific risk estimate.

2.6.1.2 *Chemical of Potential Concern Selection*

No background data were available for surface water or groundwater. This may have lead to the inclusion of some inorganics, particularly

arsenic, that are present at background levels and resulting in overestimation of risks associated with these media.

Detected chemical concentrations in surface water were screened for COPC selection using domestic-use groundwater screening values. As the surface water incidental contact exposures are significantly lower than domestic-use exposures, the use of groundwater criteria will result in more chemicals being selected as COPCs when in fact the detected concentrations are well below a concentration of interest.

2.6.1.3 *Regional Screening Levels*

After submittal of the Final Draft PGOU RI/FS report, USEPA released the Regional Screening Levels for Chemical Contaminants at Superfund Sites (RSLs) (USEPA, September 2008). Because USEPA Region 9 PRGs were utilized as one of the sources of information from which COPC screening levels were derived (in addition to Cal/EPA CHHSLs), a comparison was conducted between the previously utilized screening levels and the RSLs. The goal of this evaluation was to understand if any meaningful changes would occur in the COPC selection process had the RSLs been utilized to derive the screening criteria.

For groundwater, this comparison indicated RSL-based screening criteria for the following chemicals would be more conservative than the previous screening criteria:

- Chloromethane;
- NDMA;
- Vinyl chloride;
- 1,4-Dioxane;
- Dimethyl phthalate; and
- 1,4-Dichlorobenzene.

Of these, changes to 1,4-dioxane, dimethyl phthalate, NDMA, vinyl chloride, and 1,4-dichlorobenzene would not result in changes to the COPC selection, as these chemicals are already selected as COPCs. The only chemical for which the RSL appears to indicate additional consideration is warranted is chloromethane (i.e., RSL is more conservative and would potentially result in chloromethane being selected as a COPC if the RSL had been utilized). The RSL is based upon a cancer slope factor from USEPA's 1997 HEAST. However, review of USEPA's

IRIS database demonstrates that in the USEPA's most recent update (2001) for chloromethane, the chemical was identified as a Class D carcinogen (data insufficient to determine the chemical's carcinogenicity). This is further supported by the fact that Cal/EPA has not listed it under Proposition 65 as a chemical known to be a carcinogen, and subsequently has not estimated a cancer slope factor for the chemical. Therefore, available data suggest that chloromethane currently is not considered carcinogenic and does not support the use of the CSF-based RSL. Therefore, the noncarcinogenic-based screening criterion utilized is recommended and chloromethane would not be selected as a COPC.

Therefore, while there are several groundwater RSLs that are more conservative than the criteria utilized for COPC selection, the use of RSLs would not likely have an effect on the selected groundwater COPCs for the site or the risk estimates.

Because the RSL document in some cases contains new toxicity criteria (predominantly ATSDR MRLs and PPRTV) for some chemicals, a comparison was conducted between the previously utilized toxicity criteria and the criteria presented in the RSL document. The goal of such an evaluation was to understand if any meaningful changes would occur in the risk evaluation should the toxicity criteria from the RSL document be utilized.

For groundwater, this comparison indicated RSL-based toxicity criteria for cobalt, 1,1,2,2-tetrachloroethane, methylene chloride, would be more conservative than the previous criteria. However, incorporation of these toxicity criteria would not result in substantial increases in risk estimates, nor increase the number of locations above *de minimus* risk. Therefore, the risks for groundwater are unlikely to have been substantially or meaningfully underestimated.

2.6.2 *Fate and Transport Modeling*

The assumptions and uncertainties inherent in each of the fate and transport models applied to the site are discussed in each of the individual model sections. To the extent practical, models have been calibrated to reflect actual site conditions. However, where site-specific data were unavailable, fate and transport models and their input parameters were selected such that modeled concentrations at a temporally or spatially remote receptor point would be overestimated. Thus, actual future concentrations of COPCs in each of the modeled media at the site are likely to be less than those predicted by the model.

2.6.3 *Exposure Assessment*

In this report, the exposure assessment is based on a number of assumptions with varying degrees of uncertainty (USEPA, 1992). Uncertainties can arise from the types of exposures examined, the points of potential human exposure, the concentrations of COPCs at the points of human exposure, and the intake assumptions. These factors and the ways in which they contribute to the risk estimation are discussed below.

2.6.3.1 *Types of Exposures Examined*

The selection of exposure pathways is a process, often based on professional judgment, which attempts to identify the most probable potentially harmful exposure scenarios. In an evaluation, risks are sometimes not calculated for all of the exposure pathways that may occur, possibly causing some underestimation of risk. In this HHRA, potential risks were estimated for future hypothetical residential and worker exposure scenarios at the site. Risks to potential receptors were estimated for a number of different exposure pathways (e.g., inhalation during showering). While other exposure routes could exist for a particular site use, these exposures are expected to be lower than the risks associated with the pathways considered.

2.6.3.2 *Points of Human Exposure*

Another source of uncertainty in the exposure assessment is the assumption made regarding the locations where individuals could be exposed to media at the site. In this HHRA, assumptions were made to indicate the locations where people could come into contact with a specific media. It is conservatively assumed that individuals will be exposed to a consistent COPC concentration in each media, based on the assumptions used in the assessment, regardless of where they are on the site. That is, fluctuations in chemical concentrations, either spatially or temporally, are not considered.

Furthermore, calculation of exposures on a point by point basis assumes that receptors are limited to COPC concentration(s) in immediate proximity to the location and depth, when in fact the receptor may be exposed to a much broader range of chemical concentrations. This is likely to lead to an overestimation of potential risk.

2.6.3.3 *Intake Assumptions Used*

The risks calculated depend largely on the assumptions used to calculate the rate of COPC intake. The uncertainties associated with the parameters used in this risk assessment are described below.

Individuals can come into contact with chemicals via a number of different exposure routes (i.e., ingestion, dermal contact, and inhalation). Standard default rates were used for these exposures. These represent upper bound values and provide reasonable maximum activity assumptions. The use of these standard default and upper end values makes it likely that the risk is not underestimated, and may in fact be overestimated.

The amount of COPCs the body absorbs may be different from the amount of a COPC contacted. In this assessment, absorption of ingested and inhaled COPCs is conservatively assumed to be 100 percent. Actual chemical- and site-specific values are likely less than this default value.

2.6.3.4 *Perchlorate*

Perchlorate has been used as an oxidizer in solid propellants and has been detected in soils and groundwater at PGOU. Existing toxicological research indicates that perchlorate may interfere with thyroid function, which can be of special concern to pregnant women and children (particularly infants), due to the thyroid's role in development. Specifically it reduces iodine transport and concurrently affects thyroid hormone production. Perchlorate exposures are of greatest concern to pregnant women with a fetus, lactating women and infants. Women require greater amounts of dietary iodine during pregnancy (Pearce *et al*. 2007; OEHHA 2004), and infants rely on their food source, whether formula or breast milk, as their only source of iodine, (Pearce *et al*. 2007). Therefore, appropriate dietary levels of iodine for lactating women are important not only for proper maternal, but also infant, thyroid function.

This HHRA assumes that exposures to groundwater containing perchlorate are potentially complete, and exposure and risk estimates have been quantified for these pathways. Additional exposure routes may contribute to the total receptor dose estimates. For example, several studies have indicated that perchlorate may accumulate in certain plant species (Susarla *et al.* 1999a,b,c, Susarla *et al.* 2000, Smith *et al.* 2001, Ellington *et al.* 2001, Nzengung 1998, Nzengung 2002, Nzengung and Wang 2000, Schnoor *et al*. 2002, van Aken and Schnoor 2002, Sundberg *et*

al. 2003, Tan 2003, Tan *et al.* 2004). Ingestion of homegrown produce irrigated with groundwater containing perchlorate is a potentially complete pathway for potential future residents. In rats, Dohan *et al.* (2007) have shown that translocation of perchlorate into mammary cells occurs by the sodium-iodine symporter. This has been supported by field measurements wherein Pearce *et al.* (2007) detected perchlorate in breast milk in women in the Boston area.

Neither plant uptake into homegrown produce nor breast milk exposure was evaluated quantitatively in this HHRA. Aerojet acknowledges that this is a potentially complete pathway that was not evaluated for the potential future resident, and therefore subsequently, the associated hypothetical risk from perchlorate may be underestimated.

Although these potential exposures were not quantified, mitigating factors are present. Assumed future groundwater use has produced theoretical risk estimates (as described above) that exceed regulatory metrics, and will subsequently result in restriction of groundwater from future use. Therefore, while the mother's milk and translocation of perchlorate into edible plants pathways have not been quantified in the present HHRA, this should not have an appreciable affect on the estimated future potential risks nor the decision metrics based on these risk estimates.

The USEPA reviewed site-specific biomonitoring data from women in community surrounding Aerojet and evaluated the California primary drinking water standard. This evaluation is presented in Attachment G. The memo concluded that the California MCL of 6 parts per billion would provide adequate protection to human health.

2.6.4 *Toxicity Assessment*

In this HHRA, the toxicity assessment is based on a number of assumptions with varying degrees of uncertainty (USEPA, 1992). Uncertainties can arise from the toxicological data and dose response extrapolations, extrapolation of animal studies to humans, types of exposures examined, the points of potential human exposure, the concentrations of COPCs at the points of human exposure, and the intake assumptions. These factors and the ways in which they contribute to the risk estimation are discussed below.

2.6.4.1 *Toxicological Data and Dose Response Extrapolations*

The availability and quality of toxicological data is another source of uncertainty in the risk assessment. Uncertainties associated with animal and human studies may have influenced the toxicity criteria. Carcinogenic criteria are classified according to the amount of evidence available that suggests human carcinogenicity. USEPA assigns each carcinogen a designation of A through E, dependent upon the strength of the scientific evidence for carcinogenicity. In the establishment of the non-carcinogenic criteria, conservative multipliers, known as uncertainty and modifying factors, are used.

2.6.4.2 *Uncertainties in Animal and Human Studies*

Extrapolation of toxicological data from animal tests is one of the largest sources of uncertainty in a risk assessment. There may be important, but unidentified, differences in uptake, metabolism, and distribution of chemicals in the body between the test species and humans. For the most part, these uncertainties are addressed through use of conservative assumptions in establishing values for RfDs and CSFs, which results in the likelihood that the risk is overstated.

Typically, animals are administered doses of a chemical in a standard diet or in air that are higher than would be experienced in an environmental setting. Humans may be exposed to much lower doses in a highly variable diet, which may affect the toxicity of the chemical. In these studies, animals, usually laboratory rodents, are exposed daily to the chemical agent for various periods of time up to their 2-year lifetimes. Humans have an average 70-year lifetime and may be exposed either intermittently or regularly for an exposure period ranging from months to a full lifetime. Because of these differences, it is not surprising that extrapolation error is a large source of uncertainty in a risk assessment.

2.6.4.3 *Non-Carcinogenic Toxicity Criteria*

In the establishment of the non-carcinogenic criteria, conservative multipliers, known as uncertainty factors, are used. The chronic non-carcinogenic toxicity criteria located in the IRIS database have uncertainty factors as high as 10,000. This means that the dose corresponding to a toxicological endpoint (e.g., LOAEL) was divided by 10,000; thus increasing the toxicity by several orders of magnitude. The purpose of the uncertainty factor is to account for the extrapolation of toxicity data from animals to humans and to ensure the protection of sensitive individuals.

However, in accomplishing these things, the uncertainty in the actual toxicity of the chemical in humans is greatly increased.

Uncertainty surrounding TICs could also lead to an underestimation of potential risk. However, because these compounds occur with other COPCs that have associated risks, that underestimation is not expected to alter the overall conclusions of this HHRA.

2.6.4.4 *Carcinogenic Toxicity Criteria*

Uncertainty due to extrapolation of toxicological data for potential carcinogens tested in animals-to-human data is more prominent for potentially carcinogenic chemicals than non-carcinogenic ones. USEPA uses the LMS model to extrapolate the toxicological data. The LMS assumes that there is no threshold for carcinogenic substances; that is, exposure to even one molecule of a carcinogen is sufficient to cause cancer. This is a highly conservative assumption because the body has several mechanisms to protect against cancer.

The use of the LMS model to extrapolate is a well-recognized source of significant uncertainty in the development of carcinogenic toxicity criteria and, subsequently, theoretical carcinogenic risk estimates. At high levels of exposure, there may indeed be a risk of cancer regardless of whether the effect occurs via a threshold mechanism or not. Nevertheless, an animal bioassay cannot determine what happens at low levels of exposure, which are generally typical of human exposure levels.

At low levels of exposure, the probability of cancer cannot be measured, but must be extrapolated from higher dosages. To do this, animals are typically exposed to carcinogens at levels that are orders of magnitude greater than those likely to be encountered by humans in the environment. It would be difficult, if not impossible, to perform animal experiments with a large enough number of animals to directly estimate the level of risk at the low exposure levels typically encountered by humans. Thus, to estimate the risk to humans exposed at low levels, dose response data derived from animals given high dosages are extrapolated downward using mathematical models such as the LMS, which assumes that there is no threshold of response. The dose response curve generated by the model is known as the maximum likelihood estimate (MLE). The slope of the 95 percent lower confidence interval (i.e., upper-bound limit) curve, which is a function of the variability in the input animal data, is taken as the CSF. CSFs are then used directly in cancer risk assessment.

The federal government, including USEPA itself, has acknowledged the limitations of the high to low dose extrapolation models, particularly the LMS (USEPA, 1991). In fact, this aspect of cancer risk assessment has been criticized by many scientists (including regulatory scientists) in recent years.

Even for genotoxic (i.e., non-threshold) substances, there are two major sources of bias embedded in the LMS:

- Its inherent conservatism at low doses; and
- The routine use of the linearized form in which the 95 percent upper confidence interval is used instead of the unbiased MLE.

The inherent conservatism at low doses is due in part to the fact that the LMS ignores all of the numerous biological factors that argue against a linear dose-response relationship for genotoxic effects (e.g., DNA repair, immunosurveillance, toxicokinetic factors).

Several other factors inherent in the LMS result in overestimated carcinogenic potency:

- Any exaggerations in the extrapolation that can be produced by some high dose responses (if they occur) are generally neglected;
- Upper confidence limits on the actual response observed in the animal study are used rather than the actual response, resulting in upper-bound low dose extrapolations, which can greatly overestimate risk; and
- Non-genotoxic chemicals (i.e., threshold carcinogens) are modeled in the same manner as highly genotoxic chemicals.

The following excerpts are from the *Regulatory Program of the United States Government*, April 1990 – March 1991, Executive Office of the President (USEPA, 1991):

"None of (the) purported advantages of the LMS approach has a sound statistical basis. It is a fundamental axiom of statistics that unbiased estimates are generally preferred to biased ones. Using the upper confidence limit instead of the unbiased estimate exaggerates underlying specification errors instead of eliminating them. "Instability" is overcome, but at the cost of greater errors in specification. The problem with the LMS is that it generates biases that intensify with the degree to which the multistage model mis-specifies the true dose response relationship.

The LMS cannot be justified as a method of scientific risk assessment. The "yardstick" defense implicitly asserts that scientific advancements in risk assessment methodology should take a back seat to the preservation of an outdated and misguided statistical procedure.

The habitual reliance upon either the multistage model or its LMS descendant cannot be supported by sound scientific principles."

Typically, animals are administered high doses, including the controversial maximum tolerated dose of a chemical in a standard diet. Humans, on the other hand, may be exposed to much lower doses in a highly variable diet. In these studies, animals, usually laboratory rodents, are exposed daily to the chemical agent for various periods of time up to their 2-year lifetime. Humans have an average 70-year lifetime and may be exposed either intermittently or regularly for an exposure period ranging from months to a full lifetime. Because of these differences, extrapolation error is a large source of uncertainty in risk assessment.

Even when studies of chemical effects in humans are available, they typically are for workplace exposures that exceed those expected in the environment. Uncertainties can be large because activity patterns, exposure duration, frequency, individual susceptibility, and dose may not be the same in study populations as individuals exposed to environmental concentrations. Because conservative methods are used in developing the RfDs and CSFs, the possibility of underestimating risks is low.

2.6.4.5 *Constituents Without Toxicity Data*

The absence of toxicity data for n-butylbenzenesulfonamide and 1-methyl-2-pyrrolidinone is likely to lead to an underestimation of potential risk. However, in light of the co-occurrence of these compounds with other COPCs having associated risks, the total underestimation of risk is not expected to significantly alter the results of this HHRA.

2.6.4.6 *Trichloroethene*

This HHRA used the toxicity criteria (i.e., carcinogenic slope factor and RfD) for TCE published by Cal/EPA. These toxicity criteria are less than provisional slope factors for TCE developed by the NCEA, and may lead to an underestimation of potential risk. Therefore, this HHRA included a second evaluation of the risks associated using the NCEA toxicity criteria. The following table presents an example of this evaluation prepared for

Zone 1 PGOU.

Receptor	Unit Hazard / Risk	Results above Thresholds [1]	Maximum HI or ILCR
Zone 1 PGOU Domestic Use			
Resident	Child HI	108 / 108	9.5×10^{2} / 1.1×10^{3}
Resident	Adult HI	102 / 103	4.1×10^{2} / 4.6×10^{2}
Resident	ILCR	121 / 139	4×10^{-3} / 1×10^{-1}
Zone 1 PGOU Vapor Intrusion			
Resident	Child HI	0 / 4	6.1×10^{-1} / 3.2×10^{0}
Resident	Adult HI	0 / 2	2.6×10^{-1} / 1.4×10^{0}
Resident	ILCR	15 / 33	5×10^{-5} / 3×10^{-3}
Commercial	Adult HI	0 / 0	9.9×10^{-2} / 4.8×10^{-1}
Commercial	ILCR	10 / 24	1×10^{-5} / 6×10^{-4}

Notes: OEHHA Toxicity Data / USEPA Toxicity Data
1 = Thresholds are 1.0 for Non-Carcinogenic Effects and 1×10^{-6} for Cancer Risks.
The totals for domestic use include wells screened in all layers. Wells that are screened across multiple layers were only counted once, so the totals may not equal the values listed in Section 2.5.1.1.

2.6.4.7 *Iron*

For a number of sample locations in the Zone 4 PGOU, iron is the primary contributor (driver) to the estimated HI. With iron contributing substantially to HIs, it is important to note that there is a substantial amount of uncertainty associated with the NCEA provisional iron reference dose. The reference dose is based upon mean dietary intakes rather than a distinct toxic endpoint observed in humans or animals. Complicating the consideration of the assessment results is that iron is an essential nutrient and is required for proper human physiological activity. Therefore, while in some cases iron in a number of samples is a significant contributor to the HI, this likely results in an overestimation of the hazard associated with these exposures.

2.6.5 *Cumulative Risk*

The risk from vapor intrusion and domestic use were not summed in the HHRA to estimate a cumulative risk to potential site receptors. As discussed in Section 1.1.1, groundwater on site is not used for any purpose, and future groundwater use on lands removed from the

Superfund Site boundary is governed by environmental restrictions included in the Partial Consent Decree (PCD), and recorded against title to the land.

Future additional use of groundwater off site is currently restricted by the Sacramento County Ordinance. The Sacramento County Environmental Management Department manages a "Consultation Zone," which requires all parties to consult with DTSC and the RWQCB prior to issuing a well permit within a 2,500-foot distance from chemicals in groundwater at the Aerojet site. Therefore, cumulative risk from vapor intrusion and domestic use were not calculated because this is an unrealistic scenario.

3.0 SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

This section presents the Screening Level Ecological Risk Assessment (SLERA) performed to provide a characterization of potential risks to ecological receptors that may be exposed to chemicals present in groundwater addressed in the RI/FS for the PGOU. The PGOU includes groundwater at and beyond the Aerojet site perimeter for those areas not previously addressed in the WGOU. Because groundwater is not typically considered an exposure medium for ecological receptors, this SLERA will focus on exposure of ecological receptors to surface waters potentially affected by groundwater discharge. Specifically, this SLERA focuses on Alder Creek, and the rationale for this will be discussed as part of the evaluation of potential migration pathways. The information provided in this SLERA will be used to guide, as necessary, supplemental investigation activities, remedial planning for the site, and/or to determine if a more detailed Baseline Ecological Risk Assessment (BERA) is required.

This SLERA was conducted consistent with USEPA's current guidance for performing Ecological Risk Assessments (ERAs) entitled *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (USEPA, 1997b). This guidance recommends an 8-step process for an ERA, of which this SLERA represents the completion of the following first two steps:

- Step 1: Screening-Level Problem Formulation and Ecological Effects Evaluation; and
- Step 2: Screening-Level Exposure Estimate and Risk Calculation.

At the conclusion of these two steps, according to USEPA, a Scientific/Management Decision Point (SMDP) is reached, which is a risk management review of the SLERA findings that leads to one of the following conclusions:

- Ecological risks are negligible and there is no need for remediation;
- Information is inadequate and further work is required to address data gaps; or
- The information indicates a potential risk, and a more thorough evaluation is warranted.

In addition to the above-referenced USEPA guidance, relevant guidance for conducting ERAs by the California DTSC was used in the SLERA, where appropriate.

The methods and results of this SLERA are discussed below.

3.1 *PROBLEM FORMULATION*

Problem formulation establishes the goals and focus of the SLERA. Major tasks of screening-level problem formulation consist of an assessment of the following factors:

- Environmental setting;
- Site chemicals;
- Chemical fate and transport mechanisms and migration pathways;
- Potential ecological receptors;
- Complete exposure pathways; and
- Ecological (assessment and measurement) endpoints.

The assessment is followed by the development and comparison of available data to ecological screening levels based on conservative assumptions, which concludes Step 1 of the SLERA. The results of each of these tasks are described below.

3.1.1 *Environmental Setting*

The Aerojet site is located near Rancho Cordova in Sacramento County, California, and is situated at the western end of the Sierra Nevada foothills between the Central Sierra Nevada and the Central Valley geomorphic provinces. The general ecology of the Aerojet site and vicinity has been described in several previous reports. Various surveys have been conducted to identify important biological resources that may occur on the site or in surrounding areas. These surveys were described and summarized in *Biological Resource Assessment for Easton, Sacramento County, California* (ECORP, 2004) and other reports related to the assessment of biological resources at the Aerojet site. In particular, common plant and wildlife species were described, along with aquatic resources and the potential occurrence of special-status species.

The Aerojet site is zoned for industrial use, and facilities are grouped into administrative, manufacturing, or testing areas consisting of multiple buildings. Large areas of undeveloped land that serve as buffer zones are present within the manufacturing and testing areas and along the perimeter. Land use off the Aerojet site includes residential, commercial, industrial, agricultural, recreational, and undeveloped areas. The greatest amount of development is north and northwest of the site in the communities of Rancho Cordova and Gold River. Land use immediately south and east of the site consists primarily of undeveloped land, including the IRCTS.

According to the RI reports presented in Appendix A (Zone 1 PGOU RI), Appendix B (Zone 2 PGOU RI), Appendix C (Zone 3 PGOU RI), and Appendix D (Zone 4 PGOU RI) of Part 1 of the PGOU RI/FS, surface water features in the regional vicinity of the PGOU include Folsom Lake, Lake Natoma, the American River, and the Folsom South Canal. In addition, surface water features in or near the PGOU include Alder Creek, Rebel Hill Ditch, Buffalo Creek, the Area 20 Administration Ditches, the Westlake Storm Water Retention Cells, the headwaters for Morrison Creek, Coyote Creek, and various man-made ditches and ponds.

3.1.2 Site Chemicals

As discussed in the RI report, VOCs are the predominant chemicals found in groundwater at the Aerojet site. In addition, rocket propellant constituents and potential combustion by-products were also detected in groundwater. Although numerous chemicals were used on the Aerojet site, the primary COPCs historically have included TCE, perchlorate, and NDMA. In addition, various inorganic constituents and VOCs were identified as COPCs in the HHRA presented in Section 2.

3.1.3 Chemical Fate and Transport Mechanisms and Migration Pathways

The fate and transport properties of the predominant classes of constituents (i.e., VOCs, perchlorate, NDMA, and inorganics) detected in groundwater during this RI/FS and their potential migration pathways are discussed below. The evaluation of potential fate and transport and migration pathways is necessary to identify media and locations that may be important in terms of constituent movement and subsequent exposure of ecological receptors.

3.1.3.1 *Environmental Fate and Transport Mechanisms*

The following is a discussion of the fate and transport of VOCs, perchlorate, NDMA, and inorganic constituents.

VOCs

VOCs are typically characterized by relatively low molecular weights, high Henry's Law constants, low organic carbon adsorption coefficient (K_{OC}) values, and generally high solubility in water. VOCs are typically considered to be fairly mobile in most environmental media. Movement of VOCs from groundwater to other environmental media is predominantly via volatilization and/or in the aqueous phase. Based on their low K_{OC} values and high water solubility, bioaccumulation of VOCs is not considered significant.

Perchlorate

Perchlorate salts generally exhibit high water solubility, and significant adsorption to sediments is not expected. In addition, perchlorate does not undergo significant natural chemical reduction. As a result, perchlorate can persist in groundwater and surface water for many decades under normal environmental conditions. Movement of perchlorate from groundwater to other environmental media is predominantly in the aqueous phase. Limited information is available regarding the potential for bioaccumulation of perchlorate. Available data suggest that perchlorate is not expected to bioconcentrate in aquatic organisms to any significant extent, and insufficient information is available to determine if trophic transfer of this chemical occurs in aquatic food webs.

NDMA

NDMA has a low vapor pressure and K_{OC}. Therefore, it is not expected to undergo significant volatilization from water, adsorption to sediments, or bioaccumulation. Photodegradation is the primary removal mechanism from the aquatic environment. Accordingly, NDMA has the potential to persist in groundwater in the absence of light, but not in surface water. Movement of NDMA from groundwater to other environmental media is predominantly in the aqueous phase.

Inorganics

Numerous inorganic constituents were detected in groundwater. Migration of inorganics is highly site-specific and controlled by a wide range of biogeochemical processes. Reduction-oxidation processes, solubility, sorption, and complexation in solution can affect the mobility of metals. Inorganics detected in groundwater are considered non-volatile, such that volatilization is not generally considered a significant transport mechanism. Additionally, chemically related processes such as biodegradation and photolysis are also not considered typical fate and transport mechanisms because these processes are almost always associated with organic COPCs.

Food chain transfers and biomagnification are important processes in the fate of several inorganic constituents that methylate, such as mercury and silver. Under certain conditions, these inorganics can be converted to a methyl form, which is soluble and mobile. Mercury and silver were not identified as COPCs in PGOU groundwater.

3.1.3.2 *Migration Pathways*

Potential migration pathways for exposure of ecological receptors to groundwater containing chemicals in the PGOU are illustrated in Figure 3-1. The primary mechanism of transport of VOCs, perchlorate, NDMA, and inorganics in PGOU groundwater to points of potential ecological exposure is discharge of groundwater to surface water.

As part of the RI, the PGOU was divided into four groundwater zones (1 through 4). The location of each zone is shown on Figure 1-2 of the RI and is described as follows:

- Zone 1 is located northeast of the Aerojet property, including the previously defined American River Study Area. The western portions of Zone 1 overlap with the eastern portions of the WGOU.
- Zone 2 is located along the southern Aerojet property boundary, east of the WGOU and west of Zone 3.
- Zone 3 is located south of the southern Aerojet property boundary, including Area 39 and the Aerojet-owned former Ehnisz Property, and east of the eastern property boundary at Area 40.
- Zone 4 is located along the northern Aerojet property boundary.

Based on an evaluation of potentiometric groundwater elevations in Zones 1, 2, and 3, groundwater associated with these zones is unlikely to discharge to surface water.

Within Zone 4, the potential for groundwater to discharge to surface water was evaluated in the RI for two groundwater seeps (Seep 6154 and Seep 6155) and Alder Creek. The two seeps are located at the base of the hillside south of Alder Creek and represent areas where groundwater is visibly discharging to the surface. The results of this evaluation indicated that flow from Seep 6154 likely results from local infiltration and is not necessarily connected with groundwater in the hydrostratigraphic layers. In contrast, the RI found that Seep 6155 may potentially represent surface discharge of groundwater. With respect to Alder Creek, review of the potentiometric surface elevations of shallow groundwater (i.e., Layer A) and elevations for Alder Creek indicated a qualitative potential for groundwater discharge to surface water. However, groundwater level and soil vapor data indicate the presence of a confining layer that may at least partially restrict discharge of groundwater to Alder Creek.

Finally, a third seep (Seep #3) was observed during a site reconnaissance in February 2003, and analytical samples were collected from the seep. A review of topographic maps of the area indicated that Seep #3 is located in an abandoned channel of Alder Creek and most likely represented standing water. Moreover, Seep #3 was not present during a second reconnaissance in June 2003.

In summary, the RI results indicate that Alder Creek is the only surface water feature that supports ecological receptors that could potentially receive discharge from PGOU groundwater. Therefore, Alder Creek is the focus of the remainder of this SLERA.

3.1.4 Identification of Potential Ecological Receptors

The identification of potential ecological receptors is based on the site-specific habitat characterization (Appendix P of Part 2 of the PGOU RI/FS) and information obtained from the California Department of Fish and Game's (CDFG) Natural Diversity Database, known as California Natural Diversity Database (CNDDB). A brief description of the habitat observed in and adjacent to Alder Creek is provided below to support the identification of potential ecological receptors.

Alder Creek, a small perennial tributary to the American River, flows from east to west through the northern portion of the Aerojet site. The

substrate of Alder Creek consists primarily of cobble and gravel, with some boulder and fines. Mining in the late 1940s and early 1950s disturbed much of Alder Creek, and the original stream course has been altered over time. The creek is heavily shaded by a mature forest canopy and a dense understory. Tree species associated with this community include Fremont cottonwood (*Populus fremontia*), white alder (*Alnus rhombifolia*), Oregon ash (*Fraxinus latifolia*), and interior live oak (*Quercus* sp.). Much of the understory consists primarily of Himalayan blackberry (*Rubus discolor*), but also includes California wild grape (*Vitis californica*), poison oak (*Toxicodendron diversilobum*), and willow (*Salix* spp.). Herbaceous cover was not well developed due to closure of the shrub layer throughout much of the riparian zone. Hydrophytic or moist-soil plants that occur in this community include pennyroyal (*Mentha pulegium*), sedge (*Carex* spp.), bulrush (*Scirpus acutus*), vervain (*Verbena bonariensis*), and cattail (*Typha* spp.). Herbaceous species, such as tall flat sedge, vervain, and smartweed (*Polygonum* spp.), are primarily limited to the creek banks and areas of sediment accumulation and reduced water velocities.

The ecological receptors that may potentially be exposed to constituents present in Alder Creek include primarily fish, aquatic invertebrates, piscivorous birds, amphibians, and reptiles. In addition, various species of mammals and birds (other than piscivores) may also potentially be exposed to surface water in Alder Creek; however, exposure of these receptors is expected to be more limited than the receptors identified above. The primary potential ecological receptors include common aquatic organisms and special-status species, as further discussed below.

Qualitative fisheries surveys in Alder Creek were conducted by various investigators in 1981 and 1989. These surveys identified the following fish species in Alder Creek: bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), smallmouth bass (*Micropterus dolomieu*), largemouth bass (*Micropterus salmoides*), prickly sculpin (*Cottus asper*), Sacramento pikeminnow (*Ptychocheilus grandis*), mosquitofish (*Gambusia affinis*), Sacramento sucker (*Catostomus occidentalis*), and redeye bass (*Micropterus coosae*).

A bioassessment conducted to support this SLERA identified various species of aquatic invertebrates such as mayflies, caddisflies, damselflies, beetles, true flies/midges, aquatic caterpillars, scuds, crayfish, worms, snails and clams.

Based on the site-specific habitat characterization and CNDDB search, the potential exists for the occurrence of special-status amphibians, reptiles, and birds in Alder Creek. Specifically, Alder Creek potentially provides suitable habitat for the western spadefoot toad (*Spea hammondi*), a federal species of concern and CDFG species of special concern. The western spadefoot toad utilizes ephemeral pools and drainages, which are typically absent of larger predatory fish and bullfrogs, for egg-laying and larval development. There are currently no known western spadefoot toad occurrences within Alder Creek.

Northwestern pond turtles (*Emys* [=*Clemmys*] *marmorata marmorata,* a federal species of concern and CDFG species of special concern) typically occur within perennial streams, creeks, ponds, marshes, and irrigation ditches with aquatic vegetation (CDFG, 2003). The availability of basking sites and suitable upland environments for egg laying (e.g., sandy banks or grassy open fields) are important aspects of suitable habitat. Pond turtles have been observed along Alder Creek (ECORP, 2004).

Three species of colonial nesting water birds have potential to occur in Alder Creek. These are the great blue heron (*Ardea herodias*), great egret (*Ardea alba*), and snowy egret (*Egretta thula*). Each of these species is a federal species of concern and has been observed on the Aerojet site, primarily in ponds, marshes, and waterways. These species are not formally listed and protected pursuant to either state or federal Endangered Species Acts, but are of stated interest to CDFG.

3.1.5 Identification of Complete Exposure Pathways

According to USEPA (1989), an exposure pathway generally consists of the following four elements: (1) a source, (2) a retention or transport medium, (3) a point of potential contact with the impacted medium, and (4) an exposure route. In some situations, the source itself is the exposure point, without a release to any other medium (i.e., direct ingestion of impacted soil).

Three potential exposure pathways may be associated with surface water. These pathways include direct contact (including ingestion and dermal exposures), inhalation, and food chain transfers (Figure 3-1). Based on the fate and transport characteristics of the constituents detected in surface water and the potential ecological receptors discussed previously, the primary pathway associated with surface water at the site is direct contact. Inhalation is potentially a complete exposure pathway for VOCs in surface water; however, this pathway is not expected to result in significant

exposure of ecological receptors based on the relatively low and infrequent detection of these constituents in surface water and the rapid dissipation of any volatile emissions under ambient conditions. Further, food chain transfer is not considered a pathway of potential concern based on the known properties of the constituents present in groundwater and surface water.

3.1.6 Definition of Ecological Endpoints

The next component of the problem formulation phase of this SLERA is the definition of ecological endpoints. Ecological endpoints are defined as measurable or estimable biological or ecological attributes associated with one or more levels of biological organization that serve as the focus of the risk assessment (USEPA, 1997b). Levels of biological organization can span and encompass the biochemical and cellular levels through individuals, populations, communities, and ecosystems.

3.1.6.1 Assessment Endpoints

Assessment endpoints are explicit expressions of the unique or critical ecosystem characteristics or features that are to be protected. Assessment endpoints developed for this SLERA are based on the characteristics of the ecosystem potentially at risk and the contaminant pathways within that ecosystem.

The assessment endpoint for this SLERA is protection of the communities of aquatic organisms using and/or inhabiting Alder Creek. Potential risks evaluated in this SLERA include adverse effects on these ecological receptors that may be related to past site activities. For purposes of this SLERA, the assessment endpoint did not include piscivorous birds because food chain transfer is not considered a pathway of potential concern based on the physio-chemical properties of the constituents present in groundwater and surface water. With respect to direct exposures, evaluation of aquatic organisms is expected to adequately address potential direct exposures of piscivorous birds.

3.1.6.2 Measurement Endpoints

Measurement endpoints are biological or ecological variables that can be measured or observed and are related to the valued characteristic of the ecosystem as described by the selected assessment endpoints. Because assessment endpoints often cannot be measured directly, measurement

endpoints are developed that can be related, either qualitatively or quantitatively, to the selected assessment endpoint(s).

The aquatic ecosystem measurement endpoints for this SLERA are based on a comparison of surface water data with published toxicity thresholds or ecological screening levels and the results of the Alder Creek bioassessment. The screening levels used in the SLERA have been derived based on field and laboratory studies of a range of species, and a variety of screening benchmarks have been developed for this purpose, as discussed below.

3.1.7 Ecological Effects Evaluation

The purpose of the ecological effects evaluation was to identify ecological screening levels that represent conservative thresholds for adverse ecological effects. Such screening levels were based on agency criteria (e.g., promulgated surface water quality standards), guidelines, or ecological benchmarks.

The surface water screening levels used in this SLERA were obtained from the following sources (presented in order of use):

- USEPA's *National Recommended Water Quality Criteria:* 2002c;
- California Toxics Rule (40 CFR Part 131, 18 May 2000);
- Recommended Numerical Limits to Apply to Water Quality Objectives (based on *A Compilation of Water Quality Goals*, California Regional Water Quality Control Board (RWQCB), Central Valley Region 2003);
- Toxicity Reference Values (TRVs) from the USEPA Region 9 website at http://www.epa.gov/region09/waste/sfund/prg/otherlinks.htm. The TRVs were originally presented in *Screening Level Ecological Risk Assessment Protocol, Appendix E: Toxicity Reference Values*, located at http://www.epa.gov/epaoswer/hazwaste/combust/eco-risk/volume3/appx-e.pdf.
- National Oceanic and Atmospheric Administration (NOAA), *Screening Quick Reference Tables (SQuiRTs)* (Buchman, 1999).
- Tier II Secondary Chronic Values provided in *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision*, (Suter and Tsao, 1996).

3.2 *SCREENING-LEVEL EXPOSURE ESTIMATE AND RISK CHARACTERIZATION*

Potential chemical stressors were initially identified based on the available analytical data, and only positively detected constituents were evaluated in this SLERA. Surface water samples were collected from Alder Creek at two locations (S-5 and S-6) on a quarterly basis from January 2002 through July 2004. However, a full list of parameters was only analyzed on a semiannual basis. In addition, to support the Alder Creek bioassessment, surface water samples were collected at three locations (Alder Creek-1, -2, and -3) on 17 December 2004. Samples from each of the three seeps (6154, 6155, and Seep #3) were collected in February 2003 as part of the RI. Alder Creek-3, S-5 and Seep #3 were located furthest upstream just downstream of Prairie City Road; Alder Creek 2 and Seep 6154 were located downstream from these samples; and Alder Creek-1, Seep 6155 and S-6 were located furthest downstream. These surface water and seep sample locations are depicted on Figure 3-1 of the RI. Tables summarizing the sampling results are provided in Attachment E.

To develop exposure estimates and risk calculations consistent with the methodology presented in USEPA (1997b), surface water concentrations were used as exposure point concentrations. Potential exposures were evaluated relative to the ecological screening levels previously discussed through a comparison of each surface water sample result with appropriate benchmarks. COPCs were identified as those constituents with exceedances of the ecological screening levels. Screening levels for the positively detected constituents evaluated in this SLERA are summarized in Table 3-1. Additional evaluation of potential risks to the aquatic community within Alder Creek was assessed based on the results of the Alder Creek bioassessment. The results of the identification of COPCs and the bioassessment, as well as a discussion integrating the findings of these tasks, are discussed in the following subsections.

3.2.1 *Identification of Constituents of Potential Concern*

The identification of COPCs was based on the screening of the available analytical data for the surface water and seep samples. Results of this screening for positively detected constituents are presented on Table 3-2. The following constituents exceeding screening levels in Alder Creek samples were identified as COPCs: barium, boron, cadmium, manganese, and selenium. No exceedances of screening levels were reported for the seep samples. With respect to the identification of COPCs, the following points should be noted:

- All detections of barium exceeded the screening level of 4 µg/L. Upstream and downstream concentrations were comparable, indicating that barium is not present in surface water as a result of past site activities.
- All detections of boron exceeded the screening level of 1.6 µg/L. Upstream and downstream concentrations were comparable, indicating that boron is not present in surface water as a result of past site activities.
- Cadmium detections at one downstream location and the upstream location exceeded the screening level of 0.29 µg/L. Upstream and downstream concentrations were comparable, indicating that cadmium is not present in surface water as a result of past site activities.
- One detection of manganese at 140 µg/L in the downstream station sample collected in July 2003 slightly exceeded the screening level of 120 µg/L. This was the only exceedance of a screening level by manganese in multiple rounds of sampling. Manganese concentrations in subsequent sampling events have ranged from 27 to 77 µg/L in Alder Creek.
- Selenium was detected at only one sampling location (Alder Creek-2) during one sampling event performed as part of the bioassessment (Section 3.2.2). Selenium has not been detected in any of the quarterly samples collected from Alder Creek at sampling stations S-5 and S-6.
- In addition to the screening levels presented on Table 3-1, the perchlorate and chloromethane data results were also evaluated against the following alternate screening levels: 1,800 ug/L (State of Oklahoma, 2006) and 5,500 ug/L (ORNL RAIS, 2009), respectively. However, the perchlorate and chloromethane data did not exceed these screening levels.

In addition to the points mentioned above, it is noteworthy that none of the primary groundwater COPCs (i.e., TCE, perchlorate, and NDMA) exceeded screening levels in surface water and seep samples. In addition, the barium, boron, and cadmium detected in surface water do not appear to be related to past site activities, and the isolated manganese and selenium exceedances are not characteristic of long-term water quality conditions in Alder Creek. Based on these considerations, COPCs identified in Alder Creek surface water do not appear to be site-related and/or pose a potential risk to aquatic receptors.

3.2.2 *Alder Creek Bioassessment*

A bioassessment of Alder Creek was conducted by ECORP Consulting, Inc., to support this SLERA. A copy of the ECORP report documenting the methods and results of the bioassessment is provided in Attachment F. A summary of the assessment is provided below.

3.2.2.1 *Methods*

Three benthic macroinvertebrate (BMI) sites on Alder Creek were sampled on 17 December 2004 as part of this bioassessment. Site locations were selected to assess potential effects on the biota of Alder Creek from the discharge of impacted groundwater downgradient of the landfill or sites within Aerojet Test Area A. The downstream site (Alder-1) was located between the retention pond and the landfill sites. The middle site (Alder-2) was positioned between the landfill sites and the water supply pipeline overcrossing from the city of Folsom. The upstream reference site (Alder-3) was located just downstream of the Prairie City Road overcrossing and upstream of Test Area A (Figure 1 of Attachment F).

BMI samples were collected and processed using the California Stream Bioassessment Protocols (CSBP) developed by CDFG (2003). Microhabitat data were collected using the CSBP's Physical/Habitat Quality form to provide the total Physical Habitat Quality (PHQ) score and the Substrate Complexity (SC) score. In addition, water quality data were collected during the field sampling, including dissolved oxygen, specific conductivity, water temperature, and pH.

3.2.2.2 *Results*

The CSBP, which is a rapid bioassessment protocol (RBP) methodology, provides a quick assessment of the BMI community. The protocol allows for comparison between a reference site and a potentially affected site. A reference site is defined as an undisturbed location or a site with the best possible conditions for the area. The data set for this assessment is limited to three samples collected from three different sites, which only provides a snapshot of the benthic community present at the time of sample collection. The responses for each of the 24 CSBP biological metrics at the downstream Alder Creek sites (Alder-1 and Alder-2) compared with the reference site (Alder-3) are summarized in Table 6 of Attachment F.

Comparison of the reference site (Alder-3) metrics to those for the two downstream sites (Alder-1 and Alder-2) showed variable responses. The

Alder-1 site had 12 positive, 4 equivalent, and 9 negative metric responses when compared to the Alder-3 reference site. The Alder-2 site had 13 positive, 4 equivalent, and 8 negative metric responses compared to the Alder-3 site. In general, the BMI communities at the Alder-1 and Alder-2 sites were not substantially different from the community present at the Alder-3 reference site, with the exception of BMI abundance, which was lower at the downstream stations.

The PHQ scores (sub-optimal at all sampling locations), water quality data, and SC scores were similar at all three sites. The Alder-2 site had the lowest PHQ score; however, the low score was due primarily to the channel characteristics at this site.

Substrate consolidation or the tightness of the substrate components (gravel/cobbles) was lowest at Alder-1 and Alder-3, with medium consolidation at Alder-2. Higher consolidation scores indicate that less interstitial spaces are present between substrate components. These interstitial spaces provide habitat for BMIs; consequently, decreases in the amount of space available usually correspond to lowered abundance values. The higher consolidation present at Alder-2 may partially explain the lower abundance value at this site. Other habitat differences observed between the downstream stations and the upstream station included canopy cover and riffle velocity. There was substantially more canopy cover and higher riffle velocity at the upstream station than observed at the downstream stations. No other obvious differences in either physical habitat or measured water quality parameters were observed at the three sites that might account for the lower abundance values at Alder-1 or Alder-2.

Finally, the field sampling effort for this assessment was conducted shortly after several storms had passed, which brought significant amounts of precipitation. The high watermark on the creek was more than 3 feet above the water level during the sampling activities, indicating that substantial flow increases had occurred during the storms. Hynes (1970) noted that the abundance of BMIs usually decreases following a period of increased stream flows. As a result, some of the metric values obtained at the three sites may be partially due to the variable effects of the increased stream flows at each site, and the general patchy distribution of BMIs within the stream.

3.2.3 *Discussion*

Based on the evaluation conducted in the RI of potential surface discharge points for PGOU groundwater, Alder Creek is the only surface water feature that could potentially receive discharge from the PGOU. Constituents positively detected in Alder Creek included acetone, chloromethane, naphthalene, NDMA, perchlorate, and various inorganic constituents. The only constituents identified as COPCs in surface water were inorganics (i.e., barium, boron, cadmium, manganese, and selenium); however, these constituents do not appear to be site-related and/or pose a potential risk to aquatic receptors. Further, none of the primary groundwater COPCs (i.e., TCE, perchlorate, and NDMA) exceeded screening levels in surface water samples. Thus, the screening results indicate that adverse ecological effects are not expected to occur associated with potential groundwater discharge to surface water.

The bioassessment conducted to support the SLERA found that, in general, the BMI communities at the Alder-1 and Alder-2 sites were not substantially different from the community present at the Alder-3 reference site. Overall, the downstream stations were rated as good as or better than the upstream station based on approximately 65 percent of the calculated BMI metrics. Further, most of the metric values indicating poor responses at the downstream stations (compared to the upstream station) were not substantially different than the metric values obtained for the upstream location. The most notable difference between the downstream and upstream stations was the increased abundance of organisms observed at the upstream station. Differences were also noted based on an increase of non-insect species (i.e., amphipods) and decrease in Hydropsychidae (caddisflies) at the downstream stations. Alder-1 also exhibited an increase in the percentage of tolerant organisms (i.e., amphipods); however, the overall tolerance value for this station (5.5) was comparable to that calculated for Alder-3 (5.4).

With respect to the minor observed differences in BMI community structure, it should be noted that the surface water screening results indicated that significant ecological risk was not associated with the positively detected COPCs in surface water, and differences in water quality between upstream and downstream stations were not observed. Therefore, physical stressors to the BMI community were considered.

All three sampling locations were rated as sub-optimal based on the PHQ scores, and substrate consolidation was lowest at Alder-1 and Alder-3, with medium consolidation at Alder-2. Other habitat differences

observed between the downstream stations and the upstream station included canopy cover and riffle velocity. There was substantially more canopy cover and higher riffle velocity at the upstream station than at the downstream stations. Specifically, the decrease in canopy cover associated with the downstream stations, particularly Alder-1, appears to have resulted in a decrease of organic matter (e.g., leaf litter and detrital matter) associated with the creek substrate. There was a notable difference in the quantity of detrital material collected at Alder-1 compared to Alder-3, and the observed lower BMI abundance at Alder-1 is likely due, at least in part, to the decrease in organic material at this location. Finally, the field sampling effort for the bioassessment was conducted shortly after several storms had passed, which brought significant amounts of precipitation. As a result, some of the metric values obtained at the three sites may have been affected by the increased stream flows present in Alder Creek.

In conclusion, based on a consideration of the combined screening results and BMI metrics, no specific, site-related impacts were observed. However, the results of this evaluation indicate that there are likely other potential stressors in Alder Creek influencing the BMI community structure that are unrelated to the site.

3.2.4 Uncertainty Analysis

There are a number of uncertainties involved in the prediction of ecological risk resulting in uncertainty associated with the risk assessment results. A major source of uncertainty is the extrapolation of laboratory-derived toxicity data to the natural environment. In addition, the metabolic degradation rates and many other physiological processes may differ greatly between species. Therefore, most screening levels default to the most conservative values available.

The screening levels used in this SLERA were obtained from USEPA, state, and other relevant agency guidance, which includes a variety of government agency databases from various regions, as well as U.S. Department of Energy sources. Because of factors such as the limited availability of toxicity data, wide variation in sensitivity of different species to different chemicals, the variable quality of the available data, and many others, there is uncertainty in applying the screening levels to surface water at the site. In general, the screening levels used in this SLERA are considered to be conservative. Thus, the screening conducted for this SLERA is more likely to overestimate than to underestimate risks.

There is also uncertainty associated with attempting to predict ecological risks in multi-factor situations. Often it is not possible to identify a single causative agent where potential risk may be identified. In the case of the Alder Creek bioassessment, numerous conditions exist that may confound the interpretation of the assessment results, including variability in Alder Creek physical habitat and the location of the creek within an urban area.

3.3 SUMMARY AND RECOMMENDATIONS

A summary of the results of this SLERA conducted for constituents present in surface water addressed in the PGOU RI/FS, and a discussion of the recommendations are presented below.

3.3.1 Summary

The results of the assessment are summarized below according to the following 10 steps:

1. Identification of Hazard Sources
2. Dose-Response Assessment
3. Conceptual Exposure/Pathway Analysis
4. Characterization of Site and Potential Receptors
5. Selection of Chemicals, Indicator Species, and Endpoints
6. Exposure Assessment
7. Toxicity Assessment/Ecological Effects Assessment
8. Risk Characterization
9. Identification of Limitations and Uncertainties
10. Ecological Risk Model

3.3.1.1 Identification of Hazard Sources

VOCs are the predominant chemicals found in groundwater at the Aerojet site. In addition, rocket-propellant constituents and potential combustion by-products were also detected in groundwater. Although numerous chemicals were used on the Aerojet site, the primary COPCs historically have included TCE, perchlorate, and NDMA.

3.3.1.2 *Dose-Response Assessment*

For purposes of this SLERA, conservative ecological screening levels were chosen to characterize the toxicity of detected constituents and to evaluate potential risks to aquatic receptors. As discussed in Section 3.1.7. screening levels were selected using the following guidance documents (presented in order of use):

- USEPA's *National Recommended Water Quality Criteria* (2002c);
- California Toxics Rule (40 CFR Part 131, 18 May 2000);
- Recommended Numerical Limits to Apply to Water Quality Objectives (based on *A Compilation of Water Quality Goals*, RWQCB, Central Valley Region, 2003);
- TRVs from the USEPA Region 9 website at http://www.epa.gov/region09/waste/sfund/prg/otherlinks.htm. The TRVs were originally presented in *Screening Level Ecological Risk Assessment Protocol, Appendix E: Toxicity Reference Values*, located at http://www.epa.gov/epaoswer/hazwaste/combust/eco-risk/volume3/appx-e.pdf;
- NOAA, *Screening Quick Reference Tables (SQuiRTs)* (Buchman, 1999); and
- Tier II Secondary Chronic Values provided in *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revisions*, (Suter and Tsao, 1996).

These screening levels were conservatively used to represent concentrations that are protective of ecological receptors.

3.3.1.3 *Conceptual Exposure/Pathway Analysis*

The primary mechanism of transport of VOCs, perchlorate, NDMA, and inorganics in groundwater to points of potential ecological exposure is the discharge of groundwater to surface water (Figure 3-1). The results of an evaluation of potentiometric groundwater elevations indicate that Alder Creek is the only surface water feature that could potentially receive groundwater discharge from PGOU groundwater.

Based on the fate and transport characteristics of the constituents detected in surface water, the primary pathway associated with surface water at the site is direct contact. Inhalation is potentially a complete exposure pathway for VOCs in surface water; however, this pathway is not

expected to result in significant exposure of ecological receptors based on the relatively low and infrequent detection of these constituents in surface water and the rapid dissipation of any volatile emissions under ambient conditions. Food-chain transfer is not considered a pathway of potential concern based on the known properties of the constituents present in groundwater and surface water.

3.3.1.4 *Characterization of Site and Potential Receptors*

Ecological receptors that may potentially be exposed to constituents present in Alder Creek include primarily fish, aquatic invertebrates, piscivorous birds, amphibians, and reptiles (Figure 3-1). These potential ecological receptors include common aquatic organisms and special-status species, as further discussed below.

3.3.1.5 *Selection of Chemicals, Indicator Species, and Endpoints*

Ecological endpoints were identified as part of the SLERA. Ecological endpoints are defined as measurable or estimable biological or ecological attributes associated with one or more levels of biological organization that serve as the focus of the risk assessment (USEPA, 1997b).

The assessment endpoint for this SLERA is protection of the communities of aquatic organisms using and/or inhabiting Alder Creek. Potential risks evaluated in this SLERA include adverse effects on these ecological receptors that may be related to past site activities.

The aquatic ecosystem measurement endpoints for this SLERA are based on a comparison of surface water data with published toxicity thresholds or ecological screening levels and the results of the Alder Creek bioassessment. The screening levels used in the SLERA have been derived based on field and laboratory studies of a range of species, and a variety of screening benchmarks have been developed for this purpose, as discussed below.

3.3.1.6 *Exposure Assessment*

Site-specific exposure potentially associated with the groundwater discharge to Alder Creek was evaluated in this SLERA. Exposure of ecological receptors to COPCs is typically defined as the co-occurrence or contact of a receptor with a chemical stressor. Exposure potential is possible where groundwater is the source of constituents detected in the surface water present in Alder Creek. However, none of the primary

groundwater COPCs (i.e., TCE, perchlorate, and NDMA) exceeded screening levels in surface water samples. Thus, unacceptable exposure of ecological receptors to groundwater constituents is not expected.

3.3.1.7 *Toxicity Assessment/Ecological Effects Assessment*

Characterization of the potential for adverse effects to occur in ecological receptors as a result of exposure to constituents detected in surface water was conducted by comparing reported constituent concentrations with ecological screening levels selected for use in this SLERA. The results of this evaluation indicated that the COPCs identified in Alder Creek surface water do not appear to be site-related and/or do not pose a potential risk to aquatic receptors.

3.3.1.8 *Risk Characterization*

To develop exposure estimates and risk calculations consistent with the methodology presented by USEPA (1997b), surface water concentrations were used as exposure point concentrations. Potential exposures were evaluated relative to the ecological screening levels previously discussed through a comparison of each surface water sample result with appropriate benchmarks. COPCs were identified as those constituents with exceedances of the ecological screening levels. Additional evaluation of potential risks to the aquatic community within Alder Creek was assessed based on the results of the Alder Creek bioassessment.

Constituents positively detected in Alder Creek included acetone, chloromethane, naphthalene, NDMA, perchlorate, and various inorganic constituents. The only constituents identified as COPCs in surface water were inorganics (i.e., barium, boron, cadmium, manganese, and selenium); however, these constituents do not appear to be site-related and/or pose a potential risk to aquatic receptors. Further, none of the primary groundwater COPCs (i.e., TCE, perchlorate, and NDMA) exceeded screening levels in surface water samples. Thus, the screening results indicate that adverse ecological effects are not expected associated with potential groundwater discharge to surface water.

The bioassessment conducted to support the SLERA found that, in general, the BMI communities at the Alder-1 and Alder-2 sites were not substantially different from the community present at the Alder-3 reference site. Overall, the downstream stations were rated as good as or better than the upstream station based on approximately 65 percent of the calculated BMI metrics. Further, most of the metric values indicating poor

responses at the downstream stations (compared to the upstream station) were not substantially different from the metric values obtained for the upstream location. The most notable difference between the downstream and upstream stations was the increased abundance of organisms observed at the upstream station. Differences were also noted based on an increase of non-insect species (i.e., amphipods) and a decrease in *Hydropsychidae* (caddisflies) at the downstream stations. Alder-1 also exhibited an increase in the percentage of tolerant organisms (i.e., amphipods); however, the overall tolerance value for this station (5.5) was comparable to that calculated for Alder-3 (5.4).

Based on a consideration of the combined screening results and BMI metrics, no specific, site-related impacts were observed. However, the results of this evaluation indicate that there are likely other potential stressors in Alder Creek influencing the BMI community structure that are unrelated to the site.

3.3.1.9 *Identification of Limitations and Uncertainties*

There are a number of difficulties involved in the prediction of ecological risk resulting in uncertainty associated with risk assessment results. A major source of uncertainty is the extrapolation of laboratory-derived data to the natural environment. In addition, the metabolic degradation rates and many other physiological processes may differ greatly between species. Therefore, most screening levels default to the most conservative values available.

The screening levels used in this SLERA were obtained from USEPA, state, and other relevant agency guidance, which includes a variety of government agency databases from various regions, as well as U.S. Department of Energy sources. Because of factors such as the limited availability of toxicity data, wide variation in sensitivity of different species to different contaminants, the variable quality of the available data, and many others, there is uncertainty in applying the screening levels to surface water at the site. In general, the screening levels used in this SLERA are considered to be conservative. Thus, the screening conducted for this SLERA is more likely to overestimate than to underestimate risks.

There is also uncertainty associated with attempting to predict ecological risks in multi-factor situations. Often it is not possible to identify a single causative agent where potential risk may be identified. In the case of the Alder Creek bioassessment, numerous conditions exist that may confound

the interpretation of the assessment results, including variability in Alder Creek physical habitat and the location of the creek within an urban area.

3.3.1.10 Ecological Risk Model

The primary mechanism of transport of VOCs, perchlorate, NDMA, and inorganics in groundwater to points of potential ecological exposure is discharge of groundwater to surface water. The results of an evaluation of potentiometric groundwater elevations indicate Alder Creek is the only surface water feature that could potentially receive groundwater discharge from the PGOU.

Based on a consideration of the combined screening results and BMI metrics, no specific, site-related impacts were observed. However, the results of this evaluation indicate that there are likely other potential stressors in Alder Creek influencing the BMI community structure that are unrelated to the site.

3.3.2 Recommendations

No further sampling or ecological risk assessment is recommended for PGOU groundwater. Although some groundwater COPCs were detected infrequently and at low concentrations in surface water, none of these constituents exceeded screening levels. The COPCs identified in Alder Creek were limited to inorganic constituents, and the results of this evaluation indicated that they do not appear to be site-related and/or do not pose a potential risk to aquatic receptors. Based on a consideration of the combined screening results and Alder Creek bioassessment findings, no specific, site-related impacts were observed.

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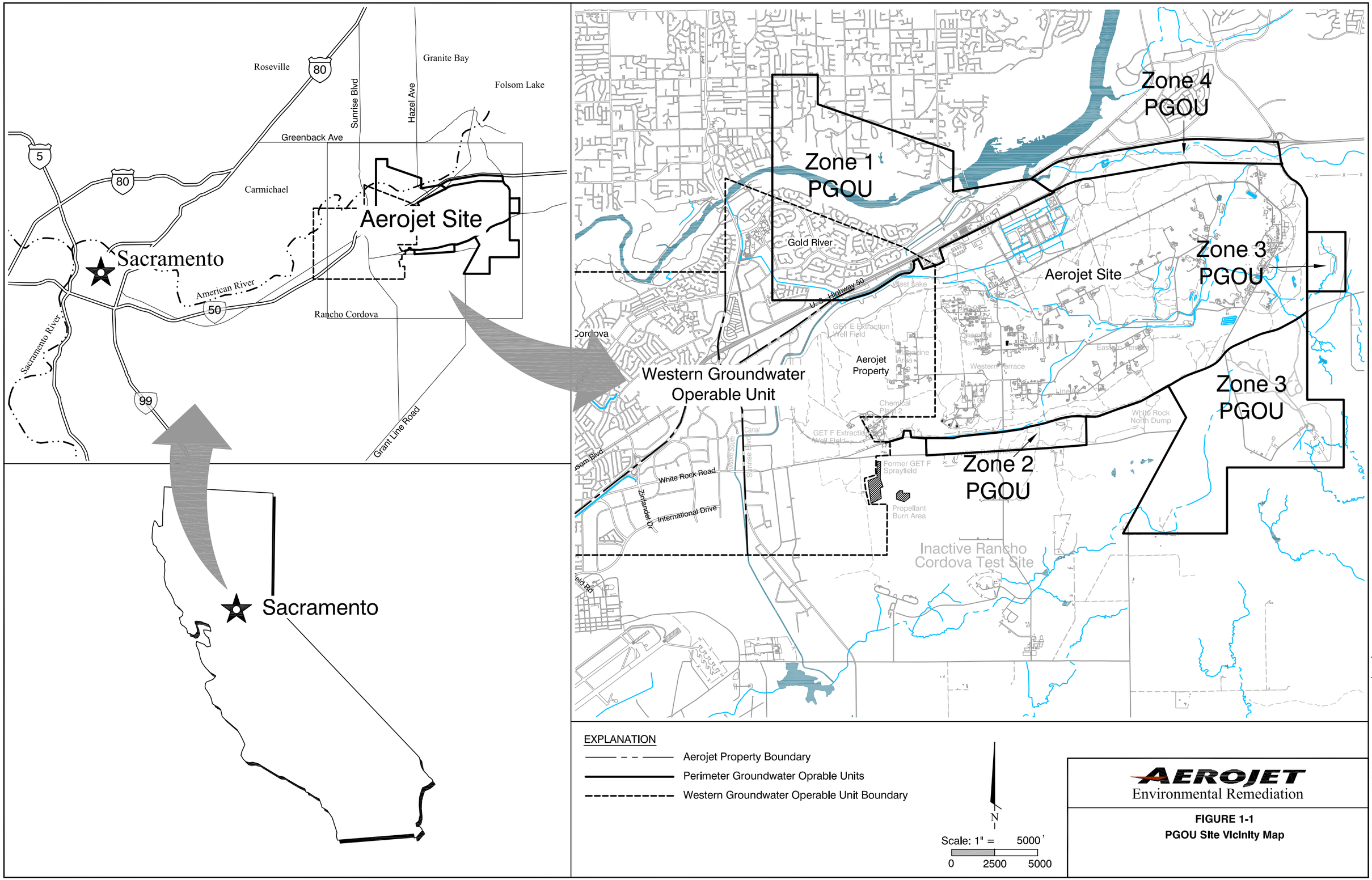
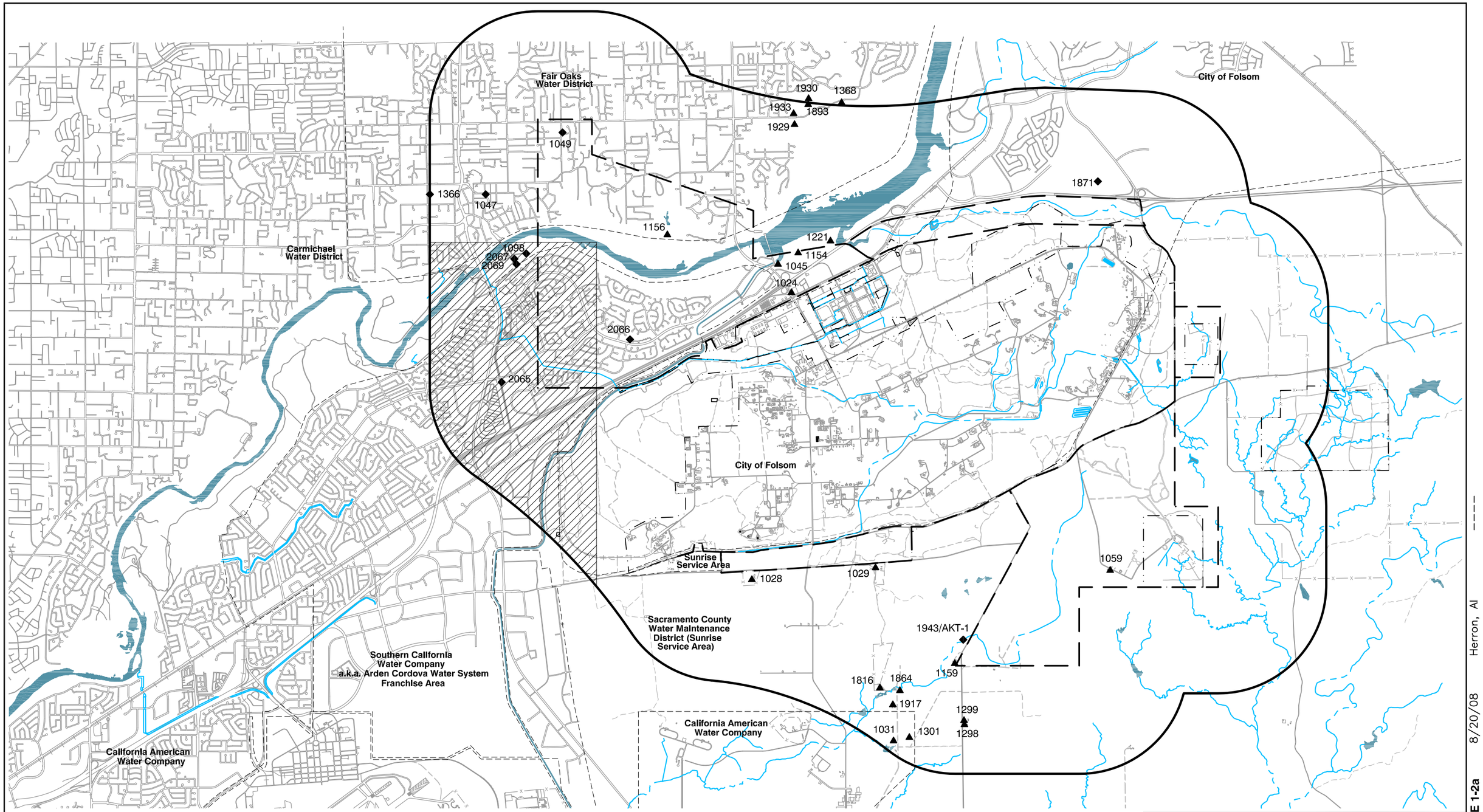
Figures


Roseville
80
Granite Bay
Folsom Lake
Sunrise Blvd
Hazel Ave
Greenback Ave
5
80
Carmichael
Aerojet Site
Sacramento
American River
50
Rancho Cordova
Sacramento River
99
Grant Line Road
Sacramento
Zone 4
PGOU
Zone 1
PGOU
Gold River
Aerojet Site
Zone 3
PGOU
U.S. Highway 50
Western Groundwater
Operable Unit
Aerojet
Property
Zone 3
PGOU
White Rock
North Dump
Zone 2
PGOU
White Rock Road
Zinfandel Dr
International Drive
Former GET F
Sprayfield
Propellant
Burn Area
Inactive Rancho
Cordova Test Site
EXPLANATION
Aerojet Property Boundary
Perimeter Groundwater Oprable Units
Western Groundwater Operable Unit Boundary
N
Scale: 1" = 5000'
0
2500
5000
AEROJET
Environmental Remediation
FIGURE 1-1
PGOU Site Vicinity Map
SR10120714
FIGURE 1-1
8/20/08
Herron, Al



EXPLANATION

- PGOU Boundary
- One Mile Radius from PGOU Boundary
- Partial Consent Decree Boundary
- Water Purveyor Service Area Boundary
- Public Water Supply Well
- Domestic Water Supply Well
- Area Included in WGOU Private Well Survey

N

Scale: 1" = 4500'

0 2250 4500

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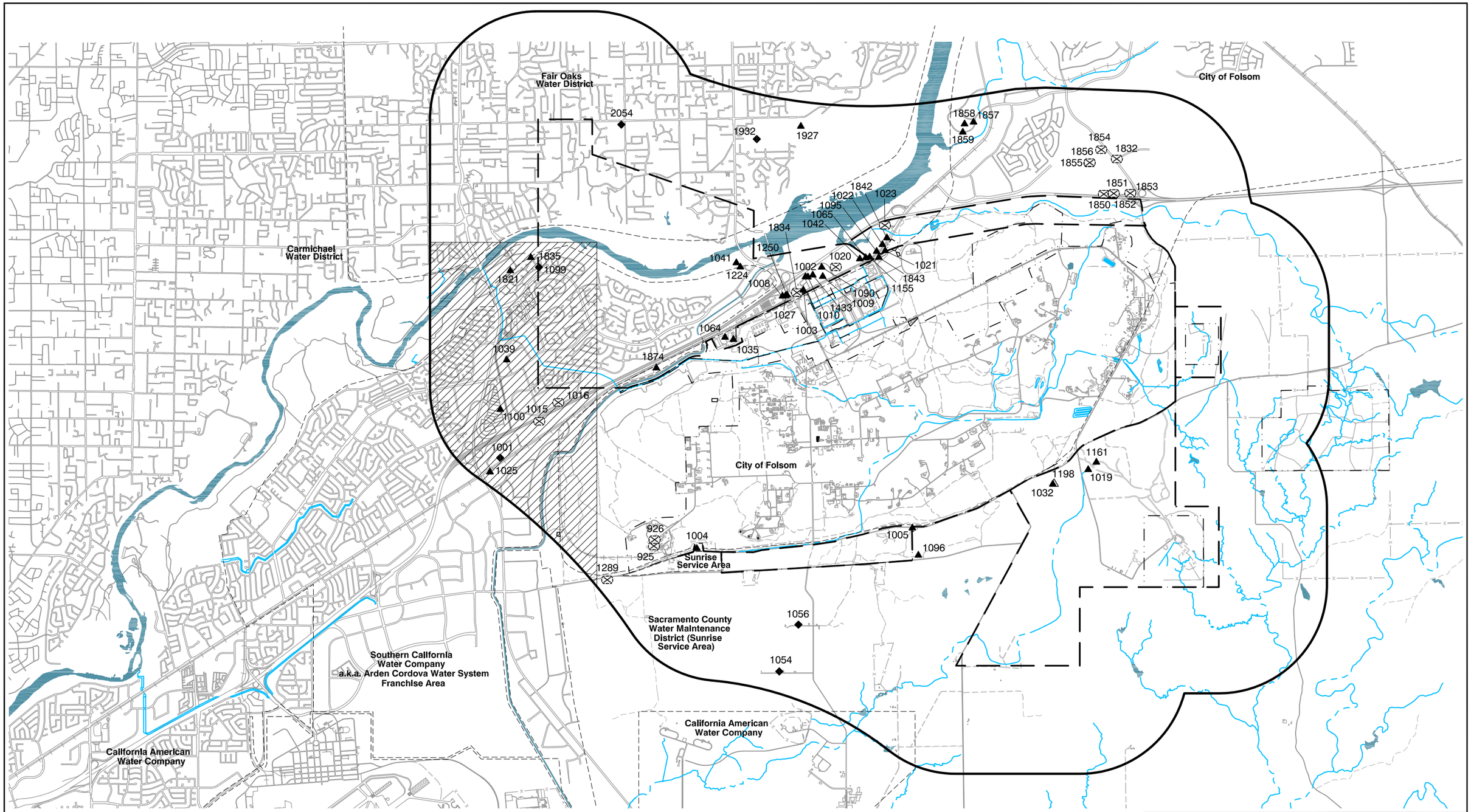
FIGURE 1-2a

Active Public and Domestic Water Supply Well Locations Perimeter Groundwater Operable Unit

FIGURE 1-2a 8/20/08 Herron, Al

SR10123771



EXPLANATION

- PGOU Boundary
- One Mile Radius from PGOU Boundary
- Partial Consent Decree Boundary
- Water Purveyor Service Area Boundary
- Public Water Supply Well
- Domestic Water Supply Well
- Destroyed Water Supply Well
- Area Included in WGOU Private Well Survey

Wells on this map that are not destroyed are abandoned or inactive.

N

Scale: 1" = 4500'

0 2250 4500

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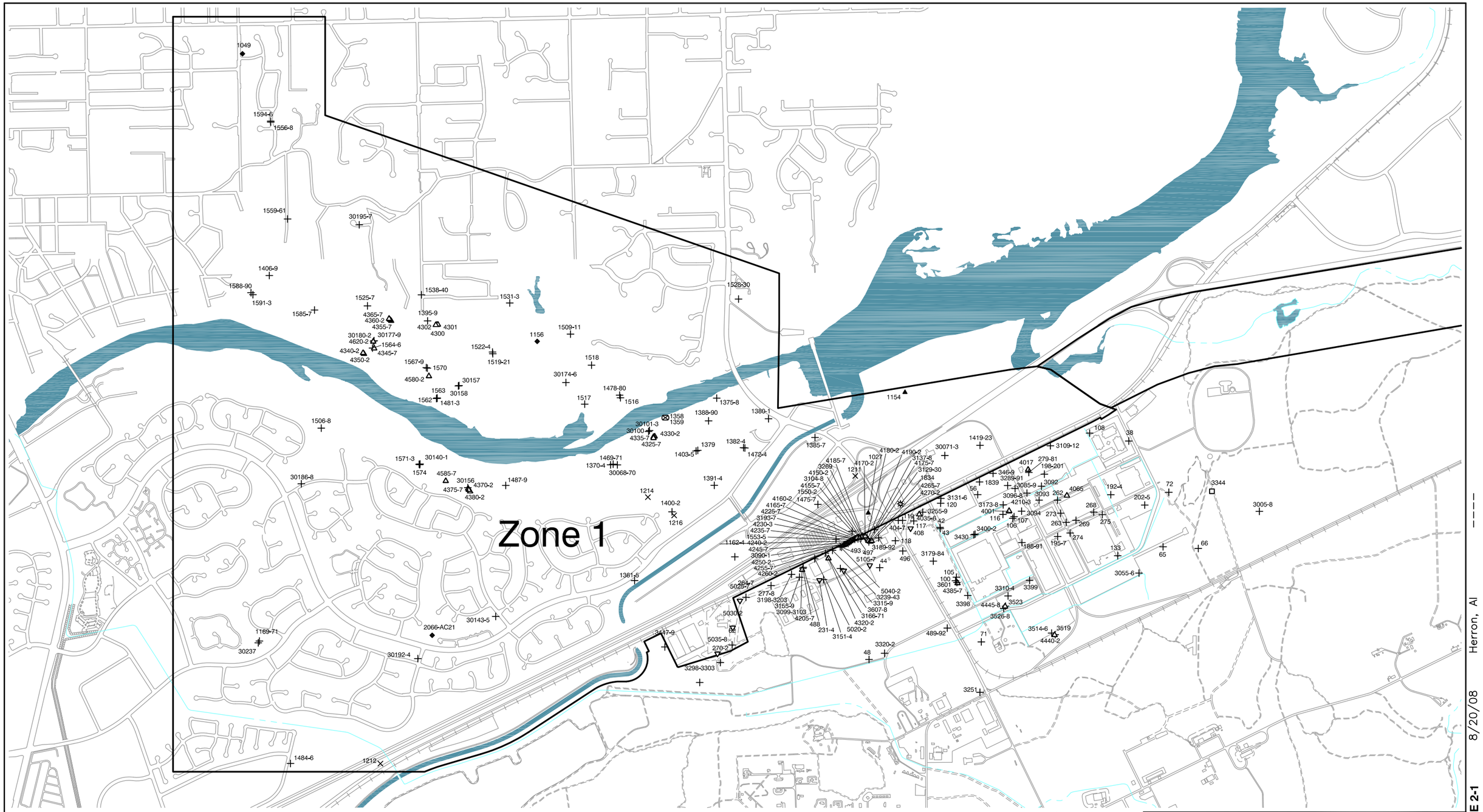
FIGURE 1-2b

Inactive, Abandoned or Destroyed Water Supply Well Locations Perimeter Groundwater Operable Unit

FIGURE 1-2b 8/20/08 Herron, Al

SR10123772



N

Scale: 1" = 1600'

0 800 1600

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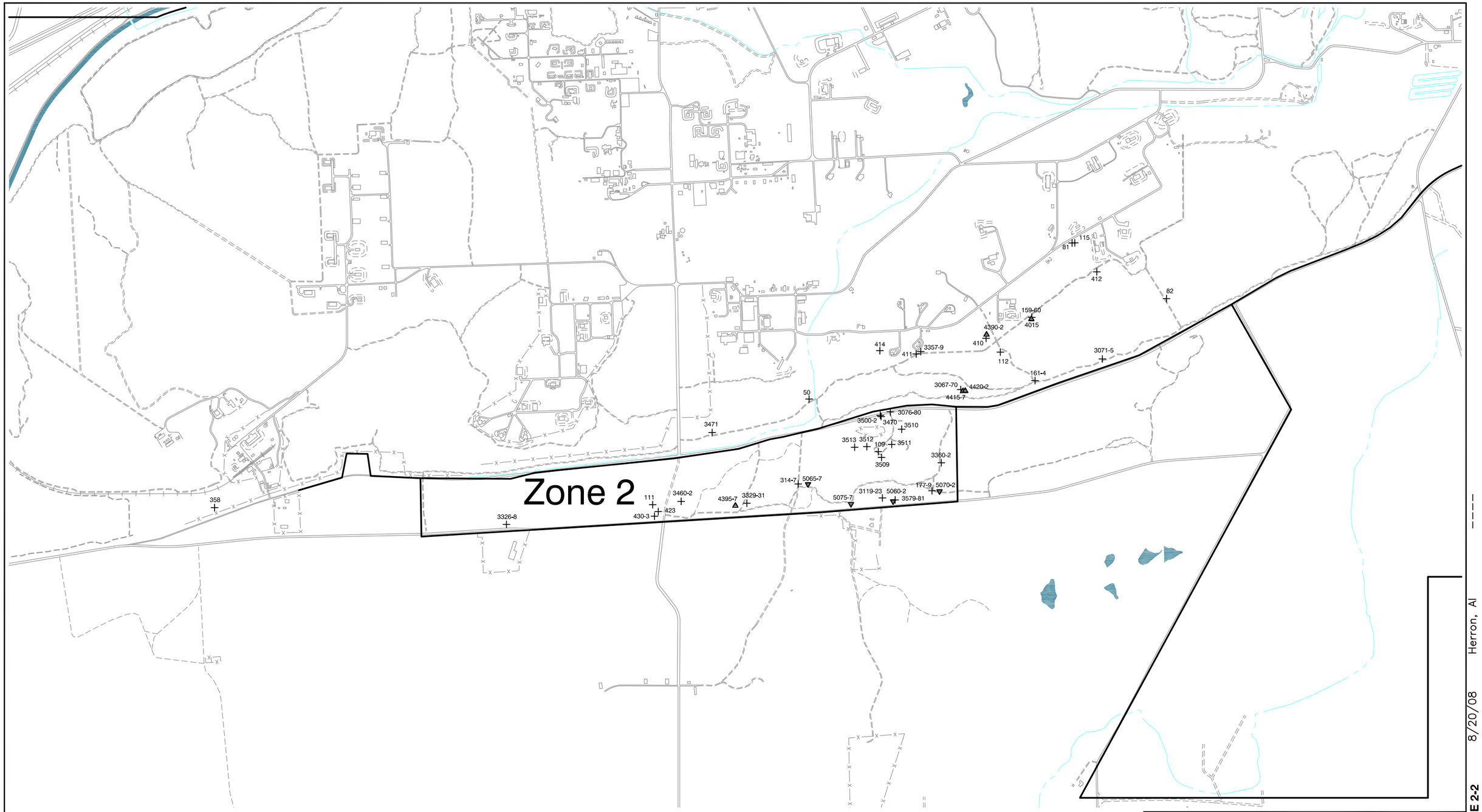
FIGURE 2-1

PGOU Exposure Zones
Zone 1
Perimeter Groundwater Operable Unit

SR10120716 **FIGURE 2-1** 8/20/08 Herron, Al



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Scale: 1" = 1600'

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FIGURE 2-2

PGOU Exposure Zones
Zone 2
Perimeter Groundwater Operable Unit

SR10120717 **FIGURE 2-2** 8/20/08 Herron, Al

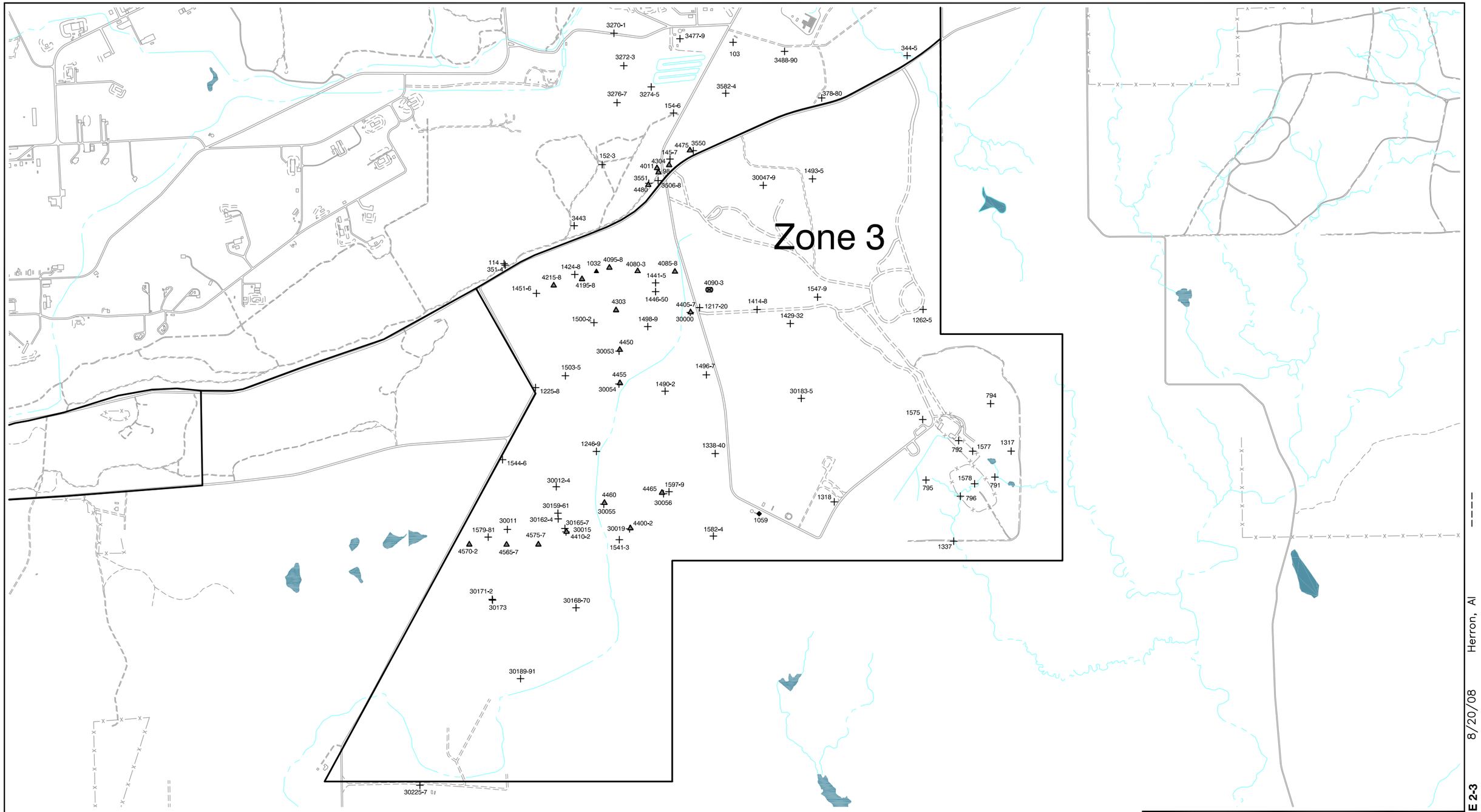

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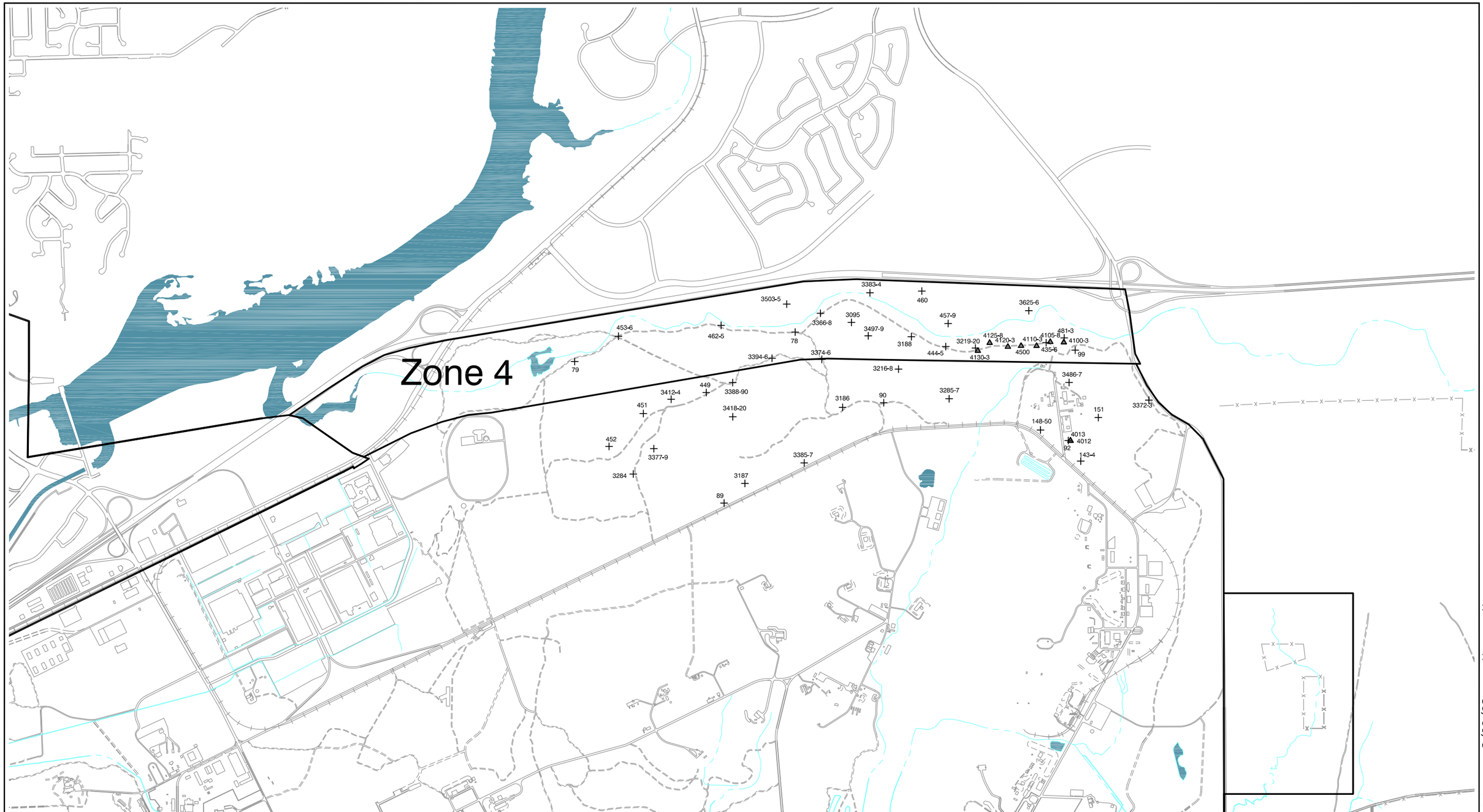
FIGURE 2-3
PGOU Exposure Zones
Zone 3
Perimeter Groundwater Operable Unit

SR10120718 **FIGURE 2-3** 8/20/08 Herron, Al



N

Scale: 1" = 1600'

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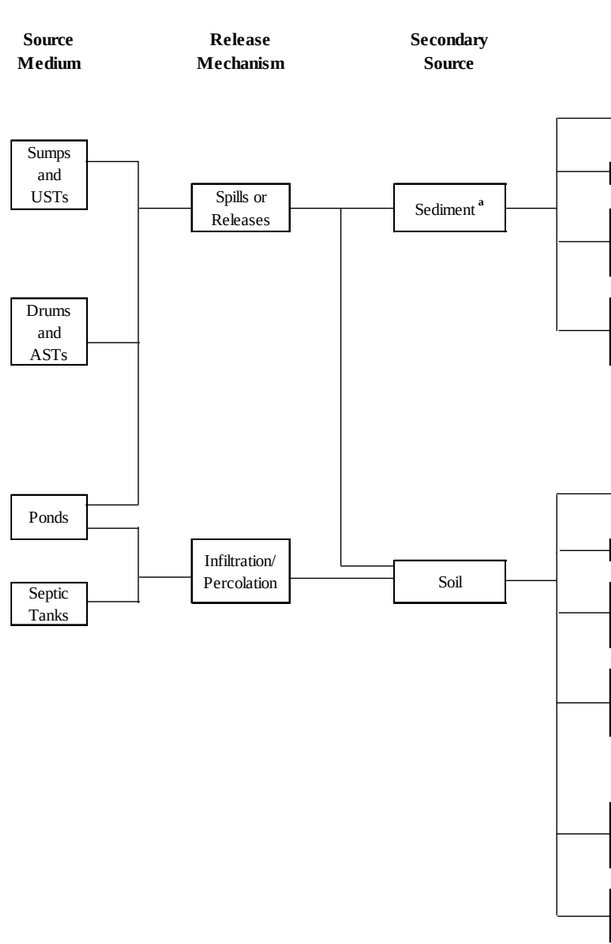
FIGURE 2-4

PGOU Exposure Zones
Zone 4
Perimeter Groundwater Operable Unit

SR10120719 **FIGURE 2-4** 8/20/08 Herron, Al



Exposure Route	Future Onsite Resident	Current/ Future Offsite Resident	Current/ Future Onsite Comm/Ind Worker	Current/ Future Onsite Visitor/ Recreator c	Current Onsite Construction Worker	Future Onsite Construction Worker
	Human Receptors					
Ingestion	I	I	I	I	I	I
Dermal Contact	I	I	I	I	I	I
Inhalation	I	I	I	I	I	I
See Figure 6-1B for Human Health Exposure Routes related to Treated and Untreated Groundwater						
Ingestion	I	I	I	I	I	I
Inhalation	I	I	I	I	I	I
Dermal Contact	I	I	I	I	I	I
Ingestion	I	I	I	I	I	I
Ingestion	C	I	C	Q	C	C
Dermal Contact	C	I	C	Q	C	C
Inhalation	C	Q	C	Q	C	C
See Figure 6-1B for Human Health Exposure Routes related to Treated and Untreated Groundwater						
Ingestion	I	I	I	I	I	I
Inhalation	I	I	I	I	I	I
Dermal Contact	I	I	I	I	I	I
Ingestion	I	I	I	I	I	I
Inhalation (Indoor)	C	I	C	I	I	I
Inhalation (Outdoor)	C	Q	C	Q	C	C
Ingestion	Q	I	I	I	I	I

Notes and Key:

a No sediment was identified in the potential source sites within Areas 20, 21 and 49. Samples collected within ditches were characterized as surface soil samples because they are 1) exposed (i.e., not covered by water); 2) dry (unsaturated); 3) sufficiently fine-grained such that they may become airborne; and 4) will be mixed in with shallow soil during site grading.

b Projected residential redevelopment at Aerojet is not likely to include land-intensive pathways, such as in-situ gardening. The naturally occurring soil at Aerojet is not suited for this type of activity. Significant land preparation activities (i.e., addition of topsoil and nutrients) would be required prior to growing fruits or vegetables.

c Since a residential and/or commercial/industrial soil exposure will be evaluated for all the source sites, there is no need to quantify a separate visitor/recreational exposure. Exposures to fish on the Aerojet property are highly unlikely, and are dependent upon the presence of edible species that are of large enough size to be filleted.

ASTs	Above-ground Storage Tank	I	Incomplete exposure pathway
C	Complete exposure pathway evaluated quantitatively	USTs	Underground Storage Tank
Comm/Ind	Commercial/Industrial	Q	Qualitative (not quantitative) evaluation conducted for this potentially complete exposure pathway

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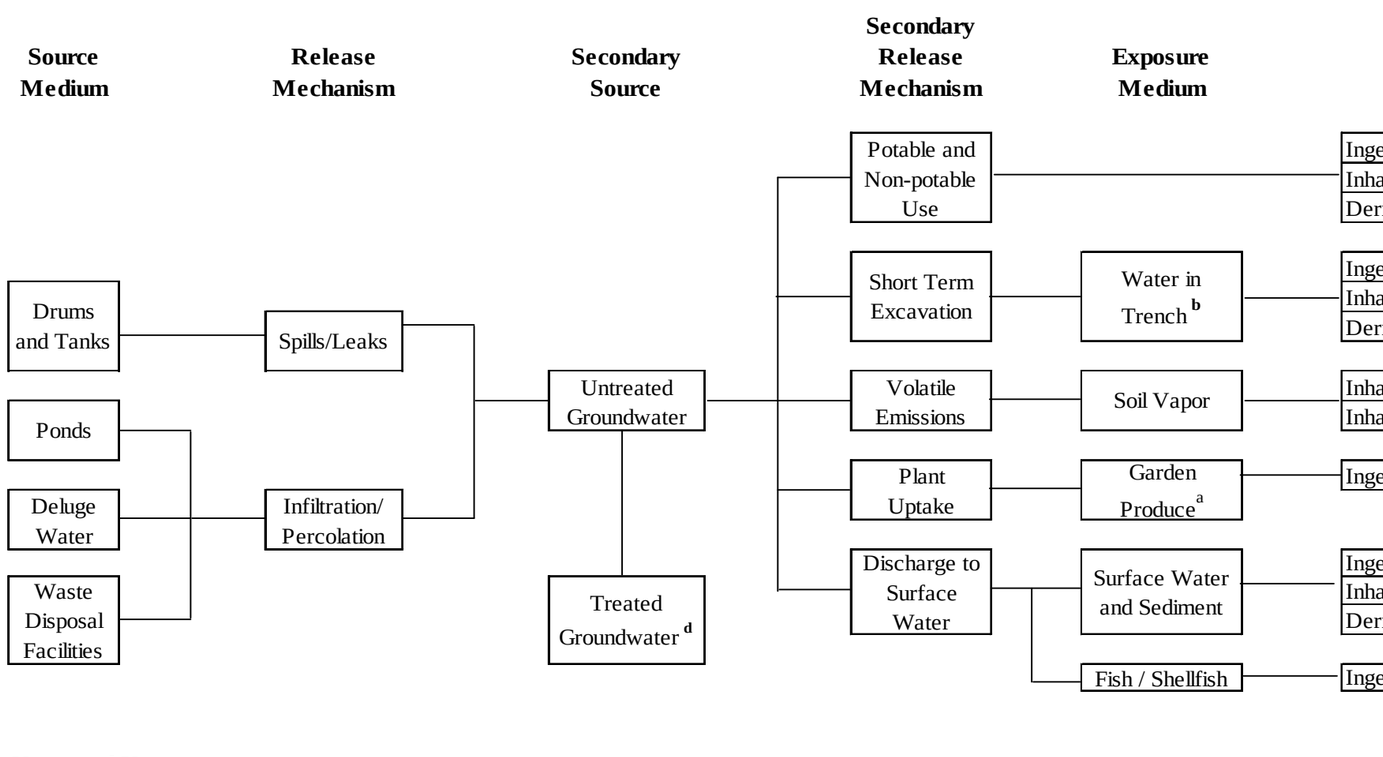
Environmental Remediation

FIGURE 2-5

Conceptual Site Model for PGOU
Soil Exposure Pathways for Human Receptors

SR10123678 **FIGURE 2-5** 8/20/08 Herron, Al ----



Exposure Route	Human Receptor: Future Onsite Resident	Current/ Future Offsite Resident	Current/ Future Onsite Comm/Ind Worker	Current/ Future Onsite Visitor/ Recreator c	Current Onsite Construction Worker	Future Onsite Construction Worker
Ingestion	H	H	I	I	I	I
Inhalation	H	H	I	I	I	I
Dermal Contact	H	H	I	I	I	I
Ingestion	I	I	I	I	Q	Q
Inhalation	I	I	I	I	Q	Q
Dermal Contact	I	I	I	I	Q	Q
Inhalation (Indoor)	C	C	C	I	I	I
Inhalation (Outdoor)	Q	Q	Q	Q	Q	Q
Ingestion	Q	Q	I	I	I	I
Ingestion	Q	I	Q	Q	Q	Q
Inhalation	I	I	I	I	I	I
Dermal Contact	Q	I	Q	C	Q	Q
Ingestion	Q	I	Q	Q	Q	Q

Notes and Key:

a Projected residential redevelopment at Aerojet is not likely to include land-intensive pathways, such as in-situ gardening. The naturally occurring soil at Aerojet is not suited for this type of activity. Significant land preparation activities (i.e., addition of topsoil and nutrients) would be required prior to growing fruits or vegetables.

b Although construction workers may briefly encounter the shallow water table in some OUs, construction activities in saturated trench conditions are generally avoided and dewatering is performed to avoid work in a wet and slippery trench. Dermal exposures to contaminants in trench water would be incomplete as steady state absorption and penetration of the skin is unlikely, given short exposure times.

c Recreational exposure will be evaluated on a site-specific basis; if a residential and/or commercial/industrial soil exposure has already been evaluated, there is no need to quantify a separate recreational exposure to soil unless the property may be transferred solely for recreational use. Exposures to fish on the Aerojet property are highly unlikely, and are dependent upon the presence of edible species that are of large enough size to be filleted.

d No discharge of treated groundwater to surface water bodies identified in PGOU.

C	Complete exposure pathway evaluated quantitatively
Comm/Ind	Commercial/Industrial
H	Hypothetically complete in absence of institutional controls
I	Incomplete exposure pathway
Q	Qualitative (not quantitative) evaluation conducted for this potentially complete exposure pathway

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FIGURE 2-6

Conceptual Site Model for PGOU Groundwater Exposure Pathways for Human Receptors Perimeter Groundwater Operable Unit

SR10123679 FIGURE 2-6 8/20/08 Herron, Al ----

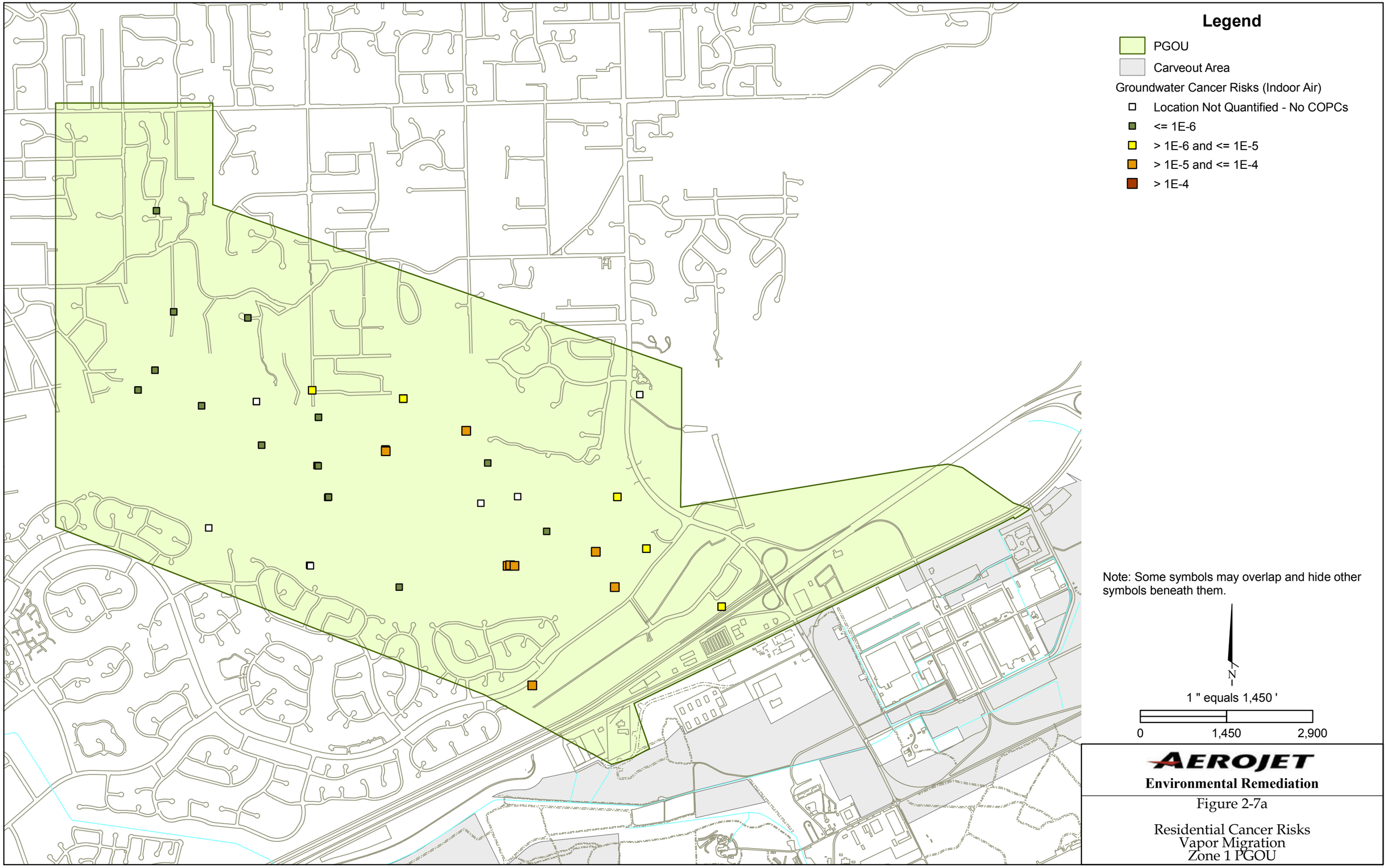

Figure 2-7a

Residential Cancer Risks
Vapor Migration
Zone 1 PGOU

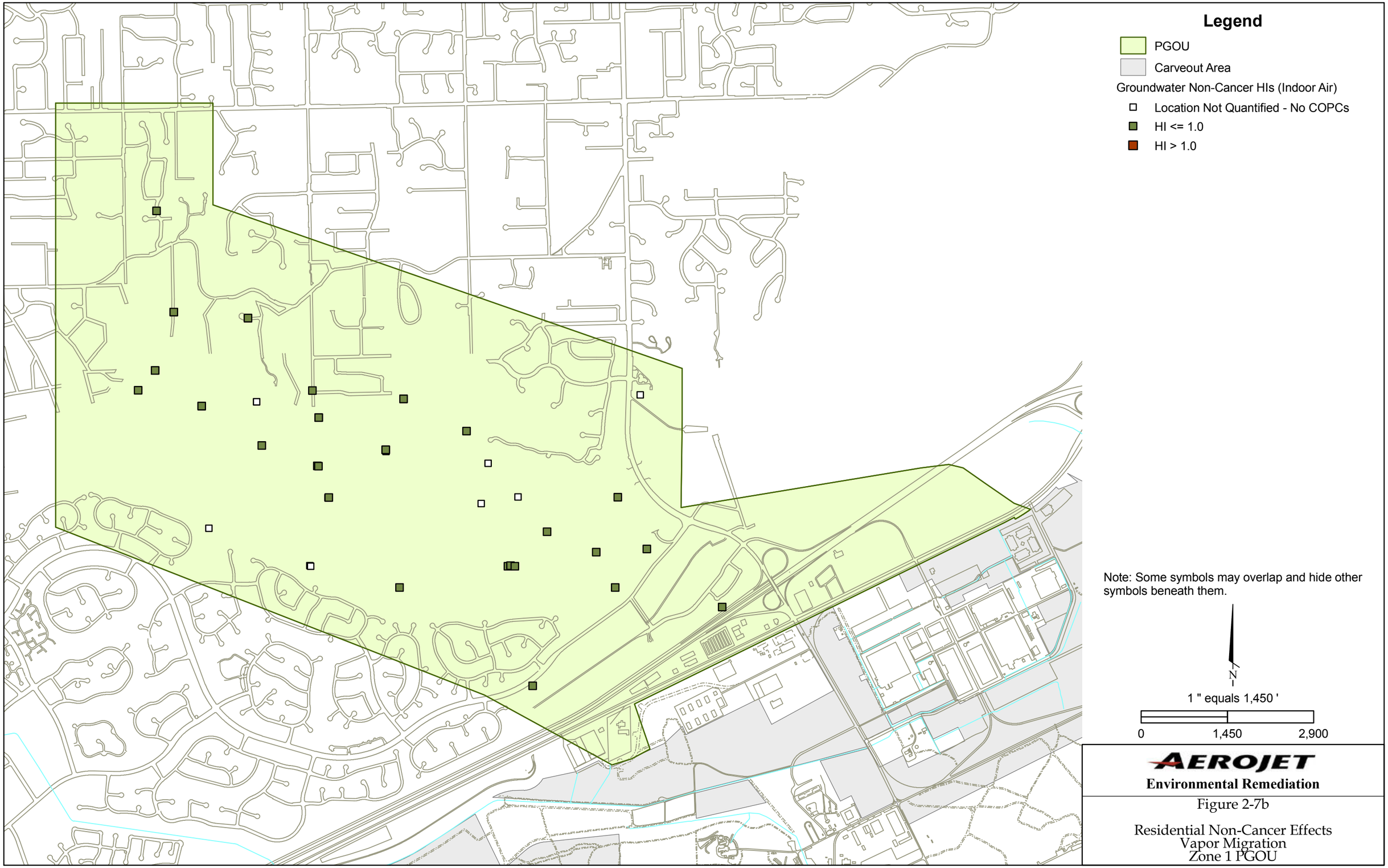

Figure 2-7b

Residential Non-Cancer Effects
Vapor Migration
Zone 1 PGOU

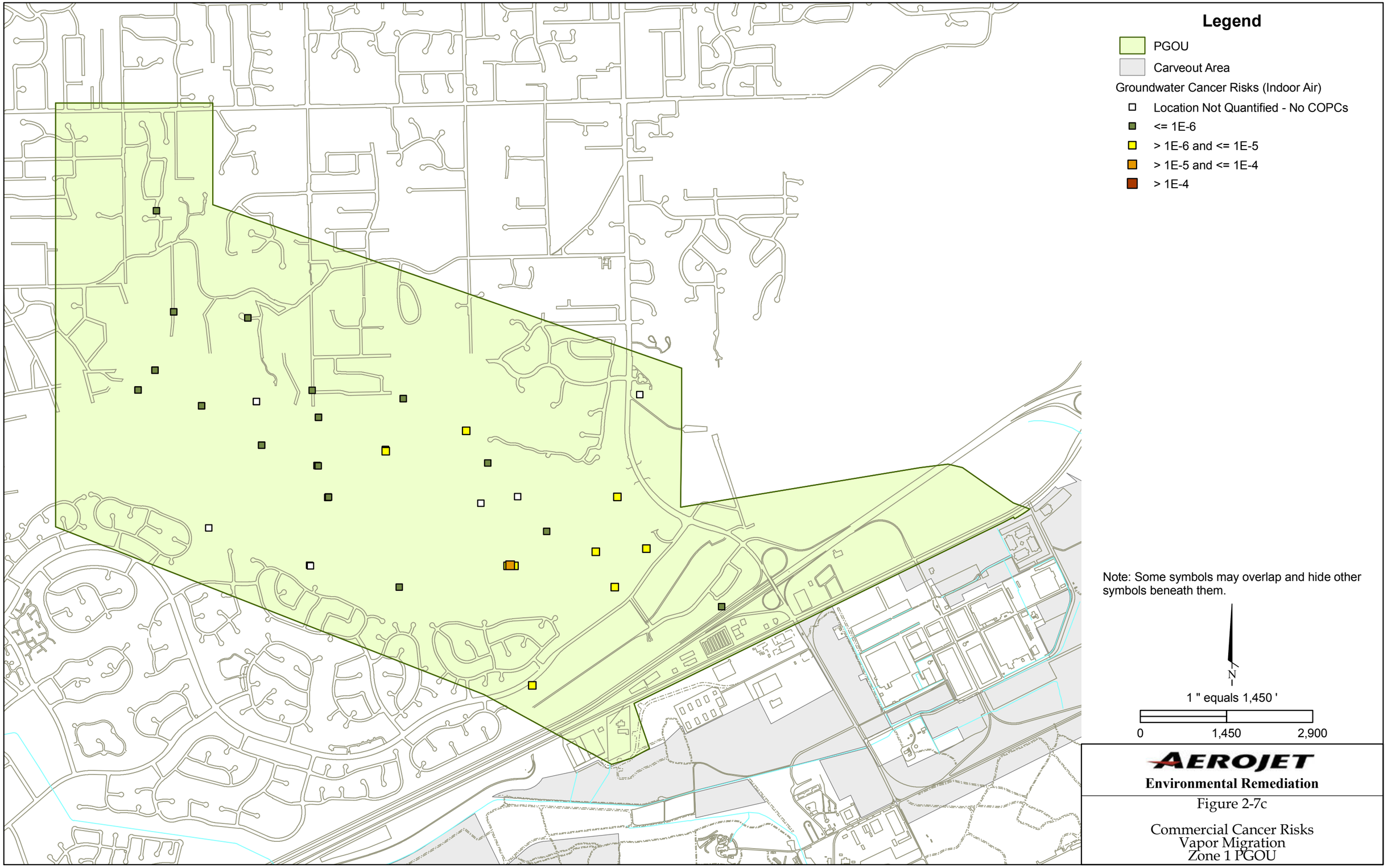

Figure 2-7c

Commercial Cancer Risks
Vapor Migration
Zone 1 PGOU

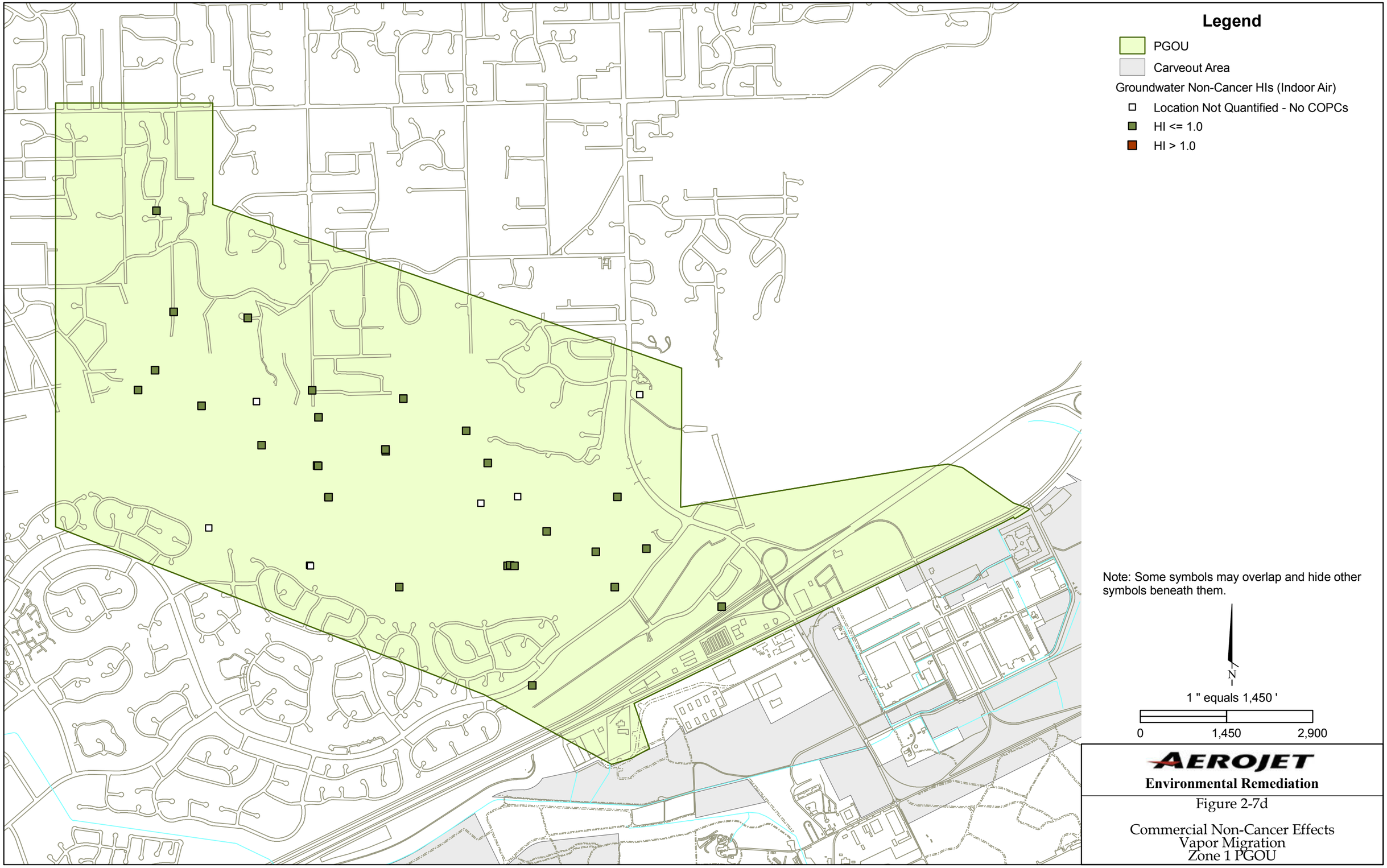

Figure 2-7d

Commercial Non-Cancer Effects
Vapor Migration
Zone 1 PGOU

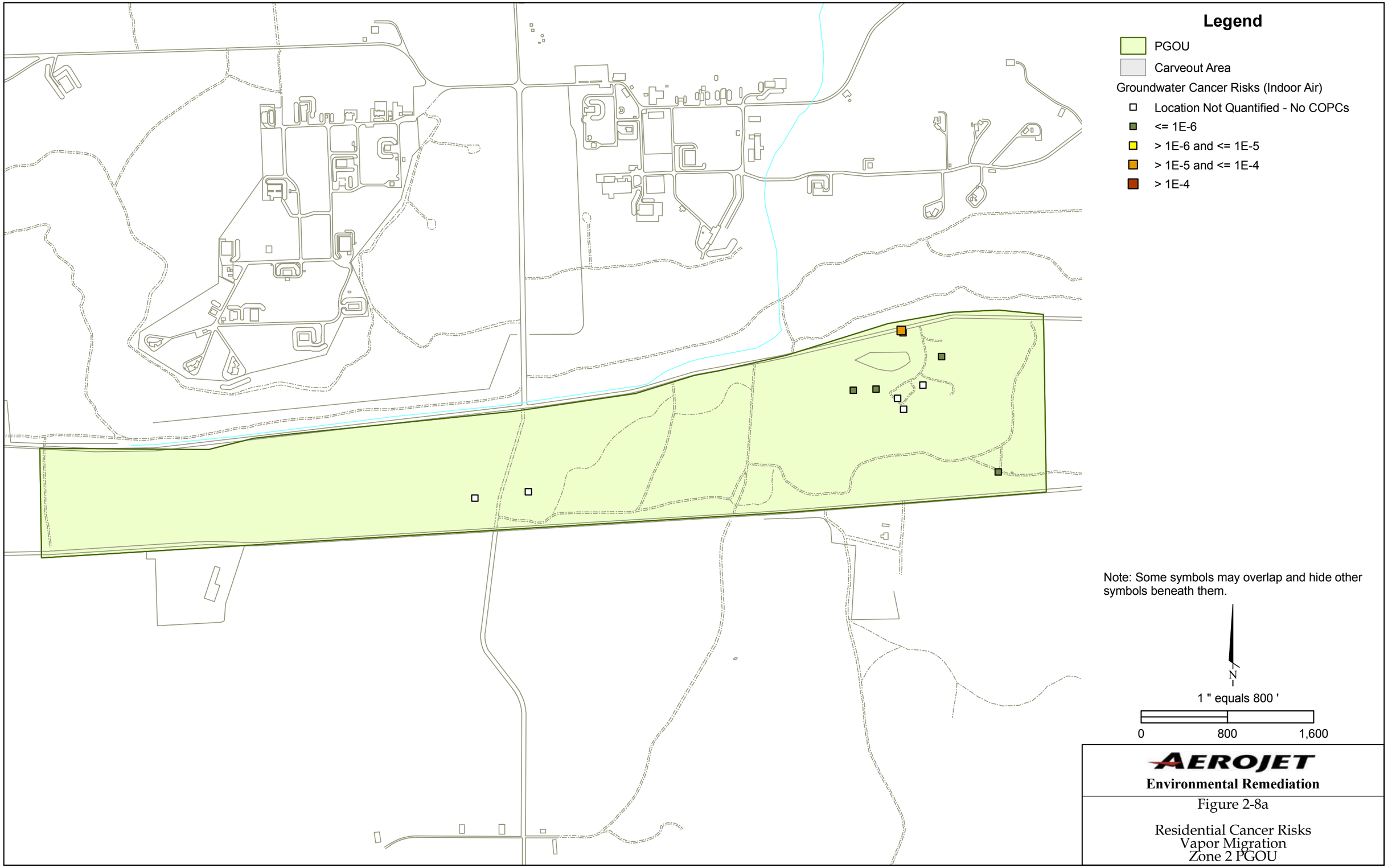

Figure 2-8a

Residential Cancer Risks
Vapor Migration
Zone 2 PGOU

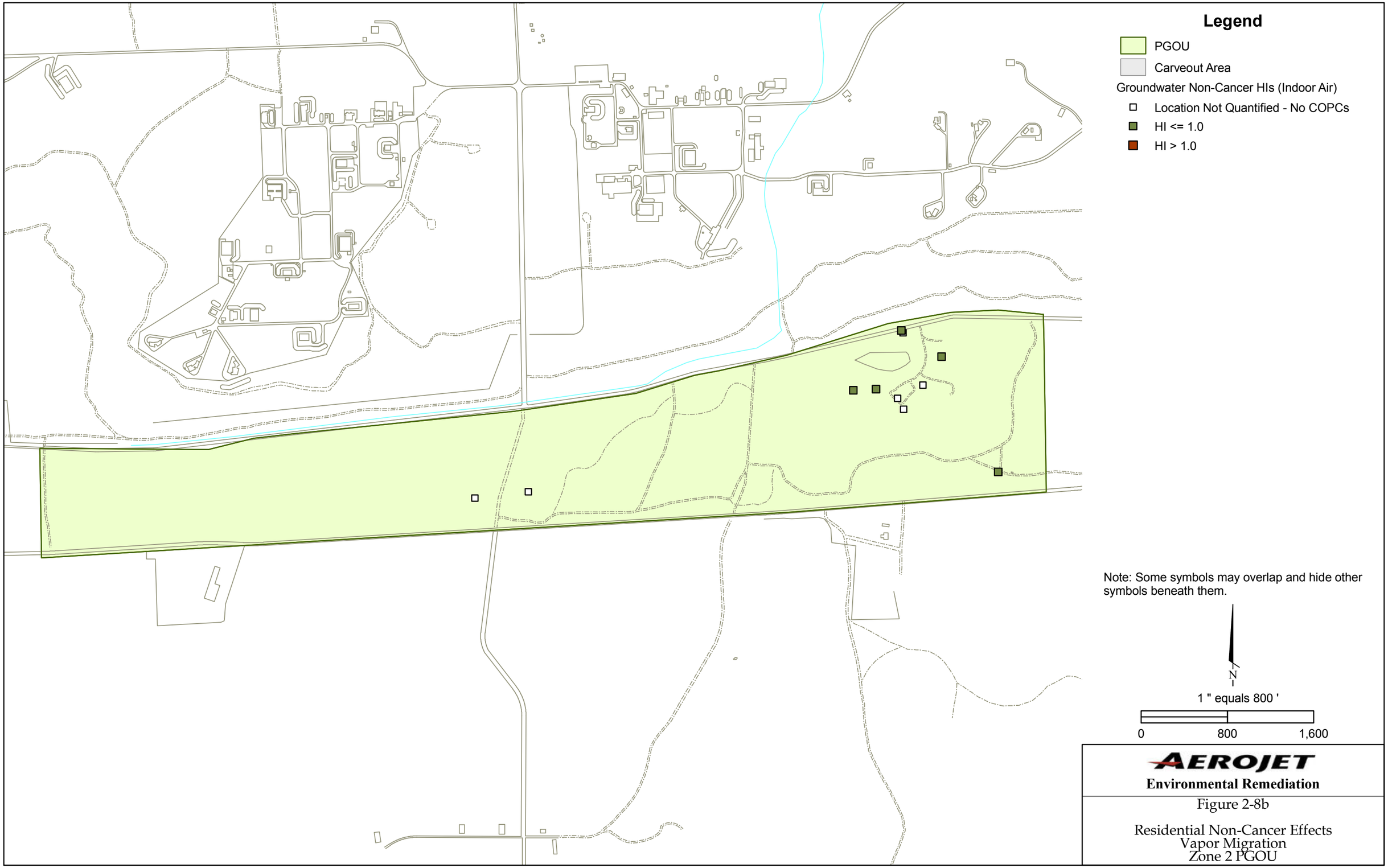

Figure 2-8b

Residential Non-Cancer Effects
Vapor Migration
Zone 2 PGOU

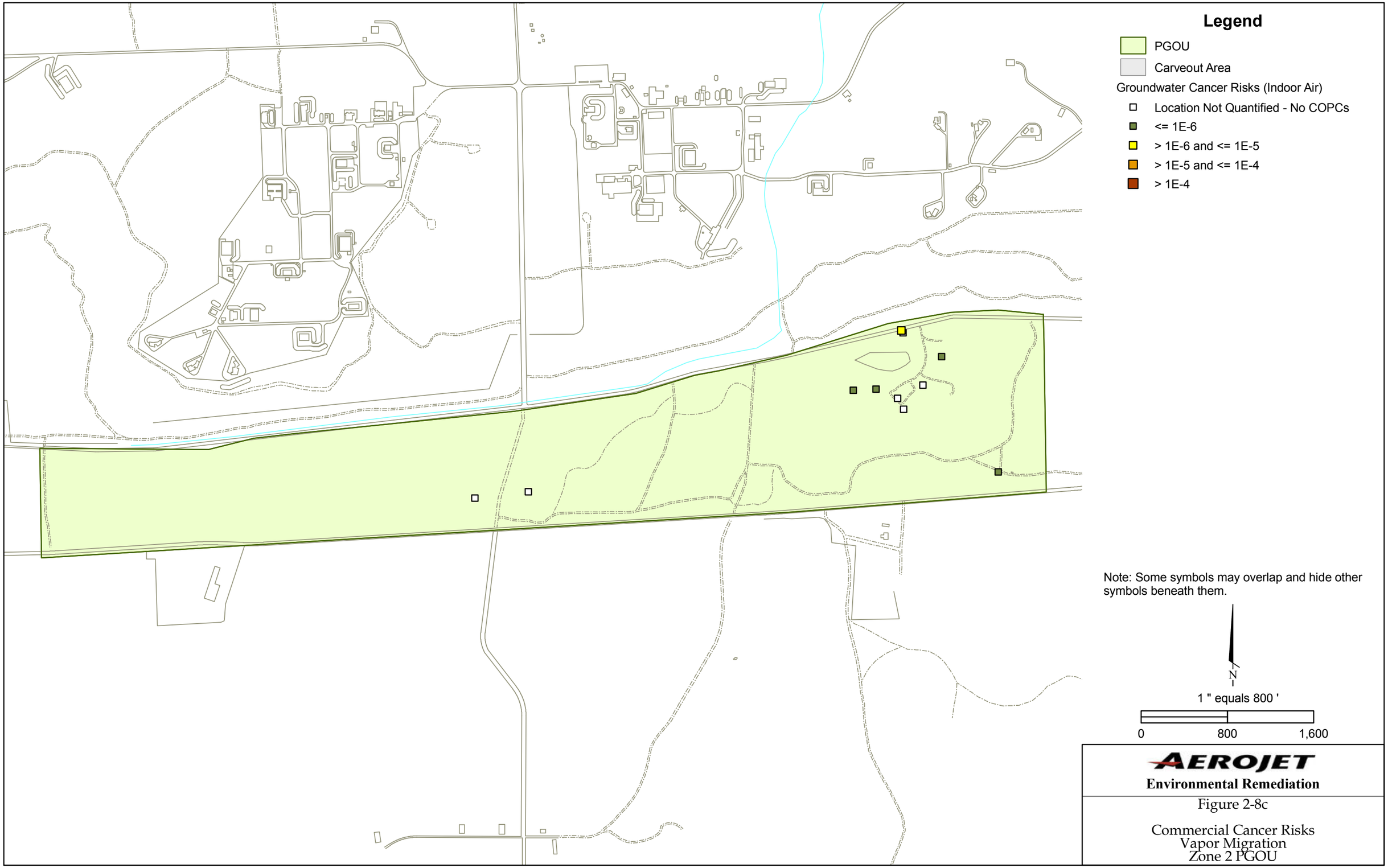

Figure 2-8c

Commercial Cancer Risks
Vapor Migration
Zone 2 PGOU

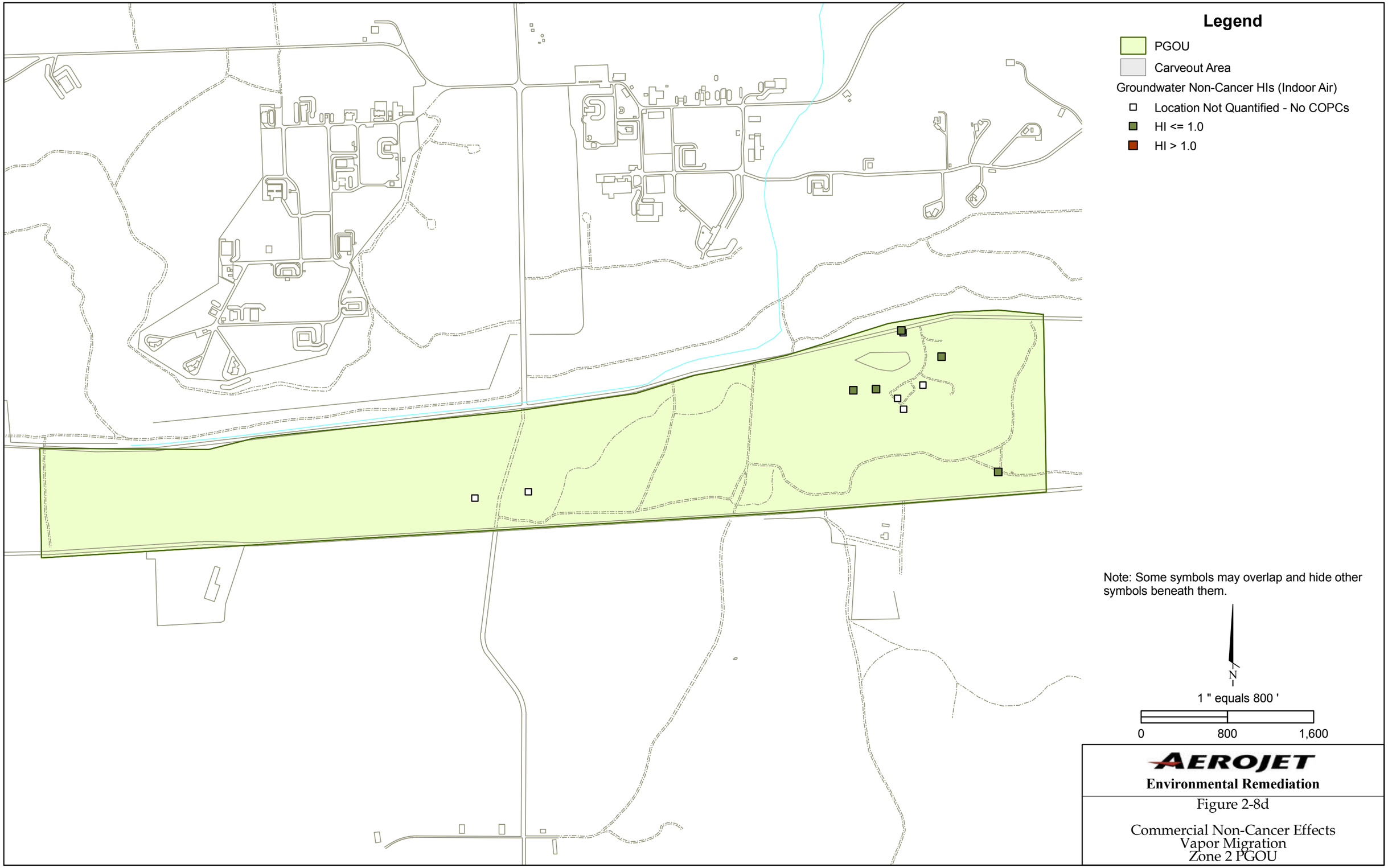

Figure 2-8d

Commercial Non-Cancer Effects
Vapor Migration
Zone 2 PGOU

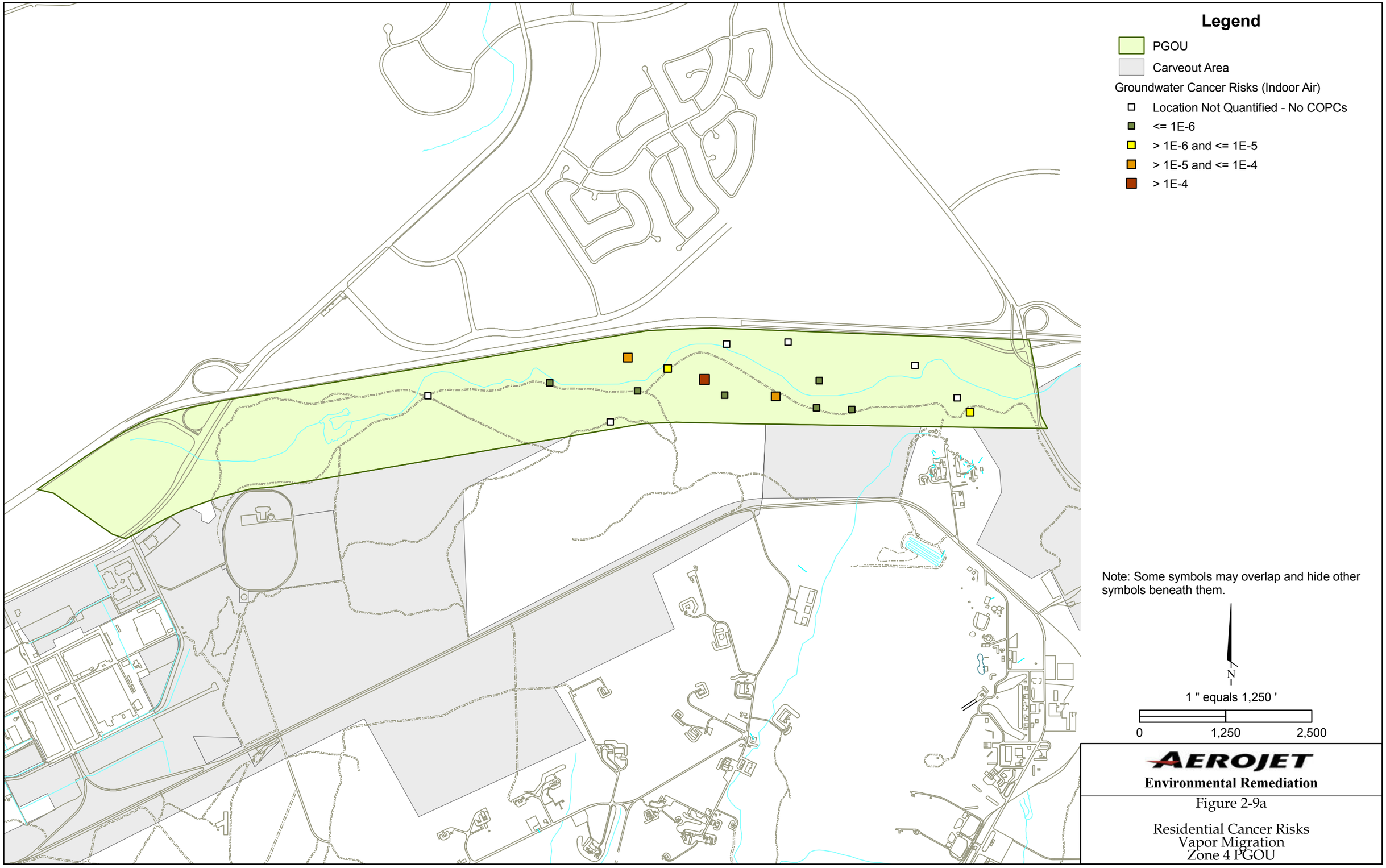

Figure 2-9a

Residential Cancer Risks
Vapor Migration
Zone 4 PGOU

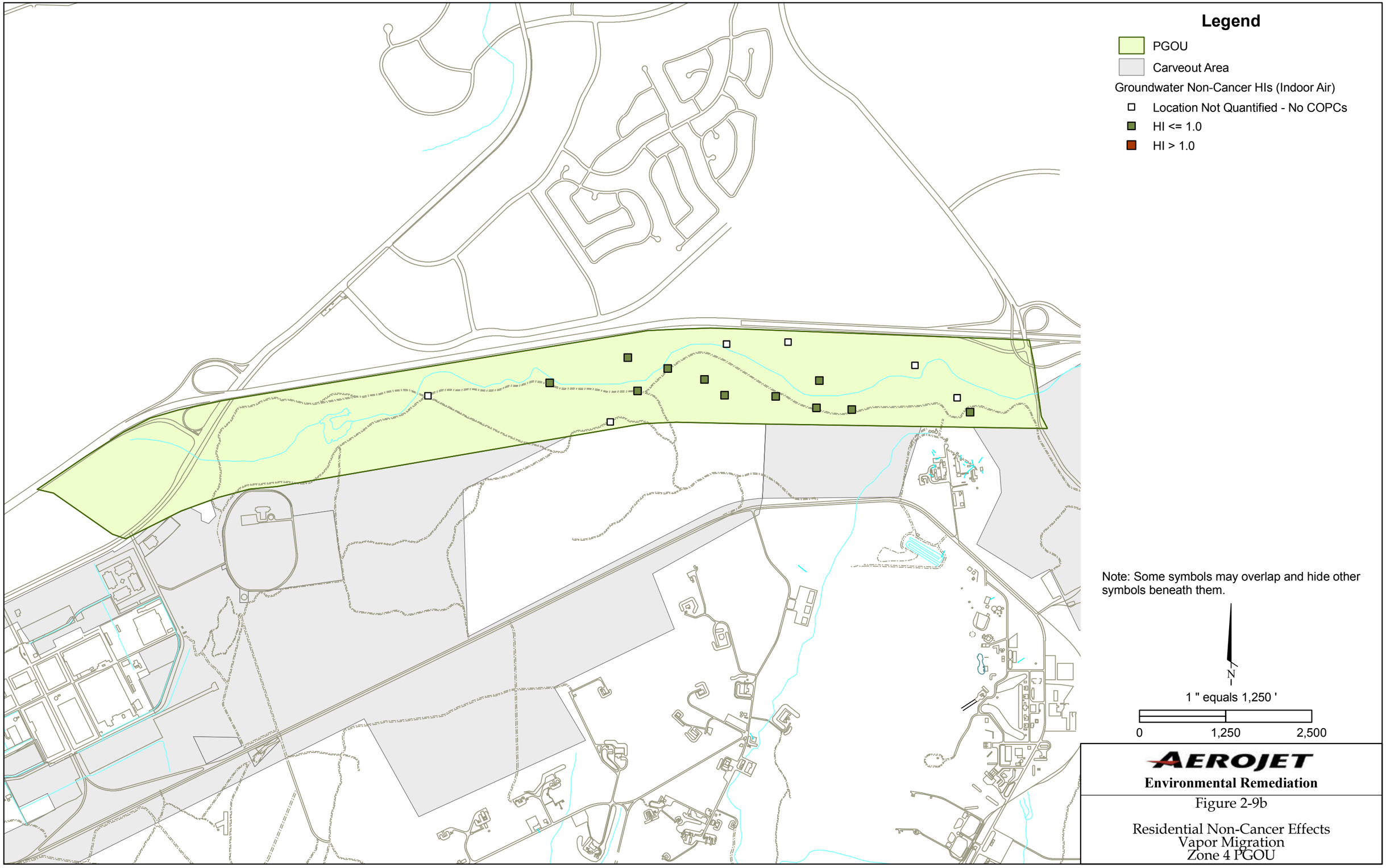

Figure 2-9b

Residential Non-Cancer Effects
Vapor Migration
Zone 4 PGOU

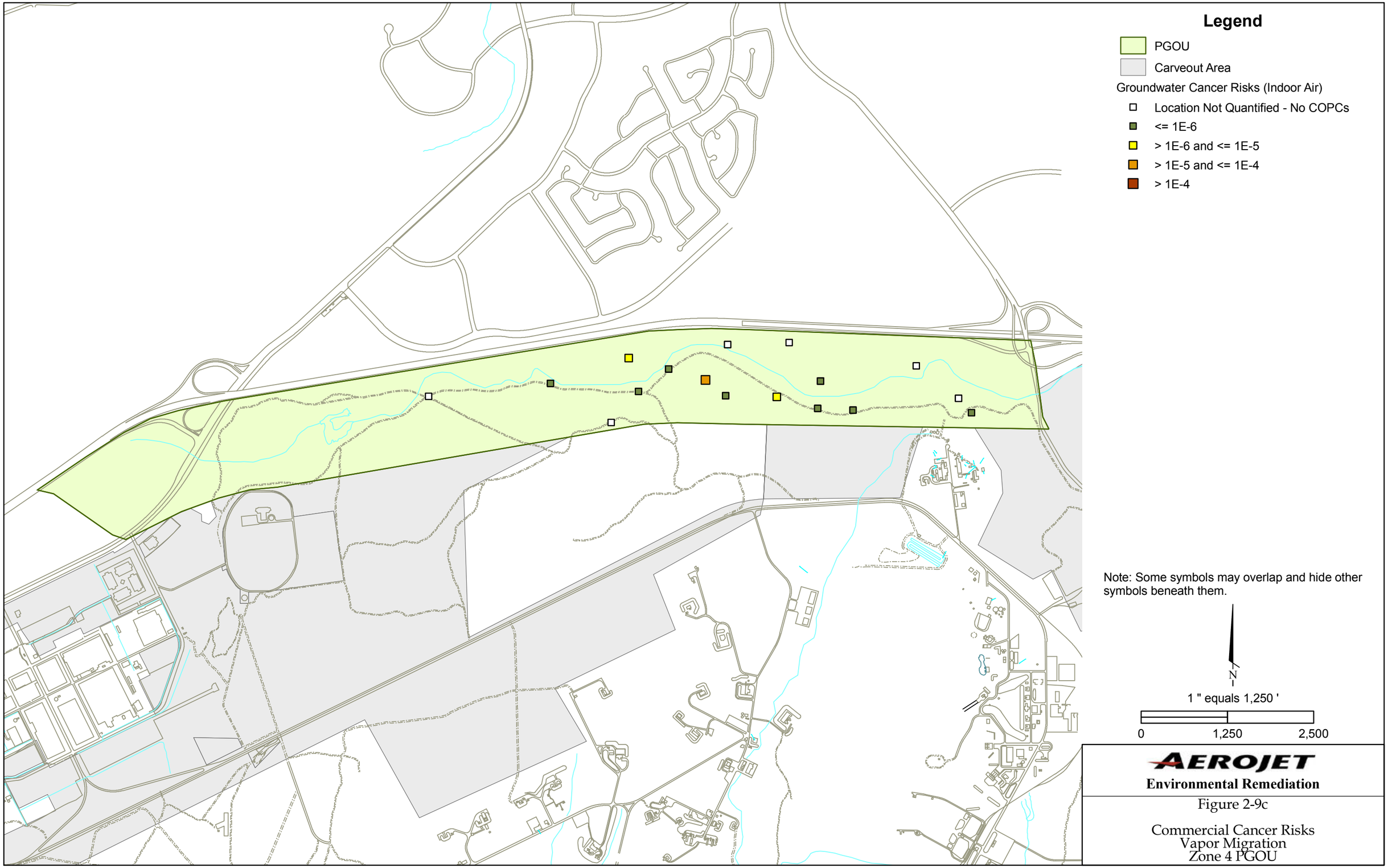

Figure 2-9c

Commercial Cancer Risks
Vapor Migration
Zone 4 PGOU

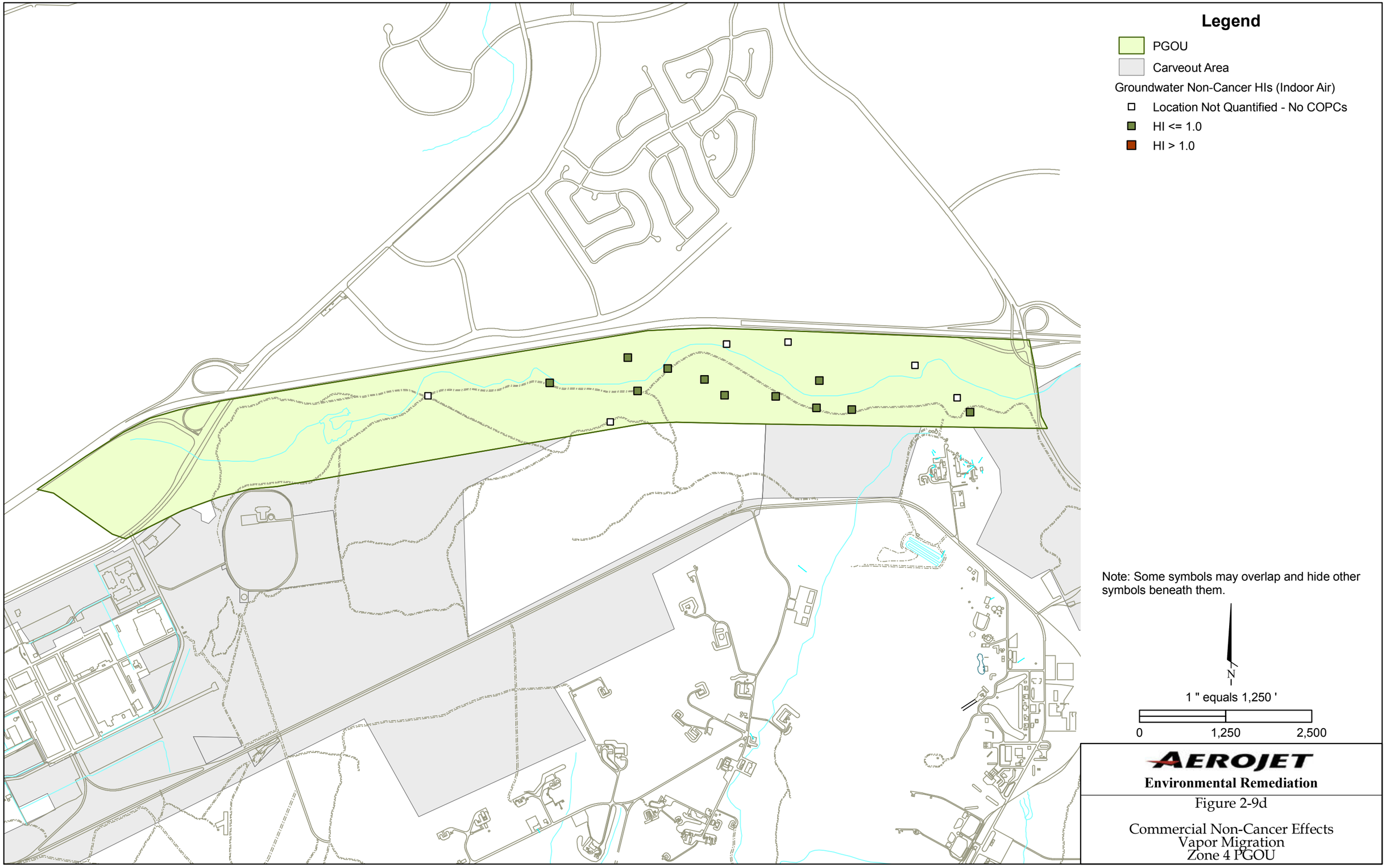

Figure 2-9d

Commercial Non-Cancer Effects
Vapor Migration
Zone 4 PGOU

Source Medium	Release Mechanism	Secondary Source	Secondary Release Mechanism	Exposure Medium	Exposure Route	Ecological Receptors																
					Trophic Level -	Producers			Primary Consumers				Secondary Consumer							Tertiary Consumer			
					Functional Group/Feeding Guild -	Aquatic Vegetation	Trees/ Shrubs	Forbs/ Grasses	Soil Invertebrates/ Herbivorous Insects	Benthic and Aquatic Invertebrates	Herbivorous Mammals	Herbivorous/ Granivorous Birds	Snakes & Lizards	Turtles	Amphibians	Fish	Omnivorous/ Insectivorous Mammals	Omnivorous/ Insectivorous Birds	Water Fowl	Raptors	Piscivorous Mammals	Carnivorous Mammals	Piscivorous Birds
			Potable and Non-potable Use		Ingestion	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
					Dermal Contact	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
					Uptake[b]	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Drums and Tanks	Spills & Leaks		Short Term Excavation	Water in Trench	Ingestion	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
					Dermal Contact	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
					Uptake[b]	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Ponds		Untreated Groundwater	Discharge to Soil	Soil	Ingestion	I	NE	NE	NE	I	I	I	I	I	I	I	I	I	I	I	I	I	I
					Dermal Contact	I	NE	NE	NE	I	I	I	I	I	I	I	I	I	I	I	I	I	I
					Uptake[b]	I	I	I	I	I	-	-	-	-	-	-	-	-	-	-	-	-	-
Deluge Water	Infiltration/ Percolation		Volatile Emissions	Soil Vapor	Inhalation[c] (Indoor)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
					Inhalation[c] (Outdoor)	-	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
		Treated Groundwater[a]	Plant Uptake	Terrestrial Food Chain	Ingestion	-	NE	NE	I	-	I	I	I	I	I	-	I	I	I	I	I	I	I
Waste Disposal Facilities			Discharge to Surface Water	Surface Water and Sediment	Ingestion	NE	I	I	I	NE	N	N	N	N	N	NE	N	N	N	N	N	N	N
					Dermal Contact	NE	I	I	I	NE	N	N	N	N	N	NE	N	N	N	N	N	N	N
					Uptake[b]	C	I	I	I	C	-	-	-	-	-	C	-	-	-	-	-	-	-
				Aquatic Food-Chain	Ingestion	NE	-	-	-	NE	-	-	I	Q	Q	NE	N	N	N	N	N	-	N

Notes:

a No discharge of treated groundwater to surface water bodies identified in PGOU.

b Uptake applies only to plants, invertebrates, and fish and includes respiration, dermal uptake, and ingestion by these receptors.

c Inhalation includes vapor uptake by plants and respiration by invertebrates

Designations:

C Complete exposure pathway evaluated quantitatively

I Incomplete exposure pathway

N Negligible or insignificant (though hypothetically potentially complete) pathway that will not be evaluated

NE Exposure route is evaluated as part of the uptake pathway

Q Qualitative (not quantitative) evaluation planned for this potentially complete exposure pathway

\- Not applicable

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FIGURE 3-1

Conceptual Site Model for PGOU Groundwater Exposure Pathways for Ecological Receptors Perimeter Groundwater Operable Unit

SR10123681 FIGURE 3-1 8/20/08 Herron, Al

Tables

Table 1-1 Aerojet Private Well Survey (1-Mile Radius of PGOU)
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Aerojet Well No.	State Well No.	Owner/Well Location	Well Type	Well Compl. Date	gse (ft, msl)	Well Depth (ft, bgs)	Perf. Interval (ft, bgs)	Well Status - 1991	Well Status	Monitored between 1991-2004?	Posted
925/926	9N/7E-32D14	Cordova Chemical Co./200 yards west of Plant #2. Located within Zone 2 on Aerojet property.	Other	10/27/76		504	380-480		Destroyed. Wells were used as injection wells.	No	Figure 1-5B
1002	9N/7E-16K3	Twilight Trailer Court	DW					Out of service. Historically monitored by Aerojet.	Abandoned. Well not in use. Pump not connected. Attempted to monitor in 1997.	1x in 91	Figure 1-5B
1003	9N/7E-16Q6	Twilight Mobile Home Park, 12415 Folsom Blvd.	DW					Unconfirmed. Well not located in field (possible location - Space #34). Historically monitored by Aerojet.	Abandoned. Well not in use. Park on municipal water.	No	Figure 1-5B
1004	9N/7E-32B1	Cora Rogers, 11801 Old White Rock Road	DW		175	130		Aerojet owns property - fenced and locked. Well not in use. Historically monitored by Aerojet.	Abandoned. Well not in use. Aerojet owns property - fenced and locked. Historically monitored by Aerojet.	No	Figure 1-5B
1005	9N/7E-27Q1	Eva Collier, 11700 Old White Rock Road	DW					House burned. Well not in use. Historically monitored by Aerojet.	Abandoned. Well not in use. House burned. Historically monitored by Aerojet.	No	Figure 1-5B
1007	9N/7E-16	Rudy's Hideaway, 12303 Folsom Blvd.	DW					Abandoned.	Destroyed.	No	not posted
1008	9N/7E-16P4	Rudy's Hideaway, 12303 Folsom Blvd. in fenced area with garbage bins	DW	1/79	140	195	148-195	Alternative water supply provided. Historically monitored by Aerojet.	Abandoned. Well capped. Historically monitored by Aerojet.	No	Figure 1-5B
1009	9N/7E-16K2	Aerojet Credit Union	DW	2/14/64	149.82	106	102-106	Aerojet monitoring well.	Well not located. Area redeveloped. Building expanded over well location.	No	Figure 1-5B
1010	9N/7E-16K1	James Johnson (prev. H. Greenhalgh). 0.1 mile west of Gate #2, Folsom Blvd.	DW					Building demolished, area graded. Historically monitored by Aerojet.	Well not located. Area redeveloped. Building demolished, area graded. Historically monitored by Aerojet.	No	Figure 1-5B
1019	9N/7E-25E1	Yost (Prairie City Off-Hwy Vehicle Park)	DW	5/14/75	308.38	169	50-169	Historically monitored by Aerojet. Poor access in winter.	Abandoned. Well not in use. Historically monitored by Aerojet.	5x thru 92	Figure 1-5B
1020	9N/7E-16J2	Pruett Manufacturing	DW			480		Abandoned.	Destroyed.	No	Figure 1-5B
1021	9N/7E-15F4	William (Helen) Casten, 12724 Folsom Blvd.	DW		157	95		Historically monitored by Aerojet.	Abandoned. Well not in use. Historically monitored by Aerojet.	2x in 92	Figure 1-5B
1022	9N/7E-15F3	Travelers Mobile Home Park, 12717 Folsom Blvd. Now Auto Mall.	DW					Building demolished, area graded. Historically monitored by Aerojet.	Well not located. Area redeveloped. Building demolished, area graded. Historically monitored by Aerojet.	No	Figure 1-5B
1023	9N/7E-15C2	Shady Oaks Trailer Park	DW					Abandoned.	Destroyed.	No	Figure 1-5B
1024	**9N/7E-16Q8**	**Russell Knauer, 12401 Folsom Blvd.**	**DW**	**4/16/79**		**125**	**100-125**		**Well in use for irrigation, per property owner. Well added to 2005-2006 Exhibit IV monitoring plan.**	**No**	**Figure 1-5A**
1027	9N/7E-16P3	Rancho Cordova Fire District #3. Well below grade (with wooden cover) behind the station.	DW	8/14/79	140	120	110-120	Aerojet monitoring well. Historically monitored by Aerojet.	Abandoned. Well not in use. Historically monitored by Aerojet.	Yes, thru 2/00	Figure 1-5B
1028	**9N/7E-33E1**	**By-Dry Feed Products, Clark Cattle company (prev. McDonnell Douglas) 12300 White Rock Road**	**DW**	**9/5/64**	**188**	**224**	**107-224**	**Well not in use, but has not been destroyed. Historically monitored by Aerojet.**	**Well in use for stock watering. Well historically monitored by Aerojet. Bi-Annual water level monitoring.**	**Yes, thru 02**	**Figure 1-5A**
1029	**9N/7E-34E1**	**Grant Line Road Properties, Trucking/Asphalt Recycling Center (prev. Olson Ranch, Clark Cattle Co.) 12584 White Rock Road**	**DW**	**9/5/64**	**188**	**224**	**107-224**	**Historically monitored by Aerojet.**	**Well in use for dust control and process water. Historically monitored by Aerojet.**		**Figure 1-5A**
1031	**8N/7E-3P1**	**US Home of KB North Douglas (formerly Archel Cupp), 12515 Douglas Road (Cupp Road)**	**DW**	**8/23/78**		**316**	**274-316**		**Well in use for domestic purposes and irrigation. Well added to 2005-2006 Exhibit IV monitoring plan.**	**No**	**Figure 1-5A**

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Aerojet Superfund Site
Sacramento County, California

Aerojet Well No.	State Well No.	Owner/Well Location	Well Type	Well Compl. Date	gse (ft, msl)	Well Depth (ft, bgs)	Perf. Interval (ft, bgs)	Well Status - 1991	Well Status	Monitored between 1991-2004?	Posted
1032	9N/7E-26J3	Patricia Timm (Ehnize). East of Prairie City Road, South of White Rock Road	DW	12/29/80	279.99	210	170-210	House destroyed. Well not in use. Historically monitored by Aerojet.	Abandoned. Well not in use. Historically monitored by Aerojet.	Yes, thru 93	Figure 1-5B
1035	9N/7E-21D1	Schnitzer Steel, 12000 Folsom Blvd. (916) 985-4810	DW	5/56	140.2	398.7	217-264	Well in use. Owner stated well was in use for industrial purposes. Historically monitored by Aerojet.	Abandoned. Well not in use. Historically monitored by Aerojet.	1x in 92	Figure 1-5B
1041	9N/7E-17J2	Department of Fish and Game, Nimbus Fish Hatchery off Hazel (near Hwy 50)	DW	10/25/77	107.96	222	101-197	Well not in use. Pump out of service; water from Natoma. Historically monitored by Aerojet.	Abandoned. Well not in use. Pump out of service; water from Natoma. Historically monitored by Aerojet.	No	Figure 1-5B
1042	9N/7E-15E3	Prev. Wallace Wilcox res., 12643 Folsom Blvd.	DW					Well not located in field. Structure demolished. Historically monitored by Aerojet.	Well not located in field. Area redeveloped. Structure demolished. Historically monitored by Aerojet.	No	Figure 1-5B
1044	9N/7E-16	Nimbus Dam	DW						Abandoned. Well not in use in 1992. Well not found in the field in 2004.	No	not posted
1045	**9N/7E-16**	**Folsom South Canal Headworks**	**DW**						**Well located at base of aerial antenna next to Aquatic center building. Well in use for irrigation. Well was historically monitored by Aerojet, however has not been monitored recently. Well added to 2005-2006 Exhibit IV monitoring plan.**	**No**	**Figure 1-5A**
1047	9N/6E-12Q1	**Fair Oaks Water District, Well #1, "Town Well", Sacramento and Main**	**WS/MUN**		**137**	**600**			**FOWD public water supply well. Well monitored under Exhibit IV monitoring plan.**	**Yes**	**Figure 1-5A**
1049	9N/7E-7F1	**Fair Oaks Irrig. Dist./Chicago Ave. (Well 4) 34-1087**	**WS/MUN**	**4/42**		**600**	**472-600**		**FOWD public water supply well. Well monitored under Exhibit IV monitoring plan.**	**Yes**	**Figure 1-5A**
1054	8N/7E-4F1	Cal-Am well; Douglas Aircraft - Sigma Complex, (east of Nike Road)	WS/MUN	9/21/61	175.4	175	126-157		Abandoned. Well not in use. Well periodically monitored under IRCTS.	Yes, thru 99	Figure 1-5B
1056	9N/7E-33Q1	Cal-Am well; DM14 (near Nike Road in Zone 2). Nimbus Road, south of White Rock Road.	WS/MUN		185.2	120			Abandoned. Well not in use. Well historically monitored by Aerojet.	Yes, thru 02	Figure 1-5B
1059	9N/7E-36F1	**Prairie City State Off-Hwy Vehicle Park (OHV-1)**	**DW**	**5/3/1978**		**305**	**197-269**		**Well in use for irrigation. Well monitored under Exhibit IV monitoring plan.**	**Yes**	**Figure 1-5A**
1064	9N/7E-20A1	Becks, 11850 Folsom Blvd. (prev. R & M Office Furniture and Overhead Door)	DW	12/70	137	240	190-240	Well appears operational.	Abandoned. Well not in use. Business is on municipal water.	2x in 92	Figure 1-5B
1065	9N/7E-15F1	Prev. Hoffman (Mott), Folsom Blvd. across from Aerojet, Gate 5	DW					Well not located in field; structure demolished.	Well not located. Area redeveloped, structure demolished.	No	Figure 1-5B
1084	9N/7E-16	Lake Natomas, Drake	DW					Unconfirmed. Historically monitored and sampled by Aerojet.	Abandoned. Well not in use in 1992. Well not located in the field 2004.	No	not posted
1086	9N/7E-16	Barton- Barton Ranch Area, East of Prairie City Road and South of White Rock Road.	DW						Well outside survey area. Status not confirmed.	No	not posted
1089	9N/7E-16Q5	Darr Trailer Sales. North of Folsom in area near auto mall.	DW					Sampled as part of area of influence.	Abandoned. Area redeveloped. Structure demolished.	1x in 91	not posted
1090	9N/7E-16J1	Daves, Keith (prev. W. Clarkson). Well off Folsom near Cattlemans.	DW		150	120		Building demolished, area graded.	Well not located. Area redeveloped. Building demolished, area graded.	No	Figure 1-5B
1095	9N/7E-15F5	Prev. Y. Ehrhadt/B.E. Morgan, Folsom Blvd. across from Aerojet, Gate 5	DW	1947	156	50		Unconfirmed; well not located in field; structure demolished. Historically monitored by Aerojet.	Well not located. Area redeveloped. Structure demolished. Historically monitored by Aerojet.	No	Figure 1-5B

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Aerojet Well No.	State Well No.	Owner/Well Location	Well Type	Well Compl. Date	gse (ft, msl)	Well Depth (ft, bgs)	Perf. Interval (ft, bgs)	Well Status - 1991	Well Status	Monitored between 1991-2004?	Posted
1096	9N/7E-34G1	Prev. Nicolicci/Capitol Dredging Co (#7). North of White Rock Road, East of Nimbus Road.	DW	3/47	240	204	108-192	Unconfirmed; well not located in field. Historically monitored by Aerojet.	Abandoned. Well not in use. Historically monitored by Aerojet.	No	Figure 1-5B
1132	9N/7E-15	Mott. Across from Gate 5 on Folsom Blvd.	DW					Building demolished, area graded.	Well not located. Area redeveloped. Building demolished, area graded.	No	not posted
1154	9N/7E-16G1	**Nimbus Flat Park (#1) Zone 1**	**DW**						**Well in use for irrigation. Well monitored under Exhibit IV monitoring plan.**	**Yes, many x**	**Figure 1-5A**
1155	9N/7E-15	Prev. Robert Baker, Folsom Blvd. across from Aerojet, Gate 5	DW		153.1	47		Building demolished, area graded.	Well not located. Area redeveloped. Building demolished, area graded.	No	Figure 1-5B
1156	9N/7E-17F	**Sailor Bar (County Parks & Rec)**	**DW**		**135**	**478**	**87-478**	**Aerojet monitoring well.**	**Well in use to fill pond in Sailor Bar Park. Wellhead treatment provided, monitored by Aerojet.**	**Yes, many x**	**Figure 1-5A**
1159	8N/7E-3A1	**Lash, 3450 Grant Line Road (SW corner of Ehnizs in Zone 3)**	**DW**		**253.8**	**175**			**Well monitored under Exhibit IV monitoring plan.**	**Yes, many x**	**Figure 1-5A**
1161	9N/7E-25E2	Yost, Prairie City Off Hwy Vehicle Park. North of road near park entrance.	DW		313.39	170	100-170	Historically monitored by Aerojet.	Abandoned. Well not in use. Field location not verified. Historically monitored by Aerojet.	No	Figure 1-5B
1198	9N/7E-26J2	Timm Irrigation, 32 B Ehinez. Same as well 1032.	DW	2/6/81	279.99	494			This well log is for deepening Well 1032. See Well 1032 for status. Well abandoned, not in use.	Yes, thru 93	Figure 1-5B
1221	**9N/7E-16H1**	**Parks and Recreation - Nimbus Flat Park #2**	**DW**		**124.8**	**80**	**60-80**	**Historically monitored by Aerojet.**	**Well in use for irrigation. Well monitored under Exhibit IV monitoring plan.**	**Yes, many x**	**Figure 1-5A**
1224	9N/7E-17J1	Dept. of Fish and Game, Nimbus Fish Hatchery #1	DW	10/8/77	107.76	251	143-251	Well not in use; pump out of service; water from Natoma.	Abandoned. Well not in use. Pump out of service; water from Lake Natoma.	4x in 4/92	Figure 1-5B
1250	9N/7E-16	Giffs Rail Road Ties, corner of Folsom and Hazel in vacant dirt lot next to Fire Station.	DW		144.2	90.5		Historically monitored by Aerojet.	Abandoned. Well not in use. Well not field checked. Historically monitored by Aerojet.	No	Figure 1-5B
1289	9N/7E-31G1	McDonnell Douglas (Clark) Aerojet, 11550 White Rock Road.	DW		134.8	150		Building demolished; area graded. Aerojet owns property.	Destroyed.	5x thru 2002	Figure 1-5B
1298	**8N/7E-2N1**	**John and Peter Tracy/ Grantline Road (2.25 mile South of White Rock Road). Irrigation well.**	**DW**	**1956**				**Irrigation.**	**Well has not been used in 2 years, however, is available for irrigation and domestic use, if needed. If owner elects to use, Aerojet will conduct monitoring.**	**No**	**Figure 1-5A**
1299	**8N/7E-2N1**	**John and Peter Tracy/ Grantline Road (2.25 mile South of White Rock Road). House well.**	**DW**	**4/19/56**	**258**	**675**	**180-200 220-235 254-276**	**House and Irrigation**	**Well used for irrigation and domestic purposes. Monitored under Exhibit IV monitoring plan.**	**Yes, many x**	**Figure 1-5A**
1301	**8N/7E-3Q1**	**US Home of KB North Douglas (formerly James D Weidinger and Victor Murphy) 12575 Douglas Road (985-0625) (near Cupp lane)**	**DW**	**8/20/78**		**330**	**260-300**		**Well in use for domestic purposes and irrigation. Well added to Exhibit IV 2005-2006 Exhibit IV monitoring plan.**	**No**	**Figure 1-5A**
1366	**9N/6E-12N**	**Fair Oaks Water District, New York north of Fair Oaks Blvd.**	**WS/MUN**		**162.63**	**475**	**150-475**		**FOWD public water supply well. Well operational. Monitored under Exhibit IV and Aerojet sitewide monitoring plan.**		**Figure 1-5A**
1368	**9N/7E-10D1**	**Shadow Glen Riding Stables, 4854 Main (prev. Sacramento County Sewage Disposal Plant) (989-1826). Well on left at property entrance.**	**DW**	**11/20/56**	**157.5**	**175**	**91-175**	**Well appears operational; well on bluff.**	**Well in use for domestic purposes and irrigation. Well upgradient of Aerojet site; not monitored.**	**No**	**Figure 1-5A**
1433	9N/7E-16K	Sacramento Regional Sanitation District at sanitary sewer lift station (north of Folsom, east of Hazel).	DW					Unconfirmed; well not located in field.	Abandoned. Well not in use.	1x in 91	Figure 1-5B

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Aerojet Well No.	State Well No.	Owner/Well Location	Well Type	Well Compl. Date	gse (ft, msl)	Well Depth (ft, bgs)	Perf. Interval (ft, bgs)	Well Status - 1991	Well Status	Monitored between 1991-2004?	Posted
1816	**8N/7E-3E1**	**Larry McKenna/ 12535 Douglas Road (Prev. Fagundus Well). Located ~2 miles east of Sunrise, 1/2 mile north of Douglas.**	**DW**	**8/15/78**	**244**	**330**	**260-300**		**Well is in use for domestic purposes. Well head treatment provided. Well monitored under WRND monitoring plan.**	**Yes, many x**	**Figure 1-5A**
1832	9N/7E-12L1	Intel (prev. M. Brown), Prairie City Road and Hwy 50	DW	12/49	290	103		Unconfirmed; well not located in field. Well reported "abandoned" on 8/21/57, water level measurements continue to 3/12/80 [reference DWR files - Well #9N/7E-12L1]; upgradient of Aerojet site.	Destroyed.	No	Figure 1-5B
1834	9N/7E-16Q1	Knauer (Prev. Libby, McNeill & Libby Olive Plant), 12401 Folsom Blvd. at Hazel	DW	10/16/60	144.5	138	80-130	Unconfirmed; well not located in field. Well reported "abandoned" on 6 or 7/78 due to construction of sewer interceptor line [reference DWR files - Well #9N/7E-16Q1].	Destroyed, per communication with owner (2004).	No	Figure 1-5B
1842	9N/7E-15F7	Prev. Shady Oaks Travelers Park, Folsom Blvd. across from Aerojet, Gate 5.	DW					Unconfirmed; well not located in field. Alternative water was offered, but refused (1982).	Well not located. Area redeveloped. Structures have been demolished. Currently an auto mall.	No	Figure 1-5B
1843	9N/7E-15F8	Pacific Bell, Folsom & Alabama (Aerojet, Gate 5)	DW					Well not in use; well not destroyed. Employee stated that business went on public water supply approximately 3 years ago.	Abandoned. Well not in use.	No	Figure 1-5B
1848	9N/7E-11R1	Intel 5S	MW		280.91	57	35-55	Unconfirmed; well not located in field; upgradient.	Monitoring well. Bi-Annual water level monitoring.	2x thru 00	not posted
1849	9N/7E-11RS	Intel 5M	MW		279.71	80	60-80	Unconfirmed; well not located in field; upgradient. Historically monitored by Aerojet.	Monitoring well. Bi-Annual water level monitoring.	6x thru 00	not posted
1850	9N/7E-12N1	Intel 2M			282.61	100	80-100	Unconfirmed; well not located in field; upgradient.	Destroyed.	6x thru 00	Figure 1-5B
1851	9N/7E-12P2	Intel 1M (prev. Brown)		1/1/49	282.16	100	80-100	Unconfirmed; well not located in field; upgradient.	Destroyed.	1x in 96	Figure 1-5B
1852	9N/7E-12P3	Intel 1S			282.03	55	35-55	Unconfirmed; well not located in field; upgradient. Historically monitored by Aerojet.	Destroyed.	6x thru 00	Figure 1-5B
1853	9N/7E-12Q1	Intel (Brown), Prairie City Road and Hwy 50 (MW-9M).	DW	1/53	308.62	130		Well in use; observed locked metal cap; appears to be used as a monitoring well. No log available in DWR files.	Destroyed.	1x in 96	Figure 1-5B
1854	9N/7E-12L2	Intel 4s			278.35	58	30-52	Unconfirmed; well not located in field; upgradient.	Destroyed.	No	Figure 1-5B
1855	9N/7E-12M1	Intel 3s			277.44	60	40-60	Unconfirmed; well not located in field; upgradient.	Destroyed.	No	Figure 1-5B
1856	9N/7E-12M2	Intel 3m			277.3	102	82-102	Unconfirmed; well not located in field; upgradient.	Destroyed.	No	Figure 1-5B
1857	9N/7E-11D1	Intel West, Blue Ravine Road	DW					Unconfirmed; well not located in field.	Abandoned. Well not in use per owner; upgradient.	No	Figure 1-5B
1858	9N/7E-11D2	Intel West, Blue Ravine Road	DW					Unconfirmed; well not located in field.	Abandoned. Well not in use per owner; upgradient.	No	Figure 1-5B

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1859	9N/7E-11E1	Intel West, Blue Ravine Road	DW					Unconfirmed; well not located in field.	Abandoned. Well not in use per owner; upgradient.	No	Figure 1-5B
1861	9N/7E-35	AKT Corporation, Grant Line Road south of White Rock Road	other	02/16/89		412	160-175	Test well for development.	Well was actually a boring.	No	not posted
1862	9N/7E-35	AKT Corporation, Grant Line Road	other					Test well for development.	Well was actually a boring.	No	not posted
1864		**Divine, David and Alaina**	**DW**						**Well in use for drinking and irrigation. Well monitored under Exhibit IV monitoring plan.**		**Figure 1-5A**
1871		**Intel**	**WS/IND**	**2003**		**220**	**77-177**		**Well only used in an emergency for industrial purposes; not monitored.**	**No**	**Figure 1-5A**
1874	9N/7E-20F	2300 Mine Shaft Lane (off Folsom and Sunrise)	DW	12/91		240			Well not in use. Well pump is currently not operable and well cannot be monitored. Owner has indicated a desire to use the well for irrigation in the future. Well is included in Exhibit IV monitoring plan.	No.	Figure 1-5B
1884	9N/7E-12	Intel, 1900 Prairie City Road and Hwy 50 (Lake well)	DW	8/9/85		238	70-233	Well in use; upgradient.	Abandoned. Well not in use per owner; upgradient.	No	not posted
1893	**9N/7E-9A1**	**Rudek (prev. Nazimoff, Roediger), 9151 Sunset Ave.**	**DW**		**192**	**130**		**Unconfirmed; well not located in field - no visual evidence of municipal water supply to residence; on bluff.**	**Well in use for irrigation. House on municipal water. Well in gully behind house. Upgradient of Aerojet; not monitored.**	**No**	**Figure 1-5A**
1894	9N/7E-10Q1	State Dept. Parks and Recreation. 700' NE of Folsom and route 50 near pumphouse	DW	1936	170	318		Well not found in 1992.	Well not located. Personnel not aware of domestic well.	No	not posted
1895	9N/7E-10Q2	State Dept. Parks and Recreation	DW					Well not found in 1992.	Destroyed.	No	not posted
1896	9N/7E-12K1	Intel (Brown),1900 Prairie City Road and Hwy 50	DW	5/46		103		Well not in use; well not destroyed; upgradient.	Abandoned. Well not in use per owner. Well is upgradient of Aerojet site.	No	not posted
1897	9N/7E-12Q2	State Dept. Parks and Recreation. Prairie City Road and Hwy 50.	DW	1947	295	60			Destroyed.	No	not posted
1899	9N/7E-15E1	Shady Oaks Investments	DW		143	185		Building demolished, area graded.	Well not located. Area redeveloped. Building demolished, area graded.	No	not posted
1900	9N/7E-12K1	Rogers	DW						Well not located in 1992 or 2004. No additional information available.	No	not posted
1901	9N/7E-16A1	State Dept. Parks and Recreation	DW		131			Unconfirmed.	Destroyed.	No	not posted
1902	9N/7E-16P1	Natomas Land Co. (200' west of cannery at Nimbus Road on Folsom Blvd., 150' north of road behind houses)	DW					Well not found in 1992.	Well not located. Area redeveloped.	No	not posted
1903	9N/7E-16P2	Thompson, R. 300' west of Nimbus Road on Folsom Blvd., 40' north of road and 30' west of Jet Club	DW					Well not found in 1992.	Well not located. Area redeveloped.	No	not posted
1905	9N/7E-19B1	DWR - Water Problem Area, Folsom/East Sacramento Study	MW	1/8/63	100	80	76-80	Area graded.	Monitoring well. Well not found in 2004.	No	not posted
1909	9N/7E-34D1	Capital Dredging Co. (Well 5) / 4400 feet north, 4200' west of southeast corner of Section 34 (south of White Rock Road)	DW			197	70-145		Abandoned. Well not in use. Well location not field checked.		not posted
1910	9N/7E-34R1	Grant Line Road Properties, Prev. A.E. Cummings 12545 Douglas Road (Cupp Lane)	DW	9/20/50		112	64-112	Unconfirmed; well not located in field.	Well not located. Spoke with Grant Line Road Properties manager. They have no knowledge of well.	No	not posted

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1911	9N/7E-36C1	Capitol Dredging #4. Near moon building at Prairie City.	WS/IND	8/27		420	158-355	Well supplied water for dredging operations.	Abandoned. Well not in use. Not field checked.	No	not posted
1912	9N/7E-36C2	Capitol Dredging #6. Near moon building at Prairie City.	WS/IND	3/25	320	489	155-262	Well supplied water for dredging operations.	Abandoned. Well not in use. Not field checked.	No	not posted
1913	9N/7E-36N1	Capitol Dredging	WS/IND	1/33	295	500		Well supplied water for dredging operations.	Abandoned. Well not in use. Not field checked.	No	not posted
1917	**9N/7E-34**	**12525 A Calif General Partnership (previously owned by Whitlow and Lehman). 12525 Douglas Rd (Cupp Lane)**	**DW**					**Unconfirmed; well not located in field.**	**Neighbor stated well in use for domestic and irrigation purposes. Added to 2005-2006 Exhibit IV monitoring plan.**	**No**	**Figure 1-5A**
1921	9N/7E	Near Main Ave. and Dredger Way at end of Sunset	MW	6/25/886		27		Well not in use. Well has been destroyed.	Destroyed.	No	not posted
1922	9N/7E	Near Main Ave. and Dredger Way at end of Sunset	MW	6/27/86		18		Well not in use. Well has been destroyed.	Destroyed.	No	not posted
1923	9N/7E	Near Main Ave. and Dredger Way at end of Sunset	MW	6/27/86		15		Well not in use. Well has been destroyed.	Destroyed.	No	not posted
1925	9N/7E-9B	Prev. Robert G. Burris, 9101 Sunset Ave.	DW	7/18/63		208	160-208	Well in use; neighbor stated that well was in use for domestic purposes; on bluff; well upgradient of site.	Well not located. Area redeveloped. Status unknown. No such address.	No	not posted
1926	9N/7E-9B	Mearly Brown. Sunset Ave.	DW	3/20/63		210	96-210	Well upgradient of site. Well not found in field.	Well not located. Upgradient of site.	No	not posted
1927	9N/7E-9B	McCann, Bill and Elizabeth (prev. William Ludwig), 9110 Sunset Ave.	DW	11/58		187	34-187	Well in use; neighbor stated that well was in use for domestic purposes; on bluff; well upgradient of site.	Abandoned. Well not in use. Pump does not work and well has not been operated in approximately 25 years. House on municipal water.	No	Figure 1-5B
1929	**9N/7E-9B**	**William Ludwig 9106 Sunset Ave.**	**DW**	**8/4/67**		**195**	**85-195**	**Well upgradient of site.**	**Well in use for domestic purposes. Well upgradient of site; not monitored.**	**No**	**Figure 1-5A**
1930	**9N/7E-9G1**	**Prev. A.E. Cummings, 9251 Sunset Ave.**	**DW**	**5/15/50**		**210**	**91-210**	**Well in use; owner stated that they were trying to connect to municipal water supply; on bluff; well upgradient of site.**	**Well in use for irrigation, possibly for domestic purposes. Well upgradient of site; not monitored.**	**No**	**Figure 1-5A**
1931	9N/7E-9G	Near Serena Drive in Zone 1	other			692		Well is actually a test hole. No well was set.	Well is actually a test hole. No well was set.	No	not posted
1932	9N/7E-9G	Fair Oaks Irrigation Dist., Kruithof Ave. Phoenix Field Well.	WS/MUN	6/12/69		420	178-411		Abandoned. Well not in use per water district.	No	Figure 1-5B
1933	**9N/7E-9A**	**Joel Leach, 9105 Sunset Ave.**	**DW**	**6/9/74**		**250**	**125-175**	**Well in use; neighbor stated that well was in use for domestic purposes; on bluff.**	**Well in use; neighbor stated that well was in use for domestic purposes; upgradient of site on bluff; not monitored.**	**No**	**Figure 1-5A**
1939	9N/7E-12	Orangevale Sportsmans Club. Off Prairie City Road, North of Willow Hill Reservoir.	DW	4/10/59		80	40-80	Well not in use.	Abandoned. Well not in use in 1992. Area redeveloped. Well location not field checked.	No	not posted
1941	9N/7E-16Q2	Nimbus Winery, 9101 Folsom Blvd. (prev. Libby, McNeill & Libby Olive Plant)	DW	8/23/55		135	90-132	Well appears to be operational.	Destroyed.	No	not posted
1943	**9N/7E-35**	**AKT Corporation (AKT-1), Grant Line Road south of White Rock Road**	**DW**	**2/6/89**		**412**	**160-390**	**Test well - extraction well (see WRND Database).**	**Well in use by Teichert Plant as extraction well. Well head treatment provided by Aerojet. Well monitored by Aerojet.**	**2x in 01**	**Figure 1-5A**

Table 1-1 Aerojet Private Well Survey (1-Mile Radius of PGOU)
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Aerojet Well No.	State Well No.	Owner/Well Location	Well Type	Well Compl. Date	gse (ft, msl)	Well Depth (ft, bgs)	Perf. Interval (ft, bgs)	Well Status - 1991	Well Status	Monitored between 1991-2004?	Posted
1944	9N/7E-35	AKT Corporation. southwest corner of Ehnizs in Zone 3	MW					Test well - monitor well (see WRND Database). Exhibit IV.	Monitor well. Monitored by Aerojet under Exhibit IV.		not posted
1970	9N/7E-12	Intel, 1900 Prairie City Road/Hwy 50 (Lawn well #1)	DW	7/3/84		70	70-130	Unconfirmed; well not located in field; upgradient.	Abandoned. Well not in use per owner; upgradient.	No	not posted
2000	9N/8E-7	Kemp, John. East of Illinois, South of Sunset.	DW	6/14/84		350	270-350		Well not located. Well not in use in 1992. Area north of known groundwater impacts.	No	not posted
2001	9N/8E-17N	Rick Davies, White Rock Road	DW	7/29/83		300	52-350		Well not located. Well not in use in 1992. Area redeveloped since 1983.	No	not posted
2054	9N/7E-7A2	Fair Oaks Irrig. Dist./Sunset Ave. (Well 2) 34-1086. Sunset and Kenneth.	WS/MUN	1945	180	592			Abandoned. Well not in use per water district.	No	Figure 1-5B
2066	**9N/7E-20C**	**SCWC, 11715 Gold Country Blvd. (#21)**	**WS/MUN**	**5/5/1994**	**120**	**620**	**290-580**		**SCWC public water supply well. Well monitored under Western Groundwater Operable Unit monitoring plan.**	**Yes, many x**	**Figure 1-5A**
		Sailor Bar, Olive (near 9N/7E-17)	DW						Well is a standby well for fire suppression.		not posted
	9N/7E-34	Yost well/4400' north, 3250' west of southeast corner of Section 34	DW	4/23/40	225				Abandoned. Well not in use.		not posted
		Dalton, 8001 Alta Vista Court	DW						Well located in Galt.		not posted
		McMillan, Fair Oaks Blvd., North of Sunset	DW						Well not located. Area served by municipal water.		not posted
	9N/7E-6C1	W.K. Tiffany, Tiffany Way (34-1084),	DW	6/1/51		102	open hole		Well not located. Area served by municipal water.		not posted
	9N/7E-6M1	Herbert Niessen, Fair Oaks Blvd., North of Sunset (34-1085)	DW	5/7/51		206	open hole		Well not located. Area served by municipal water.		not posted

Notes:

Wells **bolded** are used for domestic or irrigation water supply and are not monitored by Aerojet.

1. Survey results from *Revised Scoping Operable Unit Analysis* (ICF Technology, 1991) and November 2003 survey of DWR files (CVEI, Nov 2003).

2. Monitoring wells and piezometers identified during the August 1991 and November 2003 well surveys were not included in this water supply well list.

3. November 2003 survey included review of DWR files for the following township/range/section areas:

8N, 6E, 1	8N, 7E, 10	9N, 6E, 23	9N, 7E, 3	9N, 7E, 11	9N, 7E, 25	9N, 8E, 17
8N, 6E, 2	8N, 7E, 11	9N, 6E, 24	9N, 7E, 4	9N, 7E, 12	9N, 7E, 32	9N, 8E, 18
8N, 7E, 1	8N, 7E, 12	9N, 6E, 25	9N, 7E, 5	9N, 7E, 15	9N, 7E, 33	9N, 8E, 19
8N, 7E, 2	8N, 8E, 5	9N, 6E, 26	9N, 7E, 6	9N, 7E, 16	9N, 7E, 34	9N, 8E, 20
8N, 7E, 3	8N, 8E, 6	9N, 6E, 35	9N, 7E, 7	9N, 7E, 17	9N, 7E, 36	9N, 8E, 29
8N, 7E, 4	9N, 6E, 1	9N, 6E, 36	9N, 7E, 8	9N, 7E, 18	9N, 8E, 6	9N, 8E, 30
8N, 7E, 5	9N, 6E, 12	9N, 7E, 1	9N, 7E, 9	9N, 7E, 19	9N, 8E, 7	9N, 8E, 31
8N, 7E, 6	9N, 6E, 13	9N, 7E, 2	9N, 7E, 10	9N, 8E, 20	9N, 8E, 8	9N, 8E, 32

Abbreviations:

gse = Ground surface elevation
ft. msl = Feet above mean sea level
ft, bgs = Feet below ground surface
DW = Domestic well. May be used for domestic purposes or irrigation.
CalAm = Cal-American Water Company, previously Citizens Utilities Company
MW = Monitor well
WS/IND = Water supply well used for industrial purposes.
WS/MUN = Water supply well used for municipal purposes.
SCWC = Southern California Water Company, includes Arden-Cordova Water Service
SWMD = Sunrise Water Maintenance District

Table 2-1 *Management Unit Description*
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Zone	Layers	Current Land Use	Highest Water (ft bgs)	Current Groundwater Use[1]
1	Layer B Layer C Layer D Layer E Layer F	Occupational Agricultural Residential	South of River - 40 (Layer B) North of River - >100 (Layer B)	Domestic, Industrial, and Agricultural Water Supply
2	Layer A Layer B Layer C Layer D Layer E	Occupational	50 (Layer A, which is non continuous throughout the site)	None (deed restrictions)
3	Layer A Layer B Layer C Layer D Layer E	Occupational Agricultural Recreational	Layer A is dry Remainder of layers have potentiometric head > 100	Domestic, Industrial, and Agricultural Water Supply
4	Dredged Layer A Layer B Bedrock	Occupational	40 (Layer A)	None (deed restrictions)

Notes
1 = All domestic, industrial, and agricultural water supply wells known to be in use and potentially downgradient plumes are monitored, or will be monitored, by Aerojet under Exhibit IV of the Partial Consent Decree.
ft bgs = Feet below ground surface

Table 2-2 Human Health Screening Levels for Surface Water and Groundwater
Perimeter Groundwater Operable Unit Lands Risk Assessment
Aerojet Superfund Site
Sacramento County, California

CAS No.	Chemical	Tap Water PRG (µg/L)	OEHHA Public Health Goal (µg/L)	Direct Ground-water Exposure Human Health Screening Level (µg/L)	Minimal Risk from Vapor Intrusion (µg/L)	Human Health Screening Level Including Vapor Intrusion (µg/L)
30560-19-1	Acephate	7.7 E+0		7.7 E-1		7.7E-01
75-07-0	Acetaldehyde	1.7 E+0		1.7 E-1	P	1.7E-01
34256-82-1	Acetochlor	7.3 E+2		7.3 E+1		7.3E+01
67-64-1	Acetone	5.5 E+3		5.5 E+2	P	5.5E+02
75-86-5	Acetone cyanohydrin	2.9 E+1		2.9 E+0		2.9E+00
75-05-8	Acetonitrile	1.0 E+2		1.0 E+1		1.0E+01
107-02-8	Acrolein	4.2 E-2		4.2 E-3		4.2E-03
79-06-1	Acrylamide	1.5 E-2		1.5 E-3		1.5E-03
79-10-7	Acrylic acid	1.8 E+4		1.8 E+3		1.8E+03
107-13-1	Acrylonitrile [a]	1.1 E-2		1.1 E-3		1.1E-03
15972-60-8	Alachlor	8.4 E-1	4.0 E+0	8.4 E-2		8.4E-02
1596-84-5	Alar	5.5 E+3		5.5 E+2		5.5E+02
116-06-3	Aldicarb	3.6 E+1		3.6 E+0		3.6E+00
1646-88-4	Aldicarb sulfone	3.6 E+1		3.6 E+0		3.6E+00
309-00-2	Aldrin	4.0 E-3		4.0 E-4		4.0E-04
74223-64-6	Ally	9.1 E+3		9.1 E+2		9.1E+02
107-18-6	Allyl alcohol	1.8 E+2		1.8 E+1		1.8E+01
107-05-1	Allyl chloride	1.0 E+1		1.0 E+0	P	1.0E+00
7429-90-5	Aluminum	3.6 E+4	6.0 E+2	6.0 E+1		6.0E+01
20859-73-8	Aluminum phosphide	1.5 E+1		1.5 E+0		1.5E+00
67485-29-4	Amdro	1.1 E+1		1.1 E+0		1.1E+00
834-12-8	Ametryn	3.3 E+2		3.3 E+1		3.3E+01
1321-12-6	Aminodinitrotoluene	7.3 E+0		7.3 E-1		7.3E-01
591-27-5	m-Aminophenol	2.6 E+3		2.6 E+2		2.6E+02
504-24-5	4-Aminopyridine	7.3 E-1		7.3 E-2		7.3E-02
33089-61-1	Amitraz	9.1 E+1		9.1 E+0		9.1E+00
7773-06-0	Ammonium sulfamate	7.3 E+3		7.3 E+2		7.3E+02
62-53-3	Aniline	1.2 E+1		1.2 E+0		1.2E+00
7440-36-0	Antimony and compounds	1.5 E+1	2.0 E+1	1.5 E+0		1.5E+00
74115-24-5	Apollo	4.7 E+2		4.7 E+1		4.7E+01
140-57-8	Aramite	2.7 E+0		2.7 E-1		2.7E-01
7440-38-2	Arsenic [a]	7.1 E-3	4.0 E-3	4.0 E-4		4.0E-04
76578-14-8	Assure	3.3 E+2		3.3 E+1		3.3E+01
3337-71-1	Asulam	1.8 E+3		1.8 E+2		1.8E+02
1912-24-9	Atrazine	3.0 E-1	1.5 E-1	1.5 E-2		1.5E-02
71751-41-2	Avermectin B1	1.5 E+1		1.5 E+0		1.5E+00
103-33-3	Azobenzene	6.1 E-1		6.1 E-2		6.1E-02
7440-39-3	Barium and compounds	2.6 E+3	2.0 E+3	2.0 E+2		2.0E+02
114-26-1	Baygon	1.5 E+2		1.5 E+1		1.5E+01
43121-43-3	Bayleton	1.1 E+3		1.1 E+2		1.1E+02
68359-37-5	Baythroid	9.1 E+2		9.1 E+1		9.1E+01
1861-40-1	Benefin	1.1 E+4		1.1 E+3		1.1E+03
17804-35-2	Benomyl	1.8 E+3		1.8 E+2		1.8E+02
25057-89-0	Bentazon	1.1 E+3	2.0 E+2	2.0 E+1		2.0E+01
100-52-7	Benzaldehyde	3.6 E+3		3.6 E+2		3.6E+02
71-43-2	Benzene	3.5 E-1	1.5 E-1	1.5 E-2	P	1.5E-02
92-87-5	Benzidine	2.9 E-4		2.9 E-5		2.9E-05
65-85-0	Benzoic acid	1.5 E+5		1.5 E+4		1.5E+04
98-07-7	Benzotrichloride	5.2 E-3		5.2 E-4		5.2E-04
100-51-6	Benzyl alcohol	1.1 E+4		1.1 E+3		1.1E+03
100-44-7	Benzyl chloride	6.6 E-2		6.6 E-3	P	6.6E-03
7440-41-7	Beryllium and compounds	7.3 E+1	1.0 E+0	1.0 E-1		1.0E-01
141-66-2	Bidrin	3.6 E+0		3.6 E-1		3.6E-01
82657-04-3	Biphenthrin (Talstar)	5.5 E+2		5.5 E+1		5.5E+01
92-52-4	1,1-Biphenyl	3.0 E+2		3.0 E+1		3.0E+01
111-44-4	Bis(2-chloroethyl)ether	1.0 E-2		1.0 E-3	P	1.0E-03
108-60-1	Bis(2-chloroisopropyl)ether	2.7 E-1		2.7 E-2		2.7E-02
542-88-1	Bis(chloromethyl)ether	5.2 E-5		5.2 E-6	P	5.2E-06
108-60-1	Bis(2-chloro-1-methylethyl)ether	2.7 E-1		2.7 E-2		2.7E-02
117-81-7	Bis(2-ethylhexyl)phthalate (DEHP)	4.8 E+0	1.2 E+1	4.8 E-1		4.8E-01
80-05-7	Bisphenol A	1.8 E+3		1.8 E+2		1.8E+02
7440-42-8	Boron	7.3 E+3		7.3 E+2		7.3E+02
15541-45-4	Bromate	9.6 E-2		9.6 E-3		9.6E-03
108-86-1	Bromobenzene	2.0 E+1		2.0 E+0		2.0E+00
75-27-4	Bromodichloromethane	1.8 E-1		1.8 E-2	P	1.8E-02
75-25-2	Bromoform (tribromomethane)	8.5 E+0		8.5 E-1	P	8.5E-01

Table 2-2 Human Health Screening Levels for Surface Water and Groundwater
Perimeter Groundwater Operable Unit Lands Risk Assessment
Aerojet Superfund Site
Sacramento County, California

CAS No.	Chemical	Tap Water PRG (µg/L)	OEHHA Public Health Goal (µg/L)	Direct Ground-water Exposure Human Health Screening Level (µg/L)	Minimal Risk from Vapor Intrusion (µg/L)	Human Health Screening Level Including Vapor Intrusion (µg/L)
74-83-9	Bromomethane (Methyl bromide)	8.7 E+0		8.7 E-1	P	8.7E-01
2104-96-3	Bromophos	1.8 E+2		1.8 E+1		1.8E+01
1689-84-5	Bromoxynil	7.3 E+2		7.3 E+1		7.3E+01
1689-99-2	Bromoxynil octanoate	7.3 E+2		7.3 E+1		7.3E+01
106-99-0	1,3-Butadiene [a]	1.9 E-2		1.9 E-3	P	1.9E-03
71-36-3	1-Butanol	3.6 E+3		3.6 E+2		3.6E+02
2008-41-5	Butylate	1.8 E+3		1.8 E+2		1.8E+02
104-51-8	n-Butylbenzene	2.4 E+2		2.4 E+1	P	2.4E+01
135-9-88	sec-Butylbenzene	2.4 E+2		2.4 E+1	P	2.4E+01
98-06-6	tert-Butylbenzene	2.4 E+2		2.4 E+1	P	2.4E+01
85-68-7	Butyl benzyl phthalate	7.3 E+3		7.3 E+2		7.3E+02
85-70-1	Butylphthalyl butylglycolate	3.6 E+4		3.6 E+3		3.6E+03
7440-43-9	Cadmium and compounds	1.8 E+1	4.0 E-2	4.0 E-3		4.0E-03
105-60-2	Caprolactam	1.8 E+4		1.8 E+3		1.8E+03
2425-06-1	Captafol	7.8 E+0		7.8 E-1		7.8E-01
133-06-2	Captan	1.9 E+1		1.9 E+0		1.9E+00
63-25-2	Carbaryl	3.6 E+3		3.6 E+2		3.6E+02
86-74-8	Carbazole	3.4 E+0		3.4 E-1		3.4E-01
1563-66-2	Carbofuran	1.8 E+2	1.7 E+0	1.7 E-1		1.7E-01
75-15-0	Carbon disulfide	1.0 E+3		1.0 E+2	P	1.0E+02
56-23-5	Carbon tetrachloride	1.7 E-1	1.0 E-1	1.0 E-2	P	1.0E-02
55285-14-8	Carbosulfan	3.6 E+2		3.6 E+1		3.6E+01
5234-68-4	Carboxin	3.6 E+3		3.6 E+2		3.6E+02
133-90-4	Chloramben	5.5 E+2		5.5 E+1		5.5E+01
118-75-2	Chloranil	1.7 E-1		1.7 E-2		1.7E-02
12789-03-6	Chlordane (technical)	1.9 E-1	3.0 E-2	3.0 E-3		3.0E-03
90982-32-4	Chlorimuron-ethyl	7.3 E+2		7.3 E+1		7.3E+01
79-11-8	Chloroacetic acid	7.3 E+1		7.3 E+0		7.3E+00
532-27-4	2-Chloroacetophenone	5.2 E-2		5.2 E-3		5.2E-03
106-47-8	4-Chloroaniline	1.5 E+2		1.5 E+1		1.5E+01
108-90-7	Chlorobenzene	1.1 E+2	2.0 E+2	1.1 E+1	P	1.1E+01
510-15-6	Chlorobenzilate	2.5 E-1		2.5 E-2		2.5E-02
74-11-3	p-Chlorobenzoic acid	7.3 E+3		7.3 E+2		7.3E+02
98-56-6	4-Chlorobenzotrifluoride	7.3 E+2		7.3 E+1		7.3E+01
126-99-8	2-Chloro-1,3-butadiene	1.4 E+1		1.4 E+0		1.4E+00
109-69-3	1-Chlorobutane	2.4 E+3		2.4 E+2		2.4E+02
75-68-3	1-Chloro-1,1-difluoroethane (HCFC-142b)	8.7 E+4		8.7 E+3		8.7E+03
75-45-6	Chlorodifluoromethane	8.5 E+4		8.5 E+3		8.5E+03
75-00-3	Chloroethane	4.6 E+0		4.6 E-1	P	4.6E-01
67-66-3	Chloroform	1.7 E-1		1.7 E-2	P	1.7E-02
74-87-3	Chloromethane (methyl chloride)	1.6 E+2		1.6 E+1	P	1.6E+01
95-69-2	4-Chloro-2-methylaniline	1.2 E-1		1.2 E-2		1.2E-02
3165-93-3	4-Chloro-2-methylaniline hydrochloride	1.5 E-1		1.5 E-2		1.5E-02
91-58-7	beta-Chloronaphthalene	4.9 E+2		4.9 E+1		4.9E+01
88-73-3	o-Chloronitrobenzene	1.5 E-1		1.5 E-2		1.5E-02
100-00-5	p-Chloronitrobenzene	1.2 E+0		1.2 E-1		1.2E-01
95-57-8	2-Chlorophenol	3.0 E+1		3.0 E+0		3.0E+00
75-29-6	2-Chloropropane	1.7 E+2		1.7 E+1		1.7E+01
1897-45-6	Chlorothalonil	6.1 E+0		6.1 E-1		6.1E-01
95-49-8	o-Chlorotoluene	1.2 E+2		1.2 E+1		1.2E+01
101-21-3	Chlorpropham	7.3 E+3		7.3 E+2		7.3E+02
2921-88-2	Chlorpyrifos	1.1 E+2		1.1 E+1		1.1E+01
5598-13-0	Chlorpyrifos-methyl	3.6 E+2		3.6 E+1		3.6E+01
64902-72-3	Chlorsulfuron	1.8 E+3		1.8 E+2		1.8E+02
60238-56-4	Chlorthiophos	2.9 E+1		2.9 E+0		2.9E+00
16065-83-1	Chromium III	5.5 E+4		5.5 E+3		5.5E+03
18540-29-9	Chromium VI	1.1 E+2		1.1 E+1		1.1E+01
7440-48-4	Cobalt	7.3 E+2		7.3 E+1		7.3E+01
7440-50-8	Copper and compounds	1.5 E+3	1.7 E+2	1.7 E+1		1.7E+01
123-73-9	Crotonaldehyde	5.9 E-3		5.9 E-4		5.9E-04
98-82-8	Cumene (isopropylbenzene)	6.6 E+2		6.6 E+1	P	6.6E+01
21725-46-2	Cyanazine	8.0 E-2		8.0 E-3		8.0E-03
57-12-5	Cyanide (free)	7.3 E+2	1.5 E+2	1.5 E+1		1.5E+01
74-90-8	Cyanide (hydrogen)	6.2 E+0		6.2 E-1		6.2E-01
460-19-5	Cyanogen	2.4 E+2		2.4 E+1		2.4E+01
506-68-3	Cyanogen bromide	5.5 E+2		5.5 E+1		5.5E+01

Table 2-2 Human Health Screening Levels for Surface Water and Groundwater
Perimeter Groundwater Operable Unit Lands Risk Assessment
Aerojet Superfund Site
Sacramento County, California

CAS No.	Chemical	Tap Water PRG (µg/L)	OEHHA Public Health Goal (µg/L)	Direct Ground-water Exposure Human Health Screening Level (µg/L)	Minimal Risk from Vapor Intrusion (µg/L)	Human Health Screening Level Including Vapor Intrusion (µg/L)
506-77-4	Cyanogen chloride	3.0 E+2		3.0 E+1		3.0E+01
110-82-7	Cyclohexane	1.0 E+4		1.0 E+3	P	1.0E+03
108-94-1	Cyclohexanone	1.8 E+5		1.8 E+4		1.8E+04
108-91-8	Cyclohexylamine	7.3 E+3		7.3 E+2		7.3E+02
68085-85-8	Cyhalothrin/Karate	1.8 E+2		1.8 E+1		1.8E+01
52315-07-8	Cypermethrin	3.6 E+2		3.6 E+1		3.6E+01
66215-27-8	Cyromazine	2.7 E+2		2.7 E+1		2.7E+01
1861-32-1	Dacthal	3.6 E+2		3.6 E+1		3.6E+01
75-99-0	Dalapon	1.1 E+3	7.9 E+2	7.9 E+1		7.9E+01
39515-41-8	Danitol	9.1 E+2		9.1 E+1		9.1E+01
72-54-8	DDD	2.8 E-1		2.8 E-2		2.8E-02
72-55-9	DDE	2.0 E-1		2.0 E-2		2.0E-02
50-29-3	DDT	2.0 E-1		2.0 E-2		2.0E-02
1163-19-5	Decabromodiphenyl ether	3.6 E+2		3.6 E+1		3.6E+01
8065-48-3	Demeton	1.5 E+0		1.5 E-1		1.5E-01
2303-16-4	Diallate	1.1 E+0		1.1 E-1		1.1E-01
333-41-5	Diazinon	3.3 E+1		3.3 E+0		3.3E+00
132-64-9	Dibenzofuran	1.2 E+1		1.2 E+0		1.2E+00
106-37-6	1,4-Dibromobenzene	3.6 E+2		3.6 E+1		3.6E+01
124-48-1	Dibromochloromethane	1.3 E-1		1.3 E-2	P	1.3E-02
96-12-8	1,2-Dibromo-3-chloropropane (DBCP) [a]	1.6 E-3	1.7 E-3	1.6 E-4	P	1.6E-04
106-93-4	1,2-Dibromoethane (EDB)	5.6 E-3	1.0 E-2	5.6 E-4	P	5.6E-04
84-74-2	Dibutyl phthalate	3.6 E+3		3.6 E+2		3.6E+02
1918-00-9	Dicamba	1.1 E+3		1.1 E+2		1.1E+02
95-50-1	1,2-Dichlorobenzene	3.7 E+2	6.0 E+2	3.7 E+1	P	3.7E+01
541-73-1	1,3-Dichlorobenzene	1.8 E+2		1.8 E+1	P	1.8E+01
106-46-7	1,4-Dichlorobenzene	5.0 E-1	6.0 E+0	5.0 E-2	P	5.0E-02
91-94-1	3,3-Dichlorobenzidine	1.5 E-1		1.5 E-2		1.5E-02
90-98-2	4,4'-Dichlorobenzophenone	1.1 E+3		1.1 E+2		1.1E+02
764-41-0	1,4-Dichloro-2-butene	1.2 E-3		1.2 E-4		1.2E-04
75-71-8	Dichlorodifluoromethane	3.9 E+2		3.9 E+1	P	3.9E+01
75-34-3	1,1-Dichloroethane [a]	2.0 E+0	3.0 E+0	2.0 E-1	P	2.0E-01
107-06-2	1,2-Dichloroethane (EDC)	1.2 E-1	4.0 E-1	1.2 E-2	P	1.2E-02
75-35-4	1,1-Dichloroethylene	3.4 E+2	1.0 E+1	1.0 E+0	P	1.0E+00
156-59-2	1,2-Dichloroethylene (cis)	6.1 E+1	1.0 E+2	6.1 E+0	P	6.1E+00
156-60-5	1,2-Dichloroethylene (trans)	1.2 E+2	6.0 E+1	6.0 E+0	P	6.0E+00
120-83-2	2,4-Dichlorophenol	1.1 E+2		1.1 E+1		1.1E+01
94-82-6	4-(2,4-Dichlorophenoxy)butyric Acid (2,4-DB)	2.9 E+2		2.9 E+1		2.9E+01
94-75-7	2,4-Dichlorophenoxyacetic Acid (2,4-D)	3.6 E+2	7.0 E+1	7.0 E+0		7.0E+00
78-87-5	1,2-Dichloropropane	1.6 E-1	5.0 E-1	1.6 E-2	P	1.6E-02
142-28-9	1,3-Dichloropropane	1.2 E+2		1.2 E+1		1.2E+01
542-75-6	1,3-Dichloropropene	4.0 E-1	2.0 E-1	2.0 E-2	P	2.0E-02
616-23-9	2,3-Dichloropropanol	1.1 E+2		1.1 E+1		1.1E+01
62-73-7	Dichlorvos	2.3 E-1		2.3 E-2		2.3E-02
115-32-2	Dicofol	1.5 E-1		1.5 E-2		1.5E-02
77-73-6	Dicyclopentadiene	4.2 E-1		4.2 E-2		4.2E-02
60-57-1	Dieldrin	4.2 E-3		4.2 E-4		4.2E-04
112-34-5	Diethylene glycol, monobutyl ether	3.6 E+2		3.6 E+1		3.6E+01
111-90-0	Diethylene glycol, monoethyl ether	2.2 E+3		2.2 E+2		2.2E+02
617-84-5	Diethylformamide	1.5 E+1		1.5 E+0		1.5E+00
103-23-1	Di(2-ethylhexyl)adipate	5.6 E+1	2.0 E+2	5.6 E+0		5.6E+00
84-66-2	Diethyl phthalate	2.9 E+4		2.9 E+3		2.9E+03
56-53-1	Diethylstilbestrol	1.4 E-5		1.4 E-6		1.4E-06
43222-48-6	Difenzoquat (Avenge)	2.9 E+3		2.9 E+2		2.9E+02
35367-38-5	Diflubenzuron	7.3 E+2		7.3 E+1		7.3E+01
75-37-6	1,1-Difluoroethane	6.9 E+4		6.9 E+3		6.9E+03
28553-12-0	Diisononyl phthalate	7.3 E+2		7.3 E+1		7.3E+01
1445-75-6	Diisopropyl methylphosphonate	2.9 E+3		2.9 E+2		2.9E+02
55290-64-7	Dimethipin	7.3 E+2		7.3 E+1		7.3E+01
60-51-5	Dimethoate	7.3 E+0		7.3 E-1		7.3E-01
119-90-4	3,3'-Dimethoxybenzidine	4.8 E+0		4.8 E-1		4.8E-01
124-40-3	Dimethylamine	3.5 E-2		3.5 E-3		3.5E-03
121-69-7	N-N-Dimethylaniline	7.3 E+1		7.3 E+0		7.3E+00
95-68-1	2,4-Dimethylaniline	9.0 E-2		9.0 E-3		9.0E-03
21436-96-4	2,4-Dimethylaniline hydrochloride	1.2 E-1		1.2 E-2		1.2E-02
119-93-7	3,3'-Dimethylbenzidine	2.9 E-2		2.9 E-3		2.9E-03

Table 2-2 Human Health Screening Levels for Surface Water and Groundwater
Perimeter Groundwater Operable Unit Lands Risk Assessment
Aerojet Superfund Site
Sacramento County, California

CAS No.	Chemical	Tap Water PRG (µg/L)	OEHHA Public Health Goal (µg/L)	Direct Ground-water Exposure Human Health Screening Level (µg/L)	Minimal Risk from Vapor Intrusion (µg/L)	Human Health Screening Level Including Vapor Intrusion (µg/L)
68-12-2	N,N-Dimethylformamide	3.6 E+3		3.6 E+2		3.6E+02
122-09-8	Dimethylphenethylamine	3.6 E+1		3.6 E+0		3.6E+00
105-67-9	2,4-Dimethylphenol	7.3 E+2		7.3 E+1		7.3E+01
576-26-1	2,6-Dimethylphenol	2.2 E+1		2.2 E+0		2.2E+00
95-65-8	3,4-Dimethylphenol	3.6 E+1		3.6 E+0		3.6E+00
131-11-3	Dimethyl phthalate	3.6 E+5		3.6 E+4		3.6E+04
120-61-6	Dimethyl terephthalate	3.6 E+3		3.6 E+2		3.6E+02
534-52-1	4,6-Dinitro-o-cresol	3.6 E+0		3.6 E-1		3.6E-01
131-89-5	4,6-Dinitro-o-cyclohexyl phenol	7.3 E+1		7.3 E+0		7.3E+00
528-29-0	1,2-Dinitrobenzene	3.6 E+0		3.6 E-1		3.6E-01
99-65-0	1,3-Dinitrobenzene	3.6 E+0		3.6 E-1		3.6E-01
100-25-4	1,4-Dinitrobenzene	3.6 E+0		3.6 E-1		3.6E-01
51-28-5	2,4-Dinitrophenol	7.3 E+1		7.3 E+0		7.3E+00
25321-14-6	Dinitrotoluene mixture	9.9 E-2		9.9 E-3		9.9E-03
121-14-2	2,4-Dinitrotoluene (also see Dinitrotoluene mixture)	7.3 E+1		7.3 E+0		7.3E+00
606-20-2	2,6-Dinitrotoluene (also see Dinitrotoluene mixture)	3.6 E+1		3.6 E+0		3.6E+00
88-85-7	Dinoseb	3.6 E+1	1.4 E+1	1.4 E+0		1.4E+00
117-84-0	di-n-Octyl phthalate	1.5 E+3		1.5 E+2		1.5E+02
123-91-1	1,4-Dioxane	6.1 E+0		6.1 E-1	P	6.1E-01
1746-01-6	Dioxin (2,3,7,8-TCDD)	4.5 E-7		4.5 E-8		4.5E-08
957-51-7	Diphenamid	1.1 E+3		1.1 E+2		1.1E+02
122-39-4	Diphenylamine	9.1 E+2		9.1 E+1		9.1E+01
74-31-7	N,N-Diphenyl-1,4 benzenediamine (DPPD)	1.1 E+1		1.1 E+0		1.1E+00
122-66-7	1,2-Diphenylhydrazine	8.4 E-2		8.4 E-3		8.4E-03
127-63-9	Diphenyl sulfone	1.1 E+2		1.1 E+1		1.1E+01
85-00-7	Diquat	8.0 E+1	1.5 E+1	1.5 E+0		1.5E+00
1937-37-7	Direct black 38	7.8 E-3		7.8 E-4		7.8E-04
2602-46-2	Direct blue 6	8.3 E-3		8.3 E-4		8.3E-04
16071-86-6	Direct brown 95	7.2 E-3		7.2 E-4		7.2E-04
298-04-4	Disulfoton	1.5 E+0		1.5 E-1		1.5E-01
505-29-3	1,4-Dithiane	3.6 E+2		3.6 E+1		3.6E+01
330-54-1	Diuron	7.3 E+1		7.3 E+0		7.3E+00
2439-10-3	Dodine	1.5 E+2		1.5 E+1		1.5E+01
7429-91-6	Dysprosium	3.6 E+3		3.6 E+2		3.6E+02
115-29-7	Endosulfan	2.2 E+2		2.2 E+1		2.2E+01
145-73-3	Endothall	7.3 E+2	5.8 E+2	5.8 E+1		5.8E+01
72-20-8	Endrin	1.1 E+1	1.8 E+0	1.8 E-1		1.8E-01
106-89-8	Epichlorohydrin [a]	1.4 E-1		1.4 E-2	P	1.4E-02
106-88-7	1,2-Epoxybutane	2.1 E+2		2.1 E+1		2.1E+01
759-94-4	EPTC (S-Ethyl dipropylthiocarbamate)	9.1 E+2		9.1 E+1		9.1E+01
16672-87-0	Ethephon (2-chloroethyl phosphonic acid)	1.8 E+2		1.8 E+1		1.8E+01
563-12-2	Ethion	1.8 E+1		1.8 E+0		1.8E+00
110-80-5	2-Ethoxyethanol	1.5 E+4		1.5 E+3		1.5E+03
111-15-9	2-Ethoxyethanol acetate	1.1 E+4		1.1 E+3		1.1E+03
141-78-6	Ethyl acetate	5.5 E+3		5.5 E+2		5.5E+02
140-88-5	Ethyl acrylate	2.3 E-1		2.3 E-2		2.3E-02
100-41-4	Ethylbenzene	1.3 E+3	3.0 E+2	3.0 E+1	P	3.0E+01
75-00-3	Ethyl chloride	4.6 E+0		4.6 E-1		4.6E-01
109-78-4	Ethylene cyanohydrin	1.1 E+4		1.1 E+3		1.1E+03
107-15-3	Ethylene diamine	3.3 E+3		3.3 E+2		3.3E+02
107-21-1	Ethylene glycol	7.3 E+4		7.3 E+3		7.3E+03
111-76-2	Ethylene glycol, monobutyl ether	1.8 E+4		1.8 E+3		1.8E+03
75-21-8	Ethylene oxide	2.4 E-2		2.4 E-3		2.4E-03
96-45-7	Ethylene thiourea (ETU)	6.1 E-1		6.1 E-2		6.1E-02
60-29-7	Ethyl ether	1.2 E+3		1.2 E+2		1.2E+02
97-63-2	Ethyl methacrylate	5.5 E+2		5.5 E+1		5.5E+01
2104-64-5	Ethyl p-nitrophenyl phenylphosphorothioate	3.6 E-1		3.6 E-2		3.6E-02
84-72-0	Ethylphthalyl ethyl glycolate	1.1 E+5		1.1 E+4		1.1E+04
101200-48-0	Express	2.9 E+2		2.9 E+1		2.9E+01
22224-92-6	Fenamiphos	9.1 E+0		9.1 E-1		9.1E-01
2164-17-2	Fluometuron	4.7 E+2		4.7 E+1		4.7E+01
16984-48-8	Fluorine (soluble fluoride)	2.2 E+3	1.0 E+3	1.0 E+2		1.0E+02
59756-60-4	Fluoridone	2.9 E+3		2.9 E+2		2.9E+02
56425-91-3	Flurprimidol	7.3 E+2		7.3 E+1		7.3E+01
66332-96-5	Flutolanil	2.2 E+3		2.2 E+2		2.2E+02
69409-94-5	Fluvalinate	3.6 E+2		3.6 E+1		3.6E+01

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CAS No.	Chemical	Tap Water PRG (µg/L)	OEHHA Public Health Goal (µg/L)	Direct Ground-water Exposure Human Health Screening Level (µg/L)	Minimal Risk from Vapor Intrusion (µg/L)	Human Health Screening Level Including Vapor Intrusion (µg/L)
133-07-3	Folpet	1.9 E+1		1.9 E+0		1.9E+00
72178-02-0	Fomesafen	3.5 E-1		3.5 E-2		3.5E-02
944-22-9	Fonofos	7.3 E+1		7.3 E+0		7.3E+00
50-00-0	Formaldehyde	5.5 E+3		5.5 E+2		5.5E+02
64-18-6	Formic Acid	7.3 E+4		7.3 E+3		7.3E+03
39148-24-8	Fosetyl-al	1.1 E+5		1.1 E+4		1.1E+04
76-13-1	Freon 113	5.9 E+4	4.0 E+3	4.0 E+2	P	4.0E+02
110-00-9	Furan	6.1 E+0		6.1 E-1		6.1E-01
67-45-8	Furazolidone	1.8 E-2		1.8 E-3		1.8E-03
98-01-1	Furfural	1.1 E+2		1.1 E+1		1.1E+01
531-82-8	Furium	1.3 E-3		1.3 E-4		1.3E-04
60568-05-0	Furmecyclox	2.2 E+0		2.2 E-1		2.2E-01
77182-82-2	Glufosinate-ammonium	1.5 E+1		1.5 E+0		1.5E+00
765-34-4	Glycidaldehyde	1.5 E+1		1.5 E+0		1.5E+00
1071-83-6	Glyphosate	3.6 E+3	9.0 E+2	9.0 E+1		9.0E+01
69806-40-2	Haloxyfop-methyl	1.8 E+0		1.8 E-1		1.8E-01
79277-27-3	Harmony	4.7 E+2		4.7 E+1		4.7E+01
76-44-8	Heptachlor	1.5 E-2	8.0 E-3	8.0 E-4		8.0E-04
1024-57-3	Heptachlor epoxide	7.4 E-3	6.0 E-3	6.0 E-4		6.0E-04
87-82-1	Hexabromobenzene	7.3 E+1		7.3 E+0		7.3E+00
118-74-1	Hexachlorobenzene	4.2 E-2	3.0 E-2	3.0 E-3		3.0E-03
87-68-3	Hexachlorobutadiene	8.6 E-1		8.6 E-2	P	8.6E-02
319-84-6	HCH (alpha)	1.1 E-2		1.1 E-3		1.1E-03
319-85-7	HCH (beta)	3.7 E-2		3.7 E-3		3.7E-03
58-89-9	HCH (gamma) Lindane	5.2 E-2	3.2 E-2	3.2 E-3		3.2E-03
608-73-1	HCH-technical	3.7 E-2		3.7 E-3		3.7E-03
77-47-4	Hexachlorocyclopentadiene	2.2 E+2	5.0 E+1	5.0 E+0		5.0E+00
67-72-1	Hexachloroethane	4.8 E+0		4.8 E-1		4.8E-01
70-30-4	Hexachlorophene	1.1 E+1		1.1 E+0		1.1E+00
121-82-4	Hexahydro-1,3,5-trinitro-1,3,5-triazine	6.1 E-1		6.1 E-2		6.1E-02
822-06-0	1,6-Hexamethylene diisocyanate	1.0 E-1		1.0 E-2		1.0E-02
110-54-3	n-Hexane	4.2 E+2		4.2 E+1	P	4.2E+01
51235-04-2	Hexazinone	1.2 E+3		1.2 E+2		1.2E+02
2691-41-0	HMX	1.8 E+3		1.8 E+2		1.8E+02
302-01-2	Hydrazine, hydrazine sulfate	2.2 E-2		2.2 E-3		2.2E-03
60-34-4	Hydrazine, monomethyl	2.2 E-2		2.2 E-3		2.2E-03
57-14-7	Hydrazine, dimethyl	2.2 E-2		2.2 E-3		2.2E-03
74-90-8	Hydrogen cyanide	6.2 E+0		6.2 E-1		6.2E-01
7783-06-4	Hydrogen sulfide	1.1 E+2		1.1 E+1		1.1E+01
123-31-9	p-Hydroquinone	1.2 E+0		1.2 E-1		1.2E-01
35554-44-0	Imazalil	4.7 E+2		4.7 E+1		4.7E+01
81335-37-7	Imazaquin	9.1 E+3		9.1 E+2		9.1E+02
36734-19-7	Iprodione	1.5 E+3		1.5 E+2		1.5E+02
7439-89-6	Iron	1.1 E+4		1.1 E+3		1.1E+03
78-83-1	Isobutanol	1.8 E+3		1.8 E+2		1.8E+02
78-59-1	Isophorone	7.1 E+1		7.1 E+0		7.1E+00
33820-53-0	Isopropalin	5.5 E+2		5.5 E+1		5.5E+01
1832-54-8	Isopropyl methyl phosphonic acid	3.6 E+3		3.6 E+2		3.6E+02
82558-50-7	Isoxaben	1.8 E+3		1.8 E+2		1.8E+02
143-50-0	Kepone	8.4 E-3		8.4 E-4		8.4E-04
77501-63-4	Lactofen	7.3 E+1		7.3 E+0		7.3E+00
7439-92-1	Lead		2.0 E+0	2.0 E-1		2.0E-01
78-00-2	Lead (tetraethyl)	3.6 E-3		3.6 E-4		3.6E-04
330-55-2	Linuron	7.3 E+1		7.3 E+0		7.3E+00
7439-93-2	Lithium	7.3 E+2		7.3 E+1		7.3E+01
83055-99-6	Londax	7.3 E+3		7.3 E+2		7.3E+02
121-75-5	Malathion	7.3 E+2		7.3 E+1		7.3E+01
108-31-6	Maleic anhydride	3.6 E+3		3.6 E+2		3.6E+02
123-33-1	Maleic hydrazide	3.0 E+3		3.0 E+2		3.0E+02
109-77-3	Malononitrile	3.6 E+0		3.6 E-1		3.6E-01
8018-01-7	Mancozeb	1.1 E+3		1.1 E+2		1.1E+02
12427-38-2	Maneb	1.1 E+0		1.1 E-1		1.1E-01
7439-96-5	Manganese and compounds	8.8 E+2		8.8 E+1		8.8E+01
950-10-7	Mephosfolan	3.3 E+0		3.3 E-1		3.3E-01
24307-26-4	Mepiquat chloride	1.1 E+3		1.1 E+2		1.1E+02
149-30-4	2-Mercaptobenzothiazole	2.3 E+0		2.3 E-1		2.3E-01

Table 2-2 Human Health Screening Levels for Surface Water and Groundwater
Perimeter Groundwater Operable Unit Lands Risk Assessment
Aerojet Superfund Site
Sacramento County, California

CAS No.	Chemical	Tap Water PRG (µg/L)	OEHHA Public Health Goal (µg/L)	Direct Ground-water Exposure Human Health Screening Level (µg/L)	Minimal Risk from Vapor Intrusion (µg/L)	Human Health Screening Level Including Vapor Intrusion (µg/L)
7487-94-7	Mercury and compounds	1.1 E+1	1.2 E+0	1.2 E-1		1.2E-01
22967-92-6	Mercury (methyl)	3.6 E+0		3.6 E-1		3.6E-01
150-50-5	Merphos	1.1 E+0		1.1 E-1		1.1E-01
78-48-8	Merphos oxide	1.1 E+0		1.1 E-1		1.1E-01
57837-19-1	Metalaxyl	2.2 E+3		2.2 E+2		2.2E+02
126-98-7	Methacrylonitrile	1.0 E+0		1.0 E-1		1.0E-01
10265-92-6	Methamidophos	1.8 E+0		1.8 E-1		1.8E-01
67-56-1	Methanol	1.8 E+4		1.8 E+3		1.8E+03
950-37-8	Methidathion	3.6 E+1		3.6 E+0		3.6E+00
16752-77-5	Methomyl	1.5 E+2		1.5 E+1		1.5E+01
72-43-5	Methoxychlor	1.8 E+2	3.0 E+1	3.0 E+0		3.0E+00
109-86-4	2-Methoxyethanol	3.6 E+1		3.6 E+0		3.6E+00
110-49-6	2-Methoxyethanol acetate	7.3 E+1		7.3 E+0		7.3E+00
99-59-2	2-Methoxy-5-nitroaniline	1.5 E+0		1.5 E-1		1.5E-01
79-20-9	Methyl acetate	6.1 E+3		6.1 E+2		6.1E+02
96-33-3	Methyl acrylate	1.8 E+2		1.8 E+1		1.8E+01
95-53-4	2-Methylaniline (o-toluidine)	2.8 E-1		2.8 E-2		2.8E-02
636-21-5	2-Methylaniline hydrochloride	3.7 E-1		3.7 E-2		3.7E-02
94-74-6	2-Methyl-4-chlorophenoxyacetic acid	1.8 E+1		1.8 E+0		1.8E+00
94-81-5	4-(2-Methyl-4-chlorophenoxy) butyric acid	3.6 E+2		3.6 E+1		3.6E+01
93-65-2	2-(2-Methyl-4-chlorophenoxy) propionic acid	3.6 E+1		3.6 E+0		3.6E+00
16484-77-8	2-(2-Methyl-1,4-chlorophenoxy) propionic acid	3.6 E+1		3.6 E+0		3.6E+00
108-87-2	Methylcyclohexane	5.2 E+3		5.2 E+2		5.2E+02
101-77-9	4,4'-Methylenebisbenzeneamine	2.7 E-1		2.7 E-2		2.7E-02
101-14-4	4,4'-Methylene bis(2-chloroaniline)	5.2 E-1		5.2 E-2		5.2E-02
101-61-1	4,4'-Methylene bis(N,N'-dimethyl)aniline	1.5 E+0		1.5 E-1		1.5E-01
74-95-3	Methylene bromide	6.1 E+1		6.1 E+0		6.1E+00
75-09-2	Methylene chloride	4.3 E+0	4.0 E+0	4.0 E-1	P	4.0E-01
101-68-8	4,4'-Methylene diphenyl diisocyanate	6.2 E+0		6.2 E-1		6.2E-01
78-93-3	Methyl ethyl ketone (2-Butanone)	7.0 E+3		7.0 E+2	P	7.0E+02
108-10-1	Methyl isobutyl ketone	2.0 E+3		2.0 E+2	P	2.0E+02
74-93-1	Methyl Mercaptan	2.1 E+1		2.1 E+0		2.1E+00
80-62-6	Methyl methacrylate	1.4 E+3		1.4 E+2		1.4E+02
99-55-8	2-Methyl-5-nitroaniline	2.0 E+0		2.0 E-1		2.0E-01
298-00-0	Methyl parathion	9.1 E+0		9.1 E-1		9.1E-01
95-48-7	2-Methylphenol	1.8 E+3		1.8 E+2		1.8E+02
108-39-4	3-Methylphenol	1.8 E+3		1.8 E+2		1.8E+02
106-44-5	4-Methylphenol	1.8 E+2		1.8 E+1		1.8E+01
993-13-5	Methyl phosphonic acid	7.3 E+2		7.3 E+1		7.3E+01
25013-15-4	Methyl styrene (mixture)	6.0 E+1		6.0 E+0		6.0E+00
98-83-9	Methyl styrene (alpha)	4.3 E+2		4.3 E+1		4.3E+01
1634-04-4	Methyl tertbutyl ether (MTBE)	1.1 E+1	1.3 E+1	1.1 E+0	P	1.1E+00
51218-45-2	Metolaclor (Dual)	5.5 E+3		5.5 E+2		5.5E+02
21087-64-9	Metribuzin	9.1 E+2		9.1 E+1		9.1E+01
2385-85-5	Mirex	3.7 E-2		3.7 E-3		3.7E-03
2212-67-1	Molinate	7.3 E+1		7.3 E+0		7.3E+00
7439-98-7	Molybdenum	1.8 E+2		1.8 E+1		1.8E+01
10599-90-3	Monochloramine	3.6 E+3		3.6 E+2		3.6E+02
300-76-5	Naled	7.3 E+1		7.3 E+0		7.3E+00
15299-99-7	Napropamide	3.6 E+3		3.6 E+2		3.6E+02
7440-02-0	Nickel (soluble salts)	7.3 E+2	1.2 E+1	1.2 E+0		1.2E+00
14797-55-8	Nitrate	1.0 E+4	1.0 E+4	1.0 E+3		1.0E+03
14797-65-0	Nitrite	1.0 E+3	1.0 E+3	1.0 E+2		1.0E+02
88-74-4	2-Nitroaniline	1.1 E+2		1.1 E+1		1.1E+01
99-09-2	3-Nitroaniline	3.2 E+0		3.2 E-1		3.2E-01
100-01-6	4-Nitroaniline	3.2 E+0		3.2 E-1		3.2E-01
98-95-3	Nitrobenzene	3.4 E+0		3.4 E-1		3.4E-01
67-20-9	Nitrofurantoin	2.6 E+3		2.6 E+2		2.6E+02
59-87-0	Nitrofurazone	4.5 E-2		4.5 E-3		4.5E-03
55-63-0	Nitroglycerin	4.8 E+0		4.8 E-1		4.8E-01
556-88-7	Nitroguanidine	3.6 E+3		3.6 E+2		3.6E+02
79-46-9	2-Nitropropane	1.2 E-3		1.2 E-4		1.2E-04
924-16-3	N-Nitrosodi-n-butylamine	2.0 E-3		2.0 E-4		2.0E-04
1116-54-7	N-Nitrosodiethanolamine	2.4 E-2		2.4 E-3		2.4E-03
55-18-5	N-Nitrosodiethylamine	4.5 E-4		4.5 E-5		4.5E-05
62-75-9	N-Nitrosodimethylamine	1.3 E-3	3.0 E-3	1.3 E-4		1.3E-04

Table 2-2 Human Health Screening Levels for Surface Water and Groundwater
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Aerojet Superfund Site
Sacramento County, California

CAS No.	Chemical	Tap Water PRG (µg/L)	OEHHA Public Health Goal (µg/L)	Direct Ground-water Exposure Human Health Screening Level (µg/L)	Minimal Risk from Vapor Intrusion (µg/L)	Human Health Screening Level Including Vapor Intrusion (µg/L)
86-30-6	N-Nitrosodiphenylamine	1.4 E+1		1.4 E+0		1.4E+00
621-64-7	N-Nitroso di-n-propylamine	9.6 E-3		9.6 E-4		9.6E-04
10595-95-6	N-Nitroso-N-methylethylamine	3.1 E-3		3.1 E-4		3.1E-04
930-55-2	N-Nitrosopyrrolidine	3.2 E-2		3.2 E-3		3.2E-03
99-08-1	m-Nitrotoluene	1.2 E+2		1.2 E+1		1.2E+01
88-72-2	o-Nitrotoluene	4.9 E-2		4.9 E-3		4.9E-03
99-99-0	p-Nitrotoluene	6.6 E-1		6.6 E-2		6.6E-02
27314-13-2	Norflurazon	1.5 E+3		1.5 E+2		1.5E+02
85509-19-9	NuStar	2.6 E+1		2.6 E+0		2.6E+00
32536-52-0	Octabromodiphenyl ether	1.1 E+2		1.1 E+1		1.1E+01
152-16-9	Octamethylpyrophosphoramide	7.3 E+1		7.3 E+0		7.3E+00
19044-88-3	Oryzalin	1.8 E+3		1.8 E+2		1.8E+02
19666-30-9	Oxadiazon	1.8 E+2		1.8 E+1		1.8E+01
23135-22-0	Oxamyl	9.1 E+2	5.0 E+1	5.0 E+0		5.0E+00
42874-03-3	Oxyfluorfen	1.1 E+2		1.1 E+1		1.1E+01
76738-62-0	Paclobutrazol	4.7 E+2		4.7 E+1		4.7E+01
4685-14-7	Paraquat	1.6 E+2		1.6 E+1		1.6E+01
56-38-2	Parathion	2.2 E+2		2.2 E+1		2.2E+01
1114-71-2	Pebulate	1.8 E+3		1.8 E+2		1.8E+02
40487-42-1	Pendimethalin	1.5 E+3		1.5 E+2		1.5E+02
87-84-3	Pentabromo-6-chloro cyclohexane	2.9 E+0		2.9 E-1		2.9E-01
32534-81-9	Pentabromodiphenyl ether	7.3 E+1		7.3 E+0		7.3E+00
608-93-5	Pentachlorobenzene	2.9 E+1		2.9 E+0		2.9E+00
82-68-8	Pentachloronitrobenzene	2.6 E-1		2.6 E-2		2.6E-02
87-86-5	Pentachlorophenol	5.6 E-1	4.0 E-1	4.0 E-2		4.0E-02
7601-90-3	Perchlorate	3.6 E+0	6.0 E+0	3.6 E-1		3.6E-01
52645-53-1	Permethrin	1.8 E+3		1.8 E+2		1.8E+02
13684-63-4	Phenmedipham	9.1 E+3		9.1 E+2		9.1E+02
108-95-2	Phenol	1.1 E+4		1.1 E+3		1.1E+03
92-84-2	Phenothiazine	7.3 E+1		7.3 E+0		7.3E+00
108-45-2	m-Phenylenediamine	2.2 E+2		2.2 E+1		2.2E+01
95-54-5	o-Phenylenediamine	1.4 E+0		1.4 E-1		1.4E-01
106-50-3	p-Phenylenediamine	6.9 E+3		6.9 E+2		6.9E+02
62-38-4	Phenylmercuric acetate	2.9 E+0		2.9 E-1		2.9E-01
90-43-7	2-Phenylphenol	3.5 E+1		3.5 E+0		3.5E+00
298-02-2	Phorate	7.3 E+0		7.3 E-1		7.3E-01
732-11-6	Phosmet	7.3 E+2		7.3 E+1		7.3E+01
7803-51-2	Phosphine	1.1 E+1		1.1 E+0		1.1E+00
7723-14-0	Phosphorus (white)	7.3 E-1		7.3 E-2		7.3E-02
100-21-0	p-Phthalic acid	3.6 E+4		3.6 E+3		3.6E+03
85-44-9	Phthalic anhydride	7.3 E+4		7.3 E+3		7.3E+03
1918-02-1	Picloram	2.6 E+3	5.0 E+2	5.0 E+1		5.0E+01
29232-93-7	Pirimiphos-methyl	3.6 E+2		3.6 E+1		3.6E+01
	Polybrominated biphenyls	7.6 E-3		7.6 E-4		7.6E-04
12674-11-2	PCBs (unspeciated mixture, low risk)	9.6 E-1	9.0 E-2	9.0 E-3		9.0E-03
11097-69-1	PCBs (unspeciated mixture, high risk)	3.4 E-2	9.0 E-2	3.4 E-3		3.4E-03
61788-33-8	Polychlorinated terphenyls	1.5 E-2		1.5 E-3		1.5E-03
83-32-9	Acenaphthene	3.7 E+2		3.7 E+1		3.7E+01
120-12-7	Anthracene	1.8 E+3		1.8 E+2		1.8E+02
56-55-3	Benz[a]anthracene	9.2 E-2		9.2 E-3		9.2E-03
205-99-2	Benzo[b]fluoranthene	9.2 E-2		9.2 E-3		9.2E-03
207-08-9	Benzo[k]fluoranthene [a]	5.6 E-2		5.6 E-3		5.6E-03
50-32-8	Benzo[a]pyrene	9.2 E-3	4.0 E-3	4.0 E-4		4.0E-04
218-01-9	Chrysene [a]	5.6 E-1		5.6 E-2		5.6E-02
53-70-3	Dibenz[ah]anthracene	9.2 E-3		9.2 E-4		9.2E-04
206-44-0	Fluoranthene	1.5 E+3		1.5 E+2		1.5E+02
86-73-7	Fluorene	2.4 E+2		2.4 E+1		2.4E+01
193-39-5	Indeno[1,2,3-cd]pyrene	9.2 E-2		9.2 E-3		9.2E-03
91-20-3	Naphthalene [a]	9.3 E-2		9.3 E-3		9.3E-03
129-00-0	Pyrene	1.8 E+2		1.8 E+1		1.8E+01
67747-09-5	Prochloraz	4.5 E-1		4.5 E-2		4.5E-02
26399-36-0	Profluralin	2.2 E+2		2.2 E+1		2.2E+01
1610-18-0	Prometon	5.5 E+2		5.5 E+1		5.5E+01
7287-19-6	Prometryn	1.5 E+2		1.5 E+1		1.5E+01
23950-58-5	Pronamide	2.7 E+3		2.7 E+2		2.7E+02
1918-16-7	Propachlor	4.7 E+2		4.7 E+1		4.7E+01

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CAS No.	Chemical	Tap Water PRG (µg/L)	OEHHA Public Health Goal (µg/L)	Direct Ground-water Exposure Human Health Screening Level (µg/L)	Minimal Risk from Vapor Intrusion (µg/L)	Human Health Screening Level Including Vapor Intrusion (µg/L)
709-98-8	Propanil	1.8 E+2		1.8 E+1		1.8E+01
2312-35-8	Propargite	7.3 E+2		7.3 E+1		7.3E+01
107-19-7	Propargyl alcohol	7.3 E+1		7.3 E+0		7.3E+00
139-40-2	Propazine	7.3 E+2		7.3 E+1		7.3E+01
122-42-9	Propham	7.3 E+2		7.3 E+1		7.3E+01
60207-90-1	Propiconazole	4.7 E+2		4.7 E+1		4.7E+01
103-65-1	n-Propylbenzene	2.4 E+2		2.4 E+1	P	2.4E+01
57-55-6	Propylene glycol	1.8 E+4		1.8 E+3		1.8E+03
52125-53-8	Propylene glycol, monoethyl ether	2.6 E+4		2.6 E+3		2.6E+03
107-98-2	Propylene glycol, monomethyl ether	2.6 E+4		2.6 E+3		2.6E+03
75-56-9	Propylene oxide	2.2 E-1		2.2 E-2		2.2E-02
81335-77-5	Pursuit	9.1 E+3		9.1 E+2		9.1E+02
51630-58-1	Pydrin	9.1 E+2		9.1 E+1		9.1E+01
110-86-1	Pyridine	3.6 E+1		3.6 E+0		3.6E+00
13593-03-8	Quinalphos	1.8 E+1		1.8 E+0		1.8E+00
91-22-5	Quinoline	2.2 E-2		2.2 E-3		2.2E-03
121-82-4	RDX (Cyclonite)	6.1 E-1		6.1 E-2		6.1E-02
10453-86-8	Resmethrin	1.1 E+3		1.1 E+2		1.1E+02
299-84-3	Ronnel	1.8 E+3		1.8 E+2		1.8E+02
83-79-4	Rotenone	1.5 E+2		1.5 E+1		1.5E+01
78587-05-0	Savey	9.1 E+2		9.1 E+1		9.1E+01
7783-00-8	Selenious Acid	1.8 E+2		1.8 E+1		1.8E+01
7782-49-2	Selenium	1.8 E+2		1.8 E+1		1.8E+01
630-10-4	Selenourea	1.8 E+2		1.8 E+1		1.8E+01
74051-80-2	Sethoxydim	3.3 E+3		3.3 E+2		3.3E+02
7440-22-4	Silver and compounds	1.8 E+2		1.8 E+1		1.8E+01
122-34-9	Simazine	5.6 E-1	4.0 E+0	5.6 E-2		5.6E-02
148-18-5	Sodium diethyldithiocarbamate	2.5 E-1		2.5 E-2		2.5E-02
62-74-8	Sodium fluoroacetate	7.3 E-1		7.3 E-2		7.3E-02
13718-26-8	Sodium metavanadate	3.6 E+1		3.6 E+0		3.6E+00
7440-24-6	Strontium, stable	2.2 E+4		2.2 E+3		2.2E+03
57-24-9	Strychnine	1.1 E+1		1.1 E+0		1.1E+00
100-42-5	Styrene	1.6 E+3		1.6 E+2	P	1.6E+02
80-07-9	1,1'-Sulfonylbis (4-chlorobenzene)	1.8 E+2		1.8 E+1		1.8E+01
88671-89-0	Systhane	9.1 E+2		9.1 E+1		9.1E+01
1746-01-6	2,3,7,8-TCDD (dioxin)	4.5 E-7	1.0 E-6	4.5 E-8		4.5E-08
34014-18-1	Tebuthiuron	2.6 E+3		2.6 E+2		2.6E+02
3383-96-8	Temephos	7.3 E+2		7.3 E+1		7.3E+01
5902-51-2	Terbacil	4.7 E+2		4.7 E+1		4.7E+01
13071-79-9	Terbufos	9.1 E-1		9.1 E-2		9.1E-02
886-50-0	Terbutryn	3.6 E+1		3.6 E+0		3.6E+00
95-94-3	1,2,4,5-Tetrachlorobenzene	1.1 E+1		1.1 E+0		1.1E+00
630-20-6	1,1,1,2-Tetrachloroethane	4.3 E-1		4.3 E-2		4.3E-02
79-34-5	1,1,2,2-Tetrachloroethane	5.5 E-2	1.0 E-1	5.5 E-3	P	5.5E-03
127-18-4	Tetrachloroethylene (PCE)	1.0 E-1	6.0 E-2	6.0 E-3	P	6.0E-03
58-90-2	2,3,4,6-Tetrachlorophenol	1.1 E+3		1.1 E+2		1.1E+02
5216-25-1	p,a,a,a-Tetrachlorotoluene	3.4 E-3		3.4 E-4		3.4E-04
961-11-5	Tetrachlorovinphos	2.8 E+0		2.8 E-1		2.8E-01
3689-24-5	Tetraethyldithiopyrophosphate	1.8 E+1		1.8 E+0		1.8E+00
109-99-9	Tetrahydrofuran	1.6 E+0		1.6 E-1	P	1.6E-01
7440-28-0	Thallium and compounds	2.4 E+0	1.0 E-1	1.0 E-2		1.0E-02
28249-77-6	Thiobencarb	3.6 E+2	7.0 E+1	7.0 E+0		7.0E+00
N/A	Thiocyanate	1.8 E+3		1.8 E+2		1.8E+02
39196-18-4	Thiofanox	1.1 E+1		1.1 E+0		1.1E+00
23564-05-8	Thiophanate-methyl	2.9 E+3		2.9 E+2		2.9E+02
137-26-8	Thiram	1.8 E+2		1.8 E+1		1.8E+01
7440-31-5	Tin (inorganic, also see tributyltin oxide)	2.2 E+4		2.2 E+3		2.2E+03
7440-32-6	Titanium	1.5 E+5		1.5 E+4		1.5E+04
108-88-3	Toluene	7.2 E+2	1.5 E+2	1.5 E+1	P	1.5E+01
95-80-7	Toluene-2,4-diamine	2.1 E-2		2.1 E-3		2.1E-03
95-70-5	Toluene-2,5-diamine	2.2 E+4		2.2 E+3		2.2E+03
823-40-5	Toluene-2,6-diamine	7.3 E+3		7.3 E+2		7.3E+02
106-49-0	p-Toluidine	3.5 E-1		3.5 E-2		3.5E-02
8001-35-2	Toxaphene	6.1 E-2	3.0 E-2	3.0 E-3		3.0E-03
66841-25-6	Tralomethrin	2.7 E+2		2.7 E+1		2.7E+01
2303-17-5	Triallate	4.7 E+2		4.7 E+1		4.7E+01

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Aerojet Superfund Site
Sacramento County, California

CAS No.	Chemical	Tap Water PRG (µg/L)	OEHHA Public Health Goal (µg/L)	Direct Ground-water Exposure Human Health Screening Level (µg/L)	Minimal Risk from Vapor Intrusion (µg/L)	Human Health Screening Level Including Vapor Intrusion (µg/L)
82097-50-5	Triasulfuron	3.6 E+2		3.6 E+1		3.6E+01
615-54-3	1,2,4-Tribromobenzene	1.8 E+2		1.8 E+1		1.8E+01
126-73-8	Tributyl phosphate	7.3 E+0		7.3 E-1		7.3E-01
56-35-9	Tributyltin oxide (TBTO)	1.1 E+1		1.1 E+0		1.1E+00
634-93-5	2,4,6-Trichloroaniline	2.0 E+0		2.0 E-1		2.0E-01
33663-50-2	2,4,6-Trichloroaniline hydrochloride	2.3 E+0		2.3 E-1		2.3E-01
120-82-1	1,2,4-Trichlorobenzene	7.2 E+0	5.0 E+0	5.0 E-1	P	5.0E-01
71-55-6	1,1,1-Trichloroethane	3.2 E+3	1.0 E+3	1.0 E+2	P	1.0E+02
79-00-5	1,1,2-Trichloroethane	2.0 E-1	3.0 E-1	2.0 E-2	P	2.0E-02
79-01-6	Trichloroethylene (TCE)	2.8 E-2	8.0 E-1	2.8 E-3	P	2.8E-03
75-69-4	Trichlorofluoromethane	1.3 E+3	7.0 E+2	7.0 E+1	P	7.0E+01
95-95-4	2,4,5-Trichlorophenol	3.6 E+3		3.6 E+2		3.6E+02
88-06-2	2,4,6-Trichlorophenol [a]	9.6 E-1		9.6 E-2		9.6E-02
93-76-5	2,4,5-Trichlorophenoxyacetic Acid	3.6 E+2		3.6 E+1		3.6E+01
93-72-1	2-(2,4,5-Trichlorophenoxy) propionic acid	2.9 E+2	2.5 E+1	2.5 E+0		2.5E+00
598-77-6	1,1,2-Trichloropropane	3.0 E+1		3.0 E+0		3.0E+00
96-18-4	1,2,3-Trichloropropane	5.6 E-3		5.6 E-4		5.6E-04
96-19-5	1,2,3-Trichloropropene	2.2 E+0		2.2 E-1		2.2E-01
58138-08-2	Tridiphane	1.1 E+2		1.1 E+1		1.1E+01
121-44-8	Triethylamine	1.2 E+1		1.2 E+0		1.2E+00
1582-09-8	Trifluralin	8.7 E+0		8.7 E-1		8.7E-01
552-30-7	Trimellitic Anhydride (TMAN)	5.1 E+0		5.1 E-1		5.1E-01
95-63-6	1,2,4-Trimethylbenzene	1.2 E+1		1.2 E+0	P	1.2E+00
108-67-8	1,3,5-Trimethylbenzene	1.2 E+1		1.2 E+0	P	1.2E+00
512-56-1	Trimethyl phosphate	1.8 E+0		1.8 E-1		1.8E-01
99-35-4	1,3,5-Trinitrobenzene	1.1 E+3		1.1 E+2		1.1E+02
479-45-8	Trinitrophenylmethylnitramine	3.6 E+2		3.6 E+1		3.6E+01
118-96-7	2,4,6-Trinitrotoluene	2.2 E+0		2.2 E-1		2.2E-01
791-28-6	Triphenylphosphine oxide	7.3 E+2		7.3 E+1		7.3E+01
115-96-8	Tris(2-chloroethyl) phosphate	4.8 E+0		4.8 E-1		4.8E-01
78-42-2	Tris(2-ethylhexyl) phosphate	2.1 E+1		2.1 E+0		2.1E+00
7440-61-1	Uranium (chemical toxicity only)	7.3 E+0	5.0 E-1	5.0 E-2		5.0E-02
7440-62-2	Vanadium and compounds	3.6 E+1		3.6 E+0		3.6E+00
1929-77-7	Vernam	3.6 E+1		3.6 E+0		3.6E+00
50471-44-8	Vinclozolin	9.1 E+2		9.1 E+1		9.1E+01
108-05-4	Vinyl acetate	4.1 E+2		4.1 E+1		4.1E+01
593-60-2	Vinyl bromide (bromoethene)	1.0 E-1		1.0 E-2		1.0E-02
75-01-4	Vinyl chloride (child/adult)	2.0 E-2	5.0 E-2	2.0 E-3	P	2.0E-03
81-81-2	Warfarin	1.1 E+1		1.1 E+0		1.1E+00
1330-20-7	Xylenes	2.1 E+2	1.8 E+3	2.1 E+1	P	2.1E+01
7440-66-6	Zinc	1.1 E+4		1.1 E+3		1.1E+03
1314-84-7	Zinc phosphide	1.1 E+1		1.1 E+0		1.1E+00
12122-67-7	Zineb	1.8 E+3		1.8 E+2		1.8E+02

Key:

Screening levels are one-tenth the lower of the carcinogenic Preliminary Remediation Goal (PRG), non-carcinogenic PRG, or public health goal.

If a California Modified PRG was identified for a compound, the lower of the Cal-modified PRG or standard PRG was used.

[a] = Indicates the California Modified PRG was used to develop the screening value.
P = Pending results of the Johnson and Ettinger model calibration study.
COPC = Chemical of potential concern
µg/L = Micrograms per liter
OEHHA = Office of Environmental Health Hazard Assessment

Sources:

United States Environmental Protection Agency (USEPA) Region 9 Preliminary Remediation Goals (PRGs), Version 9, October 2004.
Stanford J. Smucker Ph.D., USEPA Region IX, Technical Support Section (SFD-8-4), 75 Hawthorne Street, San Francisco, CA 94105-3901.
OEHHA Public Health Goals (PHGs), http://www.oehha.ca.gov/water/phg/allphgs.html

Table 2-3 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Groundwater
Zone 1
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
Zone 1	630-20-6	1,1,1,2-Tetrachloroethane	ND	ND	µg/L	ND	38	0	0.0%	1 - 50	4.3E-02	ca	N	ND*
	71-55-6	1,1,1-Trichloroethane	0.5	2.3	µg/L	30101	1949	14	0.7%	0.5 - 100	1.0E+02	nc	N	BSL/FOD
	79-34-5	1,1,2,2-Tetrachloroethane	2.3	2.3	µg/L	1569	1943	1	0.1%	0.5 - 100	5.5E-03	ca	Y	
	79-00-5	1,1,2-Trichloroethane	0.51	110 (J)	µg/L	1361	1944	31	1.6%	0.5 - 100	2.0E-02	ca	Y	
	75-34-3	1,1-Dichloroethane	0.51	14	µg/L	1379	1944	338	17.4%	0.5 - 100	2.0E-01	nc	Y	
	75-35-4	1,1-Dichloroethylene	0.51	110 (D)	µg/L	30101	1950	513	26.3%	0.5 - 100	1.0E+00	nc	Y	
	563-58-6	1,1-Dichloropropene	ND	ND	µg/L	ND	38	0	0.0%	1 - 50	2.0E-02	ca	N	ND*
		1-Ethyl-2,3-dimethylcyclohexane	4.5 (NJ)	4.5 (NJ)	µg/L	1374	1	1	100.0%	0 - 0	NA		N	TIC
		1-Indanone	4.8 (NJ)	4.8 (NJ)	µg/L	30195	1	1	100.0%	0 - 0	NA		N	TIC
	87-61-6	1,2,3-Trichlorobenzene	ND	ND	µg/L	ND	38	0	0.0%	1 - 50	5.0E-01	nc	N	ND*
	96-18-4	1,2,3-Trichloropropane	ND	ND	µg/L	ND	38	0	0.0%	1 - 50	5.6E-04	ca	N	ND*
	120-82-1	1,2,4-Trichlorobenzene	ND	ND	µg/L	ND	691	0	0.0%	1 - 50	5.0E-01	nc	N	ND*
	95-63-6	1,2,4-Trimethylbenzene	ND	ND	µg/L	ND	38	0	0.0%	1 - 50	1.2E+00	nc	N	ND*
	96-12-8	1,2-Dibromo-3-chloropropane	ND	ND	µg/L	ND	38	0	0.0%	1 - 50	1.6E-04	ca	N	ND*
	106-93-4	1,2-Dibromoethane (EDB)	ND	ND	µg/L	ND	71	0	0.0%	0.5 - 100	5.6E-04	ca	N	ND*
	95-50-1	o-Dichlorobenzene	ND	ND	µg/L	ND	763	0	0.0%	0.5 - 100	3.7E+01	nc	N	ND*
	1121-21-7	1,2-Dichlorocyclohexane	8.2 (NJ)	11 (NJ)	µg/L	1471	8	8	100.0%	0 - 0	NA		N	TIC
	107-06-2	1,2-Dichloroethane	0.5	100	µg/L	30102	1950	168	8.6%	0.5 - 100	1.2E-02	ca	Y	
	540-59-0	1,2-Dichloroethene (cis/trans)	0.5	150	µg/L	1403 30101	1833	625	34.1%	0.5 - 5	6.0E+00	nc	Y	
	78-87-5	1,2-Dichloropropane	ND	ND	µg/L	ND	1944	0	0.0%	0.5 - 100	1.6E-02	ca*	N	ND*
	122-66-7	1,2-Diphenylhydrazine (as Azobenzene)	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	6.1E-02	ca	N	ND*
	108-67-8	1,3,5-Trimethylbenzene	ND	ND	µg/L	ND	38	0	0.0%	1 - 50	1.2E+00	nc	N	ND*
	541-73-1	m-Dichlorobenzene	ND	ND	µg/L	ND	763	0	0.0%	0.5 - 100	1.8E+01	nc	N	ND*
	142-28-9	1,3-Dichloropropane	ND	ND	µg/L	ND	38	0	0.0%	1 - 50	1.2E+01	nc	N	ND*
	106-46-7	p-Dichlorobenzene	ND	ND	µg/L	ND	763	0	0.0%	0.5 - 100	5.0E-02	ca	N	ND*
	123-91-1	1,4-Dioxane	1.5	37	µg/L	1379	659	72	10.9%	0.96 - 10	6.1E-01	ca	Y	
	872-50-4	1-Methyl-2-Pyrrolidinone	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	NA		N	ND
	122-00-9	1-(4-methylphenyl)ethanone	4.2 (NJ)	4.2 (NJ)	µg/L	30195	1	1	100.0%	0 - 0	NA		N	TIC
		2-Ethyl-1-hexanol	4.9 (NJ)	15 (NJ)	µg/L	1470	11	11	100.0%	0 - 0	NA		N	TIC
	149-57-5	2-ethylhexanoic acid	5.4 (NJ)	33 (NJ)	µg/L	1373	8	8	100.0%	0 - 0	NA		N	TIC
	594-20-7	2,2-Dichloropropane	ND	ND	µg/L	ND	38	0	0.0%	1 - 50	1.2E+01	nc	N	ND*
	95-95-4	2,4,5-Trichlorophenol	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	3.6E+02	nc	N	ND
	88-06-2	2,4,6-Trichlorophenol	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	9.6E-02	nc**	N	ND*
	120-83-2	2,4-Dichlorophenol	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	1.1E+01	nc	N	ND
	105-67-9	2,4-Dimethylphenol	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	7.3E+01	nc	N	ND
	51-28-5	2,4-Dinitrophenol	ND	ND	µg/L	ND	653	0	0.0%	50 - 50	7.3E+00	nc	N	ND*
	121-14-2	2,4-Dinitrotoluene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	7.3E+00	nc	N	ND*
	606-20-2	2,6-Dinitrotoluene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	3.6E+00	nc	N	ND*
	110-75-8	2-Chloroethylvinyl ether	ND	ND	µg/L	ND	69	0	0.0%	5 - 1000	NA		N	ND
	91-58-7	2-Chloronaphthalene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	4.9E+01	nc	N	ND
	95-57-8	2-Chlorophenol	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	3.0E+00	nc	N	ND*
	95-49-8	o-Chlorotoluene	ND	ND	µg/L	ND	38	0	0.0%	1 - 50	1.2E+01	nc	N	ND*
	591-78-6	2-Hexanone	ND	ND	µg/L	ND	57	0	0.0%	10 - 500	2.0E+02	nc	N	ND*
	91-57-6	2-Methylnaphthalene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	9.3E-03	ca	N	ND*

Table 2-3 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Groundwater
Zone 1
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
Zone 1	88-74-4	o-Nitroaniline	ND	ND	µg/L	ND	653	0	0.0%	50 - 50	1.1E+01	nc	N	ND*
	88-75-5	o-Nitrophenol	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	NA		N	ND
	128-37-0	2,6-Di-tert-butyl-4-methyl phenol	6.3 (NJ)	6.3 (NJ)	µg/L	30101	1	1	100.0%	0 - 0	NA		N	TIC
	91-94-1	3,3-Dichlorobenzidine	ND	ND	µg/L	ND	653	0	0.0%	50 - 50	1.5E-02	ca	N	ND*
	99-09-2	m-Nitroaniline	ND	ND	µg/L	ND	653	0	0.0%	50 - 50	3.2E-01	ca**	N	ND*
	534-52-1	4,6-Dinitro-2-methylphenol	ND	ND	µg/L	ND	653	0	0.0%	50 - 50	3.6E-01	nc	N	ND*
	101-55-3	4-Bromophenyl phenyl ether	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	NA		N	ND
	59-50-7	4-Chloro-3-methylphenol	ND	ND	µg/L	ND	653	0	0.0%	20 - 20	NA		N	ND
	106-47-8	p-Chloroaniline	ND	ND	µg/L	ND	653	0	0.0%	50 - 50	1.5E+01	nc	N	ND*
	7005-72-3	4-Chlorophenyl phenyl ether	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	NA		N	ND
	106-43-4	p-Chlorotoluene	ND	ND	µg/L	ND	38	0	0.0%	1 - 50	1.2E+01	nc	N	ND*
	106-44-5	4-Methylphenol	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	1.8E+01	nc	N	ND
	100-01-6	p-Nitroaniline	ND	ND	µg/L	ND	653	0	0.0%	50 - 50	3.2E-01	ca*	N	ND*
	100-02-7	p-Nitrophenol	ND	ND	µg/L	ND	653	0	0.0%	50 - 50	NA		N	ND
	83-32-9	Acenaphthene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	3.7E+01	nc	N	ND
	208-96-8	Acenaphthylene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	3.7E+01	nc	N	ND
	67-64-1	Acetone	22	22	µg/L	30195	57	1	1.8%	10 - 500	5.5E+02	nc	N	BSL/FOD
	98-86-2	Acetophenone	13 (NJ)	13 (NJ)	µg/L	30195	1	1	100.0%	0 - 0	NA		N	TIC
	107-02-8	Acrolein	ND	ND	µg/L	ND	19	0	0.0%	25 - 25	4.2E-03	nc	N	ND*
	107-13-1	Acrylonitrile	ND	ND	µg/L	ND	19	0	0.0%	25 - 25	1.1E-03	ca*	N	ND*
	7429-90-5	Aluminum	210	1000 (J)	µg/L	30179	19	4	21.1%	0 - 0	6.0E+01	nc	Y	
	62-53-3	Aniline	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	1.2E+00	ca*	N	ND*
	120-12-7	Anthracene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	1.8E+02	nc	N	ND
	7440-36-0	Antimony	ND	ND	µg/L	ND	19	0	0.0%	0 - 0	1.5E+00	nc	N	ND
	7440-38-2	Arsenic	ND	ND	µg/L	ND	19	0	0.0%	0 - 0	4.0E-04	ca	N	ND*
	7440-39-3	Barium	26	590 (J)	µg/L	30179	19	19	100.0%	0 - 0	2.0E+02	nc	Y	
	71-43-2	Benzene	ND	ND	µg/L	ND	79	0	0.0%	0.5 - 50	1.5E-02	ca	N	ND*
	92-87-5	Benzidine	ND	ND	µg/L	ND	653	0	0.0%	50 - 50	2.9E-05	ca	N	ND*
	56-55-3	Benzo(a)anthracene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	9.2E-03	ca	N	ND*
	50-32-8	Benzo(a)pyrene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	4.0E-04	ca	N	ND*
	205-99-2	Benzo(b)fluoranthene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	9.2E-03	ca	N	ND*
	191-24-2	Benzo(ghi)perylene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	1.8E+01	nc	N	ND
	207-08-9	Benzo(k)fluoranthene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	5.6E-03	ca	N	ND*
	65-85-0	Benzoic acid	ND	ND	µg/L	ND	653	0	0.0%	50 - 50	1.5E+04	nc	N	ND
	95-16-9	Benzothiazole	7.4 (NJ)	7.4 (NJ)	µg/L	30195	1	1	100.0%	0 - 0	NA		N	TIC
	100-51-6	Benzyl alcohol	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	1.1E+03	nc	N	ND
	85-68-7	butyl Benzyl phthalate	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	7.3E+02	nc	N	ND
	7440-41-7	Beryllium	ND	ND	µg/L	ND	19	0	0.0%	0 - 0	1.0E-01	nc	N	ND
	111-91-1	Bis(2-chloroethoxy)methane	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	NA		N	ND
	111-44-4	Bis(2-chloroethyl)ether	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	1.0E-03	ca	N	ND*
	108-60-1	Bis(2-chloroisopropyl)ether	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	2.7E-02	ca	N	ND*
	117-81-7	Bis(2-ethylhexyl)phthalate (BEHP)	ND	ND	µg/L	ND	653	0	0.0%	50 - 50	4.8E-01	ca	N	ND*
	7440-42-8	Boron	160	1200	µg/L	30179	19	2	10.5%	0 - 0	7.3E+02	nc	Y	
	108-86-1	Bromobenzene	ND	ND	µg/L	ND	38	0	0.0%	1 - 50	2.0E+00	nc	N	ND*

Table 2-3 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Groundwater
Zone 1
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
Zone 1	74-97-5	Bromochloromethane	ND	ND	µg/L	ND	38	0	0.0%	1 - 50	NA		N	ND
	75-27-4	Bromodichloromethane	0.52	4.1	µg/L	1049	1944	6	0.3%	0.5 - 100	1.8E-02	ca	Y	
	75-25-2	Bromoform	0.7	0.7	µg/L	4330	1944	1	0.1%	0.5 - 100	8.5E-01	ca	N	BSL/FOD
	96-48-0	Butyrolacetone	9.6 (NJ)	9.6 (NJ)	µg/L	1387	1	1	100.0%	0 - 0	NA		N	TIC
	74-83-9	Methyl bromide	ND	ND	µg/L	ND	129	0	0.0%	0.5 - 354	8.7E-01	nc	N	ND*
	7440-43-9	Cadmium	ND	ND	µg/L	ND	19	0	0.0%	0 - 0	4.0E-03	nc	N	ND
	2223-93-0	Cadmium Stearate	4.1 (NJ)	6.8 (NJ)	µg/L	1374	3	3	100.0%	0 - 0	NA		N	TIC
	7440-70-2	Calcium	5900 (J)	240000	µg/L	30195	19	19	100.0%	0 - 0	NA		N	EN
	75-15-0	Carbon disulfide	ND	ND	µg/L	ND	57	0	0.0%	5 - 500	1.0E+02	nc	N	ND*
	56-23-5	Carbon tetrachloride	0.51	5.9 (J)	µg/L	30101	1944	159	8.2%	0.5 - 100	1.0E-02	ca*	Y	
	108-90-7	Chlorobenzene	ND	ND	µg/L	ND	1944	0	0.0%	0.5 - 100	1.1E+01	nc	N	ND*
	75-00-3	Chloroethane	ND	ND	µg/L	ND	129	0	0.0%	0.5 - 156	4.6E-01	ca	N	ND*
	67-66-3	Chloroform	0.5	35	µg/L	1049	1950	304	15.6%	0.5 - 100	1.7E-02	ca	Y	
	74-87-3	Chloromethane	0.92	1.4	µg/L	30100	129	2	1.6%	0.5 - 100	1.6E+01	ca	N	BSL/FOD
	7440-47-3	Chromium	11	140	µg/L	30195	19	2	10.5%	0 - 0	5.5E+03	nc	N	BSL
	218-01-9	Chrysene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	5.6E-02	ca	N	ND*
	156-59-2	cis-1,2-Dichloroethylene	1	130 (D)	µg/L	30101	112	36	32.1%	0.5 - 50	6.1E+00	nc	Y	
	10061-01-5	cis-1,3-Dichloropropene	ND	ND	µg/L	ND	129	0	0.0%	0.5 - 102	2.0E-02	ca	N	ND*
	7440-48-4	Cobalt	ND	ND	µg/L	ND	19	0	0.0%	0 - 0	7.3E+01	nc	N	ND
	7440-50-8	Copper	6.3 (J)	23	µg/L	30195	19	2	10.5%	0 - 0	1.7E+01	nc	Y	
	53-70-3	Dibenzo(a,h)anthracene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	9.2E-04	ca	N	ND*
	132-64-9	Dibenzofuran	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	1.2E+00	nc	N	ND*
	124-48-1	Dibromochloromethane	1.4	3.9	µg/L	30176	1944	2	0.1%	0.5 - 100	1.3E-02	ca	Y	
	74-95-3	Dibromomethane	ND	ND	µg/L	ND	38	0	0.0%	1 - 50	6.1E+00	nc	N	ND*
	75-71-8	Dichlorodifluoromethane	ND	ND	µg/L	ND	1944	0	0.0%	0.5 - 543	3.9E+01	nc	N	ND*
	84-66-2	Diethyl phthalate	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	2.9E+03	nc	N	ND
	AER-001-070	Dimexano	4.1 (NJ)	18 (NJ)	µg/L	1590	17	17	100.0%	0 - 0	NA		N	TIC
	131-11-3	Dimethyl phthalate	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	3.6E+04	nc	N	ND
	84-74-2	Di-n-butyl phthalate	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	3.6E+02	nc	N	ND
	117-84-0	Di-n-octyl phthalate	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	1.5E+02	nc	N	ND
	127-63-9	Diphenyl Sulfone	4.6 (NJ)	11 (NJ)	µg/L	1374	3	3	100.0%	0 - 0	NA		N	TIC
	2440-22-4	Drometrizole	7.2 (NJ)	7.2 (NJ)	µg/L	1470	1	1	100.0%	0 - 0	NA		N	TIC
	100-41-4	Ethylbenzene	ND	ND	µg/L	ND	79	0	0.0%	0.5 - 50	3.0E+01	nc	N	ND*
	206-44-0	Fluoranthene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	1.5E+02	nc	N	ND
	86-73-7	Fluorene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	2.4E+01	nc	N	ND
	76-13-1	Freon 113	0.5	400 (D)	µg/L	1381	1944	263	13.5%	0.5 - 500	4.0E+02	nc	Y	
	118-74-1	Hexachlorobenzene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	3.0E-03	ca	N	ND*
	87-68-3	Hexachlorobutadiene	ND	ND	µg/L	ND	691	0	0.0%	1 - 50	8.6E-02	ca*	N	ND*
	77-47-4	Hexachlorocyclopentadiene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	5.0E+00	nc	N	ND*
	67-72-1	Hexachloroethane	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	4.8E-01	ca**	N	ND*
	18540-29-9	Chromium (Hexavalent)	78.0	78.0	µg/L	30195	19	1	5.3%	0 - 0	1.1E+01	nc	Y	
	193-39-5	Indeno(1,2,3-cd)pyrene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	9.2E-03	ca	N	ND*
	485-43-8	Iridomyrmecin	4.3 (NJ)	4.3 (NJ)	µg/L	1567	1	1	100.0%	0 - 0	NA		N	TIC
	7439-89-6	Iron	1200	1400 (J)	µg/L	30179	19	2	10.5%	0 - 0	1.1E+03	nc	Y	

Table 2-3 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Groundwater
Zone 1
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
Zone 1	78-59-1	Isophorone	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	7.1E+00	ca	N	ND*
	98-82-8	Isopropylbenzene	ND	ND	µg/L	ND	38	0	0.0%	1 - 50	6.6E+01	nc	N	ND
	7439-92-1	Lead	ND	ND	µg/L	ND	19	0	0.0%	0 - 0	2.0E-01		N	ND
	7439-95-4	Magnesium	780	11000	µg/L	30156 4585	19	18	94.7%	0 - 0	NA		N	EN
	7439-96-5	Manganese	5.1	47	µg/L	30176	19	11	57.9%	0 - 0	8.8E+01	nc	N	BSL
	7439-97-6	Mercury	ND	ND	µg/L	ND	19	0	0.0%	0 - 0	1.2E-01	nc	N	ND
	78-93-3	Methyl ethyl ketone	ND	ND	µg/L	ND	57	0	0.0%	10 - 500	7.0E+02	nc	N	ND
	108-10-1	Methyl isobutyl ketone (MIBK)	ND	ND	µg/L	ND	57	0	0.0%	10 - 500	2.0E+02	nc	N	ND*
	1634-04-4	Methyl tert-butyl ether	ND	ND	µg/L	ND	38	0	0.0%	1 - 50	1.1E+00	ca	N	ND*
	75-09-2	Methylene chloride	0.54	4.3	µg/L	1381	1944	7	0.4%	0.5 - 200	4.0E-01	ca	Y	
	7439-98-7	Molybdenum	77	810	µg/L	30195	19	2	10.5%	0 - 0	1.8E+01	nc	Y	
	108-38-3	m,p-Xylenes	ND	ND	µg/L	ND	38	0	0.0%	1 - 50	2.1E+01	nc	N	ND*
	91-20-3	Naphthalene	ND	ND	µg/L	ND	691	0	0.0%	1 - 50	9.3E-03	ca	N	ND*
	104-51-8	n-Butylbenzene	ND	ND	µg/L	ND	38	0	0.0%	1 - 50	2.4E+01	nc	N	ND*
	3622-84-2	N-Butylbenzenesulfonamide	120	7100 (D)	µg/L	1374	653	49	7.5%	10 - 10	NA		Y	
	1907-65-9	N-Butyl-4-methylbenzenesulfonamide	4 (NJ)	4 (NJ)	µg/L	1374	1	1	100.0%	0 - 0	NA		N	TIC
	7440-02-0	Nickel	ND	ND	µg/L	ND	19	0	0.0%	0 - 0	1.2E+00	nc	N	ND
	S-NANO3	Nitrate	240	5300	µg/L	30197	19	18	94.7%	0 - 0	1.0E+03	nc	Y	
	GIS-230-001	Nitrite (as N)	92	320	µg/L	30195	19	3	15.8%	0 - 0	1.0E+02	nc	Y	
	98-95-3	Nitrobenzene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	3.4E-01	nc	N	ND*
	62-75-9	N-Nitrosodimethylamine	0.002	0.012	µg/L	30195	697	3	0.4%	0.005 - 10	1.3E-04	ca	Y	
	621-64-7	N-Nitrosodipropylamine	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	9.6E-04	ca	N	ND*
	86-30-6	N-Nitrosodiphenylamine	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	1.4E+00	ca*	N	ND*
	57-10-3	Palmitic acid	5.7 (NJ)	14 (NJ)	µg/L	1374	4	2	50.0%	0 - 0	NA		N	TIC
	103-65-1	n-Propylbenzene	ND	ND	µg/L	ND	38	0	0.0%	1 - 50	2.4E+01	nc	N	ND*
	95-47-6	o-Xylene	ND	ND	µg/L	ND	40	0	0.0%	1 - 50	2.1E+01	nc	N	ND*
	87-86-5	Pentachlorophenol	ND	ND	µg/L	ND	653	0	0.0%	50 - 50	4.0E-02	ca	N	ND*
	14797-73-0	Perchlorate	4.2	220	µg/L	1163	407	152	37.3%	1 - 20	3.6E-01	ca/nc	Y	
	85-01-8	Phenanthrene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	1.8E+01	nc	N	ND
	108-95-2	Phenol	10 (J)	14	µg/L	30195	653	2	0.3%	10 - 10	1.1E+03	nc	N	BSL/FOD
	7440-09-7	Potassium	2400	37000	µg/L	30195	19	19	100.0%	0 - 0	NA		N	EN
	129-00-0	Pyrene	ND	ND	µg/L	ND	653	0	0.0%	10 - 10	1.8E+01	nc	N	ND
	90-02-8	Salicylaldehyde	4.2 (NJ)	4.2 (NJ)	µg/L	30195	1	1	100.0%	0 - 0	NA		N	TIC
	69-72-7	Salicylic acid	93 (NJ)	93 (NJ)	µg/L	30195	1	1	100.0%	0 - 0	NA		N	TIC
	135-98-8	sec-Butylbenzene	ND	ND	µg/L	ND	38	0	0.0%	1 - 50	2.4E+01	nc	N	ND*
	7782-49-2	Selenium	ND	ND	µg/L	ND	19	0	0.0%	0 - 0	1.8E+01	nc	N	ND
	7440-22-4	Silver	33 (J)	33 (J)	µg/L	30158	19	1	5.3%	0 - 0	1.8E+01	nc	Y	
	7440-23-5	Sodium	6700	130000	µg/L	30195	19	19	100.0%	0 - 0	NA		N	EN
	57-11-4	Stearic Acid	4.7 (NJ)	4.7 (NJ)	µg/L	1394	1	1	100.0%	0 - 0	NA		N	TIC
	100-42-5	Styrene	ND	ND	µg/L	ND	57	0	0.0%	1 - 50	1.6E+02	nc	N	ND
	98-06-6	tert-Butylbenzene	ND	ND	µg/L	ND	38	0	0.0%	1 - 50	2.4E+01	nc	N	ND*
	127-18-4	Tetrachloroethylene	0.5	56	µg/L	1376	1963	425	21.7%	0.5 - 100	6.0E-03	ca	Y	
	7440-28-0	Thallium	ND	ND	µg/L	ND	20	0	0.0%	0 - 0	1.0E-02	nc	N	ND
	108-88-3	Toluene	4.4	11 (NJB)	µg/L	1385	110	31	28.2%	0.5 - 50	1.5E+01	nc	Y	

Table 2-3 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Groundwater
Zone 1
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
Zone 1	99-04-7	m-Toluic acid	7 (NJ)	7 (NJ)	µg/L	30195	1	1	100.0%	0 - 0	NA		N	TIC
	118-90-1	o-Toluic acid	4.1 (NJ)	4.1 (NJ)	µg/L	30195	1	1	100.0%	0 - 0	NA		N	TIC
	156-60-5	trans-1,2-Dichloroethylene	1.5	4.9	µg/L	30101	112	3	2.7%	0.5 - 100	6.0E+00	nc	N	BSL/FOD
	10061-02-6	trans-1,3-Dichloropropene	ND	ND	µg/L	ND	129	0	0.0%	0.5 - 100	2.0E-02	ca	N	ND*
	79-01-6	Trichloroethylene	0.5	3700 (D)	µg/L	30101	1989	1234	62.0%	0.5 - 5	2.8E-03	ca	Y	
	75-69-4	Trichlorofluoromethane	0.51	2.7	µg/L	1385	1945	9	0.5%	0.5 - 500	7.0E+01	nc	N	BSL/FOD
		Triethyl phosphate	4.2 (NJ)	4.2 (NJ)	µg/L	1399	1	1	100.0%	0 - 0	NA		N	TIC
	7440-62-2	Vanadium	7.3	37	µg/L	30176	19	8	42.1%	0 - 0	3.6E+00	nc	Y	
	108-05-4	Vinyl Acetate	ND	ND	µg/L	ND	57	0	0.0%	20 - 1000	4.1E+01	nc	N	ND*
	75-01-4	Vinyl chloride	0.57	1.3	µg/L	4330	1949	7	0.4%	0.5 - 100	2.0E-03	ca	Y	
	1330-20-7	Xylene (total)	ND	ND	µg/L	ND	41	0	0.0%	0.5 - 10	2.1E+01	nc	N	ND
	7440-66-6	Zinc	110	460	µg/L	30158	19	2	10.5%	0 - 0	1.1E+03	nc	N	BSL

Footnotes:
(1) See Table 2-2
(2) FOD = Frequency of detection screening
BSL = Below screening level
TIC = Tentatively identified compound
EN = Essential Nutrient
ND = Not detected above the reporting limit
* = Some of the detection limits are elevated (i.e., half the reporting limit above screening level)
PM = Individual toxic compounds associated with the mixture are assessed separately.

Key:
ca = Cancer
COPC = Chemical of potential concern
µg/L = Micrograms per liter
nc = Noncancer
ND = Not detected

Chemical	Surrogate
1,1-Dichloropropene	1,3-Dichloropropene
1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene
2,2-Dichloropropane	1,2-Dichloropropane
2-Hexanone	Methyl isobutyl ketone
2-methlynaphthalene	Naphthalene
4-Chlorotoluene	2-Chlorotoluene
Acenaphthalene	Acenaphthene
Benzo (b & k) fluoranthene (total)	Benzo (k) fluoranthene
Benzo(ghi)perylene	Pyrene
cis-1,3-Dichloropropene	1,3-Dichloropropene
cis-1,3-Dichloropropene	1,3-Dichloropropene
Phenanthrene	Pyrene

Table 2-4 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Groundwater
Zone 2
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
Zone 2	71-55-6	1,1,1-Trichloroethane	ND	ND	µg/L	ND	41	0	0.0%	0.5 - 5	1.0E+02	nc	N	ND
	79-34-5	1,1,2,2-Tetrachloroethane	ND	ND	µg/L	ND	41	0	0.0%	0.5 - 5	5.5E-03	ca	N	ND*
	79-00-5	1,1,2-Trichloroethane	ND	ND	µg/L	ND	41	0	0.0%	0.5 - 5	2.0E-02	ca	N	ND*
	75-34-3	1,1-Dichloroethane	ND	ND	µg/L	ND	41	0	0.0%	0.5 - 5	2.0E-01	nc	N	ND*
	75-35-4	1,1-Dichloroethylene	ND	ND	µg/L	ND	41	0	0.0%	0.5 - 5	1.0E+00	nc	N	ND
	95-50-1	1,2-Dichlorobenzene	ND	ND	µg/L	ND	11	0	0.0%	0.5 - 0.5	3.7E+01	nc	N	ND
	107-06-2	1,2-Dichloroethane	3.9	3.9	µg/L	3512	41	1	2.4%	0.5 - 5	1.2E-02	ca	Y	
	540-59-0	1,2-Dichloroethene (cis/trans)	0.61	53	µg/L	3500	31	4	12.9%	0.5 - 5	6.0E+00	nc	Y	
	78-87-5	1,2-Dichloropropane	ND	ND	µg/L	ND	41	0	0.0%	0.5 - 5	1.6E-02	ca*	N	ND*
	541-73-1	1,3-Dichlorobenzene	ND	ND	µg/L	ND	11	0	0.0%	0.5 - 0.5	1.8E+01	nc	N	ND
	541-73-1	1,4-Dichlorobenzene	ND	ND	µg/L	ND	11	0	0.0%	0.5 - 0.5	5.0E-02	ca	N	ND*
	591-78-6	2-Hexanone	ND	ND	µg/L	ND	22	0	0.0%	20 - 20	2.0E+02	nc	N	ND
	67-64-1	Acetone	ND	ND	µg/L	ND	23	0	0.0%	20 - 20	5.5E+02	nc	N	ND
	107-02-8	Acrolein	ND	ND	µg/L	ND	22	0	0.0%	25 - 25	4.2E-03	nc	N	ND*
	107-13-1	Acrylonitrile	ND	ND	µg/L	ND	22	0	0.0%	25 - 25	1.1E-03	ca*	N	ND*
	7429-90-5	Aluminum	ND	ND	µg/L	ND	9	0	0.0%	200 - 200	6.0E+01	nc	N	ND*
	7440-36-0	Antimony	ND	ND	µg/L	ND	10	0	0.0%	3 - 200	1.5E+00	nc	N	ND*
	7440-38-2	Arsenic	ND	ND	µg/L	ND	9	0	0.0%	80 - 80	4.0E-04	ca	N	ND*
	7440-39-3	Barium	44	59	µg/L	109	9	9	100.0%	0 - 0	2.0E+02	nc	N	BSL
	71-43-2	Benzene	ND	ND	µg/L	ND	33	0	0.0%	0.5 - 5	1.5E-02	ca	N	ND*
	7440-41-7	Beryllium	ND	ND	µg/L	ND	10	0	0.0%	0.25 - 1	1.0E-01	nc	N	ND*
	7440-42-8	Boron	ND	ND	µg/L	ND	9	0	0.0%	40 - 40	7.3E+02	nc	N	ND
	75-27-4	Bromodichloromethane	ND	ND	µg/L	ND	41	0	0.0%	0.5 - 5	1.8E-02	ca	N	ND*
	75-25-2	Bromoform	ND	ND	µg/L	ND	41	0	0.0%	0.5 - 5	8.5E-01	ca	N	ND
	74-83-9	Methyl bromide	ND	ND	µg/L	ND	27	0	0.0%	1 - 10	8.7E-01	nc	N	ND
	7440-43-9	Cadmium	ND	ND	µg/L	ND	9	0	0.0%	4 - 4	4.0E-03	nc	N	ND*
	7440-70-2	Calcium	17000	23000	µg/L	109	9	9	100.0%	0 - 0	NA		N	EN
	75-15-0	Carbon disulfide	ND	ND	µg/L	ND	22	0	0.0%	5 - 5	1.0E+02	nc	N	ND
	56-23-5	Carbon tetrachloride	ND	ND	µg/L	ND	41	0	0.0%	0.5 - 5	1.0E-02	ca*	N	ND*
	108-90-7	Chlorobenzene	ND	ND	µg/L	ND	41	0	0.0%	0.5 - 5	1.1E+01	nc	N	ND
	75-00-3	Chloroethane	ND	ND	µg/L	ND	27	0	0.0%	0.5 - 10	4.6E-01	ca	N	ND*
	67-66-3	Chloroform	0.61	0.63	µg/L	3078	41	2	4.9%	0.5 - 5	1.7E-02	ca	Y	
	74-87-3	Chloromethane	ND	ND	µg/L	ND	27	0	0.0%	0.5 - 10	1.6E+01	ca	N	ND
	7440-47-3	Chromium	ND	ND	µg/L	ND	9	0	0.0%	8 - 8	5.5E+03	nc	N	ND
	156-59-2	cis-1,2-Dichloroethylene	ND	ND	µg/L	ND	10	0	0.0%	0.5 - 5	6.1E+00	nc	N	ND
	10061-01-5	cis-1,3-Dichloropropene	ND	ND	µg/L	ND	27	0	0.0%	0.5 - 5	2.0E-02	ca	N	ND*

Table 2-4 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Groundwater
Zone 2
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
Zone 2	7440-48-4	Cobalt	ND	ND	µg/L	ND	9	0	0.0%	8 - 8	7.3E+01	nc	N	ND
	7440-50-8	Copper	8	26	µg/L	109	9	2	22.2%	6 - 6	1.7E+01	nc	Y	
	124-48-1	Dibromochloromethane	ND	ND	µg/L	ND	41	0	0.0%	0.5 - 5	1.3E-02	ca	N	ND*
	75-71-8	Dichlorodifluoromethane	ND	ND	µg/L	ND	41	0	0.0%	0.5 - 10	3.9E+01	nc	N	ND
	100-41-4	Ethylbenzene	ND	ND	µg/L	ND	33	0	0.0%	0.5 - 5	3.0E+01	nc	N	ND
	76-13-1	Freon 113	ND	ND	µg/L	ND	41	0	0.0%	0.5 - 5	4.0E+02	nc	N	ND
	7439-89-6	Iron	330	10000	µg/L	109	9	7	77.8%	300 - 300	1.1E+03	nc	Y	
	7439-92-1	Lead	ND	ND	µg/L	ND	10	0	0.0%	2 - 60	2.0E-01		N	ND*
	7439-95-4	Magnesium	12000	15000	µg/L	109	9	9	100.0%	0 - 0	NA		N	EN
	7439-96-5	Manganese	11	180	µg/L	109	9	7	77.8%	5 - 5	8.8E+01	nc	Y	
	7439-97-6	Mercury	ND	ND	µg/L	ND	2	0	0.0%	0.2 - 0.2	1.2E-01	nc	N	ND*
	78-93-3	Methyl ethyl ketone	ND	ND	µg/L	ND	22	0	0.0%	20 - 20	7.0E+02	nc	N	ND
	108-10-1	Methyl isobutyl ketone (MIBK)	ND	ND	µg/L	ND	22	0	0.0%	20 - 20	2.0E+02	nc	N	ND
	75-09-2	Methylene chloride	ND	ND	µg/L	ND	41	0	0.0%	0.5 - 5	4.0E-01	ca	N	ND*
	7439-98-7	Molybdenum	ND	ND	µg/L	ND	9	0	0.0%	40 - 40	1.8E+01	nc	N	ND*
	7440-02-0	Nickel	ND	ND	µg/L	ND	9	0	0.0%	20 - 20	1.2E+00	nc	N	ND*
	S-NANO3	Nitrate	1400	5200	µg/L	109	12	10	83.3%	50 - 50	1.0E+03	nc	Y	
	62-75-9	N-Nitrosodimethylamine	ND	ND	µg/L	ND	9	0	0.0%	0.02 - 0.02	1.3E-04	ca	N	ND*
	95-47-6	o-Xylene	ND	ND	µg/L	ND	11	0	0.0%	0.5 - 5	2.1E+01	nc	N	ND
	14797-73-0	Perchlorate	6.8	1300	µg/L	3501	22	12	54.5%	4 - 20	3.6E-01	ca/nc	Y	
	7440-09-7	Potassium	2100	2100	µg/L	109	9	2	22.2%	2000 - 2000	NA		N	EN
	7782-49-2	Selenium	ND	ND	µg/L	ND	10	0	0.0%	2 - 100	1.8E+01	nc	N	ND
	7440-22-4	Silver	ND	ND	µg/L	ND	9	0	0.0%	20 - 20	1.8E+01	nc	N	ND*
	7440-23-5	Sodium	13000	15000	µg/L	109	9	9	100.0%	0 - 0	NA		N	EN
	100-42-5	Styrene	ND	ND	µg/L	ND	22	0	0.0%	5 - 5	1.6E+02	nc	N	ND
	127-18-4	Tetrachloroethylene	0.59	0.59	µg/L	177	41	1	2.4%	0.5 - 5	6.0E-03	ca	Y	
	7440-28-0	Thallium	ND	ND	µg/L	ND	9	0	0.0%	50 - 50	1.0E-02	nc	N	ND*
	108-88-3	Toluene	ND	ND	µg/L	ND	33	0	0.0%	0.5 - 5	1.5E+01	nc	N	ND
	156-60-5	trans-1,2-Dichloroethylene	ND	ND	µg/L	ND	10	0	0.0%	0.5 - 5	6.0E+00	nc	N	ND
	10061-02-6	trans-1,3-Dichloropropene	ND	ND	µg/L	ND	27	0	0.0%	0.5 - 5	2.0E-02	ca	N	ND*
	79-01-6	Trichloroethylene	0.57	440 (D)	µg/L	3500	41	12	29.3%	0.5 - 5	2.8E-03	ca	Y	
	75-69-4	Trichlorofluoromethane	ND	ND	µg/L	ND	41	0	0.0%	0.5 - 5	7.0E+01	nc	N	ND
	7440-62-2	Vanadium	6.9	6.9	µg/L	109	9	1	11.1%	6 - 6	3.6E+00	nc	Y	
	108-05-4	Vinyl Acetate	ND	ND	µg/L	ND	22	0	0.0%	20 - 20	4.1E+01	nc	N	ND
	75-01-4	Vinyl chloride	ND	ND	µg/L	ND	41	0	0.0%	0.5 - 10	2.0E-03	ca	N	ND*

Table 2-4 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Groundwater
Zone 2
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
Zone 2	1330-20-7	Xylene (total)	ND	ND	µg/L	ND	33	0	0.0%	0.5 - 10	2.1E+01	nc	N	ND
	7440-66-6	Zinc	ND	ND	µg/L	ND	9	0	0.0%	100 - 100	1.1E+03	nc	N	ND

Footnotes:
(1) See Table 2-2
(2) FOD = Frequency of detection screening
BSL = Below screening level
TIC = Tentatively identified compound
EN = Essential Nutrient
ND = Not detected above the reporting limit
* = Some of the detection limits are elevated (i.e., half the reporting limit above screening level)
PM = Individual toxic compounds associated with the mixture are assessed separately.

Key:
ca = Cancer
COPC = Chemical of potential concern
µg/L = Micrograms per liter
nc = Noncancer
ND = Not detected

Chemical	Surrogate
2-Hexanone	Methyl isobutyl ketone

Table 2-5 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Groundwater
Zone 3
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
Zone 3	630-20-6	1,1,1,2-Tetrachloroethane	ND	ND	µg/L	ND	2	0	0.0%	1 - 1	4.3E-02	ca	N	ND*
	71-55-6	1,1,1-Trichloroethane	ND	ND	µg/L	ND	737	0	0.0%	0.5 - 5	1.0E+02	nc	N	ND
	79-34-5	1,1,2,2-Tetrachloroethane	ND	ND	µg/L	ND	731	0	0.0%	0.5 - 5	5.5E-03	ca	N	ND*
	79-00-5	1,1,2-Trichloroethane	ND	ND	µg/L	ND	731	0	0.0%	0.5 - 5	2.0E-02	ca	N	ND*
	75-34-3	1,1-Dichloroethane	0.53	6.4	µg/L	1442	731	156	21.3%	0.5 - 5	2.0E-01	nc	Y	
	75-35-4	1,1-Dichloroethylene	0.51	87	µg/L	1442	737	292	39.6%	0.5 - 5	1.0E+00	nc	Y	
	563-58-6	1,1-Dichloropropene	ND	ND	µg/L	ND	2	0	0.0%	1 - 1	2.0E-02	ca	N	ND*
	87-61-6	1,2,3-Trichlorobenzene	ND	ND	µg/L	ND	2	0	0.0%	1 - 1	5.0E-01	nc	N	ND*
	96-18-4	1,2,3-Trichloropropane	ND	ND	µg/L	ND	2	0	0.0%	1 - 1	5.6E-04	ca	N	ND*
	120-82-1	1,2,4-Trichlorobenzene	ND	ND	µg/L	ND	16	0	0.0%	1 - 10	5.0E-01	nc	N	ND*
	95-63-6	1,2,4-Trimethylbenzene	ND	ND	µg/L	ND	2	0	0.0%	1 - 1	1.2E+00	nc	N	ND
	96-12-8	1,2-Dibromo-3-chloropropane	ND	ND	µg/L	ND	2	0	0.0%	1 - 1	1.6E-04	ca	N	ND*
	106-93-4	1,2-Dibromoethane (EDB)	ND	ND	µg/L	ND	18	0	0.0%	0.5 - 1	5.6E-04	ca	N	ND*
	95-50-1	1,2-Dichlorobenzene	ND	ND	µg/L	ND	48	0	0.0%	0.5 - 10	3.7E+01	nc	N	ND
	107-06-2	1,2-Dichloroethane	0.5	14	µg/L	1448	737	267	36.2%	0.5 - 5	1.2E-02	ca	Y	
	540-59-0	1,2-Dichloroethene (cis/trans)	0.51	9.3	µg/L	4085	698	262	37.5%	0.5 - 5	6.0E+00	nc	Y	
	78-87-5	1,2-Dichloropropane	ND	ND	µg/L	ND	731	0	0.0%	0.5 - 5	1.6E-02	ca*	N	ND*
	108-67-8	1,3,5-Trimethylbenzene	ND	ND	µg/L	ND	2	0	0.0%	1 - 1	1.2E+00	nc	N	ND
	541-73-1	1,3-Dichlorobenzene	ND	ND	µg/L	ND	48	0	0.0%	0.5 - 10	1.8E+01	nc	N	ND
	142-28-9	1,3-Dichloropropane	ND	ND	µg/L	ND	2	0	0.0%	1 - 1	1.2E+01	nc	N	ND
	106-46-7	1,4-Dichlorobenzene	ND	ND	µg/L	ND	48	0	0.0%	0.5 - 10	5.0E-02	ca	N	ND*
	123-91-1	1,4-Dioxane	1.8	2.5	µg/L	1541	25	2	8.0%	0.95 - 10	6.1E-01	ca	Y	
	872-50-4	1-Methyl-2-Pyrrolidinone	68	68	µg/L	30159	14	1	7.1%	10 - 10	NA		Y	
	594-20-7	2,2-Dichloropropane	ND	ND	µg/L	ND	2	0	0.0%	1 - 1	1.2E+01	nc	N	ND
	95-95-4	2,4,5-Trichlorophenol	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	3.6E+02	nc	N	ND
	88-06-2	2,4,6-Trichlorophenol	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	9.6E-02	nc**	N	ND*
	120-83-2	2,4-Dichlorophenol	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	1.1E+01	nc	N	ND
	105-67-9	2,4-Dimethylphenol	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	7.3E+01	nc	N	ND
	51-28-5	2,4-Dinitrophenol	ND	ND	µg/L	ND	14	0	0.0%	50 - 50	7.3E+00	nc	N	ND*
	121-14-2	2,4-Dinitrotoluene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	7.3E+00	nc	N	ND*
	606-20-2	2,6-Dinitrotoluene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	3.6E+00	nc	N	ND*
	110-75-8	2-Chloroethylvinyl ether	ND	ND	µg/L	ND	30	0	0.0%	5 - 5	NA		N	ND
	91-58-7	2-Chloronaphthalene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	4.9E+01	nc	N	ND
	95-57-8	2-Chlorophenol	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	3.0E+00	nc	N	ND*
	95-49-8	2-Chlorotoluene	ND	ND	µg/L	ND	2	0	0.0%	1 - 1	1.2E+01	nc	N	ND
	591-78-6	2-Hexanone	ND	ND	µg/L	ND	17	0	0.0%	10 - 20	2.0E+02	nc	N	ND
	91-57-6	2-Methylnaphthalene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	9.3E-03	nc	N	ND*
	95-48-7	2-Methylphenol	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	1.8E+02	nc	N	ND

Table 2-5 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Groundwater
Zone 3
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
Zone 3	88-74-4	2-Nitroaniline	ND	ND	µg/L	ND	14	0	0.0%	50 - 50	1.1E+01	nc	N	ND*
	88-75-5	2-Nitrophenol	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	NA		N	ND
	91-94-1	3,3-Dichlorobenzidine	ND	ND	µg/L	ND	14	0	0.0%	50 - 50	1.5E-02	ca	N	ND*
	99-09-2	3-Nitroaniline	ND	ND	µg/L	ND	14	0	0.0%	50 - 50	3.2E-01	ca**	N	ND*
	534-52-1	4,6-Dinitro-2-methylphenol	ND	ND	µg/L	ND	14	0	0.0%	50 - 50	3.6E-01	nc	N	ND*
	101-55-3	4-Bromophenyl phenyl ether	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	NA		N	ND
	106-47-8	4-Chloroaniline	ND	ND	µg/L	ND	14	0	0.0%	50 - 50	1.5E+01	nc	N	ND*
	7005-72-3	4-Chlorophenyl phenyl ether	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	NA		N	ND
	106-43-4	4-Chlorotoluene	ND	ND	µg/L	ND	2	0	0.0%	1 - 1	1.2E+01	nc	N	ND
		4-Methylphenol	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	1.2E+01	nc	N	ND
	100-01-6	4-Nitroaniline	ND	ND	µg/L	ND	14	0	0.0%	50 - 50	3.2E-01	ca*	N	ND*
	100-02-7	4-Nitrophenol	ND	ND	µg/L	ND	14	0	0.0%	50 - 50	NA		N	ND
	83-32-9	Acenaphthene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	3.7E+01	nc	N	ND
	208-96-8	Acenaphthylene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	3.7E+01	nc	N	ND
	67-64-1	Acetone	ND	ND	µg/L	ND	17	0	0.0%	10 - 20	5.5E+02	nc	N	ND
	107-02-8	Acrolein	ND	ND	µg/L	ND	15	0	0.0%	25 - 25	4.2E-03	nc	N	ND*
	107-13-1	Acrylonitrile	ND	ND	µg/L	ND	15	0	0.0%	25 - 25	1.1E-03	ca*	N	ND*
	7429-90-5	Aluminum	240	780	µg/L	30165	33	4	12.1%	200 - 200	6.0E+01	nc	Y	
	62-53-3	Aniline	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	1.2E+00	ca*	N	ND*
	120-12-7	Anthracene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	1.8E+02	nc	N	ND
	7440-36-0	Antimony	ND	ND	µg/L	ND	32	0	0.0%	200 - 200	1.5E+00	nc	N	ND*
	7440-38-2	Arsenic	ND	ND	µg/L	ND	33	0	0.0%	80 - 80	4.0E-04	ca	N	ND*
	7440-39-3	Barium	14	110	µg/L	30185	33	33	100.0%	0 - 0	2.0E+02	nc	N	BSL
	71-43-2	Benzene	ND	ND	µg/L	ND	34	0	0.0%	0.5 - 5	1.5E-02	ca	N	ND*
	92-87-5	Benzidine	ND	ND	µg/L	ND	14	0	0.0%	50 - 50	2.9E-05	ca	N	ND*
	56-55-3	Benzo(a)anthracene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	9.2E-03	ca	N	ND*
	50-32-8	Benzo(a)pyrene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	4.0E-04	ca	N	ND*
	205-99-2	Benzo(b)fluoranthene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	9.2E-03	ca	N	ND*
	191-24-2	Benzo(ghi)perylene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	1.8E+01	nc	N	ND
	207-08-9	Benzo(k)fluoranthene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	5.6E-03	ca	N	ND*
	65-85-0	Benzoic acid	ND	ND	µg/L	ND	14	0	0.0%	50 - 50	1.5E+04	nc	N	ND
	100-51-6	Benzyl alcohol	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	1.1E+03	nc	N	ND
	85-68-7	butyl Benzyl phthalate	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	7.3E+02	nc	N	ND
	7440-41-7	Beryllium	ND	ND	µg/L	ND	33	0	0.0%	1 - 1	1.0E-01	nc	N	ND*
	111-91-1	Bis(2-chloroethoxy)methane	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	NA		N	ND
	111-44-4	Bis(2-chloroethyl)ether	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	1.0E-03	ca	N	ND*
	108-60-1	Bis(2-chloroisopropyl)ether	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	2.7E-02	ca	N	ND*
	117-81-7	Bis(2-ethylhexyl)phthalate (BEHP)	ND	ND	µg/L	ND	14	0	0.0%	50 - 50	4.8E-01	ca	N	ND*

Table 2-5 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Groundwater
Zone 3
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
Zone 3	7440-42-8	Boron	41	130	µg/L	30163 30164 30191	31	28	90.3%	40 - 40	7.3E+02	nc	N	BSL
	108-86-1	Bromobenzene	ND	ND	µg/L	ND	2	0	0.0%	1 - 1	2.0E+00	nc	N	ND
	74-97-5	Bromochloromethane	ND	ND	µg/L	ND	2	0	0.0%	1 - 1	NA		N	ND
	75-27-4	Bromodichloromethane	ND	ND	µg/L	ND	737	0	0.0%	0.5 - 5	1.8E-02	ca	N	ND*
	75-25-2	Bromoform	ND	ND	µg/L	ND	731	0	0.0%	0.5 - 5	8.5E-01	ca	N	ND*
	74-83-9	Methyl bromide	ND	ND	µg/L	ND	48	0	0.0%	0.5 - 10	8.7E-01	nc	N	ND*
	7440-43-9	Cadmium	ND	ND	µg/L	ND	33	0	0.0%	4 - 4	4.0E-03	nc	N	ND*
	7440-70-2	Calcium	11000	53000	µg/L	30189	32	32	100.0%	0 - 0	NA		N	EN
	75-15-0	Carbon disulfide	ND	ND	µg/L	ND	17	0	0.0%	5 - 10	1.0E+02	nc	N	ND
	56-23-5	Carbon tetrachloride	0.5	13	µg/L	1498	731	59	8.1%	0.5 - 5	1.0E-02	ca*	Y	
	108-90-7	Chlorobenzene	ND	ND	µg/L	ND	731	0	0.0%	0.5 - 5	1.1E+01	nc	N	ND
	75-00-3	Chloroethane	ND	ND	µg/L	ND	48	0	0.0%	0.5 - 10	4.6E-01	ca	N	ND*
	67-66-3	Chloroform	0.51	8.2	µg/L	1498	738	272	36.9%	0.5 - 5	1.7E-02	ca	Y	
	74-87-3	Chloromethane	ND	ND	µg/L	ND	48	0	0.0%	0.5 - 10	1.6E+01	ca	N	ND
	7440-47-3	Chromium	27	44	µg/L	30190	33	2	6.1%	8 - 8	5.5E+03	nc	N	BSL
	218-01-9	Chrysene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	5.6E-02	ca	N	ND*
	156-59-2	cis-1,2-Dichloroethylene	0.512	8.2	µg/L	4085	33	12	36.4%	0.5 - 1	6.1E+00	nc	Y	
	10061-01-5	cis-1,3-Dichloropropene	ND	ND	µg/L	ND	48	0	0.0%	0.5 - 5	2.0E-02	ca	N	ND*
	7440-48-4	Cobalt	ND	ND	µg/L	ND	32	0	0.0%	8 - 8	7.3E+01	nc	N	ND
	7440-50-8	Copper	7	17	µg/L	30166	33	5	15.2%	6 - 6	1.7E+01	nc	N	BSL
	53-70-3	Dibenzo(a,h)anthracene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	9.2E-04	ca	N	ND*
	132-64-9	Dibenzofuran	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	1.2E+00	nc	N	ND*
	124-48-1	Dibromochloromethane	ND	ND	µg/L	ND	731	0	0.0%	0.5 - 5	1.3E-02	ca	N	ND*
	75-71-8	Dichlorodifluoromethane	0.5	1.1	µg/L	1544	731	4	0.5%	0.5 - 10	3.9E+01	nc	N	BSL/FOD
	68334-30-5	Diesel Range Organics (C10-C28)	74	130	µg/L	30162	14	5	35.7%	50 - 96	NA		N	PM
	84-66-2	Diethyl phthalate	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	2.9E+03	nc	N	ND
	AER-001-070	Dimexano	4.6 (NJ)	6.4 (NJ)	µg/L	30165	4	4	100.0%	0 - 0	NA		N	TIC
	131-11-3	Dimethyl phthalate	12	30	µg/L	30164	14	3	21.4%	10 - 10	3.6E+04	nc	Y	
	84-74-2	Di-n-butyl phthalate	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	3.6E+02	nc	N	ND
	117-84-0	Di-n-octyl phthalate	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	1.5E+02	nc	N	ND
	104-76-7	2-Ethyl-1-hexanol	7.4 (NJ)	32 (NJ)	µg/L	30163 30164	6	6	100.0%	0 - 0	NA		N	TIC
	100-41-4	Ethylbenzene	ND	ND	µg/L	ND	34	0	0.0%	0.5 - 5	3.0E+01	nc	N	ND
	206-44-0	Fluoranthene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	1.5E+02	nc	N	ND
	86-73-7	Fluorene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	2.4E+01	nc	N	ND
	76-13-1	Freon 113	0.5	39	µg/L	30047	731	125	17.1%	0.5 - 5	4.0E+02	nc	Y	
	118-74-1	Hexachlorobenzene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	3.0E-03	ca	N	ND*
	87-68-3	Hexachlorobutadiene	ND	ND	µg/L	ND	16	0	0.0%	1 - 20	8.6E-02	ca*	N	ND*
	77-47-4	Hexachlorocyclopentadiene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	5.0E+00	nc	N	ND*

Table 2-5 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Groundwater
Zone 3
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
Zone 3	67-72-1	Hexachloroethane	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	4.8E-01	ca**	N	ND*
		1,2-Diphenylhydrazine	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	8.4E-03		N	ND*
	18540-29-9	Chromium (Hexavalent)	ND	ND	µg/L	ND	15	0	0.0%	1 - 10	1.1E+01	nc	N	ND
	193-39-5	Indeno(1,2,3-cd)pyrene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	9.2E-03	ca	N	ND*
	7439-89-6	Iron	310	15000	µg/L	30166	33	11	33.3%	300 - 300	1.1E+03	nc	Y	
	78-59-1	Isophorone	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	7.1E+00	ca	N	ND*
	98-82-8	Isopropylbenzene	ND	ND	µg/L	ND	2	0	0.0%	1 - 1	6.6E+01	nc	N	ND
	7439-92-1	Lead	ND	ND	µg/L	ND	33	0	0.0%	60 - 60	2.0E-01		N	ND*
	7439-95-4	Magnesium	3900	27000	µg/L	30159	32	32	100.0%	0 - 0	NA		N	EN
	7439-96-5	Manganese	8.2	93	µg/L	4575	32	18	56.3%	5 - 5	8.8E+01	nc	Y	
	7439-97-6	Mercury	ND	ND	µg/L	ND	18	0	0.0%	0.2 - 0.2	1.2E-01	nc	N	ND
	78-93-3	Methyl ethyl ketone	ND	ND	µg/L	ND	17	0	0.0%	10 - 20	7.0E+02	nc	N	ND
	108-10-1	Methyl isobutyl ketone (MIBK)	ND	ND	µg/L	ND	17	0	0.0%	10 - 20	2.0E+02	nc	N	ND
	1634-04-4	Methyl tert-butyl ether	ND	ND	µg/L	ND	2	0	0.0%	1 - 1	1.1E+00	ca	N	ND
	75-09-2	Methylene chloride	0.52	0.52	µg/L	30053	731	1	0.1%	0.5 - 5	4.0E-01	ca	Y	
	7439-98-7	Molybdenum	ND	ND	µg/L	ND	32	0	0.0%	40 - 40	1.8E+01	nc	N	ND*
	108-38-3	m,p-Xylenes	ND	ND	µg/L	ND	2	0	0.0%	1 - 1	2.1E+01	nc	N	ND
	91-20-3	Naphthalene	ND	ND	µg/L	ND	16	0	0.0%	1 - 10	9.3E-03	ca	N	ND*
	104-51-8	n-Butylbenzene	ND	ND	µg/L	ND	2	0	0.0%	1 - 1	2.4E+01	nc	N	ND
	3622-84-2	N-Butylbenzenesulfonamide	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	NA		N	ND
	7440-02-0	Nickel	ND	ND	µg/L	ND	33	0	0.0%	20 - 20	1.2E+00	nc	N	ND*
	S-NANO3	Nitrate	4300	11000	µg/L	30185	14	14	100.0%	0 - 0	1.0E+03	nc	Y	
	GIS-230-001	Nitrite (as N)	100	330	µg/L	30159	14	7	50.0%	50 - 50	1.0E+02	nc	Y	
	98-95-3	Nitrobenzene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	3.4E-01	nc	N	ND*
	62-75-9	N-Nitrosodimethylamine	0.0013	150	µg/L	1442	720	486	67.5%	0.005 - 10	1.3E-04	ca	Y	
	621-64-7	N-Nitrosodipropylamine	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	9.6E-04	ca	N	ND*
	86-30-6	N-Nitrosodiphenylamine	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	1.4E+00	ca*	N	ND*
	103-65-1	n-Propylbenzene	ND	ND	µg/L	ND	2	0	0.0%	1 - 1	2.4E+01	nc	N	ND
	95-47-6	o-Xylene	ND	ND	µg/L	ND	3	0	0.0%	0.5 - 1	2.1E+01	nc	N	ND
	87-86-5	Pentachlorophenol	ND	ND	µg/L	ND	14	0	0.0%	50 - 50	4.0E-02	ca	N	ND*
	14797-73-0	Perchlorate	4	440	µg/L	351	911	687	75.4%	4 - 40	3.6E-01	ca/nc	Y	
	85-01-8	Phenanthrene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	1.8E+01	nc	N	ND
	108-95-2	Phenol	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	1.1E+03	nc	N	ND
	7440-09-7	Potassium	2000	9100	µg/L	30190	32	29	90.6%	2000 - 2000	NA		N	EN
	106-42-3	m,p-Xylenes	ND	ND	µg/L	ND	2	0	0.0%	1 - 1	2.1E+01	nc	N	ND
	129-00-0	Pyrene	ND	ND	µg/L	ND	14	0	0.0%	10 - 10	1.8E+01	nc	N	ND
	135-98-8	sec-Butylbenzene	ND	ND	µg/L	ND	2	0	0.0%	1 - 1	2.4E+01	nc	N	ND
	7782-49-2	Selenium	ND	ND	µg/L	ND	32	0	0.0%	100 - 100	1.8E+01	nc	N	ND*
	7440-22-4	Silver	820	820	µg/L	30159	33	1	3.0%	20 - 20	1.8E+01	nc	Y	
	7440-23-5	Sodium	21000	79000	µg/L	30189	32	32	100.0%	0 - 0	NA		N	EN

Table 2-5 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Groundwater
Zone 3
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
Zone 3	100-42-5	Styrene	ND	ND	µg/L	ND	17	0	0.0%	1 - 5	1.6E+02	nc	N	ND
	98-06-6	tert-Butylbenzene	ND	ND	µg/L	ND	2	0	0.0%	1 - 1	2.4E+01	nc	N	ND
	127-18-4	Tetrachloroethylene	0.5	2.5	µg/L	4570	739	76	10.3%	0.5 - 5	6.0E-03	ca	Y	
	7440-28-0	Thallium	ND	ND	µg/L	ND	33	0	0.0%	50 - 50	1.0E-02	nc	N	ND*
	108-88-3	Toluene	ND	ND	µg/L	ND	34	0	0.0%	0.5 - 5	1.5E+01	nc	N	ND
	156-60-5	trans-1,2-Dichloroethylene	ND	ND	µg/L	ND	33	0	0.0%	0.5 - 1	6.0E+00	nc	N	ND
	10061-02-6	trans-1,3-Dichloropropene	ND	ND	µg/L	ND	48	0	0.0%	0.5 - 5	2.0E-02	ca	N	ND*
	79-01-6	Trichloroethylene	0.5	190	µg/L	4080	739	536	72.5%	0.5 - 5	2.8E-03	ca	Y	
	75-69-4	Trichlorofluoromethane	0.5	2.5	µg/L	4450	731	24	3.3%	0.5 - 5	7.0E+01	nc	N	BSL/FOD
	7440-62-2	Vanadium	7.2	28	µg/L	30190	32	32	100.0%	0 - 0	3.6E+00	nc	Y	
	108-05-4	Vinyl Acetate	ND	ND	µg/L	ND	17	0	0.0%	20 - 20	4.1E+01	nc	N	ND
	75-01-4	Vinyl chloride	0.54	0.54	µg/L	4575	737	1	0.1%	0.5 - 10	2.0E-03	ca	Y	
	1330-20-7	Xylene (total)	ND	ND	µg/L	ND	32	0	0.0%	0.5 - 5	2.1E+01	nc	N	ND
	7440-66-6	Zinc	500	4300	µg/L	30159	33	3	9.1%	100 - 100	1.1E+03	nc	Y	

Footnotes:

(1) See Table 2-2

(2) FOD = Frequency of detection screening
BSL = Below screening level
TIC = Tentatively identified compound
EN = Essential Nutrient
ND = Not detected above the reporting limit
* = Some of the detection limits are elevated (i.e., half the reporting limit above screening level)
PM = Individual toxic compounds associated with the mixture are assessed separately.

Key:

ca = Cancer
COPC = Chemical of potential concern
µg/L = Micrograms per liter
nc = Noncancer
ND = Not detected

Chemical	Surrogate	Chemical	Surrogate
1,1-Dichloropropene	1,3-Dichloropropene	Acenaphthalene	Acenaphthene
1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene	p-isopropyltoluene	Toluene
2,2-Dichloropropane	1,2-Dichloropropane	Benzo(ghi)perylene	Pyrene
2-Hexanone	Methyl isobutyl ketone	cis-1,3-Dichloropropene	1,3-Dichloropropene
2-methlynaphthalene	Naphthalene	cis-1,3-Dichloropropene	1,3-Dichloropropene
4-Chlorotoluene	2-Chlorotoluene	Phenanthrene	Pyrene

Table 2-6 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Groundwater
Zone 4
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
Zone 4	630-20-6	1,1,1,2-Tetrachloroethane	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	4.3E-02	ca	N	ND*
	71-55-6	1,1,1-Trichloroethane	ND	ND	µg/L	ND	347	0	0.0%	0.5 - 5	1.0E+02	nc	N	ND
	79-34-5	1,1,2,2-Tetrachloroethane	ND	ND	µg/L	ND	347	0	0.0%	0.5 - 5	5.5E-03	ca	N	ND*
	79-00-5	1,1,2-Trichloroethane	ND	ND	µg/L	ND	347	0	0.0%	0.5 - 5	2.0E-02	ca	N	ND*
	75-34-3	1,1-Dichloroethane	0.51	5.5	µg/L	4500	347	136	39.2%	0.5 - 5	2.0E-01	nc	Y	
	75-35-4	1,1-Dichloroethylene	0.5	20	µg/L	4100	347	155	44.7%	0.5 - 5	1.0E+00	nc	Y	
	563-58-6	1,1-Dichloropropene	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	2.0E-02	ca	N	ND*
	87-61-6	1,2,3-Trichlorobenzene	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	5.0E-01	nc	N	ND*
	96-18-4	1,2,3-Trichloropropane	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	5.6E-04	ca	N	ND*
	120-82-1	1,2,4-Trichlorobenzene	ND	ND	µg/L	ND	9	0	0.0%	1 - 1	5.0E-01	nc	N	ND*
	95-63-6	1,2,4-Trimethylbenzene	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	1.2E+00	nc	N	ND
	96-12-8	1,2-Dibromo-3-chloropropane	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	1.6E-04	ca	N	ND*
	106-93-4	1,2-Dibromoethane (EDB)	ND	ND	µg/L	ND	22	0	0.0%	0.5 - 2.5	5.6E-04	ca	N	ND*
	95-50-1	1,2-Dichlorobenzene	ND	ND	µg/L	ND	103	0	0.0%	0.5 - 5	3.7E+01	nc	N	ND
	107-06-2	1,2-Dichloroethane	0.5	4.1	µg/L	4100	347	112	32.3%	0.5 - 5	1.2E-02	ca	Y	
	540-59-0	1,2-Dichloroethene (cis/trans)	0.5	130	µg/L	3188	296	99	33.4%	0.5 - 0.5	6.0E+00	nc	Y	
	78-87-5	1,2-Dichloropropane	ND	ND	µg/L	ND	347	0	0.0%	0.5 - 5	1.6E-02	ca	N	ND*
	122-66-7	1,2-Diphenylhydrazine (as Azobenzene)	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	6.1E-02	ca	N	ND*
	108-67-8	1,3,5-Trimethylbenzene	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	1.2E+00	nc	N	ND
	541-73-1	1,3-Dichlorobenzene	0.78	0.78	µg/L	3095	103	1	1.0%	0.5 - 5	1.8E+01	nc	N	BSL/FOD
	142-28-9	1,3-Dichloropropane	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	1.2E+01	nc	N	ND
	106-46-7	1,4-Dichlorobenzene	0.57	0.9	µg/L	3095	103	8	7.8%	0.5 - 5	5.0E-02	ca	Y	
	123-91-1	1,4-Dioxane	1.4	5.3	µg/L	3095	8	4	50.0%	0.96 - 1	6.1E-01	ca	Y	
	872-50-4	1-Methyl-2-Pyrrolidinone	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	NA		N	ND
	594-20-7	2,2-Dichloropropane	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	1.2E+01	nc	N	ND
	95-95-4	2,4,5-Trichlorophenol	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	3.6E+02	nc	N	ND
	88-06-2	2,4,6-Trichlorophenol	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	9.6E-02	nc	N	ND*
	120-83-2	2,4-Dichlorophenol	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	1.1E+01	nc	N	ND
	105-67-9	2,4-Dimethylphenol	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	7.3E+01	nc	N	ND
	51-28-5	2,4-Dinitrophenol	ND	ND	µg/L	ND	1	0	0.0%	50 - 50	7.3E+00	nc	N	ND*
	121-14-2	2,4-Dinitrotoluene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	7.3E+00	nc	N	ND*
	94-82-6	2,4-DB	ND	ND	µg/L	ND	1	0	0.0%	0.95 - 0.95	2.9E+01	nc	N	ND
	606-20-2	2,6-Dinitrotoluene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	3.6E+00	nc	N	ND*
	91-58-7	2-Chloronaphthalene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	4.9E+01	nc	N	ND
	95-57-8	2-Chlorophenol	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	3.0E+00	nc	N	ND*
	95-49-8	2-Chlorotoluene	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	1.2E+01	nc	N	ND

Table 2-6 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Groundwater
Zone 4
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
Zone 4	591-78-6	2-Hexanone	ND	ND	µg/L	ND	9	0	0.0%	10 - 10	2.0E+02	nc	N	ND
	91-57-6	2-Methylnaphthalene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	9.3E-03	nc	N	ND*
	95-48-7	2-Methylphenol	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	1.8E+02	nc	N	ND
	88-74-4	2-Nitroaniline	ND	ND	µg/L	ND	1	0	0.0%	50 - 50	1.1E+01	nc	N	ND*
	88-75-5	2-Nitrophenol	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	NA		N	ND
	91-94-1	3,3-Dichlorobenzidine	ND	ND	µg/L	ND	1	0	0.0%	50 - 50	1.5E-02	ca	N	ND*
	99-09-2	3-Nitroaniline	ND	ND	µg/L	ND	1	0	0.0%	50 - 50	3.2E-01	ca	N	ND*
	534-52-1	4,6-Dinitro-2-methylphenol	ND	ND	µg/L	ND	1	0	0.0%	50 - 50	3.6E-01	nc	N	ND*
	101-55-3	4-Bromophenyl phenyl ether	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	NA		N	ND
	59-50-7	4-Chloro-3-methylphenol	ND	ND	µg/L	ND	1	0	0.0%	20 - 20	NA		N	ND
	106-47-8	4-Chloroaniline	ND	ND	µg/L	ND	1	0	0.0%	50 - 50	1.5E+01	nc	N	ND*
	7005-72-3	4-Chlorophenyl phenyl ether	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	NA		N	ND
	106-43-4	4-Chlorotoluene	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	1.2E+01	nc	N	ND
	106-44-5	4-Methylphenol	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	1.8E+01	nc	N	ND
	100-01-6	4-Nitroaniline	ND	ND	µg/L	ND	1	0	0.0%	50 - 50	3.2E-01	ca	N	ND*
	100-02-7	4-Nitrophenol	ND	ND	µg/L	ND	1	0	0.0%	50 - 50	NA		N	ND
	83-32-9	Acenaphthene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	3.7E+01	nc	N	ND
	208-96-8	Acenaphthylene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	3.7E+01	nc	N	ND
	67-64-1	Acetone	ND	ND	µg/L	ND	65	0	0.0%	0.5 - 50	5.5E+02	nc	N	ND
	107-02-8	Acrolein	ND	ND	µg/L	ND	1	0	0.0%	25 - 25	4.2E-03	nc	N	ND*
	107-13-1	Acrylonitrile	ND	ND	µg/L	ND	1	0	0.0%	25 - 25	1.1E-03	ca	N	ND*
	7429-90-5	Aluminum	50	3300	µg/L	453	58	37	63.8%	50 - 200	6.0E+01	nc	Y	
	62-53-3	Aniline	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	1.2E+00	ca	N	ND*
	120-12-7	Anthracene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	1.8E+02	nc	N	ND
	7440-36-0	Antimony	ND	ND	µg/L	ND	58	0	0.0%	50 - 200	1.5E+00	nc	N	ND*
	7440-38-2	Arsenic	ND	ND	µg/L	ND	59	0	0.0%	2 - 80	4.0E-04	ca	N	ND*
	7440-39-3	Barium	29	500	µg/L	78	58	58	100.0%	NA	2.0E+02	nc	Y	
	71-43-2	Benzene	ND	ND	µg/L	ND	99	0	0.0%	0.5 - 5	1.5E-02	ca	N	ND*
	92-87-5	Benzidine	ND	ND	µg/L	ND	1	0	0.0%	50 - 50	2.9E-05	ca	N	ND*
	56-55-3	Benzo(a)anthracene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	9.2E-03	ca	N	ND*
	50-32-8	Benzo(a)pyrene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	4.0E-04	ca	N	ND*
	205-99-2	Benzo(b)fluoranthene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	9.2E-03	ca	N	ND*
	191-24-2	Benzo(ghi)perylene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	1.8E+01	nc	N	ND
	207-08-9	Benzo(k)fluoranthene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	5.6E-03	ca	N	ND*
	65-85-0	Benzoic acid	ND	ND	µg/L	ND	1	0	0.0%	50 - 50	1.5E+04	nc	N	ND
	100-51-6	Benzyl alcohol	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	1.1E+03	nc	N	ND

Table 2-6 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Groundwater
Zone 4
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
Zone 4	85-68-7	butyl Benzyl phthalate	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	7.3E+02	nc	N	ND
	7440-41-7	Beryllium	ND	ND	µg/L	ND	58	0	0.0%	0.25 - 1	1.0E-01	nc	N	ND*
	111-91-1	Bis(2-chloroethoxy)methane	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	NA		N	ND
	111-44-4	Bis(2-chloroethyl)ether	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	1.0E-03	ca	N	ND*
	108-60-1	Bis(2-chloroisopropyl)ether	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	2.7E-02	ca	N	ND*
	117-81-7	Bis(2-ethylhexyl)phthalate (BEHP)	ND	ND	µg/L	ND	1	0	0.0%	50 - 50	4.8E-01	ca	N	ND*
	7440-42-8	Boron	10	100	µg/L	3626	58	21	36.2%	10 - 0	7.3E+02	nc	N	BSL
	108-86-1	Bromobenzene	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	2.0E+00	nc	N	ND
	74-97-5	Bromochloromethane	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	NA		N	ND
	75-27-4	Bromodichloromethane	0.83	0.83	µg/L	3095	347	1	0.3%	0.5 - 5	1.8E-02	ca	Y	
	75-25-2	Bromoform	ND	ND	µg/L	ND	347	0	0.0%	0.5 - 5	8.5E-01	ca	N	ND*
	74-83-9	Methyl bromide	0.78	0.78	µg/L	3626	52	1	1.9%	0.5 - 10	8.7E-01	nc	N	BSL/FOD
	7440-43-9	Cadmium	1.1	2000	µg/L	3095	58	4	6.9%	1 - 4	4.0E-03	nc	Y	
	7440-70-2	Calcium	11000	43000	µg/L	78	58	58	100.0%	NA	NA		N	EN
	75-15-0	Carbon disulfide	ND	ND	µg/L	ND	9	0	0.0%	5 - 10	1.0E+02	nc	N	ND
	56-23-5	Carbon tetrachloride	0.99	0.99	µg/L	3095	347	1	0.3%	0.5 - 5	1.0E-02	ca*	Y	
	108-90-7	Chlorobenzene	ND	ND	µg/L	ND	347	0	0.0%	0.5 - 5	1.1E+01	nc	N	ND*
	75-00-3	Chloroethane	ND	ND	µg/L	ND	52	0	0.0%	0.5 - 10	4.6E-01	ca	N	ND*
	67-66-3	Chloroform	0.5	2.6	µg/L	3188	347	25	7.2%	0.5 - 5	1.7E-02	ca	Y	
	74-87-3	Chloromethane	0.61	1.2	µg/L	4120	52	3	5.8%	0.5 - 10	1.6E+01	ca	Y	
	7440-47-3	Chromium	2.1	10	µg/L	3095	58	7	12.1%	2 - 8	5.5E+03	nc	N	BSL
	218-01-9	Chrysene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	5.6E-02	ca	N	ND*
	156-59-2	cis-1,2-Dichloroethylene	0.63	140	µg/L	3188	51	12	23.5%	0.5 - 5	6.1E+00	nc	Y	
	10061-01-5	cis-1,3-Dichloropropene	ND	ND	µg/L	ND	52	0	0.0%	0.5 - 5	2.0E-02	ca	N	ND*
	7440-48-4	Cobalt	2.4	21	µg/L	3095	58	9	15.5%	2 - 8	7.3E+01	nc	Y	
	7440-50-8	Copper	1.7	8.8	µg/L	453	58	14	24.1%	1.5 - 6	1.7E+01	nc	N	BSL
	53-70-3	Dibenzo(a,h)anthracene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	9.2E-04	ca	N	ND*
	132-64-9	Dibenzofuran	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	1.2E+00	nc	N	ND*
	124-48-1	Dibromochloromethane	ND	ND	µg/L	ND	347	0	0.0%	0.5 - 5	1.3E-02	ca	N	ND*
	74-95-3	Dibromomethane	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	6.1E+00	nc	N	ND
	75-71-8	Dichlorodifluoromethane	0.5	1.1	µg/L	3188	347	7	2.0%	0.5 - 10	3.9E+01	nc	N	BSL/FOD
	68334-30-5	Diesel	ND	ND	µg/L	ND	9	0	0.0%	49 - 50	NA		N	PM

Table 2-6 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Groundwater
Zone 4
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
Zone 4	84-66-2	Diethyl phthalate	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	2.9E+03	nc	N	ND
	131-11-3	Dimethyl phthalate	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	3.6E+04	nc	N	ND
	84-74-2	Di-n-butyl phthalate	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	3.6E+02	nc	N	ND
	117-84-0	Di-n-octyl phthalate	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	1.5E+02	nc	N	ND
	100-41-4	Ethylbenzene	ND	ND	µg/L	ND	99	0	0.0%	0.5 - 5	3.0E+01	nc	N	ND
	206-44-0	Fluoranthene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	1.5E+02	nc	N	ND
	86-73-7	Fluorene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	2.4E+01	nc	N	ND
	76-13-1	Freon 113	0.6	550 (D)	µg/L	4100	347	130	37.5%	0.5 - 5	4.0E+02	nc	Y	
	118-74-1	Hexachlorobenzene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	3.0E-03	ca	N	ND*
	87-68-3	Hexachlorobutadiene	ND	ND	µg/L	ND	9	0	0.0%	1 - 1	8.6E-02	ca	N	ND*
	77-47-4	Hexachlorocyclopentadiene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	5.0E+00	nc	N	ND*
	67-72-1	Hexachloroethane	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	4.8E-01	ca	N	ND*
	18540-29-9	Chromium (Hexavalent)	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	1.1E+01	nc	N	ND
	193-39-5	Indeno(1,2,3-cd)pyrene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	9.2E-03	ca	N	ND*
	7439-89-6	Iron	1400	78000	µg/L	78	58	57	98.3%	300 - 0	1.1E+03	nc	Y	
	78-59-1	Isophorone	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	7.1E+00	ca	N	ND*
	98-82-8	Isopropylbenzene	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	6.6E+01	nc	N	ND
	7439-92-1	Lead	39	39	µg/L	453	59	1	1.7%	2 - 60	2.0E-01		Y	
	7439-95-4	Magnesium	5600	14000	µg/L	78	58	58	100.0%	NA	NA		N	EN
	7439-96-5	Manganese	19	440	µg/L	78	58	58	100.0%	NA	8.8E+01	nc	Y	
	7439-97-6	Mercury	ND	ND	µg/L	ND	58	0	0.0%	0.2 - 0.2	1.2E-01	nc	N	ND*
	78-93-3	Methyl ethyl ketone	ND	ND	µg/L	ND	9	0	0.0%	10 - 10	7.0E+02	nc	N	ND
	108-10-1	Methyl isobutyl ketone (MIBK)	ND	ND	µg/L	ND	9	0	0.0%	10 - 10	2.0E+02	nc	N	ND
	1634-04-4	Methyl tert-butyl ether	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	1.1E+00	ca	N	ND
	75-09-2	Methylene chloride	0.51	0.97	µg/L	3188	347	5	1.4%	0.5 - 5	4.0E-01	ca	Y	
	7439-98-7	Molybdenum	ND	ND	µg/L	ND	58	0	0.0%	10 - 40	1.8E+01	nc	N	ND*
	l Range Organics (	Motor Oil Range Organics (C16-C36)	ND	ND	µg/L	ND	4	0	0.0%	250 - 250	NA		N	PM
	108-38-3	m,p-Xylenes	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	2.1E+01	nc	N	ND
	91-20-3	Naphthalene	ND	ND	µg/L	ND	9	0	0.0%	1 - 1	9.3E-03	ca	N	ND*
	104-51-8	n-Butylbenzene	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	2.4E+01	nc	N	ND
	3622-84-2	N-Butylbenzenesulfonamide	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	NA		N	ND
	7440-02-0	Nickel	6.1	12	µg/L	3095	59	5	8.5%	5 - 20	1.2E+00	nc	Y	

Table 2-6 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Groundwater
Zone 4
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
Zone 4	S-NANO3	Nitrate	140	5400	µg/L	78	65	59	90.8%	50 - 0	1.0E+03	nc	Y	
	GIS-230-001	Nitrite (as N)	ND	ND	µg/L	ND	6	0	0.0%	50 - 50	1.0E+02	nc	N	ND
	98-95-3	Nitrobenzene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	3.4E-01	nc	N	ND*
	62-75-9	N-Nitrosodimethylamine	0.0013	46	µg/L	4120	272	181	66.5%	0.005 - 0.02	1.3E-04	ca	Y	
	621-64-7	N-Nitrosodipropylamine	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	9.6E-04	ca	N	ND*
	86-30-6	N-Nitrosodiphenylamine	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	1.4E+00	ca	N	ND*
	103-65-1	n-Propylbenzene	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	2.4E+01	nc	N	ND
	95-47-6	o-Xylene	ND	ND	µg/L	ND	65	0	0.0%	0.5 - 5	2.1E+01	nc	N	ND
	12674-11-2	Aroclor 1016	ND	ND	µg/L	ND	2	0	0.0%	0.95 - 1	9.0E-03	ca	N	ND*
	11104-28-2	Aroclor 1221	ND	ND	µg/L	ND	2	0	0.0%	0.95 - 1	9.0E-03	ca	N	ND*
	11141-16-5	Aroclor 1232	ND	ND	µg/L	ND	2	0	0.0%	0.95 - 1	9.0E-03	ca	N	ND*
	53469-21-9	Aroclor 1242	ND	ND	µg/L	ND	2	0	0.0%	0.95 - 1	9.0E-03	ca	N	ND*
	12672-29-6	Aroclor 1248	ND	ND	µg/L	ND	2	0	0.0%	0.95 - 1	3.4E-03	ca	N	ND*
	11097-69-1	Aroclor 1254	ND	ND	µg/L	ND	2	0	0.0%	0.95 - 1	3.4E-03	ca	N	ND*
	11096-82-5	Aroclor 1260	ND	ND	µg/L	ND	2	0	0.0%	0.95 - 1	3.4E-03	ca	N	ND*
	87-86-5	Pentachlorophenol	ND	ND	µg/L	ND	1	0	0.0%	50 - 50	4.0E-02	ca	N	ND*
	14797-73-0	Perchlorate	4.4	49	µg/L	458	32	8	25.0%	4 - 4	3.6E-01	ca/nc	Y	
	85-01-8	Phenanthrene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	1.8E+01	nc	N	ND
	108-95-2	Phenol	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	1.1E+03	nc	N	ND
	99-87-6	p-Isopropyltoluene	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	1.5E+01	nc	N	ND
	7440-09-7	Potassium	540	2200	µg/L	78	58	52	89.7%	500 - 2000	NA		N	EN
	106-42-3	m,p-Xylenes	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	2.1E+01	nc	N	ND
	129-00-0	Pyrene	ND	ND	µg/L	ND	1	0	0.0%	10 - 10	1.8E+01	nc	N	ND
	135-98-8	sec-Butylbenzene	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	2.4E+01	nc	N	ND
	7782-49-2	Selenium	ND	ND	µg/L	ND	64	0	0.0%	2 - 25	1.8E+01	nc	N	ND*
	7440-22-4	Silver	ND	ND	µg/L	ND	58	0	0.0%	5 - 20	1.8E+01	nc	N	ND
	7440-23-5	Sodium	13000	39000	µg/L	3626	58	58	100.0%	NA	NA		N	EN
	100-42-5	Styrene	ND	ND	µg/L	ND	9	0	0.0%	1 - 1	1.6E+02	nc	N	ND
	98-06-6	tert-Butylbenzene	ND	ND	µg/L	ND	8	0	0.0%	1 - 1	2.4E+01	nc	N	ND
	127-18-4	Tetrachloroethylene	0.52	0.7	µg/L	3188	347	2	0.6%	0.5 - 5	6.0E-03	ca	Y	
	7440-28-0	Thallium	ND	ND	µg/L	ND	58	0	0.0%	12 - 50	1.0E-02	nc	N	ND*
	108-88-3	Toluene	ND	ND	µg/L	ND	99	0	0.0%	0.5 - 5	1.5E+01	nc	N	ND
	156-60-5	trans-1,2-Dichloroethylene	0.71	1.1	µg/L	3188	51	2	3.9%	0.5 - 5	6.0E+00	nc	N	BSL/FOD
	10061-02-6	trans-1,3-Dichloropropene	ND	ND	µg/L	ND	52	0	0.0%	0.5 - 5	2.0E-02	ca	N	ND*
	79-01-6	Trichloroethylene	0.5	510 (D)	µg/L	3188	347	170	49.0%	0.5 - 1	2.8E-03	ca	Y	
	75-69-4	Trichlorofluoromethane	0.72	12	µg/L	78	347	19	5.5%	0.5 - 5	7.0E+01	nc	Y	

Table 2-6 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Groundwater
Zone 4
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
Zone 4	7440-62-2	Vanadium	1.5	40	µg/L	3095	58	36	62.1%	1.5 - 0	3.6E+00	nc	Y	
	108-05-4	Vinyl Acetate	ND	ND	µg/L	ND	9	0	0.0%	20 - 20	4.1E+01	nc	N	ND
	75-01-4	Vinyl chloride	0.62	31	µg/L	3095	347	28	8.1%	0.5 - 5	2.0E-03	ca	Y	
	1330-20-7	Xylene (total)	ND	ND	µg/L	ND	91	0	0.0%	0.5 - 5	2.1E+01	nc	N	ND
	7440-66-6	Zinc	270	3100 (C)	µg/L	453	58	19	32.8%	25 - 100	1.1E+03	nc	Y	

Footnotes:

(1) See Table 2-2

(2) FOD = Frequency of detection screening
BSL = Below screening level
TIC = Tentatively identified compound
EN = Essential Nutrient
ND = Not detected above the reporting limit
* = Some of the detection limits are elevated (i.e., half the reporting limit above screening level)
PM = Individual toxic compounds associated with the mixture are assessed separately.

Key:

ca = Cancer
COPC = Chemical of potential concern
µg/L = Micrograms per liter
nc = Noncancer
ND = Not detected

Chemical	Surrogate
1,1-Dichloropropene	1,3-Dichloropropene
1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene
2,2-Dichloropropane	1,2-Dichloropropane
2-Hexanone	Methyl isobutyl ketone
2-methlynaphthalene	Naphthalene
4-Chlorotoluene	2-Chlorotoluene
Acenaphthalene	Acenaphthene
Benzo (b & k) fluoranthene (total)	Benzo (k) fluoranthene
Benzo(ghi)perylene	Pyrene
cis-1,3-Dichloropropene	1,3-Dichloropropene
cis-1,3-Dichloropropene	1,3-Dichloropropene
Phenanthrene	Pyrene
Endosulfan sulfate	Endosulfan
Endrin Aldehyde	Endrin
p-Isopropyltoluene	Toluene

Table 2-7 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Surface Water
Perimeter Groundwater Operable Unit Lands Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Scenario Timeframe: Current and Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Sample Depth (feet bgs)	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
PGOU	630-20-6	1,1,1,2-Tetrachloroethane	ND	ND	µg/L	ND	ND	3	0	0%	0.5-0.5	4.3E-02	nc	N	ND*
	71-55-6	1,1,1-Trichloroethane	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	1.0E+02	nc	N	ND
	79-34-5	1,1,2,2-Tetrachloroethane	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	5.5E-03	ca	N	ND*
	79-00-5	1,1,2-Trichloroethane	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	2.0E-02	ca	N	ND*
	75-34-3	1,1-Dichloroethane	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	2.0E-01	nc	N	ND*
	75-35-4	1,1-Dichloroethene	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	1.0E+00	nc	N	ND*
	563-58-6	1,1-Dichloropropene	ND	ND	µg/L	ND	ND	3	0	0%	0.5-0.5	2.0E-02	nc	N	ND*
	87-61-6	1,2,3-Trichlorobenzene	ND	ND	µg/L	ND	ND	3	0	0%	0.5-0.5	5.0E-01	nc	N	ND
	96-18-4	1,2,3-Trichloropropane	ND	ND	µg/L	ND	ND	3	0	0%	0.5-0.5	5.6E-04	nc	N	ND*
	120-82-1	1,2,4-Trichlorobenzene	ND	ND	µg/L	ND	ND	9	0	0%	0.5-10	5.0E-01	nc	N	ND*
	95-63-6	1,2,4-Trimethylbenzene	ND	ND	µg/L	ND	ND	3	0	0%	0.5-0.5	1.2E+00	nc	N	ND
	96-12-8	1,2-Dibromo-3-chloropropane	ND	ND	µg/L	ND	ND	3	0	0%	1-1	1.6E-04	nc	N	ND*
	106-93-4	1,2-Dibromoethane (EDB)	ND	ND	µg/L	ND	ND	3	0	0%	0.5-0.5	5.6E-04	nc	N	ND*
	95-50-1	1,2-Dichlorobenzene	ND	ND	µg/L	ND	ND	9	0	0%	0.5-10	3.7E+01	nc	N	ND
	107-06-2	1,2-Dichloroethane	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	1.2E-02	ca	N	ND*
	78-87-5	1,2-Dichloropropane	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	1.6E-02	ca	N	ND*
	122-66-7	1,2-Diphenyl-hydrazine	ND	ND	µg/L	ND	ND	4	0	0%	10-10	8.4E-03	ca	N	ND*
	103-33-3	1,2-Diphenyl-hydrazine/Azobenzene	ND	ND	µg/L	ND	ND	2	0	0%	10-10	6.1E-02	ca	N	ND*
	108-67-8	1,3,5-Trimethylbenzene	ND	ND	µg/L	ND	ND	3	0	0%	0.5-0.5	1.2E+00	nc	N	ND
	541-73-1	1,3-Dichlorobenzene	ND	ND	µg/L	ND	ND	9	0	0%	0.5-10	1.8E+01	nc	N	ND
	142-28-9	1,3-Dichloropropane	ND	ND	µg/L	ND	ND	3	0	0%	0.5-0.5	1.2E+01	nc	N	ND
	106-46-7	1,4-Dichlorobenzene	ND	ND	µg/L	ND	ND	9	0	0%	0.5-10	5.0E-02	ca	N	ND*
	123-91-1	1,4-Dioxane	ND	ND	µg/L	ND	ND	6	0	0%	10-10	6.1E-01	ca	N	ND*
	872-50-4	1-Methyl-2-Pyrrolidnone	ND	ND	µg/L	ND	ND	6	0	0%	10-10	NA		N	ND
	594-20-7	2,2-Dichloropropane	ND	ND	µg/L	ND	ND	3	0	0%	0.5-0.5	1.2E+01	nc	N	ND
	95-95-4	2,4,5-Trichlorophenol	ND	ND	µg/L	ND	ND	6	0	0%	10-10	3.6E+02	nc	N	ND
	88-06-2	2,4,6-Trichlorophenol	ND	ND	µg/L	ND	ND	6	0	0%	10-10	9.6E-02	nc	N	ND*
	120-83-2	2,4-Dichlorophenol	ND	ND	µg/L	ND	ND	6	0	0%	10-10	1.1E+01	nc	N	ND
	105-67-9	2,4-Dimethylphenol	ND	ND	µg/L	ND	ND	6	0	0%	10-10	7.3E+01	nc	N	ND
	51-28-5	2,4-Dinitrophenol	ND	ND	µg/L	ND	ND	6	0	0%	50-50	7.3E+00	nc	N	ND*
	121-14-2	2,4-Dinitrotoluene	ND	ND	µg/L	ND	ND	6	0	0%	10-10	7.3E+00	nc	N	ND
	606-20-2	2,6-Dinitrotoluene	ND	ND	µg/L	ND	ND	6	0	0%	10-10	3.6E+00	nc	N	ND*
	110-75-8	2-Chloroethyl Vinyl Ether	ND	ND	µg/L	ND	ND	131	0	0%	10-10	NA		N	ND
	91-58-7	2-Chloronaphthalene	ND	ND	µg/L	ND	ND	6	0	0%	10-10	4.9E+01	nc	N	ND
	95-57-8	2-Chlorophenol	ND	ND	µg/L	ND	ND	6	0	0%	10-10	3.0E+00	nc	N	ND*
	95-49-8	2-Chlorotoluene	ND	ND	µg/L	ND	ND	3	0	0%	0.5-0.5	1.2E+01	nc	N	ND
	591-78-6	2-Hexanone	ND	ND	µg/L	ND	ND	134	0	0%	5-20	2.0E+02	nc	N	ND

Table 2-7 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Surface Water
Perimeter Groundwater Operable Unit Lands Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Scenario Timeframe: Current and Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Sample Depth (feet bgs)	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
PGOU	91-57-6	2-Methylnaphthalene	ND	ND	µg/L	ND	ND	6	0	0%	10-10	9.3E-03	nc	N	ND*
	95-48-7	2-Methylphenol	ND	ND	µg/L	ND	ND	6	0	0%	10-10	1.8E+02	nc	N	ND
	88-74-4	2-Nitroaniline	ND	ND	µg/L	ND	ND	6	0	0%	50-50	1.1E+01	nc	N	ND*
	88-75-5	2-Nitrophenol	ND	ND	µg/L	ND	ND	6	0	0%	10-10	NA		N	ND
	91-94-1	3,3'-Dichlorobenzidine	ND	ND	µg/L	ND	ND	5	0	0%	50-50	1.5E-02	ca	N	ND*
	99-09-2	3-Nitroaniline	ND	ND	µg/L	ND	ND	6	0	0%	50-50	3.2E-01	ca	N	ND*
	534-52-1	4,6-Dinitro-2-Methyl Phenol	ND	ND	µg/L	ND	ND	6	0	0%	50-50	3.6E-01	nc	N	ND*
	101-55-3	4-Bromophenyl Phenyl Ether	ND	ND	µg/L	ND	ND	6	0	0%	10-10	NA		N	ND
	106-47-8	4-Chloroaniline	ND	ND	µg/L	ND	ND	6	0	0%	50-50	1.5E+01	nc	N	ND*
	7005-72-3	4-Chlorophenyl Phenyl Ether	ND	ND	µg/L	ND	ND	6	0	0%	10-10	NA		N	ND
	106-43-4	4-Chlorotoluene	ND	ND	µg/L	ND	ND	3	0	0%	0.5-0.5	1.2E+01	nc	N	ND
	108-10-1	4-Methyl-2-Pentanone	ND	ND	µg/L	ND	ND	134	0	0%	5-20	2.0E+02	nc	N	ND
	106-44-5	4-Methylphenol	ND	ND	µg/L	ND	ND	6	0	0%	10-10	1.8E+01	nc	N	ND
	100-01-6	4-Nitroaniline	ND	ND	µg/L	ND	ND	6	0	0%	50-50	3.2E-01	ca	N	ND*
	100-02-7	4-Nitrophenol	ND	ND	µg/L	ND	ND	6	0	0%	50-50	NA		N	ND
	83-32-9	Acenaphthene	ND	ND	µg/L	ND	ND	6	0	0%	10-10	3.7E+01	nc	N	ND
	208-96-8	Acenaphthylene	ND	ND	µg/L	ND	ND	4	0	0%	10-10	3.7E+01	nc	N	ND
	67-64-1	Acetone	2.4	3.4	µg/L	Alder Creek #3	NA	134	3	2%	20-20	5.5E+02	nc	N	BSL/FOD
	107-02-8	Acrolein	ND	ND	µg/L	ND	ND	131	0	0%	25-25	4.2E-03	nc	N	ND*
	107-13-1	Acrylonitrile	ND	ND	µg/L	ND	ND	131	0	0%	25-25	1.1E-03	ca	N	ND*
	7429-90-5	Aluminum	540	1,300	µg/L	S-2	NA	6	2	33%	0	6.0E+01	nc	Y	
		Ammonia as N	100	1,100	µg/L	S-2	NA	135	21	16%	100-100	NA		Y	
	62-53-3	Aniline	ND	ND	µg/L	ND	ND	6	0	0%	10-10	1.2E+00	ca	N	ND*
	120-12-7	Anthracene	ND	ND	µg/L	ND	ND	5	0	0%	10-10	1.8E+02	nc	N	ND
	7440-36-0	Antimony	ND	ND	µg/L	ND	ND	9	0	0%	3-60	1.5E+00	nc	N	ND*
	7440-38-2	Arsenic	2.3	3.8	µg/L	S-5	NA	9	3	33%	2-100	4.0E-04	ca	Y	
	7440-39-3	Barium	34	71	µg/L	S-6	NA	9	9	100%	0-0	2.0E+02	nc	N	BSL
	71-43-2	Benzene	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	1.5E-02	ca	N	ND*
	92-87-5	Benzidine	ND	ND	µg/L	ND	ND	5	0	0%	50-50	2.9E-05	ca	N	ND*
	207-08-9	Benzo(k)fluoranthene	ND	ND	µg/L	ND	ND	5	0	0%	10-10	5.6E-03	ca	N	ND*
	56-55-3	Benzo[a]anthracene	ND	ND	µg/L	ND	ND	5	0	0%	10-10	9.2E-03	ca	N	ND*
	50-32-8	Benzo[a]pyrene	ND	ND	µg/L	ND	ND	5	0	0%	10-10	4.0E-04	ca	N	ND*
	205-99-2	Benzo[b]fluoroanthene	ND	ND	µg/L	ND	ND	5	0	0%	10-10	9.2E-03	ca	N	ND*
	191-24-2	Benzo[ghi]perylene	ND	ND	µg/L	ND	ND	5	0	0%	10-10	1.8E+01	nc	N	ND
	65-85-0	Benzoic acid	ND	ND	µg/L	ND	ND	6	0	0%	50-50	1.5E+04	nc	N	ND
	100-51-6	Benzyl Alcohol	ND	ND	µg/L	ND	ND	6	0	0%	10-10	1.1E+03	nc	N	ND
	7440-41-7	Beryllium	ND	ND	µg/L	ND	ND	9	0	0%	0.25 - 1	1.0E-01	nc	N	ND*
	111-91-1	Bis(2-Chloroethoxy) methane	ND	ND	µg/L	ND	ND	6	0	0%	10-10	NA		N	ND

Table 2-7 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Surface Water
Perimeter Groundwater Operable Unit Lands Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Scenario Timeframe: Current and Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Sample Depth (feet bgs)	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
PGOU	111-44-4	Bis(2-Chloroethyl) Ether	ND	ND	µg/L	ND	ND	6	0	0%	10-10	1.0E-03	ca	N	ND*
	108-60-1	Bis(2-chloroisopropyl) ether	ND	ND	µg/L	ND	ND	6	0	0%	10-10	2.7E-02	ca	N	ND*
	117-81-7	Bis(2-ethylhexyl) Phthalate	ND	ND	µg/L	ND	ND	5	0	0%	50-50	4.8E-01	ca	N	ND*
	7440-42-8	Boron	16	40	µg/L	S-6	NA	6	5	83%	0	7.3E+02	nc	N	BSL
	108-86-1	Bromobenzene	ND	ND	µg/L	ND	ND	3	0	0%	0.5-0.5	2.0E+00	nc	N	ND
	74-97-5	Bromochloromethane	ND	ND	µg/L	ND	ND	3	0	0%	0.5-0.5	1.8E-02	nc	N	ND*
	75-27-4	Bromodichloromethane	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	1.8E-02	ca	N	ND*
	75-25-2	Bromoform	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	8.5E-01	ca	N	ND
	74-83-9	Bromomethane	ND	ND	µg/L	ND	ND	134	0	0%	1-10	8.7E-01	nc	N	ND*
	85-68-7	Butyl Benzyl Phthalate	ND	ND	µg/L	ND	ND	5	0	0%	10-10	7.3E+02	nc	N	ND
	7440-43-9	Cadmium	2.9 J	3.0	µg/L	Alder Creek #3	NA	9	2	22%	0	4.0E-03	nc	Y	
	7440-70-2	Calcium	4400	30,000	µg/L	S-5	NA	15	15	100%	0	NA		N	EN
	75-15-0	Carbon Disulfide	ND	ND	µg/L	ND	ND	134	0	0%	5-5	1.0E+02	nc	N	ND
	56-23-5	Carbon tetrachloride	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	1.0E-02	ca*	N	ND*
	108-90-7	Chlorobenzene	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	1.1E+01	nc	N	ND
	124-48-1	Chlorodibromomethane	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	1.3E-02	ca	N	ND*
	75-00-3	Chloroethane	ND	ND	µg/L	ND	ND	134	0	0%	0.5-10	4.6E-01	ca	N	ND*
	67-66-3	Chloroform	6.3	16	µg/L	S-2	NA	134	7	5%	0.5-5	1.7E-02	ca	Y	
	74-87-3	Chloromethane	0.19	0.19	µg/L	Alder Creek #1	NA	134	1	1%	0.5-10	1.6E+01	ca	N	BSL/FOD
	7440-47-3	Chromium	2.8	2.8	µg/L	S-2	NA	9	1	11%	0	5.5E+03	nc	N	BSL
	218-01-9	Chrysene	ND	ND	µg/L	ND	ND	5	0	0%	10-10	5.6E-02	ca	N	ND*
	540-59-0	cis/trans-1,2-Dichloroethylene	ND	ND	µg/L	ND	ND	127	0	0%	5-5	6.1E+00	nc	N	ND
	156-59-2	cis-1,2-Dichloroethene	ND	ND	µg/L	ND	ND	3	0	0%	0.5-0.5	6.1E+00	nc	N	ND
	10061-01-5	cis-1,3-Dichloropropylene	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	2.0E-02	ca	N	ND*
	7440-48-4	Cobalt	2.3	57	µg/L	S-2	NA	15	3	20%	0	7.3E+01	nc	N	BSL
	7440-50-8	Copper	2.6	2.6	µg/L	S-2	NA	3	1	33%	0	1.7E+01	nc	N	BSL
	53-70-3	Dibenzo[a,h]anthracene	ND	ND	µg/L	ND	ND	5	0	0%	10-10	9.2E-04	ca	N	ND*
	132-64-9	Dibenzofuran	ND	ND	µg/L	ND	ND	6	0	0%	10-10	1.2E+00	nc	N	ND*
	84-74-2	Dibutyl Phthalate	ND	ND	µg/L	ND	ND	5	0	0%	10-10	3.6E+02	nc	N	ND
	75-71-8	Dichlorodifluoromethane	ND	ND	µg/L	ND	ND	134	0	0%	0.5-10	3.9E+01	nc	N	ND
	75-09-2	Dichloromethane	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	4.0E-01	ca	N	ND*
	84-66-2	Diethyl Phthalate	ND	ND	µg/L	ND	ND	6	0	0%	10-10	2.9E+03	nc	N	ND
	131-11-3	Dimethyl Phthalate	ND	ND	µg/L	ND	ND	6	0	0%	10-10	3.6E+04	nc	N	ND
	117-84-0	Di-n-octyl-phthalate	ND	ND	µg/L	ND	ND	5	0	0%	10-10	1.5E+02	nc	N	ND
	100-41-4	Ethylbenzene	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	3.0E+01	nc	N	ND
	206-44-0	Fluoranthene	ND	ND	µg/L	ND	ND	5	0	0%	10-10	1.5E+02	nc	N	ND
	86-73-7	Fluorene	ND	ND	µg/L	ND	ND	6	0	0%	10-10	2.4E+01	nc	N	ND

Table 2-7 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Surface Water
Perimeter Groundwater Operable Unit Lands Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Scenario Timeframe: Current and Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Sample Depth (feet bgs)	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
PGOU	76-13-1	Freon 113	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	4.0E+02	nc	N	ND
	118-74-1	Hexachlorobenzene	ND	ND	µg/L	ND	ND	5	0	0%	10-10	3.0E-03	ca	N	ND*
	87-68-3	Hexachlorobutadiene	ND	ND	µg/L	ND	ND	9	0	0%	0.5-20	8.6E-02	ca	N	ND*
	77-47-4	Hexachlorocyclopentadiene	ND	ND	µg/L	ND	ND	6	0	0%	10-10	5.0E+00	nc	N	ND*
	67-72-1	Hexachloroethane	ND	ND	µg/L	ND	ND	6	0	0%	10-10	4.8E-01	ca	N	ND*
	18540-29-9	Hexavalent Chromium	ND	ND	µg/L	ND	ND	6	0	0%	10-10	1.1E+01	nc	N	ND
	302-01-2	Hydrazine	ND	ND	µg/L	ND	ND	12	0	0%	5-5	2.2E-03	ca	N	ND*
	193-39-5	Indeno(1,2,3-cd)pyrene	ND	ND	µg/L	ND	ND	5	0	0%	10-10	9.2E-03	ca	N	ND*
	7439-89-6	Iron	150	1,800	µg/L	S-2	NA	6	6	100%	0	1.1E+03	nc	Y	
	78-59-1	Isophorone	ND	ND	µg/L	ND	ND	6	0	0%	10-10	7.1E+00	ca	N	ND*
	98-82-8	Isopropylbenzene	ND	ND	µg/L	ND	ND	3	0	0%	0.5-0.5	6.6E+01	nc	N	ND
	7439-92-1	Lead	3.1	3	µg/L	S-2	NA	9	2	22%	0	2.0E-01		Y	
	108-38-3	m,p-Xylene	ND	ND	µg/L	ND	ND	90	0	0%	0.5-10	2.1E+01	nc	N	ND
	7439-95-4	Magnesium	1300	21,000	µg/L	S-5	NA	15	15	100%	0	NA		N	EN
	7439-96-5	Manganese	23	77	µg/L	S-5	NA	6	6	100%	0	8.8E+01	nc	N	BSL
	7439-97-6	Mercury	ND	ND	µg/L	ND	ND	9	0	0%	0.2-0.2	1.2E-01	nc	N	ND*
	78-93-3	Methyl ethyl ketone	ND	ND	µg/L	ND	ND	134	0	0%	5-20	7.0E+02	nc	N	ND
	1634-04-4	Methyl tert-butyl ether	ND	ND	µg/L	ND	ND	3	0	0%	0.5-0.5	1.1E+00	nc	N	ND
	7439-98-7	Molybdenum	46	46	µg/L	S-2	NA	9	1	11%	0	1.8E+01	nc	Y	
	60-34-4	Monomethylhydrazine	ND	ND	µg/L	ND	ND	12	0	0%	5-5	2.2E-03	ca	N	ND*
	91-20-3	Naphthalene	0.17	0.17	µg/L	Alder Creek #1	NA	9	1	11%	0.5-10	9.3E-03	ca	Y	
	104-51-8	n-Butylbenzene	ND	ND	µg/L	ND	ND	3	0	0%	0.5-0.5	2.4E+01	nc	N	ND
	3622-84-2	N-Butyl-benzene-sulfonamide	ND	ND	µg/L	ND	ND	6	0	0%	10-10	NA		N	ND
	7440-02-0	Nickel	ND	ND	µg/L	ND	ND	9	0	0%	5-30	1.2E+00	nc	N	ND*
	14797-55-8	Nitrate as N	25	3,100	µg/L	S-2	NA	135	102	76%	23-23	1.0E+03	nc	Y	
	98-95-3	Nitrobenzene	ND	ND	µg/L	ND	ND	6	0	0%	10-10	3.4E-01	nc	N	ND*
	62-75-9	N-Nitrosodi-methylamine	ND	ND	µg/L	ND	ND	6	0	0%	10-10	1.3E-04	ca	N	ND*
	621-64-7	N-Nitrosodi-n-Propylamine	ND	ND	µg/L	ND	ND	6	0	0%	10-10	9.6E-04	ca	N	ND*
	86-30-6	N-Nitrosodi-phenylamine	ND	ND	µg/L	ND	ND	6	0	0%	10-10	1.4E+00	ca	N	ND*
	103-65-1	n-Propylbenzene	ND	ND	µg/L	ND	ND	3	0	0%	0.5-0.5	2.4E+01	nc	N	ND
		Oil and Grease	ND	ND	µg/L	ND	ND	12	0	0%	10000-11000	NA		N	PM
	95-47-6	o-Xylene	ND	ND	µg/L	ND	ND	130	0	0%	0.5-5	2.1E+01	nc	N	ND
	59-50-7	p-Chloro-m-cresol	ND	ND	µg/L	ND	ND	6	0	0%	20-20	NA		N	ND
	87-86-5	Pentachlorophenol	ND	ND	µg/L	ND	ND	5	0	0%	50-50	4.0E-02	ca	N	ND*
	14797-73-0	Perchlorate	4.8	7	µg/L	S-6	NA	139	3	2%	4-4	3.6E-01	ca/nc	Y	
	85-01-8	Phenanthrene	ND	ND	µg/L	ND	ND	5	0	0%	10-10	1.8E+01	nc	N	ND
	108-95-2	Phenol	ND	ND	µg/L	ND	ND	6	0	0%	10-10	1.1E+03	nc	N	ND

Table 2-7 Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Surface Water
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Aerojet Superfund Site
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Medium: Surface Water
Exposure Medium: Surface Water

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Sample Depth (feet bgs)	Number of Samples	Number of Detections	Detection Frequency	Range of Detection Limits	Screening Toxicity Value (1)	N/C	COPC Flag (Y/N)	Rationale for Deletion (2)
PGOU	99-87-6	p-Isopropyltoluene	ND	ND	µg/L	ND	ND	3	0	0%	0.5-0.5	2.1E+01	nc	N	ND
	7440-09-7	Potassium	520	50,000	µg/L	S-2	NA	12	8	1	0	NA		N	EN
	129-00-0	Pyrene	ND	ND	µg/L	ND	ND	5	0	0%	10-10	1.8E+01	nc	N	ND
	135-9-88	sec-Butylbenzene	ND	ND	µg/L	ND	ND	3	0	0%	0.5-0.5	2.4E+01	nc	N	ND
	7782-49-2	Selenium	19 J	19 J	µg/L	ND	ND	9	1	11%	0	1.8E+01	nc	Y	
	7440-22-4	Silver	ND	ND	µg/L	ND	ND	9	0	0%	5-7	1.8E+01	nc	N	ND
	7440-23-5	Sodium	2500	18,000	µg/L	S-2	NA	12	12	1	0	NA		N	EN
	100-42-5	Styrene	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	1.6E+02	nc	N	ND
	98-06-6	tert-Butylbenzene	ND	ND	µg/L	ND	ND	3	0	0%	0.5-0.5	2.4E+01	nc	N	ND
	127-18-4	Tetrachloroethylene	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	6.0E-03	ca	N	ND*
	7440-28-0	Thallium	ND	ND	µg/L	ND	ND	9	0	0%	12-100	1.0E-02	nc	N	ND*
	108-88-3	Toluene	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	1.5E+01	nc	N	ND
	156-60-5	trans-1,2-Dichloroethene	ND	ND	µg/L	ND	ND	7	0	0%	0.5-5	6.0E+00	nc	N	ND
	10061-02-6	Trans-1,3-dichloropropylene	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	2.0E-02	ca	N	ND*
	79-01-6	Trichloroethylene	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	2.8E-03	ca	N	ND*
	75-69-4	Trichlorofluoromethane	ND	ND	µg/L	ND	ND	134	0	0%	0.5-5	7.0E+01	nc	N	ND
		Unsymmetrical Dimethylhydrazine	ND	ND	µg/L	ND	ND	12	0	0%	5-5	NA		N	ND
	7440-62-2	Vanadium	1.7	6	µg/L	S-2	NA	9	7	78%	0	3.6E+00	nc	Y	
	108-05-4	Vinyl Acetate	ND	ND	µg/L	ND	ND	134	0	0%	5-20	4.1E+01	nc	N	ND
	75-01-4	Vinyl Chloride	ND	ND	µg/L	ND	ND	134	0	0%	0.5-10	2.0E-03	ca	N	ND*
	1330-20-7	Xylenes	ND	ND	µg/L	ND	ND	44	0	0%	5-10	2.1E+01	nc	N	ND
	7440-66-6	Zinc	6.6	120	µg/L	S-2	NA	9	4	44%	0	1.1E+03	nc	N	BSL

Footnotes:
(1) See Table 2-2
(2) FOD = Frequency of detection screening
BSL = Below screening level
TIC = Tentatively identified compound
EN = Essential Nutrient
ND = Not detected above the reporting limit
* = Some of the detection limits are elevated (i.e., half the reporting limit above screening level)
PM = Individual toxic compounds associated with the mixture are assessed separately.

Key:
ca = Cancer
COPC = Chemical of potential concern
µg/L = Micrograms per liter
nc = Noncancer

Chemical	Surrogate
Monomethylhydrazine	hydrazine
2-Hexanone	Methyl isobutyl ketone
2-methlynaphthalene	Naphthalene
Acenaphthalene	Acenaphthene
Benzo(ghi)perylene	Pyrene
cis-1,3-Dichloropropene	1,3-Dichloropropene
trans-1,3-Dichloropropene	1,3-Dichloropropene
1,1-Dichloropropene	1,3-Dichloropropene
Phenanthrene	Pyrene
1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene
2,2-Dichloropropane	1,3-Dichloropropane
4-Chlorotoluene	2-Chlorotoluene
Bromochloromethane	Bromodichloromethane
p-Isopropyltolene (p-cymene)	Xylene

Table 2-8 *Selection of Exposure Pathways*
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Medium	Scenario Timeframe	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
	Current	Groundwater	All Layers	Occupational	Adult	Dermal Ingestion	None	No known use of untreated/unmonitored groundwater.
				Agricultural	Adult	Dermal Ingestion	None	No known use of untreated/unmonitored groundwater.
				Residential	Adult	Dermal Ingestion	None	No known use of untreated/unmonitored groundwater.
					Child	Dermal Ingestion	None	No known use of untreated/unmonitored groundwater.
		Air	Shallow Layer Volatilization through Subsurface into Indoor Air	Occupational	Adult	Inhalation	Quant	Potential evaluation of VOC migration into indoor air.
				Residential	Adult	Inhalation	Quant	Potential evaluation of VOC migration into indoor air.
					Child	Inhalation	Quant	Potential evaluation of VOC migration into indoor air.
			All Layers - Water Vapors from Groundwater Non-Ingestion Use	Residential	Adult	Inhalation	None	No known use of untreated/unmonitored groundwater.
					Child	Inhalation	None	No known use of untreated/unmonitored groundwater.
		Surface water	American River and Lake Natoma, the Folsom South Canal, the former Valley Ditch, Buffalo Creek, the Westlake Storm-water Retention Basins, and the Area 20 Administration Ditches	Occupational	Adult	Dermal Ingestion	None	Pathway is not complete from groundwater to American River and Lake Natoma, the Folsom South Canal, the former Valley Ditch, Buffalo Creek, the Westlake Storm Water Retention Basins, and the Area 20 Administration Ditches in Zone 1.
	Future	Groundwater	All Layers	Residential	Adult	Dermal Ingestion	Quant	Default assumption for future exposure.
					Child	Dermal Ingestion	Quant	Default assumption for future exposure.
		Air	Shallow Layer Volatilization through Subsurface into Indoor Air	Occupational	Adult	Inhalation	Quant	Default assumption for future exposure.
				Residential	Adult	Inhalation	Quant	Default assumption for future exposure.
					Child	Inhalation	Quant	Default assumption for future exposure.
			All Layers - Water Vapors from Groundwater Non-Ingestion Use	Residential	Adult	Inhalation	Quant	Default assumption for future exposure.
					Child	Inhalation	Quant	Default assumption for future exposure.
		Surface water	American River and Lake Natoma, the Folsom South Canal, the former Valley Ditch, Buffalo Creek, the Westlake Storm-water Retention Basins, and the Area 20 Administration Ditches	Recreational	Adult	Dermal Ingestion	Quant None	Pathway is not complete from groundwater to American River and Lake Natoma, the Folsom South Canal, the former Valley Ditch, Buffalo Creek, the Westlake Storm Water Retention Basins, and the Area 20 Administration Ditches in Zone 1.
					Child	Dermal Ingestion	Quant None	Pathway is not complete from groundwater to American River and Lake Natoma, the Folsom South Canal, the former Valley Ditch, Buffalo Creek, the Westlake Storm Water Retention Basins, and the Area 20 Administration Ditches in Zone 1.
Zone 2 Groundwater	Current	Groundwater	All Layers	Occupational	Adult	Dermal Ingestion	None	Groundwater is not currently used at property boundary.
		Air	Shallow Layer Volatilization through Subsurface into Indoor Air	Occupational	Adult	Inhalation	Semi-Quant	Potential impact to residents was evaluated and is considered more conservative.
		Surface water	Rebel Hill Ditch, Buffalo Creek, and the Westlake Storm-water Retention Cells	Occupational	Adult	Dermal Ingestion	None	Pathway is not complete from groundwater to Rebel Hill Ditch, Buffalo Creek, and the Westlake Storm Water Retention Cells in Zone 2.

Table 2-8 *Selection of Exposure Pathways*
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Medium	Scenario Timeframe	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Zone 2 Groundwater (continued)	Future	Groundwater	All Layers	Residential	Adult	Dermal Ingestion	Quant	Default assumption for future exposure.
					Child	Dermal Ingestion	Quant	Default assumption for future exposure.
		Air	Shallow Layer Volatilization through Subsurface into Indoor Air	Occupational	Adult	Inhalation	Quant	Default assumption for future exposure.
				Residential	Adult	Inhalation	Quant	Default assumption for future exposure.
					Child	Inhalation	Quant	Default assumption for future exposure.
			All Layers - Water Vapors from Groundwater Non-Ingestion Use	Residential	Adult	Inhalation	Quant	Default assumption for future exposure.
					Child	Inhalation	Quant	Default assumption for future exposure.
		Surface water	Rebel Hill Ditch, Buffalo Creek, and the Westlake Storm-water Retention Cells	Recreational	Adult	Dermal Ingestion	None	Pathway is not complete from groundwater to Rebel Hill Ditch, Buffalo Creek, and the Westlake Storm Water Retention Cells in Zone 2.
					Child	Dermal Ingestion	None	Pathway is not complete from groundwater to Rebel Hill Ditch, Buffalo Creek, and the Westlake Storm Water Retention Cells in Zone 2.
Zone 3 Groundwater	Current	Groundwater	All Layers	Occupational	Adult	Dermal Ingestion	None	No known use of untreated/unmonitored groundwater.
				Agricultural	Adult	Dermal Ingestion	None	No known use of untreated/unmonitored groundwater.
				Residential	Adult	Dermal Ingestion	None	No known use of untreated/unmonitored groundwater.
					Child	Dermal Ingestion	None	No known use of untreated/unmonitored groundwater.
		Air	Shallow Layer Volatilization through Subsurface into Indoor Air	Occupational	Adult	Inhalation	None	Depth to shallowest groundwater is greater than 100 feet.
				Residential	Adult	Inhalation	None	Depth to shallowest groundwater is greater than 100 feet.
					Child	Inhalation	None	Depth to shallowest groundwater is greater than 100 feet.
			All Layers - Water Vapors from Groundwater Non-Ingestion Use	Residential	Adult	Inhalation	None	No known use of untreated/unmonitored groundwater.
					Child	Inhalation	None	No known use of untreated/unmonitored groundwater.
		Surface water	Buffalo Creek, the headwaters of Morrison and Coyote Creeks, and Rebel Hill Ditch	Recreational	Adult	Dermal Ingestion	None	Pathway is not complete from groundwater to Buffalo Creek, the headwaters of Morrison and Coyote Creeks, and Rebel Hill Ditch in Zone 3.
	Future	Groundwater	All Layers	Residential	Adult	Dermal Ingestion	Quant	Default assumption for future exposure.
					Child	Dermal Ingestion	Quant	Default assumption for future exposure.
		Groundwater	All Layers	Residential	Adult	Dermal Ingestion	Quant	Default assumption for future exposure.
					Child	Dermal Ingestion	Quant	Default assumption for future exposure.

Table 2-8 *Selection of Exposure Pathways*
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Medium	Scenario Timeframe	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Zone 3 Groundwater (continued)	Future	Air	Shallow Layer Volatilization through Subsurface into Indoor Air	Occupational	Adult	Inhalation	Quant	Default assumption for future exposure.
				Residential	Adult	Inhalation	None	Depth to shallowest groundwater is greater than 100 feet.
					Child	Inhalation	None	Depth to shallowest groundwater is greater than 100 feet.
			All Layers - Water Vapors from Groundwater Non-Ingestion Use	Residential	Adult	Inhalation	Quant	Default assumption for future exposure.
					Child	Inhalation	Quant	Default assumption for future exposure.
		Surface water	Buffalo Creek, the headwaters of Morrison and Coyote Creeks, and Rebel Hill Ditch	Recreational	Adult	Dermal Ingestion	None	Pathway is not complete from groundwater to Buffalo Creek, the headwaters of Morrison and Coyote Creeks, and Rebel Hill Ditch in Zone 3.
					Child	Dermal Ingestion	None	Pathway is not complete from groundwater to Buffalo Creek, the headwaters of Morrison and Coyote Creeks, and Rebel Hill Ditch in Zone 3.
Zone 4 Groundwater	Current	Groundwater	All Layers	Occupational	Adult	Dermal Ingestion	None	Groundwater is not currently used at property boundary.
		Air	Shallow Layer Volatilization through Subsurface into Indoor Air	Occupational	Adult	Inhalation	Semi-Quant	Potential impact to residents was evaluated and is considered more conservative.
		Surface water	Alder Creek and Seeps	Occupational	Adult	Dermal Ingestion	Quant Qual	Pathway potentially complete and evaluated qualitatively for ingestion and quantitatively for dermal contact.
	Future	Groundwater	All Layers	Residential	Adult	Dermal Ingestion	Quant	Default assumption for future exposure.
					Child	Dermal Ingestion	Quant	Default assumption for future exposure.
		Air	Shallow Layer Volatilization through Subsurface into Indoor Air	Occupational	Adult	Inhalation	Quant	Default assumption for future exposure.
				Residential	Adult	Inhalation	Quant	Default assumption for future exposure.
					Child	Inhalation	Quant	Default assumption for future exposure.
			All Layers - Water Vapors from Groundwater Non-Ingestion Use	Residential	Adult	Inhalation	Quant	Default assumption for future exposure.
					Child	Inhalation	Quant	Default assumption for future exposure.
		Surface water	Alder Creek and Seeps	Recreational	Adult	Dermal Ingestion	Quant Qual	Pathway potentially complete and evaluated qualitatively for ingestion and quantitatively for dermal contact.
					Child	Dermal Ingestion	Quant Qual	Pathway potentially complete and evaluated qualitatively for ingestion and quantitatively for dermal contact.

Notes:
Quant = Quantitative
Semi-Quant = semi-quantitative
Qual = Qualitative
VOC = Volatile organic compound

Table 2-9a Values used for Daily Intake Calculations - Groundwater
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Scenario Timeframe: Current and Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residential	Adult/Child	Zones 1, 2, 3, and 4 groundwater (all aquifers)	CW	Chemical Concentration in Water	chemical specific	µg/L	See Tables 2-14, 2-15, 2-16, and 2-17	Chronic Daily Intake (CDI) (mg/kg/day) = CW x IR-Wadj x EF x 1/AT-C x CF
				IR-Wadj	Age Adjusted Ingestion Rate of Water	1.1	L-yr/kg-day	USEPA, 2004b	
				EF	Exposure Frequency	350	days/year	USEPA, 2004b	
				CF	Conversion Factor	0.001	mg/µg		
				AT-C	Averaging Time - Cancer	25550	days	USEPA, 2004b	
		Adult	Zones 1, 2, 3, and 4 groundwater (all aquifers)	CW	Chemical Concentration in Water	chemical specific	µg/L	See Tables 2-14, 2-15, 2-16, and 2-17	Chronic Daily Intake (CDI) (mg/kg/day) = CW x IR-Wa x EF x EDa x 1/BWa x 1/AT-Na x CF
				IR-Wa	Ingestion Rate of Water (adult)	2	L/day	USEPA, 2004b	
				EF	Exposure Frequency	350	days/year	USEPA, 2004b	
				EDa	Exposure Duration (adult)	30	years	USEPA, 2004b	
				BWa	Body Weight (adult)	70	kg	USEPA, 2004b	
				CF	Conversion Factor	0.001	mg/µg		
				AT-Na	Averaging Time - Non-Cancer	10950	days	USEPA, 2004b	
		Child	Zones 1, 2, 3, and 4 groundwater (all aquifers)	CW	Chemical Concentration in Water	chemical specific	µg/L	See Tables 2-14, 2-15, 2-16, and 2-17	Chronic Daily Intake (CDI) (mg/kg/day) = CW x IR-Wc x EF x EDc x 1/BWc x 1/AT-Nc x CF
				IR-Wc	Ingestion Rate of Water (child)	1	L/day	USEPA, 2004b	
				EF	Exposure Frequency	350	days/year	USEPA, 2004b	
				EDc	Exposure Duration (child)	6	years	USEPA, 2004b	
				BWc	Body Weight (child)	15	kg	USEPA, 2004b	
				CF	Conversion Factor	0.001	mg/µg		
				AT-Nc	Averaging Time - Non-Cancer	2190	days	USEPA, 2004b	
Dermal	Residential	Adult/Child	Zones 1, 2, 3, and 4 groundwater (all aquifers)	CW	Chemical Concentration in Water	chemical specific	µg/L	See Tables 2-14, 2-15, 2-16, and 2-17	Chronic Daily Intake (CD) (mg/kg/day) = (CW x CF1 x CF2 x EV x EF x 1/AT-C) x [(DADa x SAa x EDa x 1/BWa) + (DADc x SAc x EDc x 1/BWc)]
				AT-C	Averaging Time - Cancer	25550	days	USEPA, 2004b	
				BWc	Body Weight (child)	15	kg	USEPA, 2004b	
				BWa	Body Weight (adult)	70	kg	USEPA, 2004b	
				CF1	Conversion Factor	0.001	L/cm^3		
				CF2	Conversion Factor	0.001	mg/µg		
				EV	Exposure Event	1	event/day	USEPA, 2004a	
				EF	Exposure Frequency	350	days/year	USEPA, 2004b	
				DADa	Dermal Absorbed Dose (adult)	chemical specific	cm/event	See Table 11	
				DADc	Dermal Absorbed Dose (child)	chemical specific	cm/event	See Table 11	
				Sac	Surface Area (child)	6600	cm^2	USEPA, 2004a	
				SAa	Surface Area (adult)	18000	cm^2	USEPA, 2004a	
				EDc	Exposure Duration (child)	6	years	USEPA, 2004b	
				EDa	Exposure Duration (adult)	24	years	USEPA, 2004b	
				ETc	Exposure Time (child)	1	hr/event	USEPA, 2004a	
				ETa	Exposure Time (adult)	0.58	hr/event	USEPA, 2004a	

Table 2-9a Values used for Daily Intake Calculations - Groundwater
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Scenario Timeframe: Current and Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (continued)	Residential (continued)	Adult	Zones 1, 2, 3, and 4 groundwater (all aquifers)	CW	Chemical Concentration in Water	chemical specific	µg/L	See Tables 2-14, 2-15, 2-16, and 2-17	Chronic Daily Intake (CD) (mg/kg/day) = (CW x CF1 x CF2 x EV x EF x 1/AT-Na x DADa x SAa x EDa x 1/BWa)
				AT-Na	Averaging Time - Non-Cancer (adult)	10950	days	USEPA, 2004b	
				BWa	Body Weight (adult)	70	kg	USEPA, 2004b	
				CF1	Conversion Factor	0.001	L/cm^3		
				CF2	Conversion Factor	0.001	mg/µg		
				EV	Exposure Event	1	event/day	USEPA, 2004a	
				EF	Exposure Frequency	350	days/year	USEPA, 2004b	
				DADa	Dermal Absorbed Dose (adult)	chemical specific	cm/event	See Table 11	
				SAa	Surface Area (adult)	18000	cm^2	USEPA, 2004a	
				EDa	Exposure Duration (adult)	30	years	USEPA, 2004b	
				ETa	Exposure Time (adult)	0.58	hr/event	USEPA, 2004a	
		Child	Zones 1, 2, 3, and 4 groundwater (all aquifers)	CW	Chemical Concentration in Water	chemical specific	µg/L	See Tables 2-14, 2-15, 2-16, and 2-17	Chronic Daily Intake (CD) (mg/kg/day) = (CW x CF1 x CF2 x EV x EF x 1/AT-Nc x DADc x SAc x EDc x 1/BWc)
				AT-Nc	Averaging Time - Non-Cancer (child)	2190	days	USEPA, 2004b	
				BWc	Body Weight (child)	15	kg	USEPA, 2004b	
				CF1	Conversion Factor	0.001	L/cm^3		
				CF2	Conversion Factor	0.001	mg/µg		
				EF	Exposure Frequency	350	days/year	USEPA, 2004b	
				DADc	Dermal Absorbed Dose (adult)	chemical specific	cm/event	See Table 11	
				SAc	Surface Area (child)	6600	cm^2	USEPA, 2001	
				EDc	Exposure Duration (child)	6	years	USEPA, 2004b	
				ETc	Exposure Time (child)	1	hr/event	USEPA, 2004a	
Inhalation	Residential	Adult/Child	Zones 1, 2, 3, and 4 Groundwater (all aquifers) Household Non-Ingestion Use	CW	Chemical Concentration in Water	chemical specific	µg/L	See Tables 2-14, 2-15, 2-16, and 2-17	Chronic Daily Intake (CD) (mg/kg/day) = CW x IR-Aadj x VF x EF x 1/AT-C x CF
				IR-Aadj	Age Adjusted Inhalation Rate	11	m^3-yr/kg-d	USEPA, 2004b	
				VF	Volatilization Factor	0.5	L/m^3	USEPA, 2004b	
				EF	Exposure Frequency	350	days/year	USEPA, 2004b	
				CF	Conversion Factor	0.001	mg/µg		
				AT-C	Averaging Time - Cancer	25550	days	USEPA, 2004b	
		Adult	Zones 1, 2, 3, and 4 Groundwater (all aquifers) Household Non-Ingestion Use	CW	Chemical Concentration in Water	chemical specific	µg/L	See Tables 2-14, 2-15, 2-16, and 2-17	Chronic Daily Intake (CD) (mg/kg/day) = CW x IR-Aa x VF x EF x EDa x 1/BWa x 1/AT-Na x CF
				IR-Aa	Inhalation Rate (adult)	20	m^3/day	USEPA, 2004b	
				VF	Volatilization Factor	0.5	L/m^3	USEPA, 2004b	
				EF	Exposure Frequency	350	days/year	USEPA, 2004b	
				EDa	Exposure Duration (adult)	30	years	USEPA, 2004b	
				BWa	Body Weight (adult)	70	kg	USEPA, 2004b	
				CF	Conversion Factor	0.001	mg/µg		
				AT-Na	Averaging Time - Non-Cancer (adult)	10950	days	USEPA, 2004b	

Table 2-9a *Values used for Daily Intake Calculations - Groundwater*
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Scenario Timeframe: Current and Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Residential	Child	Zones 1, 2, 3, and 4 Groundwater (all aquifers) Household Non-Ingestion Use	CW	Chemical Concentration in Water	chemical specific	µg/L	See Tables 2-14, 2-15, 2-16, and 2-17	Chronic Daily Intake (CD) (mg/kg/day) = CW x IR-Ac x VF x EF x EDc x 1/BWc x 1/AT-Nc x CF
				IR-Ac	Inhalation Rate (child)	10	m^3/day	USEPA, 2004b	
				VF	Volatilization Factor	0.5	L/m^3	USEPA, 2004b	
				EF	Exposure Frequency	350	days/year	USEPA, 2004b	
				EDc	Exposure Duration (child)	6	years	USEPA, 2004b	
				BWc	Body Weight (child)	15	kg	USEPA, 2004b	
				CF	Conversion Factor	0.001	mg/µg		
				AT-Nc	Averaging Time - Non-Cancer (child)	2190	days	USEPA, 2004b	
	Commercial	Adult	Volatilization into Indoor Air	CW	Chemical Concentration in Water	chemical specific	µg/L	See Tables 2-14, 2-15, 2-16, and 2-17	Chronic Daily Intake (CD) (mg/kg/day) = CW x AF x IR-Aa x EF x EDa x 1/BWa x 1/AT-C x CF
				AF	Attenuation Factor	chemical specific	unitless	See Table 2-10b	
				IR-Aa	Inhalation Rate (adult)	20	m^3/day	USEPA, 2004b	
				EF	Exposure Frequency	250	days/year	USEPA, 2004b	
				EDa	Exposure Duration (adult)	25	years	USEPA, 2004b	
				BWa	Body Weight (adult)	70	kg	USEPA, 2004b	
				CF	Conversion Factor	0.001	mg/µg		
				AT-C	Averaging Time - Cancer (adult)	25550	days	USEPA, 2004b	
		Adult	Volatilization into Indoor Air	CW	Chemical Concentration in Water	chemical specific	µg/L	See Tables 2-14, 2-15, 2-16, and 2-17	Chronic Daily Intake (CD) (mg/kg/day) = CW x AF x IR-Aa x EF x EDa x 1/BWa x 1/AT-Na x CF
				AF	Attenuation Factor	chemical specific	unitless	See Table 2-10b	
				IR-Aa	Inhalation Rate (adult)	20	m^3/day	USEPA, 2004b	
				EF	Exposure Frequency	250	days/year	USEPA, 2004b	
				EDa	Exposure Duration (adult)	25	years	USEPA, 2004b	
				BWa	Body Weight (adult)	70	kg	USEPA, 2004b	
				CF	Conversion Factor	0.001	mg/µg		
				AT-Na	Averaging Time - Non-Cancer (adult)	9125	days	USEPA, 2004b	
	Residential	Adult	Volatilization into Indoor Air	CW	Chemical Concentration in Water	chemical specific	µg/L	See Tables 2-14, 2-15, 2-16, and 2-17	Chronic Daily Intake (CD) (mg/kg/day) = CW x AF x IR-Aa x EF x EDa x 1/BWa x 1/AT-Na x CF
				AF	Attenuation Factor	chemical specific	unitless	See Table 2-10a	
				IR-Aa	Inhalation Rate (adult)	20	m^3/day	USEPA, 2004b	
				EF	Exposure Frequency	350	days/year	USEPA, 2004b	
				EDa	Exposure Duration (adult)	30	years	USEPA, 2004b	
				BWa	Body Weight (adult)	70	kg	USEPA, 2004b	
				CF	Conversion Factor	0.001	mg/µg		
				AT-Na	Averaging Time - Non-Cancer (adult)	10950	days	USEPA, 2004b	

Table 2-9a Values used for Daily Intake Calculations - Groundwater
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Scenario Timeframe: Current and Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Residential	Child	Volatilization into Indoor Air	CW	Chemical Concentration in Water	chemical specific	µg/L	See Tables 2-14, 2-15, 2-16, and 2-17	Chronic Daily Intake (CD) (mg/kg/day) = CW x AF x IR-Ac x EF x EDc x 1/BWc x 1/AT-Nc x CF
				AF	Attenuation Factor	chemical specific	unitless	See Table 2-10a	
				IR-Ac	Inhalation Rate (child)	10	m^3/d	USEPA, 2004b	
				EF	Exposure Frequency	350	d/yr	USEPA, 2004b	
				EDc	Exposure Duration (child)	6	yr	USEPA, 2004b	
				BWc	Body Weight (child)	15	kg	USEPA, 2004b	
				CF	Conversion Factor	0.001	mg/µg		
				AT-Nc	Averaging Time - Non-Cancer (child)	2190	d	USEPA, 2004b	
		Adult/Child	Volatilization into Indoor Air	CW	Chemical Concentration in Water	chemical specific	µg/L	See Tables 2-14, 2-15, 2-16, and 2-17	Chronic Daily Intake (CD) (mg/kg/day) = CW x AF x IR-Aadj x EF x 1/AT-C x CF
				AF	Attenuation Factor	chemical specific	unitless	See Table 2-10a	
				IR-Aadj	Age Adjusted Inhalation Rate	11	m^3-yr/kg-d	USEPA, 2004b	
				EF	Exposure Frequency	350	d/yr	USEPA, 2004b	
				CF	Conversion Factor	0.001	mg/µg		
				AT-C	Averaging Time - Cancer	25550	d	USEPA, 2004b	

Notes and Key:
USEPA, 2004a = *Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual* (Part E, Supplemental Guidance for Dermal Risk Assessment Final) July 2004.

USEPA, 2004b = USEPA Region IX Preliminary Remediation Goals User's Guide. October 2004.

cm = Centimeter
cm^2 = Square centimeter
d = day
hr = Hour
kg = Kilogram
L/cm^3 = Liters per cubic centimeter
m^3 = Cubic meter
µg/L = Micrograms per liter
mg/µg = Milligrams per Microgram
yr = Year
USEPA = United States Environmental Protection Agency

Table 2-9b *Values Used for Daily Intake Calculations - Surface Water*
Administration Area West Management Unit
Boundary Operable Unit Risk Assessment Example
Aerojet Superfund Site
Sacramento County, California

Scenario Timeframe: Current and Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Recreational	Adult/Child	Surface Water Recreational Wading	CW	Chemical Concentration in Water	chemical specific	µg/L	See Table 2-18	Chronic Daily Intake (CD) (mg/kg/day) = (CW x CF1 x CF2 x EV x EF x 1/AT-C) x [(DADa x SAa x EDa x 1/BWa) + (DADc x SAc x EDc x 1/BWc)]
				AT-C	Averaging Time - Cancer	25550	d	USEPA, 2004b	
				BWc	Body Weight (child)	15	kg	USEPA, 2004b	
				BWa	Body Weight (adult)	70	kg	USEPA, 2004b	
				CF1	Conversion Factor	0.001	L/cm^3		
				CF2	Conversion Factor	0.001	mg/µg		
				EV	Exposure Event	1	event/d	USEPA, 2004a	
				EF	Exposure Frequency	12	d/yr	USEPA, 1997	
				DADa	Dermal Absorbed Dose (adult)	chemical specific	cm/event	See Table 2-11	
				DADc	Dermal Absorbed Dose (child)	chemical specific	cm/event	See Table 2-11	
				SAc	Surface Area (child)	6600	cm^2/day	USEPA, 2004a	
				SAa	Surface Area (adult)	18000	cm^2/day	USEPA, 2004a	
				EDc	Exposure Duration (child)	6	yr	USEPA, 2004b	
				EDa	Exposure Duration (adult)	24	yr	USEPA, 2004b	
				ETc	Exposure Time (child)	1	hr/event	USEPA, 2004a	
				ETa	Exposure Time (adult)	0.58	hr/event	USEPA, 2004a	
		Adult	Surface Water Recreational Wading	CW	Chemical Concentration in Water	chemical specific	µg/L	See Table 2-18	Chronic Daily Intake (CD) (mg/kg/day) = (CW x CF1 x CF2 x EV x EF x 1/AT-Na x DADa x SAa x EDa x 1/BWa)
				AT-Na	Averaging Time - Non-Cancer (adult)	10950	d	USEPA, 2004b	
				BWc	Body Weight (adult)	70	kg	USEPA, 2004b	
				CF1	Conversion Factor	0.001	L/cm^3		
				CF2	Conversion Factor	0.001	mg/µg		
				EV	Exposure Event	1	event/d	USEPA, 2004a	
				EF	Exposure Frequency	12	d/yr	USEPA, 1997	
				DADa	Dermal Absorbed Dose (adult)	chemical specific	cm/event	See Table 2-11	
				SAa	Surface Area (adult)	18000	cm^2/day	USEPA, 2004a	
				EDa	Exposure Duration (adult)	30	yr	USEPA, 2004b	
				ETa	Exposure Time (adult)	0.58	hr/event	USEPA, 2004a	
		Child	Surface Water Recreational Wading	CW	Chemical Concentration in Water	chemical specific	µg/L	See Table 2-18	Chronic Daily Intake (CD) (mg/kg/day) = (CW x CF1 x CF2 x EV x EF x 1/AT-Nc x DADc x SAc x EDc x 1/BWc)
				AT-Nc	Averaging Time - Non-Cancer (child)	2190	d	USEPA, 2004b	
				BWc	Body Weight (child)	15	kg	USEPA, 2004b	
				CF1	Conversion Factor	0.001	L/cm^3		
				CF2	Conversion Factor	0.001	mg/µg		
				EV	Exposure Event	1	event/d	USEPA, 2004a	
				EF	Exposure Frequency	12	d/yr	USEPA, 1997	
				DADc	Dermal Absorbed Dose (child)	chemical specific	cm/event	See Table 2-11	
				SAc	Surface Area (child)	6600	cm^2/day	USEPA, 2004a	
				EDc	Exposure Duration (child)	6	yr	USEPA, 2004b	
				ETc	Exposure Time (child)	1	hr/event	USEPA, 2004a	

Table 2-9b ***Values Used for Daily Intake Calculations - Surface Water***
Administration Area West Management Unit
Boundary Operable Unit Risk Assessment Example
Aerojet Superfund Site
Sacramento County, California

Notes and Key:

USEPA, 2004a = *Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual* (Part E, Supplemental Guidance for Dermal Risk Assessment Final) July 2004.

USEPA, 2004b = *USEPA Region IX Preliminary Remediation Goals User's Guide* . October 2004.

USEPA, 1997 = *Exposure Factors Handbook* . August.

µg = Microgram
cm = Centimeter
cm^2 = Squared centimeter
cm^3 = Cubic centimeter
d = Day
hr = Hour
kg = Kilogram
L = Liter
m^3 = Cubic meter
mg = Milligram
yr = Year
USEPA = United States Environmental Protection Agency

Table 2-10a Residential Groundwater to Indoor Air Attenuation Factors
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

	Groundwater to Indoor Air Attenuation Factors (µg/m³ per µg/L)			
	Feet bgs			
Chemical	**30**	**40**	**50**	**60**
1,1,2,2-Tetrachloroethane	2.0 E-3	1.5 E-3	1.3 E-3	1.1 E-3
1,1,2-Trichloroethane	5.8 E-3	4.5 E-3	3.6 E-3	3.1 E-3
1,1-Dichloroethane	3.4 E-2	2.7 E-2	2.2 E-2	1.8 E-2
1,1-Dichloroethene	1.9 E-1	1.5 E-1	1.2 E-1	1.0 E-1
1,2-Dichloroethane	8.2 E-3	6.3 E-3	5.2 E-3	4.4 E-3
1,2-Dichloroethene (cis/trans)	2.5 E-2	1.9 E-2	1.6 E-2	1.3 E-2
1,4-Dichlorobenzene	1.3 E-2	1.0 E-2	8.4 E-3	7.1 E-3
1,4-Dioxane	7.5 E-5	5.7 E-5	4.7 E-5	3.9 E-5
Benzene	4.0 E-2	3.1 E-2	2.5 E-2	2.1 E-2
Bromodichloromethane	4.1 E-3	3.1 E-3	2.5 E-3	2.1 E-3
Bromoform	7.6 E-4	5.8 E-4	4.7 E-4	3.9 E-4
Carbon tetrachloride	1.9 E-1	1.5 E-1	1.2 E-1	1.0 E-1
Chloroform	3.1 E-2	2.4 E-2	1.9 E-2	1.6 E-2
Chloromethane	8.9 E-2	7.0 E-2	5.7 E-2	4.8 E-2
cis-1,2-Dichloroethene	2.5 E-2	1.9 E-2	1.6 E-2	1.3 E-2
Dibromochloromethane	1.3 E-3	1.0 E-3	8.3 E-4	6.9 E-4
Dichlorodifluoromethane	1.9 E+0	1.5 E+0	1.2 E+0	1.0 E+0
Freon 113	3.1 E+0	2.4 E+0	1.9 E+0	1.6 E+0
Methylene chloride	1.8 E-2	1.4 E-2	1.1 E-2	9.6 E-3
Tetrachloroethene	1.1 E-1	8.4 E-2	6.8 E-2	5.7 E-2
Toluene	4.7 E-2	3.6 E-2	2.9 E-2	2.5 E-2
Trichloroethene	6.7 E-2	5.1 E-2	4.2 E-2	3.5 E-2
Trichlorofluoromethane	7.0 E-1	5.4 E-1	4.4 E-1	3.7 E-1
Vinyl chloride	2.3 E-1	1.8 E-1	1.5 E-1	1.3 E-1

Key:
bgs = Below ground surface
ft = Feet
µg/m³ = Micrograms per cubic meter
µg/L = Micrograms per liter

Table 2-10b Commercial Groundwater to Indoor Air Attenuation Factors
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

	Groundwater to Indoor Air Attenuation Factors (µg/m³ per µg/L)			
	Feet bgs			
Chemical	**30**	**40**	**50**	**60**
1,1,2,2-Tetrachloroethane	1.0 E-3	7.7 E-4	6.3 E-4	5.3 E-4
1,1,2-Trichloroethane	2.9 E-3	2.2 E-3	1.8 E-3	1.5 E-3
1,1-Dichloroethane	1.7 E-2	1.3 E-2	1.1 E-2	9.1 E-3
1,1-Dichloroethene	9.6 E-2	7.4 E-2	6.1 E-2	5.1 E-2
1,2-Dichloroethane	4.1 E-3	3.2 E-3	2.6 E-3	2.2 E-3
1,2-Dichloroethene (cis/trans)	1.2 E-2	9.6 E-3	7.8 E-3	6.6 E-3
1,4-Dichlorobenzene	6.7 E-3	5.2 E-3	4.2 E-3	3.6 E-3
1,4-Dioxane	3.7 E-5	2.9 E-5	2.3 E-5	2.0 E-5
Benzene	2.0 E-2	1.5 E-2	1.3 E-2	1.1 E-2
Bromodichloromethane	2.0 E-3	1.6 E-3	1.3 E-3	1.1 E-3
Bromoform	3.8 E-4	2.9 E-4	2.3 E-4	2.0 E-4
Carbon tetrachloride	9.7 E-2	7.5 E-2	6.1 E-2	5.2 E-2
Chloroform	1.5 E-2	1.2 E-2	9.7 E-3	8.2 E-3
Chloromethane	4.5 E-2	3.5 E-2	2.8 E-2	2.4 E-2
cis-1,2-Dichloroethene	1.2 E-2	9.6 E-3	7.8 E-3	6.6 E-3
Dibromochloromethane	6.7 E-4	5.1 E-4	4.1 E-4	3.5 E-4
Dichlorodifluoromethane	9.5 E-1	7.3 E-1	5.9 E-1	5.0 E-1
Freon 113	1.5 E+0	1.2 E+0	9.7 E-1	8.2 E-1
Methylene chloride	9.0 E-3	6.9 E-3	5.7 E-3	4.8 E-3
Tetrachloroethene	5.4 E-2	4.2 E-2	3.4 E-2	2.9 E-2
Toluene	2.3 E-2	1.8 E-2	1.5 E-2	1.2 E-2
Trichloroethene	3.3 E-2	2.6 E-2	2.1 E-2	1.8 E-2
Trichlorofluoromethane	3.5 E-1	2.7 E-1	2.2 E-1	1.8 E-1
Vinyl chloride	1.2 E-1	9.1 E-2	7.4 E-2	6.3 E-2

Key:
AF = Attenuation Factor
bgs = Below ground surface
ft = Feet
µg/m³ = Micrograms per cubic meter
µg/L = Micrograms per liter
NA = Not available

Table 2-11 *Calculation of Dermal Absorption Coefficients*
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Chemical	Organic Carbon Partition Coefficient (mL/g)	Log() Octanol Water Partition Coefficient (dimensionless)	Molecular Weight (g/mole)	D_{sc} (cm^2/hr)	l_{sc} (cm)	Dermal Permeability Coefficient K_p (cm/hr)	Lag Time (hr/event) t	Time Steady State (hr) t*	B	Child Contact Time (hr)	Child Absorption DA_{water} (cm/event)	Adult Contact Time (hr)	Adult Absorption DA_{water} (cm/event)
1,1,1-Trichloroethane	110	2.43	133	2.94 E-7	0.001	1.3 E-2	0.60	1.43	0.10	1.00	0.0278	0.58	0.0212
1,1,2-Trichloroethane	50	2.05	133	2.94 E-7	0.001	6.4 E-3	0.60	1.43	0.00	1.00	0.0137	0.58	0.0104
1,1,2,2-Tetrachloroethane	93	2.36	168	1.80 E-7	0.001	6.9 E-3	0.93	2.24	0.00	1.00	0.0184	0.58	0.0140
1,1-Dichloroethane	32	1.89	99	4.74 E-7	0.001	6.7 E-3	0.38	0.92	0.00	1.00	0.0118	0.58	0.0087
1,1-Dichloroethene	59	2.16	97	4.88 E-7	0.001	1.2 E-2	0.37	0.89	0.00	1.00	0.0209	0.58	0.0154
1,2-Dichlorobenzene	620	3.18	150	2.32 E-7	0.001	4.1 E-2	0.71	1.71	0.20	1.00	0.0955	0.58	0.0727
1,2-Dichloroethane	38	1.97	99	4.74 E-7	0.001	4.2 E-3	0.38	0.92	0.00	1.00	0.0074	0.58	0.0054
1,2-Dichloroethene (cis/trans)	53	1.86	97	4.89 E-7	0.001	7.7 E-3	0.37	0.89	0.00	1.00	0.0134	0.58	0.0099
1,2,4-Trimethylbenzene	3,700	3.96	120	3.53 E-7	0.001	4.2 E-1	0.47	3	1.78	1.00	0.8023	0.58	0.6110
1,4-Dichlorobenzene	620	3.39	147	2.42 E-7	0.001	4.2 E-2	0.71	1.71	0.20	1.00	0.0978	0.58	0.0745
1,4-Dioxane	29	1.85	88	5.53 E-7	0.001	3.3 E-4	0.33	0.80	0.00	1.00	0.0005	0.58	0.0004
Benzene	62	2.18	78	6.36 E-7	0.001	1.5 E-2	0.29	0.70	0.10	1.00	0.0232	0.58	0.0170
Bromodichloromethane	55	2.13	164	1.90 E-7	0.001	4.6 E-3	0.88	2.12	0.00	1.00	0.0119	0.58	0.0091
Bromoform	35	1.93	253	5.45 E-8	0.001	2.2 E-3	2.79	6.70	0.00	1.00	0.0102	0.58	0.0077
n-Butylbenzene	2,800	3.83	130	3.07 E-7	0.001	3.7 E-1	0.54	3	1.62	1.00	0.7513	0.58	0.5722
sec-Butylbenzene	2,200	3.73	130	3.07 E-7	0.001	3.4 E-1	0.54	2	1.51	1.00	0.7011	0.58	0.5340
Carbon tetrachloride	170	2.83	154	2.20 E-7	0.001	1.6 E-2	0.78	1.86	0.10	1.00	0.0391	0.58	0.0297
Chloroethane	15	1.55	65	7.65 E-7	0.001	6.1 E-3	0.24	0.59	0.00	1.00	0.0090	0.58	0.0063
Chloroform	53	2.11	119	3.58 E-7	0.001	6.8 E-3	0.50	1.19	0.00	1.00	0.0133	0.58	0.0101
Dibromochloromethane	470	3.06	210	9.98 E-8	0.001	3.2 E-3	1.57	3.77	0.00	1.00	0.0111	0.58	0.0084
Dichlorodifluoromethane	58	2.15	120	3.53 E-7	0.001	9.0 E-3	0.51	1.22	1.00	1.00	0.0178	0.58	0.0135
cis-1,2-Dichloroethene	36	1.94	97	4.88 E-7	0.001	7.7 E-3	0.37	0.89	0.00	1.00	0.0134	0.58	0.0099
Methylene chloride	10	1.39	85	5.78 E-7	0.001	3.5 E-3	0.32	0.76	0.00	1.00	0.0057	0.58	0.0042
Ethylbenzene	363	2.95	106	4.29 E-7	0.001	4.9 E-2	0.42	1.01	0.20	1.00	0.0878	0.58	0.0668
Freon 113	160	2.59	187	1.37 E-7	0.001	1.2 E-1	1.22	-2	0.62	1.00	0.5106	0.58	0.4801
p-Isopropyltoluene	4,050	3.99	134	2.89 E-7	0.001	4.0 E-1	0.58	4	1.78	1.00	0.8402	0.58	0.6399
Tetrachloroethene	155	2.58	166	1.86 E-7	0.001	3.3 E-2	0.91	2.18	0.03	1.00	0.0870	0.58	0.0663
Toluene	140	2.53	92	5.23 E-7	0.001	3.1 E-2	0.35	0.84	0.10	1.00	0.0520	0.58	0.0386
trans-1,2-Dichloroethene	38	1.97	97	4.88 E-7	0.001	7.7 E-3	0.37	0.89	0.00	1.00	0.0134	0.58	0.0099
trans-1,3-Dichloropropene	46	2.05	111	4.01 E-7	0.001	4.3 E-3	0.45	1.07	0.00	1.00	0.0080	0.58	0.0061
Trichloroethene	166	2.61	131	3.03 E-7	0.001	1.2 E-2	0.58	1.39	0.10	1.00	0.0253	0.58	0.0192
Vinyl chloride	19	1.66	63	7.87 E-7	0.001	5.6 E-3	0.24	0.57	0.00	1.00	0.0083	0.58	0.0059
m-Xylene	407	3.00	106	4.30 E-7	0.001	5.3 E-2	0.42	1.01	0.20	1.00	0.0949	0.58	0.0723
o-Xylene	407	3.00	106	4.30 E-7	0.001	5.3 E-2	0.42	1.01	0.20	1.00	0.0949	0.58	0.0723
p-Xylene	407	3.00	106	4.30 E-7	0.001	5.3 E-2	0.42	1.01	0.20	1.00	0.0949	0.58	0.0723
Xylenes (total)	407	3.00	106	4.30 E-7	0.001	5.3 E-2	0.42	1.01	0.20	1.00	0.0949	0.58	0.0723

Table 2-11 *Calculation of Dermal Absorption Coefficients*
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Chemical	Organic Carbon Partition Coefficient (mL/g)	Log() Octanol Water Partition Coefficient (dimensionless)	Molecular Weight (g/mole)	D_{sc} (cm^2/hr)	l_{sc} (cm)	Dermal Permeability Coefficient K_p (cm/hr)	Lag Time (hr/event) t	Time Steady State (hr) t*	B	Child Contact Time (hr)	Child Absorption DA_{water} (cm/event)	Adult Contact Time (hr)	Adult Absorption DA_{water} (cm/event)
Aluminum	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	1.00	0.00100	0.58	0.00058
Antimony	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	1.00	0.00100	0.58	0.00058
Arsenic	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	1.00	0.00100	0.58	0.00058
Barium	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	1.00	0.00100	0.58	0.00058
Beryllium	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	1.00	0.00100	0.58	0.00058
Boron	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	1.00	0.00100	0.58	0.00058
Cadmium	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	1.00	0.00100	0.58	0.00058
Chromium	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	1.00	0.00100	0.58	0.00058
Chromium VI	NA	NA	NA	NA	NA	2.0 E-3	NA	NA	NA	1.00	0.00200	0.58	0.00116
Cobalt	NA	NA	NA	NA	NA	4.0 E-4	NA	NA	NA	1.00	0.00040	0.58	0.00023
Copper	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	1.00	0.00100	0.58	0.00058
Iron	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	1.00	0.00100	0.58	0.00058
Lead	NA	NA	NA	NA	NA	1.0 E-4	NA	NA	NA	1.00	0.00010	0.58	0.00006
Lithium	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	1.00	0.00100	0.58	0.00058
Manganese	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	1.00	0.00100	0.58	0.00058
Mercury	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	1.00	0.00100	0.58	0.00058
Molybdenum	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	1.00	0.00100	0.58	0.00058
Nickel	NA	NA	NA	NA	NA	2.0 E-4	NA	NA	NA	1.00	0.00020	0.58	0.00012
Nitrate	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	1.00	0.00100	0.58	0.00058
Nitrite as N	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	1.00	0.00100	0.58	0.00058
Perchlorate	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	1.00	0.00100	0.58	0.00058
Selenium	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	1.00	0.00100	0.58	0.00058
Silver	NA	NA	NA	NA	NA	6.0 E-4	NA	NA	NA	1.00	0.00060	0.58	0.00035
Thallium	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	1.00	0.00100	0.58	0.00058
Titanium	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	1.00	0.00100	0.58	0.00058
Vanadium	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	1.00	0.00100	0.58	0.00058
Zinc	NA	NA	NA	NA	NA	6.0 E-4	NA	NA	NA	1.00	0.00060	0.58	0.00035
Acenaphthene	4,898	4.08	154	2.18 E-7	0.001	3.8 E-1	0.32	0.76	1.19	1.0	0.618	0.58	0.450
Acenaphthylene	950	4.07	152	2.25 E-7	0.001	3.8 E-1	0.74	5.02	1.81	1.0	0.906	0.58	0.690
Anthracene	23,500	4.76	178	1.56 E-7	0.001	5.2 E-1	1.07	4.11	0.70	1.0	1.480	0.58	1.127
Benzo (a) anthracene	398,000	5.99	228	7.72 E-8	0.001	4.7 E-1	2.03	8.53	2.80	1.0	1.851	0.58	1.410
Benzo(a)pyrene	1,020,000	6.40	252	5.51 E-8	0.001	7.0 E-1	2.69	11.67	4.30	1.0	3.173	0.58	2.417
Benzo(b)fluoranthene	1,230,000	6.48	252	5.51 E-8	0.001	7.0 E-1	2.77	12.03	4.30	1.0	3.220	0.58	2.452
Benzo (ghi) perylene	96,000	5.82	252	5.51 E-8	0.001	6.9 E-1	2.77	12.03	4.30	1.0	3.172	0.58	2.416
Benzo(k)fluoranthene	1,230,000	6.48	252	5.51 E-8	0.001	7.0 E-1	2.77	12.03	4.30	1.0	3.220	0.58	2.452
Chrysene	398,000	5.99	228	7.72 E-8	0.001	4.7 E-1	2.03	8.53	2.80	1.0	1.851	0.58	1.410

Table 2-11 ***Calculation of Dermal Absorption Coefficients***
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Chemical	Organic Carbon Partition Coefficient (mL/g)	Log() Octanol Water Partition Coefficient (dimensionless)	Molecular Weight (g/mole)	D_{sc} (cm^2/hr)	l_{sc} (cm)	Dermal Permeability Coefficient K_p (cm/hr)	Lag Time (hr/event) t	Time Steady State (hr) t*	B	Child Contact Time (hr)	Child Absorption DA_{water} (cm/event)	Adult Contact Time (hr)	Adult Absorption DA_{water} (cm/event)
Dibenzo(a,h)anthracene	3,800,000	6.97	278	3.82 E-8	0.001	1.5 E+0	3.88	17.57	9.70	1.0	8.167	0.58	6.219
Fluoranthene	107,000	5.42	202	1.11 E-7	0.001	2.2 E-1	1.45	5.68	1.20	1.0	0.732	0.58	0.558
Fluorene	5,012	4.09	166	1.85 E-7	0.001	3.6 E-1	1.06	4.11	0.70	1.0	1.013	0.58	0.771
Indeno(1,2,3-cd)pyrene	3,470,000	6.93	276	3.93 E-8	0.001	1.0 E+0	3.78	16.83	6.70	1.0	5.374	0.58	4.093
Naphthalene	2,000	3.69	128	3.15 E-7	0.001	4.7 E-2	0.56	1.34	0.20	1.0	0.097	0.58	0.074
2,4-Dimethylphenol	209	2.71	122	3.43 E-7	0.001	1.1 E-2	0.52	1.24	0.00	1.0	0.022	0.58	0.017
2-Methylnaphthalene	4,400	3.86	142	2.59 E-7	0.001	3.5 E-1	0.64	3.05	1.61	1.0	0.778	0.58	0.592
Benzoic acid	0.576	0.15	122	3.43 E-7	0.001	5.7 E-3	0.51	1.24	0.00	1.0	0.011	0.58	0.009
bis(2-Chloroethyl)ether	76	2.27	143	2.56 E-7	0.001	1.8 E-3	0.68	1.62	0.00	1.0	0.004	0.58	0.003
Benzyl butyl phthalate	57,500	5.15	312	2.38 E-8	0.001	3.2 E-1	7.00	77.09	2.15	1.0	2.315	0.58	1.763
bis(2-Ethylhexyl)phthalate	15,100,000	7.57	391	7.91 E-9	0.001	2.5 E-2	16.64	39.93	0.20	1.0	0.282	0.58	0.215
Dibenzofuran	7,760	4.28	170	1.75 E-7	0.001	3.9 E-1	0.95	8.39	1.98	1.0	1.065	0.58	0.811
Diethylphthalate	288	2.85	222	8.41 E-8	0.001	3.9 E-3	1.87	4.50	0.00	1.0	0.015	0.58	0.011
Di-n-butylphthalate	33,900	4.92	278	3.84 E-8	0.001	2.4 E-2	3.86	9.27	0.20	1.0	0.130	0.58	0.099
Di-n-octyl phthalate	83,200,000	8.31	391	7.90 E-9	0.001	1.6 E+0	21.10	11737	12.48	1.0	20.842	0.58	15.873
N-Butylbenzenesulfonamide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodimethylamine	12	-0.57	74	6.74 E-7	0.001	2.8 E-2	0.25	1	0.09	1.0	0.040	0.58	0.029
n-Nitrosodiphenylamine	1,290	3.50	198	1.18 E-7	0.001	2.6 E-2	1.38	3.31	0.10	1.0	0.084	0.58	0.064
PCB-1254	100,000	5.39	327	1.93 E-8	0.001	3.4 E-1	8.64	123	2.37	1.0	2.771	0.58	2.110
Pentachlorophenol	592	3.16	266	4.54 E-8	0.001	3.9 E-1	3.33	13.82	2.50	1.0	1.967	0.58	1.498
Phenanthrene	78	4.46	178	1.56 E-7	0.001	1.4 E-1	1.06	4.11	0.70	1.0	0.398	0.58	0.303
Pyrene	105,000	5.41	200	1.15 E-7	0.001	7.0 E-1	1.45	64.53	3.83	1.0	2.346	0.58	1.786

Notes:
Chemical-specific values obtained from USEPA (2004b) or calculated per methods in USEPA (2004b).
t_{event} - duration of groundwater exposure (ETw from Table 10).
DAevent was estimated consistent with USEPA (2004a).
$DA_{event} = FA \times K_p \times [(t_{event}/(1+B))+(2 \times T ((1+3B + 3B^2)/(1+B)^2))]$; when $t_{event} > t^*$ for all organic chemicals.
$DA_{event} = 2 \times FA \times K_p \times sqrt (6 \times T \times t_{event}/PI)$; when tevent < t* for all organic chemicals.
$DA_{event} = K_p \times t_{event}$, for inorganic chemicals.

Key:
cm = Centimeter
Hr = Hour
NA = Not applicable
USEPA = United States Environmental Protection Agency

USEPA, 2004a = *Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual* (Part E, Supplemental Guidance for Dermal Risk Assessment Final) July 2004.
USEPA, 2004b = USEPA Region IX Preliminary Remediation Goals User's Guide. October 2004.

Table 2-12a Non-Cancer Toxicity Data — Oral/Dermal
Baseline Risk Assessment PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral Absorbance Efficiency for Dermal [1]	Dermal RfD Values	Dermal RfD Units	Primary Target Organ(s)	Combined Uncertainty/ Modifying Factors	Sources of RfD Target Organ	Date of RfD Target Organ
1,1,2,2-Tetrachloroethane	Chronic	6.00E-02	mg/kg-d	1	6.00E-02	mg/kg-d	Liver / Central Nervous System	300	USEPA, 2008	6/12/2008
1,1,2-Trichloroethane	Chronic	4.00E-03	mg/kg-d	1	4.00E-03	mg/kg-d	NOEL	1000	USEPA, 2008	6/12/2008
1,1-Dichloroethane	Chronic	2.00E-01	mg/kg-d	1	2.00E-01	mg/kg-d	Kidney	1000	PPRTV	6/12/2008
1,1-Dichloroethylene	Chronic	5.00E-02	mg/kg-d	1	5.00E-02	mg/kg-d	Liver / Kidney	100	USEPA, 2008	6/12/2008
1,2-Dichloroethane	Chronic	2.00E-02	mg/kg-d	1	2.00E-02	mg/kg-d	Nervous System / Liver / Kidney	--	NCEA	6/12/2008
1,2-Dichloroethene (total) [2]	Chronic	1.00E-02	mg/kg-d	1	1.00E-02	mg/kg-d	Blood	3000	PPRTV	6/12/2008
1,4-Dichlorobenzene	Chronic	3.00E-02	mg/kg-d	1	3.00E-02	mg/kg-d	Liver / Kidney	--	NCEA	6/12/2008
1,4-Dioxane	Chronic	--	mg/kg-d	--	--	mg/kg-d	--	--	--	--
1-Methyl-2-Pyrrolidinone	Chronic	--	mg/kg-d	--		mg/kg-d	--	--	--	--
2-4-DB	Chronic	8.00E-03	mg/kg-d	1	8.00E-03	mg/kg-d	--	--	USEPA, 2008	6/12/2008
Aluminum	Chronic	1.00E+00	mg/kg-d	1	1.00E+00	mg/kg-d	Nervous System	--	PPRTV	6/12/2008
Ammonia as N	Chronic	--	mg/kg-d	--	--	mg/kg-d	--	--	--	--
Arsenic	Chronic	3.00E-04	mg/kg-d	1	3.00E-04	mg/kg-d	Skin / Nervous System	3	USEPA, 2008	6/12/2008
Barium	Chronic	2.00E-01	mg/kg-d	0.07	1.40E-02	mg/kg-d	Cardiovascular System / Nervous System	300	USEPA, 2008	6/12/2008
Benzene	Chronic	4.00E-03	mg/kg-d	1	4.00E-03	mg/kg-d	Hematopoietic system / Immune System / Nervous System	300	USEPA, 2008	6/12/2008
Beryllium	Chronic	2.00E-03	mg/kg-d	0.007	1.40E-05	mg/kg-d	Skeletal System	300	USEPA, 2008	6/12/2008
Boron	Chronic	2.00E-01	mg/kg-d	1	2.00E-01	mg/kg-d	Developmental	66	USEPA, 2008	6/12/2008
Bromodichloromethane	Chronic	2.00E-02	mg/kg-d	1	2.00E-02	mg/kg-d	Kidney	1000	USEPA, 2008	6/12/2008
Bromoform	Chronic	2.00E-02	mg/kg-d	1	2.00E-02	mg/kg-d	Liver / Kidney		USEPA, 2008	6/12/2008
Cadmium	Chronic	1.00E-03	mg/kg-d	0.05	5.00E-05	mg/kg-d	Kidney/Gastrointestinal Tract	10	USEPA, 2008	6/12/2008
Carbon Tetrachloride	Chronic	7.00E-04	mg/kg-d	1	7.00E-04	mg/kg-d	Liver / Kidney / Central Nervous System	1000	USEPA, 2008	6/12/2008
Chloroform	Chronic	1.00E-02	mg/kg-d	1	1.00E-02	mg/kg-d	Liver / Kidney / Testes	100	USEPA, 2008	6/12/2008
Chloromethane	Chronic	NA	mg/kg-d	1	NA	mg/kg-d	--	--	--	--
Chromium (hexavalent)	Chronic	3.00E-03	mg/kg-d	0.025	7.50E-05	mg/kg-d	Gastrointestinal Tract	900	USEPA, 2008	06/12/08
cis-1,2-Dichloroethylene	Chronic	1.00E-02	mg/kg-d	1	1.00E-02	mg/kg-d	Blood	3000	PPRTV	06/12/08
Cobalt	Chronic	2.00E-02	mg/kg-d	1	2.00E-02	mg/kg-d	--	--	PPRTV	6/12/2008
Copper	Chronic	3.70E-02	mg/kg-d	1	3.70E-02	mg/kg-d	Gastrointestinal / Liver / Kidneys / Hematopoietic / Central Nervous System / Reproductive and Development	--	USEPA, 1997	6/12/2008
Dibromochloromethane	Chronic	2.00E-02	mg/kg-d	1	2.00E-02	mg/kg-d	Liver	1000	USEPA, 2008	6/12/2008
Dichlorodifluoromethane	Chronic	2.00E-01	mg/kg-d	1	2.00E-01	mg/kg-d	Decreased Body Weight	100	USEPA, 2008	6/12/2008
Dimethyl phthalate	Chronic	1.10E+01	mg/kg-d	1	1.10E+01	mg/kg-d	--	--	USEPA, 1997	6/12/2008
Freon 113	Chronic	3.00E+01	mg/kg-d	1	3.00E+01	mg/kg-d	--	--	USEPA, 2008	6/12/2008
Iron	Chronic	7.00E-01	mg/kg-d	1	7.00E-01	mg/kg-d	Gastrointestinal Tract	--	NCEA	06/12/08

Table 2-12a *Non-Cancer Toxicity Data — Oral/Dermal*
Baseline Risk Assessment PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral Absorbance Efficiency for Dermal [1]	Dermal RfD Values	Dermal RfD Units	Primary Target Organ(s)	Combined Uncertainty/ Modifying Factors	Sources of RfD Target Organ	Date of RfD Target Organ
Lead	Chronic	--	mg/kg-d	--	--	mg/kg-d	Central Nervous System / Cardiovascular System / Red Blood Cells / Kidney	--	--	06/12/08
Manganese	Chronic	2.40E-02	mg/kg-d	0.04	9.60E-04	mg/kg-d	Central Nervous System / Reproductive	1	USEPA, 2008	6/12/2008
Mercury	Chronic	3.00E-04	mg/kg-d	0.07	2.10E-05	mg/kg-d	Central Nervous System	30	USEPA, 2008	06/12/08
Methylene chloride	Chronic	6.00E-02	mg/kg-d	1	6.00E-02	mg/kg-d	Liver	100	USEPA, 2008	6/12/2008
Molybdenum	Chronic	5.00E-03	mg/kg-d	1	5.00E-03	mg/kg-d	Skeletal System / Liver	30	USEPA, 2008	6/12/2008
N-Butylbenzenesulfonamide	Chronic	--	mg/kg-d	--	--	mg/kg-d	--	--	--	--
Naphthalene	Chronic	8.57E-04	mg/kg-d	1	8.57E-04	mg/kg-d	Body Weight	3000	USEPA, 2008	6/12/2008
Nickel	Chronic	2.00E-02	mg/kg-d	0.04	8.00E-04	mg/kg-d	Kidney / Blood	300	USEPA, 2008	6/12/2008
Nitrate	Chronic	1.60E+00	mg/kg-d	1	1.60E+00	mg/kg-d	Blood / Cardiovascular	1	USEPA, 2008	6/12/2008
Nitrite (as N)	Chronic	1.60E-01	mg/kg-d	1	1.60E-01	mg/kg-d	Blood / Cardiovascular	10	R9PRG	6/12/2008
N-Nitrosodimethylamine	Chronic	8.00E-06	mg/kg-d	1	8.00E-06	mg/kg-d	--	--	PPRTV	6/12/2008
Perchlorate	Chronic	7.00E-04	mg/kg-d	1	7.00E-04	mg/kg-d	Thyroid	10	USEPA, 2008	6/12/2008
Selenium	Chronic	5.00E-03	mg/kg-d	0.04	2.00E-04	mg/kg-d	Clinical selenosis	3	USEPA, 2008	6/12/2008
Silver	Chronic	5.00E-03	mg/kg-d	0.04	2.00E-04	mg/kg-d	Skin and Mucous Membranes	3	USEPA, 2008	6/12/2008
Tetrachloroethylene	Chronic	1.00E-02	mg/kg-d	1	1.00E-02	mg/kg-d	Liver / Kidney	1000	USEPA, 2008	6/12/2008
Toluene	Chronic	8.00E-02	mg/kg-d	1	8.00E-02	mg/kg-d	Central Nervous System / Kidney / Liver / Reproductive System		USEPA, 2008	6/12/2008
Trichloroethylene	Chronic	3.00E-04	mg/kg-d	1	3.00E-04	mg/kg-d	Liver / Kidney	1000	NCEA	6/12/2008
Trichlorofluoromethane	Chronic	2.00E-01	mg/kg-d	1	2.00E-01	mg/kg-d	Survival / Liver	1000	USEPA, 2008	6/12/2008
Vanadium	Chronic	1.00E-03	mg/kg-d	0.026	2.60E-05	mg/kg-d	Gastrointestinal System / Kidney / Blood	--	NCEA	6/12/2008
Vinyl Chloride	Chronic	3.00E-03	mg/kg-d	1	3.00E-03	mg/kg-d	Liver	30	USEPA, 2008	6/12/2008
Zinc	Chronic	3.00E-01	mg/kg-d	1	3.00E-01	mg/kg-d	Blood / Pancreas / Gastrointestinal Tract	3	USEPA, 2008	6/12/2008

Notes:
1 = Source = Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part E, upplemental Guidance for Dermal Risk Assessment).
2 = cis-1,2-Dichloroethene was used as a surrogate for total 1,2-Dichloroethene as it is more conservative.
3 = Naphthalene was used as a surrogate
4 = USEPA Region IX table recommends this value. However, the PRG table notes that this value has been withdrawn from IRIS and HEAST and is under review.
-- = No information available
IRIS - Integrated Risk Information System, USEPA
HEAST = Health Effect Assessment Summary Table
mg/kg-d = Milligrams per kilogram per day
NCEA = National Center for Environmental Assessment, USEPA
PPRTV = Provisional Peer Reviewed Toxicity Value
USEPA = United States Environmental Protection Agency

Table 2-12b *Non-Cancer Toxicity Data — Inhalation*
Baseline Risk Assessment PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Chemical of Potential Concern	Inhalation RfC Value	Inhalation RfC Units	Inhalation RfD Values	Inhalation RfD Units	Primary Target Organ(s)	Combined Uncertainty/ Modifying Factors	Sources of RfD Target Organ	Date of RfD Target Organ
1,1,2,2-Tetrachloroethane	2.1E-01	mg/m^3	6.0E-02	mg/kg-d	Kidney / Liver	OV	route-to-route	6/12/2008
1,1,2-Trichloroethane	1.4E-02	mg/m^3	4.0E-03	mg/kg-d	Liver / Immune	OV	route-to-route	6/12/2008
1,1-Dichloroethane	7.0E-01	mg/m^3	2.0E-01	mg/kg-d	NOEL	OV	route-to-route	6/12/2008
1,1-Dichloroethylene	7.0E-02	mg/m^3	2.0E-02	mg/kg-d	Liver / Kidneys / Development	30	OEHHA, 2008	6/12/2008
1,2-Dichloroethane	4.9E-03	mg/m^3	1.4E-03	mg/kg-d	Nervous System / Liver / Kidney / Heart / Reproductive	1000	NCEA	6/17/2008
1,2-Dichloroethene (cis/trans)	3.5E-02	mg/m^3	1.0E-02	mg/kg-d	Central Nervous System / Liver	OV	cis-1,2-dichloroethene as surrogate	6/12/2008
1,4-Dichlorobenzene	8.1E-01	mg/m^3	2.3E-01	mg/kg-d	Liver / Central Nervous System	100	USEPA 2008	6/12/2008
1,4-Dioxane	3.0E+00	mg/m^3	8.6E-01	mg/kg-d	Alimentary system / kidney / cardiovascular system	--	OEHHA, 2008	6/12/2008
1-Methyl-2-Pyrrolidinone	--	mg/m^3	--	mg/kg-d	--	--	--	--
2-4-DB	--	mg/m^3	--	mg/kg-d	--	--	--	--
Aluminum	4.9E-03	mg/m^3	1.4E-03	mg/kg-d	--	Respiratory System	PPRTV	6/12/2008
Ammonia as N	1.0E-01	mg/m^3	2.9E-02	mg/kg-d	Respiratory System	--	USEPA, 2008	6/12/2008
Arsenic	3.0E-05	mg/m^3	8.6E-06	mg/kg-d	Skin / Nervous System / Cardiovascular System	--	OEHHA, 2008	6/12/2008
Barium	4.9E-04	mg/m^3	1.4E-04	mg/kg-d	Cardiovascular System / Reproductive and Development	1000	USEPA, 1997	6/12/2008
Benzene	3.0E-02	mg/m^3	8.6E-03	mg/kg-d	Hematopoietic system / Immune System / Nervous System	300	USEPA 2008	6/12/2008
Beryllium	2.0E-05	mg/m^3	5.7E-06	mg/kg-d	Lungs	10	USEPA 2008	6/12/2008
Boron	--	mg/m^3	5.7E-03	mg/kg-d	--	--	USEPA, 1997	6/12/2008
Bromodichloromethane	7.0E-02	mg/m^3	2.0E-02	mg/kg-d	--	OV	route-to-route	6/12/2008
Bromoform			2.0E-02	mg/kg-d	Liver / Kidney	OV	route-to-route	6/12/2008
Cadmium	3.5E-03	mg/m^3	1.0E-03	mg/kg-d	Kidney/Lung	OV	route-to-route	06/12/2008
Carbon Tetrachloride	3.9E-02	mg/m^3	1.1E-02	mg/kg-d	Liver / Kidney / Central Nervous System	--	OEHHA, 2008	6/12/2008
Chloroform	4.6E-02	mg/m^3	1.3E-02	mg/kg-d	Liver / Kidney / Central Nervous System / Gastrointestinal Tract / Reproduction and Development	--	PPRTV	6/12/2008
Chloromethane	9.0E-02	mg/m^3	2.6E-02	mg/kg-d	Brain	1000	USEPA 2008	06/12/2008
Chromium (hexavalent)	7.7E-06	mg/m3	2.2E-06	mg/kg-d	Respiratory Tract	300	USEPA 2008	06/12/2008
cis-1,2-Dichloroethene	3.5E-02	mg/m^3	1.0E-02	mg/kg-d	Central Nervous System / Liver	OV	route-to-route	6/12/2008
Cobalt	2.0E-05	mg/m^3	5.7E-06	mg/kg-d	--	--	PPRTV	6/12/2008
Copper	1.3E-01	mg/m^3	3.7E-02	mg/kg-d	Respiratory / Liver / Gastrointestinal / Central Nervous System	OV	route-to-route	6/12/2008
Dibromochloromethane	7.0E-02	mg/m^3	2.0E-02	mg/kg-d	OV	OV	route-to-route	6/12/2008
Dichlorodifluoromethane	2.0E-01	mg/m^3	5.7E-02	mg/kg-d	Liver	1000	USEPA, 1997	6/12/2008
Dimethyl phthalate	3.9E+01	mg/m^3	1.1E+01	mg/kg-d	--	--	USEPA 2008	06/12/2008
Freon 113	3.0E+01	mg/m^3	8.6E+00	mg/kg-d	Developmental Effects	30	USEPA, 1997	6/12/2008
Iron	NA	mg/m^3	NA	mg/kg-d	--	--	NCEA	06/12/08
Lead	NA	mg/m^3	NA	mg/kg-d	--	--	USEPA 2008	06/12/2008
Manganese	5.0E-05	mg/m^3	1.4E-05	mg/kg-d	Central Nervous System / Respiratory / Reproductive	1000	USEPA 2008	06/12/2008
Mercury	3.0E-04	mg/m3	8.6E-05	mg/kg-d	Central Nervous System / Kidney	30	USEPA 2008	06/12/2008

Table 2-12b *Non-Cancer Toxicity Data — Inhalation*
Baseline Risk Assessment PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Chemical of Potential Concern	Inhalation RfC Value	Inhalation RfC Units	Inhalation RfD Values	Inhalation RfD Units	Primary Target Organ(s)	Combined Uncertainty/ Modifying Factors	Sources of RfD Target Organ	Date of RfD Target Organ
Methylene Chloride	3.0E+00	mg/m^3	8.6E-01	mg/kg-d	Central Nervous System / Liver / Kidney	100	USEPA, 1997	6/12/2008
Molybdenum	1.8E-02	mg/m^3	5.0E-03	mg/kg-d	Lung / Skeletal System	OV	route-to-route	6/12/2008
Naphthalene	3.0E-03	mg/m^3	8.6E-04	mg/kg-d	Respiratory System	3000	OEHHA, 2008	6/12/2008
N-Butylbenzenesulfonamide	--	mg/m^3	--	mg/kg-d	--	--	--	--
Nickel	4.9E-05	mg/m^3	1.4E-05	mg/kg-d	Respiratory Tract / Immune System	30	OEHHA, 2008	6/12/2008
Nitrate	5.6E+00	mg/m^3	1.6E+00	mg/kg-d	Cardiovascular System	--	USEPA, 1991	--
Nitrite (as N)	3.5E+00	mg/m^3	1.0E+00	mg/kg-d	Cardiovascular System	--	USEPA, 1997	--
N-Nitrosodimethylamine	2.8E-05	mg/m^3	8.0E-06	mg/kg-d	OV	OV	route-to-route	6/12/2008
Perchlorate	2.5E-03	mg/m^3	7.0E-04	mg/kg-d	OV	OV	route-to-route	6/12/2008
Selenium	1.8E-02	mg/m^3	5.0E-03	mg/kg-d	OV	OV	route-to-route	6/12/2008
Silver	1.8E-02	mg/m^3	5.0E-03	mg/kg-d	Skin and Mucous Membranes / Respiratory Tract	OV	route-to-route	6/12/2008
Tetrachloroethylene	3.5E-02	mg/m^3	1.0E-02	mg/kg-d	Central Nervous System / Liver / Kidney	OV	route-to-route	6/12/2008
Toluene	3.0E-01	mg/m3	8.6E-02	mg/kg-d	Nervous System / Respiratory System / Developmental	300	OEHHA, 2008	6/12/2008
Trichloroethylene [2]	3.5E-02	mg/m^3	1.0E-02	mg/kg-d	Central Nervous System / Liver / Kidney / Cardiovascular System / Hematopoietic System / Reproduction / Eyes	1000	NCEA	12/28/2004
Trichloroethylene [2]	6.0E-01	mg/m^3	1.7E-01	mg/kg-d		1000	OEHHA, 2008	6/12/2008
Trichlorofluoromethane	2.0E-01	mg/m^3	5.7E-02	mg/kg-d	Increased Mortality	1000	USEPA, 1997	6/12/2008
Vanadium	3.5E-03	mg/m^3	1.0E-03	mg/kg-d	Respiratory System	--	route-to-route	6/12/2008
Vinyl Chloride	1.0E-01	mg/m^3	2.9E-02	mg/kg-d	Liver / Vascular / Bones / Connective Tissue and Skin / Nervous System / Reproductive and Development / Lungs	30	USEPA 2008	6/12/2008
Zinc	1.1E+00	mg/m^3	3.0E-01	mg/kg-d	Lung	OV	route-to-route	06/12/2008

Notes and Key:

1 = The following compounds are listed as nonvolatile in the USEPA Region IX Preliminary Remediation Goals tables: aluminum, arsenic, barium, boron, cadmium, chromium (hexavalent), cobalt, copper, iron, lead, manganese, molybdenum, nickel, nitrate, nitrite, n-nitrosodimethylamine, perchlorate, silver, vanadium, and zinc. Therefore, the inhalation reference doses have been listed as not applicable (NA) in the risk calculation tables.

2 = At the request of the agencies, trichloroehtylene was evaluated using both the USEPA and OEHHA slope factors. Both values are included in this table.

b = cis-1,2-Dichloroethene was used as a surrogate for total 1,2-Dichloroethene as it is more conservative.

-- = No information available

USEPA, 2008 - Integrated Risk Information System, USEPA

USEPA, 1997 = Health Effect Assessment Summary Table

mg/m^3 = Milligrams per cubic meter

mg/kg-d = Milligrams per kilogram per day

NCEA = National Center for Environmental Assessment, USEPA

OV = Primary target organ is based on the oral value

PPRTV = Provisional Peer Reviewed Toxicity Value

USEPA = United States Environmental Protection Agency

Table 2-13a *Cancer Toxicity Data — Oral/Dermal*
Baseline Risk Assessment PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Chemical of Potential Concern	Oral Cancer Slope Factor Value	Slope Factor Unit	Oral Absorption Efficiency for Dermal (1)	Dermal Cancer Slope Factor Value	Slope Factor Unit	Weight of Evidence/Cancer Guideline Description	Source	Date
1,1,2,2-Tetrachloroethane	2.7E-01	(mg/kg-d)-1	1	2.7E-01	(mg/kg-d)-1	C	OEHHA, 2008	6/12/08
1,1,2-Trichloroethane	7.2E-02	(mg/kg-d)-1	1	7.2E-02	(mg/kg-d)-1	C	OEHHA, 2008	6/12/08
1,1-Dichloroethane	5.7E-03	(mg/kg-d)-1	1	5.7E-03	(mg/kg-d)-1	C	OEHHA, 2008	6/12/08
1,1-Dichloroethylene	--	(mg/kg-d)-1	1	--	(mg/kg-d)-1	C	USEPA, 2008	6/12/08
1,2-Dichloroethane	9.1E-02	(mg/kg-d)-1	1	9.1E-02	(mg/kg-d)-1	B2	USEPA, 2008	6/12/08
1,2-Dichloroethene (total)	--	(mg/kg-d)-1	1	--	(mg/kg-d)-1	D	USEPA, 2008	6/12/08
1,4-Dichlorobenzene	2.4E-02	(mg/kg-d)-1	1	2.4E-02	(mg/kg-d)-1	C	USEPA, 1997	6/12/08
1,4-Dioxane	2.7E-02	(mg/kg-d)-1	1	2.7E-02	(mg/kg-d)-1	B2	OEHHA, 2008	6/12/08
1-Methyl-2-Pyrrolidinone	--	(mg/kg-d)-1	1	--	(mg/kg-d)-1	--	--	--
2,4-DB	--	(mg/kg-d)-1	1	--	(mg/kg-d)-1	--	--	--
Aluminum	--	(mg/kg-d)-1	1	--	(mg/kg-d)-1	D	--	--
Ammonia as N	--	(mg/kg-d)-1	1	--	(mg/kg-d)-1	D	--	--
Arsenic	9.5E+00	(mg/kg-d)-1	1	9.5E+00	(mg/kg-d)-1	A	OEHHA, 2008	6/12/08
Barium	--	(mg/kg-d)-1	0.07	--	(mg/kg-d)-1	D	USEPA, 2008	6/12/08
Benzene	1.0E-01	(mg/kg-d)-1	1	1.0E-01	(mg/kg-d)-1	A	OEHHA, 2008	6/12/08
Beryllium	--	(mg/kg-d)-1	1	--	(mg/kg-d)-1	B1	--	--
Boron	--	(mg/kg-d)-1	1	--	(mg/kg-d)-1	--	--	--
Bromodichloromethane	1.3E-01	(mg/kg-d)-1	1	1.3E-01	(mg/kg-d)-1	B2	OEHHA, 2008	6/12/2008
Bromoform	7.9E-03	(mg/kg-d)-1	1	7.9E-03	(mg/kg-d)-1	B2	USEPA, 2008	6/12/2008
Cadmium	--	$(mg/kg\text{-}d)^{-1}$	0.025	--	$(mg/kg\text{-}d)^{-1}$	B1	OEHHA, 2008	6/12/2008
Carbon Tetrachloride	1.5E-01	(mg/kg-d)-1	1	1.5E-01	(mg/kg-d)-1	B2	OEHHA, 2008	6/12/2008
Chloroform	3.1E-02	(mg/kg-d)-1	1	3.1E-02	(mg/kg-d)-1	B2	OEHHA, 2008	6/12/2008
Chloromethane	1.3E-02	(mg/kg-d)-1	1	1.3E-02	(mg/kg-d)-1	C	USEPA, 1997	6/12/2008
Chromium (hexavalent)	--	$(mg/kg\text{-}d)^{-1}$	0.025	--	$(mg/kg\text{-}d)^{-1}$	D	USEPA, 2008	6/12/08
cis-1,2-Dichloroethylene	--	(mg/kg-d)-1	1	--	(mg/kg-d)-1	D	USEPA, 2008	6/12/08
Cobalt	--	(mg/kg-d)-1	1	--	(mg/kg-d)-1	D	--	--
Copper	--	(mg/kg-d)-1	1	--	(mg/kg-d)-1	D	USEPA, 2008	6/12/08
Dibromochloromethane	9.4E-02	(mg/kg-d)-1	1	9.4E-02	(mg/kg-d)-1	C	OEHHA, 2008	6/12/08
Dichlorodifluoromethane	--	(mg/kg-d)-1	1	--	(mg/kg-d)-1	D	--	--
Dimethyl phthalate	--	(mg/kg-d)-1	1	--	(mg/kg-d)-1	D	--	--
Freon 113	--	(mg/kg-d)-1	1	--	(mg/kg-d)-1	D	--	--
Iron	--	(mg/kg-d)-1	1	--	(mg/kg-d)-1	D	--	--
Lead[2]	--	(mg/kg-d)-1	1	--	$(mg/kg\text{-}d)^{-1}$	B2	USEPA, 2008	6/12/08
Manganese	--	(mg/kg-d)-1	0.04	--	(mg/kg-d)-1	D	OEHHA, 2008	6/12/08
Mercury	--	$(mg/kg\text{-}d)^{-1}$	1	--	$(mg/kg\text{-}d)^{-1}$	D	USEPA, 2008	6/12/08
Methylene chloride	1.4E-02	(mg/kg-d)-1	1	1.4E-02	(mg/kg-d)-1	B2	OEHHA, 2008	6/12/08
Molybdenum	--	(mg/kg-d)-1	1	--	(mg/kg-d)-1	D	--	--
N-Butylbenzenesulfonamide	--	(mg/kg-d)-1	1	--	(mg/kg-d)-1	--	--	--
Naphthalene	--	(mg/kg-d)-1	1	--	(mg/kg-d)-1	C	OEHHA, 2008	6/12/08
Nickel	--	(mg/kg-d)-1	1	--	(mg/kg-d)-1	D	USEPA, 2008	6/12/2008
Nitrate	--	(mg/kg-d)-1	1	--	(mg/kg-d)-1	D	--	--
Nitrite (as N)	--	(mg/kg-d)-1	1	--	(mg/kg-d)-1	D	--	--
N-Nitrosodimethylamine	5.1E+01	(mg/kg-d)-1	1	5.1E+01	(mg/kg-d)-1	B2	USEPA, 2008	6/12/08
Perchlorate	--	$(mg/kg\text{-}d)^{-1}$	1	--	$(mg/kg\text{-}d)^{-1}$	D		
Selenium	--	$(mg/kg\text{-}d)^{-1}$	1	--	$(mg/kg\text{-}d)^{-1}$	D		
Silver	--	$(mg/kg\text{-}d)^{-1}$	0.04	--	$(mg/kg\text{-}d)^{-1}$	D		
Tetrachloroethylene	5.4E-01	(mg/kg-d)-1	1	5.4E-01	(mg/kg-d)-1	B2	OEHHA, 2008	6/12/08
Toluene	--	(mg/kg-d)-1	--	--	(mg/kg-d)-1	D	--	--
Trichloroethylene [7]	1.3E-02	(mg/kg-d)-1	1	1.3E-02	(mg/kg-d)-1	B1	OEHHA, 2008	6/12/08
Trichloroethylene [7]	4.0E-01	(mg/kg-d)-1	1	4.0E-01	(mg/kg-d)-1	B1	NCEA	8/2001
Trichlorofluoromethane	--	(mg/kg-d)-1	--	--	(mg/kg-d)-1	D	--	--
Vanadium	--	(mg/kg-d)-1	0.026	--	(mg/kg-d)-1	D	--	--
Vinyl Chloride	1.5E+00	(mg/kg-d)-1	1	1.5E+00	(mg/kg-d)-1	A	USEPA, 2008	6/12/08
Zinc	NA	$(mg/kg\text{-}d)^{-1}$	1	NA	$(mg/kg\text{-}d)^{-1}$	D		

Table 2-13a *Cancer Toxicity Data — Oral/Dermal*
Baseline Risk Assessment PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Notes

-- = No information available.

1 = cis-1,2-Dichloroethene used as a surrogate

2 = At the request of the agencies, trichloroehtylene was evaluated using both the USEPA and OEHHA slope factors. Both values are included in this table.

HEAST = Health Effect Assessment Summary Table

IRIS = Integrate Risk Information System

$(\mu g/m^3)^{-1}$ = Invert of micrograms per cubic meter

$(mg/kg\text{-}d)^{-1}$ = Invert of milligrams per kilogram-day

NCEA = National Center for Environmental Assessment, USEPA

PPRTV = Provisional Peer Reviewed Toxicity Value

OEHHA - Office of Environmental Health Hazard Assessement

USEPA 2008 = Integrated Risk Information System

USEPA Group

A - Human carcinogen

B1 - Probable human carcinogen - Indicates that limited human data are available

B2 - Probable human carcinogen - Indicates that sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of non-carcinogenicity

Table 2-13b Cancer Toxicity Data — Inhalation
Baseline Risk Assessment PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Chemical of Potential Concern	Unit Risk Value	Unit Risk Units	Inhalation Cancer Slope Factor	Units	Weight of Evidence/ Cancer Guideline Description	Source	Date
1,1,2,2-Tetrachloroethane	5.7E-05	$(\mu g/m^3)^{-1}$	2.0E-01	$(mg/kg\text{-}d)^{-1}$	C	OEHHA, 2008	06/12/08
1,1,2-Trichloroethane	1.6E-05	$(\mu g/m^3)^{-1}$	5.7E-02	$(mg/kg\text{-}d)^{-1}$	C	OEHHA, 2008	06/12/08
1,1-Dichloroethane	1.6E-06	$(\mu g/m^3)^{-1}$	5.7E-03	$(mg/kg\text{-}d)^{-1}$	C	OEHHA 2008	06/12/08
1,1-Dichloroethylene	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	C	USEPA 2008	06/12/08
1,2-Dichloroethane	2.6E-05	$(\mu g/m^3)^{-1}$	9.1E-02	$(mg/kg\text{-}d)^{-1}$	B2	USEPA 2008	06/12/08
1,2-Dichloroethene (cis/trans)	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	USEPA 2008	06/12/08
1,4-Dichlorobenzene	5.7E-06	$(\mu g/m^3)^{-1}$	2.0E-02	$(mg/kg\text{-}d)^{-1}$	--	NCEA	06/12/08
1,4-Dioxane	7.7E-06	$(\mu g/m^3)^{-1}$	2.7E-02	$(mg/kg\text{-}d)^{-1}$	B2	OEHHA, 2008	06/12/08
1-Methyl-2-Pyrrolidinone	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	--	--	--
2,4-DB	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	--	--	--
Aluminum	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	--	--
Ammonia as N	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	--	--
Arsenic	4.3E-03	$(\mu g/m^3)^{-1}$	1.5E+01	$(mg/kg\text{-}d)^{-1}$	A	USEPA 2008	06/12/08
Barium	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	USEPA 2008	06/12/08
Benzene	2.9E-05	$(\mu g/m^3)^{-1}$	1.0E-01	$(mg/kg\text{-}d)^{-1}$	A	OEHHA 2008	06/12/08
Beryllium	2.4E-03	$(\mu g/m^3)^{-1}$	8.4E+00	$(mg/kg\text{-}d)^{-1}$	--	OEHHA 2008	06/12/08
Boron	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	--	--	--
Bromodichloromethane	3.7E-05	$(\mu g/m^3)^{-1}$	1.3E-01	$(mg/kg\text{-}d)^{-1}$	B2	OEHHA 2008	06/12/08
Bromoform	1.1E-06	$(\mu g/m^3)^{-1}$	3.9E-03	$(mg/kg\text{-}d)^{-1}$	B2	USEPA 2008	06/12/08
Cadmium	4.3E-03	$(\mu g/m^3)^{-1}$	1.5E+01	$(mg/kg\text{-}d)^{-1}$	B1	OEHHA 2008	06/12/08
Carbon tetrachloride	4.3E-05	$(\mu g/m^3)^{-1}$	1.5E-01	$(mg/kg\text{-}d)^{-1}$	B2	OEHHA 2008	06/12/08
Chloroform	2.3E-05	$(\mu g/m^3)^{-1}$	8.1E-02	$(mg/kg\text{-}d)^{-1}$	B2	USEPA 2008	06/12/08
Chloromethane	1.8E-06	$(\mu g/m^3)^{-1}$	6.3E-03	$(mg/kg\text{-}d)^{-1}$	C	USEPA 1997	06/12/08
Chromium (hexavalent)	1.5E-01	$(\mu g/m^3)^{-1}$	5.1E+02	$(mg/kg\text{-}d)^{-1}$	A	OEHHA 2008	06/12/08
cis-1,2-Dichloroethene	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	USEPA 2008	06/12/08
Cobalt	2.8E-03	$(\mu g/m^3)^{-1}$	9.8E+00	$(mg/kg\text{-}d)^{-1}$	D	PPRTV	06/12/08
Copper	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	USEPA 2008	06/12/08
Dibromochloromethane	2.7E-05	$(\mu g/m^3)^{-1}$	9.4E-02	$(mg/kg\text{-}d)^{-1}$	C	OEHHA, 2008	6/12/2008
Dichlorodifluoromethane	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	--	--
Dimethyl phthalate	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	--	--
Freon 113	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	--	--
Iron	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	--	--
Lead	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	B2	USEPA, 2008	6/12/08
Manganese	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	--	--
Mercury	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	USEPA, 2008	6/12/08
Methylene Chloride	1.0E-06	$(\mu g/m^3)^{-1}$	3.5E-03	$(mg/kg\text{-}d)^{-1}$	B2	OEHHA 2008	06/12/08
Molybdenum	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	--	--
N-Butylbenzenesulfonamide	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	--	--	--
Naphthalene	3.4E-05	$(\mu g/m^3)^{-1}$	1.2E-01	$(mg/kg\text{-}d)^{-1}$	C	OEHHA 2008	06/12/08
Nickel	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	--	--
Nitrate	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	USEPA, 2008	6/12/08
Nitrite (as N)	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	--	--
N-Nitrosodimethylamine	1.4E-02	$(\mu g/m^3)^{-1}$	4.9E+01	$(mg/kg\text{-}d)^{-1}$	B2	USEPA 2008	6/12/2008
Perchlorate	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	--	--
Selenium	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	--	--
Silver	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	--	--
Tetrachloroethylene	6.0E-06	$(\mu g/m^3)^{-1}$	2.1E-02	$(mg/kg\text{-}d)^{-1}$	B2	OEHHA 2008	06/12/08
Toluene	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	--	--
Trichloroethylene [2]	2.0E-06	$(\mu g/m^3)^{-1}$	7.0E-03	$(mg/kg\text{-}d)^{-1}$	B2	OEHHA 2008	06/12/08
Trichloroethylene [2]	1.1E-04	$(\mu g/m^3)^{-1}$	4.0E-01	$(mg/kg\text{-}d)^{-1}$	B2	NCEA	06/12/08
Trichlorofluoromethane	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	--	--
Vanadium	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	--	--	--
Vinyl chloride	7.7E-05	$(\mu g/m^3)^{-1}$	2.7E-01	$(mg/kg\text{-}d)^{-1}$	A	OEHHA 2008	06/12/08
Zinc	--	$(\mu g/m^3)^{-1}$	--	$(mg/kg\text{-}d)^{-1}$	D	USEPA 2008	06/12/08

Table 2-13b Cancer Toxicity Data — Inhalation
Baseline Risk Assessment PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Notes and Key:

-- = No information available.

1 = cis-1,2-Dichloroethene used as a surrogate

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USEPA Group

A - Human carcinogen

B1 - Probable human carcinogen - Indicates that limited human data are available

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C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of non-carcinogenicity

Table 2-14a
Location-Specific Domestic Use of Groundwater Risk Assessment Results -Resident
Zone 1 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Concentration																														
Sample Name	Layer	1,1,2,2-PCA	1,1,2-TCA	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (total)	1,4-Dioxe	Al	Ba	BDCM	CCL	CF	CrVI	cis-1,2-DCE	Cu	DBCM	Freon 113	Fe	DCM	Mo	Nitrate	Nitrite	NDMA	Perc	Ag	PCE	TOL	TCE	V	VC	Bo	N-BBS
Unit Hazard Child		6.5 E-3	9.7 E-2	1.9 E-3	1.7 E-2	2.3 E-1	3.9 E-2	3.7 E-4	6.7 E-5	3.5 E-4	1.9 E-2	1.4 E-1	3.2 E-2	3.3 E-2	3.9 E-2	1.7 E-3	1.9 E-2	4.6 E-5	9.2 E-5	1.5 E-3	1.3 E-2	4.0 E-5	4.0 E-4	1.0 E+1	9.2 E-2	1.3 E-2	4.2 E-2	4.8 E-3	2.5 E-1	8.0 E-2	3.3 E-2	3.2 E-4	NA
Unit Hazard Adult		2.8 E-3	4.2 E-2	8.3 E-4	7.5 E-3	9.9 E-2	1.7 E-2	1.6 E-4	2.8 E-5	1.5 E-4	8.3 E-3	6.2 E-2	1.4 E-2	1.3 E-2	1.7 E-2	7.4 E-4	8.3 E-3	2.1 E-5	3.9 E-5	6.3 E-4	5.5 E-3	1.7 E-5	1.7 E-4	4.3 E+0	3.9 E-2	5.5 E-3	1.8 E-2	2.1 E-3	1.1 E-1	3.3 E-2	1.4 E-2	1.4 E-4	NA
Unit Risk		1.9 E-5	5.4 E-6	5.2 E-7	NA	8.2 E-6	NA	2.4 E-6	NA	NA	1.2 E-5	1.4 E-5	6.5 E-6	NA	NA	NA	8.5 E-6	NA	NA	4.8 E-7	NA	NA	NA	9.6 E-4	NA	NA	1.4 E-5	NA	7.5 E-7	NA	4.4 E-5	NA	NA
1027	C						2						1.2												88		1.3		20				
1049	F										4.1		35																				
1154	C																																
1156	C/D/E			1.5	3.4		5.4				1				4.3												2.5		270				
1162	C				3.5	0.69	1.7						0.91												110				140				
1163	D																								220				1.4				
1164	E			2.7	28	11	2	19					1.2					1.1											44				
1211	C/D				2		4.2						4.8					3.2							11		2.3		34				
1214	C			2.5	14	0.54	16						1.5												99		3.7		320				
1216	C			2.5	15		18						1.3		7.5										7.8		3.9		360				
1361	C		110	2.9	8.3	1.2	4.4						2.9		1.2		1.4	0.77							60		1		110				
1362	D		94	3.4	5.7	1.3	8.1						6.6		3.6			1.6							120		1.4		100				
1363	D			0.93	2.7	0.61	4.1											1.8							160		0.53		40				
1364	D																												1.5				680
1365	E																												1.1				1700
1370	C			7.1	30	1.3	44	17					3.1					3.8		1					86		8.6		630				
1371	D			3.9	13	1.4	23	12					2					4.3							140		3.7		310				
1372	D			5.1	28	2	51					1.4	4					8.1									8.7		890				
1373	D/E				0.89		1.6																						10				1000
1374	E																												0.5				7100
1375	C			1.7	11	0.55	27						1.2					7									8.2	7.9	120				
1376	D		0.75	7.1	51	2	23	20				2.6	6.9					300		0.56					25		56	7.1	460				
1377	E			5.5	41	1.6	16	13				1.6	5.5					270							5.2		28	6.7	510				
1378	E																																3800
1379	D/E		5.6	14	88	4.5	76	37				4.9	9.3					190							32		14		640				
1380	D			1.1	8.6	0.72	2.7	13				1.2	1.6					13							19		3.1		65				800
1381	E		1.1	7.6	49	2.2	18	18				2.5	8.3					400		4.3							43		750				1100
1382	D			0.75	3.6		17						3.7		31.8			2.7							96		3.2		144				
1383	D			2.7	19		18	14				0.53	4.2		17.7			75							90		8.2		240				
1384	D/E			7.2	76.4	1	18	16				0.98	5.5					280							54		12		460				
1385	D			2.6	17.9		2.9					0.8	1					21							5.2		5.03	11	136				
1386	D				5.8		2.4											10									0.9	10	43.2				
1387	E																																3200
1388	D			3	17	0.77	45	12					4.4					19							84		8	7.2	220				
1389	E		0.88	9	55	1.7	22	18				4.9	5.4					78							12		4.5	6.5	350				
1390	E																											6.7					
1391	C			2.1	7.5		13						1.2												69		4.1		170				
1392	D			1.6	8		20						1.5					1.7							110		3.5		290				
1393	D/E			12	75	6.2	89	33				4.9	9.6					72							46		15		1100				
1394	F																												2.7				3600
1395	C																												3.7				
1396	C																												2				
1397	D						2.1																						81				
1398	E																																2100
1399	E																																5900
1400	D			0.77	2.9		4						0.6					1.4							170		0.58		60				
1401	D			3.8	37	4.6	18	11				0.88	2.7					6.8							13		2.6		280				
1402	F			0.82	2.2	0.51	4.3																						24				
1403	C		0.85	6.8	40	0.7	150	15					6.2					4.7							12		20	7.5	640				
1404	D			3.4	25	1.1	35	16				0.51	2.8					30							110		8	9.4	360				
1405	D			6.5	60	4.2	120	22				1.4	7.9					34							65		21	7.8	2200				
1406	C					0.51																							0.67				230
1407	C																												9.4				
1408	E																												1.1				
1409	F																																810
1419	C			1.2	30	1.2						5.6	0.81												4.6				34				
1420	D			1.1	29	1.1	0.83					4.7	0.55																38				
1421	D			0.99	30	1	1.3					4	0.76					2.6											67				
1422	E												5.1							2.3													
1423	E																			0.69													
1469	C			1.7	36	1.2	30	10					1.8		25.7												9		870				
1470	D			6	38	0.6	56	15				0.76	3.5		31.5			8.6							41		10		1100				
1471	E			1.9	9.9	0.61	8.3								2.52												3.5		120				
1472	C			1.3	6.9		30						1.3					1.8									4.5		140				
1473	E																																
1474	F																											11					
1475	C				0.84		3.7						1.1												85		0.92		47				
1476	D																								200				1.1				
1477	E		0.51	5.7	42	4.7	19	19					3.2					290							99		13		410				
1478	C				2.5		2.4																				0.64		23				
1479	D		1.1	4.6	37	3	59	6.3				1.9	4.4		58			48							9.8		14		1600				
1480	E			2.6	8.9	0.6	15	1.5				0.61	1.6		12			8.8		0.73							5.6		670				
1481	C																												1.2				
1482	D																												1				
1483	E						0.66																						25				
1487	C																												1.4				
1488	C						2.5								1														56				
1489	E		1.7	6.7	41	2.1	42	3.5				3.7	5.4					19									8.3		1100				
1506	C																																
1507	D																																
1508	E																																
1509	C				2.7	0.57	7.6				1		0.61		5.7												3.2		290				
1510	D																												4.3				
1511	E																																
1516	B																																
1517	B																																
1518	B/C																												3.7				
1519	C				1.1		4.8						0.59														1.8		190				
1520	D				2.2		9.2						0.61														2.6		320				
1521	E																																
1522	C																											7.7	6.1				
1523	C				0.68		2																					10	31				
1524	E						1.4																				0.7	8.2	73				
1525	C																																
1526	C																																
1527	E						0.68																				0.54		25				
1528	C																																
1529	E																																
1530	E																																
1531	C				0.57		0.67																						47				
1532	C																												37				
1533	D																																
1539	C												4																29				
1540	D				0.89		4.7								2.8												2.5		150				
1557	C/D																												1.6				
1558	D																																
1559	C																										1.8		2.8				
1560	C																										0.84						
1561	D																																
1562	C																																
1563	C																																
1564	C																												0.54				
1565	C																																
1566	D																												3.2				
1567	B																												1.6				
1568	C																																
1569	D	2.3																											12				

Table 2-14a
Location-Specific Domestic Use of Groundwater Risk Assessment Results -Resident
Zone 1 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Concentration																														
Sample Name	**Layer**	**1,1,2,2-PCA**	**1,1,2-TCA**	**1,1-DCA**	**1,1-DCE**	**1,2-DCA**	**1,2-DCE (total)**	**1,4-Diox**	**Al**	**Ba**	**BDCM**	**CCL**	**CF**	**CrVI**	**cis-1,2-DCE**	**Cu**	**DBCM**	**Freon 113**	**Fe**	**DCM**	**Mo**	**Nitrate**	**Nitrite**	**NDMA**	**Perc**	**Ag**	**PCE**	**TOL**	**TCE**	**V**	**VC**	**Bo**	**N-BBS**
Unit Hazard Child		6.5 E-3	9.7 E-2	1.9 E-3	1.7 E-2	2.3 E-1	3.9 E-2	3.7 E-4	6.7 E-5	3.5 E-4	1.9 E-2	1.4 E-1	3.2 E-2	3.3 E-2	3.9 E-2	1.7 E-3	1.9 E-2	4.6 E-5	9.2 E-5	1.5 E-3	1.3 E-2	4.0 E-5	4.0 E-4	1.0 E+1	9.2 E-2	1.3 E-2	4.2 E-2	4.8 E-3	2.5 E-1	8.0 E-2	3.3 E-2	3.2 E-4	NA
Unit Hazard Adult		2.8 E-3	4.2 E-2	8.3 E-4	7.5 E-3	9.9 E-2	1.7 E-2	1.6 E-4	2.8 E-5	1.5 E-4	8.3 E-3	6.2 E-2	1.4 E-2	1.3 E-2	1.7 E-2	7.4 E-4	8.3 E-3	2.1 E-5	3.9 E-5	6.3 E-4	5.5 E-3	1.7 E-5	1.7 E-4	4.3 E+0	3.9 E-2	5.5 E-3	1.8 E-2	2.1 E-3	1.1 E-1	3.3 E-2	1.4 E-2	1.4 E-4	NA
Unit Risk		1.9 E-5	5.4 E-6	5.2 E-7	NA	8.2 E-6	NA	2.4 E-6	NA	NA	1.2 E-5	1.4 E-5	6.5 E-6	NA	NA	NA	8.5 E-6	NA	NA	4.8 E-7	NA	NA	NA	9.6 E-4	NA	NA	1.4 E-5	NA	7.5 E-7	NA	4.4 E-5	NA	NA
1570	C																												1				
1571	C																																
1572	C																																
1573	D																																
1574	C																																
1585	C														2.8													4.7	23				
1586	C					1							4															4.4	4.6				
1587	D														1.3													5.6	14				
1588	E																												2.3				
1589	E																												1.8				
1590	F																																
1591	C																																
1592	C																												0.82				
1593	D																																
1594	C																												2.3				
1595	D/E																																
1596	E																																
4300	C																											11	2.2				
4301	C						1.6								1.69												0.51	9.9	57				
4302	D						1.4						0.72		1.13												0.56	8.3	53				
4325	C			1.9	14		26						1.4		21.6			2							8.1		5.3	9.4	209				
4330	C/D			6.8	48	6	64	13				2.5	5.3		59.9			78							33		11	9.3	840		1.3		
4335	D/E		2.8	8.7	64	50	69	15				4.8	8.1		60.2			74							22		17	8.7	1330		1.1		
4340	C																											8.4					
4345	C																											7.9	1.6				
4350	D																											9.6	2.1				
4355	C																											8.8	3.3				
4360	C																											9.5	24				
4365	D						1.2																					9.1	34				
4370	C																												2.6				
4375	C																												8.2				
4380	D						1.2								1.3					0.54									42				
4580	D/E						3.4						0.57														0.82		110				
4585	E				3.4		5			57	0.52		2.4									3700					0.61		81				
4620	E									60												2500							19				
30068	C			7.7	27	0.74	41	14			1		2.4		38.2			2.7							140		7.9		490				
30069	E			1.8	14		15								13												4.3		200				
30070	E				2.8		5.7								4.01												0.59		68				
30071	C/D				11	0.79						1.9																	30				
30072	D				14	0.96						2.4						1.3											42				
30073	D/E				19	1.2						3.4						4.1											82				
30100	C																												1.8				
30101	C		3.3	9.8	110	24	150	23				5.9	12		130			60							17		40		3700				
30102	D		1.3	9.3	63	100	57	20				4.4	7.5		39			150							50		14		850				
30103	E				0.79		1.6																					9.5	32				
30140	E									34												2800											
30141	E									26												3400							1.6				
30156	E			2.3	19	1.4	23			64		2	2.5					5.4				4800					5.6		610				
30157	E						2.9			50												3600					0.52		79				
30158	D				2.4		4.9			53	0.58				3.2							1600				33	1.1		150				
30174	D			3	9.7	0.85	13			85		1.2	1.8		6.4			15				4700	170				3.7		400	9.2			
30175	E						1.2		580	510									1200			370							46	9.5		160	
30176	F									140							3.9												1.4	37			
30177	E						0.59		210	99												2500							28	9.8			
30178	E									90												2700	92						27	13			
30179	F								1000	590						6.3			1400		77	630			7.2				24	16		1200	
30180	D						1.2			49												1100							34				
30181	D						1.4			71												1400							41				
30182	E						0.6			74												2700							29	7.3			
30195	C								950	220			0.86	78		23					810	240	320	0.012						9.1			
30196	C									90												4700							11				
30197	D									70												5300							17				

		Child Non-Cancer Hazard Index																																
Sample Name	**Layer**	**1,1,2,2-PCA**	**1,1,2-TCA**	**1,1-DCA**	**1,1-DCE**	**1,2-DCA**	**1,2-DCE (total)**	**1,4-Diox**	**Al**	**Ba**	**BDCM**	**CCL**	**CF**	**CrVI**	**cis-1,2-DCE**	**Cu**	**DBCM**	**Freon 113**	**Fe**	**DCM**	**Mo**	**Nitrate**	**Nitrite**	**NDMA**	**Perc**	**Ag**	**PCE**	**TOL**	**TCE**	**V**	**VC**	**Bo**	**N-BBS**	**HI**
Unit Hazard Child																																		
Unit Hazard Adult																																		
Unit Risk																																		
1027	C	NA	NA	NA	NA	NA	7.8 E-2	NA	NA	NA	NA	NA	3.8 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.1 E+0	NA	5.5 E-2	NA	5.0 E+0	NA	NA	NA	NA	1.3 E+1
1049	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.0 E-2	NA	1.1 E+0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E+0
1154	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1156	C/D/E	NA	NA	2.9 E-3	5.9 E-2	NA	2.1 E-1	NA	NA	NA	1.9 E-2	NA	NA	NA	1.7 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-1	NA	6.8 E+1	NA	NA	NA	NA	6.8 E+1
1162	C	NA	NA	NA	6.1 E-2	1.6 E-1	6.6 E-2	NA	NA	NA	NA	NA	2.9 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E+1	NA	NA	NA	3.5 E+1	NA	NA	NA	NA	4.5 E+1
1163	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E+1	NA	NA	NA	3.5 E-1	NA	NA	NA	NA	2.1 E+1
1164	E	NA	NA	5.2 E-3	4.9 E-1	2.5 E+0	7.8 E-2	7.1 E-3	NA	NA	NA	NA	3.8 E-2	NA	NA	NA	NA	5.1 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E+1	NA	NA	NA	NA	1.4 E+1
1211	C/D	NA	NA	NA	3.5 E-2	NA	1.6 E-1	NA	NA	NA	NA	NA	1.5 E-1	NA	NA	NA	NA	1.5 E-4	NA	NA	NA	NA	NA	NA	1.0 E+0	NA	9.7 E-2	NA	8.5 E+0	NA	NA	NA	NA	1.0 E+1
1214	C	NA	NA	4.9 E-3	2.4 E-1	1.3 E-1	6.2 E-1	NA	NA	NA	NA	NA	4.7 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.1 E+0	NA	1.6 E-1	NA	8.0 E+1	NA	NA	NA	NA	9.0 E+1
1216	C	NA	NA	4.9 E-3	2.6 E-1	NA	7.0 E-1	NA	NA	NA	NA	NA	4.1 E-2	NA	2.9 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.2 E-1	NA	1.6 E-1	NA	9.0 E+1	NA	NA	NA	NA	9.2 E+1
1361	C	NA	1.1 E+1	5.6 E-3	1.4 E-1	2.8 E-1	1.7 E-1	NA	NA	NA	NA	NA	9.1 E-2	NA	4.7 E-2	NA	2.7 E-2	3.6 E-5	NA	NA	NA	NA	NA	NA	5.5 E+0	NA	4.2 E-2	NA	2.8 E+1	NA	NA	NA	NA	4.5 E+1
1362	D	NA	9.1 E+0	6.6 E-3	9.9 E-2	3.0 E-1	3.2 E-1	NA	NA	NA	NA	NA	2.1 E-1	NA	1.4 E-1	NA	NA	7.4 E-5	NA	NA	NA	NA	NA	NA	1.1 E+1	NA	5.9 E-2	NA	2.5 E+1	NA	NA	NA	NA	4.6 E+1
1363	D	NA	NA	1.8 E-3	4.7 E-2	1.4 E-1	1.6 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.4 E-5	NA	NA	NA	NA	NA	NA	1.5 E+1	NA	2.2 E-2	NA	1.0 E+1	NA	NA	NA	NA	2.5 E+1
1364	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.8 E-1	NA	NA	NA	NA	3.8 E-1
1365	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.8 E-1	NA	NA	NA	NA	2.8 E-1
1370	C	NA	NA	1.4 E-2	5.2 E-1	3.0 E-1	1.7 E+0	6.3 E-3	NA	NA	NA	NA	9.8 E-2	NA	NA	NA	NA	1.8 E-4	NA	1.5 E-3	NA	NA	NA	NA	7.9 E+0	NA	3.6 E-1	NA	1.6 E+2	NA	NA	NA	NA	1.7 E+2
1371	D	NA	NA	7.6 E-3	2.3 E-1	3.2 E-1	9.0 E-1	4.5 E-3	NA	NA	NA	NA	6.3 E-2	NA	NA	NA	NA	2.0 E-4	NA	NA	NA	NA	NA	NA	1.3 E+1	NA	1.6 E-1	NA	7.8 E+1	NA	NA	NA	NA	9.2 E+1
1372	D	NA	NA	9.9 E-3	4.9 E-1	4.6 E-1	2.0 E+0	NA	NA	NA	NA	2.0 E-1	1.3 E-1	NA	NA	NA	NA	3.8 E-4	NA	NA	NA	NA	NA	NA	NA	NA	3.7 E-1	NA	2.2 E+2	NA	NA	NA	NA	2.3 E+2
1373	D/E	NA	NA	NA	1.6 E-2	NA	6.2 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E+0	NA	NA	NA	NA	2.6 E+0
1374	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-1	NA	NA	NA	NA	1.3 E-1
1375	C	NA	NA	3.3 E-3	1.9 E-1	1.3 E-1	1.1 E+0	NA	NA	NA	NA	NA	3.8 E-2	NA	NA	NA	NA	3.3 E-4	NA	NA	NA	NA	NA	NA	NA	NA	3.4 E-1	3.8 E-2	3.0 E+1	NA	NA	NA	NA	3.2 E+1
1376	D	NA	7.3 E-2	1.4 E-2	8.9 E-1	4.6 E-1	9.0 E-1	7.5 E-3	NA	NA	NA	3.7 E-1	2.2 E-1	NA	NA	NA	NA	1.4 E-2	NA	8.3 E-4	NA	NA	NA	NA	2.3 E+0	NA	2.4 E+0	3.4 E-2	1.2 E+2	NA	NA	NA	NA	1.2 E+2
1377	E	NA	NA	1.1 E-2	7.1 E-1	3.7 E-1	6.2 E-1	4.8 E-3	NA	NA	NA	2.3 E-1	1.7 E-1	NA	NA	NA	NA	1.3 E-2	NA	NA	NA	NA	NA	NA	4.8 E-1	NA	1.2 E+0	3.2 E-2	1.3 E+2	NA	NA	NA	NA	1.3 E+2
1378	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1379	D/E	NA	5.5 E-1	2.7 E-2	1.5 E+0	1.0 E+0	3.0 E+0	1.4 E-2	NA	NA	NA	7.0 E-1	2.9 E-1	NA	NA	NA	NA	8.8 E-3	NA	NA	NA	NA	NA	NA	2.9 E+0	NA	5.9 E-1	NA	1.6 E+2	NA	NA	NA	NA	1.7 E+2
1380	D	NA	NA	2.1 E-3	1.5 E-1	1.7 E-1	1.1 E-1	4.8 E-3	NA	NA	NA	1.7 E-1	5.0 E-2	NA	NA	NA	NA	6.0 E-4	NA	NA	NA	NA	NA	NA	1.7 E+0	NA	1.3 E-1	NA	1.6 E+1	NA	NA	NA	NA	1.9 E+1
1381	E	NA	1.1 E-1	1.5 E-2	8.5 E-1	5.1 E-1	7.0 E-1	6.7 E-3	NA	NA	NA	3.6 E-1	2.6 E-1	NA	NA	NA	NA	1.9 E-2	NA	6.4 E-3	NA	NA	NA	NA	NA	NA	1.8 E+0	NA	1.9 E+2	NA	NA	NA	NA	1.9 E+2
1382	D	NA	NA	1.5 E-3	6.3 E-2	NA	6.6 E-1	NA	NA	NA	NA	NA	1.2 E-1	NA	1.2 E+0	NA	NA	1.3 E-4	NA	NA	NA	NA	NA	NA	8.8 E+0	NA	1.3 E-1	NA	3.6 E+1	NA	NA	NA	NA	4.7 E+1
1383	D	NA	NA	5.2 E-3	3.3 E-1	NA	7.0 E-1	5.2 E-3	NA	NA	NA	7.6 E-2	1.3 E-1	NA	6.9 E-1	NA	NA	3.5 E-3	NA	NA	NA	NA	NA	NA	8.3 E+0	NA	3.4 E-1	NA	6.0 E+1	NA	NA	NA	NA	7.1 E+1
1384	D/E	NA	NA	1.4 E-2	1.3 E+0	2.3 E-1	7.0 E-1	6.0 E-3	NA	NA	NA	1.4 E-1	1.7 E-1	NA	NA	NA	NA	1.3 E-2	NA	NA	NA	NA	NA	NA	5.0 E+0	NA	5.0 E-1	NA	1.2 E+2	NA	NA	NA	NA	1.2 E+2
1385	D	NA	NA	5.1 E-3	3.1 E-1	NA	1.1 E-1	NA	NA	NA	NA	1.1 E-1	3.2 E-2	NA	NA	NA	NA	9.8 E-4	NA	NA	NA	NA	NA	NA	4.8 E-1	NA	2.1 E-1	5.3 E-2	3.4 E+1	NA	NA	NA	NA	3.5 E+1
1386	D	NA	NA	NA	1.0 E-1	NA	9.3 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.6 E-4	NA	NA	NA	NA	NA	NA	NA	NA	3.8 E-2	4.8 E-2	1.1 E+1	NA	NA	NA	NA	1.1 E+1
1387	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1388	D	NA	NA	5.8 E-3	3.0 E-1	1.8 E-1	1.8 E+0	4.5 E-3	NA	NA	NA	NA	1.4 E-1	NA	NA	NA	NA	8.8 E-4	NA	NA	NA	NA	NA	NA	7.7 E+0	NA	3.4 E-1	3.4 E-2	5.5 E+1	NA	NA	NA	NA	6.6 E+1
1389	E	NA	8.6 E-2	1.7 E-2	9.6 E-1	3.9 E-1	8.6 E-1	6.7 E-3	NA	NA	NA	7.0 E-1	1.7 E-1	NA	NA	NA	NA	3.6 E-3	NA	NA	NA	NA	NA	NA	1.1 E+0	NA	1.9 E-1	3.1 E-2	8.8 E+1	NA	NA	NA	NA	9.2 E+1
1390	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.2 E-2	NA	NA	NA	NA	NA	3.2 E-2
1391	C	NA	NA	4.1 E-3	1.3 E-1	NA	5.1 E-1	NA	NA	NA	NA	NA	3.8 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.3 E+0	NA	1.7 E-1	NA	4.3 E+1	NA	NA	NA	NA	5.0 E+1
1392	D	NA	NA	3.1 E-3	1.4 E-1	NA	7.8 E-1	NA	NA	NA	NA	NA	4.7 E-2	NA	NA	NA	NA	7.9 E-5	NA	NA	NA	NA	NA	NA	1.0 E+1	NA	1.5 E-1	NA	7.3 E+1	NA	NA	NA	NA	8.4 E+1
1393	D/E	NA	NA	2.3 E-2	1.3 E+0	1.4 E+0	3.5 E+0	1.2 E-2	NA	NA	NA	7.0 E-1	3.0 E-1	NA	NA	NA	NA	3.3 E-3	NA	NA	NA	NA	NA	NA	4.2 E+0	NA	6.3 E-1	NA	2.8 E+2	NA	NA	NA	NA	2.9 E+2
1394	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.8 E-1	NA	NA	NA	NA	6.8 E-1
1395	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.3 E-1	NA	NA	NA	NA	9.3 E-1
1396	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.0 E-1	NA	NA	NA	NA	5.0 E-1
1397	D	NA	NA	NA	NA	NA	8.2 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E+1	NA	NA	NA	NA	2.0 E+1
1398	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1399	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1400	D	NA	NA	1.5 E-3	5.1 E-2	NA	1.6 E-1	NA	NA	NA	NA	NA	1.9 E-2	NA	NA	NA	NA	6.5 E-5	NA	NA	NA	NA	NA	NA	1.6 E+1	NA	2.4 E-2	NA	1.5 E+1	NA	NA	NA	NA	3.1 E+1
1401	D	NA	NA	7.4 E-3	6.5 E-1	1.1 E+0	7.0 E-1	4.1 E-3	NA	NA	NA	1.3 E-1	8.5 E-2	NA	NA	NA	NA	3.2 E-4	NA	NA	NA	NA	NA	NA	1.2 E+0	NA	1.1 E-1	NA	7.0 E+1	NA	NA	NA	NA	7.4 E+1
1402	F	NA	NA	1.6 E-3	3.8 E-2	1.2 E-1	1.7 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.0 E+0	NA	NA	NA	NA	6.3 E+0
1403	C	NA	8.3 E-2	1.3 E-2	7.0 E-1	1.6 E-1	5.8 E+0	5.6 E-3	NA	NA	NA	NA	2.0 E-1	NA	NA	NA	NA	2.2 E-4	NA	NA	NA	NA	NA	NA	1.1 E+0	NA	8.4 E-1	3.6 E-2	1.6 E+2	NA	NA	NA	NA	1.7 E+2
1404	D	NA	NA	6.6 E-3	4.4 E-1	2.5 E-1	1.4 E+0	6.0 E-3	NA	NA	NA	7.3 E-2	8.8 E-2	NA	NA	NA	NA	1.4 E-3	NA	NA	NA	NA	NA	NA	1.0 E+1	NA	3.4 E-1	4.5 E-2	9.0 E+1	NA	NA	NA	NA	1.0 E+2
1405	D	NA	NA	1.3 E-2	1.0 E+0	9.7 E-1	4.7 E+0	8.2 E-3	NA	NA	NA	2.0 E-1	2.5 E-1	NA	NA	NA	NA	1.6 E-3	NA	NA	NA	NA	NA	NA	6.0 E+0	NA	8.8 E-1	3.7 E-2	5.5 E+2	NA	NA	NA	NA	5.7 E+2
1406	C	NA	NA	NA	NA	1.2 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.7 E-1	NA	NA	NA	NA	2.9 E-1
1407	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.4 E+0	NA	NA	NA	NA	2.4 E+0
1408	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.8 E-1	NA	NA	NA	NA	2.8 E-1
1409	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1419	C	NA	NA	2.3 E-3	5.2 E-1	2.8 E-1	NA	NA	NA	NA	NA	8.0 E-1	2.6 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.2 E-1	NA	NA	NA	8.5 E+0	NA	NA	NA	NA	1.1 E+1
1420	D	NA	NA	2.1 E-3	5.1 E-1	2.5 E-1	3.2 E-2	NA	NA	NA	NA	6.7 E-1	1.7 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.5 E+0	NA	NA	NA	NA	1.1 E+1
1421	D	NA	NA	1.9 E-3	5.2 E-1	2.3 E-1	5.1 E-2	NA	NA	NA	NA	5.7 E-1	2.4 E-2	NA	NA	NA	NA	1.2 E-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.7 E+1	NA	NA	NA	NA	1.8 E+1
1422	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E-1	NA	NA	NA	NA	NA	NA	3.4 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E-1
1423	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E-3
1469	C	NA	NA	3.3 E-3	6.3 E-1	2.8 E-1	1.2 E+0	3.7 E-3	NA	NA	NA	NA	5.7 E-2	NA	1.0 E+0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.8 E-1	NA	2.2 E+2	NA	NA	NA	NA	2.2 E+2
1470	D	NA	NA	1.2 E-2	6.6 E-1	1.4 E-1	2.2 E+0	5.6 E-3	NA	NA	NA	1.1 E-1	1.1 E-1	NA	1.2 E+0	NA	NA	4.0 E-4	NA	NA	NA	NA	NA	NA	3.8 E+0	NA	4.2 E-1	NA	2.8 E+2	NA	NA	NA	NA	2.8 E+2
1471	E	NA	NA	3.7 E-3	1.7 E-1	1.4 E-1	3.2 E-1	NA	NA	NA	NA	NA	NA	NA	9.8 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E-1	NA	3.0 E+1	NA	NA	NA	NA	3.1 E+1
1472	C	NA	NA	2.5 E-3	1.2 E-1	NA	1.2 E+0	NA	NA	NA	NA	NA	4.1 E-2	NA	NA	NA	NA	8.4 E-5	NA	NA	NA	NA	NA	NA	NA	NA	1.9 E-1	NA	3.5 E+1	NA	NA	NA	NA	3.7 E+1
1473	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1474	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.3 E-2	NA	NA	NA	NA	NA	5.3 E-2
1475	C	NA	NA	NA	1.5 E-2	NA	1.4 E-1	NA	NA	NA	NA	NA	3.5 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.8 E+0	NA	3.9 E-2	NA	1.2 E+1	NA	NA	NA	NA	2.0 E+1
1476	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.8 E+1	NA	NA	NA	2.8 E-1	NA	NA	NA	NA	1.9 E+1
1477	E	NA	5.0 E-2	1.1 E-2	7.3 E-1	1.1 E+0	7.4 E-1	7.1 E-3	NA	NA	NA	NA	1.0 E-1	NA	NA	NA	NA	1.3 E-2	NA	NA	NA	NA	NA	NA	9.1 E+0	NA	5.5 E-1	NA	1.0 E+2	NA	NA	NA	NA	1.2 E+2
1478	C	NA	NA	NA	4.4 E-2	NA	9.3 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.7 E-2	NA	5.8 E+0	NA	NA	NA	NA	5.9 E+0
1479	D	NA	1.1 E-1	8.9 E-3	6.5 E-1	6.9 E-1	2.3 E+0	2.3 E-3	NA	NA	NA	2.7 E-1	1.4 E-1	NA	2.3 E+0	NA	NA	2.2 E-3	NA	NA	NA	NA	NA	NA	9.0 E-1	NA	5.9 E-1	NA	4.0 E+2	NA	NA	NA	NA	4.1 E+2
1480	E	NA	NA	5.1 E-3	1.6 E-1	1.4 E-1	5.8 E-1	5.6 E-4	NA	NA	NA	8.7 E-2	5.0 E-2	NA	4.7 E-1	NA	NA	4.1 E-4	NA	1.1 E-3	NA	NA	NA	NA	NA	NA	2.4 E-1	NA	1.7 E+2	NA	NA	NA	NA	1.7 E+2
1481	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.0 E-1	NA	NA	NA	NA	3.0 E-1
1482	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-1	NA	NA	NA	NA	2.5 E-1
1483	E	NA	NA	NA	NA	NA	2.6 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.3 E+0	NA	NA	NA	NA	6.3 E+0
1487	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.5 E-1	NA	NA	NA	NA	3.5 E-1
1488	C	NA	NA	NA	NA	NA	9.7 E-2	NA	NA	NA	NA	NA	NA	NA	3.9 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.4 E+1	NA	NA	NA	NA	1.4 E+1
1489	E	NA	1.7 E-1	1.3 E-2	7.1 E-1	4.9 E-1	1.6 E+0	1.3 E-3	NA	NA	NA	5.3 E-1	1.7 E-1	NA	NA	NA	NA	8.8 E-4	NA	NA	NA	NA	NA	NA	NA	NA	3.5 E-1	NA	2.8 E+2	NA	NA	NA	NA	2.8 E+2
1506	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1507	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1508	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1509	C	NA	NA	NA	4.7 E-2	1.3 E-1	3.0 E-1	NA	NA	NA	1.9 E-2	NA	1.9 E-2	NA	2.2 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-1	NA	7.3 E+1	NA	NA	NA	NA	7.4 E+1
1510	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E+0	NA	NA	NA	NA	1.1 E+0
1511	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1516	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1517	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1518	B/C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.3 E-1	NA	NA	NA	NA	9.3 E-1
1519	C	NA	NA	NA	1.9 E-2	NA	1.9 E-1	NA	NA	NA	NA	NA	1.9 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.6 E-2	NA	4.8 E+1	NA	NA	NA	NA	4.8 E+1
1520	D	NA	NA	NA	3.8 E-2	NA	3.6 E-1	NA	NA	NA	NA	NA	1.9 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-1	NA	8.0 E+1	NA	NA	NA	NA	8.1 E+1
1521	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1522	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.7 E-2	1.5 E+0	NA	NA	NA	NA	1.6 E+0
1523	C	NA	NA	NA	1.2 E-2	NA	7.8 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.8 E-2	7.8 E+0	NA	NA	NA	NA	7.9 E+0
1524	E	NA	NA	NA	NA	NA	5.4 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.9 E-2	3.9 E-2	1.8 E+1	NA	NA	NA	NA	1.8 E+1
1525	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1526	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1527	E	NA	NA	NA	NA	NA	2.6 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.3 E-2	NA	6.3 E+0	NA	NA	NA	NA	6.3 E+0
1528	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1529	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1530	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1531	C	NA	NA	NA	9.9 E-3	NA	2.6 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E+1	NA	NA	NA	NA	1.2 E+1
1532	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.3 E+0	NA	NA	NA	NA	9.3 E+0
1533	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1539	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.3 E+0	NA	NA	NA	NA	7.4 E+0
1540	D	NA	NA	NA	1.6 E-2	NA	1.8 E-1	NA	NA	NA	NA	NA	NA	NA	1.1 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-1	NA	3.8 E+1	NA	NA	NA	NA	3.8 E+1
1557	C/D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.0 E-1	NA	NA	NA	NA	4.0 E-1
1558	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1559	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.6 E-2	NA	7.0 E-1	NA	NA	NA	NA	7.8 E-1
1560	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.5 E-2	NA	NA	NA	NA	NA	NA	3.5 E-2
1561	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1562	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1563	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1564	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.4 E-1	NA	NA	NA	NA	1.4 E-1
1565	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1566	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.0 E-1	NA	NA	NA	NA	8.0 E-1
1567	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.0 E-1	NA	NA	NA	NA	4.0 E-1
1568	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1569	D	1.5 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.0 E+0	NA	NA	NA	NA	3.0 E+0

		Child Non-Cancer Hazard Index																															
Sample Name	**Layer**	**1,1,2,2-PCA**	**1,1,2-TCA**	**1,1-DCA**	**1,1-DCE**	**1,2-DCA**	**1,2-DCE (total)**	**1,4-Diox**	**Al**	**Ba**	**BDCM**	**CCL**	**CF**	**CrVI**	**cis-1,2-DCE**	**Cu**	**DBCM**	**Freon 113**	**Fe**	**DCM**	**Mo**	**Nitrate**	**Nitrite**	**NDMA**	**Perc**	**Ag**	**PCE**	**TOL**	**TCE**	**V**	**VC**	**Bo**	**N-BBS**	**HI**
Unit Hazard Child																																		
Unit Hazard Adult																																		
Unit Risk																																		
1570	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-1	NA	NA	NA	NA	2.5 E-1
1571	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1572	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1573	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1574	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1585	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.3 E-2	5.8 E+0	NA	NA	NA	NA	5.9 E+0
1586	C	NA	NA	NA	NA	2.3 E-1	NA	NA	NA	NA	NA	NA	1.3 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.1 E-2	1.2 E+0	NA	NA	NA	NA	1.5 E+0
1587	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.1 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.7 E-2	3.5 E+0	NA	NA	NA	NA	3.6 E+0
1588	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.8 E-1	NA	NA	NA	NA	5.8 E-1
1589	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.5 E-1	NA	NA	NA	NA	4.5 E-1
1590	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1591	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1592	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.1 E-1	NA	NA	NA	NA	2.1 E-1
1593	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1594	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.8 E-1	NA	NA	NA	NA	5.8 E-1
1595	D/E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1596	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4300	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.3 E-2	5.5 E-1	NA	NA	NA	NA	6.0 E-1
4301	C	NA	NA	NA	NA	NA	6.2 E-2	NA	NA	NA	NA	NA	NA	NA	6.6 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.1 E-2	4.7 E-2	1.4 E+1	NA	NA	NA	NA	1.4 E+1
4302	D	NA	NA	NA	NA	NA	5.4 E-2	NA	NA	NA	NA	NA	2.3 E-2	NA	4.4 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.4 E-2	4.0 E-2	1.3 E+1	NA	NA	NA	NA	1.3 E+1
4325	C	NA	NA	3.7 E-3	2.4 E-1	NA	1.0 E+0	NA	NA	NA	NA	NA	4.4 E-2	NA	8.4 E-1	NA	NA	9.3 E-5	NA	NA	NA	NA	NA	NA	7.4 E-1	NA	2.2 E-1	4.5 E-2	5.2 E+1	NA	NA	NA	NA	5.6 E+1
4330	C/D	NA	NA	1.3 E-2	8.4 E-1	1.4 E+0	2.5 E+0	4.8 E-3	NA	NA	NA	3.6 E-1	1.7 E-1	NA	2.3 E+0	NA	NA	3.6 E-3	NA	NA	NA	NA	NA	NA	3.0 E+0	NA	4.6 E-1	4.5 E-2	2.1 E+2	NA	4.4 E-2	NA	NA	2.2 E+2
4335	D/E	NA	2.7 E-1	1.7 E-2	1.1 E+0	1.2 E+1	2.7 E+0	5.6 E-3	NA	NA	NA	6.9 E-1	2.6 E-1	NA	2.3 E+0	NA	NA	3.4 E-3	NA	NA	NA	NA	NA	NA	2.0 E+0	NA	7.1 E-1	4.2 E-2	3.3 E+2	NA	3.7 E-2	NA	NA	3.5 E+2
4340	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.0 E-2	NA	NA	NA	NA	NA	4.0 E-2
4345	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.8 E-2	4.0 E-1	NA	NA	NA	NA	4.4 E-1
4350	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.6 E-2	5.3 E-1	NA	NA	NA	NA	5.7 E-1
4355	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.2 E-2	8.3 E-1	NA	NA	NA	NA	8.7 E-1
4360	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.6 E-2	6.0 E+0	NA	NA	NA	NA	6.1 E+0
4365	D	NA	NA	NA	NA	NA	4.7 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.4 E-2	8.5 E+0	NA	NA	NA	NA	8.6 E+0
4370	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 E-1	NA	NA	NA	NA	6.5 E-1
4375	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.1 E+0	NA	NA	NA	NA	2.1 E+0
4380	D	NA	NA	NA	NA	NA	4.7 E-2	NA	NA	NA	NA	NA	NA	NA	5.1 E-2	NA	NA	NA	NA	8.0 E-4	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E+1	NA	NA	NA	NA	1.1 E+1
4580	D/E	NA	NA	NA	NA	NA	1.3 E-1	NA	NA	NA	NA	NA	1.8 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.4 E-2	NA	2.8 E+1	NA	NA	NA	NA	2.8 E+1
4585	E	NA	NA	NA	5.9 E-2	NA	1.9 E-1	NA	NA	2.0 E-2	1.0 E-2	NA	7.6 E-2	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E-1	NA	NA	NA	NA	2.6 E-2	NA	2.0 E+1	NA	NA	NA	NA	2.1 E+1
4620	E	NA	NA	NA	NA	NA	NA	NA	NA	2.1 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E-1	NA	NA	NA	NA	NA	NA	4.8 E+0	NA	NA	NA	NA	4.9 E+0
30068	C	NA	NA	1.5 E-2	4.7 E-1	1.7 E-1	1.6 E+0	5.2 E-3	NA	NA	1.9 E-2	NA	7.6 E-2	NA	1.5 E+0	NA	NA	1.3 E-4	NA	NA	NA	NA	NA	NA	1.3 E+1	NA	3.3 E-1	NA	1.2 E+2	NA	NA	NA	NA	1.4 E+2
30069	E	NA	NA	3.5 E-3	2.4 E-1	NA	5.8 E-1	NA	NA	NA	NA	NA	NA	NA	5.1 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.8 E-1	NA	5.0 E+1	NA	NA	NA	NA	5.2 E+1
30070	E	NA	NA	NA	4.9 E-2	NA	2.2 E-1	NA	NA	NA	NA	NA	NA	NA	1.6 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-2	NA	1.7 E+1	NA	NA	NA	NA	1.7 E+1
30071	C/D	NA	NA	NA	1.9 E-1	1.8 E-1	NA	NA	NA	NA	NA	2.7 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.5 E+0	NA	NA	NA	NA	8.2 E+0
30072	D	NA	NA	NA	2.4 E-1	2.2 E-1	NA	NA	NA	NA	NA	3.4 E-1	NA	NA	NA	NA	NA	6.0 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E+1	NA	NA	NA	NA	1.1 E+1
30073	D/E	NA	NA	NA	3.3 E-1	2.8 E-1	NA	NA	NA	NA	NA	4.9 E-1	NA	NA	NA	NA	NA	1.9 E-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.1 E+1	NA	NA	NA	NA	2.2 E+1
30100	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.5 E-1	NA	NA	NA	NA	4.5 E-1
30101	C	NA	3.2 E-1	1.9 E-2	1.9 E+0	5.6 E+0	5.8 E+0	8.6 E-3	NA	NA	NA	8.4 E-1	3.8 E-1	NA	5.1 E+0	NA	NA	2.8 E-3	NA	NA	NA	NA	NA	NA	1.6 E+0	NA	1.7 E+0	NA	9.3 E+2	NA	NA	NA	NA	9.5 E+2
30102	D	NA	1.3 E-1	1.8 E-2	1.1 E+0	2.3 E+1	2.2 E+0	7.5 E-3	NA	NA	NA	6.3 E-1	2.4 E-1	NA	1.5 E+0	NA	NA	7.0 E-3	NA	NA	NA	NA	NA	NA	4.6 E+0	NA	5.9 E-1	NA	2.1 E+2	NA	NA	NA	NA	2.5 E+2
30103	E	NA	NA	NA	1.4 E-2	NA	6.2 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.6 E-2	8.0 E+0	NA	NA	NA	NA	8.1 E+0
30140	E	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-1
30141	E	NA	NA	NA	NA	NA	NA	NA	NA	9.1 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.4 E-1	NA	NA	NA	NA	NA	NA	4.0 E-1	NA	NA	NA	NA	5.5 E-1
30156	E	NA	NA	4.5 E-3	3.3 E-1	3.2 E-1	9.0 E-1	NA	NA	2.2 E-2	NA	2.9 E-1	7.9 E-2	NA	NA	NA	NA	2.5 E-4	NA	NA	NA	1.9 E-1	NA	NA	NA	NA	2.4 E-1	NA	1.5 E+2	NA	NA	NA	NA	1.6 E+2
30157	E	NA	NA	NA	NA	NA	1.1 E-1	NA	NA	1.7 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.4 E-1	NA	NA	NA	NA	2.2 E-2	NA	2.0 E+1	NA	NA	NA	NA	2.0 E+1
30158	D	NA	NA	NA	4.2 E-2	NA	1.9 E-1	NA	NA	1.9 E-2	1.1 E-2	NA	NA	NA	1.2 E-1	NA	NA	NA	NA	NA	NA	6.4 E-2	NA	NA	NA	4.2 E-1	4.6 E-2	NA	3.8 E+1	NA	NA	NA	NA	3.8 E+1
30174	D	NA	NA	5.8 E-3	1.7 E-1	2.0 E-1	5.1 E-1	NA	NA	3.0 E-2	NA	1.7 E-1	5.7 E-2	NA	2.5 E-1	NA	NA	7.0 E-4	NA	NA	NA	1.9 E-1	6.8 E-2	NA	NA	NA	1.6 E-1	NA	1.0 E+2	7.4 E-1	NA	NA	NA	1.0 E+2
30175	E	NA	NA	NA	NA	NA	4.7 E-2	NA	3.9 E-2	1.8 E-1	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-1	NA	NA	1.5 E-2	NA	NA	NA	NA	NA	NA	1.2 E+1	7.6 E-1	NA	5.1 E-2	NA	1.3 E+1
30176	F	NA	NA	NA	NA	NA	NA	NA	NA	4.9 E-2	NA	NA	NA	NA	NA	NA	7.6 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.5 E-1	3.0 E+0	NA	NA	NA	3.4 E+0
30177	E	NA	NA	NA	NA	NA	2.3 E-2	NA	1.4 E-2	3.5 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E-1	NA	NA	NA	NA	NA	NA	7.0 E+0	7.9 E-1	NA	NA	NA	8.0 E+0
30178	E	NA	NA	NA	NA	NA	NA	NA	NA	3.1 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-1	3.7 E-2	NA	NA	NA	NA	NA	6.8 E+0	1.0 E+0	NA	NA	NA	8.0 E+0
30179	F	NA	NA	NA	NA	NA	NA	NA	6.7 E-2	2.1 E-1	NA	NA	NA	NA	NA	1.1 E-2	NA	NA	1.3 E-1	NA	9.9 E-1	2.5 E-2	NA	NA	6.6 E-1	NA	NA	NA	6.0 E+0	1.3 E+0	NA	3.9 E-1	NA	9.8 E+0
30180	D	NA	NA	NA	NA	NA	4.7 E-2	NA	NA	1.7 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.4 E-2	NA	NA	NA	NA	NA	NA	8.5 E+0	NA	NA	NA	NA	8.6 E+0
30181	D	NA	NA	NA	NA	NA	5.4 E-2	NA	NA	2.5 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.6 E-2	NA	NA	NA	NA	NA	NA	1.0 E+1	NA	NA	NA	NA	1.0 E+1
30182	E	NA	NA	NA	NA	NA	2.3 E-2	NA	NA	2.6 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-1	NA	NA	NA	NA	NA	NA	7.3 E+0	5.9 E-1	NA	NA	NA	8.0 E+0
30195	C	NA	NA	NA	NA	NA	NA	NA	6.3 E-2	7.7 E-2	NA	NA	2.7 E-2	2.5 E+0	NA	4.0 E-2	NA	NA	NA	NA	1.0 E+1	9.7 E-3	1.3 E-1	1.2 E-1	NA	NA	NA	NA	NA	7.3 E-1	NA	NA	NA	1.4 E+1
30196	C	NA	NA	NA	NA	NA	NA	NA	NA	3.1 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.9 E-1	NA	NA	NA	NA	NA	NA	2.8 E+0	NA	NA	NA	NA	3.0 E+0
30197	D	NA	NA	NA	NA	NA	NA	NA	NA	2.4 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.1 E-1	NA	NA	NA	NA	NA	NA	4.3 E+0	NA	NA	NA	NA	4.5 E+0

		Adult Non-Cancer Hazard Index																																
Sample Name	**Layer**	**1,1,2,2-PCA**	**1,1,2-TCA**	**1,1-DCA**	**1,1-DCE**	**1,2-DCA**	**1,2-DCE (total)**	**1,4-Diox**	**Al**	**Ba**	**BDCM**	**CCL**	**CF**	**CrVI**	**cis-1,2-DCE**	**Cu**	**DBCM**	**Freon 113**	**Fe**	**DCM**	**Mo**	**Nitrate**	**Nitrite**	**NDMA**	**Perc**	**Ag**	**PCE**	**TOL**	**TCE**	**V**	**VC**	**Bo**	**N-BBS**	**HI**
Unit Hazard Child																																		
Unit Hazard Adult																																		
Unit Risk																																		
1027	C	NA	NA	NA	NA	NA	3.3 E-2	NA	NA	NA	NA	NA	1.6 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.5 E+0	NA	2.3 E-2	NA	2.2 E+0	NA	NA	NA	NA	5.7 E+0
1049	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.4 E-2	NA	4.7 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.1 E-1
1154	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1156	C/D/E	NA	NA	1.2 E-3	2.5 E-2	NA	9.0 E-2	NA	NA	NA	8.3 E-3	NA	NA	NA	7.2 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.5 E-2	NA	2.9 E+1	NA	NA	NA	NA	2.9 E+1
1162	C	NA	NA	NA	2.6 E-2	6.9 E-2	2.8 E-2	NA	NA	NA	NA	NA	1.2 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.3 E+0	NA	NA	NA	1.5 E+1	NA	NA	NA	NA	2.0 E+1
1163	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.7 E+0	NA	NA	NA	1.5 E-1	NA	NA	NA	NA	8.8 E+0
1164	E	NA	NA	2.2 E-3	2.1 E-1	1.1 E+0	3.3 E-2	3.0 E-3	NA	NA	NA	NA	1.6 E-2	NA	NA	NA	NA	2.3 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.7 E+0	NA	NA	NA	NA	6.1 E+0
1211	C/D	NA	NA	NA	1.5 E-2	NA	7.0 E-2	NA	NA	NA	NA	NA	6.5 E-2	NA	NA	NA	NA	6.7 E-5	NA	NA	NA	NA	NA	NA	4.3 E-1	NA	4.2 E-2	NA	3.7 E+0	NA	NA	NA	NA	4.3 E+0
1214	C	NA	NA	2.1 E-3	1.0 E-1	5.4 E-2	2.7 E-1	NA	NA	NA	NA	NA	2.0 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.9 E+0	NA	6.7 E-2	NA	3.5 E+1	NA	NA	NA	NA	3.9 E+1
1216	C	NA	NA	2.1 E-3	1.1 E-1	NA	3.0 E-1	NA	NA	NA	NA	NA	1.8 E-2	NA	1.3 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.1 E-1	NA	7.0 E-2	NA	3.9 E+1	NA	NA	NA	NA	4.0 E+1
1361	C	NA	4.6 E+0	2.4 E-3	6.2 E-2	1.2 E-1	7.3 E-2	NA	NA	NA	NA	NA	3.9 E-2	NA	2.0 E-2	NA	1.2 E-2	1.6 E-5	NA	NA	NA	NA	NA	NA	2.4 E+0	NA	1.8 E-2	NA	1.2 E+1	NA	NA	NA	NA	1.9 E+1
1362	D	NA	3.9 E+0	2.8 E-3	4.3 E-2	1.3 E-1	1.4 E-1	NA	NA	NA	NA	NA	8.9 E-2	NA	6.0 E-2	NA	NA	3.3 E-5	NA	NA	NA	NA	NA	NA	4.7 E+0	NA	2.5 E-2	NA	1.1 E+1	NA	NA	NA	NA	2.0 E+1
1363	D	NA	NA	7.7 E-4	2.0 E-2	6.1 E-2	6.8 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.7 E-5	NA	NA	NA	NA	NA	NA	6.3 E+0	NA	9.6 E-3	NA	4.3 E+0	NA	NA	NA	NA	1.1 E+1
1364	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E-1	NA	NA	NA	NA	1.6 E-1
1365	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-1	NA	NA	NA	NA	1.2 E-1
1370	C	NA	NA	5.9 E-3	2.2 E-1	1.3 E-1	7.3 E-1	2.7 E-3	NA	NA	NA	NA	4.2 E-2	NA	NA	NA	NA	7.9 E-5	NA	6.3 E-4	NA	NA	NA	NA	3.4 E+0	NA	1.6 E-1	NA	6.8 E+1	NA	NA	NA	NA	7.3 E+1
1371	D	NA	NA	3.2 E-3	9.7 E-2	1.4 E-1	3.8 E-1	1.9 E-3	NA	NA	NA	NA	2.7 E-2	NA	NA	NA	NA	8.9 E-5	NA	NA	NA	NA	NA	NA	5.5 E+0	NA	6.7 E-2	NA	3.3 E+1	NA	NA	NA	NA	4.0 E+1
1372	D	NA	NA	4.2 E-3	2.1 E-1	2.0 E-1	8.5 E-1	NA	NA	NA	NA	8.6 E-2	5.4 E-2	NA	NA	NA	NA	1.7 E-4	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E-1	NA	9.6 E+1	NA	NA	NA	NA	9.8 E+1
1373	D/E	NA	NA	NA	6.7 E-3	NA	2.7 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E+0	NA	NA	NA	NA	1.1 E+0
1374	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.4 E-2	NA	NA	NA	NA	5.4 E-2
1375	C	NA	NA	1.4 E-3	8.2 E-2	5.5 E-2	4.5 E-1	NA	NA	NA	NA	NA	1.6 E-2	NA	NA	NA	NA	1.5 E-4	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E-1	1.6 E-2	1.3 E+1	NA	NA	NA	NA	1.4 E+1
1376	D	NA	3.1 E-2	5.9 E-3	3.8 E-1	2.0 E-1	3.8 E-1	3.2 E-3	NA	NA	NA	1.6 E-1	9.3 E-2	NA	NA	NA	NA	6.2 E-3	NA	3.5 E-4	NA	NA	NA	NA	9.8 E-1	NA	1.0 E+0	1.5 E-2	5.0 E+1	NA	NA	NA	NA	5.3 E+1
1377	E	NA	NA	4.6 E-3	3.1 E-1	1.6 E-1	2.7 E-1	2.1 E-3	NA	NA	NA	9.9 E-2	7.4 E-2	NA	NA	NA	NA	5.6 E-3	NA	NA	NA	NA	NA	NA	2.0 E-1	NA	5.1 E-1	1.4 E-2	5.5 E+1	NA	NA	NA	NA	5.7 E+1
1378	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1379	D/E	NA	2.3 E-1	1.2 E-2	6.6 E-1	4.5 E-1	1.3 E+0	5.9 E-3	NA	NA	NA	3.0 E-1	1.3 E-1	NA	NA	NA	NA	3.9 E-3	NA	NA	NA	NA	NA	NA	1.3 E+0	NA	2.5 E-1	NA	6.9 E+1	NA	NA	NA	NA	7.4 E+1
1380	D	NA	NA	9.2 E-4	6.4 E-2	7.1 E-2	4.5 E-2	2.1 E-3	NA	NA	NA	7.4 E-2	2.2 E-2	NA	NA	NA	NA	2.7 E-4	NA	NA	NA	NA	NA	NA	7.5 E-1	NA	5.6 E-2	NA	7.0 E+0	NA	NA	NA	NA	8.1 E+0
1381	E	NA	4.6 E-2	6.3 E-3	3.7 E-1	2.2 E-1	3.0 E-1	2.9 E-3	NA	NA	NA	1.5 E-1	1.1 E-1	NA	NA	NA	NA	8.3 E-3	NA	2.7 E-3	NA	NA	NA	NA	NA	NA	7.8 E-1	NA	8.1 E+1	NA	NA	NA	NA	8.3 E+1
1382	D	NA	NA	6.2 E-4	2.7 E-2	NA	2.8 E-1	NA	NA	NA	NA	NA	5.0 E-2	NA	5.3 E-1	NA	NA	5.6 E-5	NA	NA	NA	NA	NA	NA	3.8 E+0	NA	5.8 E-2	NA	1.6 E+1	NA	NA	NA	NA	2.0 E+1
1383	D	NA	NA	2.2 E-3	1.4 E-1	NA	3.0 E-1	2.2 E-3	NA	NA	NA	3.3 E-2	5.7 E-2	NA	3.0 E-1	NA	NA	1.6 E-3	NA	NA	NA	NA	NA	NA	3.5 E+0	NA	1.5 E-1	NA	2.6 E+1	NA	NA	NA	NA	3.0 E+1
1384	D/E	NA	NA	6.0 E-3	5.7 E-1	9.9 E-2	3.0 E-1	2.6 E-3	NA	NA	NA	6.0 E-2	7.4 E-2	NA	NA	NA	NA	5.8 E-3	NA	NA	NA	NA	NA	NA	2.1 E+0	NA	2.2 E-1	NA	5.0 E+1	NA	NA	NA	NA	5.3 E+1
1385	D	NA	NA	2.2 E-3	1.3 E-1	NA	4.8 E-2	NA	NA	NA	NA	4.9 E-2	1.4 E-2	NA	NA	NA	NA	4.4 E-4	NA	NA	NA	NA	NA	NA	2.0 E-1	NA	9.1 E-2	2.3 E-2	1.5 E+1	NA	NA	NA	NA	1.5 E+1
1386	D	NA	NA	NA	4.3 E-2	NA	4.0 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.1 E-4	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E-2	2.1 E-2	4.7 E+0	NA	NA	NA	NA	4.8 E+0
1387	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1388	D	NA	NA	2.5 E-3	1.3 E-1	7.6 E-2	7.5 E-1	1.9 E-3	NA	NA	NA	NA	6.0 E-2	NA	NA	NA	NA	3.9 E-4	NA	NA	NA	NA	NA	NA	3.3 E+0	NA	1.4 E-1	1.5 E-2	2.4 E+1	NA	NA	NA	NA	2.8 E+1
1389	E	NA	3.7 E-2	7.5 E-3	4.1 E-1	1.7 E-1	3.7 E-1	2.9 E-3	NA	NA	NA	3.0 E-1	7.3 E-2	NA	NA	NA	NA	1.6 E-3	NA	NA	NA	NA	NA	NA	4.7 E-1	NA	8.1 E-2	1.3 E-2	3.8 E+1	NA	NA	NA	NA	4.0 E+1
1390	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.4 E-2	NA	NA	NA	NA	NA	1.4 E-2
1391	C	NA	NA	1.7 E-3	5.6 E-2	NA	2.2 E-1	NA	NA	NA	NA	NA	1.6 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.7 E+0	NA	7.4 E-2	NA	1.8 E+1	NA	NA	NA	NA	2.1 E+1
1392	D	NA	NA	1.3 E-3	6.0 E-2	NA	3.3 E-1	NA	NA	NA	NA	NA	2.0 E-2	NA	NA	NA	NA	3.5 E-5	NA	NA	NA	NA	NA	NA	4.3 E+0	NA	6.3 E-2	NA	3.1 E+1	NA	NA	NA	NA	3.6 E+1
1393	D/E	NA	NA	1.0 E-2	5.6 E-1	6.2 E-1	1.5 E+0	5.3 E-3	NA	NA	NA	3.0 E-1	1.3 E-1	NA	NA	NA	NA	1.5 E-3	NA	NA	NA	NA	NA	NA	1.8 E+0	NA	2.7 E-1	NA	1.2 E+2	NA	NA	NA	NA	1.2 E+2
1394	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.9 E-1	NA	NA	NA	NA	2.9 E-1
1395	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.0 E-1	NA	NA	NA	NA	4.0 E-1
1396	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.2 E-1	NA	NA	NA	NA	2.2 E-1
1397	D	NA	NA	NA	NA	NA	3.5 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.7 E+0	NA	NA	NA	NA	8.8 E+0
1398	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1399	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1400	D	NA	NA	6.4 E-4	2.2 E-2	NA	6.7 E-2	NA	NA	NA	NA	NA	8.1 E-3	NA	NA	NA	NA	2.9 E-5	NA	NA	NA	NA	NA	NA	6.7 E+0	NA	1.0 E-2	NA	6.5 E+0	NA	NA	NA	NA	1.3 E+1
1401	D	NA	NA	3.2 E-3	2.8 E-1	4.6 E-1	3.0 E-1	1.8 E-3	NA	NA	NA	5.4 E-2	3.7 E-2	NA	NA	NA	NA	1.4 E-4	NA	NA	NA	NA	NA	NA	5.1 E-1	NA	4.7 E-2	NA	3.0 E+1	NA	NA	NA	NA	3.2 E+1
1402	F	NA	NA	6.8 E-4	1.6 E-2	5.1 E-2	7.2 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.6 E+0	NA	NA	NA	NA	2.7 E+0
1403	C	NA	3.5 E-2	5.7 E-3	3.0 E-1	6.9 E-2	2.5 E+0	2.4 E-3	NA	NA	NA	NA	8.4 E-2	NA	NA	NA	NA	9.8 E-5	NA	NA	NA	NA	NA	NA	4.7 E-1	NA	3.6 E-1	1.5 E-2	6.9 E+1	NA	NA	NA	NA	7.3 E+1
1404	D	NA	NA	2.8 E-3	1.9 E-1	1.1 E-1	5.8 E-1	2.6 E-3	NA	NA	NA	3.1 E-2	3.8 E-2	NA	NA	NA	NA	6.2 E-4	NA	NA	NA	NA	NA	NA	4.3 E+0	NA	1.4 E-1	1.9 E-2	3.9 E+1	NA	NA	NA	NA	4.4 E+1
1405	D	NA	NA	5.4 E-3	4.5 E-1	4.2 E-1	2.0 E+0	3.5 E-3	NA	NA	NA	8.6 E-2	1.1 E-1	NA	NA	NA	NA	7.1 E-4	NA	NA	NA	NA	NA	NA	2.6 E+0	NA	3.8 E-1	1.6 E-2	2.4 E+2	NA	NA	NA	NA	2.4 E+2
1406	C	NA	NA	NA	NA	5.1 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.2 E-2	NA	NA	NA	NA	1.2 E-1
1407	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E+0	NA	NA	NA	NA	1.0 E+0
1408	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-1	NA	NA	NA	NA	1.2 E-1
1409	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1419	C	NA	NA	1.0 E-3	2.2 E-1	1.2 E-1	NA	NA	NA	NA	NA	3.4 E-1	1.1 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.8 E-1	NA	NA	NA	3.7 E+0	NA	NA	NA	NA	4.6 E+0
1420	D	NA	NA	9.2 E-4	2.2 E-1	1.1 E-1	1.4 E-2	NA	NA	NA	NA	2.9 E-1	7.4 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.1 E+0	NA	NA	NA	NA	4.7 E+0
1421	D	NA	NA	8.2 E-4	2.2 E-1	9.9 E-2	2.2 E-2	NA	NA	NA	NA	2.5 E-1	1.0 E-2	NA	NA	NA	NA	5.4 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.2 E+0	NA	NA	NA	NA	7.8 E+0
1422	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.9 E-2	NA	NA	NA	NA	NA	NA	1.5 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.0 E-2
1423	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.4 E-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.4 E-4
1469	C	NA	NA	1.4 E-3	2.7 E-1	1.2 E-1	5.0 E-1	1.6 E-3	NA	NA	NA	NA	2.4 E-2	NA	4.3 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E-1	NA	9.4 E+1	NA	NA	NA	NA	9.5 E+1
1470	D	NA	NA	5.0 E-3	2.8 E-1	6.0 E-2	9.3 E-1	2.4 E-3	NA	NA	NA	4.7 E-2	4.7 E-2	NA	5.3 E-1	NA	NA	1.8 E-4	NA	NA	NA	NA	NA	NA	1.6 E+0	NA	1.8 E-1	NA	1.2 E+2	NA	NA	NA	NA	1.2 E+2
1471	E	NA	NA	1.6 E-3	7.4 E-2	6.1 E-2	1.4 E-1	NA	NA	NA	NA	NA	NA	NA	4.2 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.3 E-2	NA	1.3 E+1	NA	NA	NA	NA	1.3 E+1
1472	C	NA	NA	1.1 E-3	5.2 E-2	NA	5.0 E-1	NA	NA	NA	NA	NA	1.8 E-2	NA	NA	NA	NA	3.7 E-5	NA	NA	NA	NA	NA	NA	NA	NA	8.1 E-2	NA	1.5 E+1	NA	NA	NA	NA	1.6 E+1
1473	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1474	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.3 E-2	NA	NA	NA	NA	NA	2.3 E-2
1475	C	NA	NA	NA	6.3 E-3	NA	6.2 E-2	NA	NA	NA	NA	NA	1.5 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.3 E+0	NA	1.7 E-2	NA	5.1 E+0	NA	NA	NA	NA	8.5 E+0
1476	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.9 E+0	NA	NA	NA	1.2 E-1	NA	NA	NA	NA	8.0 E+0
1477	E	NA	2.1 E-2	4.7 E-3	3.1 E-1	4.7 E-1	3.2 E-1	3.0 E-3	NA	NA	NA	NA	4.3 E-2	NA	NA	NA	NA	6.0 E-3	NA	NA	NA	NA	NA	NA	3.9 E+0	NA	2.3 E-1	NA	4.4 E+1	NA	NA	NA	NA	5.0 E+1
1478	C	NA	NA	NA	1.9 E-2	NA	4.0 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-2	NA	2.5 E+0	NA	NA	NA	NA	2.6 E+0
1479	D	NA	4.6 E-2	3.8 E-3	2.8 E-1	3.0 E-1	9.8 E-1	1.0 E-3	NA	NA	NA	1.2 E-1	6.0 E-2	NA	9.7 E-1	NA	NA	1.0 E-3	NA	NA	NA	NA	NA	NA	3.9 E-1	NA	2.5 E-1	NA	1.7 E+2	NA	NA	NA	NA	1.8 E+2
1480	E	NA	NA	2.2 E-3	6.7 E-2	6.0 E-2	2.5 E-1	2.4 E-4	NA	NA	NA	3.8 E-2	2.2 E-2	NA	2.0 E-1	NA	NA	1.8 E-4	NA	4.6 E-4	NA	NA	NA	NA	NA	NA	1.0 E-1	NA	7.2 E+1	NA	NA	NA	NA	7.3 E+1
1481	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-1	NA	NA	NA	NA	1.3 E-1
1482	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-1	NA	NA	NA	NA	1.1 E-1
1483	E	NA	NA	NA	NA	NA	1.1 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.7 E+0	NA	NA	NA	NA	2.7 E+0
1487	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E-1	NA	NA	NA	NA	1.5 E-1
1488	C	NA	NA	NA	NA	NA	4.2 E-2	NA	NA	NA	NA	NA	NA	NA	1.7 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.0 E+0	NA	NA	NA	NA	6.1 E+0
1489	E	NA	7.1 E-2	5.6 E-3	3.1 E-1	2.1 E-1	7.0 E-1	5.6 E-4	NA	NA	NA	2.3 E-1	7.3 E-2	NA	NA	NA	NA	3.9 E-4	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E-1	NA	1.2 E+2	NA	NA	NA	NA	1.2 E+2
1506	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1507	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1508	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1509	C	NA	NA	NA	2.0 E-2	5.7 E-2	1.3 E-1	NA	NA	NA	8.3 E-3	NA	8.3 E-3	NA	9.5 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.8 E-2	NA	3.1 E+1	NA	NA	NA	NA	3.2 E+1
1510	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.6 E-1	NA	NA	NA	NA	4.6 E-1
1511	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1516	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1517	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1518	B/C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.0 E-1	NA	NA	NA	NA	4.0 E-1
1519	C	NA	NA	NA	8.2 E-3	NA	8.0 E-2	NA	NA	NA	NA	NA	8.0 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.3 E-2	NA	2.1 E+1	NA	NA	NA	NA	2.1 E+1
1520	D	NA	NA	NA	1.6 E-2	NA	1.5 E-1	NA	NA	NA	NA	NA	8.3 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.7 E-2	NA	3.5 E+1	NA	NA	NA	NA	3.5 E+1
1521	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1522	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E-2	6.6 E-1	NA	NA	NA	NA	6.7 E-1
1523	C	NA	NA	NA	5.1 E-3	NA	3.3 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.1 E-2	3.3 E+0	NA	NA	NA	NA	3.4 E+0
1524	E	NA	NA	NA	NA	NA	2.3 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-2	1.7 E-2	7.9 E+0	NA	NA	NA	NA	7.9 E+0
1525	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1526	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1527	E	NA	NA	NA	NA	NA	1.1 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.8 E-3	NA	2.7 E+0	NA	NA	NA	NA	2.7 E+0
1528	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1529	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1530	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1531	C	NA	NA	NA	4.3 E-3	NA	1.1 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.1 E+0	NA	NA	NA	NA	5.1 E+0
1532	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.0 E+0	NA	NA	NA	NA	4.0 E+0
1533	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1539	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.4 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.1 E+0	NA	NA	NA	NA	3.2 E+0
1540	D	NA	NA	NA	6.7 E-3	NA	7.8 E-2	NA	NA	NA	NA	NA	NA	NA	4.7 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.5 E-2	NA	1.6 E+1	NA	NA	NA	NA	1.6 E+1
1557	C/D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.7 E-1	NA	NA	NA	NA	1.7 E-1
1558	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1559	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.3 E-2	NA	3.0 E-1	NA	NA	NA	NA	3.3 E-1
1560	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E-2	NA	NA	NA	NA	NA	NA	1.5 E-2
1561	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1562	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1563	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1564	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.8 E-2	NA	NA	NA	NA	5.8 E-2
1565	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1566	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.5 E-1	NA	NA	NA	NA	3.5 E-1
1567	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.7 E-1	NA	NA	NA	NA	1.7 E-1
1568	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1569	D	6.4 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E+0	NA	NA	NA	NA	1.3 E+0

		Adult Non-Cancer Hazard Index																																
Sample Name	Layer	1,1,2,2-PCA	1,1,2-TCA	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (total)	1,4-Diox	Al	Ba	BDCM	CCL	CF	CrVI	cis-1,2-DCE	Cu	DBCM	Freon 113	Fe	DCM	Mo	Nitrate	Nitrite	NDMA	Perc	Ag	PCE	TOL	TCE	V	VC	Bo	N-BBS	HI
Unit Hazard Child																																		
Unit Hazard Adult																																		
Unit Risk																																		
1570	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-1	NA	NA	NA	NA	1.1 E-1
1571	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1572	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1573	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1574	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1585	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.7 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.7 E-3	2.5 E+0	NA	NA	NA	NA	2.5 E+0
1586	C	NA	NA	NA	NA	9.9 E-2	NA	NA	NA	NA	NA	NA	5.4 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.0 E-3	5.0 E-1	NA	NA	NA	NA	6.6 E-1
1587	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.2 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-2	1.5 E+0	NA	NA	NA	NA	1.5 E+0
1588	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-1	NA	NA	NA	NA	2.5 E-1
1589	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.9 E-1	NA	NA	NA	NA	1.9 E-1
1590	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1591	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1592	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.9 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.9 E-2	NA	NA	NA	NA	8.9 E-2
1593	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1594	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-1	NA	NA	NA	NA	2.5 E-1
1595	D/E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1596	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4300	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.3 E-2	2.4 E-1	NA	NA	NA	NA	2.6 E-1
4301	C	NA	NA	NA	NA	NA	2.7 E-2	NA	NA	NA	NA	NA	NA	NA	2.8 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.2 E-3	2.0 E-2	6.2 E+0	NA	NA	NA	NA	6.2 E+0
4302	D	NA	NA	NA	NA	NA	2.3 E-2	NA	NA	NA	NA	NA	9.7 E-3	NA	1.9 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E-2	1.7 E-2	5.7 E+0	NA	NA	NA	NA	5.8 E+0
4325	C	NA	NA	1.6 E-3	1.0 E-1	NA	4.3 E-1	NA	NA	NA	NA	NA	1.9 E-2	NA	3.6 E-1	NA	NA	4.2 E-5	NA	NA	NA	NA	NA	NA	3.2 E-1	NA	9.6 E-2	1.9 E-2	2.3 E+1	NA	NA	NA	NA	2.4 E+1
4330	C/D	NA	NA	5.7 E-3	3.6 E-1	6.0 E-1	1.1 E+0	2.1 E-3	NA	NA	NA	1.5 E-1	7.2 E-2	NA	1.0 E+0	NA	NA	1.6 E-3	NA	NA	NA	NA	NA	NA	1.3 E+0	NA	2.0 E-1	1.9 E-2	9.1 E+1	NA	1.9 E-2	NA	NA	9.5 E+1
4335	D/E	NA	1.2 E-1	7.2 E-3	4.8 E-1	5.0 E+0	1.2 E+0	2.4 E-3	NA	NA	NA	3.0 E-1	1.1 E-1	NA	1.0 E+0	NA	NA	1.5 E-3	NA	NA	NA	NA	NA	NA	8.7 E-1	NA	3.1 E-1	1.8 E-2	1.4 E+2	NA	1.6 E-2	NA	NA	1.5 E+2
4340	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.7 E-2	NA	NA	NA	NA	1.7 E-2
4345	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E-2	1.7 E-1	NA	NA	NA	NA	1.9 E-1
4350	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-2	2.3 E-1	NA	NA	NA	NA	2.5 E-1
4355	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.8 E-2	3.6 E-1	NA	NA	NA	NA	3.7 E-1
4360	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-2	2.6 E+0	NA	NA	NA	NA	2.6 E+0
4365	D	NA	NA	NA	NA	NA	2.0 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.9 E-2	3.7 E+0	NA	NA	NA	NA	3.7 E+0
4370	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.8 E-1	NA	NA	NA	NA	2.8 E-1
4375	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.9 E-1	NA	NA	NA	NA	8.9 E-1
4380	D	NA	NA	NA	NA	NA	2.0 E-2	NA	NA	NA	NA	NA	NA	NA	2.2 E-2	NA	NA	NA	NA	3.4 E-4	NA	NA	NA	NA	NA	NA	NA	4.5 E+0	NA	NA	NA	NA	4.6 E+0
4580	D/E	NA	NA	NA	NA	NA	5.7 E-2	NA	NA	NA	NA	NA	7.7 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.7 E-1	NA	1.5 E-2	NA	1.2 E+1	NA	NA	NA	NA	1.2 E+1
4585	E	NA	NA	NA	2.5 E-2	NA	8.3 E-2	NA	NA	8.4 E-3	4.3 E-3	NA	3.2 E-2	NA	NA	NA	NA	NA	NA	NA	NA	6.4 E-2	NA	NA	NA	NA	1.1 E-2	NA	8.7 E+0	NA	NA	NA	NA	9.0 E+0
4620	E	NA	NA	NA	NA	NA	NA	NA	NA	8.8 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.3 E-2	NA	NA	NA	NA	NA	NA	2.1 E+0	NA	NA	NA	NA	2.1 E+0
30068	C	NA	NA	6.4 E-3	2.0 E-1	7.3 E-2	6.8 E-1	2.2 E-3	NA	NA	8.3 E-3	NA	3.2 E-2	NA	6.4 E-1	NA	NA	5.6 E-5	NA	NA	NA	NA	NA	NA	5.5 E+0	NA	1.4 E-1	NA	5.3 E+1	NA	NA	NA	NA	6.0 E+1
30069	E	NA	NA	1.5 E-3	1.0 E-1	NA	2.5 E-1	NA	NA	NA	NA	NA	NA	NA	2.2 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.8 E-2	NA	2.2 E+1	NA	NA	NA	NA	2.2 E+1
30070	E	NA	NA	NA	2.1 E-2	NA	9.5 E-2	NA	NA	NA	NA	NA	NA	NA	6.7 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-2	NA	7.3 E+0	NA	NA	NA	NA	7.5 E+0
30071	C/D	NA	NA	NA	8.2 E-2	7.8 E-2	NA	NA	NA	NA	NA	1.2 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.2 E+0	NA	NA	NA	NA	3.5 E+0
30072	D	NA	NA	NA	1.0 E-1	9.5 E-2	NA	NA	NA	NA	NA	1.5 E-1	NA	NA	NA	NA	NA	2.7 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.5 E+0	NA	NA	NA	NA	4.9 E+0
30073	D/E	NA	NA	NA	1.4 E-1	1.2 E-1	NA	NA	NA	NA	NA	2.1 E-1	NA	NA	NA	NA	NA	8.5 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.9 E+0	NA	NA	NA	NA	9.3 E+0
30100	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.9 E-1	NA	NA	NA	NA	1.9 E-1
30101	C	NA	1.4 E-1	8.2 E-3	8.2 E-1	2.4 E+0	2.5 E+0	3.7 E-3	NA	NA	NA	3.6 E-1	1.6 E-1	NA	2.2 E+0	NA	NA	1.2 E-3	NA	NA	NA	NA	NA	NA	6.7 E-1	NA	7.2 E-1	NA	4.0 E+2	NA	NA	NA	NA	4.1 E+2
30102	D	NA	5.4 E-2	7.7 E-3	4.7 E-1	9.9 E+0	9.5 E-1	3.2 E-3	NA	NA	NA	2.7 E-1	1.0 E-1	NA	6.5 E-1	NA	NA	3.1 E-3	NA	NA	NA	NA	NA	NA	2.0 E+0	NA	2.5 E-1	NA	9.2 E+1	NA	NA	NA	NA	1.1 E+2
30103	E	NA	NA	NA	5.9 E-3	NA	2.7 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-2	3.5 E+0	NA	NA	NA	NA	3.5 E+0
30140	E	NA	NA	NA	NA	NA	NA	NA	NA	5.0 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.8 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.3 E-2
30141	E	NA	NA	NA	NA	NA	NA	NA	NA	3.8 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.9 E-2	NA	NA	NA	NA	NA	1.7 E-1	NA	NA	NA	NA	2.4 E-1
30156	E	NA	NA	1.9 E-3	1.4 E-1	1.4 E-1	3.8 E-1	NA	NA	9.4 E-3	NA	1.2 E-1	3.4 E-2	NA	NA	NA	NA	1.1 E-4	NA	NA	NA	8.3 E-2	NA	NA	NA	NA	1.0 E-1	NA	6.6 E+1	NA	NA	NA	NA	6.7 E+1
30157	E	NA	NA	NA	NA	NA	4.8 E-2	NA	NA	7.4 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.2 E-2	NA	NA	NA	NA	9.4 E-3	NA	8.5 E+0	NA	NA	NA	NA	8.7 E+0
30158	D	NA	NA	NA	1.8 E-2	NA	8.2 E-2	NA	NA	7.8 E-3	4.8 E-3	NA	NA	NA	5.3 E-2	NA	NA	NA	NA	NA	NA	2.8 E-2	NA	NA	NA	1.8 E-1	2.0 E-2	NA	1.6 E+1	NA	NA	NA	NA	1.7 E+1
30174	D	NA	NA	2.5 E-3	7.2 E-2	8.4 E-2	2.2 E-1	NA	NA	1.3 E-2	NA	7.4 E-2	2.4 E-2	NA	1.1 E-1	NA	NA	3.1 E-4	NA	NA	NA	8.1 E-2	2.9 E-2	NA	NA	NA	6.7 E-2	NA	4.3 E+1	3.0 E-1	NA	NA	NA	4.4 E+1
30175	E	NA	NA	NA	NA	NA	2.0 E-2	NA	1.6 E-2	7.5 E-2	NA	NA	NA	NA	NA	NA	NA	NA	4.7 E-2	NA	NA	6.4 E-3	NA	NA	NA	NA	NA	NA	5.0 E+0	3.1 E-1	NA	2.2 E-2	NA	5.5 E+0
30176	F	NA	NA	NA	NA	NA	NA	NA	NA	2.1 E-2	NA	NA	NA	NA	NA	NA	3.2 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E-1	1.2 E+0	NA	NA	NA	1.4 E+0
30177	E	NA	NA	NA	NA	NA	9.8 E-3	NA	6.0 E-3	1.5 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.3 E-2	NA	NA	NA	NA	NA	NA	3.0 E+0	3.2 E-1	NA	NA	NA	3.4 E+0
30178	E	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.6 E-2	1.6 E-2	NA	NA	NA	NA	NA	2.9 E+0	4.3 E-1	NA	NA	NA	3.4 E+0
30179	F	NA	NA	NA	NA	NA	NA	NA	2.8 E-2	8.7 E-2	NA	NA	NA	NA	NA	4.7 E-3	NA	NA	5.5 E-2	NA	4.2 E-1	1.1 E-2	NA	NA	2.8 E-1	NA	NA	NA	2.6 E+0	5.3 E-1	NA	1.7 E-1	NA	4.2 E+0
30180	D	NA	NA	NA	NA	NA	2.0 E-2	NA	NA	7.2 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.9 E-2	NA	NA	NA	NA	NA	NA	3.7 E+0	NA	NA	NA	NA	3.7 E+0
30181	D	NA	NA	NA	NA	NA	2.3 E-2	NA	NA	1.0 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.4 E-2	NA	NA	NA	NA	NA	NA	4.4 E+0	NA	NA	NA	NA	4.5 E+0
30182	E	NA	NA	NA	NA	NA	1.0 E-2	NA	NA	1.1 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.6 E-2	NA	NA	NA	NA	NA	NA	3.1 E+0	2.4 E-1	NA	NA	NA	3.4 E+0
30195	C	NA	NA	NA	NA	NA	NA	NA	2.7 E-2	3.2 E-2	NA	NA	1.2 E-2	1.0 E+0	NA	1.7 E-2	NA	NA	NA	NA	4.5 E+0	4.1 E-3	5.5 E-2	5.2 E-2	NA	NA	NA	NA	NA	3.0 E-1	NA	NA	NA	6.0 E+0
30196	C	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.1 E-2	NA	NA	NA	NA	NA	NA	1.2 E+0	NA	NA	NA	NA	1.3 E+0
30197	D	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.1 E-2	NA	NA	NA	NA	NA	NA	1.8 E+0	NA	NA	NA	NA	1.9 E+0

Table 2-14a
Location-Specific Domestic Use of Groundwater Risk Assessment Results -Resident
Zone 1 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Incremental Lifetime Cancer Risk																																		
Sample Name	**Layer**	**1,1,2,2-PCA**	**1,1,2-TCA**	**1,1-DCA**	**1,1-DCE**	**1,2-DCA**	**1,2-DCE (total)**	**1,4-Diox**	**Al**	**Ba**	**BDCM**	**CCL**	**CF**	**CrVI**	**cis-1,2-DCE**	**Cu**	**DBCM**	**Freon 113**	**Fe**	**DCM**	**Mo**	**Nitrate**	**Nitrite**	**NDMA**	**Perc**	**Ag**	**PCE**	**TOL**	**TCE**	**V**	**VC**	**Bo**	**N-BBS**	**ILCR**
Unit Hazard Child																																		
Unit Hazard Adult																																		
Unit Risk																																		
1027	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.8 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.9 E-5	NA	1.5 E-5	NA	NA	NA	NA	4 E-5
1049	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.8 E-5	NA	2.3 E-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3 E-4
1154	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1156	C/D/E	NA	NA	7.7 E-7	NA	NA	NA	NA	NA	NA	1.2 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.6 E-5	NA	2.0 E-4	NA	NA	NA	NA	2 E-4
1162	C	NA	NA	NA	NA	5.6 E-6	NA	NA	NA	NA	NA	NA	5.9 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E-4	NA	NA	NA	NA	1 E-4
1163	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E-6	NA	NA	NA	NA	1 E-6
1164	E	NA	NA	1.4 E-6	NA	9.0 E-5	NA	4.6 E-5	NA	NA	NA	NA	7.8 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.3 E-5	NA	NA	NA	NA	2 E-4
1211	C/D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.1 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.3 E-5	NA	2.5 E-5	NA	NA	NA	NA	9 E-5
1214	C	NA	NA	1.3 E-6	NA	4.4 E-6	NA	NA	NA	NA	NA	NA	9.7 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.3 E-5	NA	2.4 E-4	NA	NA	NA	NA	3 E-4
1216	C	NA	NA	1.3 E-6	NA	NA	NA	NA	NA	NA	NA	NA	8.4 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.6 E-5	NA	2.7 E-4	NA	NA	NA	NA	3 E-4
1361	C	NA	5.9 E-4	1.5 E-6	NA	9.8 E-6	NA	NA	NA	NA	NA	NA	1.9 E-5	NA	NA	NA	1.2 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.4 E-5	NA	8.2 E-5	NA	NA	NA	NA	7 E-4
1362	D	NA	5.1 E-4	1.8 E-6	NA	1.1 E-5	NA	NA	NA	NA	NA	NA	4.3 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-5	NA	7.5 E-5	NA	NA	NA	NA	7 E-4
1363	D	NA	NA	4.8 E-7	NA	5.0 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.6 E-6	NA	3.0 E-5	NA	NA	NA	NA	4 E-5
1364	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-6	NA	NA	NA	NA	1 E-6
1365	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.2 E-7	NA	NA	NA	NA	8 E-7
1370	C	NA	NA	3.7 E-6	NA	1.1 E-5	NA	4.1 E-5	NA	NA	NA	NA	2.0 E-5	NA	NA	NA	NA	NA	NA	4.8 E-7	NA	NA	NA	NA	NA	NA	1.2 E-4	NA	4.7 E-4	NA	NA	NA	NA	7 E-4
1371	D	NA	NA	2.0 E-6	NA	1.1 E-5	NA	2.9 E-5	NA	NA	NA	NA	1.3 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.3 E-5	NA	2.3 E-4	NA	NA	NA	NA	3 E-4
1372	D	NA	NA	2.6 E-6	NA	1.6 E-5	NA	NA	NA	NA	NA	2.0 E-5	2.6 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-4	NA	6.6 E-4	NA	NA	NA	NA	9 E-4
1373	D/E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.5 E-6	NA	NA	NA	NA	7 E-6
1374	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.7 E-7	NA	NA	NA	NA	4 E-7
1375	C	NA	NA	8.8 E-7	NA	4.5 E-6	NA	NA	NA	NA	NA	NA	7.8 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-4	NA	9.0 E-5	NA	NA	NA	NA	2 E-4
1376	D	NA	4.1 E-6	3.7 E-6	NA	1.6 E-5	NA	4.8 E-5	NA	NA	NA	3.6 E-5	4.5 E-5	NA	NA	NA	NA	NA	NA	2.7 E-7	NA	NA	NA	NA	NA	NA	8.0 E-4	NA	3.4 E-4	NA	NA	NA	NA	1 E-3
1377	E	NA	NA	2.8 E-6	NA	1.3 E-5	NA	3.1 E-5	NA	NA	NA	2.2 E-5	3.6 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.0 E-4	NA	3.8 E-4	NA	NA	NA	NA	9 E-4
1378	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1379	D/E	NA	3.0 E-5	7.2 E-6	NA	3.7 E-5	NA	8.9 E-5	NA	NA	NA	6.8 E-5	6.0 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-4	NA	4.8 E-4	NA	NA	NA	NA	1 E-3
1380	D	NA	NA	5.7 E-7	NA	5.9 E-6	NA	3.1 E-5	NA	NA	NA	1.7 E-5	1.0 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.4 E-5	NA	4.9 E-5	NA	NA	NA	NA	2 E-4
1381	E	NA	5.9 E-6	3.9 E-6	NA	1.8 E-5	NA	4.3 E-5	NA	NA	NA	3.5 E-5	5.4 E-5	NA	NA	NA	NA	NA	NA	2.0 E-6	NA	NA	NA	NA	NA	NA	6.2 E-4	NA	5.6 E-4	NA	NA	NA	NA	1 E-3
1382	D	NA	NA	3.9 E-7	NA	NA	NA	NA	NA	NA	NA	NA	2.4 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.6 E-5	NA	1.1 E-4	NA	NA	NA	NA	2 E-4
1383	D	NA	NA	1.4 E-6	NA	NA	NA	3.4 E-5	NA	NA	NA	7.4 E-6	2.7 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-4	NA	1.8 E-4	NA	NA	NA	NA	4 E-4
1384	D/E	NA	NA	3.7 E-6	NA	8.2 E-6	NA	3.9 E-5	NA	NA	NA	1.4 E-5	3.6 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.7 E-4	NA	3.4 E-4	NA	NA	NA	NA	6 E-4
1385	D	NA	NA	1.3 E-6	NA	NA	NA	NA	NA	NA	NA	1.1 E-5	6.5 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.2 E-5	NA	1.0 E-4	NA	NA	NA	NA	2 E-4
1386	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-5	NA	3.2 E-5	NA	NA	NA	NA	5 E-5
1387	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1388	D	NA	NA	1.5 E-6	NA	6.3 E-6	NA	2.9 E-5	NA	NA	NA	NA	2.9 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-4	NA	1.6 E-4	NA	NA	NA	NA	3 E-4
1389	E	NA	4.8 E-6	4.6 E-6	NA	1.4 E-5	NA	4.3 E-5	NA	NA	NA	6.8 E-5	3.5 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.4 E-5	NA	2.6 E-4	NA	NA	NA	NA	5 E-4
1390	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1391	C	NA	NA	1.1 E-6	NA	NA	NA	NA	NA	NA	NA	NA	7.8 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.9 E-5	NA	1.3 E-4	NA	NA	NA	NA	2 E-4
1392	D	NA	NA	8.2 E-7	NA	NA	NA	NA	NA	NA	NA	NA	9.7 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.0 E-5	NA	2.2 E-4	NA	NA	NA	NA	3 E-4
1393	D/E	NA	NA	6.2 E-6	NA	5.1 E-5	NA	8.0 E-5	NA	NA	NA	6.8 E-5	6.2 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.1 E-4	NA	8.2 E-4	NA	NA	NA	NA	1 E-3
1394	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-6	NA	NA	NA	NA	2 E-6
1395	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.8 E-6	NA	NA	NA	NA	3 E-6
1396	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E-6	NA	NA	NA	NA	1 E-6
1397	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.0 E-5	NA	NA	NA	NA	6 E-5
1398	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1399	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1400	D	NA	NA	4.0 E-7	NA	NA	NA	NA	NA	NA	NA	NA	3.9 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.3 E-6	NA	4.5 E-5	NA	NA	NA	NA	6 E-5
1401	D	NA	NA	2.0 E-6	NA	3.8 E-5	NA	2.7 E-5	NA	NA	NA	1.2 E-5	1.8 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.7 E-5	NA	2.1 E-4	NA	NA	NA	NA	3 E-4
1402	F	NA	NA	4.2 E-7	NA	4.2 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.8 E-5	NA	NA	NA	NA	2 E-5
1403	C	NA	4.6 E-6	3.5 E-6	NA	5.7 E-6	NA	3.6 E-5	NA	NA	NA	NA	4.0 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.9 E-4	NA	4.8 E-4	NA	NA	NA	NA	9 E-4
1404	D	NA	NA	1.8 E-6	NA	9.0 E-6	NA	3.9 E-5	NA	NA	NA	7.1 E-6	1.8 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-4	NA	2.7 E-4	NA	NA	NA	NA	5 E-4
1405	D	NA	NA	3.3 E-6	NA	3.4 E-5	NA	5.3 E-5	NA	NA	NA	2.0 E-5	5.1 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.0 E-4	NA	1.6 E-3	NA	NA	NA	NA	2 E-3
1406	C	NA	NA	NA	NA	4.2 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.0 E-7	NA	NA	NA	NA	5 E-6
1407	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.0 E-6	NA	NA	NA	NA	7 E-6
1408	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.2 E-7	NA	NA	NA	NA	8 E-7
1409	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1419	C	NA	NA	6.2 E-7	NA	9.8 E-6	NA	NA	NA	NA	NA	7.8 E-5	5.3 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-5	NA	NA	NA	NA	1 E-4
1420	D	NA	NA	5.7 E-7	NA	9.0 E-6	NA	NA	NA	NA	NA	6.6 E-5	3.6 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.8 E-5	NA	NA	NA	NA	1 E-4
1421	D	NA	NA	5.1 E-7	NA	8.2 E-6	NA	NA	NA	NA	NA	5.6 E-5	4.9 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.0 E-5	NA	NA	NA	NA	1 E-4
1422	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.3 E-5	NA	NA	NA	NA	NA	NA	1.1 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3 E-5
1423	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.3 E-7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3 E-7
1469	C	NA	NA	8.8 E-7	NA	9.8 E-6	NA	2.4 E-5	NA	NA	NA	NA	1.2 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-4	NA	6.5 E-4	NA	NA	NA	NA	8 E-4
1470	D	NA	NA	3.1 E-6	NA	4.9 E-6	NA	3.6 E-5	NA	NA	NA	1.1 E-5	2.3 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.4 E-4	NA	8.2 E-4	NA	NA	NA	NA	1 E-3
1471	E	NA	NA	9.8 E-7	NA	5.0 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.0 E-5	NA	9.0 E-5	NA	NA	NA	NA	1 E-4
1472	C	NA	NA	6.7 E-7	NA	NA	NA	NA	NA	NA	NA	NA	8.4 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.4 E-5	NA	1.0 E-4	NA	NA	NA	NA	2 E-4
1473	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1474	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1475	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.1 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-5	NA	3.5 E-5	NA	NA	NA	NA	6 E-5
1476	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.2 E-7	NA	NA	NA	NA	8 E-7
1477	E	NA	2.8 E-6	2.9 E-6	NA	3.8 E-5	NA	4.6 E-5	NA	NA	NA	NA	2.1 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.9 E-4	NA	3.1 E-4	NA	NA	NA	NA	6 E-4
1478	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.2 E-6	NA	1.7 E-5	NA	NA	NA	NA	3 E-5
1479	D	NA	5.9 E-6	2.4 E-6	NA	2.5 E-5	NA	1.5 E-5	NA	NA	NA	2.7 E-5	2.9 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-4	NA	1.2 E-3	NA	NA	NA	NA	1 E-3
1480	E	NA	NA	1.3 E-6	NA	4.9 E-6	NA	3.6 E-6	NA	NA	NA	8.5 E-6	1.0 E-5	NA	NA	NA	NA	NA	NA	3.5 E-7	NA	NA	NA	NA	NA	NA	8.0 E-5	NA	5.0 E-4	NA	NA	NA	NA	6 E-4
1481	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.0 E-7	NA	NA	NA	NA	9 E-7
1482	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.5 E-7	NA	NA	NA	NA	7 E-7
1483	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.9 E-5	NA	NA	NA	NA	2 E-5
1487	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E-6	NA	NA	NA	NA	1 E-6
1488	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.2 E-5	NA	NA	NA	NA	4 E-5
1489	E	NA	9.2 E-6	3.5 E-6	NA	1.7 E-5	NA	8.4 E-6	NA	NA	NA	5.2 E-5	3.5 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-4	NA	8.2 E-4	NA	NA	NA	NA	1 E-3
1506	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1507	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1508	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1509	C	NA	NA	NA	NA	4.7 E-6	NA	NA	NA	NA	1.2 E-5	NA	4.0 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.6 E-5	NA	2.2 E-4	NA	NA	NA	NA	3 E-4
1510	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.2 E-6	NA	NA	NA	NA	3 E-6
1511	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1516	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1517	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1518	B/C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.8 E-6	NA	NA	NA	NA	3 E-6
1519	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.8 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.6 E-5	NA	1.4 E-4	NA	NA	NA	NA	2 E-4
1520	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.0 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.7 E-5	NA	2.4 E-4	NA	NA	NA	NA	3 E-4
1521	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1522	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.6 E-6	NA	NA	NA	NA	5 E-6
1523	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.3 E-5	NA	NA	NA	NA	2 E-5
1524	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E-5	NA	5.5 E-5	NA	NA	NA	NA	6 E-5
1525	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1526	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1527	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.7 E-6	NA	1.9 E-5	NA	NA	NA	NA	3 E-5
1528	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1529	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1530	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1531	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.5 E-5	NA	NA	NA	NA	4 E-5
1532	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.8 E-5	NA	NA	NA	NA	3 E-5
1533	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1539	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.6 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.2 E-5	NA	NA	NA	NA	5 E-5
1540	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.6 E-5	NA	1.1 E-4	NA	NA	NA	NA	1 E-4
1557	C/D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-6	NA	NA	NA	NA	1 E-6
1558	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1559	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.6 E-5	NA	2.1 E-6	NA	NA	NA	NA	3 E-5
1560	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-5	NA	NA	NA	NA	NA	NA	1 E-5
1561	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1562	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1563	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1564	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.0 E-7	NA	NA	NA	NA	4 E-7
1565	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1566	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.4 E-6	NA	NA	NA	NA	2 E-6
1567	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-6	NA	NA	NA	NA	1 E-6
1568	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1569	D	4.5 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.0 E-6	NA	NA	NA	NA	5 E-5

		Incremental Lifetime Cancer Risk																														
Sample Name	**Layer**	**1,1,2,2-PCA**	**1,1,2-TCA**	**1,1-DCA**	**1,1-DCE**	**1,2-DCA**	**1,2-DCE (total)**	**1,4-Diox**	**Al**	**Ba**	**BDCM**	**CCL**	**CF**	**CrVI**	**cis-1,2-DCE**	**Cu**	**DBCM**	**Freon 113**	**Fe**	**DCM**	**Mo**	**Nitrate**	**Nitrite**	**NDMA**	**Perc**	**Ag**	**PCE**	**TOL**	**TCE**	**V**	**VC**	**Bo**	**N-BBS**	**ILCR**
Unit Hazard Child																																		
Unit Hazard Adult																																		
Unit Risk																																		
1570	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.5 E-7	NA	NA	NA	NA	7 E-7
1571	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1572	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1573	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1574	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1585	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.7 E-5	NA	NA	NA	NA	2 E-5
1586	C	NA	NA	NA	NA	8.2 E-6	NA	NA	NA	NA	NA	NA	2.6 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.4 E-6	NA	NA	NA	NA	4 E-5
1587	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E-5	NA	NA	NA	NA	1 E-5
1588	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.7 E-6	NA	NA	NA	NA	2 E-6
1589	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-6	NA	NA	NA	NA	1 E-6
1590	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1591	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1592	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.1 E-7	NA	NA	NA	NA	6 E-7
1593	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1594	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.7 E-6	NA	NA	NA	NA	2 E-6
1595	D/E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1596	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4300	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E-6	NA	NA	NA	NA	2 E-6
4301	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.3 E-6	NA	4.3 E-5	NA	NA	NA	NA	5 E-5
4302	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.7 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.0 E-6	NA	4.0 E-5	NA	NA	NA	NA	5 E-5
4325	C	NA	NA	9.8 E-7	NA	NA	NA	NA	NA	NA	NA	NA	9.1 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.6 E-5	NA	1.6 E-4	NA	NA	NA	NA	2 E-4
4330	C/D	NA	NA	3.5 E-6	NA	4.9 E-5	NA	3.1 E-5	NA	NA	NA	3.5 E-5	3.4 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E-4	NA	6.3 E-4	NA	5.7 E-5	NA	NA	1 E-3
4335	D/E	NA	1.5 E-5	4.5 E-6	NA	4.1 E-4	NA	3.6 E-5	NA	NA	NA	6.7 E-5	5.3 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.4 E-4	NA	9.9 E-4	NA	4.8 E-5	NA	NA	2 E-3
4340	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4345	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-6	NA	NA	NA	NA	1 E-6
4350	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E-6	NA	NA	NA	NA	2 E-6
4355	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-6	NA	NA	NA	NA	2 E-6
4360	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.8 E-5	NA	NA	NA	NA	2 E-5
4365	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-5	NA	NA	NA	NA	3 E-5
4370	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.9 E-6	NA	NA	NA	NA	2 E-6
4375	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.1 E-6	NA	NA	NA	NA	6 E-6
4380	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.6 E-7	NA	NA	NA	NA	NA	NA	NA	NA	3.1 E-5	NA	NA	NA	NA	3 E-5
4580	D/E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.7 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-5	NA	8.2 E-5	NA	NA	NA	NA	1 E-4
4585	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.1 E-6	NA	1.6 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.7 E-6	NA	6.0 E-5	NA	NA	NA	NA	9 E-5
4620	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.4 E-5	NA	NA	NA	NA	1 E-5
30068	C	NA	NA	4.0 E-6	NA	6.1 E-6	NA	3.4 E-5	NA	NA	1.2 E-5	NA	1.6 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-4	NA	3.7 E-4	NA	NA	NA	NA	6 E-4
30069	E	NA	NA	9.3 E-7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.2 E-5	NA	1.5 E-4	NA	NA	NA	NA	2 E-4
30070	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.4 E-6	NA	5.1 E-5	NA	NA	NA	NA	6 E-5
30071	C/D	NA	NA	NA	NA	6.5 E-6	NA	NA	NA	NA	NA	2.7 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.2 E-5	NA	NA	NA	NA	6 E-5
30072	D	NA	NA	NA	NA	7.9 E-6	NA	NA	NA	NA	NA	3.4 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.1 E-5	NA	NA	NA	NA	7 E-5
30073	D/E	NA	NA	NA	NA	9.8 E-6	NA	NA	NA	NA	NA	4.8 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.1 E-5	NA	NA	NA	NA	1 E-4
30100	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-6	NA	NA	NA	NA	1 E-6
30101	C	NA	1.8 E-5	5.0 E-6	NA	2.0 E-4	NA	5.5 E-5	NA	NA	NA	8.2 E-5	7.8 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.7 E-4	NA	2.8 E-3	NA	NA	NA	NA	4 E-3
30102	D	NA	7.0 E-6	4.8 E-6	NA	8.2 E-4	NA	4.8 E-5	NA	NA	NA	6.1 E-5	4.9 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-4	NA	6.3 E-4	NA	NA	NA	NA	2 E-3
30103	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.4 E-5	NA	NA	NA	NA	2 E-5
30140	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
30141	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-6	NA	NA	NA	NA	1 E-6
30156	E	NA	NA	1.2 E-6	NA	1.1 E-5	NA	NA	NA	NA	NA	2.8 E-5	1.6 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.0 E-5	NA	4.6 E-4	NA	NA	NA	NA	6 E-4
30157	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.4 E-6	NA	5.9 E-5	NA	NA	NA	NA	7 E-5
30158	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.8 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E-5	NA	1.1 E-4	NA	NA	NA	NA	1 E-4
30174	D	NA	NA	1.5 E-6	NA	7.0 E-6	NA	NA	NA	NA	NA	1.7 E-5	1.2 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.3 E-5	NA	3.0 E-4	NA	NA	NA	NA	4 E-4
30175	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.4 E-5	NA	NA	NA	NA	3 E-5
30176	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.3 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E-6	NA	NA	NA	NA	3 E-5
30177	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.1 E-5	NA	NA	NA	NA	2 E-5
30178	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-5	NA	NA	NA	NA	2 E-5
30179	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.8 E-5	NA	NA	NA	NA	2 E-5
30180	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-5	NA	NA	NA	NA	3 E-5
30181	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.1 E-5	NA	NA	NA	NA	3 E-5
30182	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.2 E-5	NA	NA	NA	NA	2 E-5
30195	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.6 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	2 E-5
30196	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.2 E-6	NA	NA	NA	NA	8 E-6
30197	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-5	NA	NA	NA	NA	1 E-5

All concentrations reported in micrograms per liter.
HI = Hazard index
ILCR = Incremental lifetime cancer risk
NA = Not applicable.
HI = Unit Hazard x Concentration; ILCR = Unit Risk x Concentration

Chemical Abbreviations

1,1,2,2-PCA	1,1,2,2-Tetrachloroethane	DCM	Methylene chloride
1,1,2-TCA	1,1,2-Trichloroethane	Mo	Molybdenum
1,1-DCA	1,1-Dichloroethane	Nitrate	Nitrate
1,1-DCE	1,1-Dichloroethene	Nitrite	Nitrite as N
1,2-DCA	1,2-Dichloroethane	NDMA	N-Nitrosodimethylamine
1,2-DCE (total)	1,2-Dichloroethene (cis/trans)	Perc	Perchlorate
1,4-Diox	1,4-Dioxane	Ag	Silver
Al	Aluminum	PCE	Tetrachloroethene
Ba	Barium	TOL	Toluene
BDCM	Bromodichloromethane	TCE	Trichloroethene
CCL	Carbon tetrachloride	V	Vanadium
CF	Chloroform	VC	Vinyl chloride
cis-1,2-DCE	cis-1,2-Dichloroethene	Zn	Zinc
Cu	Copper	Bo	Boron
DBCM	Dibromochloromethane	N-BBS	N-Butylbenzenesulfonamide
Freon 113	Freon 113		
Fe	Iron		

Table 2-14b
Location-Specific Indoor Air Risk Assessment Results - Resident
Zone 1 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Concentration																	
		1,1,2,2-PCA	1,1,2-TCA	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (total)	1,4-Diox	BDCM	CCL	CF	cis-1,2-DCE	DBCM	Freon 113	DCM	PCE	TOL	TCE	VC
Unit Hazard Child		1.1 E+1	1.6 E+2	3.2 E+0	3.2 E+1	4.6 E+2	6.4 E+1	7.5 E-1	3.2 E+1	5.6 E+1	4.9 E+1	6.4 E+1	3.2 E+1	7.4 E-2	7.5 E-1	6.4 E+1	7.4 E+0	3.7 E+0	2.2 E+1
Unit Hazard Adult		4.6 E+0	6.8 E+1	1.4 E+0	1.4 E+1	2.0 E+2	2.7 E+1	3.2 E-1	1.4 E+1	2.4 E+1	2.1 E+1	2.7 E+1	1.4 E+1	3.2 E-2	3.2 E-1	2.7 E+1	3.2 E+0	1.6 E+0	9.4 E+0
Unit Risk		3.0 E-2	8.5 E-3	8.5 E-4	NA	1.4 E-2	NA	4.0 E-3	1.9 E-2	2.2 E-2	1.2 E-2	NA	1.4 E-2	NA	5.2 E-4	3.1 E-3	NA	1.0 E-3	4.0 E-2
Attenuation Factor		1.5 E-3	4.5 E-3	2.7 E-2	1.5 E-1	6.3 E-3	1.9 E-2	5.7 E-5	3.1 E-3	1.5 E-1	2.4 E-2	1.9 E-2	1.0 E-3	2.4 E+0	1.4 E-2	8.4 E-2	3.6 E-2	5.1 E-2	1.8 E-1
1361	C		110	2.9	8.3	1.2	4.4				2.9	1.2	1.4	0.77		1		110	
1370	C			7.1	30	1.3	44	17			3.1			3.8	1	8.6		630	
1375	C			1.7	11	0.55	27				1.2			7		8.2	7.9	120	
1391	C			2.1	7.5		13				1.2					4.1		170	
1395	C																	3.7	
1396	C																	2	
1403	C		0.85	6.8	40	0.7	150	15			6.2			4.7		20	7.5	640	
1406	C					0.51												0.67	
1407	C																	9.4	
1469	C			1.7	36	1.2	30	10			1.8	25.7				9		870	
1472	C			1.3	6.9		30				1.3			1.8		4.5		140	
1475	C				0.84		3.7				1.1					0.92		47	
1481	C																	1.2	
1487	C																	1.4	
1506	C																		
1509	C				2.7	0.57	7.6		1		0.61	5.7				3.2		290	
1516	B																		
1517	B																		
1518	B/C																	3.7	
1519	C				1.1		4.8				0.59					1.8		190	
1522	C																7.7	6.1	
1523	C				0.68		2										10	31	
1525	C																		
1526	C																		
1528	C																		
1531	C				0.57		0.67											47	
1532	C																	37	
1539	C										4							29	
1559	C															1.8		2.8	
1560	C															0.84			
1562	C																		
1563	C																		
1564	C																	0.54	
1565	C																		
1567	B																	1.6	
1568	C																		
1570	C																	1	
1571	C																		
1574	C																		
1585	C											2.8					4.7	23	
1586	C					1					4						4.4	4.6	
1591	C																		
1592	C																	0.82	
1594	C																	2.3	
30068	C			7.7	27	0.74	41	14	1		2.4	38.2		2.7		7.9		490	
30100	C																	1.8	
30195	C										0.86								
30196	C																	11	

		Child Non-Cancer Hazard Index																			Child Non-Cancer Hazard Index
		1,1,2,2-PCA	1,1,2-TCA	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (total)	1,4-Diox	BDCM	CCL	CF	cis-1,2-DCE	DBCM	Freon 113	DCM	PCE	TOL	TCE	VC		HI
Unit Hazard Child																					
Unit Hazard Adult																					
Unit Risk																					
Attenuation Factor																					
1361	C	NA	7.9 E-2	2.5 E-4	4.0 E-2	3.5 E-3	5.4 E-3	NA	NA	NA	3.4 E-3	1.5 E-3	4.6 E-5	1.4 E-4	NA	5.3 E-3	NA	2.1 E-2	NA		1.6 E-1
1370	C	NA	NA	6.0 E-4	1.4 E-1	3.8 E-3	5.4 E-2	7.3 E-7	NA	NA	3.6 E-3	NA	NA	6.8 E-4	1.0 E-5	4.6 E-2	NA	1.2 E-1	NA		3.7 E-1
1375	C	NA	NA	1.4 E-4	5.2 E-2	1.6 E-3	3.3 E-2	NA	NA	NA	1.4 E-3	NA	NA	1.2 E-3	NA	4.4 E-2	2.1 E-3	2.3 E-2	NA		1.6 E-1
1391	C	NA	NA	1.8 E-4	3.6 E-2	NA	1.6 E-2	NA	NA	NA	1.4 E-3	NA	NA	NA	NA	2.2 E-2	NA	3.3 E-2	NA		1.1 E-1
1395	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.1 E-4	NA		7.1 E-4
1396	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.8 E-4	NA		3.8 E-4
1403	C	NA	6.1 E-4	5.8 E-4	1.9 E-1	2.0 E-3	1.8 E-1	6.4 E-7	NA	NA	7.3 E-3	NA	NA	8.4 E-4	NA	1.1 E-1	2.0 E-3	1.2 E-1	NA		6.2 E-1
1406	C	NA	NA	NA	NA	1.5 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-4	NA		1.6 E-3
1407	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.8 E-3	NA		1.8 E-3
1469	C	NA	NA	1.4 E-4	1.7 E-1	3.5 E-3	3.7 E-2	4.3 E-7	NA	NA	2.1 E-3	3.1 E-2	NA	NA	NA	4.8 E-2	NA	1.7 E-1	NA		4.6 E-1
1472	C	NA	NA	1.1 E-4	3.3 E-2	NA	3.7 E-2	NA	NA	NA	1.5 E-3	NA	NA	3.2 E-4	NA	2.4 E-2	NA	2.7 E-2	NA		1.2 E-1
1475	C	NA	NA	NA	4.0 E-3	NA	4.5 E-3	NA	NA	NA	1.3 E-3	NA	NA	NA	NA	4.9 E-3	NA	9.0 E-3	NA		2.4 E-2
1481	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.3 E-4	NA		2.3 E-4
1487	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.7 E-4	NA		2.7 E-4
1506	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
1509	C	NA	NA	NA	1.3 E-2	1.6 E-3	9.3 E-3	NA	1.0 E-4	NA	7.2 E-4	7.0 E-3	NA	NA	NA	1.7 E-2	NA	5.6 E-2	NA		1.0 E-1
1516	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
1517	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
1518	B/C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.1 E-4	NA		7.1 E-4
1519	C	NA	NA	NA	5.2 E-3	NA	5.9 E-3	NA	NA	NA	6.9 E-4	NA	NA	NA	NA	9.6 E-3	NA	3.6 E-2	NA		5.8 E-2
1522	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.1 E-3	1.2 E-3	NA		3.2 E-3
1523	C	NA	NA	NA	3.2 E-3	NA	2.4 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.7 E-3	5.9 E-3	NA		1.4 E-2
1525	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
1526	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
1528	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
1531	C	NA	NA	NA	2.7 E-3	NA	8.2 E-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.0 E-3	NA		1.3 E-2
1532	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.1 E-3	NA		7.1 E-3
1539	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.7 E-3	NA	NA	NA	NA	NA	NA	5.6 E-3	NA		1.0 E-2
1559	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.6 E-3	NA	5.4 E-4	NA		1.0 E-2
1560	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.5 E-3	NA	NA	NA		4.5 E-3
1562	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
1563	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
1564	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E-4	NA		1.0 E-4
1565	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
1567	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.1 E-4	NA		3.1 E-4
1568	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
1570	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.9 E-4	NA		1.9 E-4
1571	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
1574	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
1585	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.4 E-3	NA	NA	NA	NA	1.3 E-3	4.4 E-3	NA		9.1 E-3
1586	C	NA	NA	NA	NA	2.9 E-3	NA	NA	NA	NA	4.7 E-3	NA	NA	NA	NA	NA	1.2 E-3	8.8 E-4	NA		9.6 E-3
1591	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
1592	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E-4	NA		1.6 E-4
1594	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.4 E-4	NA		4.4 E-4
30068	C	NA	NA	6.5 E-4	1.3 E-1	2.1 E-3	5.0 E-2	6.0 E-7	1.0 E-4	NA	2.8 E-3	4.7 E-2	NA	4.8 E-4	NA	4.2 E-2	NA	9.4 E-2	NA		3.7 E-1
30100	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.4 E-4	NA		3.4 E-4
30195	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E-3	NA	NA	NA	NA	NA	NA	NA	NA		1.0 E-3
30196	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.1 E-3	NA		2.1 E-3

Table 2-14b
Location-Specific Indoor Air Risk Assessment Results - Resident
Zone 1 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Adult Non-Cancer Hazard Index														Adult Non-Cancer Hazard Index				
		1,1,2,2-PCA	1,1,2-TCA	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (total)	1,4-Diox	BDCM	CCL	CF	cis-1,2-DCE	DBCM	Freon 113	DCM	PCE	TOL	TCE	VC	HI
Unit Hazard Child																				
Unit Hazard Adult																				
Unit Risk																				
Attenuation Factor																				
1361	C	NA	3.4 E-2	1.1 E-4	1.7 E-2	1.5 E-3	2.3 E-3	NA	NA	NA	1.5 E-3	6.3 E-4	2.0 E-5	5.9 E-5	NA	2.3 E-3	NA	9.0 E-3	NA	6.8 E-2
1370	C	NA	NA	2.6 E-4	6.1 E-2	1.6 E-3	2.3 E-2	3.1 E-7	NA	NA	1.6 E-3	NA	NA	2.9 E-4	4.4 E-6	2.0 E-2	NA	5.2 E-2	NA	1.6 E-1
1375	C	NA	NA	6.2 E-5	2.2 E-2	6.8 E-4	1.4 E-2	NA	NA	NA	6.0 E-4	NA	NA	5.3 E-4	NA	1.9 E-2	9.1 E-4	9.9 E-3	NA	6.8 E-2
1391	C	NA	NA	7.6 E-5	1.5 E-2	NA	6.8 E-3	NA	NA	NA	6.0 E-4	NA	NA	NA	NA	9.4 E-3	NA	1.4 E-2	NA	4.6 E-2
1395	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.0 E-4	NA	3.0 E-4
1396	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E-4	NA	1.6 E-4
1403	C	NA	2.6 E-4	2.5 E-4	8.2 E-2	8.7 E-4	7.9 E-2	2.8 E-7	NA	NA	3.1 E-3	NA	NA	3.6 E-4	NA	4.6 E-2	8.6 E-4	5.3 E-2	NA	2.6 E-1
1406	C	NA	NA	NA	NA	6.3 E-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.5 E-5	NA	6.9 E-4
1407	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.7 E-4	NA	7.7 E-4
1469	C	NA	NA	6.2 E-5	7.3 E-2	1.5 E-3	1.6 E-2	1.8 E-7	NA	NA	9.0 E-4	1.3 E-2	NA	NA	NA	2.1 E-2	NA	7.1 E-2	NA	2.0 E-1
1472	C	NA	NA	4.7 E-5	1.4 E-2	NA	1.6 E-2	NA	NA	NA	6.5 E-4	NA	NA	1.4 E-4	NA	1.0 E-2	NA	1.1 E-2	NA	5.2 E-2
1475	C	NA	NA	NA	1.7 E-3	NA	1.9 E-3	NA	NA	NA	5.5 E-4	NA	NA	NA	NA	2.1 E-3	NA	3.9 E-3	NA	1.0 E-2
1481	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.9 E-5	NA	9.9 E-5
1487	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-4	NA	1.1 E-4
1506	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1509	C	NA	NA	NA	5.5 E-3	7.1 E-4	4.0 E-3	NA	4.3 E-5	NA	3.1 E-4	3.0 E-3	NA	NA	NA	7.3 E-3	NA	2.4 E-2	NA	4.5 E-2
1516	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1517	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1518	B/C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.0 E-4	NA	3.0 E-4
1519	C	NA	NA	NA	2.2 E-3	NA	2.5 E-3	NA	NA	NA	3.0 E-4	NA	NA	NA	NA	4.1 E-3	NA	1.6 E-2	NA	2.5 E-2
1522	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.9 E-4	5.0 E-4	NA	1.4 E-3
1523	C	NA	NA	NA	1.4 E-3	NA	1.0 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-3	2.5 E-3	NA	6.1 E-3
1525	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1526	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1528	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1531	C	NA	NA	NA	1.2 E-3	NA	3.5 E-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.9 E-3	NA	5.4 E-3
1532	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.0 E-3	NA	3.0 E-3
1539	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-3	NA	NA	NA	NA	NA	NA	2.4 E-3	NA	4.4 E-3
1559	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.1 E-3	NA	2.3 E-4	NA	4.3 E-3
1560	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.9 E-3	NA	NA	NA	1.9 E-3
1562	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1563	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1564	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.4 E-5	NA	4.4 E-5
1565	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1567	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-4	NA	1.3 E-4
1568	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1570	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.2 E-5	NA	8.2 E-5
1571	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1574	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1585	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E-3	NA	NA	NA	NA	5.4 E-4	1.9 E-3	NA	3.9 E-3
1586	C	NA	NA	NA	NA	1.2 E-3	NA	NA	NA	NA	2.0 E-3	NA	NA	NA	NA	NA	5.1 E-4	3.8 E-4	NA	4.1 E-3
1591	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1592	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.7 E-5	NA	6.7 E-5
1594	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.9 E-4	NA	1.9 E-4
30068	C	NA	NA	2.8 E-4	5.5 E-2	9.2 E-4	2.1 E-2	2.6 E-7	4.3 E-5	NA	1.2 E-3	2.0 E-2	NA	2.1 E-4	NA	1.8 E-2	NA	4.0 E-2	NA	1.6 E-1
30100	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E-4	NA	1.5 E-4
30195	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.3 E-4	NA	NA	NA	NA	NA	NA	NA	NA	4.3 E-4
30196	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.0 E-4	NA	9.0 E-4

Table 2-14b
Location-Specific Indoor Air Risk Assessment Results - Resident
Zone 1 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Incremental Lifetime Cancer Risk																		Incremental Lifetime Cancer Risk
		1,1,2,2-PCA	1,1,2-TCA	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (total)	1,4-Diox	BDCM	CCL	CF	cis-1,2-DCE	DBCM	Freon 113	DCM	PCE	TOL	TCE	VC	ILCR
Unit Hazard Child																				
Unit Hazard Adult																				
Unit Risk																				
Attenuation Factor																				
1361	C	NA	4.2 E-6	6.5 E-8	NA	1.0 E-7	NA	NA	NA	NA	8.3 E-7	NA	2.0 E-8	NA	NA	2.6 E-7	NA	5.9 E-6	NA	1 E-5
1370	C	NA	NA	1.6 E-7	NA	1.1 E-7	NA	3.9 E-9	NA	NA	8.8 E-7	NA	NA	NA	7.2 E-9	2.2 E-6	NA	3.4 E-5	NA	4 E-5
1375	C	NA	NA	3.8 E-8	NA	4.7 E-8	NA	NA	NA	NA	3.4 E-7	NA	NA	NA	NA	2.1 E-6	NA	6.4 E-6	NA	9 E-6
1391	C	NA	NA	4.7 E-8	NA	NA	NA	NA	NA	NA	3.4 E-7	NA	NA	NA	NA	1.1 E-6	NA	9.1 E-6	NA	1 E-5
1395	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-7	NA	2 E-7
1396	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-7	NA	1 E-7
1403	C	NA	3.2 E-8	1.5 E-7	NA	6.0 E-8	NA	3.5 E-9	NA	NA	1.8 E-6	NA	NA	NA	NA	5.2 E-6	NA	3.4 E-5	NA	4 E-5
1406	C	NA	NA	NA	NA	4.4 E-8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.6 E-8	NA	8 E-8
1407	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.0 E-7	NA	5 E-7
1469	C	NA	NA	3.8 E-8	NA	1.0 E-7	NA	2.3 E-9	NA	NA	5.1 E-7	NA	NA	NA	NA	2.3 E-6	NA	4.7 E-5	NA	5 E-5
1472	C	NA	NA	2.9 E-8	NA	NA	NA	NA	NA	NA	3.7 E-7	NA	NA	NA	NA	1.2 E-6	NA	7.5 E-6	NA	9 E-6
1475	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.1 E-7	NA	NA	NA	NA	2.4 E-7	NA	2.5 E-6	NA	3 E-6
1481	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.4 E-8	NA	6 E-8
1487	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.5 E-8	NA	7 E-8
1506	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1509	C	NA	NA	NA	NA	4.9 E-8	NA	NA	6.0 E-8	NA	1.7 E-7	NA	NA	NA	NA	8.3 E-7	NA	1.6 E-5	NA	2 E-5
1516	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1517	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1518	B/C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-7	NA	2 E-7
1519	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.7 E-7	NA	NA	NA	NA	4.7 E-7	NA	1.0 E-5	NA	1 E-5
1522	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.3 E-7	NA	3 E-7
1523	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.7 E-6	NA	2 E-6
1525	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1526	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1528	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1531	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-6	NA	3 E-6
1532	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-6	NA	2 E-6
1539	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-6	NA	NA	NA	NA	NA	NA	1.6 E-6	NA	3 E-6
1559	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.7 E-7	NA	1.5 E-7	NA	6 E-7
1560	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.2 E-7	NA	NA	NA	2 E-7
1562	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1563	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1564	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.9 E-8	NA	3 E-8
1565	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1567	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.6 E-8	NA	9 E-8
1568	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1570	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.3 E-8	NA	5 E-8
1571	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1574	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1585	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-6	NA	1 E-6
1586	C	NA	NA	NA	NA	8.6 E-8	NA	NA	NA	NA	1.1 E-6	NA	NA	NA	NA	NA	NA	2.5 E-7	NA	1 E-6
1591	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1592	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.4 E-8	NA	4 E-8
1594	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-7	NA	1 E-7
30068	C	NA	NA	1.7 E-7	NA	6.3 E-8	NA	3.2 E-9	6.0 E-8	NA	6.9 E-7	NA	NA	NA	NA	2.1 E-6	NA	2.6 E-5	NA	3 E-5
30100	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.6 E-8	NA	1 E-7
30195	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-7	NA	NA	NA	NA	NA	NA	NA	NA	2 E-7
30196	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.9 E-7	NA	6 E-7

Notes and Key:
All concentrations reported in micrograms per liter.
HI = AF x Concentration x 1 ug/L/1000 ug/m^3 x Unit Hazard;
ILCR = AF x Concentration x 1 ug/L/1000 ug/m^3 / Unit Risk
HI = Hazard index
ILCR = Incremental lifetime cancer risk
NA = Not applicable.

Chemical Abbreviations

1,1,2-TCA	1,1,2-Trichloroethane	1,4-Diox	1,4-Dioxane	DCM	Methylene chloride	CF	Chloroform
1,1-DCA	1,1-Dichloroethane	BDCM	Bromodichloromethane	PCE	Tetrachloroethene	VC	
1,1-DCE	1,1-Dichloroethene	cis-1,2-DCE	cis-1,2-Dichloroethene	TOL	Toluene		Vinyl chloride
1,2-DCA	1,2-Dichloroethane	DBCM	Dibromochloromethane	TCE	Trichloroethene		
1,2-DCE(total)	1,2-Dichloroethene (cis/trans)	1,1,2,2-PCA	1,1,2,2-Tetrachloroethane	CCL	Carbon tetrachloride		

Table 2-14c
Location-Specific Indoor Air Risk Assessment Results - Commercial Worker
Zone 1 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Concentration																	
	Zone[a]	1,1,2,2-PCA	1,1,2-TCA	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (total)	1,4-Diox	BDCM	CCL	CF	cis-1,2-DCE	DBCM	Freon 113	DCM	PCE	TOL	TCE	VC
Unit Hazard		3.3 E+0	4.9 E+1	9.8 E-1	9.8 E+0	1.4 E+2	2.0 E+1	2.3 E-1	9.8 E+0	1.7 E+1	1.5 E+1	2.0 E+1	9.8 E+0	2.3 E-2	2.3 E-1	2.0 E+1	2.3 E+0	1.1 E+0	6.7 E+0
Unit Risk		1.4 E-2	4.0 E-3	4.0 E-4	NA	6.4 E-3	NA	1.9 E-3	9.1 E-3	1.0 E-2	5.6 E-3	NA	6.6 E-3	NA	2.4 E-4	1.5 E-3	NA	4.9 E-4	1.9 E-2
Attenuation Factor		7.7 E-4	2.2 E-3	1.3 E-2	7.4 E-2	3.2 E-3	9.6 E-3	2.9 E-5	1.6 E-3	7.5 E-2	1.2 E-2	9.6 E-3	5.1 E-4	1.2 E+0	6.9 E-3	4.2 E-2	1.8 E-2	2.6 E-2	9.1 E-2
1361	C		110	2.9	8.3	1.2	4.4				2.9	1.2	1.4	0.77		1		110	
1370	C			7.1	30	1.3	44	17			3.1			3.8	1	8.6		630	
1375	C			1.7	11	0.55	27				1.2			7		8.2	7.9	120	
1391	C			2.1	7.5		13				1.2					4.1		170	
1395	C																	3.7	
1396	C																	2	
1403	C		0.85	6.8	40	0.7	150	15			6.2			4.7		20	7.5	640	
1406	C					0.51												0.67	
1407	C																	9.4	
1469	C			1.7	36	1.2	30	10			1.8	25.7				9		870	
1472	C			1.3	6.9		30				1.3			1.8		4.5		140	
1475	C				0.84		3.7				1.1					0.92		47	
1481	C																	1.2	
1487	C																	1.4	
1506	C																		
1509	C				2.7	0.57	7.6		1		0.61	5.7				3.2		290	
1516	B																		
1517	B																		
1518	B/C																	3.7	
1519	C				1.1		4.8				0.59					1.8		190	
1522	C																7.7	6.1	
1523	C				0.68		2										10	31	
1525	C																		
1526	C																		
1528	C																		
1531	C				0.57		0.67											47	
1532	C																	37	
1539	C										4							29	
1559	C															1.8		2.8	
1560	C															0.84			
1562	C																		
1563	C																		
1564	C																	0.54	
1565	C																		
1567	B																	1.6	
1568	C																		
1570	C																	1	
1571	C																		
1574	C																		
1585	C											2.8					4.7	23	
1586	C					1					4						4.4	4.6	
1591	C																		
1592	C																	0.82	
1594	C																	2.3	
30068	C			7.7	27	0.74	41	14	1		2.4	38.2		2.7		7.9		490	
30100	C																	1.8	
30195	C										0.86								
30196	C																	11	

Table 2-14c
Location-Specific Indoor Air Risk Assessment Results - Commercial Worker
Zone 1 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Non-Cancer Hazard Index																		
	Zone[a]	1,1,2,2-PCA	1,1,2-TCA	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (total)	1,4-Diox	BDCM	CCL	CF	cis-1,2-DCE	DBCM	Freon 113	DCM	PCE	TOL	TCE	VC	HI
Unit Hazard																				
Unit Risk																				
Attenuation Factor																				
1361	C	NA	1.2 E-2	3.8 E-5	6.0 E-3	5.3 E-4	8.2 E-4	NA	NA	NA	5.2 E-4	2.2 E-4	7.0 E-6	2.1 E-5	NA	8.2 E-4	NA	3.2 E-3	NA	2.4 E-2
1370	C	NA	NA	9.2 E-5	2.2 E-2	5.8 E-4	8.2 E-3	1.1 E-7	NA	NA	5.6 E-4	NA	NA	1.0 E-4	1.6 E-6	7.0 E-3	NA	1.8 E-2	NA	5.7 E-2
1375	C	NA	NA	2.2 E-5	8.0 E-3	2.4 E-4	5.1 E-3	NA	NA	NA	2.2 E-4	NA	NA	1.9 E-4	NA	6.7 E-3	3.2 E-4	3.5 E-3	NA	2.4 E-2
1391	C	NA	NA	2.7 E-5	5.5 E-3	NA	2.4 E-3	NA	NA	NA	2.2 E-4	NA	NA	NA	NA	3.4 E-3	NA	5.0 E-3	NA	1.6 E-2
1395	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-4	NA	1.1 E-4
1396	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.9 E-5	NA	5.9 E-5
1403	C	NA	9.3 E-5	8.8 E-5	2.9 E-2	3.1 E-4	2.8 E-2	9.8 E-8	NA	NA	1.1 E-3	NA	NA	1.3 E-4	NA	1.6 E-2	3.1 E-4	1.9 E-2	NA	9.4 E-2
1406	C	NA	NA	NA	NA	2.3 E-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-5	NA	2.5 E-4
1407	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.8 E-4	NA	2.8 E-4
1469	C	NA	NA	2.2 E-5	2.6 E-2	5.3 E-4	5.6 E-3	6.6 E-8	NA	NA	3.2 E-4	4.8 E-3	NA	NA	NA	7.4 E-3	NA	2.6 E-2	NA	7.0 E-2
1472	C	NA	NA	1.7 E-5	5.0 E-3	NA	5.6 E-3	NA	NA	NA	2.3 E-4	NA	NA	4.9 E-5	NA	3.7 E-3	NA	4.1 E-3	NA	1.9 E-2
1475	C	NA	NA	NA	6.1 E-4	NA	6.9 E-4	NA	NA	NA	2.0 E-4	NA	NA	NA	NA	7.5 E-4	NA	1.4 E-3	NA	3.6 E-3
1481	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.5 E-5	NA	3.5 E-5
1487	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.1 E-5	NA	4.1 E-5
1506	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1509	C	NA	NA	NA	2.0 E-3	2.5 E-4	1.4 E-3	NA	1.5 E-5	NA	1.1 E-4	1.1 E-3	NA	NA	NA	2.6 E-3	NA	8.5 E-3	NA	1.6 E-2
1516	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1517	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1518	B/C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-4	NA	1.1 E-4
1519	C	NA	NA	NA	8.0 E-4	NA	9.0 E-4	NA	NA	NA	1.1 E-4	NA	NA	NA	NA	1.5 E-3	NA	5.6 E-3	NA	8.8 E-3
1522	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.2 E-4	1.8 E-4	NA	5.0 E-4
1523	C	NA	NA	NA	5.0 E-4	NA	3.7 E-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.1 E-4	9.1 E-4	NA	2.2 E-3
1525	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1526	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1528	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1531	C	NA	NA	NA	4.2 E-4	NA	1.3 E-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.4 E-3	NA	1.9 E-3
1532	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-3	NA	1.1 E-3
1539	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.2 E-4	NA	NA	NA	NA	NA	NA	8.5 E-4	NA	1.6 E-3
1559	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E-3	NA	8.2 E-5	NA	1.6 E-3
1560	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.9 E-4	NA	NA	NA	6.9 E-4
1562	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1563	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1564	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E-5	NA	1.6 E-5
1565	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1567	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.7 E-5	NA	4.7 E-5
1568	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1570	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.9 E-5	NA	2.9 E-5
1571	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1574	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1585	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.2 E-4	NA	NA	NA	NA	1.9 E-4	6.7 E-4	NA	1.4 E-3
1586	C	NA	NA	NA	NA	4.4 E-4	NA	NA	NA	NA	7.2 E-4	NA	NA	NA	NA	NA	1.8 E-4	1.3 E-4	NA	1.5 E-3
1591	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1592	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.4 E-5	NA	2.4 E-5
1594	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.7 E-5	NA	6.7 E-5
30068	C	NA	NA	1.0 E-4	2.0 E-2	3.3 E-4	7.7 E-3	9.2 E-8	1.5 E-5	NA	4.3 E-4	7.1 E-3	NA	7.3 E-5	NA	6.5 E-3	NA	1.4 E-2	NA	5.6 E-2
30100	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.3 E-5	NA	5.3 E-5
30195	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E-4	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E-4
30196	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.2 E-4	NA	3.2 E-4

Table 2-14c
Location-Specific Indoor Air Risk Assessment Results - Commercial Worker
Zone 1 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Incremental Lifetime Cancer Risk																		
	Zone[a]	1,1,2,2-PCA	1,1,2-TCA	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (total)	1,4-Diox	BDCM	CCL	CF	cis-1,2-DCE	DBCM	Freon 113	DCM	PCE	TOL	TCE	VC	ILCR
Unit Hazard																				
Unit Risk																				
Attenuation Factor																				
1361	C	NA	9.8 E-7	1.5 E-8	NA	2.4 E-8	NA	NA	NA	NA	1.9 E-7	NA	4.7 E-9	NA	NA	6.1 E-8	NA	1.4 E-6	NA	3 E-6
1370	C	NA	NA	3.8 E-8	NA	2.6 E-8	NA	9.2 E-10	NA	NA	2.1 E-7	NA	NA	NA	1.7 E-9	5.3 E-7	NA	7.9 E-6	NA	9 E-6
1375	C	NA	NA	9.0 E-9	NA	1.1 E-8	NA	NA	NA	NA	8.0 E-8	NA	NA	NA	NA	5.0 E-7	NA	1.5 E-6	NA	2 E-6
1391	C	NA	NA	1.1 E-8	NA	NA	NA	NA	NA	NA	8.0 E-8	NA	NA	NA	NA	2.5 E-7	NA	2.1 E-6	NA	2 E-6
1395	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.6 E-8	NA	5 E-8
1396	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-8	NA	3 E-8
1403	C	NA	7.6 E-9	3.6 E-8	NA	1.4 E-8	NA	8.1 E-10	NA	NA	4.2 E-7	NA	NA	NA	NA	1.2 E-6	NA	8.0 E-6	NA	1 E-5
1406	C	NA	NA	NA	NA	1.0 E-8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.4 E-9	NA	2 E-8
1407	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-7	NA	1 E-7
1469	C	NA	NA	9.0 E-9	NA	2.4 E-8	NA	5.4 E-10	NA	NA	1.2 E-7	NA	NA	NA	NA	5.5 E-7	NA	1.1 E-5	NA	1 E-5
1472	C	NA	NA	6.9 E-9	NA	NA	NA	NA	NA	NA	8.7 E-8	NA	NA	NA	NA	2.8 E-7	NA	1.8 E-6	NA	2 E-6
1475	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.4 E-8	NA	NA	NA	NA	5.6 E-8	NA	5.9 E-7	NA	7 E-7
1481	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E-8	NA	2 E-8
1487	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.8 E-8	NA	2 E-8
1506	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1509	C	NA	NA	NA	NA	1.1 E-8	NA	NA	1.4 E-8	NA	4.1 E-8	NA	NA	NA	NA	2.0 E-7	NA	3.6 E-6	NA	4 E-6
1516	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1517	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1518	B/C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.6 E-8	NA	5 E-8
1519	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.0 E-8	NA	NA	NA	NA	1.1 E-7	NA	2.4 E-6	NA	3 E-6
1522	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.7 E-8	NA	8 E-8
1523	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.9 E-7	NA	4 E-7
1525	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1526	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1528	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1531	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.9 E-7	NA	6 E-7
1532	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.6 E-7	NA	5 E-7
1539	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.7 E-7	NA	NA	NA	NA	NA	NA	3.6 E-7	NA	6 E-7
1559	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-7	NA	3.5 E-8	NA	1 E-7
1560	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.1 E-8	NA	NA	NA	5 E-8
1562	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1563	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1564	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.8 E-9	NA	7 E-9
1565	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1567	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-8	NA	2 E-8
1568	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1570	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-8	NA	1 E-8
1571	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1574	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1585	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.9 E-7	NA	3 E-7
1586	C	NA	NA	NA	NA	2.0 E-8	NA	NA	NA	NA	2.7 E-7	NA	NA	NA	NA	NA	NA	5.8 E-8	NA	3 E-7
1591	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1592	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E-8	NA	1 E-8
1594	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.9 E-8	NA	3 E-8
30068	C	NA	NA	4.1 E-8	NA	1.5 E-8	NA	7.6 E-10	1.4 E-8	NA	1.6 E-7	NA	NA	NA	NA	4.8 E-7	NA	6.2 E-6	NA	7 E-6
30100	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.3 E-8	NA	2 E-8
30195	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.8 E-8	NA	NA	NA	NA	NA	NA	NA	NA	6 E-8
30196	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.4 E-7	NA	1 E-7

Notes and Key:
All concentrations reported in micrograms per liter.
HI = AF x Concentration x 1 ug/L/1000 ug/m^3 x Unit Hazard; ILCR = AF x Concentration x 1 ug/L/1000 ug/m^3 /
HI = Hazard index
ILCR = Incremental lifetime cancer risk
NA = Not applicable.

Chemical Abbreviations

1,1,2-TCA	1,1,2-Trichloroethane	1,4-Diox	1,4-Dioxane	DCM	Methylene chloride	CF	Chloroform
1,1-DCA	1,1-Dichloroethane	BDCM	Bromodichloromethane	PCE	Tetrachloroethene	VC	Vinyl chloride
1,1-DCE	1,1-Dichloroethene	cis-1,2-DCE	cis-1,2-Dichloroethene	TOL	Toluene		
1,2-DCA	1,2-Dichloroethane	DBCM	Dibromochloromethane	TCE	Trichloroethene		
1,2-DCE(total)	1,2-Dichloroethene (cis/trans)	1,1,2,2-PCA	1,1,2,2-Tetrachloroethane	CCL	Carbon tetrachloride		

Table 2-15a
Location-Specific Domestic Use of Groundwater Risk Assessment Results - Resident
Zone 2 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Concentration											Child Non-Cancer Hazard Index											
Sample Name	**Layer**	**1,2-DCA**	**1,2-DCE (cis/trans)**	**CF**	**Cu**	**Fe**	**Mn**	**Nitrate**	**Perc**	**PCE**	**TCE**	**V**	**1,2-DCA**	**1,2-DCE (cis/trans)**	**CF**	**Cu**	**Fe**	**Mn**	**Nitrate**	**Perc**	**PCE**	**TCE**	**V**	**HI**
Unit Hazard Child		2.3 E-1	3.9 E-2	3.2 E-2	1.7 E-3	9.2 E-5	3.1 E-3	4.0 E-5	9.2 E-2	4.2 E-2	2.5 E-1	8.0 E-2												
Unit Hazard Adult		9.9 E-2	1.7 E-2	1.4 E-2	7.4 E-4	3.9 E-5	1.3 E-3	1.7 E-5	3.9 E-2	1.8 E-2	1.1 E-1	3.3 E-2												
Unit Risk		8.2 E-6	NA	6.5 E-6	NA	NA	NA	NA	NA	1.4 E-5	7.5 E-7	NA												
109	A				26	10000	180	5200				6.9	NA	NA	NA	4.5 E-2	9.2 E-1	5.6 E-1	2.1 E-1	NA	NA	NA	5.5 E-1	2.3 E+0
111	A								8.3				NA	NA	NA	NA	NA	NA	NA	7.6 E-1	NA	NA	NA	7.6 E-1
177	A								6.8	0.59			NA	NA	NA	NA	NA	NA	NA	6.3 E-1	2.5 E-2	NA	NA	6.5 E-1
178	C								260		6.8		NA	NA	NA	NA	NA	NA	NA	2.4 E+1	NA	1.7 E+0	NA	2.6 E+1
179	D												NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
314	B								460		65		NA	NA	NA	NA	NA	NA	NA	4.2 E+1	NA	1.6 E+1	NA	5.9 E+1
315	B								230		39		NA	NA	NA	NA	NA	NA	NA	2.1 E+1	NA	9.8 E+0	NA	3.1 E+1
317	D												NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3076	A							1400					NA	NA	NA	NA	NA	NA	5.6 E-2	NA	NA	NA	NA	5.6 E-2
3077	B												NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3078	C			0.63									NA	NA	2.0 E-2	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-2
3119	A												NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3120	C												NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3326	B			0.61									NA	NA	1.9 E-2	NA	NA	NA	NA	NA	NA	NA	NA	1.9 E-2
3327	C												NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3328	E												NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3329	B		16						990		360		NA	6.2 E-1	NA	NA	NA	NA	NA	9.1 E+1	NA	9.0 E+1	NA	1.8 E+2
3360	D								680		16		NA	NA	NA	NA	NA	NA	NA	6.3 E+1	NA	4.0 E+0	NA	6.7 E+1
3460	A												NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3470	A												NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3500	A		53						500		440		NA	2.1 E+0	NA	NA	NA	NA	NA	4.6 E+1	NA	1.1 E+2	NA	1.6 E+2
3501	B		18						1300		280		NA	7.0 E-1	NA	NA	NA	NA	NA	1.2 E+2	NA	7.0 E+1	NA	1.9 E+2
3502	C										0.86		NA	NA	NA	NA	NA	NA	NA	NA	NA	2.2 E-1	NA	2.2 E-1
3509	A												NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3510	A										0.57		NA	NA	NA	NA	NA	NA	NA	NA	NA	1.4 E-1	NA	1.4 E-1
3511	A												NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3512	A	3.9							28				9.0 E-1	NA	NA	NA	NA	NA	NA	2.6 E+0	NA	NA	NA	3.5 E+0
3513	A								22		6.1		NA	NA	NA	NA	NA	NA	NA	2.0 E+0	NA	1.5 E+0	NA	3.6 E+0
3579	B		0.61								18		NA	2.4 E-2	NA	NA	NA	NA	NA	NA	NA	4.5 E+0	NA	4.5 E+0
3580	C								210		7.3		NA	NA	NA	NA	NA	NA	NA	1.9 E+1	NA	1.8 E+0	NA	2.1 E+1
3581	C												NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 2-15a
Location-Specific Domestic Use of Groundwater Risk Assessment Results - Resident
Zone 2 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Adult Non-Cancer Hazard Index												Incremental Lifetime Cancer Risk											
Sample Name	Layer	1,2-DCA	1,2-DCE (cis/trans)	CF	Cu	Fe	Mn	Nitrate	Perc	PCE	TCE	V	HI	1,2-DCA	1,2-DCE (cis/trans)	CF	Cu	Fe	Mn	Nitrate	Perc	PCE	TCE	V	ILCR
Unit Hazard Child																									
Unit Hazard Adult																									
Unit Risk																									
109	A	NA	NA	NA	1.9 E-2	3.9 E-1	2.3 E-1	9.0 E-2	NA	NA	NA	2.3 E-1	9.6 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
111	A	NA	NA	NA	NA	NA	NA	NA	3.3 E-1	NA	NA	NA	3.3 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
177	A	NA	NA	NA	NA	NA	NA	NA	2.7 E-1	1.1 E-2	NA	NA	2.8 E-1	NA	NA	NA	NA	NA	NA	NA	NA	8.4 E-6	NA	NA	8 E-6
178	C	NA	NA	NA	NA	NA	NA	NA	1.0 E+1	NA	7.3 E-1	NA	1.1 E+1	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.1 E-6	NA	5 E-6
179	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
314	B	NA	NA	NA	NA	NA	NA	NA	1.8 E+1	NA	7.0 E+0	NA	2.5 E+1	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.9 E-5	NA	5 E-5
315	B	NA	NA	NA	NA	NA	NA	NA	9.0 E+0	NA	4.2 E+0	NA	1.3 E+1	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.9 E-5	NA	3 E-5
317	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3076	A	NA	NA	NA	NA	NA	NA	2.4 E-2	NA	NA	NA	NA	2.4 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3077	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3078	C	NA	NA	8.5 E-3	NA	NA	NA	NA	NA	NA	NA	NA	8.5 E-3	NA	NA	4.1 E-6	NA	NA	NA	NA	NA	NA	NA	NA	4 E-6
3119	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3120	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3326	B	NA	NA	8.3 E-3	NA	NA	NA	NA	NA	NA	NA	NA	8.3 E-3	NA	NA	4.0 E-6	NA	NA	NA	NA	NA	NA	NA	NA	4 E-6
3327	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3328	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3329	B	NA	2.7 E-1	NA	NA	NA	NA	NA	3.9 E+1	NA	3.9 E+1	NA	7.8 E+1	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.7 E-4	NA	3 E-4
3360	D	NA	NA	NA	NA	NA	NA	NA	2.7 E+1	NA	1.7 E+0	NA	2.8 E+1	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-5	NA	1 E-5
3460	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3470	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3500	A	NA	8.8 E-1	NA	NA	NA	NA	NA	2.0 E+1	NA	4.7 E+1	NA	6.8 E+1	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.3 E-4	NA	3 E-4
3501	B	NA	3.0 E-1	NA	NA	NA	NA	NA	5.1 E+1	NA	3.0 E+1	NA	8.2 E+1	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.1 E-4	NA	2 E-4
3502	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.3 E-2	NA	9.3 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.4 E-7	NA	6 E-7
3509	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3510	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.2 E-2	NA	6.2 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.3 E-7	NA	4 E-7
3511	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3512	A	3.9 E-1	NA	NA	NA	NA	NA	NA	1.1 E+0	NA	NA	NA	1.5 E+0	3.2 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3 E-5
3513	A	NA	NA	NA	NA	NA	NA	NA	8.7 E-1	NA	6.6 E-1	NA	1.5 E+0	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.6 E-6	NA	5 E-6
3579	B	NA	1.0 E-2	NA	NA	NA	NA	NA	NA	NA	1.9 E+0	NA	2.0 E+0	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-5	NA	1 E-5
3580	C	NA	NA	NA	NA	NA	NA	NA	8.3 E+0	NA	7.9 E-1	NA	9.1 E+0	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.5 E-6	NA	5 E-6
3581	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes and Key:
All concentrations reported in micrograms per liter.
HI = Hazard index
ILCR = Incremental lifetime cancer risk
NA = Not applicable.
HI = Unit Hazard x Concentration; ILCR = Unit Risk x Concentration

Chemical Abbreviations

1,2-DCA	1,2-Dichloroethane	Mn	Manganese
1,2-DCE	1,2-Dichloroethene	Perc	Perchlorate
CF	Chloroform	PCE	Tetrachloroethene
Cu	Copper	TCE	Trichloroethene
Fe	Iron	V	Vanadium

Table 2-15b
Location-Specific Indoor Air Risk Assessment Results - Resident
Zone 2 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Concentration					Child Non-Cancer Hazard Index						Adult Non-Cancer Hazard Index											
Sample Name	**Layer**	**1,2-DCA**	**1,2-DCE (cis/trans)**	**CF**	**PCE**	**TCE**	**1,2-DCA**	**1,2-DCE (cis/trans)**	**CF**	**PCE**	**TCE**	**HI**	**1,2-DCA**	**1,2-DCE (cis/trans)**	**CF**	**PCE**	**TCE**	**HI**	**1,2-DCA**	**1,2-DCE (cis/trans)**	**CF**	**PCE**	**TCE**	**ILCR**
Unit Hazard Child		4.6 E+2	6.4 E+1	4.9 E+1	6.4 E+1	3.7 E+0																		
Unit Hazard Adult		2.0 E+2	2.7 E+1	2.1 E+1	2.7 E+1	1.6 E+0																		
Unit Risk		1.4 E-2	NA	1.2 E-2	3.1 E-3	1.0 E-3																		
Attenuation Factor		5.2 E-3	1.6 E-2	1.9 E-2	6.8 E-2	4.2 E-2																		
109	A						NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
111	A						NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
177	A				0.59		NA	NA	NA	2.6 E-3	NA	2.6 E-3	NA	NA	NA	1.1 E-3	NA	1.1 E-3	NA	NA	NA	1.3 E-7	NA	1 E-7
3460	A						NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3470	A						NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3500	A		53			440	NA	5.3 E-2	NA	NA	6.9 E-2	1.2 E-1	NA	2.3 E-2	NA	NA	2.9 E-2	5.2 E-2	NA	NA	NA	NA	1.9 E-5	2 E-5
3509	A						NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3510	A					0.57	NA	NA	NA	NA	8.9 E-5	8.9 E-5	NA	NA	NA	NA	3.8 E-5	3.8 E-5	NA	NA	NA	NA	2.5 E-8	2 E-8
3511	A						NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3512	A	3.9					9.2 E-3	NA	NA	NA	NA	9.2 E-3	3.9 E-3	NA	NA	NA	NA	3.9 E-3	2.7 E-7	NA	NA	NA	NA	3 E-7
3513	A					6.1	NA	NA	NA	NA	9.5 E-4	9.5 E-4	NA	NA	NA	NA	4.1 E-4	4.1 E-4	NA	NA	NA	NA	2.7 E-7	3 E-7

Notes and Key:

All concentrations reported in micrograms per liter.

HI = AF x Concentration x 1 ug/L/1000 ug/m^3 x Unit Hazard; ILCR = AF x Concentration x 1 ug/L/1000 ug/m^3 / Unit Risk

HI = Hazard index

ILCR = Incremental lifetime cancer risk

NA = Not applicable.

Chemical Abbreviations

1,2-DCA	1,2-Dichloroethane
1,2-DCE	1,2-Dichloroethene
CF	Chloroform
PCE	Tetrachloroethene
TCE	Trichloroethene

Table 2-15c
Location-Specific Indoor Air Risk Assessment Results - Commercial Worker
Zone 2 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Concentration						Adult Non-Cancer Hazard Index							Incremental Lifetime Cancer Risk					
Sample Name	Layer	1,2-DCA	1,2-DCE (cis/trans)	CF	c-1,2-DCE	PCE	TCE	1,2-DCA	1,2-DCE (cis/trans)	CF	c-1,2-DCE	PCE	TCE	HI	1,2-DCA	1,2-DCE (cis/trans)	CF	PCE	TCE	ILCR
Unit Hazard		1.4 E+2	2.0 E+1	1.5 E+1	2.0 E+1	2.0 E+1	1.1 E+0													
Unit Risk		6.4 E-3	NA	5.6 E-3	NA	1.5 E-3	4.9 E-4													
Attenuation Factor		2.6 E-3	7.8 E-3	9.7 E-3	7.8 E-3	3.4 E-2	2.1 E-2													
109	A							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
111	A							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
177	A					0.59		NA	NA	NA	NA	3.9 E-4	NA	3.9 E-4	NA	NA	NA	2.9 E-8	NA	3 E-8
3460	A							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3470	A							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3500	A		53				440	NA	8.1 E-3	NA	NA	NA	1.1 E-2	1.9 E-2	NA	NA	NA	NA	4.5 E-6	5 E-6
3509	A							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3510	A						0.57	NA	NA	NA	NA	NA	1.4 E-5	1.4 E-5	NA	NA	NA	NA	5.8 E-9	6 E-9
3511	A							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3512	A	3.9						1.4 E-3	NA	NA	NA	NA	NA	1.4 E-3	6.4 E-8	NA	NA	NA	NA	6 E-8
3513	A						6.1	NA	NA	NA	NA	NA	1.5 E-4	1.5 E-4	NA	NA	NA	NA	6.2 E-8	6 E-8

Notes and Key:

All concentrations reported in micrograms per liter.

HI = AF x Concentration x 1 ug/L/1000 ug/m^3 x Unit Hazard; ILCR = AF x Concentration x 1 ug/L/1000 ug/m^3 / Unit Risk

HI = Hazard index

ILCR = Incremental lifetime cancer risk

NA = Not applicable.

Chemical Abbreviations

1,2-DCA	1,2-Dichloroethane
1,2-DCE	1,2-Dichloroethene
CF	Chloroform
PCE	Tetrachloroethene
TCE	Trichloroethene

Table 2-16
Location-Specific Domestic Use of Groundwater Risk Assessment Results - Resident
Zone 3 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Sample Name	Layer	Concentration																								
		1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (cis/trans)	1,4-DIOX	Al	CCL	CF	c-1,2-DCE	DMP	Freon 113	Fe	Mn	DCM	Nitrate	Nitrite as N	NDMA	Perc	Ag	PCE	TCE	Va	VC	Zn	1-M-2-P
Unit Hazard Child		1.9 E-3	1.7 E-2	2.3 E-1	3.9 E-2	3.7 E-4	6.7 E-5	1.4 E-1	3.2 E-2	3.9 E-2	6.6 E-6	4.6 E-5	9.2 E-5	3.1 E-3	1.5 E-3	4.0 E-5	4.0 E-4	1.0 E+1	9.2 E-2	1.3 E-2	4.2 E-2	2.5 E-1	8.0 E-2	3.3 E-2	2.1 E-4	NA
Unit Hazard Adult		8.3 E-4	7.5 E-3	9.9 E-2	1.7 E-2	1.6 E-4	2.8 E-5	6.2 E-2	1.4 E-2	1.7 E-2	2.8 E-6	2.1 E-5	3.9 E-5	1.3 E-3	6.3 E-4	1.7 E-5	1.7 E-4	4.3 E+0	3.9 E-2	5.5 E-3	1.8 E-2	1.1 E-1	3.3 E-2	1.4 E-2	9.2 E-5	NA
Unit Risk		5.2 E-7	NA	8.2 E-6	NA	2.4 E-6	NA	1.4 E-5	6.5 E-6	NA	NA	NA	NA	NA	4.8 E-7	NA	NA	9.6 E-4	NA	NA	1.4 E-5	7.5 E-7	NA	4.4 E-5	NA	NA
1059	C								3.1													1.4				
1218	C	4.3	30	4.7	2.4				2.6			30						53	25			130				
1219	E																	0.0099								
1220	F																									
1226	C		4.8	0.67					1.5									3.7	440			7.7				
1227	E							0.68	0.56																	
1228	F																									
1246	B																									
1247	C	0.84	11	2.6	1.3				0.51									1.1	53			66				
1248	D	0.75	13	2.5	2				0.57			0.67						1.5	34			61				
1262	C																									
1263	E																									
1264	F																									
1265	F																	0.0017								
1318	A																									
1339	C																									
1340	C																									
1416	C	1.9	11	3.6					1.2			9.8						55	40			51				
1417	E																									
1418	F																	0.12								
1425	C								1									6.9	39			4.4				
1426	D								2.1			1.2						13	16			12.8				
1428	E																		49							
1442	C	6.4	87	9.3	5.6			1.3	3.4			4.3						150	21			100				
1443	D	2.5	27	6	1.3				0.97			1.7						21	20			54				
1444	E																									
1445	F																									
1447	C	5.7	71	12	4.4			1.2	3.5			3.7						130	18			90				
1448	D	3.9	34	14	2.9				2.1			9						75	21			80				
1449	E																	0.016								
1450	F																									
1451	B		1.8	0.5					1.4									2.7	130			7.5			500	
1452	C		2.2	0.54					1.6									4.1	260			6.5				
1453	C								1.5			0.56						7.3	50			6.1				
1454	D								1.3									6	40			5.5				
1456	E																									
1491	C		1															0.074				0.51				
1492	C		2.5	2.1								0.94						9.4	15			9.2				
1493	C	3.4	70	7.4	2.3				1.6			4.9						22	16			160				
1494	D	2.9	46	5.2	1.7				1.7			7						36	24			130				
1495	F	1.6	25	3.4	0.92				1.4			3.1						21	21			84				
1497	C	3.1	15	4.9	0.72				1.6			14						56	39			68				
1498	C	4.5	61	10	6.9			13	8.2			4.7						87	14			120				
1499	D	4.2	47	6.4	4				2.2			9.1						65	20			87				
1500	C																	3.2	14			3.8				
1501	D		0.74	2.7					1.1	0.605								26	19			34				
1502	D			0.54					1.6									7.4	71			12				
1503	C		0.69						0.55									2	220			5.1				
1504	D		0.96						0.81									2.6	280			5.7				
1505	D		1.2	0.5					1.1									2.9	230			7.5				
1541	C		4.4	1	3.3	2.5												0.085	6.3			100				
1542	D		1.3		0.57	1.8												0.084	34			23				
1543	F																									
1544	B			0.55														0.6	64		1.3	4.6				
1545	C			1.1														2.9	120			10				
1546	E																	0.0013								
1547	C																									
1548	E	1.9	14	4.4					0.56			3.6						53	68			32				
1549	F	1.9	16	4					0.69			6						68	63			42				
1579	C			0.56														0.09	29			7.4				
1580	D																		6.1			0.6				
1581	E																									
1582	C								5.4													14				

Sample Name	Layer	Concentration																								
		1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (cis/trans)	1,4-DIOX	Al	CCL	CF	c-1,2-DCE	DMP	Freon 113	Fe	Mn	DCM	Nitrate	Nitrite as N	NDMA	Perc	Ag	PCE	TCE	Va	VC	Zn	1-M-2-P
Unit Hazard Child		1.9 E-3	1.7 E-2	2.3 E-1	3.9 E-2	3.7 E-4	6.7 E-5	1.4 E-1	3.2 E-2	3.9 E-2	6.6 E-6	4.6 E-5	9.2 E-5	3.1 E-3	1.5 E-3	4.0 E-5	4.0 E-4	1.0 E+1	9.2 E-2	1.3 E-2	4.2 E-2	2.5 E-1	8.0 E-2	3.3 E-2	2.1 E-4	NA
Unit Hazard Adult		8.3 E-4	7.5 E-3	9.9 E-2	1.7 E-2	1.6 E-4	2.8 E-5	6.2 E-2	1.4 E-2	1.7 E-2	2.8 E-6	2.1 E-5	3.9 E-5	1.3 E-3	6.3 E-4	1.7 E-5	1.7 E-4	4.3 E+0	3.9 E-2	5.5 E-3	1.8 E-2	1.1 E-1	3.3 E-2	1.4 E-2	9.2 E-5	NA
Unit Risk		5.2 E-7	NA	8.2 E-6	NA	2.4 E-6	NA	1.4 E-5	6.5 E-6	NA	NA	NA	NA	NA	4.8 E-7	NA	NA	9.6 E-4	NA	NA	1.4 E-5	7.5 E-7	NA	4.4 E-5	NA	NA
1583	D																									
1584	E																									
1597	C																									
1598	D																									
1599	E																									
4080	C/D	2.5	23	6	3.5			3.6	2.8			4.6						71	30			190				
4085	C/D	5.4	62	11	9.3				3.2	8.2		7.1						110	14			130	15			
4095	C/D	0.57	2.1	1.5	0.72				1.3	0.63		0.5						29	21			53	18			
4195	C/D		0.59						1.1			1.5						8	23			8.2				
4215	C/D								1.5			0.85						6.4	63			7.7				
4303	C/D	2.8	15	2.7	3.3			1.3	2.1	1.6		0.94						55	37			130	16			
4400	C/D		0.56															0.087	9.9			7.3	18			
4405	C	3	24	4.1	1.8				1.9	1.6		22						52	24		0.61	110	16			
4410	C/D		0.8	0.72	1.7					0.88				31				1	190		1.1	12	13			
4450	C/D	3.7	33	4.9	3.8			2.3	2.3	2.6		3.4						42	20			130	17			
4455	C/D	2.5	43	7.5	4.7			2	1.9			3.6						23	25			150				
4460	C/D	2.2	4.7	1.5	2.3					0.67								0.71	38			30	19			
4465	C/D																	0.093				2.4				
4565	C/D			0.88												4600		0.33	37			8.9	14			
4570	C/D			0.58												4500		0.053	31		2.5	3.6	12			
4575	C/D			0.91	2.2					0.71			1100	93		4300		0.95	100		0.67	7.5	9.2	0.54		
30000	C	3.9	27	4.3	2.8				2.5			28						53	21			120				
30011	C/D																	0.15	23			3				
30012	C		3.5	1	3.8				0.54	0.87								1.5	290		1.7	11				
30013	D		0.55	0.57						0.512								0.99	250		1.4	6.7				
30014	E																									
30015	C/D		0.75	0.82	3													1	210		0.8	8.6				
30019	C/D		2.3	0.77	1.3													0.13	23			34				
30047	C	3	30	3.5	2.2				1.8			39						15	11		0.6	160				
30048	D	3.9	17	4	1.5				1.3			9.2						26	12			75				
30049	F	4.2	19	4.5	1.5				1.7			2.5						12	24			61				
30053	C/D	3.2	37	5.1	5.1			4.8	4.4			2			0.52			34	15			170				
30054	C/D	1.4	18	3	2.6			0.74	1.3			1						6.8	40			87				
30055	C/D		1.4	0.51														0.75	73			22				
30056	C/D																									
30159	C		0.62	0.63	1.6								2500	38		5700	330	1.9	200	820	0.84	9.2	8.7		4300	68
30162	C		0.65	0.7	1.9		410				12		1500	50		4600	260	1.6	160		0.73	9.2	17			
30163	D		0.69	0.7	4.6						17		650	23		5200	100	1.6	200			7.6	19			
30164	D			0.63	0.77						30		650	24		5500		0.59	160		0.65	9.5	12			
30165	C		0.75	0.71	2		780		0.61				9200	71		5400	230	1.5	180		1.2	10	17			
30166	D			0.58	0.99		310						15000	90		5600	150	1.2	190			7.3	20			
30167	D			0.64	2								5200	70		6300		0.78	150		0.55	8	14			
30168	C		1.4	0.5	0.73													0.1	14			14				
30169	D		0.98	0.53	0.64													0.11	66			13				
30170	D		1.5	0.53	0.77													0.039	11			27				
30171	D																		25			2.6				
30172	D																									
30173	C																		8.4			0.58				
30185	D															11000						0.58	15			
30189	C				0.53											4600	120		13			3.7	20			
30190	D				0.8		240									5400	280		9.9		0.78	5.7	28			
30191	D				0.75									23		5800			11		0.58	5	16			

		Child Non-Cancer Hazard Index																									
Sample Name	Layer	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (cis/trans)	1,4-DIOX	Al	CCL	CF	c-1,2-DCE	DMP	Freon 113	Fe	Mn	DCM	Nitrate	Nitrite as N	NDMA	Perc	Ag	PCE	TCE	Va	VC	Zn	1-M-2-P	HI
Unit Hazard Child																											
Unit Hazard Adult																											
Unit Risk																											
1059	C	NA	NA	NA	NA	NA	NA	NA	9.8 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.5 E-1	NA	NA	NA	NA	4.5 E-1
1218	C	8.4 E-3	5.2 E-1	1.1 E+0	9.3 E-2	NA	NA	NA	8.2 E-2	NA	NA	1.4 E-3	NA	NA	NA	NA	NA	5.4 E+2	2.3 E+0	NA	NA	3.3 E+1	NA	NA	NA	NA	5.7 E+2
1219	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E-1	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E-1
1220	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1226	C	NA	8.4 E-2	1.6 E-1	NA	NA	NA	NA	4.7 E-2	NA	NA	NA	NA	NA	NA	NA	NA	3.7 E+1	4.0 E+1	NA	NA	1.9 E+0	NA	NA	NA	NA	8.0 E+1
1227	E	NA	NA	NA	NA	NA	NA	9.7 E-2	1.8 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-1
1228	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1246	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1247	C	1.6 E-3	1.9 E-1	6.0 E-1	5.1 E-2	NA	NA	NA	1.6 E-2	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E+1	4.9 E+0	NA	NA	1.7 E+1	NA	NA	NA	NA	3.3 E+1
1248	D	1.5 E-3	2.3 E-1	5.8 E-1	7.8 E-2	NA	NA	NA	1.8 E-2	NA	NA	3.1 E-5	NA	NA	NA	NA	NA	1.5 E+1	3.1 E+0	NA	NA	1.5 E+1	NA	NA	NA	NA	3.4 E+1
1262	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1263	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1264	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1265	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.7 E-2	NA	NA	NA	NA	NA	NA	NA	NA	1.7 E-2
1318	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1339	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1340	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1416	C	3.7 E-3	1.9 E-1	8.3 E-1	NA	NA	NA	NA	3.8 E-2	NA	NA	4.6 E-4	NA	NA	NA	NA	NA	5.6 E+2	3.7 E+0	NA	NA	1.3 E+1	NA	NA	NA	NA	5.7 E+2
1417	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1418	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E+0	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E+0
1425	C	NA	NA	NA	NA	NA	NA	NA	3.2 E-2	NA	NA	NA	NA	NA	NA	NA	NA	7.0 E+1	3.6 E+0	NA	NA	1.1 E+0	NA	NA	NA	NA	7.4 E+1
1426	D	NA	NA	NA	NA	NA	NA	NA	6.6 E-2	NA	NA	5.6 E-5	NA	NA	NA	NA	NA	1.3 E+2	1.5 E+0	NA	NA	3.2 E+0	NA	NA	NA	NA	1.4 E+2
1428	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.5 E+0	NA	NA	NA	NA	NA	NA	NA	4.5 E+0
1442	C	1.2 E-2	1.5 E+0	2.2 E+0	2.2 E-1	NA	NA	1.9 E-1	1.1 E-1	NA	NA	2.0 E-4	NA	NA	NA	NA	NA	1.5 E+3	1.9 E+0	NA	NA	2.5 E+1	NA	NA	NA	NA	1.5 E+3
1443	D	4.9 E-3	4.7 E-1	1.4 E+0	5.1 E-2	NA	NA	NA	3.1 E-2	NA	NA	7.9 E-5	NA	NA	NA	NA	NA	2.1 E+2	1.8 E+0	NA	NA	1.4 E+1	NA	NA	NA	NA	2.3 E+2
1444	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1445	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1447	C	1.1 E-2	1.2 E+0	2.8 E+0	1.7 E-1	NA	NA	1.7 E-1	1.1 E-1	NA	NA	1.7 E-4	NA	NA	NA	NA	NA	1.3 E+3	1.7 E+0	NA	NA	2.3 E+1	NA	NA	NA	NA	1.3 E+3
1448	D	7.6 E-3	5.9 E-1	3.2 E+0	1.1 E-1	NA	NA	NA	6.6 E-2	NA	NA	4.2 E-4	NA	NA	NA	NA	NA	7.6 E+2	1.9 E+0	NA	NA	2.0 E+1	NA	NA	NA	NA	7.8 E+2
1449	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E-1	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E-1
1450	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1451	B	NA	3.1 E-2	1.2 E-1	NA	NA	NA	NA	4.4 E-2	NA	NA	NA	NA	NA	NA	NA	NA	2.7 E+1	1.2 E+1	NA	NA	1.9 E+0	NA	NA	1.1 E-1	NA	4.1 E+1
1452	C	NA	3.8 E-2	1.3 E-1	NA	NA	NA	NA	5.0 E-2	NA	NA	NA	NA	NA	NA	NA	NA	4.1 E+1	2.4 E+1	NA	NA	1.6 E+0	NA	NA	NA	NA	6.7 E+1
1453	C	NA	NA	NA	NA	NA	NA	NA	4.7 E-2	NA	NA	2.6 E-5	NA	NA	NA	NA	NA	7.4 E+1	4.6 E+0	NA	NA	1.5 E+0	NA	NA	NA	NA	8.0 E+1
1454	D	NA	NA	NA	NA	NA	NA	NA	4.1 E-2	NA	NA	NA	NA	NA	NA	NA	NA	6.1 E+1	3.7 E+0	NA	NA	1.4 E+0	NA	NA	NA	NA	6.6 E+1
1456	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1491	C	NA	1.7 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.5 E-1	NA	NA	NA	1.3 E-1	NA	NA	NA	NA	8.9 E-1
1492	C	NA	4.4 E-2	4.9 E-1	NA	NA	NA	NA	NA	NA	NA	4.4 E-5	NA	NA	NA	NA	NA	9.5 E+1	1.4 E+0	NA	NA	2.3 E+0	NA	NA	NA	NA	9.9 E+1
1493	C	6.6 E-3	1.2 E+0	1.7 E+0	9.0 E-2	NA	NA	NA	5.0 E-2	NA	NA	2.3 E-4	NA	NA	NA	NA	NA	2.2 E+2	1.5 E+0	NA	NA	4.0 E+1	NA	NA	NA	NA	2.7 E+2
1494	D	5.6 E-3	8.0 E-1	1.2 E+0	6.6 E-2	NA	NA	NA	5.4 E-2	NA	NA	3.3 E-4	NA	NA	NA	NA	NA	3.6 E+2	2.2 E+0	NA	NA	3.3 E+1	NA	NA	NA	NA	4.0 E+2
1495	F	3.1 E-3	4.4 E-1	7.9 E-1	3.6 E-2	NA	NA	NA	4.4 E-2	NA	NA	1.4 E-4	NA	NA	NA	NA	NA	2.1 E+2	1.9 E+0	NA	NA	2.1 E+1	NA	NA	NA	NA	2.4 E+2
1497	C	6.0 E-3	2.6 E-1	1.1 E+0	2.8 E-2	NA	NA	NA	5.0 E-2	NA	NA	6.5 E-4	NA	NA	NA	NA	NA	5.7 E+2	3.6 E+0	NA	NA	1.7 E+1	NA	NA	NA	NA	5.9 E+2
1498	C	8.7 E-3	1.1 E+0	2.3 E+0	2.7 E-1	NA	NA	1.9 E+0	2.6 E-1	NA	NA	2.2 E-4	NA	NA	NA	NA	NA	8.8 E+2	1.3 E+0	NA	NA	3.0 E+1	NA	NA	NA	NA	9.2 E+2
1499	D	8.2 E-3	8.2 E-1	1.5 E+0	1.6 E-1	NA	NA	NA	6.9 E-2	NA	NA	4.2 E-4	NA	NA	NA	NA	NA	6.6 E+2	1.8 E+0	NA	NA	2.2 E+1	NA	NA	NA	NA	6.8 E+2
1500	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.2 E+1	1.3 E+0	NA	NA	9.5 E-1	NA	NA	NA	NA	3.5 E+1
1501	D	NA	1.3 E-2	6.3 E-1	NA	NA	NA	NA	3.5 E-2	2.4 E-2	NA	NA	NA	NA	NA	NA	NA	2.6 E+2	1.7 E+0	NA	NA	8.5 E+0	NA	NA	NA	NA	2.7 E+2
1502	D	NA	NA	1.3 E-1	NA	NA	NA	NA	5.0 E-2	NA	NA	NA	NA	NA	NA	NA	NA	7.5 E+1	6.5 E+0	NA	NA	3.0 E+0	NA	NA	NA	NA	8.5 E+1
1503	C	NA	1.2 E-2	NA	NA	NA	NA	NA	1.7 E-2	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E+1	2.0 E+1	NA	NA	1.3 E+0	NA	NA	NA	NA	4.2 E+1
1504	D	NA	1.7 E-2	NA	NA	NA	NA	NA	2.6 E-2	NA	NA	NA	NA	NA	NA	NA	NA	2.6 E+1	2.6 E+1	NA	NA	1.4 E+0	NA	NA	NA	NA	5.3 E+1
1505	D	NA	2.1 E-2	1.2 E-1	NA	NA	NA	NA	3.5 E-2	NA	NA	NA	NA	NA	NA	NA	NA	2.9 E+1	2.1 E+1	NA	NA	1.9 E+0	NA	NA	NA	NA	5.3 E+1
1541	C	NA	7.7 E-2	2.3 E-1	1.3 E-1	9.3 E-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.6 E-1	5.8 E-1	NA	NA	2.5 E+1	NA	NA	NA	NA	2.7 E+1
1542	D	NA	2.3 E-2	NA	2.2 E-2	6.7 E-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.5 E-1	3.1 E+0	NA	NA	5.8 E+0	NA	NA	NA	NA	9.8 E+0
1543	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1544	B	NA	NA	1.3 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.1 E+0	5.9 E+0	NA	5.5 E-2	1.2 E+0	NA	NA	NA	NA	1.3 E+1
1545	C	NA	NA	2.5 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.9 E+1	1.1 E+1	NA	NA	2.5 E+0	NA	NA	NA	NA	4.3 E+1
1546	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-2	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-2
1547	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1548	E	3.7 E-3	2.4 E-1	1.0 E+0	NA	NA	NA	NA	1.8 E-2	NA	NA	1.7 E-4	NA	NA	NA	NA	NA	5.4 E+2	6.3 E+0	NA	NA	8.0 E+0	NA	NA	NA	NA	5.5 E+2
1549	F	3.7 E-3	2.8 E-1	9.3 E-1	NA	NA	NA	NA	2.2 E-2	NA	NA	2.8 E-4	NA	NA	NA	NA	NA	6.9 E+2	5.8 E+0	NA	NA	1.1 E+1	NA	NA	NA	NA	7.0 E+2
1579	C	NA	NA	1.3 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.1 E-1	2.7 E+0	NA	NA	1.9 E+0	NA	NA	NA	NA	5.6 E+0
1580	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.6 E-1	NA	NA	1.5 E-1	NA	NA	NA	NA	7.1 E-1
1581	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1582	C	NA	NA	NA	NA	NA	NA	NA	1.7 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.5 E+0	NA	NA	NA	NA	3.7 E+0

		Child Non-Cancer Hazard Index																									
Sample Name	Layer	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (cis/trans)	1,4-DIOX	Al	CCL	CF	c-1,2-DCE	DMP	Freon 113	Fe	Mn	DCM	Nitrate	Nitrite as N	NDMA	Perc	Ag	PCE	TCE	Va	VC	Zn	1-M-2-P	HI
Unit Hazard Child																											
Unit Hazard Adult																											
Unit Risk																											
1583	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1584	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1597	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1598	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1599	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4080	C/D	4.9 E-3	4.0 E-1	1.4 E+0	1.4 E-1	NA	NA	5.1 E-1	8.8 E-2	NA	NA	2.1 E-4	NA	NA	NA	NA	NA	7.2 E+2	2.8 E+0	NA	NA	4.8 E+1	NA	NA	NA	NA	7.7 E+2
4085	C/D	1.0 E-2	1.1 E+0	2.5 E+0	3.6 E-1	NA	NA	NA	1.0 E-1	3.2 E-1	NA	3.3 E-4	NA	NA	NA	NA	NA	1.1 E+3	1.3 E+0	NA	NA	3.3 E+1	1.2 E+0	NA	NA	NA	1.2 E+3
4095	C/D	1.1 E-3	3.7 E-2	3.5 E-1	2.8 E-2	NA	NA	NA	4.1 E-2	2.5 E-2	NA	2.3 E-5	NA	NA	NA	NA	NA	2.9 E+2	1.9 E+0	NA	NA	1.3 E+1	1.4 E+0	NA	NA	NA	3.1 E+2
4195	C/D	NA	1.0 E-2	NA	NA	NA	NA	NA	3.5 E-2	NA	NA	7.0 E-5	NA	NA	NA	NA	NA	8.1 E+1	2.1 E+0	NA	NA	2.1 E+0	NA	NA	NA	NA	8.5 E+1
4215	C/D	NA	NA	NA	NA	NA	NA	NA	4.7 E-2	NA	NA	4.0 E-5	NA	NA	NA	NA	NA	6.5 E+1	5.8 E+0	NA	NA	1.9 E+0	NA	NA	NA	NA	7.2 E+1
4303	C/D	5.4 E-3	2.6 E-1	6.3 E-1	1.3 E-1	NA	NA	1.9 E-1	6.6 E-2	6.2 E-2	NA	4.4 E-5	NA	NA	NA	NA	NA	5.6 E+2	3.4 E+0	NA	NA	3.3 E+1	1.3 E+0	NA	NA	NA	5.9 E+2
4400	C/D	NA	9.8 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.8 E-1	9.1 E-1	NA	NA	1.8 E+0	1.4 E+0	NA	NA	NA	5.1 E+0
4405	C	5.8 E-3	4.2 E-1	9.5 E-1	7.0 E-2	NA	NA	NA	6.0 E-2	6.2 E-2	NA	1.0 E-3	NA	NA	NA	NA	NA	5.3 E+2	2.2 E+0	NA	2.6 E-2	2.8 E+1	1.3 E+0	NA	NA	NA	5.6 E+2
4410	C/D	NA	1.4 E-2	1.7 E-1	6.6 E-2	NA	NA	NA	NA	3.4 E-2	NA	NA	NA	9.6 E-2	NA	NA	NA	1.0 E+1	1.7 E+1	NA	4.6 E-2	3.0 E+0	1.0 E+0	NA	NA	NA	3.2 E+1
4450	C/D	7.2 E-3	5.8 E-1	1.1 E+0	1.5 E-1	NA	NA	3.3 E-1	7.3 E-2	1.0 E-1	NA	1.6 E-4	NA	NA	NA	NA	NA	4.2 E+2	1.8 E+0	NA	NA	3.3 E+1	1.4 E+0	NA	NA	NA	4.6 E+2
4455	C/D	4.9 E-3	7.5 E-1	1.7 E+0	1.8 E-1	NA	NA	2.9 E-1	6.0 E-2	NA	NA	1.7 E-4	NA	NA	NA	NA	NA	2.3 E+2	2.3 E+0	NA	NA	3.8 E+1	NA	NA	NA	NA	2.8 E+2
4460	C/D	4.3 E-3	8.2 E-2	3.5 E-1	9.0 E-2	NA	NA	NA	NA	2.6 E-2	NA	NA	NA	NA	NA	NA	NA	7.2 E+0	3.5 E+0	NA	NA	7.5 E+0	1.5 E+0	NA	NA	NA	2.0 E+1
4465	C/D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.4 E-1	NA	NA	NA	6.0 E-1	NA	NA	NA	NA	1.5 E+0
4565	C/D	NA	NA	2.0 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.9 E-1	NA	3.3 E+0	3.4 E+0	NA	NA	2.2 E+0	1.1 E+0	NA	NA	NA	1.0 E+1
4570	C/D	NA	NA	1.3 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.8 E-1	NA	5.4 E-1	2.8 E+0	NA	1.1 E-1	9.0 E-1	9.6 E-1	NA	NA	NA	5.7 E+0
4575	C/D	NA	NA	2.1 E-1	8.6 E-2	NA	NA	NA	NA	2.8 E-2	NA	NA	1.0 E-1	2.9 E-1	NA	1.7 E-1	NA	9.6 E+0	9.2 E+0	NA	2.8 E-2	1.9 E+0	7.4 E-1	1.8 E-2	NA	NA	2.2 E+1
30000	C	7.6 E-3	4.7 E-1	1.0 E+0	1.1 E-1	NA	NA	NA	7.9 E-2	NA	NA	1.3 E-3	NA	NA	NA	NA	NA	5.4 E+2	1.9 E+0	NA	NA	3.0 E+1	NA	NA	NA	NA	5.7 E+2
30011	C/D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E+0	2.1 E+0	NA	NA	7.5 E-1	NA	NA	NA	NA	4.4 E+0
30012	C	NA	6.1 E-2	2.3 E-1	1.5 E-1	NA	NA	NA	1.7 E-2	3.4 E-2	NA	NA	NA	NA	NA	NA	NA	1.5 E+1	2.7 E+1	NA	7.1 E-2	2.8 E+0	NA	NA	NA	NA	4.5 E+1
30013	D	NA	9.6 E-3	1.3 E-1	NA	NA	NA	NA	NA	2.0 E-2	NA	NA	NA	NA	NA	NA	NA	1.0 E+1	2.3 E+1	NA	5.9 E-2	1.7 E+0	NA	NA	NA	NA	3.5 E+1
30014	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
30015	C/D	NA	1.3 E-2	1.9 E-1	1.2 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E+1	1.9 E+1	NA	3.4 E-2	2.2 E+0	NA	NA	NA	NA	3.2 E+1
30019	C/D	NA	4.0 E-2	1.8 E-1	5.1 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E+0	2.1 E+0	NA	NA	8.5 E+0	NA	NA	NA	NA	1.2 E+1
30047	C	5.8 E-3	5.2 E-1	8.1 E-1	8.6 E-2	NA	NA	NA	5.7 E-2	NA	NA	1.8 E-3	NA	NA	NA	NA	NA	1.5 E+2	1.0 E+0	NA	2.5 E-2	4.0 E+1	NA	NA	NA	NA	1.9 E+2
30048	D	7.6 E-3	3.0 E-1	9.3 E-1	5.8 E-2	NA	NA	NA	4.1 E-2	NA	NA	4.3 E-4	NA	NA	NA	NA	NA	2.6 E+2	1.1 E+0	NA	NA	1.9 E+1	NA	NA	NA	NA	2.8 E+2
30049	F	8.2 E-3	3.3 E-1	1.0 E+0	5.8 E-2	NA	NA	NA	5.4 E-2	NA	NA	1.2 E-4	NA	NA	NA	NA	NA	1.2 E+2	2.2 E+0	NA	NA	1.5 E+1	NA	NA	NA	NA	1.4 E+2
30053	C/D	6.2 E-3	6.5 E-1	1.2 E+0	2.0 E-1	NA	NA	6.9 E-1	1.4 E-1	NA	NA	9.3 E-5	NA	NA	7.7 E-4	NA	NA	3.4 E+2	1.4 E+0	NA	NA	4.3 E+1	NA	NA	NA	NA	3.9 E+2
30054	C/D	2.7 E-3	3.1 E-1	6.9 E-1	1.0 E-1	NA	NA	1.1 E-1	4.1 E-2	NA	NA	4.6 E-5	NA	NA	NA	NA	NA	6.9 E+1	3.7 E+0	NA	NA	2.2 E+1	NA	NA	NA	NA	9.5 E+1
30055	C/D	NA	2.4 E-2	1.2 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.6 E+0	6.7 E+0	NA	NA	5.5 E+0	NA	NA	NA	NA	2.0 E+1
30056	C/D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
30159	C	NA	1.1 E-2	1.5 E-1	6.2 E-2	NA	NA	NA	NA	NA	NA	NA	2.3 E-1	1.2 E-1	NA	2.3 E-1	1.3 E-1	1.9 E+1	1.8 E+1	1.1 E+1	3.5 E-2	2.3 E+0	7.0 E-1	NA	9.2 E-1	NA	5.3 E+1
30162	C	NA	1.1 E-2	1.6 E-1	7.4 E-2	NA	2.7 E-2	NA	NA	NA	7.9 E-5	NA	1.4 E-1	1.6 E-1	NA	1.9 E-1	1.0 E-1	1.6 E+1	1.5 E+1	NA	3.1 E-2	2.3 E+0	1.4 E+0	NA	NA	NA	3.5 E+1
30163	D	NA	1.2 E-2	1.6 E-1	1.8 E-1	NA	NA	NA	NA	NA	1.1 E-4	NA	6.0 E-2	7.1 E-2	NA	2.1 E-1	4.0 E-2	1.6 E+1	1.8 E+1	NA	NA	1.9 E+0	1.5 E+0	NA	NA	NA	3.9 E+1
30164	D	NA	NA	1.5 E-1	3.0 E-2	NA	NA	NA	NA	NA	2.0 E-4	NA	6.0 E-2	7.4 E-2	NA	2.2 E-1	NA	6.0 E+0	1.5 E+1	NA	2.7 E-2	2.4 E+0	9.6 E-1	NA	NA	NA	2.5 E+1
30165	C	NA	1.3 E-2	1.6 E-1	7.8 E-2	NA	5.2 E-2	NA	1.9 E-2	NA	NA	NA	8.5 E-1	2.2 E-1	NA	2.2 E-1	9.3 E-2	1.5 E+1	1.7 E+1	NA	5.0 E-2	2.5 E+0	1.4 E+0	NA	NA	NA	3.7 E+1
30166	D	NA	NA	1.3 E-1	3.9 E-2	NA	2.1 E-2	NA	NA	NA	NA	NA	1.4 E+0	2.8 E-1	NA	2.3 E-1	6.0 E-2	1.2 E+1	1.7 E+1	NA	NA	1.8 E+0	1.6 E+0	NA	NA	NA	3.5 E+1
30167	D	NA	NA	1.5 E-1	7.8 E-2	NA	NA	NA	NA	NA	NA	NA	4.8 E-1	2.2 E-1	NA	2.5 E-1	NA	7.9 E+0	1.4 E+1	NA	2.3 E-2	2.0 E+0	1.1 E+0	NA	NA	NA	2.6 E+1
30168	C	NA	2.4 E-2	1.2 E-1	2.8 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E+0	1.3 E+0	NA	NA	3.5 E+0	NA	NA	NA	NA	6.0 E+0
30169	D	NA	1.7 E-2	1.2 E-1	2.5 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E+0	6.1 E+0	NA	NA	3.3 E+0	NA	NA	NA	NA	1.1 E+1
30170	D	NA	2.6 E-2	1.2 E-1	3.0 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.9 E-1	1.0 E+0	NA	NA	6.8 E+0	NA	NA	NA	NA	8.3 E+0
30171	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.3 E+0	NA	NA	6.5 E-1	NA	NA	NA	NA	2.9 E+0
30172	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
30173	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.7 E-1	NA	NA	1.5 E-1	NA	NA	NA	NA	9.2 E-1
30185	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.4 E-1	NA	NA	NA	NA	NA	1.5 E-1	1.2 E+0	NA	NA	NA	1.8 E+0
30189	C	NA	NA	NA	2.1 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.9 E-1	4.8 E-2	NA	1.2 E+0	NA	NA	9.3 E-1	1.6 E+0	NA	NA	NA	4.0 E+0
30190	D	NA	NA	NA	3.1 E-2	NA	1.6 E-2	NA	NA	NA	NA	NA	NA	NA	NA	2.2 E-1	1.1 E-1	NA	9.1 E-1	NA	3.3 E-2	1.4 E+0	2.2 E+0	NA	NA	NA	5.0 E+0
30191	D	NA	NA	NA	2.9 E-2	NA	NA	NA	NA	NA	NA	NA	NA	7.1 E-2	NA	2.3 E-1	NA	NA	1.0 E+0	NA	2.4 E-2	1.3 E+0	1.3 E+0	NA	NA	NA	3.9 E+0

		Adult Non-Cancer Hazard Index																									
Sample Name	Layer	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (cis/trans)	1,4-DIOX	Al	CCL	CF	c-1,2-DCE	DMP	Freon 113	Fe	Mn	DCM	Nitrate	Nitrite as N	NDMA	Perc	Ag	PCE	TCE	Va	VC	Zn	1-M-2-P	HI
Unit Hazard Child																											
Unit Hazard Adult																											
Unit Risk																											
1059	C	NA	NA	NA	NA	NA	NA	NA	4.2 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E-1	NA	NA	NA	NA	1.9 E-1
1218	C	3.6 E-3	2.2 E-1	4.7 E-1	4.0 E-2	NA	NA	NA	3.5 E-2	NA	NA	6.2 E-4	NA	NA	NA	NA	NA	2.3 E+2	9.8 E-1	NA	NA	1.4 E+1	NA	NA	NA	NA	2.4 E+2
1219	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.3 E-2	NA	NA	NA	NA	NA	NA	NA	NA	4.3 E-2
1220	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1226	C	NA	3.6 E-2	6.7 E-2	NA	NA	NA	NA	2.0 E-2	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E+1	1.7 E+1	NA	NA	8.3 E-1	NA	NA	NA	NA	3.4 E+1
1227	E	NA	NA	NA	NA	NA	NA	4.2 E-2	7.6 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.9 E-2
1228	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1246	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1247	C	7.0 E-4	8.2 E-2	2.6 E-1	2.2 E-2	NA	NA	NA	6.9 E-3	NA	NA	NA	NA	NA	NA	NA	NA	4.7 E+0	2.1 E+0	NA	NA	7.1 E+0	NA	NA	NA	NA	1.4 E+1
1248	D	6.2 E-4	9.7 E-2	2.5 E-1	3.3 E-2	NA	NA	NA	7.7 E-3	NA	NA	1.4 E-5	NA	NA	NA	NA	NA	6.5 E+0	1.3 E+0	NA	NA	6.6 E+0	NA	NA	NA	NA	1.5 E+1
1262	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1263	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1264	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1265	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.3 E-3	NA	NA	NA	NA	NA	NA	NA	NA	7.3 E-3
1318	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1339	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1340	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1416	C	1.6 E-3	8.2 E-2	3.6 E-1	NA	NA	NA	NA	1.6 E-2	NA	NA	2.0 E-4	NA	NA	NA	NA	NA	2.4 E+2	1.6 E+0	NA	NA	5.5 E+0	NA	NA	NA	NA	2.4 E+2
1417	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1418	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.2 E-1	NA	NA	NA	NA	NA	NA	NA	NA	5.2 E-1
1425	C	NA	NA	NA	NA	NA	NA	NA	1.4 E-2	NA	NA	NA	NA	NA	NA	NA	NA	3.0 E+1	1.5 E+0	NA	NA	4.7 E-1	NA	NA	NA	NA	3.2 E+1
1426	D	NA	NA	NA	NA	NA	NA	NA	2.8 E-2	NA	NA	2.5 E-5	NA	NA	NA	NA	NA	5.6 E+1	6.3 E-1	NA	NA	1.4 E+0	NA	NA	NA	NA	5.8 E+1
1428	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.9 E+0	NA	NA	NA	NA	NA	NA	NA	1.9 E+0
1442	C	5.3 E-3	6.5 E-1	9.2 E-1	9.3 E-2	NA	NA	8.0 E-2	4.6 E-2	NA	NA	8.9 E-5	NA	NA	NA	NA	NA	6.5 E+2	8.3 E-1	NA	NA	1.1 E+1	NA	NA	NA	NA	6.6 E+2
1443	D	2.1 E-3	2.0 E-1	6.0 E-1	2.2 E-2	NA	NA	NA	1.3 E-2	NA	NA	3.5 E-5	NA	NA	NA	NA	NA	9.1 E+1	7.9 E-1	NA	NA	5.8 E+0	NA	NA	NA	NA	9.8 E+1
1444	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1445	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1447	C	4.7 E-3	5.3 E-1	1.2 E+0	7.3 E-2	NA	NA	7.4 E-2	4.7 E-2	NA	NA	7.7 E-5	NA	NA	NA	NA	NA	5.6 E+2	7.1 E-1	NA	NA	9.7 E+0	NA	NA	NA	NA	5.7 E+2
1448	D	3.2 E-3	2.5 E-1	1.4 E+0	4.8 E-2	NA	NA	NA	2.8 E-2	NA	NA	1.9 E-4	NA	NA	NA	NA	NA	3.2 E+2	8.3 E-1	NA	NA	8.6 E+0	NA	NA	NA	NA	3.3 E+2
1449	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.9 E-2	NA	NA	NA	NA	NA	NA	NA	NA	6.9 E-2
1450	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1451	B	NA	1.3 E-2	5.0 E-2	NA	NA	NA	NA	1.9 E-2	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E+1	5.1 E+0	NA	NA	8.1 E-1	NA	NA	4.6 E-2	NA	1.8 E+1
1452	C	NA	1.6 E-2	5.4 E-2	NA	NA	NA	NA	2.2 E-2	NA	NA	NA	NA	NA	NA	NA	NA	1.8 E+1	1.0 E+1	NA	NA	7.0 E-1	NA	NA	NA	NA	2.9 E+1
1453	C	NA	NA	NA	NA	NA	NA	NA	2.0 E-2	NA	NA	1.2 E-5	NA	NA	NA	NA	NA	3.1 E+1	2.0 E+0	NA	NA	6.6 E-1	NA	NA	NA	NA	3.4 E+1
1454	D	NA	NA	NA	NA	NA	NA	NA	1.8 E-2	NA	NA	NA	NA	NA	NA	NA	NA	2.6 E+1	1.6 E+0	NA	NA	5.9 E-1	NA	NA	NA	NA	2.8 E+1
1456	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1491	C	NA	7.5 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.2 E-1	NA	NA	NA	5.5 E-2	NA	NA	NA	NA	3.8 E-1
1492	C	NA	1.9 E-2	2.1 E-1	NA	NA	NA	NA	NA	NA	NA	2.0 E-5	NA	NA	NA	NA	NA	4.1 E+1	5.9 E-1	NA	NA	9.9 E-1	NA	NA	NA	NA	4.2 E+1
1493	C	2.8 E-3	5.2 E-1	7.3 E-1	3.8 E-2	NA	NA	NA	2.2 E-2	NA	NA	1.0 E-4	NA	NA	NA	NA	NA	9.5 E+1	6.3 E-1	NA	NA	1.7 E+1	NA	NA	NA	NA	1.1 E+2
1494	D	2.4 E-3	3.4 E-1	5.2 E-1	2.8 E-2	NA	NA	NA	2.3 E-2	NA	NA	1.5 E-4	NA	NA	NA	NA	NA	1.6 E+2	9.4 E-1	NA	NA	1.4 E+1	NA	NA	NA	NA	1.7 E+2
1495	F	1.3 E-3	1.9 E-1	3.4 E-1	1.5 E-2	NA	NA	NA	1.9 E-2	NA	NA	6.4 E-5	NA	NA	NA	NA	NA	9.1 E+1	8.3 E-1	NA	NA	9.1 E+0	NA	NA	NA	NA	1.0 E+2
1497	C	2.6 E-3	1.1 E-1	4.9 E-1	1.2 E-2	NA	NA	NA	2.2 E-2	NA	NA	2.9 E-4	NA	NA	NA	NA	NA	2.4 E+2	1.5 E+0	NA	NA	7.3 E+0	NA	NA	NA	NA	2.5 E+2
1498	C	3.7 E-3	4.6 E-1	9.9 E-1	1.2 E-1	NA	NA	8.0 E-1	1.1 E-1	NA	NA	9.8 E-5	NA	NA	NA	NA	NA	3.8 E+2	5.5 E-1	NA	NA	1.3 E+1	NA	NA	NA	NA	3.9 E+2
1499	D	3.5 E-3	3.5 E-1	6.4 E-1	6.7 E-2	NA	NA	NA	3.0 E-2	NA	NA	1.9 E-4	NA	NA	NA	NA	NA	2.8 E+2	7.9 E-1	NA	NA	9.4 E+0	NA	NA	NA	NA	2.9 E+2
1500	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.4 E+1	5.5 E-1	NA	NA	4.1 E-1	NA	NA	NA	NA	1.5 E+1
1501	D	NA	5.5 E-3	2.7 E-1	NA	NA	NA	NA	1.5 E-2	1.0 E-2	NA	NA	NA	NA	NA	NA	NA	1.1 E+2	7.5 E-1	NA	NA	3.7 E+0	NA	NA	NA	NA	1.2 E+2
1502	D	NA	NA	5.4 E-2	NA	NA	NA	NA	2.2 E-2	NA	NA	NA	NA	NA	NA	NA	NA	3.2 E+1	2.8 E+0	NA	NA	1.3 E+0	NA	NA	NA	NA	3.6 E+1
1503	C	NA	5.2 E-3	NA	NA	NA	NA	NA	7.4 E-3	NA	NA	NA	NA	NA	NA	NA	NA	8.6 E+0	8.7 E+0	NA	NA	5.5 E-1	NA	NA	NA	NA	1.8 E+1
1504	D	NA	7.2 E-3	NA	NA	NA	NA	NA	1.1 E-2	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E+1	1.1 E+1	NA	NA	6.2 E-1	NA	NA	NA	NA	2.3 E+1
1505	D	NA	9.0 E-3	5.0 E-2	NA	NA	NA	NA	1.5 E-2	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E+1	9.0 E+0	NA	NA	8.1 E-1	NA	NA	NA	NA	2.2 E+1
1541	C	NA	3.3 E-2	9.9 E-2	5.5 E-2	4.0 E-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.7 E-1	2.5 E-1	NA	NA	1.1 E+1	NA	NA	NA	NA	1.2 E+1
1542	D	NA	9.7 E-3	NA	9.5 E-3	2.9 E-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.6 E-1	1.3 E+0	NA	NA	2.5 E+0	NA	NA	NA	NA	4.2 E+0
1543	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1544	B	NA	NA	5.5 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.6 E+0	2.5 E+0	NA	2.3 E-2	5.0 E-1	NA	NA	NA	NA	5.7 E+0
1545	C	NA	NA	1.1 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E+1	4.7 E+0	NA	NA	1.1 E+0	NA	NA	NA	NA	1.8 E+1
1546	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.6 E-3	NA	NA	NA	NA	NA	NA	NA	NA	5.6 E-3
1547	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1548	E	1.6 E-3	1.0 E-1	4.4 E-1	NA	NA	NA	NA	7.6 E-3	NA	NA	7.5 E-5	NA	NA	NA	NA	NA	2.3 E+2	2.7 E+0	NA	NA	3.5 E+0	NA	NA	NA	NA	2.4 E+2
1549	F	1.6 E-3	1.2 E-1	4.0 E-1	NA	NA	NA	NA	9.3 E-3	NA	NA	1.2 E-4	NA	NA	NA	NA	NA	2.9 E+2	2.5 E+0	NA	NA	4.5 E+0	NA	NA	NA	NA	3.0 E+2
1579	C	NA	NA	5.6 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.9 E-1	1.1 E+0	NA	NA	8.0 E-1	NA	NA	NA	NA	2.4 E+0
1580	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.4 E-1	NA	NA	6.5 E-2	NA	NA	NA	NA	3.0 E-1
1581	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1582	C	NA	NA	NA	NA	NA	NA	NA	7.3 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E+0	NA	NA	NA	NA	1.6 E+0

		Adult Non-Cancer Hazard Index																									
Sample Name	Layer	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (cis/trans)	1,4-DIOX	Al	CCL	CF	c-1,2-DCE	DMP	Freon 113	Fe	Mn	DCM	Nitrate	Nitrite as N	NDMA	Perc	Ag	PCE	TCE	Va	VC	Zn	1-M-2-P	HI
Unit Hazard Child																											
Unit Hazard Adult																											
Unit Risk																											
1583	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1584	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1597	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1598	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1599	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4080	C/D	2.1 E-3	1.7 E-1	6.0 E-1	5.8 E-2	NA	NA	2.2 E-1	3.8 E-2	NA	NA	9.6 E-5	NA	NA	NA	NA	NA	3.1 E+2	1.2 E+0	NA	NA	2.1 E+1	NA	NA	NA	NA	3.3 E+2
4085	C/D	4.5 E-3	4.6 E-1	1.1 E+0	1.6 E-1	NA	NA	NA	4.3 E-2	1.4 E-1	NA	1.5 E-4	NA	NA	NA	NA	NA	4.7 E+2	5.5 E-1	NA	NA	1.4 E+1	4.9 E-1	NA	NA	NA	4.9 E+2
4095	C/D	4.7 E-4	1.6 E-2	1.5 E-1	1.2 E-2	NA	NA	NA	1.8 E-2	1.1 E-2	NA	1.0 E-5	NA	NA	NA	NA	NA	1.3 E+2	8.3 E-1	NA	NA	5.7 E+0	5.9 E-1	NA	NA	NA	1.3 E+2
4195	C/D	NA	4.4 E-3	NA	NA	NA	NA	NA	1.5 E-2	NA	NA	3.1 E-5	NA	NA	NA	NA	NA	3.5 E+1	9.0 E-1	NA	NA	8.9 E-1	NA	NA	NA	NA	3.6 E+1
4215	C/D	NA	NA	NA	NA	NA	NA	NA	2.0 E-2	NA	NA	1.8 E-5	NA	NA	NA	NA	NA	2.8 E+1	2.5 E+0	NA	NA	8.3 E-1	NA	NA	NA	NA	3.1 E+1
4303	C/D	2.3 E-3	1.1 E-1	2.7 E-1	5.5 E-2	NA	NA	8.0 E-2	2.8 E-2	2.7 E-2	NA	2.0 E-5	NA	NA	NA	NA	NA	2.4 E+2	1.5 E+0	NA	NA	1.4 E+1	5.3 E-1	NA	NA	NA	2.5 E+2
4400	C/D	NA	4.2 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.8 E-1	3.9 E-1	NA	NA	7.9 E-1	5.9 E-1	NA	NA	NA	2.1 E+0
4405	C	2.5 E-3	1.8 E-1	4.1 E-1	3.0 E-2	NA	NA	NA	2.6 E-2	2.7 E-2	NA	4.6 E-4	NA	NA	NA	NA	NA	2.2 E+2	9.4 E-1	NA	1.1 E-2	1.2 E+1	5.3 E-1	NA	NA	NA	2.4 E+2
4410	C/D	NA	6.0 E-3	7.1 E-2	2.8 E-2	NA	NA	NA	NA	1.5 E-2	NA	NA	NA	4.0 E-2	NA	NA	NA	4.3 E+0	7.5 E+0	NA	2.0 E-2	1.3 E+0	4.3 E-1	NA	NA	NA	1.4 E+1
4450	C/D	3.1 E-3	2.5 E-1	4.9 E-1	6.3 E-2	NA	NA	1.4 E-1	3.1 E-2	4.3 E-2	NA	7.1 E-5	NA	NA	NA	NA	NA	1.8 E+2	7.9 E-1	NA	NA	1.4 E+1	5.6 E-1	NA	NA	NA	2.0 E+2
4455	C/D	2.1 E-3	3.2 E-1	7.4 E-1	7.8 E-2	NA	NA	1.2 E-1	2.6 E-2	NA	NA	7.5 E-5	NA	NA	NA	NA	NA	9.9 E+1	9.8 E-1	NA	NA	1.6 E+1	NA	NA	NA	NA	1.2 E+2
4460	C/D	1.8 E-3	3.5 E-2	1.5 E-1	3.8 E-2	NA	NA	NA	NA	1.1 E-2	NA	NA	NA	NA	NA	NA	NA	3.1 E+0	1.5 E+0	NA	NA	3.2 E+0	6.3 E-1	NA	NA	NA	8.7 E+0
4465	C/D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.0 E-1	NA	NA	NA	2.6 E-1	NA	NA	NA	NA	6.6 E-1
4565	C/D	NA	NA	8.7 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.9 E-2	NA	1.4 E+0	1.5 E+0	NA	NA	9.6 E-1	4.6 E-1	NA	NA	NA	4.5 E+0
4570	C/D	NA	NA	5.8 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.7 E-2	NA	2.3 E-1	1.2 E+0	NA	4.5 E-2	3.9 E-1	3.9 E-1	NA	NA	NA	2.4 E+0
4575	C/D	NA	NA	9.0 E-2	3.7 E-2	NA	NA	NA	NA	1.2 E-2	NA	NA	4.3 E-2	1.2 E-1	NA	7.4 E-2	NA	4.1 E+0	3.9 E+0	NA	1.2 E-2	8.1 E-1	3.0 E-1	7.7 E-3	NA	NA	9.5 E+0
30000	C	3.2 E-3	2.0 E-1	4.3 E-1	4.7 E-2	NA	NA	NA	3.4 E-2	NA	NA	5.8 E-4	NA	NA	NA	NA	NA	2.3 E+2	8.3 E-1	NA	NA	1.3 E+1	NA	NA	NA	NA	2.4 E+2
30011	C/D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 E-1	9.0 E-1	NA	NA	3.2 E-1	NA	NA	NA	NA	1.9 E+0
30012	C	NA	2.6 E-2	9.9 E-2	6.3 E-2	NA	NA	NA	7.3 E-3	1.5 E-2	NA	NA	NA	NA	NA	NA	NA	6.5 E+0	1.1 E+1	NA	3.1 E-2	1.2 E+0	NA	NA	NA	NA	1.9 E+1
30013	D	NA	4.1 E-3	5.7 E-2	NA	NA	NA	NA	NA	8.5 E-3	NA	NA	NA	NA	NA	NA	NA	4.3 E+0	9.8 E+0	NA	2.5 E-2	7.2 E-1	NA	NA	NA	NA	1.5 E+1
30014	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
30015	C/D	NA	5.6 E-3	8.1 E-2	5.0 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.3 E+0	8.3 E+0	NA	1.4 E-2	9.3 E-1	NA	NA	NA	NA	1.4 E+1
30019	C/D	NA	1.7 E-2	7.6 E-2	2.2 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.6 E-1	9.0 E-1	NA	NA	3.7 E+0	NA	NA	NA	NA	5.3 E+0
30047	C	2.5 E-3	2.2 E-1	3.5 E-1	3.7 E-2	NA	NA	NA	2.4 E-2	NA	NA	8.1 E-4	NA	NA	NA	NA	NA	6.5 E+1	4.3 E-1	NA	1.1 E-2	1.7 E+1	NA	NA	NA	NA	8.3 E+1
30048	D	3.2 E-3	1.3 E-1	4.0 E-1	2.5 E-2	NA	NA	NA	1.8 E-2	NA	NA	1.9 E-4	NA	NA	NA	NA	NA	1.1 E+2	4.7 E-1	NA	NA	8.1 E+0	NA	NA	NA	NA	1.2 E+2
30049	F	3.5 E-3	1.4 E-1	4.5 E-1	2.5 E-2	NA	NA	NA	2.3 E-2	NA	NA	5.2 E-5	NA	NA	NA	NA	NA	5.2 E+1	9.4 E-1	NA	NA	6.6 E+0	NA	NA	NA	NA	6.0 E+1
30053	C/D	2.7 E-3	2.8 E-1	5.1 E-1	8.5 E-2	NA	NA	3.0 E-1	6.0 E-2	NA	NA	4.2 E-5	NA	NA	3.3 E-4	NA	NA	1.5 E+2	5.9 E-1	NA	NA	1.8 E+1	NA	NA	NA	NA	1.7 E+2
30054	C/D	1.2 E-3	1.3 E-1	3.0 E-1	4.3 E-2	NA	NA	4.6 E-2	1.8 E-2	NA	NA	2.1 E-5	NA	NA	NA	NA	NA	2.9 E+1	1.6 E+0	NA	NA	9.4 E+0	NA	NA	NA	NA	4.1 E+1
30055	C/D	NA	1.0 E-2	5.1 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.2 E+0	2.9 E+0	NA	NA	2.4 E+0	NA	NA	NA	NA	8.5 E+0
30056	C/D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
30159	C	NA	4.6 E-3	6.3 E-2	2.7 E-2	NA	NA	NA	NA	NA	NA	NA	9.8 E-2	4.9 E-2	NA	9.8 E-2	5.7 E-2	8.2 E+0	7.9 E+0	4.5 E+0	1.5 E-2	9.9 E-1	2.9 E-1	NA	3.9 E-1	NA	2.3 E+1
30162	C	NA	4.9 E-3	6.9 E-2	3.2 E-2	NA	1.2 E-2	NA	NA	NA	3.4 E-5	NA	5.9 E-2	6.5 E-2	NA	7.9 E-2	4.5 E-2	6.9 E+0	6.3 E+0	NA	1.3 E-2	9.9 E-1	5.6 E-1	NA	NA	NA	1.5 E+1
30163	D	NA	5.2 E-3	6.9 E-2	7.7 E-2	NA	NA	NA	NA	NA	4.8 E-5	NA	2.6 E-2	3.0 E-2	NA	9.0 E-2	1.7 E-2	6.9 E+0	7.9 E+0	NA	NA	8.2 E-1	6.3 E-1	NA	NA	NA	1.7 E+1
30164	D	NA	NA	6.3 E-2	1.3 E-2	NA	NA	NA	NA	NA	8.5 E-5	NA	2.6 E-2	3.1 E-2	NA	9.5 E-2	NA	2.5 E+0	6.3 E+0	NA	1.2 E-2	1.0 E+0	3.9 E-1	NA	NA	NA	1.0 E+1
30165	C	NA	5.6 E-3	7.0 E-2	3.3 E-2	NA	2.2 E-2	NA	8.3 E-3	NA	NA	NA	3.6 E-1	9.2 E-2	NA	9.3 E-2	4.0 E-2	6.5 E+0	7.1 E+0	NA	2.2 E-2	1.1 E+0	5.6 E-1	NA	NA	NA	1.6 E+1
30166	D	NA	NA	5.8 E-2	1.7 E-2	NA	8.8 E-3	NA	NA	NA	NA	NA	5.9 E-1	1.2 E-1	NA	9.6 E-2	2.6 E-2	5.2 E+0	7.5 E+0	NA	NA	7.9 E-1	6.6 E-1	NA	NA	NA	1.5 E+1
30167	D	NA	NA	6.4 E-2	3.3 E-2	NA	NA	NA	NA	NA	NA	NA	2.0 E-1	9.0 E-2	NA	1.1 E-1	NA	3.4 E+0	5.9 E+0	NA	9.9 E-3	8.6 E-1	4.6 E-1	NA	NA	NA	1.1 E+1
30168	C	NA	1.0 E-2	5.0 E-2	1.2 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.3 E-1	5.5 E-1	NA	NA	1.5 E+0	NA	NA	NA	NA	2.6 E+0
30169	D	NA	7.3 E-3	5.3 E-2	1.1 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.7 E-1	2.6 E+0	NA	NA	1.4 E+0	NA	NA	NA	NA	4.5 E+0
30170	D	NA	1.1 E-2	5.3 E-2	1.3 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.7 E-1	4.3 E-1	NA	NA	2.9 E+0	NA	NA	NA	NA	3.6 E+0
30171	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.8 E-1	NA	NA	2.8 E-1	NA	NA	NA	NA	1.3 E+0
30172	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
30173	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.3 E-1	NA	NA	6.3 E-2	NA	NA	NA	NA	3.9 E-1
30185	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.9 E-1	NA	NA	NA	NA	NA	6.3 E-2	4.9 E-1	NA	NA	NA	7.5 E-1
30189	C	NA	NA	NA	8.8 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.9 E-2	2.1 E-2	NA	5.1 E-1	NA	NA	4.0 E-1	6.6 E-1	NA	NA	NA	1.7 E+0
30190	D	NA	NA	NA	1.3 E-2	NA	6.8 E-3	NA	NA	NA	NA	NA	NA	NA	NA	9.3 E-2	4.8 E-2	NA	3.9 E-1	NA	1.4 E-2	6.2 E-1	9.2 E-1	NA	NA	NA	2.1 E+0
30191	D	NA	NA	NA	1.3 E-2	NA	NA	NA	NA	NA	NA	NA	NA	3.0 E-2	NA	1.0 E-1	NA	NA	4.3 E-1	NA	1.0 E-2	5.4 E-1	5.3 E-1	NA	NA	NA	1.7 E+0

Table 2-16
Location-Specific Domestic Use of Groundwater Risk Assessment Results - Resident
Zone 3 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Incremental Lifetime Cancer Risk																								
Sample Name	Layer	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (cis/trans)	1,4-DIOX	Al	CCL	CF	c-1,2-DCE	DMP	Freon 113	Fe	Mn	DCM	Nitrate	Nitrite as N	NDMA	Perc	Ag	PCE	TCE	Va	VC	Zn	1-M-2-P	ILCR
Unit Hazard Child																											
Unit Hazard Adult																											
Unit Risk																											
1059	C	NA	NA	NA	NA	NA	NA	NA	2.0 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E-6	NA	NA	NA	NA	2 E-5
1218	C	2.2 E-6	NA	3.8 E-5	NA	NA	NA	NA	1.7 E-5	NA	NA	NA	NA	NA	NA	NA	NA	5.1 E-2	NA	NA	NA	9.7 E-5	NA	NA	NA	NA	5 E-2
1219	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.5 E-6	NA	NA	NA	NA	NA	NA	NA	NA	9 E-6
1220	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1226	C	NA	NA	5.5 E-6	NA	NA	NA	NA	9.7 E-6	NA	NA	NA	NA	NA	NA	NA	NA	3.5 E-3	NA	NA	NA	5.8 E-6	NA	NA	NA	NA	4 E-3
1227	E	NA	NA	NA	NA	NA	NA	9.5 E-6	3.6 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1 E-5
1228	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1246	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1247	C	4.3 E-7	NA	2.1 E-5	NA	NA	NA	NA	3.3 E-6	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-3	NA	NA	NA	4.9 E-5	NA	NA	NA	NA	1 E-3
1248	D	3.9 E-7	NA	2.0 E-5	NA	NA	NA	NA	3.7 E-6	NA	NA	NA	NA	NA	NA	NA	NA	1.4 E-3	NA	NA	NA	4.6 E-5	NA	NA	NA	NA	2 E-3
1262	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1263	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1264	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1265	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E-6	NA	NA	NA	NA	NA	NA	NA	NA	2 E-6
1318	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1339	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1340	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1416	C	9.8 E-7	NA	2.9 E-5	NA	NA	NA	NA	7.8 E-6	NA	NA	NA	NA	NA	NA	NA	NA	5.3 E-2	NA	NA	NA	3.8 E-5	NA	NA	NA	NA	5 E-2
1417	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1418	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-4	NA	NA	NA	NA	NA	NA	NA	NA	1 E-4
1425	C	NA	NA	NA	NA	NA	NA	NA	6.5 E-6	NA	NA	NA	NA	NA	NA	NA	NA	6.6 E-3	NA	NA	NA	3.3 E-6	NA	NA	NA	NA	7 E-3
1426	D	NA	NA	NA	NA	NA	NA	NA	1.4 E-5	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-2	NA	NA	NA	9.6 E-6	NA	NA	NA	NA	1 E-2
1428	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1442	C	3.3 E-6	NA	7.6 E-5	NA	NA	NA	1.8 E-5	2.2 E-5	NA	NA	NA	NA	NA	NA	NA	NA	1.4 E-1	NA	NA	NA	7.5 E-5	NA	NA	NA	NA	1 E-1
1443	D	1.3 E-6	NA	4.9 E-5	NA	NA	NA	NA	6.3 E-6	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-2	NA	NA	NA	4.0 E-5	NA	NA	NA	NA	2 E-2
1444	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1445	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1447	C	2.9 E-6	NA	9.8 E-5	NA	NA	NA	1.7 E-5	2.3 E-5	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-1	NA	NA	NA	6.7 E-5	NA	NA	NA	NA	1 E-1
1448	D	2.0 E-6	NA	1.1 E-4	NA	NA	NA	NA	1.4 E-5	NA	NA	NA	NA	NA	NA	NA	NA	7.2 E-2	NA	NA	NA	6.0 E-5	NA	NA	NA	NA	7 E-2
1449	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E-5	NA	NA	NA	NA	NA	NA	NA	NA	2 E-5
1450	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1451	B	NA	NA	4.1 E-6	NA	NA	NA	NA	9.1 E-6	NA	NA	NA	NA	NA	NA	NA	NA	2.6 E-3	NA	NA	NA	5.6 E-6	NA	NA	NA	NA	3 E-3
1452	C	NA	NA	4.4 E-6	NA	NA	NA	NA	1.0 E-5	NA	NA	NA	NA	NA	NA	NA	NA	3.9 E-3	NA	NA	NA	4.9 E-6	NA	NA	NA	NA	4 E-3
1453	C	NA	NA	NA	NA	NA	NA	NA	9.7 E-6	NA	NA	NA	NA	NA	NA	NA	NA	7.0 E-3	NA	NA	NA	4.6 E-6	NA	NA	NA	NA	7 E-3
1454	D	NA	NA	NA	NA	NA	NA	NA	8.4 E-6	NA	NA	NA	NA	NA	NA	NA	NA	5.7 E-3	NA	NA	NA	4.1 E-6	NA	NA	NA	NA	6 E-3
1456	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1491	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.1 E-5	NA	NA	NA	3.8 E-7	NA	NA	NA	NA	7 E-5
1492	C	NA	NA	1.7 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.0 E-3	NA	NA	NA	6.9 E-6	NA	NA	NA	NA	9 E-3
1493	C	1.8 E-6	NA	6.1 E-5	NA	NA	NA	NA	1.0 E-5	NA	NA	NA	NA	NA	NA	NA	NA	2.1 E-2	NA	NA	NA	1.2 E-4	NA	NA	NA	NA	2 E-2
1494	D	1.5 E-6	NA	4.3 E-5	NA	NA	NA	NA	1.1 E-5	NA	NA	NA	NA	NA	NA	NA	NA	3.4 E-2	NA	NA	NA	9.7 E-5	NA	NA	NA	NA	3 E-2
1495	F	8.2 E-7	NA	2.8 E-5	NA	NA	NA	NA	9.1 E-6	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-2	NA	NA	NA	6.3 E-5	NA	NA	NA	NA	2 E-2
1497	C	1.6 E-6	NA	4.0 E-5	NA	NA	NA	NA	1.0 E-5	NA	NA	NA	NA	NA	NA	NA	NA	5.4 E-2	NA	NA	NA	5.1 E-5	NA	NA	NA	NA	5 E-2
1498	C	2.3 E-6	NA	8.2 E-5	NA	NA	NA	1.8 E-4	5.3 E-5	NA	NA	NA	NA	NA	NA	NA	NA	8.3 E-2	NA	NA	NA	9.0 E-5	NA	NA	NA	NA	8 E-2
1499	D	2.2 E-6	NA	5.2 E-5	NA	NA	NA	NA	1.4 E-5	NA	NA	NA	NA	NA	NA	NA	NA	6.2 E-2	NA	NA	NA	6.5 E-5	NA	NA	NA	NA	6 E-2
1500	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.1 E-3	NA	NA	NA	2.8 E-6	NA	NA	NA	NA	3 E-3
1501	D	NA	NA	2.2 E-5	NA	NA	NA	NA	7.1 E-6	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-2	NA	NA	NA	2.5 E-5	NA	NA	NA	NA	2 E-2
1502	D	NA	NA	4.4 E-6	NA	NA	NA	NA	1.0 E-5	NA	NA	NA	NA	NA	NA	NA	NA	7.1 E-3	NA	NA	NA	9.0 E-6	NA	NA	NA	NA	7 E-3
1503	C	NA	NA	NA	NA	NA	NA	NA	3.6 E-6	NA	NA	NA	NA	NA	NA	NA	NA	1.9 E-3	NA	NA	NA	3.8 E-6	NA	NA	NA	NA	2 E-3
1504	D	NA	NA	NA	NA	NA	NA	NA	5.3 E-6	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-3	NA	NA	NA	4.3 E-6	NA	NA	NA	NA	2 E-3
1505	D	NA	NA	4.1 E-6	NA	NA	NA	NA	7.1 E-6	NA	NA	NA	NA	NA	NA	NA	NA	2.8 E-3	NA	NA	NA	5.6 E-6	NA	NA	NA	NA	3 E-3
1541	C	NA	NA	8.2 E-6	NA	6.0 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.1 E-5	NA	NA	NA	7.5 E-5	NA	NA	NA	NA	2 E-4
1542	D	NA	NA	NA	NA	4.3 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.0 E-5	NA	NA	NA	1.7 E-5	NA	NA	NA	NA	1 E-4
1543	F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1544	B	NA	NA	4.5 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.7 E-4	NA	NA	1.9 E-5	3.4 E-6	NA	NA	NA	NA	6 E-4
1545	C	NA	NA	9.0 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.8 E-3	NA	NA	NA	7.5 E-6	NA	NA	NA	NA	3 E-3
1546	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-6	NA	NA	NA	NA	NA	NA	NA	NA	1 E-6
1547	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1548	E	9.8 E-7	NA	3.6 E-5	NA	NA	NA	NA	3.6 E-6	NA	NA	NA	NA	NA	NA	NA	NA	5.1 E-2	NA	NA	NA	2.4 E-5	NA	NA	NA	NA	5 E-2
1549	F	9.8 E-7	NA	3.3 E-5	NA	NA	NA	NA	4.5 E-6	NA	NA	NA	NA	NA	NA	NA	NA	6.5 E-2	NA	NA	NA	3.1 E-5	NA	NA	NA	NA	7 E-2
1579	C	NA	NA	4.6 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.6 E-5	NA	NA	NA	5.5 E-6	NA	NA	NA	NA	1 E-4
1580	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.5 E-7	NA	NA	NA	NA	4 E-7
1581	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1582	C	NA	NA	NA	NA	NA	NA	NA	3.5 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E-5	NA	NA	NA	NA	5 E-5

Table 2-16
Location-Specific Domestic Use of Groundwater Risk Assessment Results - Resident
Zone 3 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Incremental Lifetime Cancer Risk																								
Sample Name	Layer	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (cis/trans)	1,4-DIOX	Al	CCL	CF	c-1,2-DCE	DMP	Freon 113	Fe	Mn	DCM	Nitrate	Nitrite as N	NDMA	Perc	Ag	PCE	TCE	Va	VC	Zn	1-M-2-P	ILCR
Unit Hazard Child																											
Unit Hazard Adult																											
Unit Risk																											
1583	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1584	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1597	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1598	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1599	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4080	C/D	1.3 E-6	NA	4.9 E-5	NA	NA	NA	5.0 E-5	1.8 E-5	NA	NA	NA	NA	NA	NA	NA	NA	6.8 E-2	NA	NA	NA	1.4 E-4	NA	NA	NA	NA	7 E-2
4085	C/D	2.8 E-6	NA	9.0 E-5	NA	NA	NA	NA	2.1 E-5	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-1	NA	NA	NA	9.7 E-5	NA	NA	NA	NA	1 E-1
4095	C/D	2.9 E-7	NA	1.2 E-5	NA	NA	NA	NA	8.4 E-6	NA	NA	NA	NA	NA	NA	NA	NA	2.8 E-2	NA	NA	NA	4.0 E-5	NA	NA	NA	NA	3 E-2
4195	C/D	NA	NA	NA	NA	NA	NA	NA	7.1 E-6	NA	NA	NA	NA	NA	NA	NA	NA	7.7 E-3	NA	NA	NA	6.1 E-6	NA	NA	NA	NA	8 E-3
4215	C/D	NA	NA	NA	NA	NA	NA	NA	9.7 E-6	NA	NA	NA	NA	NA	NA	NA	NA	6.1 E-3	NA	NA	NA	5.8 E-6	NA	NA	NA	NA	6 E-3
4303	C/D	1.4 E-6	NA	2.2 E-5	NA	NA	NA	1.8 E-5	1.4 E-5	NA	NA	NA	NA	NA	NA	NA	NA	5.3 E-2	NA	NA	NA	9.7 E-5	NA	NA	NA	NA	5 E-2
4400	C/D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.3 E-5	NA	NA	NA	5.5 E-6	NA	NA	NA	NA	9 E-5
4405	C	1.5 E-6	NA	3.4 E-5	NA	NA	NA	NA	1.2 E-5	NA	NA	NA	NA	NA	NA	NA	NA	5.0 E-2	NA	NA	8.7 E-6	8.2 E-5	NA	NA	NA	NA	5 E-2
4410	C/D	NA	NA	5.9 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.6 E-4	NA	NA	1.6 E-5	9.0 E-6	NA	NA	NA	NA	1 E-3
4450	C/D	1.9 E-6	NA	4.0 E-5	NA	NA	NA	3.2 E-5	1.5 E-5	NA	NA	NA	NA	NA	NA	NA	NA	4.0 E-2	NA	NA	NA	9.7 E-5	NA	NA	NA	NA	4 E-2
4455	C/D	1.3 E-6	NA	6.1 E-5	NA	NA	NA	2.8 E-5	1.2 E-5	NA	NA	NA	NA	NA	NA	NA	NA	2.2 E-2	NA	NA	NA	1.1 E-4	NA	NA	NA	NA	2 E-2
4460	C/D	1.1 E-6	NA	1.2 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.8 E-4	NA	NA	NA	2.2 E-5	NA	NA	NA	NA	7 E-4
4465	C/D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.9 E-5	NA	NA	NA	1.8 E-6	NA	NA	NA	NA	9 E-5
4565	C/D	NA	NA	7.2 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.2 E-4	NA	NA	NA	6.6 E-6	NA	NA	NA	NA	3 E-4
4570	C/D	NA	NA	4.7 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.1 E-5	NA	NA	3.6 E-5	2.7 E-6	NA	NA	NA	NA	9 E-5
4575	C/D	NA	NA	7.4 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.1 E-4	NA	NA	9.6 E-6	5.6 E-6	NA	2.4 E-5	NA	NA	1 E-3
30000	C	2.0 E-6	NA	3.5 E-5	NA	NA	NA	NA	1.6 E-5	NA	NA	NA	NA	NA	NA	NA	NA	5.1 E-2	NA	NA	NA	9.0 E-5	NA	NA	NA	NA	5 E-2
30011	C/D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.4 E-4	NA	NA	NA	2.2 E-6	NA	NA	NA	NA	1 E-4
30012	C	NA	NA	8.2 E-6	NA	NA	NA	NA	3.5 E-6	NA	NA	NA	NA	NA	NA	NA	NA	1.4 E-3	NA	NA	2.4 E-5	8.2 E-6	NA	NA	NA	NA	1 E-3
30013	D	NA	NA	4.7 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.5 E-4	NA	NA	2.0 E-5	5.0 E-6	NA	NA	NA	NA	1 E-3
30014	E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
30015	C/D	NA	NA	6.7 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.6 E-4	NA	NA	1.1 E-5	6.4 E-6	NA	NA	NA	NA	1 E-3
30019	C/D	NA	NA	6.3 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-4	NA	NA	NA	2.5 E-5	NA	NA	NA	NA	2 E-4
30047	C	1.5 E-6	NA	2.9 E-5	NA	NA	NA	NA	1.2 E-5	NA	NA	NA	NA	NA	NA	NA	NA	1.4 E-2	NA	NA	8.6 E-6	1.2 E-4	NA	NA	NA	NA	1 E-2
30048	D	2.0 E-6	NA	3.3 E-5	NA	NA	NA	NA	8.4 E-6	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-2	NA	NA	NA	5.6 E-5	NA	NA	NA	NA	2 E-2
30049	F	2.2 E-6	NA	3.7 E-5	NA	NA	NA	NA	1.1 E-5	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-2	NA	NA	NA	4.6 E-5	NA	NA	NA	NA	1 E-2
30053	C/D	1.6 E-6	NA	4.2 E-5	NA	NA	NA	6.7 E-5	2.9 E-5	NA	NA	NA	NA	NA	2.5 E-7	NA	NA	3.3 E-2	NA	NA	NA	1.3 E-4	NA	NA	NA	NA	3 E-2
30054	C/D	7.2 E-7	NA	2.5 E-5	NA	NA	NA	1.0 E-5	8.4 E-6	NA	NA	NA	NA	NA	NA	NA	NA	6.5 E-3	NA	NA	NA	6.5 E-5	NA	NA	NA	NA	7 E-3
30055	C/D	NA	NA	4.2 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.2 E-4	NA	NA	NA	1.6 E-5	NA	NA	NA	NA	7 E-4
30056	C/D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
30159	C	NA	NA	5.2 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.8 E-3	NA	NA	1.2 E-5	6.9 E-6	NA	NA	NA	NA	2 E-3
30162	C	NA	NA	5.7 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E-3	NA	NA	1.0 E-5	6.9 E-6	NA	NA	NA	NA	2 E-3
30163	D	NA	NA	5.7 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E-3	NA	NA	NA	5.7 E-6	NA	NA	NA	NA	2 E-3
30164	D	NA	NA	5.2 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.6 E-4	NA	NA	9.3 E-6	7.1 E-6	NA	NA	NA	NA	6 E-4
30165	C	NA	NA	5.8 E-6	NA	NA	NA	NA	4.0 E-6	NA	NA	NA	NA	NA	NA	NA	NA	1.4 E-3	NA	NA	1.7 E-5	7.5 E-6	NA	NA	NA	NA	1 E-3
30166	D	NA	NA	4.7 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-3	NA	NA	NA	5.5 E-6	NA	NA	NA	NA	1 E-3
30167	D	NA	NA	5.2 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.5 E-4	NA	NA	7.9 E-6	6.0 E-6	NA	NA	NA	NA	8 E-4
30168	C	NA	NA	4.1 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.6 E-5	NA	NA	NA	1.0 E-5	NA	NA	NA	NA	1 E-4
30169	D	NA	NA	4.3 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-4	NA	NA	NA	9.7 E-6	NA	NA	NA	NA	1 E-4
30170	D	NA	NA	4.3 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.7 E-5	NA	NA	NA	2.0 E-5	NA	NA	NA	NA	6 E-5
30171	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.9 E-6	NA	NA	NA	NA	2 E-6
30172	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
30173	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.3 E-7	NA	NA	NA	NA	4 E-7
30185	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.3 E-7	NA	NA	NA	NA	4 E-7
30189	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.8 E-6	NA	NA	NA	NA	3 E-6
30190	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-5	4.3 E-6	NA	NA	NA	NA	2 E-5
30191	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.3 E-6	3.7 E-6	NA	NA	NA	NA	1 E-5

Key:
All concentrations reported in micrograms per liter.
HI = Hazard index
ILCR = Incremental lifetime cancer risk
NA = Not applicable.
HI = Unit Hazard x Concentration; ILCR = Unit Risk x Concentration

Chemical Abbreviations

1,1-DCA	1,1-Dichloroethane	c-1,2-DCE	cis-1,2-Dichloroethene	Ag	Silver
1,1-DCE	1,2-Dichloroethene	DMP	Dimethyl phthalate	PCE	Tetrachloroethene
1,2-DCA	1,2-Dichloroethane	Freon 113	Freon 113	TCE	Trichloroethene
1,2-DCE	1,2-Dichloroethene	Fe	Iron	V	Vanadium
1,4-DIOX	1,4-Dioxane	Mn	Manganese	VC	Vinyl chloride
Al	Aluminum	DCM	Methylene chloride	Zn	Zinc
CCL	Carbon tetrachloride	NDMA	N-Nitrosodimethylamine	1-M-2-P	1-Methyl-2-pyrrolidinone
CF	Chloroform	Perc	Perchlorate		

Table 2-17a
Location-Specific Domestic Use Groundwater Risk Assessment Results - Resident
Zone 4 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Concentration																													
Sample Name	Layer	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (cis/trans)	1,4-Diox	Al	Ba	BDCM	Cd	CCL	CF	CM	c-1,2-DCE	Co	Freon 113	Fe	Pb	Mn	DCM	Ni	Nitrate	NDMA	1,4-DCB	Perc	PCE	TCE	TCFM	V	VC	Zn
Unit Hazard Child		1.9 E-3	1.7 E-2	2.3 E-1	3.9 E-2	3.7 E-4	6.7 E-5	3.5 E-4	1.9 E-2	7.2 E-2	1.4 E-1	3.2 E-2	1.2 E-2	3.9 E-2	3.2 E-3	4.6 E-5	9.2 E-5	NA	3.1 E-3	1.5 E-3	3.3 E-3	4.0 E-5	1.0 E+1	4.9 E-3	9.2 E-2	4.2 E-2	2.5 E-1	7.0 E-3	8.0 E-2	3.3 E-2	2.1 E-4
Unit Hazard Adult		8.3 E-4	7.5 E-3	9.9 E-2	1.7 E-2	1.6 E-4	2.8 E-5	1.5 E-4	8.3 E-3	3.0 E-2	6.2 E-2	1.4 E-2	5.3 E-3	1.7 E-2	1.4 E-3	2.1 E-5	3.9 E-5	NA	1.3 E-3	6.3 E-4	1.4 E-3	1.7 E-5	4.3 E+0	2.1 E-3	3.9 E-2	1.8 E-2	1.1 E-1	3.1 E-3	3.3 E-2	1.4 E-2	9.2 E-5
Unit Risk		5.2 E-7	NA	8.2 E-6	NA	2.4 E-6	NA	NA	1.2 E-5	NA	1.4 E-5	6.5 E-6	6.7 E-7	NA	NA	NA	NA	NA	NA	4.8 E-7	NA	NA	9.6 E-4	2.2 E-6	NA	1.4 E-5	7.5 E-7	NA	NA	4.4 E-5	NA
78	A	0.74	1.8	0.75	1.9		1100	500		1.1				1.2		36	78000		440			5400			45		2	12	12		
79	A																						0.025		4.4						
99	A			0.59	4.5											2.2							0.067				31				
435	A																						0.075								
444	A																						0.013								
445	A																						0.014				0.69				
453	A						3300	230		2.3					12		56000	39	420		11	1400							35		3100
454	C																						0.26		7.5						
455	C																						0.087		9.5						
456	C																														
457	A																														
458	A																								49						
459	A																										0.68				
460	A																														
462	A																														
463	A																										2				
464	C																														
465	C																														
481	A																						0.0047								
482	A																														
483	Bedrock																														
3095	A	3.1	0.95	1.5	54	5.3	2400	240	0.83	2000	0.99			22	21		52000		350	0.51	12	400		0.9	5	0.52	130		40	31	690
3188	A	3	2.1	1.5	130	4.4						2.6		140						0.97		1600				0.7	510			1.1	
3219	A																						3.6								
3220	A		0.55	0.8								0.61											3.1				0.76				
3366	A	0.52				3.5						0.84		13								1100					31				
3367	A																														
3368	A																														
3383	A																														
3384	A																					140									
3394	Dredged																														
3395	A																														
3396	C																														
3497	Dredged	2.8			11									16													7.1				
3498	A											0.79																			
3499	A																														
3503	A				13	1.4																					2.8			2.8	
3504	A																								34						
3505	C																														
3626	A							29											19			2600							17		
4100	A	5.5	20	4.1	3.3							0.8		2.4		550							6.4				68			0.98	
4105	A	1.5	7.1	3.8	0.8									0.63		170							9.5				10				
4110	A	3	12	3.8	1								0.66	0.75		240							19				13				
4120	A	3.2	3.5	2.9								1.8	1.2			14							46				3.3	0.72			
4125	A	1.8	2.2	2.8												1.1							22				0.76				
4130	A		0.91	0.83																			10				0.63				
4500	A	0.87	2	1.2												29							9.2				1.3				

Table 2-17a
Location-Specific Domestic Use Groundwater Risk Assessment Results - Resident
Zone 4 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Child Non-Cancer Hazard Index																														
Sample Name	Layer	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (cis/trans)	1,4-Diox	Al	Ba	BDCM	Cd	CCL	CF	CM	c-1,2-DCE	Co	Freon 113	Fe	Pb	Mn	DCM	Ni	Nitrate	NDMA	1,4-DCB	Perc	PCE	TCE	TCFM	V	VC	Zn	HI
Unit Hazard Child																																
Unit Hazard Adult																																
Unit Risk																																
78	A	1.4 E-3	3.1 E-2	1.7 E-1	7.4 E-2	NA	7.3 E-2	1.7 E-1	NA	8.0 E-2	NA	NA	NA	4.7 E-2	NA	1.7 E-3	7.2 E+0	NA	1.4 E+0	NA	NA	2.2 E-1	NA	NA	4.1 E+0	NA	5.0 E-1	8.4 E-2	9.6 E-1	NA	NA	1.5 E+1
79	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-1	NA	4.0 E-1	NA	NA	NA	NA	NA	NA	6.6 E-1
99	A	NA	NA	1.4 E-1	1.8 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E-4	NA	NA	NA	NA	NA	NA	6.8 E-1	NA	NA	NA	7.8 E+0	NA	NA	NA	NA	8.8 E+0
435	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.6 E-1	NA	NA	NA	NA	NA	NA	NA	NA	7.6 E-1
444	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-1	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-1
445	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.4 E-1	NA	NA	NA	1.7 E-1	NA	NA	NA	NA	3.1 E-1
453	A	NA	NA	NA	NA	NA	2.2 E-1	8.0 E-2	NA	1.7 E-1	NA	NA	NA	NA	3.8 E-2	NA	5.1 E+0	NA	1.3 E+0	NA	3.6 E-2	5.6 E-2	NA	NA	NA	NA	NA	NA	2.8 E+0	NA	6.6 E-1	1.1 E+1
454	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.6 E+0	NA	6.9 E-1	NA	NA	NA	NA	NA	NA	3.3 E+0
455	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.8 E-1	NA	8.7 E-1	NA	NA	NA	NA	NA	NA	1.8 E+0
456	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
457	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
458	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.5 E+0	NA	NA	NA	NA	NA	NA	4.5 E+0
459	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.7 E-1	NA	NA	NA	NA	1.7 E-1
460	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
462	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
463	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.0 E-1	NA	NA	NA	NA	5.0 E-1
464	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
465	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
481	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.8 E-2	NA	NA	NA	NA	NA	NA	NA	NA	4.8 E-2
482	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
483	Bedrock	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3095	A	6.0 E-3	1.7 E-2	3.5 E-1	2.1 E+0	2.0 E-3	1.6 E-1	8.4 E-2	1.6 E-2	1.4 E+2	1.4 E-1	NA	NA	8.6 E-1	6.7 E-2	NA	4.8 E+0	NA	1.1 E+0	7.5 E-4	4.0 E-2	1.6 E-2	NA	4.4 E-3	4.6 E-1	2.2 E-2	3.3 E+1	NA	3.2 E+0	1.0 E+0	1.5 E-1	1.9 E+2
3188	A	5.8 E-3	3.7 E-2	3.5 E-1	5.1 E+0	1.6 E-3	NA	NA	NA	NA	NA	8.2 E-2	NA	5.4 E+0	NA	NA	NA	NA	NA	1.4 E-3	NA	6.4 E-2	NA	NA	NA	2.9 E-2	1.3 E+2	NA	NA	3.7 E-2	NA	1.4 E+2
3219	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.6 E+1	NA	NA	NA	NA	NA	NA	NA	NA	3.6 E+1
3220	A	NA	9.6 E-3	1.9 E-1	NA	NA	NA	NA	NA	NA	NA	1.9 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.1 E+1	NA	NA	NA	1.9 E-1	NA	NA	NA	NA	3.2 E+1
3366	A	1.0 E-3	NA	NA	NA	1.3 E-3	NA	NA	NA	NA	NA	2.6 E-2	NA	5.1 E-1	NA	NA	NA	NA	NA	NA	NA	4.4 E-2	NA	NA	NA	NA	7.8 E+0	NA	NA	NA	NA	8.3 E+0
3367	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3368	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3383	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3384	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.6 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.6 E-3
3394	Dredged	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3395	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3396	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3497	Dredged	5.4 E-3	NA	NA	4.3 E-1	NA	NA	NA	NA	NA	NA	NA	NA	6.2 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.8 E+0	NA	NA	NA	NA	2.8 E+0
3498	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-2
3499	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3503	A	NA	NA	NA	5.1 E-1	5.2 E-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.0 E-1	NA	NA	9.4 E-2	NA	1.3 E+0
3504	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.1 E+0	NA	NA	NA	NA	NA	NA	3.1 E+0
3505	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3626	A	NA	NA	NA	NA	NA	NA	1.0 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.9 E-2	NA	NA	1.0 E-1	NA	NA	NA	NA	NA	NA	1.4 E+0	NA	NA	1.5 E+0
4100	A	1.1 E-2	3.5 E-1	9.5 E-1	1.3 E-1	NA	NA	NA	NA	NA	NA	2.5 E-2	NA	9.3 E-2	NA	2.6 E-2	NA	NA	NA	NA	NA	NA	6.5 E+1	NA	NA	NA	1.7 E+1	NA	NA	3.3 E-2	NA	8.3 E+1
4105	A	2.9 E-3	1.2 E-1	8.8 E-1	3.1 E-2	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-2	NA	7.9 E-3	NA	NA	NA	NA	NA	NA	9.6 E+1	NA	NA	NA	2.5 E+0	NA	NA	NA	NA	1.0 E+2
4110	A	5.8 E-3	2.1 E-1	8.8 E-1	3.9 E-2	NA	NA	NA	NA	NA	NA	NA	8.2 E-3	2.9 E-2	NA	1.1 E-2	NA	NA	NA	NA	NA	NA	1.9 E+2	NA	NA	NA	3.3 E+0	NA	NA	NA	NA	2.0 E+2
4120	A	6.2 E-3	6.1 E-2	6.7 E-1	NA	NA	NA	NA	NA	NA	NA	5.7 E-2	1.5 E-2	NA	NA	6.5 E-4	NA	NA	NA	NA	NA	NA	4.6 E+2	NA	NA	NA	8.3 E-1	5.0 E-3	NA	NA	NA	4.7 E+2
4125	A	3.5 E-3	3.8 E-2	6.5 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.1 E-5	NA	NA	NA	NA	NA	NA	2.2 E+2	NA	NA	NA	1.9 E-1	NA	NA	NA	NA	2.2 E+2
4130	A	NA	1.6 E-2	1.9 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.0 E+2	NA	NA	NA	1.6 E-1	NA	NA	NA	NA	1.0 E+2
4500	A	1.7 E-3	3.5 E-2	2.8 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-3	NA	NA	NA	NA	NA	NA	9.3 E+1	NA	NA	NA	3.3 E-1	NA	NA	NA	NA	9.4 E+1

Table 2-17a
Location-Specific Domestic Use Groundwater Risk Assessment Results - Resident
Zone 4 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Adult Non-Cancer Hazard Index																													
Sample Name	Layer	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (cis/trans)	1,4-Diox	Al	Ba	BDCM	Cd	CCL	CF	CM	c-1,2-DCE	Co	Freon 113	Fe	Pb	Mn	DCM	Ni	Nitrate	NDMA	1,4-DCB	Perc	PCE	TCE	TCFM	V	VC	Zn	HI
Unit Hazard Child																																
Unit Hazard Adult																																
Unit Risk																																
78	A	6.2 E-4	1.3 E-2	7.4 E-2	3.2 E-2	NA	3.1 E-2	7.4 E-2	NA	3.3 E-2	NA	NA	NA	2.0 E-2	NA	7.5 E-4	3.1 E+0	NA	5.7 E-1	NA	NA	9.3 E-2	NA	NA	1.8 E+0	NA	2.2 E-1	3.7 E-2	3.9 E-1	NA	NA	6.4 E+0
79	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-1	NA	1.7 E-1	NA	NA	NA	NA	NA	NA	2.8 E-1
99	A	NA	NA	5.9 E-2	7.5 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.6 E-5	NA	NA	NA	NA	NA	NA	2.9 E-1	NA	NA	NA	3.3 E+0	NA	NA	NA	NA	3.8 E+0
435	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.2 E-1	NA	NA	NA	NA	NA	NA	NA	NA	3.2 E-1
444	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.6 E-2	NA	NA	NA	NA	NA	NA	NA	NA	5.6 E-2
445	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.0 E-2	NA	NA	NA	7.4 E-2	NA	NA	NA	NA	1.3 E-1
453	A	NA	NA	NA	NA	NA	9.4 E-2	3.4 E-2	NA	7.0 E-2	NA	NA	NA	NA	1.6 E-2	NA	2.2 E+0	NA	5.4 E-1	NA	1.5 E-2	2.4 E-2	NA	NA	NA	NA	NA	NA	1.2 E+0	NA	2.8 E-1	4.4 E+0
454	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E+0	NA	3.0 E-1	NA	NA	NA	NA	NA	NA	1.4 E+0
455	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.8 E-1	NA	3.7 E-1	NA	NA	NA	NA	NA	NA	7.5 E-1
456	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
457	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
458	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.9 E+0	NA	NA	NA	NA	NA	NA	1.9 E+0
459	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.3 E-2	NA	NA	NA	NA	7.3 E-2
460	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
462	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
463	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.2 E-1	NA	NA	NA	NA	2.2 E-1
464	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
465	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
481	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-2	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-2
482	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
483	Bedrock	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3095	A	2.6 E-3	7.1 E-3	1.5 E-1	9.0 E-1	8.5 E-4	6.8 E-2	3.5 E-2	6.9 E-3	6.1 E+1	6.1 E-2	NA	NA	3.7 E-1	2.9 E-2	NA	2.0 E+0	NA	4.5 E-1	3.2 E-4	1.7 E-2	6.9 E-3	NA	1.9 E-3	2.0 E-1	9.4 E-3	1.4 E+1	NA	1.3 E+0	4.4 E-1	6.3 E-2	8.1 E+1
3188	A	2.5 E-3	1.6 E-2	1.5 E-1	2.2 E+0	7.0 E-4	NA	NA	NA	NA	NA	3.5 E-2	NA	2.3 E+0	NA	NA	NA	NA	NA	6.1 E-4	NA	2.8 E-2	NA	NA	NA	1.3 E-2	5.5 E+1	NA	NA	1.6 E-2	NA	6.0 E+1
3219	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E+1	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E+1
3220	A	NA	4.1 E-3	7.9 E-2	NA	NA	NA	NA	NA	NA	NA	8.3 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E+1	NA	NA	NA	8.2 E-2	NA	NA	NA	NA	1.4 E+1
3366	A	4.3 E-4	NA	NA	NA	5.6 E-4	NA	NA	NA	NA	NA	1.1 E-2	NA	2.2 E-1	NA	NA	NA	NA	NA	NA	NA	1.9 E-2	NA	NA	NA	NA	3.3 E+0	NA	NA	NA	NA	3.6 E+0
3367	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3368	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3383	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3384	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.4 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.4 E-3
3394	Dredged	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3395	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3396	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3497	Dredged	2.3 E-3	NA	NA	1.8 E-1	NA	NA	NA	NA	NA	NA	NA	NA	2.7 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.7 E-1	NA	NA	NA	NA	1.2 E+0
3498	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-2
3499	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3503	A	NA	NA	NA	2.2 E-1	2.2 E-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.0 E-1	NA	NA	4.0 E-2	NA	5.6 E-1
3504	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E+0	NA	NA	NA	NA	NA	NA	1.3 E+0
3505	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3626	A	NA	NA	NA	NA	NA	NA	4.3 E-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-2	NA	NA	4.5 E-2	NA	NA	NA	NA	NA	NA	5.6 E-1	NA	NA	6.3 E-1
4100	A	4.6 E-3	1.5 E-1	4.1 E-1	5.5 E-2	NA	NA	NA	NA	NA	NA	1.1 E-2	NA	4.0 E-2	NA	1.1 E-2	NA	NA	NA	NA	NA	NA	2.8 E+1	NA	NA	NA	7.3 E+0	NA	NA	1.4 E-2	NA	3.6 E+1
4105	A	1.2 E-3	5.3 E-2	3.8 E-1	1.3 E-2	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-2	NA	3.5 E-3	NA	NA	NA	NA	NA	NA	4.1 E+1	NA	NA	NA	1.1 E+0	NA	NA	NA	NA	4.3 E+1
4110	A	2.5 E-3	9.0 E-2	3.8 E-1	1.7 E-2	NA	NA	NA	NA	NA	NA	NA	3.5 E-3	1.3 E-2	NA	5.0 E-3	NA	NA	NA	NA	NA	NA	8.2 E+1	NA	NA	NA	1.4 E+0	NA	NA	NA	NA	8.4 E+1
4120	A	2.7 E-3	2.6 E-2	2.9 E-1	NA	NA	NA	NA	NA	NA	NA	2.4 E-2	6.4 E-3	NA	NA	2.9 E-4	NA	NA	NA	NA	NA	NA	2.0 E+2	NA	NA	NA	3.6 E-1	2.2 E-3	NA	NA	NA	2.0 E+2
4125	A	1.5 E-3	1.6 E-2	2.8 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.3 E-5	NA	NA	NA	NA	NA	NA	9.5 E+1	NA	NA	NA	8.2 E-2	NA	NA	NA	NA	9.5 E+1
4130	A	NA	6.8 E-3	8.2 E-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.3 E+1	NA	NA	NA	6.8 E-2	NA	NA	NA	NA	4.3 E+1
4500	A	7.2 E-4	1.5 E-2	1.2 E-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.0 E-4	NA	NA	NA	NA	NA	NA	4.0 E+1	NA	NA	NA	1.4 E-1	NA	NA	NA	NA	4.0 E+1

Table 2-17a
Location-Specific Domestic Use Groundwater Risk Assessment Results - Resident
Zone 4 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Incremental Lifetime Cancer Risk																														Blood Lead	
Sample Name	Layer	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (cis/trans)	1,4-Diox	Al	Ba	BDCM	Cd	CCL	CF	CM	c-1,2-DCE	Co	Freon 113	Fe	Pb	Mn	DCM	Ni	Nitrate	NDMA	1,4-DCB	Perc	PCE	TCE	TCFM	V	VC	Zn	ILCR	Child	Adult
Unit Hazard Child																																	
Unit Hazard Adult																																	
Unit Risk																																	
78	A	3.8 E-7	NA	6.1 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E-6	NA	NA	NA	NA	8 E-6	NA	NA
79	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.4 E-5	NA	NA	NA	NA	NA	NA	NA	NA	2 E-5	NA	NA
99	A	NA	NA	4.8 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.4 E-5	NA	NA	NA	2.3 E-5	NA	NA	NA	NA	9 E-5	NA	NA
435	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.2 E-5	NA	NA	NA	NA	NA	NA	NA	NA	7 E-5	NA	NA
444	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.2 E-5	NA	NA	NA	NA	NA	NA	NA	NA	1 E-5	NA	NA
445	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-5	NA	NA	NA	5.2 E-7	NA	NA	NA	NA	1 E-5	NA	NA
453	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	20.4	10.2
454	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-4	NA	NA	NA	NA	NA	NA	NA	NA	2 E-4	NA	NA
455	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.3 E-5	NA	NA	NA	NA	NA	NA	NA	NA	8 E-5	NA	NA
456	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
457	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
458	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
459	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.1 E-7	NA	NA	NA	NA	5 E-7	NA	NA
460	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
462	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
463	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E-6	NA	NA	NA	NA	1 E-6	NA	NA
464	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
465	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
481	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.5 E-6	NA	NA	NA	NA	NA	NA	NA	NA	4 E-6	NA	NA
482	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
483	Bedrock	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3095	A	1.6 E-6	NA	1.2 E-5	NA	1.3 E-5	NA	NA	9.8 E-6	NA	1.4 E-5	NA	NA	NA	NA	NA	NA	NA	NA	2.4 E-7	NA	NA	NA	2.0 E-6	NA	7.4 E-6	9.7 E-5	NA	NA	1.4 E-3	NA	2 E-3	NA	NA
3188	A	1.5 E-6	NA	1.2 E-5	NA	1.1 E-5	NA	NA	NA	NA	NA	1.7 E-5	NA	NA	NA	NA	NA	NA	NA	4.6 E-7	NA	NA	NA	NA	NA	1.0 E-5	3.8 E-4	NA	NA	4.8 E-5	NA	5 E-4	NA	NA
3219	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.4 E-3	NA	NA	NA	NA	NA	NA	NA	NA	3 E-3	NA	NA
3220	A	NA	NA	6.5 E-6	NA	NA	NA	NA	NA	NA	NA	4.0 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.0 E-3	NA	NA	NA	5.7 E-7	NA	NA	NA	NA	3 E-3	NA	NA
3366	A	2.7 E-7	NA	NA	NA	8.4 E-6	NA	NA	NA	NA	NA	5.5 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.3 E-5	NA	NA	NA	NA	4 E-5	NA	NA
3367	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3368	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3383	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3384	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3394	Dredged	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3395	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3396	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3497	Dredged	1.4 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.3 E-6	NA	NA	NA	NA	7 E-6	NA	NA
3498	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.1 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5 E-6	NA	NA
3499	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3503	A	NA	NA	NA	NA	3.4 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.1 E-6	NA	NA	1.2 E-4	NA	1 E-4	NA	NA
3504	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3505	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3626	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4100	A	2.8 E-6	NA	3.4 E-5	NA	NA	NA	NA	NA	NA	NA	5.2 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.1 E-3	NA	NA	NA	5.1 E-5	NA	NA	4.3 E-5	NA	6 E-3	NA	NA
4105	A	7.7 E-7	NA	3.1 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.1 E-3	NA	NA	NA	7.5 E-6	NA	NA	NA	NA	9 E-3	NA	NA
4110	A	1.5 E-6	NA	3.1 E-5	NA	NA	NA	NA	NA	NA	NA	NA	4.4 E-7	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.8 E-2	NA	NA	NA	9.7 E-6	NA	NA	NA	NA	2 E-2	NA	NA
4120	A	1.6 E-6	NA	2.4 E-5	NA	NA	NA	NA	NA	NA	NA	1.2 E-5	8.0 E-7	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.4 E-2	NA	NA	NA	2.5 E-6	NA	NA	NA	NA	4 E-2	NA	NA
4125	A	9.3 E-7	NA	2.3 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.1 E-2	NA	NA	NA	5.7 E-7	NA	NA	NA	NA	2 E-2	NA	NA
4130	A	NA	NA	6.8 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.6 E-3	NA	NA	NA	4.7 E-7	NA	NA	NA	NA	1 E-2	NA	NA
4500	A	4.5 E-7	NA	9.8 E-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.8 E-3	NA	NA	NA	9.7 E-7	NA	NA	NA	NA	9 E-3	NA	NA

Key:
HI = Hazard index
ILCR = Incremental lifetime cancer risk
NA = Not applicable

Compound Abbreviations

1,1-DCA	1,1-Dichloroethane	CF	Chloroform	TCE	Trichloroethene
1,1-DCE	1,1-Dichloroethene	CM	Chloromethane	TCFM	Trichlorofluoromethane
1,2-DCA	1,2-Dichloroethane	c-1,2-DCE	cis-1,2-Dichloroethene	V	Vanadium
1,2-DCE (cis/trans)	1,2-Dichloroethene (cis/trans)	Co	Cobalt	VC	Vinyl chloride
1,4-Diox	1,4-Dioxane	Fe	Iron	Zn	Zinc
Al	Aluminum	Pb	Lead	NDMA	N-Nitrosodimethylamine
Ba	Barium	Mn	Manganese	1,4-DCB	1,4-Dichlorobenzene
BDCM	Bromodichloromethane	DCM	Methylene chloride	Perc	Perchlorate
Cd	Cadmium	Ni	Nickel	PCE	Tetrachloroethene
CCL	Carbon tetrachloride	Nitrate	Nitrate		

Table 2-17b
Location-Specific Indoor Air Risk Assessment Results - Resident
Zone 4 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Concentration																																		
Sample Name	Layer	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (cis/trans)	1,4-Diox	BDCM	CCL	CF	CM	c-1,2-DCE	Freon 113	DCM	1,4-DCB	PCE	TCE	TCFM	VC	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (cis/trans)	1,4-Diox	BDCM	CCL	CF	CM	c-1,2-DCE	Freon 113	DCM	1,4-DCB	PCE	TCE	TCFM	VC	HI
Unit Hazard Child		3.2 E+0	3.2 E+1	4.6 E+2	6.4 E+1	7.5 E-1	3.2 E+1	5.6 E+1	4.9 E+1	2.5 E+1	6.4 E+1	7.4 E-2	7.5 E-1	2.8 E+0	6.4 E+1	3.7 E+0	1.1 E+1	2.2 E+1																		
Unit Hazard Adult		1.4 E+0	1.4 E+1	2.0 E+2	2.7 E+1	3.2 E-1	1.4 E+1	2.4 E+1	2.1 E+1	1.1 E+1	2.7 E+1	3.2 E-2	3.2 E-1	1.2 E+0	2.7 E+1	1.6 E+0	4.8 E+0	9.4 E+0																		
Unit Risk		8.5 E-4	NA	1.4 E-2	NA	4.0 E-3	1.9 E-2	2.2 E-2	1.2 E-2	9.4 E-4	NA	NA	5.2 E-4	3.3 E-3	3.1 E-3	1.0 E-3	NA	4.0 E-2																		
Attenuation Factor		2.7 E-2	1.5 E-1	6.3 E-3	1.9 E-2	5.7 E-5	3.1 E-3	1.5 E-1	2.4 E-2	7.0 E-2	1.9 E-2	2.4 E+0	1.4 E-2	1.0 E-2	8.4 E-2	5.1 E-2	5.4 E-1	1.8 E-1																		
78	A	0.74	1.8	0.75	1.9						1.2	36				2	12		6.3 E-5	8.6 E-3	2.2 E-3	2.3 E-3	NA	NA	NA	NA	NA	1.5 E-3	6.4 E-3	NA	NA	NA	3.8 E-4	7.2 E-2	NA	9.4 E-2
99	A			0.59	4.5							2.2				31			NA	NA	1.7 E-3	5.5 E-3	NA	NA	NA	NA	NA	NA	3.9 E-4	NA	NA	NA	5.9 E-3	NA	NA	1.4 E-2
444	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
445	A															0.69			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-4	NA	NA	1.3 E-4
453	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
457	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
458	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
459	A															0.68			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-4	NA	NA	1.3 E-4
460	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
462	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
463	A															2			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.8 E-4	NA	NA	3.8 E-4
481	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
482	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3095	A	3.1	0.95	1.5	54	5.3	0.83	0.99			22		0.51	0.9	0.52	130		31	2.6 E-4	4.5 E-3	4.3 E-3	6.6 E-2	2.3 E-7	8.3 E-5	8.3 E-3	NA	NA	2.7 E-2	NA	5.3 E-6	2.6 E-5	2.8 E-3	2.5 E-2	NA	1.2 E-1	2.6 E-1
3188	A	3	2.1	1.5	130	4.4			2.6		140		0.97		0.7	510		1.1	2.5 E-4	1.0 E-2	4.3 E-3	1.6 E-1	1.9 E-7	NA	NA	3.0 E-3	NA	1.7 E-1	NA	1.0 E-5	NA	3.7 E-3	9.8 E-2	NA	4.4 E-3	4.5 E-1
3219	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3220	A		0.55	0.8					0.61							0.76			NA	2.6 E-3	2.3 E-3	NA	NA	NA	NA	7.2 E-4	NA	NA	NA	NA	NA	NA	1.5 E-4	NA	NA	5.8 E-3
3366	A	0.52				3.5			0.84		13					31			4.4 E-5	NA	NA	NA	1.5 E-7	NA	NA	9.8 E-4	NA	1.6 E-2	NA	NA	NA	NA	5.9 E-3	NA	NA	2.3 E-2
3367	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3368	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3383	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3384	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3395	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3498	A								0.79										NA	NA	NA	NA	NA	NA	NA	9.3 E-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.3 E-4
3499	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3503	A				13	1.4										2.8		2.8	NA	NA	NA	1.6 E-2	6.0 E-8	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.4 E-4	NA	1.1 E-2	2.8 E-2
3504	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3626	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 2-17b
Location-Specific Indoor Air Risk Assessment Results - Resident
Zone 4 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Adult Non-Cancer Hazard Index

Sample Name	Layer	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (cis/trans)	1,4-Diox	BDCM	CCL	CF	CM	c-1,2-DCE	Freon 113	DCM	1,4-DCB	PCE	TCE	TCFM	VC	HI
Unit Hazard Child																			
Unit Hazard Adult																			
Unit Risk																			
Attenuation Factor																			
78	A	2.7 E-5	3.7 E-3	9.3 E-4	1.0 E-3	NA	NA	NA	NA	NA	6.3 E-4	2.7 E-3	NA	NA	NA	1.6 E-4	3.1 E-2	NA	4.0 E-2
99	A	NA	NA	7.3 E-4	2.4 E-3	NA	NA	NA	NA	NA	NA	1.7 E-4	NA	NA	NA	2.5 E-3	NA	NA	5.8 E-3
444	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
445	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.7 E-5	NA	NA	5.7 E-5
453	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
457	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
458	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
459	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.6 E-5	NA	NA	5.6 E-5
460	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
462	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
463	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.6 E-4	NA	NA	1.6 E-4
481	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
482	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3095	A	1.1 E-4	1.9 E-3	1.9 E-3	2.8 E-2	9.7 E-8	3.5 E-5	3.6 E-3	NA	NA	1.2 E-2	NA	2.3 E-6	1.1 E-5	1.2 E-3	1.1 E-2	NA	5.3 E-2	1.1 E-1
3188	A	1.1 E-4	4.3 E-3	1.9 E-3	6.8 E-2	8.1 E-8	NA	NA	1.3 E-3	NA	7.3 E-2	NA	4.3 E-6	NA	1.6 E-3	4.2 E-2	NA	1.9 E-3	1.9 E-1
3219	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3220	A	NA	1.1 E-3	9.9 E-4	NA	NA	NA	NA	3.1 E-4	NA	NA	NA	NA	NA	NA	6.2 E-5	NA	NA	2.5 E-3
3366	A	1.9 E-5	NA	NA	NA	6.4 E-8	NA	NA	4.2 E-4	NA	6.8 E-3	NA	NA	NA	NA	2.5 E-3	NA	NA	9.8 E-3
3367	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3368	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3383	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3384	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3395	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3498	A	NA	NA	NA	NA	NA	NA	NA	4.0 E-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.0 E-4
3499	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3503	A	NA	NA	NA	6.8 E-3	2.6 E-8	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.3 E-4	NA	4.8 E-3	1.2 E-2
3504	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3626	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Incremental Lifetime Cancer Risk

Sample Name	Layer	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (cis/trans)	1,4-Diox	BDCM	CCL	CF	CM	c-1,2-DCE	Freon 113	DCM	1,4-DCB	PCE	TCE	TCFM	VC	ILCR
78	A	1.7 E-8	NA	6.4 E-8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-7	NA	NA	2 E-7
99	A	NA	NA	5.1 E-8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.7 E-6	NA	NA	2 E-6
444	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
445	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.7 E-8	NA	NA	4 E-8
453	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
457	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
458	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
459	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.6 E-8	NA	NA	4 E-8
460	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
462	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
463	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 E-7	NA	NA	1 E-7
481	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
482	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3095	A	7.0 E-8	NA	1.3 E-7	NA	1.2 E-9	5.0 E-8	3.3 E-6	NA	NA	NA	NA	3.7 E-9	3.1 E-8	1.4 E-7	7.0 E-6	NA	2.3 E-4	2 E-4
3188	A	6.8 E-8	NA	1.3 E-7	NA	1.0 E-9	NA	NA	7.4 E-7	NA	NA	NA	7.0 E-9	NA	1.8 E-7	2.7 E-5	NA	8.0 E-6	4 E-5
3219	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3220	A	NA	NA	6.9 E-8	NA	NA	NA	NA	1.7 E-7	NA	NA	NA	NA	NA	NA	4.1 E-8	NA	NA	3 E-7
3366	A	1.2 E-8	NA	NA	NA	8.1 E-10	NA	NA	2.4 E-7	NA	NA	NA	NA	NA	NA	1.7 E-6	NA	NA	2 E-6
3367	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3368	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3383	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3384	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3395	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3498	A	NA	NA	NA	NA	NA	NA	NA	2.3 E-7	NA	NA	NA	NA	NA	NA	NA	NA	NA	2 E-7
3499	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3503	A	NA	NA	NA	NA	3.2 E-10	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5 E-7	NA	2.0 E-5	2 E-5
3504	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3626	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes and Key:
All concentrations reported in micrograms per liter.
HI = Hazard index
ILCR = Incremental lifetime cancer risk
NA = Not applicable.

Chemical Abbreviations

1,1-DCA	1,1-Dichloroethane	CF	Chloroform
1,1-DCE	1,1-Dichloroethene	c-1,2-DCE	cis-1,2-Dichloroethene
1,2-DCA	1,2-Dichloroethane	Freon 113	Freon 113
1,2-DCE (cis/trans)	1,2-Dichloroethene (cis/trans)	DCM	Methylene chloride
1,4-Diox	1,4-Dioxane	1,4-DCB	1,4-Dichlorobenzene
BDCM	Bromodichloromethane	PCE	Tetrachloroethene
CCL	Carbon tetrachloride	TCE	Trichloroethene
		VC	Vinyl chloride

Table 2-17c
Location-Specific Indoor Air Risk Assessment Results - Commercial Worker
Zone 4 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Concentration																	Non-Cancer Hazard Index																	
Sample Name	Layer	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (cis/trans)	1,4-Diox	BDCM	CCL	CF	CM	c-1,2-DCE	Freon 113	DCM	1,4-DCB	PCE	TCE	TCFM	VC	1,1-DCA	1,1-DCE	1,2-DCA	1,2-DCE (cis/trans)	1,4-Diox	BDCM	CCL	CF	CM	c-1,2-DCE	Freon 113	DCM	1,4-DCB	PCE	TCE	TCFM	VC	HI
Unit Hazard		9.8 E-1	9.8 E+0	1.4 E+2	2.0 E+1	2.3 E-1	9.8 E+0	1.7 E+1	1.5 E+1	7.6 E+0	2.0 E+1	2.3 E-2	2.3 E-1	8.5 E-1	2.0 E+1	1.1 E+0	3.4 E+0	6.7 E+0																		
Unit Risk		4.0 E-4	NA	6.4 E-3	NA	1.9 E-3	9.1 E-3	1.0 E-2	5.6 E-3	4.4 E-4	NA	NA	2.4 E-4	1.5 E-3	1.5 E-3	4.9 E-4	NA	1.9 E-2																		
Attenuation Factor		2.2 E-3	1.3 E-2	7.4 E-2	3.2 E-3	9.6 E-3	2.9 E-5	1.6 E-3	7.5 E-2	1.2 E-2	3.5 E-2	9.6 E-3	1.2 E+0	6.9 E-3	5.2 E-3	4.2 E-2	2.6 E-2	2.7 E-1																		
78	A	0.74	1.8	0.75	1.9						1.2	36				2	12		9.6 E-6	1.3 E-3	3.3 E-4	3.6 E-4	NA	NA	NA	NA	NA	2.2 E-4	9.8 E-4	NA	NA	NA	5.9 E-5	1.1 E-2	NA	1.4 E-2
99	A			0.59	4.5							2.2				31			NA	NA	2.6 E-4	8.4 E-4	NA	NA	NA	NA	NA	NA	6.0 E-5	NA	NA	NA	9.1 E-4	NA	NA	2.1 E-3
444	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
445	A															0.69			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-5	NA	NA	2.0 E-5
453	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
457	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
458	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
459	A															0.68			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.0 E-5	NA	NA	2.0 E-5
460	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
462	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
463	A															2			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.9 E-5	NA	NA	5.9 E-5
481	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
482	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3095	A	3.1	0.95	1.5	54	5.3	0.83	0.99			22		0.51	0.9	0.52	130		31	4.0 E-5	6.9 E-4	6.6 E-4	1.0 E-2	3.5 E-8	1.3 E-5	1.3 E-3	NA	NA	4.1 E-3	NA	8.1 E-7	4.0 E-6	4.3 E-4	3.8 E-3	NA	1.9 E-2	4.0 E-2
3188	A	3	2.1	1.5	130	4.4			2.6		140		0.97		0.7	510		1.1	3.9 E-5	1.5 E-3	6.6 E-4	2.4 E-2	2.9 E-8	NA	NA	4.7 E-4	NA	2.6 E-2	NA	1.5 E-6	NA	5.7 E-4	1.5 E-2	NA	6.7 E-4	6.9 E-2
3219	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3220	A		0.55	0.8					0.61							0.76			NA	4.0 E-4	3.5 E-4	NA	NA	NA	NA	1.1 E-4	NA	NA	NA	NA	NA	NA	2.2 E-5	NA	NA	8.9 E-4
3366	A	0.52				3.5			0.84		13					31			6.8 E-6	NA	NA	NA	2.3 E-8	NA	NA	1.5 E-4	NA	2.4 E-3	NA	NA	NA	NA	9.1 E-4	NA	NA	3.5 E-3
3367	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3368	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3383	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3384	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3395	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3498	A								0.79										NA	NA	NA	NA	NA	NA	NA	1.4 E-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.4 E-4
3499	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3503	A				13	1.4										2.8		2.8	NA	NA	NA	2.4 E-3	9.2 E-9	NA	NA	NA	NA	NA	NA	NA	NA	8.2 E-5	NA	1.7 E-3	4.2 E-3
3504	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3626	A																		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 2-17c
Location-Specific Indoor Air Risk Assessment Results - Commercial Worker
Zone 4 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Incremental Lifetime Cancer Risk																	
Sample Name	**Layer**	**1,1-DCA**	**1,1-DCE**	**1,2-DCA**	**1,2-DCE (cis/trans)**	**1,4-Diox**	**BDCM**	**CCL**	**CF**	**CM**	**c-1,2-DCE**	**Freon 113**	**DCM**	**1,4-DCB**	**PCE**	**TCE**	**TCFM**	**VC**	**ILCR**
Unit Hazard																			
Unit Risk																			
Attenuation Factor																			
78	A	3.9 E-9	NA	1.5 E-8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-8	NA	NA	4 E-8
99	A	NA	NA	1.2 E-8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.9 E-7	NA	NA	4 E-7
444	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
445	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.7 E-9	NA	NA	9 E-9
453	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
457	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
458	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
459	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.5 E-9	NA	NA	9 E-9
460	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
462	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
463	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 E-8	NA	NA	3 E-8
481	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
482	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3095	A	1.6 E-8	NA	3.0 E-8	NA	2.9 E-10	1.2 E-8	7.8 E-7	NA	NA	NA	NA	8.7 E-10	7.2 E-9	3.2 E-8	1.6 E-6	NA	5.3 E-5	6 E-5
3188	A	1.6 E-8	NA	3.0 E-8	NA	2.4 E-10	NA	NA	1.7 E-7	NA	NA	NA	1.6 E-9	NA	4.3 E-8	6.4 E-6	NA	1.9 E-6	9 E-6
3219	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3220	A	NA	NA	1.6 E-8	NA	NA	NA	NA	4.1 E-8	NA	NA	NA	NA	NA	NA	9.6 E-9	NA	NA	7 E-8
3366	A	2.8 E-9	NA	NA	NA	1.9 E-10	NA	NA	5.6 E-8	NA	NA	NA	NA	NA	NA	3.9 E-7	NA	NA	4 E-7
3367	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3368	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3383	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3384	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3395	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3498	A	NA	NA	NA	NA	NA	NA	NA	5.3 E-8	NA	NA	NA	NA	NA	NA	NA	NA	NA	5 E-8
3499	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3503	A	NA	NA	NA	NA	7.6 E-11	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.5 E-8	NA	4.8 E-6	5 E-6
3504	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3626	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes and Key:

All concentrations reported in micrograms per liter.

HI = AF x Concentration x 1 ug/L/1000 ug/m^3 x Unit Hazard; ILCR = AF x Concentration x 1 ug/L/1000 ug/m^3 / Unit Risk

HI = Hazard index
ILCR = Incremental lifetime cancer risk
NA = Not applicable.

Chemical Abbreviations

1,1-DCA	1,1-Dichloroethane	CF	Chloroform
1,2-DCA	1,2-Dichloroethane	c-1,2-DCE	cis-1,2-Dichloroethene
1,2-DCE (cis/trans)	1,2-Dichloroethene (cis/trans)	Freon 113	Freon 113
1,4-Diox	1,4-Dioxane	DCM	Methylene chloride
BMDM	Bromodichloromethane	1,4-DCB	1,4-Dichlorobenzene
CCL	Carbon tetrachloride	PCE	Tetrachloroethene
CM	Chloromethane	TCE	Trichloroethene
1,1-DCE	1,1-Dichloroethene	TCFM	Trichlorofluoromethane
		VC	Vinyl chloride

Table 2-18
Location-Specific Surface Water Risk Assessment Results - Recreational
Perimeter Groundwater Operable Unit Lands Risk Assessment
Aerojet Superfund Site
Sacramento County, California

														Child Non-Cancer Hazard Index													
Sample Name	**Al**	**Ammonia as N**	**As**	**Cd**	**CF**	**Fe**	**Pb**	**Mo**	**Nap**	**Nitrate as N**	**Perc**	**Se**	**V**	**Al**	**Ammonia as N**	**As**	**Cd**	**CF**	**Fe**	**Pb**	**Mo**	**Nap**	**Nitrate as N**	**Perc**	**Se**	**V**	**HI**
Unit Hazard Child	1.4 E-8	NA	4.8 E-5	1.4 E-5	1.9 E-5	2.1 E-8	NA	2.9 E-6	7.0 E-5	9.0 E-9	2.1 E-5	2.9 E-6	1.4 E-5														
Unit Hazard Adult	4.9 E-9	NA	1.6 E-5	4.9 E-6	8.6 E-6	7.0 E-9	NA	9.8 E-7	3.1 E-5	3.1 E-9	7.0 E-6	9.8 E-7	4.9 E-6														
Unit Risk	NA	NA	2.8 E-8	NA	1.4 E-9	NA	NA	NA	NA	NA	NA	NA	NA														
S-2	1300	1100			16	1800	3.3	46		3100	5.3		5.8	1.9 E-5	NA	NA	NA	3.1 E-4	3.7 E-5	NA	1.3 E-4	NA	2.8 E-5	1.1 E-4	NA	8.4 E-5	7.2 E-4
S-5			3.8			180				1100			2.3	NA	NA	1.8 E-4	NA	NA	3.7 E-6	NA	NA	NA	9.9 E-6	NA	NA	3.3 E-5	2.3 E-4
S-6			2.5			380				740	6.9		2.2	NA	NA	1.2 E-4	NA	NA	7.9 E-6	NA	NA	NA	6.7 E-6	1.4 E-4	NA	3.2 E-5	3.1 E-4
Alder Creek #1														NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Alder Creek #2				2.9					0.17			19		NA	NA	NA	4.2 E-5	NA	NA	NA	NA	1.2 E-5	NA	NA	5.5 E-5	NA	1.1 E-4
Alder Creek #3				3									2.7	NA	NA	NA	4.3 E-5	NA	NA	NA	NA	NA	NA	NA	NA	3.9 E-5	8.2 E-5

Table 2-18
Location-Specific Surface Water Risk Assessment Results - Recreational
Perimeter Groundwater Operable Unit Lands Risk Assessment
Aerojet Superfund Site
Sacramento County, California

	Adult Non-Cancer Hazard Index														Incremental Lifetime Cancer Risk														Blood Lead	
Sample Name	**Al**	**Ammonia as N**	**As**	**Cd**	**CF**	**Fe**	**Pb**	**Mo**	**Nap**	**Nitrate as N**	**Perc**	**Se**	**V**	**HI**	**Al**	**Ammonia as N**	**As**	**Cd**	**CF**	**Fe**	**Pb**	**Mo**	**Nap**	**Nitrate as N**	**Perc**	**Se**	**V**	**ILCR**	**Child**	**Adult**
Unit Hazard Child																														
Unit Hazard Adult																														
Unit Risk																														
S-2	6.4 E-6	NA	NA	NA	1.4 E-4	1.3 E-5	NA	4.5 E-5	NA	9.5 E-6	3.7 E-5	NA	2.8 E-5	2.8 E-4	NA	NA	NA	NA	2.3 E-8	NA	NA	NA	NA	NA	NA	NA	NA	2 E-8	1.8	0.8
S-5	NA	NA	6.2 E-5	NA	NA	1.3 E-6	NA	NA	NA	3.4 E-6	NA	NA	1.1 E-5	7.8 E-5	NA	NA	1.0 E-7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1 E-7	NA	NA
S-6	NA	NA	4.1 E-5	NA	NA	2.7 E-6	NA	NA	NA	2.3 E-6	4.8 E-5	NA	1.1 E-5	1.0 E-4	NA	NA	6.9 E-8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7 E-8	NA	NA
Alder Creek #1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Alder Creek #2	NA	NA	NA	1.4 E-5	NA	NA	NA	NA	5.3 E-6	NA	NA	1.9 E-5	NA	3.8 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Alder Creek #3	NA	NA	NA	1.5 E-5	NA	NA	NA	NA	NA	NA	NA	NA	1.3 E-5	2.8 E-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes and Key:
All concentrations reported in micrograms per liter.
HI = Hazard index
ILCR = Incremental lifetime cancer risk
NA = Not applicable.
HI = Unit Hazard x Concentration; ILCR = Unit Risk x Concentration

Chemical Abbreviations

Al	Aluminum	Mo
As	Arsenic	Nap
Cd	Cadmium	Perc
CF	Chloroform	Se
Fe	Iron	V
Pb	Lead	

Table 2-19a Receptors Hazard Index and Cancer Risk Results
Zone 1 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Non-Cancer Hazard Index					Incremental Lifetime Cancer Risk		
		Ingestion and Domestic Use		Vapor Intrusion			Ingestion and Domestic Use	Vapor Intrusion	
		Resident		Resident		Commercial			Commercial
Sample Name	Layer	Child	Adult	Child	Adult	Worker	Resident	Resident	Worker
1027	C	**1.3 E+1**	**5.7 E+0**	NA	NA	NA	**4E-05**	NA	NA
1049	F	**1.2 E+0**	5.1 E-1	NA	NA	NA	**3E-04**	NA	NA
1154	C	NA	NA	NA	NA	NA	NA	NA	NA
1156	C/D/E	**6.8 E+1**	**2.9 E+1**	NA	NA	NA	**2E-04**	NA	NA
1162	C	**4.5 E+1**	**2.0 E+1**	NA	NA	NA	**1E-04**	NA	NA
1163	D	**2.1 E+1**	**8.8 E+0**	NA	NA	NA	1E-06	NA	NA
1164	E	**1.4 E+1**	**6.1 E+0**	NA	NA	NA	**2E-04**	NA	NA
1211	C/D	**1.0 E+1**	**4.3 E+0**	NA	NA	NA	**9E-05**	NA	NA
1214	C	**9.0 E+1**	**3.9 E+1**	NA	NA	NA	**3E-04**	NA	NA
1216	C	**9.2 E+1**	**4.0 E+1**	NA	NA	NA	**3E-04**	NA	NA
1361	C	**4.5 E+1**	**1.9 E+1**	1.6 E-1	6.8 E-2	2.4 E-2	**7E-04**	**1 E-5**	**3 E-6**
1362	D	**4.6 E+1**	**2.0 E+1**	NA	NA	NA	**7E-04**	NA	NA
1363	D	**2.5 E+1**	**1.1 E+1**	NA	NA	NA	**4E-05**	NA	NA
1364	D	3.8 E-1	1.6 E-1	NA	NA	NA	1E-06	NA	NA
1365	E	2.8 E-1	1.2 E-1	NA	NA	NA	8E-07	NA	NA
1370	C	**1.7 E+2**	**7.3 E+1**	3.7 E-1	1.6 E-1	5.7 E-2	**7E-04**	**4 E-5**	**9 E-6**
1371	D	**9.2 E+1**	**4.0 E+1**	NA	NA	NA	**3E-04**	NA	NA
1372	D	**2.3 E+2**	**9.8 E+1**	NA	NA	NA	**9E-04**	NA	NA
1373	D/E	**2.6 E+0**	**1.1 E+0**	NA	NA	NA	**7E-06**	NA	NA
1374	E	1.3 E-1	5.4 E-2	NA	NA	NA	4E-07	NA	NA
1375	C	**3.2 E+1**	**1.4 E+1**	1.6 E-1	6.8 E-2	2.4 E-2	**2E-04**	**9 E-6**	**2 E-6**
1376	D	**1.2 E+2**	**5.3 E+1**	NA	NA	NA	**1E-03**	NA	NA
1377	E	**1.3 E+2**	**5.7 E+1**	NA	NA	NA	**9E-04**	NA	NA
1378	E	NA	NA	NA	NA	NA	NA	NA	NA
1379	D/E	**1.7 E+2**	**7.4 E+1**	NA	NA	NA	**1E-03**	NA	NA
1380	D	**1.9 E+1**	**8.1 E+0**	NA	NA	NA	**2E-04**	NA	NA
1381	E	**1.9 E+2**	**8.3 E+1**	NA	NA	NA	**1E-03**	NA	NA
1382	D	**4.7 E+1**	**2.0 E+1**	NA	NA	NA	**2E-04**	NA	NA
1383	D	**7.1 E+1**	**3.0 E+1**	NA	NA	NA	**4E-04**	NA	NA
1384	D/E	**1.2 E+2**	**5.3 E+1**	NA	NA	NA	**6E-04**	NA	NA
1385	D	**3.5 E+1**	**1.5 E+1**	NA	NA	NA	**2E-04**	NA	NA
1386	D	**1.1 E+1**	**4.8 E+0**	NA	NA	NA	**5E-05**	NA	NA
1387	E	NA	NA	NA	NA	NA	NA	NA	NA
1388	D	**6.6 E+1**	**2.8 E+1**	NA	NA	NA	**3E-04**	NA	NA
1389	E	**9.2 E+1**	**4.0 E+1**	NA	NA	NA	**5E-04**	NA	NA
1390	E	3.2 E-2	1.4 E-2	NA	NA	NA	NA	NA	NA
1391	C	**5.0 E+1**	**2.1 E+1**	1.1 E-1	4.6 E-2	1.6 E-2	**2E-04**	**1 E-5**	**2 E-6**
1392	D	**8.4 E+1**	**3.6 E+1**	NA	NA	NA	**3E-04**	NA	NA
1393	D/E	**2.9 E+2**	**1.2 E+2**	NA	NA	NA	**1E-03**	NA	NA
1394	F	6.8 E-1	2.9 E-1	NA	NA	NA	**2E-06**	NA	NA
1395	C	9.3 E-1	4.0 E-1	7.1 E-4	3.0 E-4	1.1 E-4	**3E-06**	2 E-7	5 E-8
1396	C	5.0 E-1	2.2 E-1	3.8 E-4	1.6 E-4	5.9 E-5	**1E-06**	1 E-7	3 E-8
1397	D	**2.0 E+1**	**8.8 E+0**	NA	NA	NA	**6E-05**	NA	NA
1398	E	NA	NA	NA	NA	NA	NA	NA	NA
1399	E	NA	NA	NA	NA	NA	NA	NA	NA
1400	D	**3.1 E+1**	**1.3 E+1**	NA	NA	NA	**6E-05**	NA	NA
1401	D	**7.4 E+1**	**3.2 E+1**	NA	NA	NA	**3E-04**	NA	NA
1402	F	**6.3 E+0**	**2.7 E+0**	NA	NA	NA	**2E-05**	NA	NA
1403	C	**1.7 E+2**	**7.3 E+1**	6.2 E-1	2.6 E-1	9.4 E-2	**9E-04**	**4 E-5**	**1 E-5**
1404	D	**1.0 E+2**	**4.4 E+1**	NA	NA	NA	**5E-04**	NA	NA
1405	D	**5.7 E+2**	**2.4 E+2**	NA	NA	NA	**2E-03**	NA	NA
1406	C	2.9 E-1	1.2 E-1	1.6 E-3	6.9 E-4	2.5 E-4	**5E-06**	8 E-8	2 E-8
1407	C	**2.4 E+0**	**1.0 E+0**	1.8 E-3	7.7 E-4	2.8 E-4	**7E-06**	5 E-7	1 E-7
1408	E	2.8 E-1	1.2 E-1	NA	NA	NA	8E-07	NA	NA
1409	F	NA	NA	NA	NA	NA	NA	NA	NA
1419	C	**1.1 E+1**	**4.6 E+0**	NA	NA	NA	**1E-04**	NA	NA
1420	D	**1.1 E+1**	**4.7 E+0**	NA	NA	NA	**1E-04**	NA	NA
1421	D	**1.8 E+1**	**7.8 E+0**	NA	NA	NA	**1E-04**	NA	NA
1422	E	1.6 E-1	7.0 E-2	NA	NA	NA	**3E-05**	NA	NA
1423	E	1.0 E-3	4.4 E-4	NA	NA	NA	3E-07	NA	NA
1469	C	**2.2 E+2**	**9.5 E+1**	4.6 E-1	2.0 E-1	7.0 E-2	**8E-04**	**5 E-5**	**1 E-5**
1470	D	**2.8 E+2**	**1.2 E+2**	NA	NA	NA	**1E-03**	NA	NA
1471	E	**3.1 E+1**	**1.3 E+1**	NA	NA	NA	**1E-04**	NA	NA
1472	C	**3.7 E+1**	**1.6 E+1**	1.2 E-1	5.2 E-2	1.9 E-2	**2E-04**	9 E-6	**2 E-6**
1473	E	NA	NA	NA	NA	NA	NA	NA	NA
1474	F	5.3 E-2	2.3 E-2	NA	NA	NA	NA	NA	NA
1475	C	**2.0 E+1**	**8.5 E+0**	2.4 E-2	1.0 E-2	3.6 E-3	**6E-05**	3 E-6	7 E-7

Table 2-19a Receptors Hazard Index and Cancer Risk Results
Zone 1 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Non-Cancer Hazard Index					Incremental Lifetime Cancer Risk		
		Ingestion and Domestic Use		Vapor Intrusion			Ingestion and Domestic Use	Vapor Intrusion	
		Resident		Resident		Commercial			Commercial
Sample Name	Layer	Child	Adult	Child	Adult	Worker	Resident	Resident	Worker
1476	D	**1.9 E+1**	**8.0 E+0**	NA	NA	NA	8E-07	NA	NA
1477	E	**1.2 E+2**	**5.0 E+1**	NA	NA	NA	**6E-04**	NA	NA
1478	C	**5.9 E+0**	**2.6 E+0**	NA	NA	NA	**3E-05**	NA	NA
1479	D	**4.1 E+2**	**1.8 E+2**	NA	NA	NA	**1E-03**	NA	NA
1480	E	**1.7 E+2**	**7.3 E+1**	NA	NA	NA	**6E-04**	NA	NA
1481	C	3.0 E-1	1.3 E-1	2.3 E-4	9.9 E-5	3.5 E-5	9E-07	6 E-8	2 E-8
1482	D	2.5 E-1	1.1 E-1	NA	NA	NA	7E-07	NA	NA
1483	E	**6.3 E+0**	**2.7 E+0**	NA	NA	NA	**2E-05**	NA	NA
1487	C	3.5 E-1	1.5 E-1	2.7 E-4	1.1 E-4	4.1 E-5	1E-06	7 E-8	2 E-8
1488	C	**1.4 E+1**	**6.1 E+0**	NA	NA	NA	**4E-05**	NA	NA
1489	E	**2.8 E+2**	**1.2 E+2**	NA	NA	NA	**1E-03**	NA	NA
1506	C	NA	NA	NA	NA	NA	NA	NA	NA
1507	D	NA	NA	NA	NA	NA	NA	NA	NA
1508	E	NA	NA	NA	NA	NA	NA	NA	NA
1509	C	**7.4 E+1**	**3.2 E+1**	1.0 E-1	4.5 E-2	1.6 E-2	**3E-04**	2 E-5	**4 E-6**
1510	D	**1.1 E+0**	4.6 E-1	NA	NA	NA	**3E-06**	NA	NA
1511	E	NA	NA	NA	NA	NA	NA	NA	NA
1516	B	NA	NA	NA	NA	NA	NA	NA	NA
1517	B	NA	NA	NA	NA	NA	NA	NA	NA
1518	B/C	9.3 E-1	4.0 E-1	7.1 E-4	3.0 E-4	1.1 E-4	**3E-06**	2 E-7	5 E-8
1519	C	**4.8 E+1**	**2.1 E+1**	5.8 E-2	2.5 E-2	8.8 E-3	**2E-04**	1 E-5	**3 E-6**
1520	D	**8.1 E+1**	**3.5 E+1**	NA	NA	NA	**3E-04**	NA	NA
1521	E	NA	NA	NA	NA	NA	NA	NA	NA
1522	C	**1.6 E+0**	6.7 E-1	3.2 E-3	1.4 E-3	5.0 E-4	**5E-06**	3 E-7	8 E-8
1523	C	**7.9 E+0**	**3.4 E+0**	1.4 E-2	6.1 E-3	2.2 E-3	**2E-05**	2 E-6	4 E-7
1524	E	**1.8 E+1**	**7.9 E+0**	NA	NA	NA	**6E-05**	NA	NA
1525	C	NA	NA	NA	NA	NA	NA	NA	NA
1526	C	NA	NA	NA	NA	NA	NA	NA	NA
1527	E	**6.3 E+0**	**2.7 E+0**	NA	NA	NA	**3E-05**	NA	NA
1528	C	NA	NA	NA	NA	NA	NA	NA	NA
1529	E	NA	NA	NA	NA	NA	NA	NA	NA
1530	E	NA	NA	NA	NA	NA	NA	NA	NA
1531	C	**1.2 E+1**	**5.1 E+0**	1.3 E-2	5.4 E-3	1.9 E-3	**4E-05**	3 E-6	6 E-7
1532	C	**9.3 E+0**	**4.0 E+0**	7.1 E-3	3.0 E-3	1.1 E-3	**3E-05**	2 E-6	5 E-7
1533	D	NA	NA	NA	NA	NA	NA	NA	NA
1539	C	**7.4 E+0**	**3.2 E+0**	1.0 E-2	4.4 E-3	1.6 E-3	**5E-05**	3 E-6	6 E-7
1540	D	**3.8 E+1**	**1.6 E+1**	NA	NA	NA	**1E-04**	NA	NA
1557	C/D	4.0 E-1	1.7 E-1	NA	NA	NA	1E-06	NA	NA
1558	D	NA	NA	NA	NA	NA	NA	NA	NA
1559	C	7.8 E-1	3.3 E-1	1.0 E-2	4.3 E-3	1.6 E-3	**3E-05**	6 E-7	1 E-7
1560	C	3.5 E-2	1.5 E-2	4.5 E-3	1.9 E-3	6.9 E-4	**1E-05**	2 E-7	5 E-8
1561	D	NA	NA	NA	NA	NA	NA	NA	NA
1562	C	NA	NA	NA	NA	NA	NA	NA	NA
1563	C	NA	NA	NA	NA	NA	NA	NA	NA
1564	C	1.4 E-1	5.8 E-2	1.0 E-4	4.4 E-5	1.6 E-5	4E-07	3 E-8	7 E-9
1565	C	NA	NA	NA	NA	NA	NA	NA	NA
1566	D	8.0 E-1	3.5 E-1	NA	NA	NA	**2E-06**	NA	NA
1567	B	4.0 E-1	1.7 E-1	3.1 E-4	1.3 E-4	4.7 E-5	1E-06	9 E-8	2 E-8
1568	C	NA	NA	NA	NA	NA	NA	NA	NA
1569	D	**3.0 E+0**	**1.3 E+0**	NA	NA	NA	**5E-05**	NA	NA
1570	C	2.5 E-1	1.1 E-1	1.9 E-4	8.2 E-5	2.9 E-5	7E-07	5 E-8	1 E-8
1571	C	NA	NA	NA	NA	NA	NA	NA	NA
1572	C	NA	NA	NA	NA	NA	NA	NA	NA
1573	D	NA	NA	NA	NA	NA	NA	NA	NA
1574	C	NA	NA	NA	NA	NA	NA	NA	NA
1585	C	**5.9 E+0**	**2.5 E+0**	9.1 E-3	3.9 E-3	1.4 E-3	**2E-05**	1 E-6	3 E-7
1586	C	**1.5 E+0**	6.6 E-1	9.6 E-3	4.1 E-3	1.5 E-3	**4E-05**	1 E-6	3 E-7
1587	D	**3.6 E+0**	**1.5 E+0**	NA	NA	NA	**1E-05**	NA	NA
1588	E	5.8 E-1	2.5 E-1	NA	NA	NA	**2E-06**	NA	NA
1589	E	4.5 E-1	1.9 E-1	NA	NA	NA	1E-06	NA	NA
1590	F	NA	NA	NA	NA	NA	NA	NA	NA
1591	C	NA	NA	NA	NA	NA	NA	NA	NA
1592	C	2.1 E-1	8.9 E-2	1.6 E-4	6.7 E-5	2.4 E-5	6E-07	4 E-8	1 E-8
1593	D	NA	NA	NA	NA	NA	NA	NA	NA
1594	C	5.8 E-1	2.5 E-1	4.4 E-4	1.9 E-4	6.7 E-5	**2E-06**	1 E-7	3 E-8
1595	D/E	NA	NA	NA	NA	NA	NA	NA	NA
1596	E	NA	NA	NA	NA	NA	NA	NA	NA
4300	C	6.0 E-1	2.6 E-1	NA	NA	NA	**2E-06**	NA	NA
4301	C	**1.4 E+1**	**6.2 E+0**	NA	NA	NA	**5E-05**	NA	NA

Table 2-19a *Receptors Hazard Index and Cancer Risk Results*
Zone 1 PGOU
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Non-Cancer Hazard Index					Incremental Lifetime Cancer Risk		
		Ingestion and Domestic Use		Vapor Intrusion			Ingestion and Domestic Use	Vapor Intrusion	
		Resident		Resident		Commercial			Commercial
Sample Name	Layer	Child	Adult	Child	Adult	Worker	Resident	Resident	Worker
4302	D	**1.3 E+1**	**5.8 E+0**	NA	NA	NA	**5E-05**	NA	NA
4325	C	**5.6 E+1**	**2.4 E+1**	NA	NA	NA	**2E-04**	NA	NA
4330	C/D	**2.2 E+2**	**9.5 E+1**	NA	NA	NA	**1E-03**	NA	NA
4335	D/E	**3.5 E+2**	**1.5 E+2**	NA	NA	NA	**2E-03**	NA	NA
4340	C	4.0 E-2	1.7 E-2	NA	NA	NA	NA	NA	NA
4345	C	4.4 E-1	1.9 E-1	NA	NA	NA	1E-06	NA	NA
4350	D	5.7 E-1	2.5 E-1	NA	NA	NA	**2E-06**	NA	NA
4355	C	8.7 E-1	3.7 E-1	NA	NA	NA	**2E-06**	NA	NA
4360	C	**6.1 E+0**	**2.6 E+0**	NA	NA	NA	**2E-05**	NA	NA
4365	D	**8.6 E+0**	**3.7 E+0**	NA	NA	NA	**3E-05**	NA	NA
4370	C	6.5 E-1	2.8 E-1	NA	NA	NA	**2E-06**	NA	NA
4375	C	**2.1 E+0**	8.9 E-1	NA	NA	NA	**6E-06**	NA	NA
4380	D	**1.1 E+1**	**4.6 E+0**	NA	NA	NA	**3E-05**	NA	NA
4580	D/E	**2.8 E+1**	**1.2 E+1**	NA	NA	NA	**1E-04**	NA	NA
4585	E	**2.1 E+1**	**9.0 E+0**	NA	NA	NA	**9E-05**	NA	NA
4620	E	**4.9 E+0**	**2.1 E+0**	NA	NA	NA	**1E-05**	NA	NA
30068	C	**1.4 E+2**	**6.0 E+1**	3.7 E-1	1.6 E-1	5.6 E-2	**6E-04**	3 E-5	**7 E-6**
30069	E	**5.2 E+1**	**2.2 E+1**	NA	NA	NA	**2E-04**	NA	NA
30070	E	**1.7 E+1**	**7.5 E+0**	NA	NA	NA	**6E-05**	NA	NA
30071	C/D	**8.2 E+0**	**3.5 E+0**	NA	NA	NA	**6E-05**	NA	NA
30072	D	**1.1 E+1**	**4.9 E+0**	NA	NA	NA	**7E-05**	NA	NA
30073	D/E	**2.2 E+1**	**9.3 E+0**	NA	NA	NA	**1E-04**	NA	NA
30100	C	4.5 E-1	1.9 E-1	3.4 E-4	1.5 E-4	5.3 E-5	1E-06	1 E-7	2 E-8
30101	C	**9.5 E+2**	**4.1 E+2**	NA	NA	NA	**4E-03**	NA	NA
30102	D	**2.5 E+2**	**1.1 E+2**	NA	NA	NA	**2E-03**	NA	NA
30103	E	**8.1 E+0**	**3.5 E+0**	NA	NA	NA	**2E-05**	NA	NA
30140	E	1.2 E-1	5.3 E-2	NA	NA	NA	NA	NA	NA
30141	E	5.5 E-1	2.4 E-1	NA	NA	NA	1E-06	NA	NA
30156	E	**1.6 E+2**	**6.7 E+1**	NA	NA	NA	**6E-04**	NA	NA
30157	E	**2.0 E+1**	**8.7 E+0**	NA	NA	NA	**7E-05**	NA	NA
30158	D	**3.8 E+1**	**1.7 E+1**	NA	NA	NA	**1E-04**	NA	NA
30174	D	**1.0 E+2**	**4.4 E+1**	NA	NA	NA	**4E-04**	NA	NA
30175	E	**1.3 E+1**	**5.5 E+0**	NA	NA	NA	**3E-05**	NA	NA
30176	F	**3.4 E+0**	**1.4 E+0**	NA	NA	NA	**3E-05**	NA	NA
30177	E	**8.0 E+0**	**3.4 E+0**	NA	NA	NA	**2E-05**	NA	NA
30178	E	**8.0 E+0**	**3.4 E+0**	NA	NA	NA	**2E-05**	NA	NA
30179	F	**9.8 E+0**	**4.2 E+0**	NA	NA	NA	**2E-05**	NA	NA
30180	D	**8.6 E+0**	**3.7 E+0**	NA	NA	NA	**3E-05**	NA	NA
30181	D	**1.0 E+1**	**4.5 E+0**	NA	NA	NA	**3E-05**	NA	NA
30182	E	**8.0 E+0**	**3.4 E+0**	NA	NA	NA	**2E-05**	NA	NA
30195	C	**1.4 E+1**	**6.0 E+0**	1.0 E-3	4.3 E-4	1.5 E-4	**2E-05**	2 E-7	6 E-8
30196	C	**3.0 E+0**	**1.3 E+0**	2.1 E-3	9.0 E-4	3.2 E-4	**8E-06**	6 E-7	1 E-7
30197	D	**4.5 E+0**	**1.9 E+0**	NA	NA	NA	**1E-05**	NA	NA

Notes and Key:
HI = Hazard index
ILCR = Incremental lifetime cancer risk
NA = Not applicable

Table 2-19b Receptors Hazard Index and Cancer Risk Results - Zone 2
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Non-Cancer Hazard Index					Incremental Lifetime Cancer Risk		
		Ingestion and Domestic Use		Vapor Intrusion			Ingestion and Domestic Use	Vapor Intrusion	
		Resident		Resident		Commercial			Commercial
Sample Name	Layer	Child	Adult	Child	Adult	Worker	Resident	Resident	Worker
109	A	**2.3 E+0**	9.6 E-1	NA	NA	NA	NA	NA	NA
111	A	7.6 E-1	3.3 E-1	NA	NA	NA	NA	NA	NA
177	A	6.5 E-1	2.8 E-1	2.6 E-3	1.1 E-3	3.9 E-4	**8 E-6**	1 E-7	3 E-8
178	C	**2.6 E+1**	**1.1 E+1**	NA	NA	NA	**5 E-6**	NA	NA
179	D	NA	NA	NA	NA	NA	NA	NA	NA
314	B	**5.9 E+1**	**2.5 E+1**	NA	NA	NA	**5 E-5**	NA	NA
315	B	**3.1 E+1**	**1.3 E+1**	NA	NA	NA	**3 E-5**	NA	NA
317	D	NA	NA	NA	NA	NA	NA	NA	NA
3076	A	5.6 E-2	2.4 E-2	NA	NA	NA	NA	NA	NA
3077	B	NA	NA	NA	NA	NA	NA	NA	NA
3078	C	2.0 E-2	8.5 E-3	NA	NA	NA	**4 E-6**	NA	NA
3119	A	NA	NA	NA	NA	NA	NA	NA	NA
3120	C	NA	NA	NA	NA	NA	NA	NA	NA
3326	B	1.9 E-2	8.3 E-3	NA	NA	NA	**4 E-6**	NA	NA
3327	C	NA	NA	NA	NA	NA	NA	NA	NA
3328	E	NA	NA	NA	NA	NA	NA	NA	NA
3329	B	**1.8 E+2**	**7.8 E+1**	NA	NA	NA	**3 E-4**	NA	NA
3360	D	**6.7 E+1**	**2.8 E+1**	NA	NA	NA	**1 E-5**	NA	NA
3460	A	NA	NA	NA	NA	NA	NA	NA	NA
3470	A	NA	NA	NA	NA	NA	NA	NA	NA
3500	A	**1.6 E+2**	**6.8 E+1**	1.2 E-1	5.2 E-2	1.9 E-2	**3 E-4**	**2 E-5**	5 E-6
3501	B	**1.9 E+2**	**8.2 E+1**	NA	NA	NA	**2 E-4**	NA	NA
3502	C	2.2 E-1	9.3 E-2	NA	NA	NA	6 E-7	NA	NA
3509	A	NA	NA	NA	NA	NA	NA	NA	NA
3510	A	1.4 E-1	6.2 E-2	8.9 E-5	3.8 E-5	1.4 E-5	4 E-7	2 E-8	6 E-9
3511	A	NA	NA	NA	NA	NA	NA	NA	NA
3512	A	**3.5 E+0**	**1.5 E+0**	9.2 E-3	3.9 E-3	1.4 E-3	**3 E-5**	3 E-7	6 E-8
3513	A	**3.6 E+0**	**1.5 E+0**	9.5 E-4	4.1 E-4	1.5 E-4	**5 E-6**	3 E-7	6 E-8
3579	B	**4.5 E+0**	**2.0 E+0**	NA	NA	NA	**1 E-5**	NA	NA
3580	C	**2.1 E+1**	**9.1 E+0**	NA	NA	NA	**5 E-6**	NA	NA
3581	C	NA	NA	NA	NA	NA	NA	NA	NA

Notes and Key:
HI = Hazard index
ILCR = Incremental lifetime cancer risk
NA = Not applicable

Table 2-19c *Receptors Hazard Index and Cancer Risk Results - Zone 3*
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Non-Cancer Hazard Index		Incremental Lifetime Cancer Risk
		Ingestion and Domestic Use		Ingestion and Domestic Use
		Resident		
Sample Name	Layer	Child	Adult	Resident
1059	C	4.5 E-1	1.9 E-1	**2E-05**
1218	C	**5.7 E+2**	**2.4 E+2**	**5E-02**
1219	E	1.0 E-1	4.3 E-2	**9E-06**
1220	F	NA	NA	NA
1226	C	**8.0 E+1**	**3.4 E+1**	**4E-03**
1227	E	1.1 E-1	4.9 E-2	**1E-05**
1228	F	NA	NA	NA
1246	B	NA	NA	NA
1247	C	**3.3 E+1**	**1.4 E+1**	**1E-03**
1248	D	**3.4 E+1**	**1.5 E+1**	**2E-03**
1262	C	NA	NA	NA
1263	E	NA	NA	NA
1264	F	NA	NA	NA
1265	F	1.7 E-2	7.3 E-3	**2E-06**
1318	A	NA	NA	NA
1339	C	NA	NA	NA
1340	C	NA	NA	NA
1416	C	**5.7 E+2**	**2.4 E+2**	**5E-02**
1417	E	NA	NA	NA
1418	F	**1.2 E+0**	5.2 E-1	**1E-04**
1425	C	**7.4 E+1**	**3.2 E+1**	**7E-03**
1426	D	**1.4 E+2**	**5.8 E+1**	**1E-02**
1428	E	**4.5 E+0**	**1.9 E+0**	**NA**
1442	C	**1.5 E+3**	**6.6 E+2**	**1E-01**
1443	D	**2.3 E+2**	**9.8 E+1**	**2E-02**
1444	E	NA	NA	NA
1445	F	NA	NA	NA
1447	C	**1.3 E+3**	**5.7 E+2**	**1E-01**
1448	D	**7.8 E+2**	**3.3 E+2**	**7E-02**
1449	E	1.6 E-1	6.9 E-2	**2E-05**
1450	F	NA	NA	NA
1451	B	**4.1 E+1**	**1.8 E+1**	**3E-03**
1452	C	**6.7 E+1**	**2.9 E+1**	**4E-03**
1453	C	**8.0 E+1**	**3.4 E+1**	**7E-03**
1454	D	**6.6 E+1**	**2.8 E+1**	**6E-03**
1456	E	NA	NA	NA
1491	C	8.9 E-1	3.8 E-1	**7E-05**
1492	C	**9.9 E+1**	**4.2 E+1**	**9E-03**
1493	C	**2.7 E+2**	**1.1 E+2**	**2E-02**
1494	D	**4.0 E+2**	**1.7 E+2**	**3E-02**
1495	F	**2.4 E+2**	**1.0 E+2**	**2E-02**
1497	C	**5.9 E+2**	**2.5 E+2**	**5E-02**
1498	C	**9.2 E+2**	**3.9 E+2**	**8E-02**
1499	D	**6.8 E+2**	**2.9 E+2**	**6E-02**
1500	C	**3.5 E+1**	**1.5 E+1**	**3E-03**
1501	D	**2.7 E+2**	**1.2 E+2**	**2E-02**
1502	D	**8.5 E+1**	**3.6 E+1**	**7E-03**
1503	C	**4.2 E+1**	**1.8 E+1**	**2E-03**
1504	D	**5.3 E+1**	**2.3 E+1**	**2E-03**
1505	D	**5.3 E+1**	**2.2 E+1**	**3E-03**
1541	C	**2.7 E+1**	**1.2 E+1**	**2E-04**
1542	D	**9.8 E+0**	**4.2 E+0**	**1E-04**
1543	F	NA	NA	NA
1544	B	**1.3 E+1**	**5.7 E+0**	**6E-04**
1545	C	**4.3 E+1**	**1.8 E+1**	**3E-03**
1546	E	1.3 E-2	5.6 E-3	1E-06
1547	C	NA	NA	NA
1548	E	**5.5 E+2**	**2.4 E+2**	**5E-02**
1549	F	**7.0 E+2**	**3.0 E+2**	**7E-02**
1579	C	**5.6 E+0**	**2.4 E+0**	**1E-04**
1580	D	7.1 E-1	3.0 E-1	4E-07
1581	E	NA	NA	NA
1582	C	**3.7 E+0**	**1.6 E+0**	**5E-05**
1583	D	NA	NA	NA

Table 2-19c *Receptors Hazard Index and Cancer Risk Results - Zone 3*
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Non-Cancer Hazard Index		Incremental Lifetime Cancer Risk
		Ingestion and Domestic Use		Ingestion and Domestic Use
		Resident		
Sample Name	Layer	Child	Adult	Resident
1584	E	NA	NA	NA
1597	C	NA	NA	NA
1598	D	NA	NA	NA
1599	E	NA	NA	NA
4080	C/D	**7.7 E+2**	**3.3 E+2**	**7E-02**
4085	C/D	**1.2 E+3**	**4.9 E+2**	**1E-01**
4095	C/D	**3.1 E+2**	**1.3 E+2**	**3E-02**
4195	C/D	**8.5 E+1**	**3.6 E+1**	**8E-03**
4215	C/D	**7.2 E+1**	**3.1 E+1**	**6E-03**
4303	C/D	**5.9 E+2**	**2.5 E+2**	**5E-02**
4400	C/D	**5.1 E+0**	**2.1 E+0**	**9E-05**
4405	C	**5.6 E+2**	**2.4 E+2**	**5E-02**
4410	C/D	**3.2 E+1**	**1.4 E+1**	**1E-03**
4450	C/D	**4.6 E+2**	**2.0 E+2**	**4E-02**
4455	C/D	**2.8 E+2**	**1.2 E+2**	**2E-02**
4460	C/D	**2.0 E+1**	**8.7 E+0**	**7E-04**
4465	C/D	**1.5 E+0**	6.6 E-1	**9E-05**
4565	C/D	**1.0 E+1**	**4.5 E+0**	**3E-04**
4570	C/D	**5.7 E+0**	**2.4 E+0**	**9E-05**
4575	C/D	**2.2 E+1**	**9.5 E+0**	**1E-03**
30000	C	**5.7 E+2**	**2.4 E+2**	**5E-02**
30011	C/D	**4.4 E+0**	**1.9 E+0**	**1E-04**
30012	C	**4.5 E+1**	**1.9 E+1**	**1E-03**
30013	D	**3.5 E+1**	**1.5 E+1**	**1E-03**
30014	E	NA	NA	NA
30015	C/D	**3.2 E+1**	**1.4 E+1**	**1E-03**
30019	C/D	**1.2 E+1**	**5.3 E+0**	**2E-04**
30047	C	**1.9 E+2**	**8.3 E+1**	**1E-02**
30048	D	**2.8 E+2**	**1.2 E+2**	**2E-02**
30049	F	**1.4 E+2**	**6.0 E+1**	**1E-02**
30053	C/D	**3.9 E+2**	**1.7 E+2**	**3E-02**
30054	C/D	**9.5 E+1**	**4.1 E+1**	**7E-03**
30055	C/D	**2.0 E+1**	**8.5 E+0**	**7E-04**
30056	C/D	NA	NA	NA
30159	C	**5.3 E+1**	**2.3 E+1**	**2E-03**
30162	C	**3.5 E+1**	**1.5 E+1**	**2E-03**
30163	D	**3.9 E+1**	**1.7 E+1**	**2E-03**
30164	D	**2.5 E+1**	**1.0 E+1**	**6E-04**
30165	C	**3.7 E+1**	**1.6 E+1**	**1E-03**
30166	D	**3.5 E+1**	**1.5 E+1**	**1E-03**
30167	D	**2.6 E+1**	**1.1 E+1**	**8E-04**
30168	C	**6.0 E+0**	**2.6 E+0**	**1E-04**
30169	D	**1.1 E+1**	**4.5 E+0**	**1E-04**
30170	D	**8.3 E+0**	**3.6 E+0**	**6E-05**
30171	D	**2.9 E+0**	**1.3 E+0**	**2E-06**
30172	D	NA	NA	NA
30173	C	9.2 E-1	3.9 E-1	4E-07
30185	D	**1.8 E+0**	7.5 E-1	4E-07
30189	C	**4.0 E+0**	**1.7 E+0**	**3E-06**
30190	D	**5.0 E+0**	**2.1 E+0**	**2E-05**
30191	D	**3.9 E+0**	**1.7 E+0**	**1E-05**

Notes and Key:
HI = Hazard index
ILCR = Incremental lifetime cancer risk
NA = Not applicable
Note: Blood lead level of concern = 10 micrograms per deciliter of blood.

Table 2-19d Receptors Hazard Index and Cancer Risk Results - Zone 4
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

		Non-Cancer Hazard Index					Incremental Lifetime Cancer Risk			Blood Lead	
		Ingestion and Domestic Use		Vapor Intrusion			Ingestion and Domestic Use	Vapor Intrusion			
		Resident		Resident		Commercial			Commercial	Resident	
Sample Name	Layer	Child	Adult	Child	Adult	Worker	Resident	Resident	Worker	Child	Adult
78	A	**1.5 E+1**	**6.4 E+0**	9.4 E-2	4.0 E-2	1.4 E-2	**8E-06**	2 E-7	4 E-8	NA	NA
79	A	6.6 E-1	2.8 E-1	NA	NA	NA	**2E-05**	NA	NA	NA	NA
99	A	**8.8 E+0**	**3.8 E+0**	1.4 E-2	5.8 E-3	2.1 E-3	**9E-05**	**2 E-6**	4 E-7	NA	NA
435	A	7.6 E-1	3.2 E-1	NA	NA	NA	**7E-05**	NA	NA	NA	NA
444	A	1.3 E-1	5.6 E-2	NA	NA	NA	**1E-05**	NA	NA	NA	NA
445	A	3.1 E-1	1.3 E-1	1.3 E-4	5.7 E-5	2.0 E-5	**1E-05**	4 E-8	9 E-9	NA	NA
453	A	**1.1 E+1**	**4.4 E+0**	NA	NA	NA	NA	NA	NA	**20.4**	**10.2**
454	C	**3.3 E+0**	**1.4 E+0**	NA	NA	NA	**2E-04**	NA	NA	NA	NA
455	C	**1.8 E+0**	7.5 E-1	NA	NA	NA	**8E-05**	NA	NA	NA	NA
456	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
457	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
458	A	**4.5 E+0**	**1.9 E+0**	NA	NA	NA	NA	NA	NA	NA	NA
459	A	1.7 E-1	7.3 E-2	1.3 E-4	5.6 E-5	2.0 E-5	5E-07	4 E-8	9 E-9	NA	NA
460	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
462	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
463	A	5.0 E-1	2.2 E-1	3.8 E-4	1.6 E-4	5.9 E-5	**1E-06**	1 E-7	3 E-8	NA	NA
464	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
465	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
481	A	4.8 E-2	2.0 E-2	NA	NA	NA	**4E-06**	NA	NA	NA	NA
482	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
483	Bedrock	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3095	A	**1.9 E+2**	**8.1 E+1**	2.6 E-1	1.1 E-1	4.0 E-2	**2E-03**	**2 E-4**	**6 E-5**	NA	NA
3188	A	**1.4 E+2**	**6.0 E+1**	4.5 E-1	1.9 E-1	6.9 E-2	**5E-04**	**4 E-5**	**9 E-6**	NA	NA
3219	A	**3.6 E+1**	**1.6 E+1**	NA	NA	NA	**3E-03**	NA	NA	NA	NA
3220	A	**3.2 E+1**	**1.4 E+1**	5.8 E-3	2.5 E-3	8.9 E-4	**3E-03**	3 E-7	7 E-8	NA	NA
3366	A	**8.3 E+0**	**3.6 E+0**	2.3 E-2	9.8 E-3	3.5 E-3	**4E-05**	**2 E-6**	4 E-7	NA	NA
3367	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3368	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3383	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3384	A	5.6 E-3	2.4 E-3	NA	NA	NA	NA	NA	NA	NA	NA
3394	Dredged	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3395	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3396	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3497	Dredged	**2.8 E+0**	**1.2 E+0**	NA	NA	NA	**7E-06**	NA	NA	NA	NA
3498	A	2.5 E-2	1.1 E-2	9.3 E-4	4.0 E-4	1.4 E-4	**5E-06**	2 E-7	5 E-8	NA	NA
3499	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3503	A	**1.3 E+0**	5.6 E-1	2.8 E-2	1.2 E-2	4.2 E-3	**1E-04**	**2 E-5**	**5 E-6**	NA	NA
3504	A	**3.1 E+0**	**1.3 E+0**	NA	NA	NA	NA	NA	NA	NA	NA
3505	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3626	A	**1.5 E+0**	6.3 E-1	NA	NA	NA	NA	NA	NA	NA	NA
4100	A	**8.3 E+1**	**3.6 E+1**	NA	NA	NA	**6E-03**	NA	NA	NA	NA
4105	A	**1.0 E+2**	**4.3 E+1**	NA	NA	NA	**9E-03**	NA	NA	NA	NA
4110	A	**2.0 E+2**	**8.4 E+1**	NA	NA	NA	**2E-02**	NA	NA	NA	NA
4120	A	**4.7 E+2**	**2.0 E+2**	NA	NA	NA	**4E-02**	NA	NA	NA	NA
4125	A	**2.2 E+2**	**9.5 E+1**	NA	NA	NA	**2E-02**	NA	NA	NA	NA
4130	A	**1.0 E+2**	**4.3 E+1**	NA	NA	NA	**1E-02**	NA	NA	NA	NA
4500	A	**9.4 E+1**	**4.0 E+1**	NA	NA	NA	**9E-03**	NA	NA	NA	NA

Notes and Key:
HI = Hazard index
ILCR = Incremental lifetime cancer risk
NA = Not applicable
Note: Blood lead level of concern = 10 micrograms per deciliter of blood.

Table 2-20 *Uncertainty Analysis*
Perimeter Groundwater Operable Unit Risk Assessment - Groundwater Risk Assessm
Aerojet Superfund Site
Sacramento County, California

Assessment Element	Uncertainty	Magnitude of Impact	Direction of Impact
Uncertainties in Environmental Sampling and Analysis			
Sampling	Sample points could have missed areas containing chemicals of interest, however, sample points were selected based on areas with greatest likelihood of finding chemicals of interest.	Low	Underestimated
	Data used in the evaluation were collected over time. Older samples may no longer be reflective of concentrations of chemicals that may be degraded (TPH and related compounds) or decrease with time (e.g., VOCs).	Low	Overestimated
Laboratory Analysis	Systematic or random errors in the chemical analyses may yield erroneous data.	Low	Overestimated or Underestimated
	There are interferences for arsenic in the 6020 (ICP-MS) analysis which can lead to false positives. Chloride may interfere with the analysis by combining with the argon gas used in the instrument to create argon chloride. Argon chloride has the same mass as arsenic.	Low	Overestimated
Background Data	No background data was available for groundwater or surface water. This may have lead to the inclusion of some metals that are present at background levels.	Moderate	Overestimated
	Background levels of arsenic may be a significant contributor to risks where arsenic has been selected as a COPC (surface water).	Moderate	Overestimated
COPC Selection	COPC selection criteria included USEPA Region 9 PRGs as one of the sources for COPC screening levels (in addition to Cal/EPA CHHSLs). For several detected constituents, the newer RSLs were more conservative than the previous screening criteria, and detected chemicals may have been eliminated as COPCs when with the current RSLs they might be included as COPCs. Evaluation of maximum detected concentration to the RSLs indicates the RSLs would not substantially effect COPC selection, and would have no net effect on risk based decisions even if included.	Low	Underestimated
Groundwater Detection Limits	Tentatively identified compounds were not evaluated.	Low	Underestimated
	Some non-detect chemicals excluded as COPCs had maximum detection limits greater than the screening level. For most of these, detection limits did not exceed concentrations that would change health risk estimates sufficient to alter conclusions reached based on detected concentrations (assuming domestic use).	Moderate	Underestimated
Surface Water Detection Limits	Some non-detect chemicals excluded as COPCs had maximum detection limits greater than the screening level which assumes domestic use of surface water. Review of approximate COPCs risk estimates based on domestic use screening criteria vs quantified risks associated with recreational contact (the assessed pathway) indicates maximum detection limits are adequate to have captured concentrations sufficient to alter location specific risk estimates.	Low	Underestimated
Uncertainties in Fate and Transport Modeling			
Fate and Transport Modeling	Site-specific information is used when possible, however, default parameters are used for many parameters, and are selected be conservative. They may overestimate concentrations.	Moderate	Overestimated
Uncertainties in Exposure Assessment			
Exposure Pathways	The near-surface groundwater consumption scenario is highly unlikely since there are no plans use groundwater as a domestic water source.	Moderate	Overestimated
	The perched groundwater consumption scenario is highly unlikely since there are no plans use groundwater as a domestic water source and perched water has a limited total volume to support domestic use.	Moderate to high	Overestimated

Table 2-20 *Uncertainty Analysis*
Perimeter Groundwater Operable Unit Risk Assessment - Groundwater Risk Assessm
Aerojet Superfund Site
Sacramento County, California

Assessment Element	Uncertainty	Magnitude of Impact	Direction of Impact
Exposure Pathways (continued)	The selection of exposure pathways may eliminate some complete pathways; however, the risks associated with those pathways are expected to be much lower than the pathways selected.	Low	Underestimated
	Perchlorate plant uptake and partitioning into mother's milk were not quantified. However, several mitigating factors are present (groundwater will be restricted from use per results for other COPCs).	Low	Underestimated
Receptors	Residential receptors are assessed at every management area regardless of intended future land use. As the residential receptor is the most senstive, this may overestimate risks associated with future land use.	Low	Overestimated
Points of Human Exposure	The analysis assumes that a receptor is exposed to a consistent COPC concentration. It is more likely that a receptor is exposed to fluctuations in chemical concentrations spatially and diminish temporally .	Moderate	Overestimated
	Point by point analysis assumes that all of a receptor's exposure is to COPC concentrations in immediate proximity to the location and depth, while the receptor would be exposed to a much broader range of chemical concentrations.	Moderate	Overestimated
Exposure Point Concentrations	Because the analysis is a point by point assessment, for sample locations containing non-detected results for COPCs, no value is assessed to avoid situations where estimated risks are potentially driven at a given location by an elevated non-detect surrogate value. Chemicals may potentially be present at concentrations below the detection limit.	Low	Underestimated
Intake Assumptions	Default exposure parameters represent the upper bound of reasonable maximum activity assumptions.	Moderate	Overestimated
	The absorption of ingested and inhaled COPCs is assumed to be 100%, however it is likely less than the this default value.	Moderate	Overestimated
Uncertainties in Toxicity Assessment			
Toxicity Criteria	High degree of uncertainty in extrapolation of dose-response data from laboratory animals to humans.	High	Overestimated
	Animals are often administered doses of the chemical much higher than would be experienced in an environmental setting. This may affect the toxicity of the chemical.	Low	Overestimated
	Surrogate criteria were used for COPCs that did not have available toxicity criteria and perceived appropriate based on the chemical's structure.	Unknown	Unknown
	No toxicity data or comparable surrogate is available for n-butylbenzenesulfonamide and 1-methyl-2-pyrrolidinone	Low	Underestimated
	Toxicity criteria is not always available for both the oral and inhalation routes of exposure. In some cases a criteria is extrapolated from one route to another.	Low	Overestimated
	The cancer slope factor used for TCE was published by Cal-EPA. This slope factor is less than the provisional slope factor developed by NCEA. In recent USEPA guidance (2009), USEPA specifically recommends using the Cal/EPA cancer slope factors, and recommends against use of draft toxicity values until values are published in USEPA's IRIS database.	Low	Underestimated
	Assumes that all carcinogens do not have a threshold below which carcinogenic response occurs, and therefore, any dose, no matter how small, results in some potential risk.	Moderate	Overestimated
	Cancer slope factors derived from animal studies are the upper-bound maximum likelihood estimates based on a linear dose-response curve, and therefore, overstate carcinogenic potency.	Moderate	Overestimated
Iron	The NCEA provisional RfD is based on dietary intakes rather than a toxic endpoint and it is an essential nutrient. Iron is a HI driver at a number of sites.	Moderate	Overestimated

Table 2-20 *Uncertainty Analysis*
Perimeter Groundwater Operable Unit Risk Assessment - Groundwater Risk Assessm
Aerojet Superfund Site
Sacramento County, California

Assessment Element	Uncertainty	Magnitude of Impact	Direction of Impact
Uncertainties in Risk Characterization			
Cumulative Risk	Cumulative risk for vapor intrusion and domestic use were not summed to estimate a cumulative risk to potential site receptors.	Low	Underestimated

Notes:
Uncertainties identified as "low", may affect the estimated of exposure by less than one order of magnitude
Uncertainties identified as "moderate", may affect the estimated of exposure between one and two orders of magnitude
Uncertainties identified as "high", may affect the estimated of exposure more than two orders of magnitude

Cal/EPA = California Environmental Protection Agency
CHHSL = California Human Health Screening Level
COPC = Contaminant of potential concern
NCEA = National Center for Environmental Assessment
PRG = Preliminary remedial goal
RfD = Reference dose
RSL = Regional Screening Levels
TCE = Trichloroethene
USEPA = United States Environmental Protection Agency

Table 3-1 Surface Water Screening Levels
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Compound	Surface Water Screening Level	Source
Acetone	1,500	a
Aluminum	87	b*
Arsenic	150	b^
Barium	4	a
Boron	1.6	c
Cadmium	0.29	b^**
Chloromethane	NA	
Copper	10.96	b^**
Iron	1,000	d
Lead	3.25	b^**
Manganese	120	c
Mercury	0.77	b^
Naphthalene	620	d
N-Nitrosodimethylamine (NDMA)	40	e
Perchlorate	9,300	f
Selenium	5	b[t]
Vanadium	20	f
Zinc	144	b^**

Notes and Key:

Concentrations are in micrograms per liter (µg/L)

NA - Not available

a = TRVs from the USEPA Region 9 website at:
http://www.epa.gov/region09/waste/sfund/prg/otherlinks.htm.
The TRVs were originally presented in Screening Level Ecological Risk Assessment Protocol, Appendix E: Toxicity Reference Values, located at
http://www.epa.gov/epaoswer/hazwaste/combust/eco-risk/volume3/appx-e.pdf

b = USEPA's National Recommended Water Quality Criteria: 2002

c = Tier II Secondary Chronic Values provided in Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revisions (Suter and Tsao, 1996)

d = Recommended Numerical Limits to Apply to Water Quality Objectives (based on A Compilation of Water Quality Goals, California Regional Water Quality Control Board - Central Valley Region)

e = Estimated No-Effect Value obtained from *Concise International Chemical Assessment Document (CICAD) 38 (World Health Organization, 2002)*

f = Development of Freshwater Water-Quality Criteria for Perchlorate (Dean et al., 2004) published in *Environmental Toxicology and Chemistry* , Vol. 23, No. 6.

* = pH dependent criterion

^ = Dissolved criterion

** = Hardness dependent criterion adjusted for average measured hardness in Alder Creek of 126.67 milligrams per liter (mg/L)
Hardness dependent calculations are provided on Page 2.

[t] = Criterion for total recoverable metal

Table 3-1 Surface Water Screening Levels
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Hardness Dependent Calculation: CCC (dissolved) = exp{mc [ln(hardness) + bc} (CF)

Compound	m_C	Alder Creek ln hardness*	b_C	Freshwater Conversation Factor (CF)	CCC (dissolved) (µg/L)
Cadmium	0.7409	4.84	-4.719	1.101672-[(ln hardness)(0.041838)]	**0.29**
Copper	0.8545	4.84	-1.702	0.96	**10.96**
Lead	1.273	4.84	-4.705	1.46203-[(ln hardness)(0.145712)]	**3.25**
Zinc	0.8473	4.84	0.884	0.986	**144**

* - This is based on the average measured hardness in Alder Creek (126.67 mg/L).

Table 3-2 Screening Results for Alder Creek Surface Water Samples
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Compound	Screening Level	Units	UPSTREAM										
			S-5 1/23/2002	S-5 4/15/2002	S-5 7/2/2002	S-5 10/7/2002	S-5 1/8/2003	S-5 4/7/2002	S-5 7/2/2003	S-5 10/13/2002	S-5 1/12/2004	S-5 4/6/2002	S-5 7/12/2004
Acetone	1500	ug/l	na	na	na	na	na	na	na	na	na	na	na
Aluminum (total)	87	ug/l	68	na	ND	na	ND	na	ND	na	ND	na	ND
Aluminum (dissolved)	87	ug/l	ND	na	ND	na	ND	na	ND	na	ND	na	ND
Arsenic (total)	150	ug/l	ND	na	3.3	na	ND	na	3.2	na	ND	na	3.8
Arsenic (dissolved)	150	ug/l	ND	na	3.3	na	ND	na	3	na	ND	na	3.5
Barium (total)	4	ug/l	**36**	na	**51**	na	**35**	na	**44**	na	**35**	na	**44**
Barium (dissolved)	4	ug/l	**51**	na	**85**	na	**61**	na	**69**	na	**33**	na	**43**
Boron (total)	1.6	ug/l	**34**	na	**32**	na	**33**	na	**32**	na	**35**	na	**33**
Boron (dissolved)	1.6	ug/l	**44**	na	**52**	na	**48**	na	**34**	na	**33**	na	**31**
Cadmium (total)	0.29	ug/l	ND	na	ND	na	ND	na	ND	na	ND	na	ND
Cadmium (dissolved)	0.29	ug/l	ND	na	ND	na	ND	na	ND	na	ND	na	ND
Chloromethane	n/a	-	na	na	na	na	na	na	na	na	na	na	na
Copper (total)	10.96	ug/l	3.7	na	ND	na	1.7	na	ND	na	2.3	na	ND
Copper (dissolved)	10.96	ug/l	2.4	na	ND	na	1.8	na	ND	na	2	na	1.9
Iron (total)	1000	ug/l	130	na	170	na	160	na	170	na	150	na	180
Iron (dissolved)	1000	ug/l	ND	na	ND	na	ND	na	ND	na	ND	na	95
Lead (total)	3.25	ug/l	ND	na	ND	na	ND	na	ND	na	ND	na	ND
Lead (dissolved)	3.25	ug/l	ND	na	ND	na	3	na	ND	na	ND	na	ND
Manganese (total)	120	ug/l	16	na	50	na	21	na	25	na	33	na	77
Manganese (dissolved)	120	ug/l	15	na	35	na	19	na	22	na	27	na	67
Naphthalene	620	ug/l	na	na	na	na	na	na	na	na	na	na	na
NDMA	40	ug/l	na	na	na	na	na	na	na	na	na	na	na
Perchlorate	9300	ug/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Selenium (total)	5	ug/l	ND	na	ND	na	ND	na	ND	na	ND	na	ND
Selenium (dissolved)	5	ug/l	ND	na	ND	na	ND	na	ND	na	ND	na	ND
Vanadium (total)	20	ug/l	1.6	na	2.7	na	1.8	na	2.4	na	1.7	na	2.3
Vanadium (dissolved)	20	ug/l	ND	na	2.2	na	1.6	na	2.4	na	ND	na	1.9
Zinc (total)	144.34	ug/l	ND	na	ND	na	ND	na	ND	na	ND	na	ND
Zinc (dissolved)	144.34	ug/l	34	na	66	na	61	na	ND	na	ND	na	ND

Notes:

Results shown in bold and boxed cells represent an exceedance of the identified screening level.

n/a - not available

na - not analyzed

ND - not positively detected

Table 3-2
Screening Results for Alder Creek Surface Water Samples
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site

Compound	Screening Level	Units	----------UPSTREAM----------		----------DOWNSTREAM----------					
			Alder Creek 3 12/17/2004	Seep No. 3 2/20/03	Alder Creek 2 12/17/2004	Seep 6154 2/20/03	Alder Creek 1 12/17/2004	Seep 6155 2/20/03	S-6 1/23/2002	S-6 4/15/2002
Acetone	1500	ug/l	3.4 J	ND	3.1 J	ND	2.4 J	ND	na	na
Aluminum (total)	87	ug/l	na	na	na	na	na	na	ND	na
Aluminum (dissolved)	87	ug/l	na	na	na	na	na	na	ND	na
Arsenic (total)	150	ug/l	na	na	na	na	na	na	ND	na
Arsenic (dissolved)	150	ug/l	ND	na	ND	na	ND	na	ND	na
Barium (total)	4	ug/l	na	na	na	na	na	na	**51**	na
Barium (dissolved)	4	ug/l	**46**	na	**48**	na	**50**	na	**68**	na
Boron (total)	1.6	ug/l	na	na	na	na	na	na	**27**	na
Boron (dissolved)	1.6	ug/l	na	na	na	na	na	na	**42**	na
Cadmium (total)	0.29	ug/l	na	na	na	na	na	na	ND	na
Cadmium (dissolved)	0.29	ug/l	**3 J**	na	**2.9 J**	na	ND	na	ND	na
Chloromethane	n/a	-	ND	ND	ND	ND	0.19 J	ND	na	na
Copper (total)	10.96	ug/l	na	na	na	na	na	na	2.2	na
Copper (dissolved)	10.96	ug/l	2.6 J	na	ND	na	ND	na	2.7	na
Iron (total)	1000	ug/l	na	na	na	na	na	na	370	na
Iron (dissolved)	1000	ug/l	na	na	na	na	na	na	210	na
Lead (total)	3.25	ug/l	na	na	na	na	na	na	ND	na
Lead (dissolved)	3.25	ug/l	ND	na	ND	na	ND	na	ND	na
Manganese (total)	120	ug/l	na	na	na	na	na	na	86	na
Manganese (dissolved)	120	ug/l	na	na	na	na	na	na	80	na
Naphthalene	620	ug/l	ND	na	ND	na	0.17 J	na	na	na
NDMA	40	ug/l	ND	ND	0.014	0.00051 J	ND	ND	na	na
Perchlorate	9300	ug/l	ND	ND	ND	ND	ND	ND	ND	ND
Selenium (total)	5	ug/l	na	na	na	na	na	na	ND	na
Selenium (dissolved)	5	ug/l	ND	na	**19 J**	na	ND	na	ND	na
Vanadium (total)	20	ug/l	na	na	na	na	na	na	1.8	na
Vanadium (dissolved)	20	ug/l	2.7 J	na	ND	na	ND	na	ND	na
Zinc (total)	144.34	ug/l	na	na	na	na	na	na	ND	na
Zinc (dissolved)	144.34	ug/l	ND	na	6.6 J	na	8 J	na	41	na

Notes:
Results shown in bold and boxed cells represent an exceedance of the identified screening level.
n/a - not available
na - not analyzed
ND - not positively detected

Table 3-2
Screening Results for Alder Creek Surface Water Samples
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site

Compound	Screening Level	Units	----------DOWNSTREAM----------								
			S-6 7/2/2002	S-6 10/7/2002	S-6 1/8/2003	S-6 4/7/2002	S-6 7/2/2003	S-6 10/13/2003	S-6 1/12/2004	S-6 4/6/2002	S-6 7/12/2004
Acetone	1500	ug/l	na	na	na	na	na	na	na	na	na
Aluminum (total)	87	ug/l	ND	na	ND	na	ND	na	ND	na	ND
Aluminum (dissolved)	87	ug/l	ND	na	ND	na	ND	na	ND	na	ND
Arsenic (total)	150	ug/l	2.3	na	ND	na	2.5	na	2.3	na	2.5
Arsenic (dissolved)	150	ug/l	2.1	na	ND	na	ND	na	ND	na	ND
Barium (total)	4	ug/l	**65**	na	**55**	na	**80**	na	**51**	na	**71**
Barium (dissolved)	4	ug/l	**120**	na	**53**	na	**76**	na	**49**	na	**70**
Boron (total)	1.6	ug/l	**30**	na	**30**	na	**42**	na	**30**	na	**40**
Boron (dissolved)	1.6	ug/l	**55**	na	**31**	na	**40**	na	**30**	na	**39**
Cadmium (total)	0.29	ug/l	ND	na	ND	na	ND	na	ND	na	ND
Cadmium (dissolved)	0.29	ug/l	ND	na	ND	na	ND	na	ND	na	ND
Chloromethane	n/a	-	na	na	na	na	na	na	na	na	na
Copper (total)	10.96	ug/l	ND	na	ND	na	ND	na	ND	na	ND
Copper (dissolved)	10.96	ug/l	ND	na	ND	na	ND	na	ND	na	ND
Iron (total)	1000	ug/l	390	na	430	na	400	na	380	na	230
Iron (dissolved)	1000	ug/l	180	na	130	na	150	na	190	na	90
Lead (total)	3.25	ug/l	ND	na	ND	na	ND	na	ND	na	ND
Lead (dissolved)	3.25	ug/l	ND	na	ND	na	ND	na	ND	na	ND
Manganese (total)	120	ug/l	120	na	82	na	**140**	na	71	na	34
Manganese (dissolved)	120	ug/l	85	na	76	na	89	na	67	na	29
Naphthalene	620	ug/l	na	na	na	na	na	na	na	na	na
NDMA	40	ug/l	na	na	na	na	na	na	na	na	na
Perchlorate	9300	ug/l	ND	5.5	ND	ND	12	7	ND	ND	6.9
Selenium (total)	5	ug/l	ND	na	ND	na	ND	na	ND	na	ND
Selenium (dissolved)	5	ug/l	ND	na	ND	na	ND	na	ND	na	ND
Vanadium (total)	20	ug/l	2.2	na	1.9	na	2.7	na	1.8	na	2.2
Vanadium (dissolved)	20	ug/l	2	na	1.6	na	2.5	na	ND	na	2.4
Zinc (total)	144.34	ug/l	ND	na	ND	na	ND	na	ND	na	ND
Zinc (dissolved)	144.34	ug/l	65	na	ND	na	ND	na	ND	na	ND

Notes:
Results shown in bold and boxed cells represent an exceedance of the identified screening level.
n/a - not available
na - not analyzed
ND - not positively detected

Attachment A
List of Wells from which
Data were Used in HHRA

Table A-1 *List of Zone 1 Wells*
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Layer B	Layer C	Layer D	Layer E	Layer F
1516	1027	1156	1156	1049
1517	1154	1163	1164	1394
1518B/C	1156	1211	1365	1402
1522	1162	*1358*	1373	1409
1538	1211	*1359*	1374	1474
1553	*1212*	1362	1377	1590
1567	1214	1363	1378	30176
	1216	1364	1379	30179
	1361	1371	1381	
	1370	1372	1384	
	1375	1373	1387	
	1391	1376	1389	
	1395	1379	1390	
	1396	1380	1393	
	1403	1382	1398	
	1406	1383	1399	
	1407	1384	1408	
	1419	1385	1422	
	1469	1386	1423	
	1472	1388	1471	
	1475	1392	1473	
	1478	1393	1477	
	1481	1397	1480	
	1487	1400	1483	
	1488	1401	1489	
	1506	1404	1508	
	1509	1405	1511	
	1518B/C	1420	1521	
	1519	1421	1524	
	1522	1470	1527	
	1523	1476	1529	
	1525	1479	1530	
	1526	1482	*1552*	
	1528	1507	*1555*	
	1531	1510	1588	
	1532	1520	1589	
	1539	1533	1595	
	1556	1540	1596	
	1557	1557	4335	
	1559	1558	*4336*	
	1560	1561	*4337*	
	1562	1566	4580	
	1563	1569	*4581*	
	1564	1573	*4582*	
	1565	1587	4585	
	1568	1593	*4586*	
	1570	1595	*4587*	
	1571	4302	4620	
	1572	4330	*4621*	
	1574	*4331*	*4622*	
	1585	*4332*	30069	
	1586	4335	30070	

Table A-1 *List of Zone 1 Wells*
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Layer B	Layer C	Layer D	Layer E	Layer F
	1591	*4336*	30073	
	1592	*4337*	30103	
	1594	4350	30140	
	1834	*4351*	30141	
	4300	*4352*	30156	
	4301	4365	30157	
	4325	*4366*	30175	
	4326	*4367*	30177	
	4327	4380	30178	
	4330	*4381*	30182	
	4331	*4382*		
	4332	4580		
	4340	*4581*		
	4341	*4582*		
	4342	30071		
	4345	30072		
	4346	30073		
	4347	30102		
	4355	30145		
	4356	30158		
	4357	30174		
	4360	30180		
	4361	30181		
	4362	30197		
	4370			
	4371			
	4372			
	4375			
	4376			
	4377			
	30068			
	30071			
	30100			
	30101			
	30195			
	30196			

Italics indicate wells that were not sampled during period

Table A-2 List of Zone 2 Wells
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Layer A	Layer B	Layer C	Layer D	Layer E
81	314	178	179	*115*
109	315	*316*	317	*3080*
111	3077	*430*	*432*	*3123*
177	3326	*431*	*433*	3328
423	3329	3078	*3079*	*3330*
3076	*3461*	3120	*3121*	3361
3119	3501	3327	3360	
3460	3579	3502	3462	
3470	*4395*	3580	*5060*	
3500	*4396*	3581	*5061*	
3509	*4397*	*4395*	*5062*	
3510			*5065*	
3511			*5066*	
3512			*5067*	
3513			*5070*	
			5071	
			5072	
			5075	
			5076	
			5077	

Italics indicate wells that were not sampled during period

Table A-3 *List of Zone 3 Wells*
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Layer A	Layer B	Layer C	Layer D	Layer E	Layer F
791	*1225*	*1032*	*1032*	1219	1220
792	1246	1059	1248	1227	1228
794	*1338*	1218	1426	1263	1264
1217	*1415*	1226	1443	1417	1265
1318	*1424*	1247	1448	1428	1418
1414	*1441*	1248	1454	*1431*	*1432*
	1446	1262	1494	1444	1445
	1451	1339	1499	1449	1450
	1490	1340	1501	1456	1495
	1496	1416	1502	1546	1543
	1544	1425	1504	1548	1549
	30183	*1429*	1505	1581	30049
	30184	*1430*	1542	1584	
		1442	1580	1599	
		1447	1583	30014	
		1452	1598		
		1453	4080		
		1491	*4081*		
		1492	*4082*		
		1493	*4083*		
		1497	4085		
		1498	*4086*		
		1500	*4087*		
		1503	*4088*		
		1541	4095		
		1545	*4096*		
		1547	*4097*		
		1579	*4098*		
		1582	4195		
		1597	*4196*		
		4080	*4197*		
		4081	*4198*		
		4082	4215		
		4083	*4216*		
		4085	*4217*		
		4086	*4218*		
		4087	4303		
		4088	4400		
		4090	*4401*		
		4091	*4402*		
		4092	4410		
		4093	*4411*		
		4095	*4412*		
		4096	4450		
		4097	4455		
		4098	4460		
		4195	4465		
		4196	4565		
		4197	*4566*		

Table A-3 *List of Zone 3 Wells*
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Layer A	Layer B	Layer C	Layer D	Layer E	Layer F
		4198	*4567*		
		4215	4570		
		4216	*4571*		
		4217	*4572*		
		4218	4575		
		4303	*4576*		
		4400	*4577*		
		4401	30011		
		4402	30013		
		4405	30015		
		4406	30019		
		4407	30048		
		4410	30053		
		4411	30054		
		4412	30055		
		4450	30056		
		4455	30163		
		4460	30164		
		4465	30166		
		4565	30167		
		4566	30169		
		4567	30170		
		4570	30171		
		4571	30172		
		4572	30185		
		4575	30190		
		4576	30191		
		4577			
		30000			
		30011			
		30012			
		30015			
		30019			
		30047			
		30053			
		30054			
		30055			
		30056			
		30159			
		30160			
		30161			
		30162			
		30165			
		30168			
		30173			
		30189			

Italics indicate wells that were not sampled during period

Table A-4 *List of Zone 4 Wells*
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Dredged Layer	Layer A	Layer A	Layer B	Bedrock
3394	78	4110	454	483
3497	79	*4111*	455	*3373*
	92	*4112*	456	
	99	*4113*	464	
	435	4120	465	
	436	*4121*	3396	
	444	*4122*	3505	
	445	*4123*		
	453	4125		
	457	*4126*		
	458	*4127*		
	459	*4128*		
	460	4130		
	462	*4131*		
	463	*4132*		
	481	*4133*		
	482	*4500*		
	3095			
	3188			
	3219			
	3220			
	3366			
	3367			
	3368			
	3372			
	3383			
	3384			
	3395			
	3498			
	3499			
	3503			
	3504			
	3625			
	3626			
	4100			
	4102			
	4103			
	4105			
	4106			
	4107			
	4108			

Italics indicate wells that were not sampled during period

Attachment B
Human Health Risk Assessment
Supporting Calculations

Attachment B presents the supporting calculation tables for the Perimeter Groundwater Operable Unit (PGOU) (OU-5) human health risk assessment. This attachment includes:

- Johnson and Ettinger Model – Table B-1 presents the parameters used in the models. Also, the models are attached electronically.
- Unit Risk Calculations – Tables B-2 through B-11 present the unit hazard/risk results.
- Leadspread – Table B-12 through B-13 present an example of the DTSC's Lead Risk Assessment Spreadsheet model (Version 7) for groundwater and surface water, respectively.

Table B-1 ***List of Non-Chemical-Specific Parameters Used in the Johnson and Ettinger Model***
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Soil Vapor Model - GW-ADV, Version 3.1, 02/04

Model Data Entry Parameters	Symbol	Value	Units	Source
Groundwater Concentration	C_w	1.00E+00	µg/L	
Average soil temperature	T_s	24	Degrees Celsius	DTSC default
Depth below grade to bottom of enclosed space floor	L_f	15	cm	Slab construction
Depth below grade to water table	L_{wt}	Varies	cm	Assumed groundwater depths:30, 40, 50, and 60 feet bgs
Thickness of soil stratum A	h_A	L_t	cm	Assumed groundwater depths:30, 40, 50, and 60 feet bgs
Soil stratum A SCS soil type		S		Sand
Stratum A SCS soil type		S		Sand
Stratum A SCS soil bulk density	ρ_b^A	1.66	g/cm^3	Site-specific - See Note 1
Stratum A soil total porosity	n^A	0.422	unitless	Site-specific - See Note 1
Stratum A soil water-filled porosity	θ_w^A	0.155	unitless	Site-specific - See Note 1
Enclosed space floor thickness	L_{crack}	10	cm	Default assumption (DTSC, 2005)
Enclosed space floor length	L_B	1000	cm	Default assumption (10 meters)
Enclosed space floor width	W_B	1000	cm	Default assumption (10 meters)
Enclosed space floor height	H_B	244	cm	Default ceiling height (8 feet)
Floor-wall seam crack width	w	0.1	cm	Default assumption (DTSC, 2005)
Indoor air exchange rate	ER	0.50	1/h	DTSC default - Residential
Indoor air exchange rate	ER	1.00	1/h	DTSC default - Commercial
Average vapor flow rate into building	Q_{soil}	5.00	L/m	Based on 5 L/min per 100 m2 of building floor space

Notes and Key:

1. Site-specific LCL/UCL calculations use the 95% lower confidence limit of the soil water-filled porosity and 95% upper confidence limit of the porosity of the measured soil propoerties for samples collected during the vapor intrusion investigations (*Updated PGOU Vapor Intrusion Screening Assessment, Aerojet Superfund Site* prepared by Geosyntec Report dated April 2008).
DTSC, 2005 = *Guidance for the Evaluation and Migration of Subsurface Vapor Intrusion to Indoor Air* . December 15 2004 (Revised February 7, 2005).

µg/m^3 = Micrograms per cubic meter
cm = Centimeter
g/cm^3 = Grams per cubic centimeter
1/h = One per hour
L/m = Liter per meter

Table B-2 *Groundwater Unit Hazard and Unit Cancer Risk Results-Resident*
Zone 1
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Chemical	Groundwater Concentration (µg/L)	Child Oral HQ	Child Dermal HQ	Child Inhal HQ	Unit HI	Adult Oral HQ	Adult Dermal HQ	Adult Inhal HQ	Unit HI	Oral ILCR	Dermal ILCR	Inhal ILCR	Unit ILCR
Inorganics													
Aluminum	1.0 E+0	6.4 E-5	2.8 E-6	NA	6.7 E-5	2.7 E-5	9.5 E-7	NA	2.8 E-5	NA	NA	NA	NA
Barium	1.0 E+0	3.2 E-4	3.0 E-5	NA	3.5 E-4	1.4 E-4	1.0 E-5	NA	1.5 E-4	NA	NA	NA	NA
Boron	1.0 E+0	3.2 E-4	2.1 E-6	NA	3.2 E-4	1.4 E-4	7.2 E-7	NA	1.4 E-4	NA	NA	NA	NA
Chromium VI	1.0 E+0	2.1 E-2	1.1 E-2	NA	3.3 E-2	9.1 E-3	3.8 E-3	NA	1.3 E-2	NA	NA	NA	NA
Copper	1.0 E+0	1.7 E-3	1.1 E-5	NA	1.7 E-3	7.4 E-4	3.9 E-6	NA	7.4 E-4	NA	NA	NA	NA
Iron	1.0 E+0	9.1 E-5	6.0 E-7	NA	9.2 E-5	3.9 E-5	2.0 E-7	NA	3.9 E-5	NA	NA	NA	NA
Molybdenum	1.0 E+0	1.3 E-2	8.4 E-5	NA	1.3 E-2	5.5 E-3	2.9 E-5	NA	5.5 E-3	NA	NA	NA	NA
Nitrate	1.0 E+0	4.0 E-5	2.6 E-7	NA	4.0 E-5	1.7 E-5	8.9 E-8	NA	1.7 E-5	NA	NA	NA	NA
Nitrite as N	1.0 E+0	4.0 E-4	2.6 E-6	NA	4.0 E-4	1.7 E-4	8.9 E-7	NA	1.7 E-4	NA	NA	NA	NA
Perchlorate	1.0 E+0	9.1 E-2	6.0 E-4	NA	9.2 E-2	3.9 E-2	2.0 E-4	NA	3.9 E-2	NA	NA	NA	NA
Silver	1.0 E+0	1.3 E-2	5.1 E-5	NA	1.3 E-2	5.5 E-3	1.7 E-5	NA	5.5 E-3	NA	NA	NA	NA
Vanadium	1.0 E+0	6.4 E-2	1.6 E-2	NA	8.0 E-2	2.7 E-2	5.5 E-3	NA	3.3 E-2	NA	NA	NA	NA
Semivolatile Organic Compounds													
N-Nitrosodimethylamine	1.0 E+0	8.0 E+0	2.1 E+0	NA	1.0 E+1	3.4 E+0	8.9 E-1	NA	4.3 E+0	7.6 E-4	2.0 E-4	NA	9.6 E-4
N-Butylbenzenesulfonamide	1.0 E+0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds													
1,1,2,2-Tetrachloroethane	1.0 E+0	1.1 E-3	1.3 E-4	5.3 E-3	6.5 E-3	4.6 E-4	5.8 E-5	2.3 E-3	2.8 E-3	4 E-6	5 E-7	1 E-5	2 E-5
1,1,2-Trichloroethane	1.0 E+0	1.6 E-2	1.4 E-3	8.0 E-2	9.7 E-2	6.8 E-3	6.4 E-4	3.4 E-2	4.2 E-2	1 E-6	1 E-7	4 E-6	5 E-6
1,1-Dichloroethane	1.0 E+0	3.2 E-4	2.5 E-5	1.6 E-3	1.9 E-3	1.4 E-4	1.1 E-5	6.8 E-4	8.3 E-4	8 E-8	7 E-9	4 E-7	5 E-7
1,1-Dichloroethene	1.0 E+0	1.3 E-3	1.8 E-4	1.6 E-2	1.7 E-2	5.5 E-4	7.6 E-5	6.8 E-3	7.5 E-3	NA	NA	NA	NA
1,2-Dichloroethane	1.0 E+0	3.2 E-3	1.6 E-4	2.3 E-1	2.3 E-1	1.4 E-3	6.7 E-5	9.8 E-2	9.9 E-2	1 E-6	7 E-8	7 E-6	8 E-6
1,2-Dichloroethene (cis/trans)	1.0 E+0	6.4 E-3	5.7 E-4	3.2 E-2	3.9 E-2	2.7 E-3	2.4 E-4	1.4 E-2	1.7 E-2	NA	NA	NA	NA
1,4-Dioxane	1.0 E+0	NA	NA	3.7 E-4	3.7 E-4	NA	NA	1.6 E-4	1.6 E-4	4 E-7	1 E-9	2 E-6	2 E-6
Bromodichloromethane	1.0 E+0	3.2 E-3	2.5 E-4	1.6 E-2	1.9 E-2	1.4 E-3	1.1 E-4	6.8 E-3	8.3 E-3	2 E-6	2 E-7	1 E-5	1 E-5
Carbon tetrachloride	1.0 E+0	9.1 E-2	2.4 E-2	2.8 E-2	1.4 E-1	3.9 E-2	1.0 E-2	1.2 E-2	6.2 E-2	2 E-6	6 E-7	1 E-5	1 E-5
Chloroform	1.0 E+0	6.4 E-3	5.6 E-4	2.5 E-2	3.2 E-2	2.7 E-3	2.5 E-4	1.1 E-2	1.4 E-2	5 E-7	4 E-8	6 E-6	6 E-6
cis-1,2-Dichloroethene	1.0 E+0	6.4 E-3	5.7 E-4	3.2 E-2	3.9 E-2	2.7 E-3	2.4 E-4	1.4 E-2	1.7 E-2	NA	NA	NA	NA
Dibromochloromethane	1.0 E+0	3.2 E-3	2.3 E-4	1.6 E-2	1.9 E-2	1.4 E-3	1.0 E-4	6.8 E-3	8.3 E-3	1 E-6	1 E-7	7 E-6	8 E-6
Freon 113	1.0 E+0	2.1 E-6	7.2 E-6	3.7 E-5	4.6 E-5	9.1 E-7	3.9 E-6	1.6 E-5	2.1 E-5	NA	NA	NA	0 E+0
Methylene chloride	1.0 E+0	1.1 E-3	4.0 E-5	3.7 E-4	1.5 E-3	4.6 E-4	1.7 E-5	1.6 E-4	6.3 E-4	2 E-7	8 E-9	3 E-7	5 E-7
Tetrachloroethene	1.0 E+0	6.4 E-3	3.7 E-3	3.2 E-2	4.2 E-2	2.7 E-3	1.6 E-3	1.4 E-2	1.8 E-2	8 E-6	5 E-6	2 E-6	1 E-5
Toluene	1.0 E+0	8.0 E-4	2.7 E-4	3.7 E-3	4.8 E-3	3.4 E-4	1.2 E-4	1.6 E-3	2.1 E-3	NA	NA	NA	NA
Trichloroethene	1.0 E+0	2.1 E-1	3.6 E-2	1.9 E-3	2.5 E-1	9.1 E-2	1.6 E-2	8.0 E-4	1.1 E-1	2 E-7	3 E-8	5 E-7	7 E-7
Vinyl chloride	1.0 E+0	2.1 E-2	1.2 E-3	1.1 E-2	3.3 E-2	9.1 E-3	4.9 E-4	4.7 E-3	1.4 E-2	2 E-5	1 E-6	2 E-5	4 E-5

Key:
HQ = Hazard quotient
HI = Hazard index
ILCR = Incremental lifetime cancer risk
µg/L = Micrograms per liter
NA = Not applicable

Table B-3 *Groundwater Inhalation Hazard and Unit Cancer Risk Results-Resident Zone 1*
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Chemical	Indoor Vapor Concentration (mg/m^3)	Child Unit Inhal HQ	Adult Unit Inhal HQ	Unit Inhal ILCR
Volatile Organic Compounds				
1,1,2,2-Tetrachloroethane	1.0 E+0	1.1 E+1	4.6 E+0	3 E-2
1,1,2-Trichloroethane	1.0 E+0	1.6 E+2	6.8 E+1	8 E-3
1,1-Dichloroethane	1.0 E+0	3.2 E+0	1.4 E+0	8 E-4
1,1-Dichloroethene	1.0 E+0	3.2 E+1	1.4 E+1	NA
1,2-Dichloroethane	1.0 E+0	4.6 E+2	2.0 E+2	1 E-2
1,2-Dichloroethene (cis/trans)	1.0 E+0	6.4 E+1	2.7 E+1	NA
1,4-Dioxane	1.0 E+0	7.5 E-1	3.2 E-1	4 E-3
Bromodichloromethane	1.0 E+0	3.2 E+1	1.4 E+1	2 E-2
Carbon tetrachloride	1.0 E+0	5.6 E+1	2.4 E+1	2 E-2
Chloroform	1.0 E+0	4.9 E+1	2.1 E+1	1 E-2
cis-1,2-Dichloroethene	1.0 E+0	6.4 E+1	2.7 E+1	NA
Dibromochloromethane	1.0 E+0	3.2 E+1	1.4 E+1	1 E-2
Freon 113	1.0 E+0	7.4 E-2	3.2 E-2	NA
Methylene chloride	1.0 E+0	7.5 E-1	3.2 E-1	5 E-4
Tetrachloroethene	1.0 E+0	6.4 E+1	2.7 E+1	3 E-3
Toluene	1.0 E+0	7.4 E+0	3.2 E+0	NA
Trichloroethene	1.0 E+0	3.7 E+0	1.6 E+0	1 E-3
Vinyl chloride	1.0 E+0	2.2 E+1	9.4 E+0	4 E-2

Key:
HQ = Hazard quotient
ILCR = Incremental lifetime cancer risk
µg/L = Micrograms per liter

Table B-4 *Groundwater Inhalation Hazard and Unit Cancer Risk Results-Commercial Worker Zone 1*
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Chemical	Indoor Vapor Concentration (mg/m^3)	Unit Inhal HQ	Unit Inhal ILCR
Volatile Organic Compounds			
1,1,2,2-Tetrachloroethane	1.0 E+0	3.3 E+0	1 E-2
1,1,2-Trichloroethane	1.0 E+0	4.9 E+1	4 E-3
1,1-Dichloroethane	1.0 E+0	9.8 E-1	4 E-4
1,1-Dichloroethene	1.0 E+0	9.8 E+0	NA
1,2-Dichloroethane	1.0 E+0	1.4 E+2	6 E-3
1,2-Dichloroethene (cis/trans)	1.0 E+0	2.0 E+1	NA
1,4-Dioxane	1.0 E+0	2.3 E-1	2 E-3
Bromodichloromethane	1.0 E+0	9.8 E+0	9 E-3
Carbon tetrachloride	1.0 E+0	1.7 E+1	1 E-2
Chloroform	1.0 E+0	1.5 E+1	6 E-3
cis-1,2-Dichloroethene	1.0 E+0	2.0 E+1	NA
Dibromochloromethane	1.0 E+0	9.8 E+0	7 E-3
Freon 113	1.0 E+0	2.3 E-2	NA
Methylene chloride	1.0 E+0	2.3 E-1	2 E-4
Tetrachloroethene	1.0 E+0	2.0 E+1	1 E-3
Toluene	1.0 E+0	2.3 E+0	NA
Trichloroethene	1.0 E+0	1.1 E+0	5 E-4
Vinyl chloride	1.0 E+0	6.7 E+0	2 E-2

Key:
HQ = Hazard quotient
ILCR = Incremental lifetime cancer risk
µg/L = Micrograms per liter
NA = Not applicable

Table B-5 *Groundwater Unit Hazard and Unit Cancer Risk Results-Resident*
Zone 2
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Chemical	Groundwater Concentration (µg/L)	Child Oral HQ	Child Dermal HQ	Child Inhal HQ	Unit HI	Adult Oral HQ	Adult Dermal HQ	Adult Inhal HQ	Unit HI	Oral ILCR	Dermal ILCR	Inhal ILCR	Unit ILCR
Inorganics													
Copper	1.0 E+0	1.7 E-3	1.1 E-5	NA	1.7 E-3	7.4 E-4	3.9 E-6	NA	7.4 E-4	NA	NA	NA	NA
Iron	1.0 E+0	9.1 E-5	6.0 E-7	NA	9.2 E-5	3.9 E-5	2.0 E-7	NA	3.9 E-5	NA	NA	NA	NA
Manganese	1.0 E+0	2.7 E-3	4.4 E-4	NA	3.1 E-3	1.1 E-3	1.5 E-4	NA	1.3 E-3	NA	NA	NA	NA
Nitrate	1.0 E+0	4.0 E-5	2.6 E-7	NA	4.0 E-5	1.7 E-5	8.9 E-8	NA	1.7 E-5	NA	NA	NA	NA
Perchlorate	1.0 E+0	9.1 E-2	6.0 E-4	NA	9.2 E-2	3.9 E-2	2.0 E-4	NA	3.9 E-2	NA	NA	NA	NA
Vanadium	1.0 E+0	6.4 E-2	1.6 E-2	NA	8.0 E-2	2.7 E-2	5.5 E-3	NA	3.3 E-2	NA	NA	NA	NA
Volatile Organic Compounds													
1,2-Dichloroethane	1.0 E+0	3.2 E-3	1.6 E-4	2.3 E-1	2.3 E-1	1.4 E-3	6.7 E-5	9.8 E-2	9.9 E-2	1.4 E-6	7 E-8	7 E-6	8 E-6
1,2-Dichloroethene (cis/trans)	1.0 E+0	6.4 E-3	5.7 E-4	3.2 E-2	3.9 E-2	2.7 E-3	2.4 E-4	1.4 E-2	1.7 E-2	NA	NA	NA	NA
Chloroform	1.0 E+0	6.4 E-3	5.6 E-4	2.5 E-2	3.2 E-2	2.7 E-3	2.5 E-4	1.1 E-2	1.4 E-2	4.6 E-7	4 E-8	6 E-6	6 E-6
Tetrachloroethene	1.0 E+0	6.4 E-3	3.7 E-3	3.2 E-2	4.2 E-2	2.7 E-3	1.6 E-3	1.4 E-2	1.8 E-2	8.0 E-6	5 E-6	2 E-6	1 E-5
Trichloroethene	1.0 E+0	2.1 E-1	3.6 E-2	1.9 E-3	2.5 E-1	9.1 E-2	1.6 E-2	8.0 E-4	1.1 E-1	1.9 E-7	3 E-8	5 E-7	7 E-7

Key:
HQ = Hazard quotient
HI = Hazard index
ILCR = Incremental lifetime cancer risk
µg/L = Micrograms per liter
NA = Not applicable

Table B-6 *Groundwater Inhalation Hazard and Unit Cancer Risk Results-Resident Zone 2*
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Chemical	Indoor Vapor Concentration (µg/L)	Child Unit Inhal HQ	Adult Unit Inhal HQ	Unit Inhal ILCR
Volatile Organic Compounds				
1,2-Dichloroethane	1.0 E+0	4.6 E+2	2.0 E+2	1 E-2
1,2-Dichloroethene (cis/trans)	1.0 E+0	6.4 E+1	2.7 E+1	NA
Chloroform	1.0 E+0	4.9 E+1	2.1 E+1	1 E-2
Tetrachloroethene	1.0 E+0	6.4 E+1	2.7 E+1	3 E-3
Trichloroethene	1.0 E+0	3.7 E+0	1.6 E+0	1 E-3

Key:
HQ = Hazard quotient
ILCR = Incremental lifetime cancer risk
µg/L = Micrograms per liter

Table B-7 *Groundwater Inhalation Hazard and Unit Cancer Risk Results-Commercial Worker Zone 2*
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Chemical	Indoor Vapor Concentration (µg/L)	Unit Inhal HQ	Unit Inhal ILCR
Volatile Organic Compounds			
1,2-Dichloroethane	1.0 E+0	1.4 E+2	6 E-3
1,2-Dichloroethene (cis/trans)	1.0 E+0	2.0 E+1	NA
Chloroform	1.0 E+0	1.5 E+1	6 E-3
Tetrachloroethene	1.0 E+0	2.0 E+1	1 E-3
Trichloroethene	1.0 E+0	1.1 E+0	5 E-4

Key:
HQ = Hazard quotient
ILCR = Incremental lifetime cancer risk
µg/L = Micrograms per liter
NA = Not applicable

Table B-8 *Groundwater Unit Hazard and Unit Cancer Risk Results-Resident*
Zone 3
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Chemical	Groundwater Concentration (µg/L)	Child Oral HQ	Child Dermal HQ	Child Inhal HQ	Unit HI	Adult Oral HQ	Adult Dermal HQ	Adult Inhal HQ	Unit HI	Oral ILCR	Dermal ILCR	Inhal ILCR	Unit ILCR
Inorganics													
Aluminum	1.0 E+0	6.4 E-5	2.8 E-6	NA	6.7 E-5	2.7 E-5	9.5 E-7	NA	2.8 E-5	NA	NA	NA	NA
Iron	1.0 E+0	9.1 E-5	6.0 E-7	NA	9.2 E-5	3.9 E-5	2.0 E-7	NA	3.9 E-5	NA	NA	NA	NA
Iron	1.0 E+0	9.1 E-5	6.0 E-7	NA	9.2 E-5	3.9 E-5	2.0 E-7	NA	3.9 E-5	NA	NA	NA	NA
Manganese	1.0 E+0	2.7 E-3	4.4 E-4	NA	3.1 E-3	1.1 E-3	1.5 E-4	NA	1.3 E-3	NA	NA	NA	NA
Nitrate	1.0 E+0	4.0 E-5	2.6 E-7	NA	4.0 E-5	1.7 E-5	8.9 E-8	NA	1.7 E-5	NA	NA	NA	NA
Nitrite as N	1.0 E+0	4.0 E-4	2.6 E-6	NA	4.0 E-4	1.7 E-4	8.9 E-7	NA	1.7 E-4	NA	NA	NA	NA
Perchlorate	1.0 E+0	9.1 E-2	6.0 E-4	NA	9.2 E-2	3.9 E-2	2.0 E-4	NA	3.9 E-2	NA	NA	NA	NA
Silver	1.0 E+0	1.3 E-2	5.1 E-5	NA	1.3 E-2	5.5 E-3	1.7 E-5	NA	5.5 E-3	NA	NA	NA	NA
Vanadium	1.0 E+0	6.4 E-2	1.6 E-2	NA	8.0 E-2	2.7 E-2	5.5 E-3	NA	3.3 E-2	NA	NA	NA	NA
Zinc	1.0 E+0	2.1 E-4	8.4 E-7	NA	2.1 E-4	9.1 E-5	2.9 E-7	NA	9.2 E-5	NA	NA	NA	NA
Semivolatile Organic Compounds													
Dimethyl phthalate	1.0 E+0	6.4 E-6	1.9 E-7	NA	6.6 E-6	2.7 E-6	8.3 E-8	NA	2.8 E-6	NA	NA	NA	NA
1-Methyl-2-pyrrolidinone	1.0 E+0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0 E+0
N-Nitrosodimethylamine	1.0 E+0	8.0 E+0	2.1 E+0	NA	1.0 E+1	3.4 E+0	8.9 E-1	NA	4.3 E+0	8 E-4	2 E-4	NA	9.6 E-4
Volatile Organic Compounds													
1,1-Dichloroethane	1.0 E+0	3.2 E-4	2.5 E-5	1.6 E-3	1.9 E-3	1.4 E-4	1.1 E-5	6.8 E-4	8.3 E-4	8 E-8	7 E-9	4 E-7	5.2 E-7
1,1-Dichloroethene	1.0 E+0	1.3 E-3	1.8 E-4	1.6 E-2	1.7 E-2	5.5 E-4	7.6 E-5	6.8 E-3	7.5 E-3	NA	NA	NA	NA
1,2-Dichloroethane	1.0 E+0	3.2 E-3	1.6 E-4	2.3 E-1	2.3 E-1	1.4 E-3	6.7 E-5	9.8 E-2	9.9 E-2	1 E-6	7 E-8	7 E-6	8.2 E-6
1,2-Dichloroethene (cis/trans)	1.0 E+0	6.4 E-3	5.7 E-4	3.2 E-2	3.9 E-2	2.7 E-3	2.4 E-4	1.4 E-2	1.7 E-2	NA	NA	NA	NA
1,4-Dioxane	1.0 E+0	NA	NA	3.7 E-4	3.7 E-4	NA	NA	1.6 E-4	1.6 E-4	4 E-7	1 E-9	2 E-6	2.4 E-6
Carbon tetrachloride	1.0 E+0	9.1 E-2	2.4 E-2	2.8 E-2	1.4 E-1	3.9 E-2	1.0 E-2	1.2 E-2	6.2 E-2	2 E-6	6 E-7	1 E-5	1.4 E-5
Chloroform	1.0 E+0	6.4 E-3	5.6 E-4	2.5 E-2	3.2 E-2	2.7 E-3	2.5 E-4	1.1 E-2	1.4 E-2	5 E-7	4 E-8	6 E-6	6.5 E-6
cis-1,2-Dichloroethene	1.0 E+0	6.4 E-3	5.7 E-4	3.2 E-2	3.9 E-2	2.7 E-3	2.4 E-4	1.4 E-2	1.7 E-2	NA	NA	NA	NA
Freon 113	1.0 E+0	2.1 E-6	7.2 E-6	3.7 E-5	4.6 E-5	9.1 E-7	3.9 E-6	1.6 E-5	2.1 E-5	NA	NA	NA	NA
Methylene chloride	1.0 E+0	1.1 E-3	4.0 E-5	3.7 E-4	1.5 E-3	4.6 E-4	1.7 E-5	1.6 E-4	6.3 E-4	2 E-7	8 E-9	3 E-7	4.8 E-7
Tetrachloroethene	1.0 E+0	6.4 E-3	3.7 E-3	3.2 E-2	4.2 E-2	2.7 E-3	1.6 E-3	1.4 E-2	1.8 E-2	8 E-6	5 E-6	2 E-6	1.4 E-5
Trichloroethene	1.0 E+0	2.1 E-1	3.6 E-2	1.9 E-3	2.5 E-1	9.1 E-2	1.6 E-2	8.0 E-4	1.1 E-1	2 E-7	3 E-8	5 E-7	7.5 E-7
Vinyl chloride	1.0 E+0	2.1 E-2	1.2 E-3	1.1 E-2	3.3 E-2	9.1 E-3	4.9 E-4	4.7 E-3	1.4 E-2	2 E-5	1 E-6	2 E-5	4.4 E-5

Key:
HQ = Hazard quotient
HI = Hazard index
ILCR = Incremental lifetime cancer risk
µg/L = Micrograms per liter
NA = Not applicable

Table B-9 *Groundwater Unit Hazard and Unit Cancer Risk Results-Resident*
Zone 4
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Chemical	Groundwater Concentration (µg/L)	Child Oral HQ	Child Dermal HQ	Child Inhal HQ	Unit HI	Adult Oral HQ	Adult Dermal HQ	Adult Inhal HQ	Unit HI	Oral ILCR	Dermal ILCR	Inhal ILCR	Unit ILCR
Inorganics													
Aluminum	1.0 E+0	6.4 E-5	2.8 E-6	NA	6.7 E-5	2.7 E-5	9.5 E-7	NA	2.8 E-5	NA	NA	NA	NA
Arsenic	1.0 E+0	2.1 E-1	1.4 E-3	NA	2.1 E-1	9.1 E-2	4.8 E-4	NA	9.2 E-2	1 E-4	8 E-7	NA	1.4 E-4
Barium	1.0 E+0	3.2 E-4	3.0 E-5	NA	3.5 E-4	1.4 E-4	1.0 E-5	NA	1.5 E-4	NA	NA	NA	NA
Beryllium	1.0 E+0	3.2 E-2	3.0 E-2	NA	6.2 E-2	1.4 E-2	1.0 E-2	NA	2.4 E-2	NA	NA	NA	NA
Cadmium	1.0 E+0	6.4 E-2	8.4 E-3	NA	7.2 E-2	2.7 E-2	2.9 E-3	NA	3.0 E-2	NA	NA	NA	NA
Cobalt	1.0 E+0	3.2 E-3	8.4 E-6	NA	3.2 E-3	1.4 E-3	2.9 E-6	NA	1.4 E-3	NA	NA	NA	NA
Copper	1.0 E+0	1.7 E-3	1.1 E-5	NA	1.7 E-3	7.4 E-4	3.9 E-6	NA	7.4 E-4	NA	NA	NA	NA
Lead	1.0 E+0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	1.0 E+0	9.1 E-5	6.0 E-7	NA	9.2 E-5	3.9 E-5	2.0 E-7	NA	3.9 E-5	NA	NA	NA	NA
Manganese	1.0 E+0	2.7 E-3	4.4 E-4	NA	3.1 E-3	1.1 E-3	1.5 E-4	NA	1.3 E-3	NA	NA	NA	NA
Mercury	1.0 E+0	2.1 E-1	2.0 E-2	NA	2.3 E-1	9.1 E-2	6.8 E-3	NA	9.8 E-2	NA	NA	NA	NA
Nickel	1.0 E+0	3.2 E-3	1.1 E-4	NA	3.3 E-3	1.4 E-3	3.6 E-5	NA	1.4 E-3	NA	NA	NA	NA
Nitrate	1.0 E+0	4.0 E-5	2.6 E-7	NA	4.0 E-5	1.7 E-5	8.9 E-8	NA	1.7 E-5	NA	NA	NA	NA
Perchlorate	1.0 E+0	9.1 E-2	6.0 E-4	NA	9.2 E-2	3.9 E-2	2.0 E-4	NA	3.9 E-2	NA	NA	NA	NA
Vanadium	1.0 E+0	6.4 E-2	1.6 E-2	NA	8.0 E-2	2.7 E-2	5.5 E-3	NA	3.3 E-2	NA	NA	NA	NA
Zinc	1.0 E+0	2.1 E-4	8.4 E-7	NA	2.1 E-4	9.1 E-5	2.9 E-7	NA	9.2 E-5	NA	NA	NA	NA
Semivolatile Organic Compounds													
2,4-DB	1.0 E+0	8.0 E-3	3.0 E-2	NA	3.8 E-2	3.4 E-3	1.3 E-2	NA	1.7 E-2	NA	NA	NA	NA
N-Nitrosodimethylamine	1.0 E+0	8.0 E+0	2.1 E+0	NA	1.0 E+1	3.4 E+0	8.9 E-1	NA	4.3 E+0	8 E-4	2 E-4	NA	9.6 E-4
Volatile Organic Compounds													
1,1,2-Trichloroethane	1.0 E+0	1.6 E-2	1.4 E-3	8.0 E-2	9.7 E-2	6.8 E-3	6.4 E-4	3.4 E-2	4.2 E-2	1 E-6	1 E-7	4 E-6	5 E-6
1,1-Dichloroethane	1.0 E+0	3.2 E-4	2.5 E-5	1.6 E-3	1.9 E-3	1.4 E-4	1.1 E-5	6.8 E-4	8.3 E-4	8 E-8	7 E-9	4 E-7	5 E-7
1,1-Dichloroethene	1.0 E+0	1.3 E-3	1.8 E-4	1.6 E-2	1.7 E-2	5.5 E-4	7.6 E-5	6.8 E-3	7.5 E-3	NA	NA	NA	NA
1,2-Dichloroethane	1.0 E+0	3.2 E-3	1.6 E-4	2.3 E-1	2.3 E-1	1.4 E-3	6.7 E-5	9.8 E-2	9.9 E-2	1 E-6	7 E-8	7 E-6	8 E-6
1,2-Dichloroethene (cis/trans)	1.0 E+0	6.4 E-3	5.7 E-4	3.2 E-2	3.9 E-2	2.7 E-3	2.4 E-4	1.4 E-2	1.7 E-2	NA	NA	NA	NA
1,4-Dichlorobenzene	1.0 E+0	2.1 E-3	1.4 E-3	1.4 E-3	4.9 E-3	9.1 E-4	6.1 E-4	6.0 E-4	2.1 E-3	4 E-7	2 E-7	2 E-6	2 E-6
1,4-Dioxane	1.0 E+0	NA	NA	3.7 E-4	3.7 E-4	NA	NA	1.6 E-4	1.6 E-4	4 E-7	1 E-9	2 E-6	2 E-6
Bromodichloromethane	1.0 E+0	3.2 E-3	2.5 E-4	1.6 E-2	1.9 E-2	1.4 E-3	1.1 E-4	6.8 E-3	8.3 E-3	2 E-6	2 E-7	1 E-5	1 E-5
Carbon tetrachloride	1.0 E+0	9.1 E-2	2.4 E-2	2.8 E-2	1.4 E-1	3.9 E-2	1.0 E-2	1.2 E-2	6.2 E-2	2 E-6	6 E-7	1 E-5	1 E-5
Chloroform	1.0 E+0	6.4 E-3	5.6 E-4	2.5 E-2	3.2 E-2	2.7 E-3	2.5 E-4	1.1 E-2	1.4 E-2	5 E-7	4 E-8	6 E-6	6 E-6

Table B-9 *Groundwater Unit Hazard and Unit Cancer Risk Results-Resident*
Zone 4
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Chemical	Groundwater Concentration (µg/L)	Child Oral HQ	Child Dermal HQ	Child Inhal HQ	Unit HI	Adult Oral HQ	Adult Dermal HQ	Adult Inhal HQ	Unit HI	Oral ILCR	Dermal ILCR	Inhal ILCR	Unit ILCR
Chloromethane	1.0 E+0	NA	NA	1.2 E-2	1.2 E-2	NA	NA	5.3 E-3	5.3 E-3	2 E-7	6 E-9	5 E-7	7 E-7
cis-1,2-Dichloroethene	1.0 E+0	6.4 E-3	5.7 E-4	3.2 E-2	3.9 E-2	2.7 E-3	2.4 E-4	1.4 E-2	1.7 E-2	NA	NA	NA	NA
Freon 113	1.0 E+0	2.1 E-6	7.2 E-6	3.7 E-5	4.6 E-5	9.1 E-7	3.9 E-6	1.6 E-5	2.1 E-5	NA	NA	NA	NA
Methylene chloride	1.0 E+0	1.1 E-3	4.0 E-5	3.7 E-4	1.5 E-3	4.6 E-4	1.7 E-5	1.6 E-4	6.3 E-4	2 E-7	8 E-9	3 E-7	5 E-7
Tetrachloroethene	1.0 E+0	6.4 E-3	3.7 E-3	3.2 E-2	4.2 E-2	2.7 E-3	1.6 E-3	1.4 E-2	1.8 E-2	8 E-6	5 E-6	2 E-6	1 E-5
Trichloroethene	1.0 E+0	2.1 E-1	3.6 E-2	1.9 E-3	2.5 E-1	9.1 E-2	1.6 E-2	8.0 E-4	1.1 E-1	2 E-7	3 E-8	5 E-7	7 E-7
Trichlorofluoromethane	1.0 E+0	3.2 E-4	1.0 E-3	5.6 E-3	7.0 E-3	1.4 E-4	5.6 E-4	2.4 E-3	3.1 E-3	NA	NA	NA	NA
Vinyl chloride	1.0 E+0	2.1 E-2	1.2 E-3	1.1 E-2	3.3 E-2	9.1 E-3	4.9 E-4	4.7 E-3	1.4 E-2	2 E-5	1 E-6	2 E-5	4 E-5

Key:
HQ = Hazard quotient
HI = Hazard index
ILCR = Incremental lifetime cancer risk
µg/L = Micrograms per liter
NA = Not applicable

Table B-10 *Groundwater Inhalation Hazard and Unit Cancer Risk Results-Resident*
Zone 4
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Chemical	Indoor Vapor Concentration (µg/L)	Child Unit Inhal HQ	Adult Unit Inhal HQ	Unit Inhal ILCR
Volatile Organic Compounds				
1,1,2-Trichloroethane	1.0 E+0	1.6 E+2	6.8 E+1	8 E-3
1,1-Dichloroethane	1.0 E+0	3.2 E+0	1.4 E+0	8 E-4
1,1-Dichloroethene	1.0 E+0	3.2 E+1	1.4 E+1	NA
1,2-Dichloroethane	1.0 E+0	4.6 E+2	2.0 E+2	1 E-2
1,2-Dichloroethene (cis/trans)	1.0 E+0	6.4 E+1	2.7 E+1	NA
1,4-Dichlorobenzene	1.0 E+0	2.8 E+0	1.2 E+0	3 E-3
1,4-Dioxane	1.0 E+0	7.5 E-1	3.2 E-1	4 E-3
Bromodichloromethane	1.0 E+0	3.2 E+1	1.4 E+1	2 E-2
Carbon tetrachloride	1.0 E+0	5.6 E+1	2.4 E+1	2 E-2
Chloroform	1.0 E+0	4.9 E+1	2.1 E+1	1 E-2
Chloromethane	1.0 E+0	2.5 E+1	1.1 E+1	9 E-4
cis-1,2-Dichloroethene	1.0 E+0	6.4 E+1	2.7 E+1	NA
Freon 113	1.0 E+0	7.4 E-2	3.2 E-2	NA
Methylene chloride	1.0 E+0	7.5 E-1	3.2 E-1	5 E-4
Tetrachloroethene	1.0 E+0	6.4 E+1	2.7 E+1	3 E-3
Trichloroethene	1.0 E+0	3.7 E+0	1.6 E+0	1 E-3
Trichlorofluoromethane	1.0 E+0	1.1 E+1	4.8 E+0	NA
Vinyl chloride	1.0 E+0	2.2 E+1	9.4 E+0	4 E-2

Key:
HQ = Hazard quotient
ILCR = Incremental lifetime cancer risk
µg/L = Micrograms per liter

Table B-11 *Groundwater Inhalation Hazard and Unit Cancer Risk Results-Commercial Worker*
Zone 4
Perimeter Groundwater Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Chemical	Indoor Vapor Concentration (µg/L)	Unit Inhal HQ	Unit Inhal ILCR
Volatile Organic Compounds			
1,1,2-Trichloroethane	1.0 E+0	4.9 E+1	4 E-3
1,1-Dichloroethane	1.0 E+0	9.8 E-1	4 E-4
1,1-Dichloroethene	1.0 E+0	9.8 E+0	NA
1,2-Dichloroethane	1.0 E+0	1.4 E+2	6 E-3
1,2-Dichloroethene (cis/trans)	1.0 E+0	2.0 E+1	NA
1,4-Dichlorobenzene	1.0 E+0	8.5 E-1	2 E-3
1,4-Dioxane	1.0 E+0	2.3 E-1	2 E-3
Bromodichloromethane	1.0 E+0	9.8 E+0	9 E-3
Carbon tetrachloride	1.0 E+0	1.7 E+1	1 E-2
Chloroform	1.0 E+0	1.5 E+1	6 E-3
Chloromethane	1.0 E+0	7.6 E+0	4 E-4
cis-1,2-Dichloroethene	1.0 E+0	2.0 E+1	NA
Freon 113	1.0 E+0	2.3 E-2	NA
Methylene chloride	1.0 E+0	2.3 E-1	2 E-4
Tetrachloroethene	1.0 E+0	2.0 E+1	1 E-3
Trichloroethene	1.0 E+0	1.1 E+0	5 E-4
Trichlorofluoromethane	1.0 E+0	3.4 E+0	NA
Vinyl chloride	1.0 E+0	6.7 E+0	2 E-2

Key:
HQ = Hazard quotient
ILCR = Incremental lifetime cancer risk
µg/L = Micrograms per liter
NA = Not applicable

Table B-12 *Lead Assessment - Groundwater*
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

LEAD RISK ASSESSMENT SPREADSHEET
CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

USER'S GUIDE to version 7

INPUT	
MEDIUM	LEVEL
Lead in Air (ug/m^3)	0.028
Lead in Soil/Dust (ug/g)	0.0
Lead in Water (ug/l)	39
% Home-grown Produce	0%
Respirable Dust (ug/m^3)	1.5

OUTPUT							
	Percentile Estimate of Blood Pb (µg/dl)					PRG-99	PRG-95
	50th	90th	95th	98th	99th	(µg/g)	(µg/g)
BLOOD Pb, ADULT	3.4	6.2	7.3	8.9	10.2	-30	681
BLOOD Pb, CHILD	6.8	12.5	14.8	18.0	20.4	-247	-156
BLOOD Pb, PICA CHILD	6.8	12.5	14.8	18.0	20.4	-247	-156
BLOOD Pb, OCCUPATIONAL	3.4	6.2	7.3	8.9	10.1	-32	973

EXPOSURE PARAMETERS			
	units	adults	children
Days per week	days/wk	7	
Days per week, occupational		5	
Geometric Standard Deviation		1.6	
Blood lead level of concern (ug/dl)		10	
Skin area, residential	cm^2	5700	2800
Skin area occupational	cm^2	3300	
Soil adherence	ug/cm^2	70	200
Dermal uptake constant	(ug/dl)/(ug/day)	0.0001	
Soil ingestion	mg/day	100	200
Soil ingestion, pica	mg/day		200
Ingestion constant	(ug/dl)/(ug/day)	0.04	0.16
Bioavailability	unitless	0.44	
Breathing rate	m^3/day	20	10
Inhalation constant	(ug/dl)/(ug/day)	0.082	0.192
Water ingestion	l/day	2	1
Food ingestion	kg/day	1.9	1.1
Lead in market basket	ug/kg	3.1	
Lead in home-grown produce	ug/kg	0.0	

Click here for REFERENCES

PATHWAYS						
ADULTS	Residential			Occupational		
	Pathway contribution			Pathway contribution		
Pathway	PEF	µg/dl	percent	PEF	µg/dl	percent
Soil Contact	3.8E-5	0.00	0%	1.6E-5	0.00	0%
Soil Ingestion	1.8E-3	0.00	0%	1.3E-3	0.00	0%
Inhalation, bkgrnd		0.05	1%		0.03	1%
Inhalation	2.5E-6	0.00	0%	1.8E-6	0.00	0%
Water Ingestion		3.12	92%		3.12	92%
Food Ingestion, bkgrnd		0.23	7%		0.23	7%
Food Ingestion	0.0E+0	0.00	0%			0%

CHILDREN	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	µg/dl	percent	PEF	µg/dl	percent
Soil Contact	5.4E-5	0.00	0%		0.00	0%
Soil Ingestion	1.4E-2	0.00	0%	1.4E-2	0.00	0%
Inhalation	2.9E-6	0.00	0%		0.00	0%
Inhalation, bkgrnd		0.05	1%		0.05	1%
Water Ingestion		6.24	91%		6.24	91%
Food Ingestion, bkgrnd		0.54	8%		0.54	8%
Food Ingestion	0.0E+0	0.00	0%		0.00	0%

Table B-13 *Lead Assessment - Surface Water*
Perimeter Groundwater Operable Unit Lands Risk Assessment
Aerojet Superfund Site
Sacramento County, California

LEAD RISK ASSESSMENT SPREADSHEET
CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

USER'S GUIDE to version 7

INPUT	
MEDIUM	LEVEL
Lead in Air (ug/m^3)	0.028
Lead in Soil/Dust (ug/g)	0.0
Lead in Water (ug/l)	3.3
% Home-grown Produce	0%
Respirable Dust (ug/m^3)	1.5

OUTPUT							
	Percentile Estimate of Blood Pb (µg/dl)					PRG-99	PRG-95
	50th	90th	95th	98th	99th	(µg/g)	(µg/g)
BLOOD Pb, ADULT	0.3	0.5	0.6	0.7	0.8	3423	4846
BLOOD Pb, CHILD	0.6	1.1	1.3	1.6	1.8	389	571
BLOOD Pb, PICA CHILD	0.6	1.1	1.3	1.6	1.8	389	571
BLOOD Pb, OCCUPATIONAL	0.3	0.5	0.6	0.7	0.8	2410	3415

EXPOSURE PARAMETERS			
	units	adults	children
Days per week	days/wk	3.5	
Days per week, occupational		5	
Geometric Standard Deviation		1.6	
Blood lead level of concern (ug/dl)		10	
Skin area, residential	cm^2	5700	2800
Skin area occupational	cm^2	3300	
Soil adherence	ug/cm^2	70	200
Dermal uptake constant	(ug/dl)/(ug/day)	0.0001	
Soil ingestion	mg/day	100	200
Soil ingestion, pica	mg/day		200
Ingestion constant	(ug/dl)/(ug/day)	0.04	0.16
Bioavailability	unitless	0.44	
Breathing rate	m^3/day	20	10
Inhalation constant	(ug/dl)/(ug/day)	0.082	0.192
Water ingestion	l/day	0.05	0.05
Food ingestion	kg/day	1.9	1.1
Lead in market basket	ug/kg	3.1	
Lead in home-grown produce	ug/kg	0.0	

Click here for REFERENCES

PATHWAYS						
ADULTS	Residential			Occupational		
	Pathway contribution			Pathway contribution		
Pathway	PEF	µg/dl	percent	PEF	µg/dl	percent
Soil Contact	1.9E-5	0.00	0%	1.6E-5	0.00	0%
Soil Ingestion	8.8E-4	0.00	0%	1.3E-3	0.00	0%
Inhalation, bkgrnd		0.02	9%		0.03	12%
Inhalation	1.2E-6	0.00	0%	1.8E-6	0.00	0%
Water Ingestion		0.01	3%		0.01	2%
Food Ingestion, bkgrnd		0.23	89%		0.23	86%
Food Ingestion	0.0E+0	0.00	0%			0%

CHILDREN	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	µg/dl	percent	PEF	µg/dl	percent
Soil Contact	2.7E-5	0.00	0%		0.00	0%
Soil Ingestion	7.0E-3	0.00	0%	7.0E-3	0.00	0%
Inhalation	1.4E-6	0.00	0%		0.00	0%
Inhalation, bkgrnd		0.03	5%		0.03	5%
Water Ingestion		0.03	4%		0.03	4%
Food Ingestion, bkgrnd		0.54	91%		0.54	91%
Food Ingestion	0.0E+0	0.00	0%		0.00	0%

Attachment C
Toxicological Profiles

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

1,1,2,2-TETRACHLOROETHANE

CAS # 79-34-5

Agency for Toxic Substances and Disease Registry ToxFAQs September 1997

This fact sheet answers the most frequently asked health questions (FAQs) about 1,1,2,2-tetrachloroethane. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: 1,1,2,2-Tetrachloroethane is a manufactured chemical that is no longer used much in the United States. Breathing high levels of 1,1,2,2-tetrachloroethane can cause fatigue, vomiting, dizziness, and possibly unconsciousness. Breathing, drinking, or touching it for a long period of time can cause liver damage, stomachaches, or dizziness. 1,1,2,2-Tetrachloroethane has been found in at least 273 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is 1,1,2,2-tetrachloroethane?

(Pronounced tĕt′ rə-klôr′ ō-ĕth′ān′)

1,1,2,2-Tetrachloroethane is a manufactured, colorless chemical that does not burn easily. It is volatile and has a sweet odor.

In the past, it was used in large amounts to produce other chemicals and as a solvent, to clean and degrease metals, and in paints and pesticides. Commercial production of 1,1,2,2-tetrachloroethane for these uses has stopped in the United States. It presently is used only as a chemical intermediate in the production of other chemicals.

What happens to 1,1,2,2-tetrachloroethane when it enters the environment?

- 1,1,2,2-Tetrachloroethane eventually moves into the air or ground water.
- It does not attach to soil particles when released to land.
- When released to surface water, much of it will evaporate to the air while the rest may break down in the water.
- Breakdown of the chemical is slow; it takes about 13 months for half of the chemical to disappear in ground water and 2 months in air.
- 1,1,2,2-Tetrachloroethane does not build up significantly in the bodies of fish or other organisms.

How might I be exposed to 1,1,2,2-tetrachloroethane?

- 1,1,2,2-Tetrachloroethane can be found at low levels in both indoor and outdoor air.
- It has rarely been found in public drinking water supplies, although in a few instances it has been found in private well water that may have been used for drinking.
- It has not been reported in food or soil.
- Since production of the chemical has stopped, most workers would not be exposed to it.
- Limited exposure could occur from breathing in vapors or touching it due to spills or accidents in the workplace.

How can 1,1,2,2-tetrachloroethane affect my health?

Breathing high levels of 1,1,2,2-tetrachloroethane in a closed room can cause fatigue, vomiting, dizziness, and possibly unconsciousness. However, most people recover from these effects once they are in fresh air. Breathing, drinking, or touching 1,1,2,2-tetrachloroethane can cause liver damage, stomach-

aches, or dizziness if you are exposed to large amounts for a long period of time.

The health effects from long-term (365 days or longer) exposure to low levels of 1,1,2,2-tetrachloroethane are not known. It is also not known whether 1,1,2,2-tetrachloroethane will cause reproductive effects in people.

How likely is 1,1,2,2-tetrachloroethane to cause cancer?

It is not known whether 1,1,2,2-tetrachloroethane causes cancer in people. In a long-term study, 1,1,2,2-tetrachloroethane caused an increase in liver tumors in mice, but not in rats.

The International Agency for Research on Cancer (IARC) has determined that 1,1,2,2-tetrachloroethane cannot be classified as to its ability to cause cancer in humans, while the EPA has determined that it is a possible human carcinogen.

Is there a medical test to show whether I've been exposed to 1,1,2,2-tetrachloroethane?

There are no medical tests to determine if you have been exposed to 1,1,2,2-tetrachloroethane. The symptoms of 1,1,2,2-tetrachloroethane poisoning, such as stomachaches, fatigue, and dizziness are common to many diseases and are not useful to determine if you were exposed to this chemical.

1,1,2,2-Tetrachloroethane can affect the liver and there are medical tests to determine whether the liver is working properly. However, liver disease may have many causes and does not only indicate exposure to 1,1,2,2-tetrachloroethane.

Has the federal government made recommendations to protect human health?

The EPA requires that spills or accidental releases into the environment of 100 pounds or more of 1,1,2,2-tetrachloroethane be reported to the EPA.

The Occupational Safety and Health Administration (OSHA) has set a permissible exposure limit of 5 parts of 1,1,2,2-tetrachloroethane per million parts of air (5 ppm) in the workplace during an 8-hour workday, 40-hour workweek.

The National Institute for Occupational Safety and Health (NIOSH) recommends a maximum level of 1 ppm 1,1,2,2-tetrachloroethane for a 10-hour workday, 40-hour workweek.

The American Conference of Governmental Industrial Hygienists (ACGIH) recommends an exposure limit of 6.9 milligrams of 1,1,2,2-tetrachloroethane per cubic meter of air (6.9 mg/m^3) for an 8-hour workday, 40-hour workweek.

Glossary

Carcinogen: A substance with the ability to cause cancer.

CAS: Chemical Abstracts Service.

Ingest: To eat or drink something.

Milligram (mg): One thousandth of a gram.

Pesticide: A substance that kills pests.

Solvent: A chemical that can dissolve other substances.

Tumor: An abnormal mass of tissue.

Volatile: Easily changes into a vapor or a gas.

References

This ToxFAQs information is taken from the 1996 Toxicological Profile for 1,1,2,2-Tetrachloroethane produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

1,1,2-TRICHLOROETHANE

CAS # 79-00-5

Agency for Toxic Substances and Disease Registry ToxFAQs July 1999

This fact sheet answers the most frequently asked health questions (FAQs) about 1,1,2-trichloroethane. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: 1,1,2-Trichloroethane is primarily used as a solvent and a chemical intermediate in industry. Breathing high levels of it caused effects on the liver, kidney, and nervous system in animals. This chemical has been found in at least 45 of the 1,177 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is 1,1,2-trichloroethane?

(Pronounced 1,1,2-trī-klôr′ō-ĕth′ān′)

1,1,2-Trichloroethane is a colorless, sweet-smelling liquid. It does not burn easily, can be dissolved in water, and evaporates easily. It is used as a solvent (a chemical that dissolves other substances) and as an intermediate in the production of the chemical, 1,1-dichloroethane. 1,1,2-Trichloroethane is sometimes present as an impurity in other chemicals, and it may be formed when another chemical breaks down in the environment under conditions where there is no air.

What happens to 1,1,2-trichloroethane when it enters the environment?

- Most 1,1,2-trichloroethane released into the environment will go into the air.
- 1,1,2-Trichloroethane breaks down slowly in air; it takes approximately 49 days for half of it to break down.
- 1,1,2-Trichloroethane may enter the groundwater by filtering through the soil.
- It appears to stay in water for a long time; it takes years for it to break down.

How might I be exposed to 1,1,2-trichloroethane?

- Breathing outdoor air that contains it from industrial releases.
- Drinking contaminated water.
- Breathing contaminated workplace air.
- Touching it when used as a solvent in the workplace.
- Breathing air near a hazardous waste site that contains 1,1,2-trichloroethane.

How can 1,1,2-trichloroethane affect my health?

No information is available on how breathing or swallowing 1,1,2-trichloroethane may affect your health. Applying 1,1,2-trichloroethane to the skin of a person resulted in stinging and burning of the skin.

When animals breathed high levels of 1,1,2-trichloroethane, it affected the liver and kidneys. Nervous system effects, such as excitation and sleepiness, were also seen. When animals swallowed food or water containing 1,1,2-trichloroethane, effects on the stomach, blood, liver, kidneys, and nervous system were seen.

We do not know whether 1,1,2-trichloroethane can affect reproduction in people. Animal studies have not shown the chemical to affect normal reproduction and development.

How likely is 1,1,2-trichloroethane to cause cancer?

No information is available on whether or not 1,1,2-trichloroethane will cause cancer in people. Only one study is available on the ability of 1,1,2-trichloroethane to cause cancer in animals. This study found an increase in liver cancer in mice, but not in rats, who were fed the chemical for their lifetime.

The International Agency for Research on Cancer (IARC) has determined that 1,1,2-trichloroethane is not classifiable as to its carcinogenicity to humans.

Is there a medical test to show whether I've been exposed to 1,1,2-trichloroethane?

Samples of your breath, blood, and urine can be tested to determine if you have been recently exposed to 1,1,2-trichloroethane. These tests must be done soon after the exposure occurred. These tests will not tell you whether your health will be affected by 1,1,2-trichloroethane and are not routinely available in hospitals and clinics because they require special equipment.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 0.005 milligrams of 1,1,2-trichloroethane per liter of drinking water (0.005 mg/L).

Discharges, spills, or accidental releases of 100 pounds or more of 1,1,2-trichloroethane must be reported to the EPA.

The Occupational Safety and Health Administration (OSHA) has set a permissible exposure limit of 45 milligrams 1,1,2-trichloroethane per cubic meter of air (45 mg/m^3) for an 8-hour workday in a 40-hour workweek.

The American Conference of Governmental and Industrial Hygienists (ACGIH) and the National Institute for Occupational Safety and Health (NIOSH) also recommend an occupational exposure limit of 45 mg/m^3 for 1,1,2-trichloroethane.

The federal recommendations have been updated as of July 1999.

Glossary

Carcinogenicity: Ability to cause cancer.

CAS: Chemical Abstracts Service.

Milligram (mg): One thousandth of a gram.

National Priorities List: A list of the nation's worst hazardous waste sites.

Solvent: A substance that dissolves another substance.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1989. Toxicological profile for 1,1,2-trichloroethane. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

1,1-DICHLOROETHANE

CAS # 75-34-3

Agency for Toxic Substances and Disease Registry ToxFAQs July 1999

This fact sheet answers the most frequently asked health questions (FAQs) about 1,1-dichloroethane. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: 1,1-Dichloroethane is used to make other chemicals and to dissolve and remove grease. Breathing very high levels can affect your heart and animal studies have seen kidney disease from long-term exposure to high levels in air. 1,1-Dichloroethane has been found in at least 248 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is 1,1-dichloroethane?

(Pronounced 1,1-dī′ klôr′ ō ĕth′ ān′)

1,1-Dichloroethane is a colorless, oily liquid with a sweet odor. It evaporates easily at room temperature and burns easily. It does not occur naturally in the environment.

In the past, 1,1-dichloroethane was used as a surgical anesthetic, but it is no longer used this way. Today it is used primarily to make other chemicals, to dissolve substances such as paint, varnish, and finish removers, and to remove grease.

What happens to 1,1-dichloroethane when it enters the environment?

- 1,1-Dichloroethane is released from industrial processes primarily to the air.
- 1,1-Dichloroethane evaporates from water rapidly into the air.
- It can also be found in the air as a breakdown product of another chemical, 1,1,1-trichloroethane.
- 1,1-Dichloroethane does not dissolve easily in water.
- Small amounts of 1,1-dichloroethane released to soil can evaporate into the air or move into groundwater.
- It is not known how long it stays in soil.
- 1,1-Dichloroethane is not expected to build up in the body tissues of animals.

How might I be exposed to 1,1-dichloroethane?

- Breathing air containing it from industrial releases or hazardous waste sites.
- Drinking contaminated tap water.
- Touching soil containing it.
- Touching contaminated materials in the workplace.

How can 1,1-dichloroethane affect my health?

Very limited information is available on the effects of 1,1-dichloroethane on people's health. The chemical was discontinued as a surgical anesthetic when effects on the heart, such as irregular heart beats, were reported.

Studies in animals have shown that 1,1-dichloroethane can cause kidney disease after long-term exposure to high levels in air. Delayed growth was seen in the offspring of animals who breathed high concentrations of the chemical during pregnancy.

How likely is 1,1-dichloroethane to cause cancer?

The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the EPA have not classified 1,1-dichloroethane for carcinogenicity.

1,1-Dichloroethane caused cancer in one study in which rats and mice were fed large doses of the chemical for their lifetimes.

Is there a medical test to show whether I've been exposed to 1,1-dichloroethane?

Tests are available that measure 1,1-dichloroethane in urine, blood, breath, and body tissues. These tests aren't available at most doctors' offices, but can be done at a special laboratory that has special equipment.

The tests must be done soon after exposure occurs, because most of the 1,1-dichloroethane that is taken into the body leaves within 2 days. In addition, these tests cannot tell you when you were exposed, or whether health effects will occur.

Has the federal government made recommendations to protect human health?

The EPA requires that spills or accidental releases into the environment of 1,000 pounds or more of 1,1-dichloroethane be reported to the EPA.

The Occupational Safety and Health Administration (OSHA) has set an occupational exposure limit of 400 milligrams of 1,1-dichloroethane per cubic meter of air (400 mg/m^3) for an 8-hour workday, 40-hour workweek.

The National Institute for Occupational Safety and Health (NIOSH) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommend the same exposure limit in air.

NIOSH currently recommends that a level of 12,150 mg/m^3 be considered immediately dangerous to life and health. This is the exposure level of 1,1-dichloroethane that is likely to cause permanent health problems or death.

The federal recommendations have been uipdated as of July 1999.

Glossary

Anesthetic: A substance used to cause numbness.
Carcinogenicity: Ability to cause cancer.
CAS: Chemical Abstracts Service.
Evaporate: To change into a vapor or gas.
Milligram (mg): One thousandth of a gram.

References

Agency for Toxic Substances and Disease Registry. 1990. Toxicological profile for 1,1-dichloroethane. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

1,1-DICHLOROETHENE

CAS # 75-35-4

Agency for Toxic Substances and Disease Registry ToxFAQs September 1995

This fact sheet answers the most frequently asked health questions (FAQs) about 1,1-dichloroethene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Exposure to 1,1-dichloroethene occurs mainly in the workplace. Breathing high levels of 1,1-dichloroethene can affect the liver, kidney, and central nervous system. This chemical has been found in at least 515 of 1,416 National Priorities List sites identified by the Environmental Protection Agency.

What is 1,1-dichloroethene?

(Pronounced 1,1-dī′klôr′ō ĕth′ēn)

1,1-Dichloroethene is an industrial chemical that is not found naturally in the environment. It is a colorless liquid with a mild, sweet smell. It is also called vinylidene chloride.

1,1-Dichloroethene is used to make certain plastics, such as flexible films like food wrap, and in packaging materials. It is also used to make flame retardant coatings for fiber and carpet backings, and in piping, coating for steel pipes, and in adhesive applications.

What happens to 1,1-dichloroethene when it enters the environment?

- 1,1-Dichloroethene enters the environment from industries that make or use it.
- 1,1-Dichloroethene evaporates very quickly from water and soil to the air.
- In the air, it takes about 4 days for it to break down.
- 1,1-Dichloroethene breaks down very slowly in water.
- It does not accumulate very much in fish or birds.
- In soil, 1,1-dichloroethene is slowly transformed to other less harmful chemicals.

How might I be exposed to 1,1-dichloroethene?

- Workers may be exposed in industries that make or use 1,1-dichloroethene (these industries are mainly in Texas and Louisiana).
- Food that is wrapped in plastic wrap may contain very low levels of 1,1-dichloroethene. The government controls these levels to prevent harm to your health.
- A small percentage (3%) of the drinking water supplies may contain very low levels of 1,1-dichloroethene.
- Air near factories that make or use 1,1-dichloroethene and air near hazardous waste sites may contain low levels of it.

How can 1,1-dichloroethene affect my health?

The main effect from breathing high levels of 1,1-dichloroethene is on the central nervous system. Some people lost their breath and fainted after breathing high levels of the chemical.

Breathing lower levels of 1,1-dichloroethene in air for a long time may damage your nervous system, liver, and lungs. Workers exposed to 1,1-dichloroethene have reported a loss in liver function, but other chemicals were present.

Animals that breathed high levels of 1,1-dichloroethene had damaged livers, kidneys, and lungs. The offspring of some of the animals had a higher number of birth defects. We do not know if birth defects occur when people are exposed to 1,1-dichloroethene.

Animals that ingested high levels of 1,1-dichloroethene had damaged livers, kidneys, and lungs. There were no birth defects in animals that ingested the chemical.

Spilling 1,1-dichloroethene on your skin or in your eyes can cause irritation.

How likely is 1,1-dichloroethene to cause cancer?

The Environmental Protection Agency (EPA) has determined that 1,1-dichloroethene is a possible human carcinogen.

Studies on workers who breathed 1,1-dichloroethene have not shown an increase in cancer. These studies, however, are not conclusive because of the small numbers of workers and the short time studied.

Animal studies have shown mixed results. Several studies reported an increase in tumors in rats and mice, and other studies reported no such effects.

Is there a medical test to show whether I've been exposed to 1,1-dichloroethene?

Tests are available to measure levels of 1,1-dichloroethene in breath, urine, and body tissues. These tests are not usually available in your doctor's office. However, a sample taken in your doctor's office can be sent to a special laboratory if necessary.

Because 1,1-dichloroethene leaves the body fairly quickly, these methods are useful only for finding exposures that have occurred within the last few days. These tests can't tell you if adverse health effects will occur from exposure to 1,1-dichloroethene.

Has the federal government made recommendations to protect human health?

The EPA has set a limit in drinking water of 0.007 parts of 1,1-dichloroethene per million parts of drinking water (0.007 ppm). EPA requires that discharges or spills into the environment of 5,000 pounds or more of 1,1-dichloroethene be reported.

The Occupational Safety and Health Administration (OSHA) has set an occupational exposure limit of 1 ppm of 1,1-dichloroethene in workplace air for an 8-hour workday, 40-hour workweek.

The National Institute for Occupational Safety and Health (NIOSH) currently recommends that workers breathe as little 1,1-dichloroethene as possible.

Glossary

Carcinogen: A substance that can cause cancer.
CAS: Chemical Abstracts Service.
Ingesting: Taking food or drink into your body.
ppm: Parts per million.
Tumor: An abnormal mass of tissue.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1994. Toxicological profile for 1,1-dichloroethene. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone:1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

1,2-DICHLOROETHANE

CAS #107-06-2

Division of Toxicology ToxFAQs™ September 2001

This fact sheet answers the most frequently asked health questions (FAQs) about 1,2-Dichloroethane. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to 1,2-dichloroethane usually occurs by breathing contaminated air in workplaces that use 1,2-dichloroethane. Breathing or ingesting high levels of 1,2-dichloroethane can cause damage to the nervous system, liver, kidneys, and lungs and may cause cancer. This substance has been found in at least 570 of the 1,585 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is 1,2-dichloroethane?

1,2-Dichloroethane, also called ethylene dichloride, is a manufactured chemical that is not found naturally in the environment. It is a clear liquid and has a pleasant smell and sweet taste.

The most common use of 1,2-dichloroethane is in the production of vinyl chloride which is used to make a variety of plastic and vinyl products including polyvinyl chloride (PVC) pipes, furniture and automobile upholstery, wall coverings, housewares, and automobile parts. It is also used to as a solvent and is added to leaded gasoline to remove lead.

What happens to 1,2-dichloroethane when it enters the environment?

❑ Most of the 1,2-dichloroethane released to the environment is released to the air. In the air, 1,2-dichloroethane breaks down by reacting with other compounds formed by sunlight. It can stay in the air for more than 5 months before it is broken down.
❑ 1,2-Dichloroethane can also be released into rivers and lakes. It breaks down very slowly in water and most of it will evaporate to the air.
❑ 1,2-Dichloroethane released in soil will either evaporate into the air or travel down through the soil and enter underground water.

How might I be exposed to 1,2-dichloroethane?

❑ The general population may be exposed to 1,2-dichloroethane by breathing air or drinking water that contains 1,2-dichloroethane.
❑ People who work or live near a factory where 1,2-dichloroethane is used, may be exposed to higher than usual levels.
❑ People living near uncontrolled hazardous waste sites may also be exposed to higher than usual levels of 1,2-dichloroethane.

How can 1,2-dichloroethane affect my health?

Nervous system disorders, liver and kidney diseases, and lung effects have been reported in humans ingesting or inhaling large amounts of 1,2-dichloroethane.

In laboratory animals, breathing or ingesting large amounts of 1,2-dichloroethane have also caused nervous system disorders and liver, kidney, and lung effects. Animal studies also suggest that 1,2-dichloroethane may damage the

immune system. Kidney disease has also been seen in animals ingesting low doses of 1,2-dichloroethane for a long time. Studies in animals indicate that 1,2-dichloroethane does not affect reproduction.

How likely is 1,2-dichloroethane to cause cancer?

Human studies examining whether 1,2-dichloroethane can cause cancer have been considered inadequate. In animals, increases in the occurrence of stomach, mammary gland, liver, lung, and endometrium cancers have been seen following inhalation, oral, and dermal exposure.

The Department of Health and Human Services (DHHS) has determined that 1,2-dichloroethane may reasonably be expected to cause cancer. The EPA has determined that 1,2-dichloroethane is a probable human carcinogen and the International Agency for Cancer Research (IARC) considers it to be a possible human carcinogen.

How can 1,2-dichloroethane affect children?

We do not know if exposure to 1,2-dichloroethane will result in birth defects or other developmental effects in people. Studies in animals suggest that 1,2-dichloroethane does not produce birth defects.

It is likely that health effects seen in children exposed to high levels of 1,2-dichloroethane will be similar to the effects seen in adults.

How can families reduce the risk of exposure to 1,2-dichloroethane?

The general population is not likely to be exposed to large amounts of 1,2-dichloroethane. In the past, it was used in small amounts in household products such as cleaning agents, pesticides, and wallpaper and carpet glue. Risk of exposure from this source could be eliminated if these older products were immediately discarded.

Children should avoid playing in soils near uncontrolled hazardous waste sites where 1,2-dichloroethane may have been discarded.

Is there a medical test to show whether I've been exposed to 1,2-dichloroethane?

Tests are available to measure 1,2-dichloroethane in breath, blood, breast milk, and urine of exposed people. Because 1,2-dichloroethane leaves the body fairly quickly, these tests need to be done within a couple of days of exposure. These tests cannot be used to predict the nature or severity of toxic effects. These tests are not usually done in the doctor's office.

Has the federal government made recommendations to protect human health?

The EPA allows 0.005 milligrams of 1,2-dichloroethane per liter of drinking water (0.005 mg/L).

The Occupational Safety and Health Administration has set a limit of 50 parts of 1,2-dichloroethane per million parts of air (50 ppm) in workplace air for 8 hour shifts and 40 hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2001. Toxicological Profile for 1,2-Dichloroethane. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

1,2-DICHLOROETHENE

CAS # 540-59-0, 156-59-2, and 156-60-5

Agency for Toxic Substances and Disease Registry ToxFAQs September 1997

This fact sheet answers the most frequently asked health questions (FAQs) about 1,2-dichloroethene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to 1,2-dichloroethene occurs mainly in workplaces where it is made or used. Breathing high levels of 1,2-dichloroethene can make you feel nauseous, drowsy, and tired. *cis*-1,2-Dichloroethene has been found in at least 146 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA). *trans*-1,2-Dichloroethene was found in at least 563 NPL sites. 1,2-Dichloroethene was found at 336 sites, but the isomer (*cis*- or *trans*-) was not specified.

What is 1,2-dichloroethene?

(Pronounced 1,2-dī-klôr′ ō-ĕth′ēn)

1,2-Dichloroethene, also called 1,2-dichloroethylene, is a highly flammable, colorless liquid with a sharp, harsh odor. It is used to produce solvents and in chemical mixtures. You can smell very small amounts of 1,2-dichloroethene in air (about 17 parts of 1,2-dichloroethene per million parts of air [17 ppm]).

There are two forms of 1,2-dichloroethene; one is called *cis*-1,2-dichloroethene and the other is called *trans*-1,2-dichloroethene. Sometimes both forms are present as a mixture.

What happens to 1,2-dichloroethene when it enters the environment?

- 1,2-Dichloroethene evaporates rapidly into air.
- In the air, it takes about 5-12 days for half of it to break down.
- Most 1,2-dichloroethene in the soil surface or bodies of water will evaporate into air.
- 1,2-Dichloroethene can travel through soil or dissolve in water in the soil. It is possible that it can contaminate groundwater.
- In groundwater, it takes about 13-48 weeks to break down.
- There is a slight chance that 1,2-dichloroethene will break down into vinyl chloride, a different chemical which is believed to be more toxic than 1,2-dichloroethene.

How might I be exposed to 1,2-dichloroethene?

- Breathing 1,2-dichloroethene that has leaked from hazardous waste sites and landfills.
- Drinking contaminated tap water or breathing vapors from contaminated water while cooking, bathing, or washing dishes.
- Breathing 1,2-dichloroethene, touching it, or touching contaminated materials in the workplace.

How can 1,2-dichloroethene affect my health?

Breathing high levels of 1,2-dichloroethene can make you feel nauseous, drowsy, and tired; breathing very high levels can kill you.

When animals breathed high levels of *trans*-1,2-dichloroethene for short or longer periods of time, their livers and lungs were damaged and the effects were more severe with longer exposure times. Animals that breathed very high

levels of *trans*-1,2-dichloroethene had damaged hearts.

Animals that ingested extremely high doses of *cis*- or *trans*-1,2-dichloroethene died.

Lower doses of *cis*-1,2-dichloroethene caused effects on the blood, such as decreased numbers of red blood cells, and also effects on the liver.

The long-term (365 days or longer) human health effects after exposure to low concentrations of 1,2-dichloroethene aren't known. One animal study suggested that an exposed fetus may not grow as quickly as one that hasn't been exposed.

Exposure to 1,2-dichloroethene hasn't been shown to affect fertility in people or animals.

How likely is 1,2-dichloroethene to cause cancer?

The EPA has determined that *cis*-1,2-dichloroethene is not classifiable as to its human carcinogenicity.

No EPA cancer classification is available for *trans*-1,2-dichloroethene.

Is there a medical test to show whether I've been exposed to 1,2-dichloroethene?

Tests are available to measure concentrations of the breakdown products of 1,2-dichloroethene in blood, urine, and tissues. However, these tests aren't used routinely to determine whether a person has been exposed to this compound. This is because after you are exposed to 1,2-dichloroethene, the breakdown products in your body that are detected with these tests may be the same as those that come from exposure to other chemicals. These tests aren't available in most doctors' offices, but can be done at special laboratories that have the right equipment.

Has the federal government made recommendations to protect human health?

The EPA has set the maximum allowable level of *cis*-1,2-dichloroethene in drinking water at 0.07 milligrams per liter of water (0.07 mg/L) and *trans*-1,2-dichloroethene at 0.1 mg/L.

The EPA requires that any spills or accidental release of 1,000 pounds or more of 1,2-dichloroethene must be reported to the EPA.

The Occupational Health Safety and Health Administration (OSHA) has set the maximum allowable amount of 1,2-dichloroethene in workroom air during an 8-hour workday in a 40-hour workweek at 200 parts of 1,2-dichloroethene per million parts of air (200 ppm).

Glossary

Carcinogenicity: Ability of a substance to cause cancer.

CAS: Chemical Abstracts Service.

Fertility: Ability to reproduce.

Ingest: To eat or drink something.

Milligram (mg): One thousandth of a gram.

ppm: Parts per million.

Solvent: A chemical that can dissolve other substances.

References

This ToxFAQs information is taken from the 1996 Toxicological Profile for 1,2-Dichloroethene produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

1,4-Dioxane
CAS# 123-91-1

Division of Toxicology ToxFAQs™ September 2004

This fact sheet answers the most frequently asked health questions (FAQs) about 1,4-dioxane. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to 1,4-dioxane occurs from breathing contaminated air, ingestion of contaminated food and drinking water, and dermal contact with products such as cosmetics, containing 1,4-dioxane. Exposure to high levels of 1,4-dioxane can result in liver and kidney damage. 1,4-Dioxane has been found in at least 27 of the 1,647 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is 1,4-dioxane?

1,4-Dioxane is a clear liquid that dissolves in water at all concentrations. It is used primarily as a solvent in the manufacture of chemicals and as a laboratory reagent; 1,4-dioxane also has various other uses that take advantage of its solvent properties. 1,4-Dioxane is a trace contaminant of some chemicals used in cosmetics, detergents, and shampoos. However, manufacturers now reduce 1,4-dioxane from these chemicals to low levels before these chemicals are made into products used in the home.

What happens to 1,4-dioxane when it enters the environment?

- 1,4-Dioxane can be released into the air, water, and soil at places where it is produced or used as a solvent.
- In air, 1,4-dioxane is present as a vapor.
- In water, 1,4-dioxane is stable and does not degrade; also fish and plants will not accumulate it in their tissues.
- In soil, 1,4-dioxane does not stick to soil particles, so it can move from soil into groundwater.

How might I be exposed to 1,4-dioxane?

- Breathing air, drinking water, or eating foods that contain 1,4-dioxane. During showering, bathing, or laundering, 1,4-dioxane in tap water may volatilize and you can be exposed to 1,4-dioxane vapors.
- Your skin may contact 1,4-dioxane when you use cosmetics, detergents, and shampoos containing 1,4-dioxane.

How can 1,4-dioxane affect my health?

Few studies are available that provide information about the effects of 1,4-dioxane in humans. Exposure to very high levels of 1,4-dioxane can result in liver and kidney damage and death. Eye and nose irritation was reported by people inhaling low levels of 1,4-dioxane vapors for short periods (minutes to hours). Studies in animals have shown that breathing, ingesting, or skin contact with 1,4-dioxane can liver and kidney damage. Animals that breathed high amounts of 1,4-dioxane also became drowsy.

Scientists do not know whether 1,4-dioxane affects reproduction or the ability to fight infections in people or animals.

How likely is 1,4-dioxane to cause cancer?

The limited number of studies available does not show whether 1,4-dioxane causes cancer in humans. However, laboratory rats and mice that drank water containing 1,4-dioxane during most of their lives developed liver cancer; the rats also developed cancer inside the nose. Scientists are debating the degree to which the findings in rats and mice apply to exposure situations commonly encountered by people.

The U.S. Department of Health and Human Services considers 1,4-dioxane as reasonably anticipated to be a human carcinogen.

How can 1,4-dioxane affect children?

There are no studies of children exposed to 1,4-dioxane. However, children might experience health problems similar to those in adults if they were exposed to high concentrations of 1,4-dioxane.

Scientists do not know whether exposure of pregnant women to 1,4-dioxane can harm the unborn child. Not enough animal studies are available that can help predict what might happen in people. 1,4-Dioxane does not build up in the body, but a nursing mother exposed to a high amount of 1,4-dioxane might pass it to the infant in breast milk.

How can families reduce the risk of exposure to 1,4-dioxane?

Families that drink water that could be contaminated with 1,4-dioxane can reduce the risk for exposure to 1,4-dioxane by drinking uncontaminated bottled water. Children who live near hazardous waste sites that might be contaminated with 1,4-dioxane should be discouraged from playing in mud and water near these sites because these sites might contain 1,4-dioxane. Children also should be discouraged from eating mud, and they should follow careful hand washing.

1,4-Dioxane may be a contaminant in cosmetics, detergents, and shampoos that contain the following ingredients (which may be listed on the product label): "PEG," "polyethylene," "polyethylene glycol," "polyoxyethylene," "polyethoxyethylene," or "polyoxynolethylene." Most manufacturers remove 1,4-dioxane from these ingredients to concentrations recommended by the FDA as safe. Thus, most products on the market today contain 1,4-dioxane in very small amounts or not at all. However, some cosmetics, detergents, and shampoos may contain 1,4-dioxane at levels higher than recommended by FDA. Because products contaminated at concentrations higher than the FDA-recommended levels are not possible to determine without testing, families should avoid using products containing the ingredients listed above unless the manufacturer can guarantee that 1,4-dioxane is below the FDA-recommended level.

Is there a medical test to show whether I've been exposed to 1,4-dioxane

1,4-Dioxane and its breakdown products can be measured in your blood and urine, and positive results indicate you have been exposed to 1,4-dioxane. The tests are not routinely available at your doctor's office because they require special equipment, but the doctor can collect the samples and send them to a special laboratory. The tests need to be conducted within days after the exposure because 1,4-dioxane and its breakdown products leave the body fairly rapidly. These tests do not predict whether exposure to 1,4-dioxane will produce harmful health effects.

Has the federal government made recommendations to protect human health?

EPA recommends that the levels of 1,4-dioxane in drinking water that children drink for 1 day not exceed 4 milligrams per liter (4 mg/L) or 0.4 mg/L if they drink the water for 10 days. However, a federal drinking water standard is not available.

The Occupational Safety and Health Administration (OSHA) has set a limit for of 100 parts 1,4-dioxane per 1 million parts of air (100 ppm) in the workplace.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2004. Toxicological Profile for 1,4-Dioxane (Draft for Public Comment). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

ALUMINUM
CAS # 7429-90-5

Agency for Toxic Substances and Disease Registry ToxFAQs June 1999

This fact sheet answers the most frequently asked health questions (FAQs) about aluminum. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Everyone is exposed to low levels of aluminum from food, air, and water. Exposure to high levels of aluminum may result in respiratory problems. Aluminum has been found in at least 427 of the 1,467 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is aluminum?

(Pronounced ə-lōō′mə-nəm)

Aluminum occurs naturally and makes up about 8% of the surface of the earth. It is always found combined with other elements such as oxygen, silicon, and fluorine.

Aluminum metal is silver-white and flexible. It is often used in cooking utensils, containers, appliances, and building materials. It is also used in paints and fireworks; to produce glass, rubber, and ceramics; and in consumer products such as antacids, astringents, buffered aspirin, food additives, and antiperspirants.

What happens to aluminum when it enters the environment?

- It binds to particles in the air.
- It can dissolve in lakes, streams, and rivers depending on the quality of the water.
- Acid rain may dissolve aluminum from soil and rocks.
- It can be taken up into some plants from soil.
- It is not known to bioconcentrate up the food chain.

How might I be exposed to aluminum?

- Eating small amounts of aluminum in food.
- Breathing higher levels of aluminum dust in workplace air.
- Drinking water with high levels of aluminum near waste sites, manufacturing plants, or areas naturally high in aluminum.
- Eating substances containing high levels of aluminum (such as antacids) especially when eating or drinking citrus products at the same time.
- Very little enters your body from aluminum cooking utensils.

How can aluminum affect my health?

Low-level exposure to aluminum from food, air, water, or contact with skin is not thought to harm your health. Aluminum, however, is not a necessary substance for our bodies and too much may be harmful.

People who are exposed to high levels of aluminum in air may have respiratory problems including coughing and asthma from breathing dust.

Some studies show that people with Alzheimer's disease have more aluminum than usual in their brains. We do not know whether aluminum causes the disease or whether the buildup of aluminum happens to people who already have the disease. Infants and adults who received large doses of aluminum as a treatment for another problem developed bone

diseases, which suggests that aluminum may cause skeletal problems. Some sensitive people develop skin rashes from using aluminum chlorohydrate deodorants.

How likely is aluminum to cause cancer?

The Department of Health and Human Services, the International Agency for Research on Cancer, and the EPA have not classified aluminum for carcinogenicity. Aluminum has not been shown to cause cancer in animals.

How can aluminum affect children?

Children with kidney problems who were given aluminum in their medical treatments developed bone diseases. Other health effects of aluminum on children have not been studied. It is not known whether aluminum affects children differently than adults, or what the long-term effects might be in adults exposed as children. Large amounts of aluminum have been shown to be harmful to unborn and developing animals because it can cause delays in skeletal and neurological development. Aluminum has been shown to cause lower birthweights in some animals.

How can families reduce the risk of exposure to aluminum?

The most important way families can lower exposure to aluminum is to know about the sources of aluminum and lessen exposure to these sources. Since aluminum is so common and widespread in the environment, families cannot avoid exposure to aluminum. Exposure to the low levels of aluminum that are naturally present in food and water and the forms of aluminum present in dirt and aluminum cookware is generally not harmful. The best way to reduce exposure to aluminum is to avoid taking large quantities of soluble forms of aluminum such as aluminum-containing antacids and buffered aspirin. Make sure these products have child-proof caps so children will not accidentally eat them. Some soy-based formulas may contain high levels of aluminum, so parents may want to consult with their physician when choosing an infant formula.

Is there a medical test to show whether I've been exposed to aluminum?

There are tests to measure aluminum in blood, urine, and feces. The amount in your urine can tell you whether you have been exposed to higher than normal levels of aluminum. Tests can also detect aluminum in your hair and fingernails. Not all of these tests are routinely performed at your doctor's office, but your doctor can take samples and send them to a testing laboratory.

Has the federal government made recommendations to protect human health?

EPA requires that spills or accidental releases of 5,000 pounds or more of aluminum sulfate be reported. Special regulations are set for aluminum phosphide because it is a pesticide.

EPA recommends that the concentration of aluminum in drinking water not exceed 0.2 parts of aluminum per million parts of water (0.2 ppm) because of aesthetic effects, such as taste and odor problems.

The Food and Drug Administration (FDA) has determined that aluminum cooking utensils, aluminum foil, antiperspirants, antacids, and other aluminum products are generally safe.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for aluminum. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

ARSENIC
CAS # 7440-38-2

Division of Toxicology ToxFAQs™ December 2003

This fact sheet answers the most frequently asked health questions (FAQs) about arsenic. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to higher than average levels of arsenic occurs mostly in the workplace, near hazardous waste sites, or in areas with high natural levels. At high levels, inorganic arsenic can cause death. Exposure to lower levels for a long time can cause a discoloration of the skin and the appearance of small corns or warts. Arsenic has been found at 1,014 of the 1,598 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is arsenic?

Arsenic is a naturally occurring element widely distributed in the earth's crust. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds.

Inorganic arsenic compounds are mainly used to preserve wood. Organic arsenic compounds are used as pesticides, primarily on cotton plants.

What happens to arsenic when it enters the environment?

❑ Arsenic cannot be destroyed in the environment. It can only change its form.
❑ Arsenic in air will settle to the ground or is washed out of the air by rain.
❑ Many arsenic compounds can dissolve in water.
❑ Fish and shellfish can accumulate arsenic, but the arsenic in fish is mostly in a form that is not harmful.

How might I be exposed to arsenic?

❑ Eating food, drinking water, or breathing air containing arsenic.
❑ Breathing contaminated workplace air.
❑ Breathing sawdust or burning smoke from wood treated with arsenic.
❑ Living near uncontrolled hazardous waste sites containing arsenic.
❑ Living in areas with unusually high natural levels of arsenic in rock.

How can arsenic affect my health?

Breathing high levels of inorganic arsenic can give you a sore throat or irritated lungs. Ingesting high levels of inorganic arsenic can result in death. Lower levels of arsenic can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of "pins and needles" in hands and feet.

Ingesting or breathing low levels of inorganic arsenic for a long time can cause a darkening of the skin and the

appearance of small "corns" or "warts" on the palms, soles, and torso.

Skin contact with inorganic arsenic may cause redness and swelling.

Organic arsenic compounds are less toxic than inorganic arsenic compounds. Exposure to high levels of some organic arsenic compounds may cause similar effects as inorganic arsenic.

How likely is arsenic to cause cancer?

Several studies have shown that inorganic arsenic can increase the risk of lung cancer, skin cancer, bladder cancer, liver cancer, kidney cancer, and prostate cancer. The World Health Organization (WHO), the Department of Health and Human Services (DHHS), and the EPA have determined that inorganic arsenic is a human carcinogen.

How can arsenic affect children?

We do not know if exposure to arsenic will result in birth defects or other developmental effects in people. Birth defects have been observed in animals exposed to inorganic arsenic.

It is likely that health effects seen in children exposed to high amounts of arsenic will be similar to the effects seen in adults.

How can families reduce the risk of exposure to arsenic?

❑ If you use arsenic-treated wood in home projects, you should wear dust masks, gloves, and protective clothing to decrease exposure to sawdust.
❑ If you live in an area with high levels of arsenic in water or soil, you should use cleaner sources of water and limit contact with soil.

Is there a medical test to show whether I've been exposed to arsenic?

There are tests to measure the level of arsenic in blood, urine, hair, or fingernails. The urine test is the most reliable test for arsenic exposure within the last few days. Tests on hair and fingernails can measure exposure to high levels or arsenic over the past 6-12 months. These tests can determine if you have been exposed to above-average levels of arsenic. They cannot predict how the arsenic levels in your body will affect your health.

Has the federal government made recommendations to protect human health?

EPA has set limits on the amount of arsenic that industrial sources can release to the environment and has restricted or canceled many uses of arsenic in pesticides. EPA has set a limit of 0.01 parts per million (ppm) for arsenic in drinking water.

The Occupational Safety and Health Administration has set limits of 10 μg arsenic per cubic meter of workplace air (10 $\mu g/m^3$) for 8 hour shifts and 40 hour work weeks.

Source of Information

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for Arsenic. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs™ Internet address is http://www.atsdr.cdc.gov/toxfaq.html . ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

BARIUM
CAS # 7440-39-3

Agency for Toxic Substances and Disease Registry ToxFAQs September 1995

This fact sheet answers the most frequently asked health questions (FAQs) about barium. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Exposure to barium occurs mostly in the workplace or from drinking contaminated water. Ingesting high levels of barium can cause problems with the heart, stomach, liver, kidneys, and other organs. This chemical has been found in at least 649 of 1,416 National Priorities List sites identified by the Environmental Protection Agency.

What is barium?

(Pronounced bär′ē-əm)

Barium is a silvery-white metal found in nature. It occurs combined with other chemicals such as sulfur or carbon and oxygen. These combinations are called compounds. Barium compounds can also be produced by industry.

Barium compounds are used by the oil and gas industries to make drilling muds. Drilling muds make it easier to drill through rock by keeping the drill bit lubricated. They are also used to make paint, bricks, tiles, glass, and rubber.

A barium compound (barium sulfate) is sometimes used by doctors to perform medical tests and to take x-rays of the stomach.

What happens to barium when it enters the environment?

- Barium gets into the air during the mining, refining, and production of barium compounds, and from the burning of coal and oil.
- Some barium compounds dissolve easily in water and are found in lakes, rivers, and streams.
- Barium is found in most soils and foods at low levels.
- Fish and aquatic organisms accumulate barium.

How might I be exposed to barium?

- Breathing very low levels in air, drinking water, and eating food.
- Breathing higher levels in air while working in industries that make or use barium compounds.
- Drinking water containing high levels of barium from natural sources.
- Breathing air near barium mining or processing plants.

How can barium affect my health?

The health effects of the different barium compounds depend on how well the compound dissolves in water. Barium compounds that do not dissolve well in water are not generally harmful and are often used by doctors for medical purposes.

Those barium compounds that dissolve well in water may cause harmful health effects in people. Ingesting high levels of barium compounds that dissolve well in water over the short term has resulted in

- Difficulties in breathing
- Increased blood pressure
- Changes in heart rhythm
- Stomach irritation.

- Brain swelling
- Muscle weakness
- Damage to the liver, kidney, heart, and spleen.

We don't know the effects in people of ingesting low levels of barium over the long term. Animal studies have found increased blood pressure and changes in the heart from ingesting barium over a long time. We don't know the effects of barium from breathing it or from touching it.

How likely is barium to cause cancer?

The Department of Health and Human Services, the International Agency for Research on Cancer, and the Environmental Protection Agency (EPA) have not classified barium as to its human carcinogenicity.

Barium has not been classified because there are no studies in people and the two available animal studies were inadequate to determine whether or not barium causes cancer.

Is there a medical test to show whether I've been exposed to barium?

There is no routine medical test to show whether you have been exposed to barium. However, doctors can measure barium in the blood, bones, urine, and feces, using very complex instruments. Due to the complexity of the tests, these tests are usually done only for cases of severe barium poisoning and for medical research.

Has the federal government made recommendations to protect human health?

EPA allows 2 parts of barium per million parts of drinking water (2 ppm). EPA requires that discharges or spills into the environment of 10 pounds or more of barium cyanide be reported.

The Occupational Safety and Health Administration (OSHA), the National Institute for Occupational Safety and Health (NIOSH), and the American Conference of Governmental Industrial Hygienists (ACGIH) have set an occupational exposure limit of 0.5 milligrams of soluble barium compounds per cubic meter of air (0.5 mg/m^3) for an 8-hour workday, 40-hour workweek.

The OSHA exposure limit for barium sulfate dust in air is 5 to 15 milligrams of barium per cubic meter of air (5–15 mg/m^3).

NIOSH currently recommends that a level of 50 mg/m^3 be considered immediately dangerous to life and health. This is the exposure level of barium that is likely to cause permanent health problems or death.

Glossary

Carcinogenicity: Ability to cause cancer.

Ingesting: Taking food or drink into your body.

Long-term: Lasting one year or longer.

Milligram (mg): One thousandth of a gram.

ppm: Parts per million.

Short-term: Lasting 14 days or less.

Soluble: Dissolves well in liquid.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1992. Toxicological profile for barium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

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BENZENE
CAS # 71-43-2

Agency for Toxic Substances and Disease Registry ToxFAQs September 1997

This fact sheet answers the most frequently asked health questions (FAQs) about benzene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Benzene is a widely used chemical formed from both natural processes and human activities. Breathing benzene can cause drowsiness, dizziness, and unconsciousness; long-term benzene exposure causes effects on the bone marrow and can cause anemia and leukemia. Benzene has been found in at least 813 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is benzene?

(Pronounced bĕn′zēn′)

Benzene is a colorless liquid with a sweet odor. It evaporates into the air very quickly and dissolves slightly in water. It is highly flammable and is formed from both natural processes and human activities.

Benzene is widely used in the United States; it ranks in the top 20 chemicals for production volume. Some industries use benzene to make other chemicals which are used to make plastics, resins, and nylon and synthetic fibers. Benzene is also used to make some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides. Natural sources of benzene include volcanoes and forest fires. Benzene is also a natural part of crude oil, gasoline, and cigarette smoke.

What happens to benzene when it enters the environment?

- Industrial processes are the main source of benzene in the environment.
- Benzene can pass into the air from water and soil.
- It reacts with other chemicals in the air and breaks down within a few days.
- Benzene in the air can attach to rain or snow and be carried back down to the ground.
- It breaks down more slowly in water and soil, and can pass through the soil into underground water.
- Benzene does not build up in plants or animals.

How might I be exposed to benzene?

- Outdoor air contains low levels of benzene from tobacco smoke, automobile service stations, exhaust from motor vehicles, and industrial emissions.
- Indoor air generally contains higher levels of benzene from products that contain it such as glues, paints, furniture wax, and detergents.
- Air around hazardous waste sites or gas stations will contain higher levels of benzene.
- Leakage from underground storage tanks or from hazardous waste sites containing benzene can result in benzene contamination of well water.
- People working in industries that make or use benzene may be exposed to the highest levels of it.
- A major source of benzene exposures is tobacco smoke.

How can benzene affect my health?

Breathing very high levels of benzene can result in death, while high levels can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. Eating or drinking foods containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, and death.

The major effect of benzene from long-term (365 days or longer) exposure is on the blood. Benzene causes harmful effects on the bone marrow and can cause a decrease in red blood cells leading to anemia. It can also cause excessive bleeding and can affect the immune system, increasing the chance for infection.

Some women who breathed high levels of benzene for many months had irregular menstrual periods and a decrease in the size of their ovaries. It is not known whether benzene exposure affects the developing fetus in pregnant women or fertility in men.

Animal studies have shown low birth weights, delayed bone formation, and bone marrow damage when pregnant animals breathed benzene.

How likely is benzene to cause cancer?

The Department of Health and Human Services (DHHS) has determined that benzene is a known human carcinogen. Long-term exposure to high levels of benzene in the air can cause leukemia, cancer of the blood-forming organs.

Is there a medical test to show whether I've been exposed to benzene?

Several tests can show if you have been exposed to benzene. There is test for measuring benzene in the breath; this test must be done shortly after exposure. Benzene can also be measured in the blood, however, since benzene disappears rapidly from the blood, measurements are accurate only for recent exposures.

In the body, benzene is converted to products called metabolites. Certain metabolites can be measured in the urine. However, this test must be done shortly after exposure and is not a reliable indicator of how much benzene you have been exposed to, since the metabolites may be present in urine from other sources.

Has the federal government made recommendations to protect human health?

The EPA has set the maximum permissible level of benzene in drinking water at 0.005 milligrams per liter (0.005 mgL). The EPA requires that spills or accidental releases into the environment of 10 pounds or more of benzene be reported to the EPA.

The Occupational Safety and Health Administration (OSHA) has set a permissible exposure limit of 1 part of benzene per million parts of air (1 ppm) in the workplace during an 8-hour workday, 40-hour workweek.

Glossary

Anemia: A decreased ability of the blood to transport oxygen.

Carcinogen: A substance with the ability to cause cancer.

CAS: Chemical Abstracts Service.

Chromosomes: Parts of the cells responsible for the development of hereditary characteristics.

Metabolites: Breakdown products of chemicals.

Milligram (mg): One thousandth of a gram.

Pesticide: A substance that kills pests.

References

This ToxFAQs information is taken from the 1997 Toxicological Profile for Benzene (update) produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

BORON
CAS # 7440-42-8

Agency for Toxic Substances and Disease Registry ToxFAQs September 1995

This fact sheet answers the most frequently asked health questions (FAQs) about boron. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Exposure to boron occurs in the workplace or from using certain consumer products. Breathing moderate levels of boron irritates the nose, throat, and eyes. This chemical has been found in at least 142 of 1,416 National Priorities List sites identified by the Environmental Protection Agency.

What is boron?
(Pronounced bôr′ŏn′)

Boron is a compound that occurs in nature. It is often found combined with other substances to form compounds called borates. Common borate compounds include boric acid, salts of borates, and boron oxide.

Several companies in the United States produce most of the world's borates by processing boron compounds. Borates are used mostly to produce glass. They are also used in fire retardants, leather tanning industries, cosmetics, photographic materials, soaps and cleaners, and for high-energy fuel. Some pesticides used for cockroach control and some wood preservatives also contain borates.

What happens to boron when it enters the environment?

- Boron is released to the environment from natural sources such as oceans, volcanoes, and geothermal steam.
- Boron is also released from industries that use it.
- No information is available on how long boron remains in air, water, or soil.
- Boron does not appear to accumulate in fish or other organisms in water.
- Boron accumulates in plants and is found in foods, mainly fruits and vegetables.

How might I be exposed to boron?

- In air, water, and food at low levels.
- Drinking water that contains it from areas where boron is found naturally at high levels in the earth.
- Eating foods containing high levels.
- Working in borax mining and refining plants and at sites where boric acid is manufactured.
- Using consumer products that contain it, such as cosmetics and laundry products.

How can boron affect my health?

There is little information on the health effects of long-term exposure to boron. Most of the studies are on short-term exposures.

Breathing moderate levels of boron can result in irritation of the nose, throat, and eyes. Reproductive effects, such as low sperm count, were seen in men exposed to boron over the long-term. Animal studies have shown effects on the lungs from breathing high levels of boron.

Ingesting large amounts of boron over short periods of time can harm the stomach, intestines, liver, kidney, and

brain. Animal studies of ingestion of boron found effects on the testes in male animals. Birth defects were also seen in the offspring of female animals exposed during pregnancy.

We don't know what the effects are in people from skin contact with boron. Animal studies have found skin irritation when boron was applied directly to the skin.

How likely is boron to cause cancer?

The Department of Health and Human Services, the International Agency for Research on Cancer, and the Environmental Protection Agency (EPA) have not classified boron as to its human carcinogenicity.

One animal study found no evidence of cancer after lifetime exposure to boric acid in food. No human studies are available.

Is there a medical test to show whether I've been exposed to boron?

Tests are available to measure boron levels in blood and urine. These tests must be done shortly after exposure, because most excess boron leaves the body through the urine within a few days of exposure.

These tests are not usually performed in doctors' offices because special equipment is needed to conduct them. It is not known whether boron levels measured in the body can be used to predict whether health problems will occur.

Has the federal government made recommendations to protect human health?

The EPA allows no more than 30 parts of boron per million parts of cottonseed oil (30 ppm) and 8 ppm of boron in or on citrus fruits.

The EPA requires that discharges or spills into the environment of 100 pounds of more of boron trichloride and boron trifluoride be reported.

The Occupational Safety and Health Administration (OSHA) has set an occupational exposure limit of 15 milligrams per cubic meter (15 mg/m^3) for boron oxide dust in workplace air for an 8-hour workday, 40-hour workweek.

The National Institute for Occupational Safety and Health (NIOSH) currently recommends an occupational exposure limit of 10 mg/m^3 for boron oxide dust.

NIOSH also recommends that 25 ppm boron trifluoride be considered immediately dangerous to life and health. This is the exposure level of a chemical that is likely to cause permanent health problems or death.

The Food and Drug Administration (FDA) allows no more than 310 ppm of boron as a food additive.

Glossary

Carcinogenicity: Ability to cause cancer.

Ingesting: Taking food or drink into your body.

Long-term: Lasting one year or longer.

Milligram (mg): One thousandth of a gram.

Pesticides: Chemicals used to kill pests.

ppm: Parts per million.

Short-term: Lasting 14 days or less.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1992. Toxicological profile for boron. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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BROMODICHLOROMETHANE

CAS # 75-27-4

Agency for Toxic Substances and Disease Registry ToxFAQs July 1999

This fact sheet answers the most frequently asked health questions (FAQs) about bromodichloromethane. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Most bromodichloromethane is formed as a by-product when chlorine is added to water-supply systems. Bromodichloromethane is not known to cause adverse health effects in people, but animal studies show that high concentrations can damage the liver and kidneys and affect the brain. Bromodichloromethane has been found at 5 of the 1,518 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is bromodichloromethane?

(Pronounced brō′mō dī-klôr′ō měth′ān′)

Bromodichloromethane is a colorless, nonflammable liquid. Small amounts are formed naturally by algae in the oceans. Some of it will dissolve in water, but it readily evaporates into air.

Only small quantities of bromodichloromethane are produced in the United States. The small quantities that are produced are used in laboratories or to make other chemicals. However, most bromodichloromethane is formed as a by-product when chlorine is added to drinking water to kill bacteria.

What happens to bromodichloromethane when it enters the environment?

- Bromodichloromethane released to air is slowly broken down by reactions with other chemicals and sunlight or it can be removed by rain.
- In water, it will evaporate to the air and/or be broken down slowly by bacteria.
- When released to soil, most will evaporate to the air but some of it will be broken down by bacteria.
- Some bromodichloromethane may filter into the groundwater.
- Bromodichloromethane does not build up in the food chain.

How might I be exposed to bromodichloromethane?

- The most likely way people are exposed to bromodichloromethane is by drinking chlorinated water.
- You may breathe vapors released from chlorinated water in a swimming pool or in the home (cooking, washing dishes, bathing, etc.).
- Some bromodichloromethane may enter your body directly through your skin when bathing or swimming.
- People who live near a waste site containing bromodichloromethane could be exposed by drinking contaminated groundwater or breathing vapors released to the air.
- People who work at or live near a laboratory or factory that makes or uses this chemical could be exposed by breathing bromodichloromethane in the air.

How can bromodichloromethane affect my health?

No studies are available regarding health effects in people exposed to bromodichloromethane.

Animal studies indicate that the liver, kidney, and central nervous system are affected by exposure to bromodichloromethane. The effects of high doses on the central nervous system include sleepiness and incoordination. Longer exposure to lower doses causes damage to the liver and kidneys. There is some evidence from animal studies that bromodichloromethane may cause birth defects at doses high enough to make the mother sick. It is not known if lower doses would cause birth defects.

How likely is bromodichloromethane to cause cancer?

There is evidence that eating or drinking bromodichloromethane causes liver, kidney, and intestinal cancer in rats and mice. The Department of Health and Human Services (DHHS) has determined that bromodichloromethane is reasonably anticipated to be a human carcinogen.

Is there a medical test to show whether I've been exposed to bromodichloromethane?

Methods are available to measure low levels of bromodichloromethane in human blood, breath, urine, and fat, but not enough information is available to use such tests to predict if any health effects might occur. Because special equipment is needed, these tests are not usually done in the doctor's office.

Has the federal government made recommendations to protect human health?

The EPA has set a Maximum Contaminant Level (MCL) of 0.1 parts per million (ppm) for the combination of bromodichloromethane and a group of similar compounds (called trihalomethanes) that occur in chlorinated water. The EPA recommends that levels of halomethanes in lakes and streams should be limited to 0.19 ppm to prevent possible health effects from drinking water or eating fish contaminated with this group of chemicals.

Any release to the environment greater than 5,000 pounds of bromodichloromethane must be reported to the EPA.

The federal recommendations have been updated as of July 1999.

Glossary

Carcinogen: A substance that can cause cancer.
CAS: Chemical Abstracts Service.
Evaporate: To change into a vapor or a gas.
National Priorities List: A list of the nation's worst hazardous waste sites.
ppm: Parts per million.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1989. Toxicological profile for bromodichloromethane. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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CADMIUM
CAS # 7440-43-9

Agency for Toxic Substances and Disease Registry ToxFAQs June 1999

This fact sheet answers the most frequently asked health questions (FAQs) about cadmium. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to cadmium happens mostly in the workplace where cadmium products are made. The general population is exposed from breathing cigarette smoke or eating cadmium contaminated foods. Cadmium damages the lungs, can cause kidney disease, and may irritate the digestive tract. This substance has been found in at least 776 of the 1,467 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is cadmium?

(Pronounced kăd′mē-əm)

Cadmium is a natural element in the earth's crust. It is usually found as a mineral combined with other elements such as oxygen (cadmium oxide), chlorine (cadmium chloride), or sulfur (cadmium sulfate, cadmium sulfide).

All soils and rocks, including coal and mineral fertilizers, contain some cadmium. Most cadmium used in the United States is extracted during the production of other metals like zinc, lead, and copper. Cadmium does not corrode easily and has many uses, including batteries, pigments, metal coatings, and plastics.

What happens to cadmium when it enters the environment?

- Cadmium enters air from mining, industry, and burning coal and household wastes.
- Cadmium particles in air can travel long distances before falling to the ground or water.
- It enters water and soil from waste disposal and spills or leaks at hazardous waste sites.
- It binds strongly to soil particles.
- Some cadmium dissolves in water.
- It doesn't break down in the environment, but can change forms.
- Fish, plants, and animals take up cadmium from the environment.
- Cadmium stays in the body a very long time and can build up from many years of exposure to low levels.

How might I be exposed to cadmium?

- Breathing contaminated workplace air (battery manufacturing, metal soldering or welding).
- Eating foods containing it; low levels in all foods (highest in shellfish, liver, and kidney meats).
- Breathing cadmium in cigarette smoke (doubles the average daily intake).
- Drinking contaminated water.
- Breathing contaminated air near the burning of fossil fuels or municipal waste.

How can cadmium affect my health?

Breathing high levels of cadmium severely damages the lungs and can cause death. Eating food or drinking water with very high levels severely irritates the stomach, leading to vomiting and diarrhea. Long-term exposure to lower levels of cadmium in air, food, or water leads to a buildup of cadmium in the kidneys and possible kidney disease.

Other long-term effects are lung damage and fragile bones. Animals given cadmium in food or water had high blood pressure, iron-poor blood, liver disease, and nerve or brain damage.

We don't know if humans get any of these diseases from eating or drinking cadmium. Skin contact with cadmium is not known to cause health effects in humans or animals.

How likely is cadmium to cause cancer?

The Department of Health and Human Services (DHHS) has determined that cadmium and cadmium compounds may reasonably be anticipated to be carcinogens.

How can cadmium affect children?

The health effects in children are expected to be similar to those in adults (kidney, lung and intestinal damage).

We don't know if cadmium causes birth defects in people. Cadmium does not readily go from a pregnant woman's body into the developing child, but some portion can cross the placenta. It can also be found in breast milk. The babies of animals exposed to high levels of cadmium during pregnancy had changes in behavior and learning ability. Cadmium may also affect birth weight and the skeleton in developing animals.

Animal studies also indicate that more cadmium is absorbed into the body if the diet is low in calcium, protein, or iron, or is high in fat. A few studies show that younger animals absorb more cadmium and are more likely to lose bone and bone strength than adults.

How can families reduce the risk of exposure to cadmium?

In the home, store substances that contain cadmium safely, and keep nickel-cadmium batteries out of reach of young children. If you work with cadmium, use all safety precautions to avoid carrying cadmium-containing dust home from work on your clothing, skin, hair, or tools.

A balanced diet can reduce the amount of cadmium taken into the body from food and drink.

Is there a medical test to show whether I've been exposed to cadmium?

Tests are available in some medical laboratories that measure cadmium in blood, urine, hair, or nails. Blood levels show recent exposure to cadmium, and urine levels show both recent and earlier exposure. The reliability of tests for cadmium levels in hair or nails is unknown.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 5 parts of cadmium per billion parts of drinking water (5 ppb). EPA doesn't allow cadmium in pesticides.

The Food and Drug Administration (FDA) limits the amount of cadmium in food colors to 15 parts per million (15 ppm).

The Occupational Safety and Health Administration (OSHA) limits workplace air to 100 micrograms cadmium per cubic meter (100 $\mu g/m^3$) as cadmium fumes and 200 μg cadmium/m^3 as cadmium dust.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for cadmium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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CARBON TETRACHLORIDE

CAS # 56-23-5

Agency for Toxic Substances and Disease Registry ToxFAQs September 1995

This fact sheet answers the most frequently asked health questions (FAQs) about carbon tetrachloride. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Exposure to carbon tetrachloride results mostly from breathing air, drinking water, or coming in contact with soil that is contaminated with it. This is most likely to occur around hazardous waste sites or in the workplace. In people, exposure to very high amounts of carbon tetrachloride can damage the liver, kidneys, and nervous system. This chemical has been found in at least 326 of 1,416 National Priorities List sites identified by the Environmental Protection Agency.

What is carbon tetrachloride?

(Pronounced kär′bən tĕt′rə klôr′īd′)

Carbon tetrachloride is a manufactured compound that does not occur naturally. It's a clear liquid with a sweet smell that can be detected at low levels. It's also called carbon chloride, methane tetrachloride, perchloromethane, tetrachloromethane, or benziform. Trade names include Benzinoform, Freon 10, Halon 104, Tetraform, or Tetrasol.

Carbon tetrachloride is most often found as a colorless gas. It's not flammable and doesn't dissolve in water very easily. It was used in the production of refrigeration fluid and propellants for aerosol cans, as a pesticide, as a cleaning fluid and degreasing agent, in fire extinguishers, and in spot removers. Because of its harmful effects, these uses are now banned and it is only used in some industrial applications.

What happens to carbon tetrachloride when it enters the environment?

- It moves very quickly into the air upon release, so most of it is in the air.
- It evaporates very quickly from soil and surface water.
- Only a small amount sticks to soil particles; the rest evaporates or moves into the groundwater.
- It is very stable in air (lifetime of 30-100 years).
- It can be broken down or transformed in soil and water within several days.
- When it does break down, it forms chemicals that can destroy ozone in the upper atmosphere.
- It doesn't build up in animals. We do not know if it builds up in plants.

How might I be exposed to carbon tetrachloride?

- Breathing contaminated air near manufacturing plants or waste sites.
- Breathing workplace air when it is used.
- Drinking contaminated water near manufacturing plants and waste sites.
- Breathing contaminated air and skin contact with water while showering or cooking with contaminated water.
- Swimming or bathing in contaminated water.
- Contact with or eating contaminated soil at waste sites.

How can carbon tetrachloride affect my health?

High exposure to carbon tetrachloride can cause liver, kidney, and central nervous system damage. These effects result from either eating, drinking, or breathing it, and possibly from exposure to the skin. The liver is especially sensitive to carbon tetrachloride because it swells and cells

are damaged or destroyed. Kidneys are also damaged, causing a buildup of wastes in the blood. If exposure is low and then stops, the liver and kidneys can repair the damaged cells and function normally again.

If exposure is very high, the nervous system, including the brain, is affected. People may feel intoxicated and experience headaches, dizziness, sleepiness, and nausea and vomiting. These effects may subside if exposure is stopped, but in severe cases, coma and even death can occur.

There have been no studies in people on carbon tetrachloride's effects on reproduction or development, but studies in rats showed no adverse effects.

How likely is carbon tetrachloride to cause cancer?

The Department of Health and Human Services has determined that carbon tetrachloride may reasonably be anticipated to be a carcinogen.

Animals that ingested carbon tetrachloride over a long time developed liver cancer. We do not know if breathing carbon tetrachloride causes cancer in animals. We also do not know if breathing or ingesting it will cause cancer in people.

Is there a medical test to show whether I've been exposed to carbon tetrachloride?

Several sensitive and specific tests are available to measure the amount of carbon tetrachloride in your breath, blood, urine, and body tissues. The tests can't tell you how much carbon tetrachloride you were exposed to or whether there will be any effects on your health. The tests must be done soon after exposure because it leaves your body quickly. These tests aren't routinely performed in doctors' offices, but your doctor can tell you where to obtain such a test.

Has the federal government made recommendations to protect human health?

The Environmental Protection Agency (EPA) has set a limit of 0.005 parts of carbon tetrachloride per million parts of drinking water (0.005 ppm). The EPA recommends that drinking water exposures should not exceed 0.3 ppm for adults and 0.07 ppm for children for long periods of time (7 years).

The EPA has also set limits on how much carbon tetrachloride can be released from an industrial plant into wastewater and is preparing to set limits on how much can be released into outside air.

The Occupational Safety and Health Administration (OSHA) set a maximum concentration limit in workplace air of 10 ppm for an 8-hour workday over a 40-hour workweek.

Glossary

Carcinogen: A substance that can cause cancer.

Evaporate: To change into a vapor or a gas.

Ingesting: Taking food or drink into your body.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1994. Toxicological profile for carbon tetrachloride. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Agency for Toxic Substances and Disease Registry (ATSDR). 1992. Case studies in environmental medicine. Carbon tetrachloride toxicity. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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CHLOROFORM
CAS # 67-66-3

Agency for Toxic Substances and Disease Registry ToxFAQs September 1997

This fact sheet answers the most frequently asked health questions (FAQs) about chloroform. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to chloroform can occur when breathing contaminated air or when drinking or touching the substance or water containing it. Breathing chloroform can cause dizziness, fatigue, and headaches. Breathing chloroform or ingesting chloroform over long periods of time may damage your liver and kidneys. It can cause sores if large amounts touch your skin. This substance has been found in at least 717 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is chloroform?
(Pronounced klôr′ə-fôrm′)

Chloroform is a colorless liquid with a pleasant, nonirritating odor and a slightly sweet taste. It will burn only when it reaches very high temperatures.

In the past, chloroform was used as an inhaled anesthetic during surgery, but it isn't used that way today. Today, chloroform is used to make other chemicals and can also be formed in small amounts when chlorine is added to water.

Other names for chloroform are trichloromethane and methyl trichloride.

What happens to chloroform when it enters the environment?

- Chloroform evaporates easily into the air.
- Most of the chloroform in air breaks down eventually, but it is a slow process.
- The breakdown products in air include phosgene and hydrogen chloride, which are both toxic.
- It doesn't stick to soil very well and can travel through soil to groundwater.
- Chloroform dissolves easily in water and some of it may break down to other chemicals.
- Chloroform lasts a long time in groundwater.
- Chloroform doesn't appear to build up in great amounts in plants and animals.

How might I be exposed to chloroform?

- Drinking water or beverages made using water containing chloroform.
- Breathing indoor or outdoor air containing it, especially in the workplace.
- Eating food that contains it.
- Skin contact with chloroform or water that contains it, such as in swimming pools.

How can chloroform affect my health?

Breathing about 900 parts of chloroform per million parts air (900 ppm) for a short time can cause dizziness, fatigue, and headache. Breathing air, eating food, or drinking water containing high levels of chloroform for long periods of time may damage your liver and kidneys. Large amounts of chloroform can cause sores when chloroform touches your skin.

It isn't known whether chloroform causes reproductive effects or birth defects in people.

Animal studies have shown that miscarriages occurred in rats and mice that breathed air containing 30 to 300 ppm chloroform during pregnancy and also in rats that ate chloroform during pregnancy. Offspring of rats and mice that breathed chloroform during pregnancy had birth defects. Abnormal sperm were found in mice that breathed air containing 400 ppm chloroform for a few days.

How likely is chloroform to cause cancer?

The Department of Health and Human Services (DHHS) has determined that chloroform may reasonably be anticipated to be a carcinogen.

Rats and mice that ate food or drank water with chloroform developed cancer of the liver and kidneys.

Is there a medical test to show whether I've been exposed to chloroform?

Although the amounts of chloroform in the air that you exhale and in blood, urine, and body tissues can be measured, there is no reliable test to determine how much chloroform you have been exposed to or whether you will experience any harmful effects.

The measurement of chloroform in body fluids and tissues may help to determine if you have come into contact with large amounts of chloroform, but these tests are useful for only a short time after you are exposed. Chloroform in your body might also indicate that you have come into contact with other chemicals.

Has the federal government made recommendations to protect human health?

The EPA drinking water limit for total trihalomethanes, a class of chemicals that includes chloroform, is 100 micrograms per liter of water (100 μg/L).

The EPA requires that spills or accidental releases of 10 pounds or more of chloroform into the environment be reported to the EPA.

The Occupational Safety and Health Administration (OSHA) has set the maximum allowable concentration of chloroform in workroom air during an 8-hour workday in a 40-hour workweek at 50 ppm.

Glossary

Carcinogenicity: A substance with the ability to cause cancer.

CAS: Chemical Abstracts Service.

Ingesting: Taking food or drink into your body.

Microgram (μg): One millionth of a gram.

Miscarriage: Pregnancy loss.

ppm: Parts per million.

References

This ToxFAQs information is taken from the 1997 Toxicological Profile for Chloroform (update) produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone:1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

CHROMIUM
CAS # 7440-47-3

Division of Toxicology ToxFAQs™ February 2001

This fact sheet answers the most frequently asked health questions (FAQs) about chromium. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to chromium occurs from ingesting contaminated food or drinking water or breathing contaminated workplace air. Chromium(VI) at high levels can damage the nose and can cause cancer. Chromium has been found at 1,036 of the 1,591 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is chromium?

Chromium is a naturally occurring element found in rocks, animals, plants, soil, and in volcanic dust and gases. Chromium is present in the environment in several different forms. The most common forms are chromium(0), chromium(III), and chromium(VI). No taste or odor is associated with chromium compounds.

Chromium(III) occurs naturally in the environment and is an essential nutrient. Chromium(VI) and chromium(0) are generally produced by industrial processes.

The metal chromium, which is the chromium(0) form, is used for making steel. Chromium(VI) and chromium(III) are used for chrome plating, dyes and pigments, leather tanning, and wood preserving.

What happens to chromium when it enters the environment?

❑ Chromium enters the air, water, and soil mostly in the chromium(III) and chromium(VI) forms.
❑ In air, chromium compounds are present mostly as fine dust particles which eventually settle over land and water.
❑ Chromium can strongly attach to soil and only a small amount can dissolve in water and move deeper in the soil to underground water.
❑ Fish do not accumulate much chromium in their bodies from water.

How might I be exposed to chromium?

❑ Eating food containing chromium(III).
❑ Breathing contaminated workplace air or skin contact during use in the workplace.
❑ Drinking contaminated well water.
❑ Living near uncontrolled hazardous waste sites containing chromium or industries that use chromium.

How can chromium affect my health?

Chromium(III) is an essential nutrient that helps the body use sugar, protein, and fat.

Breathing high levels of chromium(VI) can cause irritation to the nose, such as runny nose, nosebleeds, and ulcers and holes in the nasal septum.

Ingesting large amounts of chromium(VI) can cause stomach upsets and ulcers, convulsions, kidney and liver damage, and even death.

Skin contact with certain chromium(VI) compounds can cause skin ulcers. Some people are extremely sensitive to chromium(VI) or chromium(III). Allergic reactions consisting of severe redness and swelling of the skin have been noted.

How likely is chromium to cause cancer?

Several studies have shown that chromium(VI) compounds can increase the risk of lung cancer. Animal studies have also shown an increased risk of cancer.

The World Health Organization (WHO) has determined that chromium(VI) is a human carcinogen.

The Department of Health and Human Services (DHHS) has determined that certain chromium(VI) compounds are known to cause cancer in humans.

The EPA has determined that chromium(VI) in air is a human carcinogen.

How can chromium affect children?

We do not know if exposure to chromium will result in birth defects or other developmental effects in people. Birth defects have been observed in animals exposed to chromium(VI).

It is likely that health effects seen in children exposed to high amounts of chromium will be similar to the effects seen in adults.

How can families reduce the risk of exposure to chromium?

❑ Children should avoid playing in soils near uncontrolled hazardous waste sites where chromium may have been discarded.

❑ Although chromium(III) is an essential nutrient, you should avoid excessive use of dietary supplements containing chromium.

Is there a medical test to show whether I've been exposed to chromium?

Since chromium(III) is an essential element and naturally occurs in food, there will always be some level of chromium in your body. There are tests to measure the level of chromium in hair, urine, and blood. These tests are most useful for people exposed to high levels. These tests cannot determine the exact levels of chromium that you may have been exposed to or predict how the levels in your tissues will affect your health.

Has the federal government made recommendations to protect human health?

EPA has set a limit of 100 μg chromium(III) and chromium(VI) per liter of drinking water (100 μg/L).

The Occupational Safety and Health Administration (OSHA) has set limits of 500 μg water soluble chromium(III) compounds per cubic meter of workplace air (500 $\mu g/m^3$), 1,000 $\mu g/m^3$ for metallic chromium(0) and insoluble chromium compounds, and 52 $\mu g/m^3$ for chromium(VI) compounds for 8-hour work shifts and 40-hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for Chromium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

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COBALT

CAS #7440-48-4

Division of Toxicology ToxFAQs™ April 2004

This fact sheet answers the most frequently asked health questions (FAQs) about cobalt. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: The general population is exposed to low levels of cobalt in air, water, and food. Cobalt has both beneficial and harmful effects on health. At low levels, it is part of vitamin B12, which is essential for good health. At high levels, it may harm the lungs and heart. This chemical has been found in at least 426 of the 1,636 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is cobalt?

Cobalt is a naturally occurring element found in rocks, soil, water, plants, and animals. Cobalt is used to produce alloys used in the manufacture of aircraft engines, magnets, grinding and cutting tools, artificial hip and knee joints. Cobalt compounds are also used to color glass, ceramics and paints, and used as a drier for porcelain enamel and paints.

Radioactive cobalt is used for commercial and medical purposes. ^{60}Co (read as cobalt sixty) is used for sterilizing medical equipment and consumer products, radiation therapy for treating cancer patients, manufacturing plastics, and irradiating food. ^{57}Co is used in medical and scientific research. It takes about 5.27 years for half of ^{60}Co to give off its radiation and about 272 days for ^{57}Co; this is called the half-life.

What happens to cobalt when it enters the environment?

❑ Cobalt enters the environment from natural sources and the burning of coal or oil or the production of cobalt alloys.
❑ In the air, cobalt will be associated with particles that settle to the ground within a few days.
❑ Cobalt released into water or soil will stick to particles. Some cobalt compounds may dissolve.
❑ Cobalt cannot be destroyed. It can change form or attach to or separate from particles. Radioactive decay is a way of decreasing the amount of radioactive cobalt in the environment.

How might I be exposed to cobalt?

❑ You can be exposed to low levels of cobalt by breathing air, eating food, or drinking water. Food and drinking water are the largest sources of exposure to cobalt for the general population.
❑ Working in industries that make or use cutting or grinding tools; mine, smelt, refine, or process cobalt metal or ores; or that produce cobalt alloys or use cobalt.
❑ The general population is rarely exposed to radioactive cobalt unless a person is undergoing radiation therapy. However, workers at nuclear facilities, irradiation facilities, or nuclear waste storage sites may be exposed to radiation from these sources.

How can cobalt affect my health?

Cobalt can benefit or harm human health. Cobalt is beneficial for humans because it is part of vitamin B12.

Exposure to high levels of cobalt can result in lung and heart effects and dermatitis. Liver and kidney effects have also been observed in animals exposed to high levels of cobalt.

Exposure to large amounts of radiation from radioactive cobalt can damage cells in your body from the radiation.

You might also experience acute radiation syndrome that includes nausea, vomiting, diarrhea, bleeding, coma, and even death. This would be a rare event.

How likely is cobalt to cause cancer?

Nonradioactive cobalt has not been found to cause cancer in humans or animals following exposure in food or water. Cancer has been shown, however, in animals that breathed cobalt or when cobalt was placed directly into the muscle or under the skin. Based on the laboratory animal data, the International Agency for Research on Cancer (IARC) has determined that cobalt and cobalt compounds are possibly carcinogenic to humans.

Exposure to high levels of cobalt radiation can cause changes in the genetic materials within cells and may result in the development of some types of cancer.

How can cobalt affect children?

We do not know whether children differ from adults in their susceptibility to cobalt. However, it is likely that health effects in children would be similar those in adults. Studies in animals suggest that children may absorb more cobalt than adults from foods and liquids containing cobalt.

We do not know if exposure to cobalt will result in birth defects or other developmental effects in people. Birth defects have been observed in animals exposed to nonradioactive cobalt. Exposure to cobalt radiation can also result in developmental effects.

How can families reduce the risk of exposure to cobalt?

Children should avoid playing in soils near hazardous waste sites where cobalt may be present.

Is there a medical test to show whether I've been exposed to cobalt?

Cobalt levels can be tested in the urine and blood within a couple of days of exposure. Your doctor can take samples, but must send them to a laboratory to be tested. The amount of cobalt in your blood or urine can be used to estimate how much cobalt you were exposed to. However, these tests cannot predict whether you will experience any health effects.

Two types of tests are available for radioactive cobalt. One is to see if you have been exposed to a large dose of radiation, and the other is to see if radioactive cobalt is in your body. The first looks for changes in blood cell counts or in your chromosomes that occur at 3 to 5 times the annual occupational dose limit. It cannot tell if the radiation came from cobalt. The second type of test involves examining your blood, feces, saliva, urine, and even your entire body. It is to see if cobalt is being excreted from or remains inside your body. Either the doctor's office collects and sends the samples to a special lab for testing, or you must go to the lab for testing.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.1 milligrams of nonradioactive cobalt per cubic meter of workplace air (0.1 mg/m^3) for an 8-hour workday and 40-hour work week.

The Nuclear Regulatory Commission limits radioactive cobalt in workplace air to $1x10^{-5}$ microcurie per milliliter (µCi/mL) for ^{57}Co and $7x10^{-8}$ µCi/mL for ^{60}Co. EPA has set an average annual drinking water limit of 1000 picocurie per liter (pCi/L) for ^{57}Co or 100 pCi/L for ^{60}Co so the public radiation dose will not exceed 4 millirem.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2004. Toxicological Profile for Cobalt Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

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COPPER

CAS # 7440-50-8

Division of Toxicology ToxFAQs™ September 2004

This fact sheet answers the most frequently asked health questions (FAQs) about copper. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Copper is a metal that occurs naturally in the environment, and also in plants and animals. Low levels of copper are essential for maintaining good health. High levels can cause harmful effects such as irritation of the nose, mouth and eyes, vomiting, diarrhea, stomach cramps, nausea, and even death. Copper has been found in at least 906 of the 1,647 National Priority Sites identified by the Environmental Protection Agency (EPA).

What is copper?

Copper is a metal that occurs naturally throughout the environment, in rocks, soil, water, and air. Copper is an essential element in plants and animals (including humans), which means it is necessary for us to live. Therefore, plants and animals must absorb some copper from eating, drinking, and breathing.

Copper is used to make many different kinds of products like wire, plumbing pipes, and sheet metal. U.S. pennies made before 1982 are made of copper, while those made after 1982 are only coated with copper. Copper is also combined with other metals to make brass and bronze pipes and faucets.

Copper compounds are commonly used in agriculture to treat plant diseases like mildew, for water treatment and, as preservatives for wood, leather, and fabrics.

What happens to copper when it enters the environment?

- Copper is released into the environment by mining, farming, and manufacturing operations and through waste water releases into rivers and lakes. Copper is also released from natural sources, like volcanoes, windblown dusts, decaying vegetation, and forest fires.
- Copper released into the environment usually attaches to particles made of organic matter, clay, soil, or sand.
- Copper does not break down in the environment. Copper compounds can break down and release free copper into the air, water, and foods.

How might I be exposed to copper?

- You may be exposed to copper from breathing air, drinking water, eating foods, or having skin contact with copper, particulates attached to copper, or copper-containing compounds.
- Drinking water may have high levels of copper if your house has copper pipes and acidic water.
- Lakes and rivers that have been treated with copper compounds to control algae, or that receive cooling water from power plants, can have high levels of copper. Soils can also contain high levels of copper, especially if they are near copper smelting plants.
- You may be exposed to copper by ingesting copper-containing fungicides, or if you live near a copper mine or where copper is processed into bronze or brass.
- You may be exposed to copper if you work in copper mines or if you grind metals containing copper.

How can copper affect my health?

Everyone must absorb small amounts of copper every day because copper is essential for good health. High levels of copper can be harmful. Breathing high levels of copper can cause irritation of your nose and throat. Ingesting high levels of copper can cause nausea, vomiting, and diarrhea. Very-high doses of copper can cause damage to your liver and kidneys, and can even cause death.

How likely is copper to cause cancer?

We do not know whether copper can cause cancer in humans. The EPA has determined that copper is not classifiable as to human carcinogenicity.

How can copper affect children?

Exposure to high levels of copper will result in the same type of effects in children and adults. We do not know if these effects would occur at the same dose level in children and adults. Studies in animals suggest that the young children may have more severe effects than adults, but we don't know if this would also be true in humans. There is a very small percentage of infants and children who are unusually sensitive to copper.

We do not know if copper can cause birth defects or other developmental effects in humans. Studies in animals suggest that high levels of copper may cause a decrease in fetal growth.

How can families reduce the risk of exposure to copper?

The most likely place to be exposed to copper is through drinking water, especially if your water is corrosive and you have copper pipes in your house. The best way to lower the level of copper in your drinking water is to let the water run for at least 15 seconds first thing in the morning before drinking or using it. This reduces the levels of copper in tap water dramatically.

If you work with copper, wear the necessary protective clothing and equipment, and always follow safety procedures. Shower and change your clothes before going home each day.

Is there a medical test to show whether I've been exposed to copper?

Copper is found throughout the body; in hair, nails, blood, urine, and other tissues. High levels of copper in these samples can show that you have been exposed to higher-than normal levels of copper. These tests cannot tell whether you will experience harmful effects. Tests to measure copper levels in the body are not usually available at a doctor's office because they require special equipment, but the doctor can send samples to a specialty laboratory.

Has the federal government made recommendations to protect human health?

The EPA requires that levels of copper in drinking water be less than 1.3 mg of copper per one liter of drinking water (1.3 mg/L).

The U.S. Department of Agriculture has set the recommended daily allowance for copper at 900 micrograms of copper per day (μg/day) for people older than eight years old.

The Occupational Safety and Health Administration (OSHA) requires that levels of copper in the air in workplaces not exceed 0.1 mg of copper fumes per cubic meter of air (0.1 mg/m^3) and 1.0 mg/m^3 for copper dusts.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2004. Toxicological Profile for Copper. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

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BROMOFORM and CHLORODIBROMOMETHANE

CAS # 75-25-2 and 124-48-1

Agency for Toxic Substances and Disease Registry ToxFAQs July 1999

This fact sheet answers the most frequently asked health questions (FAQs) about bromoform and chlorodibromomethane. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Small amounts of bromoform and chlorodibromomethane are naturally produced by ocean plant life. They are also formed as by-products when chlorine is added to water-supply systems. High levels of bromoform and chlorodibromomethane can damage the liver and kidneys and affect the brain. Bromoform and chlorodibromomethane have been found at 14 of the 1,177 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are bromoform and chlorodibromomethane?

(Pronounced brō′mō fôrm and klôr′ō dī brō′mō měth′ān′)

Bromoform and chlorodibromomethane are colorless, nonflammable liquids with a sweet odor. Small amounts are formed naturally by plants in the oceans. They are somewhat soluble in water and readily evaporate into air. Most of the bromoform and chlorodibromomethane that enters the environment is formed as by-products when chlorine is added to drinking water to kill bacteria.

Only small quantities of bromoform and chlorodibromomethane currently are produced in the United States. These chemicals were used in the past as solvents and flame retardants, or to make other chemicals, but now they are used mainly as laboratory reagents.

What happens to bromoform and chlorodibromomethane when they enter the environment?

- When released to air, bromoform and chlorodibromomethane are slowly broken down by reactions with other chemicals and sunlight or can be removed by rain.
- In water, these chemicals will evaporate to the air and/or be broken down slowly by bacteria.
- When released to soil, most will evaporate to the air, some will be broken down by bacteria, and some may filter into the groundwater.
- Bromoform and chlorodibromomethane do not build up in the food chain.

How might I be exposed to bromoform and chlorodibromomethane?

- The most likely way people are exposed to bromoform and chlorodibromomethane is by drinking chlorinated water.
- You may breathe vapors released from chlorinated water in a swimming pool or in the home (cooking, washing dishes, bathing, etc.).
- Some bromoform and chlorodibromomethane may enter your body directly through your skin while bathing or swimming.
- People that live near a waste site containing bromoform or chlorodibromomethane could be exposed by drinking contaminated groundwater or breathing vapors released to the air.
- Exposure could occur by breathing bromoform and chlorodibromomethane in the air in or near a laboratory or factory that makes or uses this chemical; however, this is not likely for most people.

How can bromoform and chlorodibromomethane affect my health?

No studies are available about health effects in people exposed to chlorodibromomethane. Bromoform was used as a sedative to treat children with whooping cough during the early 1900s. Several recorded cases of overdose indicate that high doses affect the central nervous system causing unconsciousness, loss of reflexes, shallow breathing, erratic heart rate, and respiratory failure. Milder cases resulted in rapid breathing, constricted pupils, and tremors.

Animal studies indicate that the liver, kidney, and central nervous system are affected by exposure to bromoform and chlorodibromomethane. The effects on the central nervous system appear quickly after exposure to high doses and include labored breathing, incoordination, sedation, and death. Longer-term exposure to lower doses causes drowsiness, increased liver weight, and liver and kidney damage. We do not know if bromoform and chlorodibromomethane cause birth defects or infertility.

How likely are bromoform and chlorodibromomethane to cause cancer?

There is evidence that ingestion of bromoform causes intestinal cancer in rats and ingestion of chlorodibromomethane causes liver cancer in mice. It is not known if they cause cancer in people. The International Agency for Research on Cancer (IARC) has determined that the human carcinogenicity of bromoform and chlorodibromomethane is not classifiable.

Is there a medical test to show whether I've been exposed to bromoform or chlorodibromomethane?

Methods are available to measure low levels of bromoform and chlorodibromomethane in human blood, breath, and fat, but not enough information is available to use such tests to predict if any health effects might occur. Because special equipment is needed, these tests are not usually done in the doctors' office.

Has the federal government made recommendations to protect human health?

The EPA has set a Maximum Contaminant Level (MCL) of 0.1 parts per million (0.1 ppm) for the combination of bromoform and chlorodibromomethane and a group of similar compounds (called trihalomethanes) that occur in chlorinated water.

The EPA recommends that levels of halomethanes in lakes and streams should be limited to 0.19 ppm to prevent possible human health effects from drinking water or eating fish contaminated with this group of chemicals. Any release to the environment greater than 100 pounds of bromoform or chlorodibromomethane must be reported to the EPA.

Because chlorodibromomethane has such a limited use in industry, the Occupational Safety and Health Administration (OSHA) has not set limits of exposure for workplace air. OSHA has set a workplace air concentration limit of 0.5 ppm for bromoform over an 8-hour workday, 40-hour workweek.

The federal recommendations have been updated as of July 1999.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1989. Toxicological profile for bromoform and chlorodibromomethane. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

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LEAD
CAS # 7439-92-1

Agency for Toxic Substances and Disease Registry ToxFAQs June 1999

This fact sheet answers the most frequently asked health questions (FAQs) about lead. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to lead can happen from breathing workplace air or dust, eating contaminated foods, or drinking contaminated water. Children can be exposed from eating lead-based paint chips or playing in contaminated soil. Lead can damage the nervous system, kidneys, and reproductive system. Lead has been found in at least 1,026 of 1,467 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is lead?

(Pronounced lĕd)

Lead is a naturally occurring bluish-gray metal found in small amounts in the earth's crust. Lead can be found in all parts of our environment. Much of it comes from human activities including burning fossil fuels, mining, and manufacturing.

Lead has many different uses. It is used in the production of batteries, ammunition, metal products (solder and pipes), and devices to shield X-rays.

Because of health concerns, lead from gasoline, paints and ceramic products, caulking, and pipe solder has been dramatically reduced in recent years.

What happens to lead when it enters the environment?

- Lead itself does not break down, but lead compounds are changed by sunlight, air, and water.
- When lead is released to the air, it may travel long distances before settling to the ground.
- Once lead falls onto soil, it usually sticks to soil particles.
- Movement of lead from soil into groundwater will depend on the type of lead compound and the characteristics of the soil.
- Much of the lead in inner-city soils comes from old houses painted with lead-based paint.

How might I be exposed to lead?

- Eating food or drinking water that contains lead.
- Spending time in areas where lead-based paints have been used and are deteriorating.
- Working in a job where lead is used.
- Using health-care products or folk remedies that contain lead.
- Engaging in certain hobbies in which lead is used (for example, stained glass).

How can lead affect my health?

Lead can affect almost every organ and system in your body. The most sensitive is the central nervous system, particularly in children. Lead also damages kidneys and the reproductive system. The effects are the same whether it is breathed or swallowed.

At high levels, lead may decrease reaction time, cause weakness in fingers, wrists, or ankles, and possibly affect the memory. Lead may cause anemia, a disorder of the blood. It can also damage the male reproductive system. The connection between these effects and exposure to low levels of lead is uncertain.

How likely is lead to cause cancer?

The Department of Health and Human Services has determined that lead acetate and lead phosphate may reasonably

be anticipated to be carcinogens based on studies in animals. There is inadequate evidence to clearly determine lead's carcinogenicity in people.

How can lead affect children?

Small children can be exposed by eating lead-based paint chips, chewing on objects painted with lead-based paint, or swallowing house dust or soil that contains lead.

Children are more vulnerable to lead poisoning than adults. A child who swallows large amounts of lead may develop blood anemia, severe stomachache, muscle weakness, and brain damage. A large amount of lead might get into a child's body if the child ate small pieces of old paint that contained large amounts of lead. If a child swallows smaller amounts of lead, much less severe effects on blood and brain function may occur. Even at much lower levels of exposure, lead can affect a child's mental and physical growth.

Exposure to lead is more dangerous for young and unborn children. Unborn children can be exposed to lead through their mothers. Harmful effects include premature births, smaller babies, decreased mental ability in the infant, learning difficulties, and reduced growth in young children. These effects are more common if the mother or baby was exposed to high levels of lead.

How can families reduce the risk of exposure to lead?

Avoid exposure to sources of lead. Do not allow children to chew or mouth painted surfaces that may have been painted with lead-based paint (homes built before 1978). Run your water for 15 to 30 seconds before drinking or cooking with it. This will get rid of lead that may have leached out of pipes. Some types of paints and pigments that are used as make-up or hair coloring contain lead. Keep these kinds of products away from children. Wash children's hands and faces often to remove lead dusts and soil, and regularly clean the house of dust and tracked in soil.

Is there a medical test to show whether I've been exposed to lead?

A blood test is available to measure the amount of lead in your blood and to estimate the amount of your exposure to lead. Blood tests are commonly used to screen children for lead poisoning. Lead in teeth and bones can be measured with X-rays, but this test is not as readily available. Medical treatment may be necessary in children if the lead concentration in blood is higher than 45 micrograms per deciliter (45 μg/dL).

Has the federal government made recommendations to protect human health?

The Centers for Disease Control and Prevention (CDC) recommends that children ages 1 and 2 be screened for lead poisoning. Children who are 3 to 6 years old should be tested for lead if they have never been tested for lead before and if they receive services from public assistance programs; if they live in or regularly visit a building built before 1950; if they live in or visit a home built before 1978 that is being remodeled; or if they have a brother, sister, or playmate who has had lead poisoning. CDC considers children to have an elevated level of lead if the amount in the blood is 10 μg/dL.

The EPA requires lead in air not to exceed 1.5 micrograms per cubic meter (1.5 $\mu g/m^3$) averaged over 3 months. EPA limits lead in drinking water to 15 μg per liter.

The Occupational Health and Safety Administration (OSHA) develops regulations for workers exposed to lead. The Clean Air Act Amendments of 1990 banned the sale of leaded gasoline. The Federal Hazardous Substance Act bans children's products that contain hazardous amounts of lead.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for lead. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

MANGANESE
CAS # 127-18-4

Division of Toxicology ToxFAQs™ February 2001

This fact sheet answers the most frequently asked health questions (FAQs) about manganese. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Manganese is a trace element and eating a small amount from food or water is needed to stay healthy. Exposure to excess levels of manganese may occur from breathing air, particularly where manganese is used in manufacturing, and from drinking water and eating food. At high levels, it can cause damage to the brain, liver, kidneys, and the developing fetus. This chemical has been found in at least 603 of 1,467 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is manganese?
(Pronounced măng′ gə-nēz′)

Manganese is a naturally occurring metal that is found in many types of rocks. Pure manganese is silver-colored, but does not occur naturally. It combines with other substances such as oxygen, sulfur, or chlorine. Manganese can also be combined with carbon to make organic manganese compounds. Common organic manganese compounds include pesticides, such as maneb or mancozeb, and methylcyclopentadienyl manganese tricarbonyl (MMT), a fuel additive in some gasolines. Manganese is an essential trace element and is necessary for good health. Manganese can be found in several food items, including grains and cereals, and is found in high amounts in other foods, such as tea.

What happens to manganese when it enters the environment?

- Manganese can enter the air from iron, steel, and power plants, coke ovens, and from dust from mining operations.
- It can enter the water and soil from natural deposits, disposal of wastes or deposits from airborne sources.
- Manganese exists naturally in rivers, lakes, and under-ground water.
- Plants in the water can take up some of the manganese from water and concentrate it.

How might I be exposed to manganese?

- Everyone is exposed to small amounts of manganese in air, water, and food.
- Individuals who work in occupations that mine or use manganese are likely to be exposed to excess levels in their work environment.
- People who improperly use pesticides such as maneb and mancozeb, may be exposed to excess levels.

How can manganese affect my health?

Some individuals exposed to very high levels of manganese for long periods of time in their work developed mental and emotional disturbances and slow and clumsy body movements. This combination of symptoms is a disease called "manganism." Workers usually do not develop symptoms of manganism unless they have been exposed to manganese for many months or years. Manganism occurs because too much manganese injures a part of the brain that helps control body movements.

Exposure to high levels of airborne manganese, such as in a manganese foundry or battery plant, can affect motor skills such as holding one's hand steady, performing fast hand movements, and maintaining balance. Exposure to high levels of the metal may also cause respiratory problems and sexual dysfunction.

How likely is manganese to cause cancer?

There are no human cancer data available for manganese. Exposure to high levels of manganese in food resulted in a slightly increased incidence of pancreatic tumors in male rats and thyroid tumors in male and female mice.

The EPA has determined that manganese is not classifiable as to human carcinogenicity.

How can manganese affect children?

Daily intake of small amounts of manganese is needed for growth and good health in children. Manganese is constantly present in the mother and is available to the developing fetus during pregnancy. Manganese is also transferred from a nursing mother to her infant in breast milk at levels that are appropriate for proper development.

Children, as well as adults, who lose the ability to remove excess manganese from their bodies develop nervous system problems. Because at certain ages children take in more than adults, there is concern that children may be more susceptible to the toxic effects of excess manganese.

Animal studies indicate that exposure to high levels of manganese can cause birth defects in the unborn. There is no information on whether mothers exposed to excess levels of manganese can transfer the excess to their developing fetus during pregnancy or to their nursing infant in breast milk.

How can families reduce the risk of exposure to manganese?

In most situations, there is no need to reduce one's exposure to manganese because it is an essential nutrient for good health.

Excess levels of manganese may be present in soils, especially at or near hazardous waste sites. Therefore, it is important to discourage hand-to-mouth activity in young children, especially near hazardous waste sites or in areas that may have increased manganese levels in the soil.

Manganese is also present in pesticides that may be used around the home. These pesticides should be used in a manner consistent with manufacturer's instructions.

Is there a medical test to show whether I've been exposed to manganese?

Tests are available that show levels of manganese in different body fluids. Measurements of manganese in blood, urine, feces, and scalp hair can be used to determine exposure to excess levels of manganese by testing whether levels of the metal in your body tissues are greater than normal. However, these tests cannot predict how the levels in your tissues will affect your health. Your doctor can take samples and send them to a testing laboratory.

Has the federal government made recommendations to protect human health?

The EPA has set a non-enforceable guideline for the level of manganese in drinking water at 0.05 milligrams per liter (0.05 mg/L).

The Occupational Safety and Health Administration (OSHA) has set a limit of 5 milligrams manganese per cubic meter (5 mg/m 3) of workplace air for the average amount of manganese during an 8-hour workday, 40-hour workweek.

The National Research Council has recommended safe and adequate daily intake levels for manganese that range from 0.3 to 1 mg/day for children up to 1 year, 1 to 2 mg/day for children up to age 10, and 2 to 5 mg/day for children 10 and older.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological profile for manganese. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs™ Internet address is http://www.atsdr.cdc.gov/toxfaq.html . ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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METHYLENE CHLORIDE

CAS # 75-09-2

Division of Toxicology ToxFAQs™ February 2001

This fact sheet answers the most frequently asked health questions (FAQs) about methylene chloride. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to methylene chloride occurs mostly from breathing contaminated air, but may also occur through skin contact or by drinking contaminated water. Breathing in large amounts of methylene chloride can damage the central nervous system. Contact of eyes or skin with methylene chloride can result in burns. Methylene chloride has been found in at least 882 of 1,569 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is methylene chloride?

Methylene chloride is a colorless liquid with a mild, sweet odor. Another name for it is dichloromethane. Methylene chloride does not occur naturally in the environment.

Methylene chloride is used as an industrial solvent and as a paint stripper. It may also be found in some aerosol and pesticide products and is used in the manufacture of photographic film.

What happens to methylene chloride when it enters the environment?

❑ Methylene chloride is mainly released to the environment in air. About half of the methylene chloride in air disappears in 53 to 127 days.

❑ Methylene chloride does not easily dissolve in water, but small amounts may be found in drinking water.

❑ We do not expect methylene chloride to build up in plants or animals.

How might I be exposed to methylene chloride?

❑ The most likely way to be exposed to methylene chloride is by breathing contaminated air.

❑ Breathing the vapors given off by products containing methylene chloride. Exposure to high levels of methylene chloride is likely if methylene chloride or a product containing it is used in a room with inadequate ventilation.

How can methylene chloride affect my health?

If you breathe in large amounts of methylene chloride you may feel unsteady, dizzy, and have nausea and a tingling or numbness of your finger and toes. A person breathing smaller amounts of methylene chloride may become less attentive and less accurate in tasks requiring hand-eye coordination. Skin contact with methylene chloride causes burning and redness of the skin.

How likely is methylene chloride to cause cancer?

We do not know if methylene chloride can cause cancer in humans. An increased cancer risk was seen in mice

breathing large amounts of methylene chloride for a long time.

The World Health Organization (WHO) has determined that methylene chloride may cause cancer in humans.

The Department of Health and Human Services (DHHS) has determined that methylene chloride can be reasonably anticipated to be a cancer-causing chemical.

The EPA has determined that methylene chloride is a probable cancer-causing agent in humans.

How can methylene chloride affect children?

It is likely that health effects seen in children exposed to high amounts of methylene chloride will be similar to the effects seen in adults. We do not know if methylene chloride can affect the ability of people to have children or if it causes birth defects. Some birth defects have been seen in animals inhaling very high levels of methylene chloride.

How can families reduce the risk of exposure to methylene chloride?

❑ Families may be exposed to methylene chloride while using products such as paint removers. Such products should always be used in well-ventilated areas and skin contact should be avoided.
❑ Children should not be allowed to remain near indoor paint removal activities.

Is there a medical test to show whether I've been exposed to methylene chloride?

❑ Several tests can measure exposure to methylene chloride. These tests are not routinely available in your doctor's office.
❑ Methylene chloride can be detected in the air you breathe out and in your blood. These tests are only useful for detecting exposures that have occurred within a few days.
❑ It is also possible to measure carboxyhemoglobin (a chemical formed in the blood as methylene chloride breaks down in the body) in the blood or formic acid (a breakdown product of methylene chloride) in the urine. These tests are not specific for methylene chloride.

Has the federal government made recommendations to protect human health?

❑ The EPA requires that releases of methylene chloride of 1,000 pounds or more be reported to the federal government.
❑ The EPA recommends that exposure of children to methylene chloride be limited to less than 10 milligrams per liter of drinking water (10 mg/L) for 1 day or 2 mg/L for 10 days.
❑ The Food and Drug Administration (FDA) has established limits on the amounts of methylene chloride that can remain after processing of spices, hops extract, and decaffeinated coffee.
❑ The Occupational Safety and Health Administration (OSHA) has set limits of 25 parts methylene chloride per million parts of workplace air (25 ppm) for 8-hour shifts and 40-hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for methylene chloride. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs™ Internet address is http://www.atsdr.cdc.gov/toxfaq.html . ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

NICKEL
CAS # 7440-02-0

Agency for Toxic Substances and Disease Registry ToxFAQs September 1997

This fact sheet answers the most frequently asked health questions (FAQs) about nickel. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Nickel is a hard, silvery-white metal used to make stainless steel and other metal alloys. Skin effects are the most common effects in people who are sensitive to nickel. Workers who breathed very large amounts of nickel compounds have developed lung and nasal sinus cancers. Nickel has been found in at least 709 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is nickel?
(Pronounced nĭk′əl)

Nickel is a very abundant element. In the environment, it is found primarily combined with oxygen (oxides) or sulfur (sulfides). It is found in all soils and is emitted from volcanos.

Pure nickel is a hard, silvery-white metal that is combined with other metals to form mixtures called alloys. Some of the metals that nickel can be alloyed with are iron, copper, chromium, and zinc. These alloys are used in the making of metal coins and jewelry and in industry for making metal items.

Nickel compounds are also used for nickel plating, to color ceramics, to make some batteries, and as substances known as catalysts that increase the rate of chemical reactions. Nickel and its compounds have no characteristic odor or taste.

What happens to nickel when it enters the environment?

- Small nickel particles in the air settle to the ground or are taken out of the air in rain.
- Much of the nickel in the environment is found with soil and sediments because nickel attaches to particles that contain iron or manganese, which are often present in soil and sediments.
- Nickel does not appear to collect in fish, plants, or animals used for food.

How might I be exposed to nickel?

- By breathing air or smoking tobacco containing nickel.
- By eating food containing nickel, which is the major source of exposure for most people.
- By drinking water which contains small amounts of nickel.
- By handling coins and touching other metals containing nickel, such as jewelry.

How can nickel affect my health?

Nickel is required to maintain health in animals. A small amount of nickel is probably essential for humans, although a lack of nickel has not been found to affect the health of humans.

The most common adverse health effect of nickel in humans is an allergic reaction. People can become sensitive to nickel when jewelry or other things containing it are in direct contact with the skin. Once a person is sensitized to nickel, further contact with it will produce a reaction. The most common reaction is a skin rash at the site of contact.

Less frequently, some people who are sensitive to nickel

have asthma attacks following exposure to nickel. People who are sensitive to nickel have reactions when it is in contact with the skin, and some sensitized persons react when they eat nickel in food, drink it in water, or breathe dust containing it.

Lung effects, including chronic bronchitis and reduced lung function, have been observed in workers who breathed large amounts of nickel. Current levels of nickel in workplace air are much lower than in the past, and today few workers show symptoms of nickel exposure.

People who are not sensitive to it must eat very large amounts of nickel to show adverse health effects. Workers who accidently drank water containing very high levels of nickel (100,000 times more than in normal drinking water) had stomachaches and effects on their blood and kidneys.

Animal studies show that breathing high levels of nickel compounds may result in inflammation of the respiratory tract. Eating or drinking large amounts of nickel has been reported to cause lung disease in dogs and rats and to affect the stomach, blood, liver, kidneys, immune system, and reproduction and development in rats and mice.

How likely is nickel to cause cancer?

The Department of Health and Human Services (DHHS) has determined that nickel and certain nickel compounds may reasonably be anticipated to be carcinogens. Cancers of the lung and nasal sinus have resulted when workers breathed dust containing high levels of nickel compounds while working in nickel refineries or nickel processing plants.

When rats and mice breathed nickel compounds for a lifetime, nickel compounds that were hard to dissolve caused cancer, while a soluble nickel compound did not cause cancer.

Is there a medical test to show whether I've been exposed to nickel?

Measurements of the amount of nickel in your blood, feces, and urine can be used to estimate your exposure to nickel. These measurements are most useful if the type of nickel compound you have been exposed to is known. However, these tests cannot predict whether you will experience any health effects.

Has the federal government made recommendations to protect human health?

The EPA recommends that children drink water containing no more than 0.04 milligrams of nickel per liter of water (0.04 mg/L) for 1-10 days of exposure.

The Occupational Safety and Health Administration (OSHA) has set an occupational exposure limit of 1 milligram of nickel per cubic meter of air (1 mg/m^3) for an 8-hour workday, 40-hour workweek.

Glossary

Carcinogen: A substance with the ability to cause cancer.

CAS: Chemical Abstracts Service.

Milligram (mg): One thousandth of a gram.

Sediments: Mud and debris that have settled to the bottom of a body of water.

Soluble: Dissolves in water.

References

This ToxFAQs information is taken from the 1997 Toxicological Profile for Nickel (update) produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

n-NITROSO-DIMETHYLAMINE

CAS #62-75-9

Agency for Toxic Substances and Disease Registry ToxFAQs July 1999

This fact sheet answers the most frequently asked health questions (FAQs) about *n*-nitrosodimethylamine. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: *n*-Nitrosodimethylamine is produced by industry in small amounts but may be formed in the environment from chemical reactions. It causes liver cancer in animals. This chemical has been found in at least 1 of the 1,177 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is *n*-nitrosodimethylamine?

(Pronounced n nī′trō-sō dī měth-ăl′ə-mēn)

n-Nitrosodimethylamine is produced by industry only in small amounts for research. At room temperature, it is a yellow liquid with no distinct odor. It was used to make rocket fuel, but this use was stopped after unusually high levels of this chemical were found in air, water, and soil samples collected near a rocket fuel manufacturing plant. It is used in some cosmetic and toiletry products and in cleansers.

n-Nitrosodimethylamine is unintentionally formed during various manufacturing processes and in air, water, and soil from reactions involving other chemicals called alkylamines. It is also found in some foods and may be formed in the body.

What happens to *n*-nitrosodimethylamine when it enters the environment?

- *n*-Nitrosodimethylamine may be found in air, water, and soil.
- When released to the air, it is broken down by sunlight in a matter of minutes.
- In water, it may break down when exposed to sunlight or by natural biological processes.
- When released to soil, it may evaporate into air.
- It could also sink down into deeper soil.

How might I be exposed to *n*-nitrosodimethylamine?

- Eating food containing it, such as cured meats, fish, and cheese.
- Using toiletry and cosmetic products such as shampoos and cleansers that contain it.
- Breathing or inhaling cigarette smoke, which may contain low levels.
- Eating foods containing alkylamines, which can cause *n*-nitrosodimethylamine to form in the stomach.
- Working in industries such as tanneries, pesticide manufacturing plants, and rubber and tire plants.

How can *n*-nitrosodimethylamine affect my health?

When people were exposed to very high levels of *n*-nitrosodimethylamine, liver damage occurred. Little else is known about the heath effects of *n*-nitrosodimethylamine in people. Liver effects have also been seen in animals that ate food, drank water, or breathed air containing high levels of *n*-nitrosodimethylamine.

Mice that were fed *n*-nitrosodimethylamine during pregnancy had offspring that were born dead or died shortly after birth.

How likely is *n*-nitrosodimethylamine to cause cancer?

n-Nitrosodimethylamine exposure has been shown to result in an increase in liver and lung cancer in animals. No information is available on whether it causes cancer in people. The Department of Health and Human Services (DHHS) has determined that *n*-nitrosodimethylamine may reasonably anticipated to be a human carcinogen.

Is there a medical test to show whether I've been exposed to *n*-nitrosodimethylamine?

Samples of your blood and urine can be tested to determine if you have been recently exposed to *n*-nitrosodimethylamine. These tests must be done soon after the exposure occurred. These tests will not tell you whether your health will be affected by *n*-nitrosodimethylamine. They are not routinely available in hospitals and clinics because they require special equipment.

Has the federal government made recommendations to protect human health?

The EPA recommends that levels in lakes and streams should be limited to 0.00069 parts of *n*-nitrosodimethylamine per billion parts of water (0.00069 ppb) to prevent possible health effects from drinking water or eating fish contaminated with *n*-nitrosodimethylamine.

The EPA requires that spills or accidental releases of 10 pounds or more of *n*-nitrosodimethylamine be reported to the EPA.

The federal recommendations have been updated as of July 1999.

Glossary

Carcinogen: A substance that can cause cancer.
CAS: Chemical Abstracts Service.
Evaporate: To change into a vapor or a gas.
National Priorities List: A list of the nation's worst hazardous waste sites.
Pesticide: A substance that kills pests.
ppb: Parts per billion.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1989. Toxicological profile for *n*-nitrosodimethylamine. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

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Dichlorobenzenes

1,2-Dichlorobenzene CAS# 95-50-1
1,3-Dichlorobenzene CAS# 541-73-1
1,4-Dichlorobenzene CAS# 106-46-7

Division of Toxicology ToxFAQs™ September 2004

This fact sheet answers the most frequently asked health questions (FAQs) about dichlorobenzenes. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because these substances may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to dichlorobenzenes mostly occurs from breathing indoor air or workplace air. Exposure to high levels of 1,2- or 1,4-dichlorobenzene may be very irritating to your eyes and nose and cause difficult breathing, and an upset stomach. Extremely high exposures to 1,4-dichlorobenzene can result in dizziness, headaches, and liver problems. Liver effects have been observed in animals exposed to high levels of dichlorobenzenes. 1,2-, 1,3-, and 1,4-Dichlorobenzenes have been identified in at least 280, 176, and 331, respectively, of the 1,647 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are dichlorobenzenes?

There are three dichlorobenzene isomers—1,2-dichlorobenzene, 1,3-dichlorobenzene, and 1,4-dichlorobenzene. Dichlorobenzenes do not occur naturally. 1,2-Dichlorobenzene is a colorless to pale yellow liquid used to make herbicides. 1,3-Dichlorobenzene is a colorless liquid used to make herbicides, insecticides, medicine, and dyes. 1,4-Dichlorobenzene, the most important of the three chemicals, is a colorless to white solid with a strong, pungent odor. When exposed to air, it slowly changes from a solid to a vapor. Most people can smell 1,4-dichlorobenzene in the air at very low levels.

What happens to dichlorobenzenes when they enter the environment?

- 1,4-Dichlorobenzene enters the environment when it is used in mothballs and in toilet-deodorizer blocks. Very little enters the environment from hazardous waste sites.
- Some 1,2- and 1,3-dichlorobenzenes are released into the environment when used to make herbicides and when people use products that contain these chemicals.
- Dichlorobenzenes do not dissolve easily in water, the small amounts that enter water quickly evaporate into the air.
- Sometimes, dichlorobenzenes bind to soil and sediment. Dichlorobenzenes in soil usually are not easily broken down by soil organisms. Evidence suggests that plants and fish absorb dichlorobenzenes.

How might I be exposed to dichlorobenzenes?

- You may be exposed to 1,4-dichlorobenzene by breathing vapors from products used in the home or in buildings, such as air fresheners, mothballs and toilet-deodorizer blocks. 1,2- and 1,3-Dichlorobenzene are not found frequently in the air of homes and buildings because these chemicals are not used in household products.
- You may be exposed to very low levels of dichlorobenzenes in drinking water. You are not likely to be exposed to dichlorobenzenes in soil.
- You may also be exposed to low levels of dichlorobenzenes in beef, pork, chicken, eggs, baked goods, soft drinks, butter, peanut butter, fruits, vegetables, and fish.

How can dichlorobenzenes affect my health?

Very little is known about the health effects of 1,3-dichlorobenzene, especially in humans, but they are likely to be similar to those of 1,2- and 1,4-dichlorobenzene. Inhaling the vapor or dusts of 1,2-dichlorobenzene and 1,4-dichlorobenzene at very high concentrations could be very irritating to your eyes and nose and cause burning and tearing of the eyes, coughing, difficult breathing, and an upset stomach. Dizziness, headaches, and liver problems have also been observed in people exposed to very high levels of 1,4-dichlorobenzene.

People who have eaten 1,4-dichlorobenzene products regularly for long periods (months to years) developed skin

blotches and anemia. 1,4-Dichlorobenzene might cause a burning feeling in your skin if you hold mothballs or toilet-deodorizer blocks against your skin for a long time.
Breathing or eating any of the dichlorobenzenes caused harmful effects in the liver of laboratory animals. Animal studies also found that 1,2- and 1,4-dichlorobenzene caused effects in the kidneys and blood, and that 1,3-dichlorobenzene caused thyroid and pituitary effects.

How likely are dichlorobenzenes to cause cancer?

The Department of Health and Human Services (DHHS) has determined that 1,4-dichlorobenzene may reasonably be anticipated to be a carcinogen. There is no direct evidence that 1,4-dichlorobenzene can cause cancer in humans. However, animals given very high levels in water developed liver and kidney tumors.
1,2-Dichlorobenzene was not carcinogenic in laboratory animals and 1,3-dichlorobenzene has not been tested for its potential to cause cancer. Both the International Agency for Research on Cancer (IARC) and the EPA concluded that 1,2- and 1,3-dichlorobenzene are not classifiable as to human carcinogenicity.

How can dichlorobenzenes affect children?

Children who are exposed to dichlorobenzenes are likely to exhibit the same effects as adults, although this is not known for certain.
Children can also be exposed to dichlorobenzenes prenatally, because all three isomers have been detected in placenta samples, as well as through breast feeding. There is no reliable evidence suggesting that dichlorobenzenes cause birth defects, although animal data raise concern for effects of 1,4-dichlorobenzene on postnatal development of the nervous system.

How can families reduce the risk of exposure to dichlorobenzenes?

Exposure of children to 1,4-dichlorobenzene can be minimized by discouraging them from playing with, swallowing, or having skin contact with products containing 1,4-dichlorobenzene. These items should be stored out of reach of young children and kept in their original containers to prevent accidental poisonings. Keep your Poison Control Center's number by the phone.

Is there a medical test to show whether I've been exposed to dichlorobenzenes?

Several tests can be used to show if you have been exposed to dichlorobenzenes. The most commonly used tests measure their dichlorophenol breakdown products in urine and blood. The presence of the dichlorophenol breakdown products in the urine indicates a person has been exposed to dichlorobenzenes within the previous day or two. Another test measures the levels of dichlorobenzenes in your blood, but this is used less often. These tests require special equipment that is not routinely available in a doctor's office, but they can be performed in a special laboratory. Neither of these tests can be used to show how high the level of dichlorobenzene exposure was or to predict whether harmful health effects will follow.

Has the federal government made recommendations to protect human health?

EPA regulates the levels of dichlorobenzenes that are allowable in drinking water. The highest level of 1,4-dichlorobenzene allowed in drinking water is 0.075 parts 1,4-dichlorobenzene per 1 million parts of water (0.075 ppm). The Occupational Safety and Health Administration (OSHA) has set a limit for 1,4-dichlorobenzene of 75 parts 1,4-dichlorobenzene per 1 million parts of air (75 ppm) in the workplace.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2004. Toxicological Profile for Dichlorobenzenes (Draft for Public Comment). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

AMMONIA

CAS # 7664-41-7

Division of Toxicology ToxFAQs™ September 2004

This fact sheet answers the most frequently asked health questions (FAQs) about ammonia. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Ammonia is found throughout the environment in the air, soil, and water, and in plants and animals including humans. Exposure to high levels of ammonia can cause irritation and serious burns on the skin and in the mouth, throat, lungs, and eyes. At very high levels, ammonia can even cause death. Ammonia has been found in at least 137 of the 1,647 current or former National Priority Sites list identified by the Environmental Protection Agency (EPA).

What is ammonia?

Ammonia occurs naturally and is produced by human activity. It is an important source of nitrogen which is needed by plants and animals. Bacteria found in the intestines can produce ammonia.

Ammonia is a colorless gas with a very distinct odor. This odor is familiar to many people because ammonia is used in smelling salts, many household and industrial cleaners, and window-cleaning products.

Ammonia gas can be dissolved in water. This kind of ammonia is called liquid ammonia or aqueous ammonia. Once exposed to open air, liquid ammonia quickly turns into a gas.

Ammonia is applied directly into soil on farm fields, and is used to make fertilizers for farm crops, lawns, and plants. Many household and industrial cleaners contain ammonia.

What happens to ammonia when it enters the environment?

❏ Ammonia is found throughout the environment in air, water, soil, animals, and plants.
❏ Ammonia does not last very long in the environment. It is rapidly taken up by plants, bacteria, and animals.
❏ Ammonia does not build up in the food chain, but serves as a nutrient for plants and bacteria.

How might I be exposed to ammonia?

❏ Everyone is exposed to low levels of naturally-occurring ammonia in air, food, water, and soil.
❏ You may be exposed to higher levels during use of cleaning products containing ammonia.
❏ You may be exposed to higher levels if you apply ammonia fertilizers or live near farms where these fertilizers have been applied.
❏ You may be exposed to high levels if you go into enclosed buildings that contain lots of animals (such as on farms).

How can ammonia affect my health?

No health effects have been found in humans exposed to typical environmental concentrations of ammonia. Exposure to high levels of ammonia in air may be irritating to your skin, eyes, throat, and lungs and cause coughing and burns. Lung damage and death may occur after exposure to very high concentrations of ammonia. Some people with asthma may be more sensitive to breathing ammonia than others.

Swallowing concentrated solutions of ammonia can cause burns in your mouth, throat, and stomach. Splashing ammonia into your eyes can cause burns and even blindness.

How likely is ammonia to cause cancer?

We do not know whether ammonia can cause cancer in humans or in laboratory animals. The Department of Health and Human Services (DHHS), the EPA, and the International Agency for Research on Cancer (IARC), have not classified ammonia for carcinogenicity.

How can ammonia affect children?

Children are less likely than adults to be exposed to concentrated levels of ammonia because most exposures occur at work. The effects on children are likely to be the same as for adults. We do not know if exposure to ammonia causes birth defects, or if it can pass to the fetus across the placenta or to infants via breast milk.

How can families reduce the risk of exposure to ammonia?

❑ Keep products that contain ammonia out of the reach of children.

❑ Make sure there is adequate ventilation when you use cleaners that contain ammonia, and wear proper clothing and eye protection.

❑ Never store cleaning solutions in containers that children might find attractive, like soda bottles.

❑ Avoid farm fields after they have been treated with ammonia or ammonia-containing fertilizers.

❑ Minimize exposure to ammonia in the workplace by wearing proper safety clothes and equipment, and by following safety rules.

Is there a medical test to show whether I've been exposed to ammonia?

There are tests to measure ammonia in blood and urine. These tests can not definitely determine whether you have been exposed because ammonia is normally found in our bodies.

Has the federal government made recommendations to protect human health?

The Food and Drug Administration (FDA) has determined that the levels of ammonia and ammonium salts typically found in foods do not pose a risk to human health.

The Occupational Safety and Health Administration (OSHA) has set an acceptable eight-hour exposure limit at 25 parts of ammonia per one million parts of air (ppm) and a short-term (15 minutes) exposure level at 35 ppm.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2004. Toxicological Profile for Ammonia. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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BERYLLIUM

CAS #7440-41-7

Division of Toxicology ToxFAQs™ September 2002

This fact sheet answers the most frequently asked health questions (FAQs) about beryllium. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: People working or living near beryllium industries have the greatest potential for exposure to beryllium. Lung damage has been observed in people exposed to high levels of beryllium in the air. About 1-15% of all people occupationally-exposed to beryllium in air become sensitive to beryllium and may develop chronic beryllium disease (CBD), an irreversible and sometimes fatal scarring of the lungs. CBD may be completely asymptomatic or begin with coughing, chest pain, shortness of breath, weakness, and/or fatigue. Beryllium has been found in at least 535 of the 1,613 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is beryllium?

Beryllium is a hard, grayish metal naturally found in mineral rocks, coal, soil, and volcanic dust. Beryllium ore is mined, and the beryllium is purified for use in nuclear weapons and reactors, aircraft and space vehicle structures, instruments, x-ray machines, and mirrors. Beryllium oxide is used to make speciality ceramics for electrical and high-technology applications. Beryllium alloys are used in automobiles, computers, sports equipment (golf clubs), and dental bridges.

What happens to beryllium when it enters the environment?

❏ Beryllium dust enters the air from burning coal and oil. This beryllium dust will eventually settle over the land and water.
❏ It enters water from erosion of rocks and soil, and from industrial waste. Some beryllium compounds will dissolve in water, but most stick to particles and settle to the bottom.
❏ Most beryllium in soil does not dissolve in water and remains bound to soil.
❏ Beryllium does not accumulate in the food chain.

How might I be exposed to beryllium?

❏ The general population is normally exposed to low levels of beryllium in air, food, and water.
❏ People working in industries where beryllium is mined, processed, machined, or converted into metal, alloys, and other chemicals may be exposed to high levels of beryllium. People living near these industries may also be exposed to higher than normal levels of beryllium in air.
❏ People living near uncontrolled hazardous waste sites may be exposed to higher than normal levels of beryllium.

How can beryllium affect my health?

Beryllium can be harmful if you breathe it. The effects depend on how much you are exposed to, for how long, and individual susceptibility. If beryllium air levels are high enough (greater than 1000 $\mu g/m^3$), an acute condition can result. This condition resembles pneumonia and is called acute beryllium disease Occupational and community air standards are effective in preventing acute lung damage.

Some exposed workers (1-15%) become sensitive to beryllium. These individuals may develop an inflammatory reaction in the respiratory system. This condition is called chronic beryllium disease (CBD), and can occur years after exposure to higher than normal levels of beryllium (greater than 0.2 $\mu g/m^3$). This disease can make you feel weak and tired, and can cause difficulty in breathing. It can also result in anorexia, weight loss, and may also lead to right side heart

enlargement and heart disease in advanced cases. Some people who are sensitized to beryllium may not have any symptoms. The general population is unlikely to develop chronic beryllium disease because ambient air levels of beryllium are normally very low (0.00003-0.0002 ug/m^3).

Swallowing beryllium has not been reported to cause effects in humans because very little beryllium is absorbed from the stomach and intestines. Ulcers have been seen in dogs ingesting beryllium in the diet. Beryllium contact with skin that has been scraped or cut may cause rashes or ulcers.

How likely is beryllium to cause cancer?

Long term exposure to beryllium can increase the risk of developing lung cancer in people.

The Department of Health and Human Services (DHHS) and the International Agency for Research on Cancer (IARC) have determined that beryllium is a human carcinogen. The EPA has determined that beryllium is a probable human carcinogen. EPA has estimated that lifetime exposure to 0.04 ug/m^3 beryllium can result in a one in a thousand chance of developing cancer.

How can beryllium affect children?

It is likely that the health effects seen in children exposed to beryllium will be similar to the effects seen in adults. We do not know whether children differ from adults in their susceptibility to beryllium.

We do not know if exposure to beryllium will result in birth defects or other developmental effects in people. The studies on developmental effects in animals are not conclusive.

How can families reduce the risk of exposure to beryllium?

❑ Individuals working at facilities that use beryllium should make sure that contaminated clothing and objects are not brought home.

❑ Children should avoid playing in soils near uncontrolled hazardous waste sites where beryllium may have been discarded.

Is there a medical test to show whether I've been exposed to beryllium?

Beryllium can be measured in samples from your blood, urine, skin, or lungs. These tests are rarely done because they are not reliable measures of your exposure over time. Also, these tests do not show if you have become sensitized to beryllium.

Another test, the beryllium lymphocyte proliferation test (BeLPT), can help your doctor decide if you are sensitized to beryllium. This test is only done in a few specialized laboratories, but doctors familiar with the test can collect blood samples and send them for testing by overnight carrier. The BeLPT is most often done for people who work with beryllium. It is also useful for separating chronic beryllium disease from diagnoses that resemble it (for example, sarcoidosis). Depending on your exposure history, clinical findings, and test results, your doctor may also recommend additional specialized testing.

Has the federal government made recommendations to protect human health?

The EPA restricts the amount of beryllium that industries may release into the air to 0.01 ug/m^3, averaged over a 30-day period.

The Occupational Safety and Health Administration (OSHA) sets a limit of 2 ug/m^3 for an 8-hour work shift measured as a personal sample.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2002. Toxicological Profile for Beryllium Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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MERCURY
CAS # 7439-97-6

Agency for Toxic Substances and Disease Registry ToxFAQs April 1999

This fact sheet answers the most frequently asked health questions (FAQs) about mercury. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to mercury occurs from breathing contaminated air, ingesting contaminated water and food, and having dental and medical treatments. Mercury, at high levels, may damage the brain, kidneys, and developing fetus. This chemical has been found in at least 714 of 1,467 National Priorities List sites identified by the Environmental Protection Agency.

What is mercury?
(Pronounced mŭr′kyə-rē)

Mercury is a naturally occurring metal which has several forms. The metallic mercury is a shiny, silver-white, odorless liquid. If heated, it is a colorless, odorless gas.

Mercury combines with other elements, such as chlorine, sulfur, or oxygen, to form inorganic mercury compounds or "salts," which are usually white powders or crystals. Mercury also combines with carbon to make organic mercury compounds. The most common one, methylmercury, is produced mainly by microscopic organisms in the water and soil. More mercury in the environment can increase the amounts of methylmercury that these small organisms make.

Metallic mercury is used to produce chlorine gas and caustic soda, and is also used in thermometers, dental fillings, and batteries. Mercury salts are sometimes used in skin lightening creams and as antiseptic creams and ointments.

What happens to mercury when it enters the environment?

- Inorganic mercury (metallic mercury and inorganic mercury compounds) enters the air from mining ore deposits, burning coal and waste, and from manufacturing plants.
- It enters the water or soil from natural deposits, disposal of wastes, and volcanic activity.
- Methylmercury may be formed in water and soil by small organisms called bacteria.
- Methylmercury builds up in the tissues of fish. Larger and older fish tend to have the highest levels of mercury.

How might I be exposed to mercury?

- Eating fish or shellfish contaminated with methylmercury.
- Breathing vapors in air from spills, incinerators, and industries that burn mercury-containing fuels.
- Release of mercury from dental work and medical treatments.
- Breathing contaminated workplace air or skin contact during use in the workplace (dental, health services, chemical, and other industries that use mercury).
- Practicing rituals that include mercury.

How can mercury affect my health?

The nervous system is very sensitive to all forms of mercury. Methylmercury and metallic mercury vapors are more harmful than other forms, because more mercury in these forms reaches the brain. Exposure to high levels of metallic, inorganic, or organic mercury can permanently damage the brain, kidneys, and developing fetus. Effects on brain functioning may result in irritability, shyness, tremors, changes in vision or hearing, and memory problems.

Short-term exposure to high levels of metallic mercury vapors may cause effects including lung damage, nausea,

vomiting, diarrhea, increases in blood pressure or heart rate, skin rashes, and eye irritation.

How likely is mercury to cause cancer?

There are inadequate human cancer data available for all forms of mercury. Mercuric chloride has caused increases in several types of tumors in rats and mice, and methylmercury has caused kidney tumors in male mice. The EPA has determined that mercuric chloride and methylmercury are possible human carcinogens.

How can mercury affect children?

Very young children are more sensitive to mercury than adults. Mercury in the mother's body passes to the fetus and may accumulate there. It can also can pass to a nursing infant through breast milk. However, the benefits of breast feeding may be greater than the possible adverse effects of mercury in breast milk.

Mercury's harmful effects that may be passed from the mother to the fetus include brain damage, mental retardation, incoordination, blindness, seizures, and inability to speak. Children poisoned by mercury may develop problems of their nervous and digestive systems, and kidney damage.

How can families reduce the risk of exposure to mercury?

Carefully handle and dispose of products that contain mercury, such as thermometers or fluorescent light bulbs. Do not vacuum up spilled mercury, because it will vaporize and increase exposure. If a large amount of mercury has been spilled, contact your health department. Teach children not to play with shiny, silver liquids.

Properly dispose of older medicines that contain mercury. Keep all mercury-containing medicines away from children.

Pregnant women and children should keep away from rooms where liquid mercury has been used.

Learn about wildlife and fish advisories in your area from your public health or natural resources department.

Is there a medical test to show whether I've been exposed to mercury?

Tests are available to measure mercury levels in the body. Blood or urine samples are used to test for exposure to metallic mercury and to inorganic forms of mercury. Mercury in whole blood or in scalp hair is measured to determine exposure to methylmercury. Your doctor can take samples and send them to a testing laboratory.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 2 parts of mercury per billion parts of drinking water (2 ppb).

The Food and Drug Administration (FDA) has set a maximum permissible level of 1 part of methylmercury in a million parts of seafood (1 ppm).

The Occupational Safety and Health Administration (OSHA) has set limits of 0.1 milligram of organic mercury per cubic meter of workplace air (0.1 mg/m^3) and 0.05 mg/m^3 of metallic mercury vapor for 8-hour shifts and 40-hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for mercury. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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PERCHLORATES

CAS #10034-81-8, 7778-74-7, 7790-98-9, 7601-89-0, 7791-03-9

Division of Toxicology and Environmental Medicine ToxFAQs™ September 2005

This fact sheet answers the most frequently asked health questions (FAQs) about perchlorates. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because these substances may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration of exposure, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Solid perchlorates are very reactive chemicals that are used mainly in fireworks, explosives, and rocket motors. The general population may be exposed to perchlorate from contaminated drinking water, food, and milk. High levels of perchlorate can affect the thyroid gland, which in turn can alter the function of many organs in the body. Developing organisms can be especially susceptible. The Environmental Protection Agency (EPA) reported that perchlorate has been found in 40 of the 1547 National Priority List sites.

What are perchlorates?

Perchlorates are colorless salts that have no odor. There are five perchlorate salts that are manufactured in large amounts: magnesium perchlorate, potassium perchlorate, ammonium perchlorate, sodium perchlorate, and lithium perchlorate. Perchlorate salts are solids that dissolve easily in water.

The health effects of perchlorate salts are due to the perchlorate itself and not to the other component (i.e., magnesium, ammonium, potassium, etc.).

One place where perchlorate occurs naturally is in saltpeter deposits in Chile, where the saltpeter is used to make fertilizer. In the past, the United States used a lot of this fertilizer on tobacco plants, but now uses very little. Perchlorates are very reactive chemicals that are used mainly in explosives, fireworks, and rocket motors. The solid booster rocket of the space shuttle is almost 70% ammonium perchlorate.

Perchlorates are also used for making other chemicals. Many years ago, perchlorate was used as a medication to treat an over-reactive thyroid gland.

What happens to perchlorate when it enters the environment?

❏ Normally, perchlorate does not remain in soil because it washes away with rain water. However, in arid environments, it may remain in soil to provide a potential for dermal exposure.

❏ Perchlorate will eventually end up in ground water.

❏ We do not know exactly how long perchlorate will last in water and soil, but the information available indicates that it is a very long time, that is, many years.

❏ Perchlorates have been found in milk and food.

How might I be exposed to perchlorate?

Perchlorates entered the environment where rockets were made, tested, and taken apart. Factories that make or use perchlorates may also release them to soil and water.

❏ Drinking water that is contaminated with perchlorate. Most contaminated water supplies are found near sites where perchlorate has been found.

❏ Eating food, including milk, contaminated with perchlorate.

❏ Living near factories that make fireworks, flares, or other explosive devices, or living near a waste site or a rocket manufacturing or testing facility.

❏ Smoking or chewing tobacco may expose you to perchlorates because a variety of tobacco products contain perchlorate.

How can perchlorate affect my health?

Perchlorate affects the ability of the thyroid gland to take up iodine. Iodine is needed to make thyroid hormones that regulate many body functions after they are released into the blood. Perchlorate's inhibition of iodine uptake must be great enough to affect the thyroid before it is considered harmful. Healthy volunteers who took about 35 milligrams (35 mg) of perchlorate every day for 14 days showed no signs of abnormal functioning of their thyroid gland or any other health problem; however, it did inhibit iodide uptake by the thyroid. Studies of workers exposed for years to approximately the same amount of perchlorate found no evidence of alterations in the worker's

thyroids, livers, kidneys, or blood. However, there is concern that exposure of people to higher amounts of perchlorate for a long time may lower the level of thyroid activity leading to hypothyroidism. Low levels of thyroid hormones in the blood may lead to adverse effects on the skin, cardiovascular system, pulmonary system, kidneys, gastrointestinal tract, liver, blood, neuromuscular system, nervous system, skeleton, male and female reproductive system, and numerous endocrine organs. Studies in animals also have shown that the thyroid gland is the main target of toxicity for perchlorate. Animal studies provided inconclusive results regarding effects of perchlorate on the immune system. Perchlorate did not affect reproduction in a study in rats.

How likely is perchlorate to cause cancer?

There are no adequate studies of exposure to perchlorate and cancer in humans. Long-term exposure to perchlorate induced thyroid cancer in rats and mice, but there are reasons to believe that humans are less likely than rodents to develop this type of cancer. The National Academy of Sciences (NAS) concluded that based on the understanding of the biology of human and rodent thyroid tumors, it is unlikely that perchlorate poses a risk of thyroid cancer in humans. Perchlorate has not been classified for carcinogenic effects by the Department of Health and Human Services (DHHS), the EPA, or the International Agency for Research on Cancer (IARC).

How can perchlorate affect children?

Children are more likely to be affected by perchlorate than adults because thyroid hormones are essential for normal growth and development.

Perchlorate has been found in breast milk. Limited studies of thyroid function of babies and young children whose mothers were exposed to perchlorate in their drinking water have not indicated thyroid abnormalities associated with perchlorate.

Studies in animals have shown that perchlorate can alter the thyroid gland in the newborn animals. Studies in rats also found alterations in the brain from pups born to rats exposed to perchlorate while pregnant; however, as rats are more sensitive to agents that disturb thyroid function than are humans, the relevance of rat studies to humans is limited.

How can families reduce the risk of exposure to perchlorate?

❑ It is very unlikely that perchlorate is present in the average home or apartment.

❑ Use bottled water if you live near an area where perchlorate has been found and you have concerns about the presence of perchlorate in your tap water.

❑ Prevent children from playing in dirt or eating dirt if you live near a waste site that has perchlorates.

❑ Contact local water purveyors, health agencies, state environmental agencies, or EPA regional offices if you have any questions.

Is there a medical test to show whether I've been exposed to perchlorate?

There are no routine medical tests to measure perchlorate in the body, but it can be measured in the urine with special tests. Because perchlorate leaves the body fairly rapidly, perchlorate in urine only indicates recent exposure and is not an indication of any adverse health effects.

Has the federal government made recommendations to protect human health?

The EPA is currently evaluating whether regulation of perchlorate in drinking water would be appropriate for reducing risks to human health. Also, other federal agencies, including the United States Department of Agriculture, the Food and Drug Administration, and the Department of Defense, are also working on this.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2005. Toxicological Profile for Perchlorates (Draft for Public Comment). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

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SILVER
CAS # 7440-22-4

Agency for Toxic Substances and Disease Registry ToxFAQs July 1999

This fact sheet answers the most frequently asked health questions (FAQs) about silver. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Silver is an element found naturally in the environment. At very high levels, it may cause argyria, a blue-gray discoloration of the skin and other organs. This chemical has been found in at least 27 of the 1,177 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is silver?
(Pronounced sĭl′vər)

Silver is a naturally occurring element. It is found in the environment combined with other elements such as sulfide, chloride, and nitrate. Pure silver is "silver" colored, but silver nitrate and silver chloride are powdery white and silver sulfide and silver oxide are dark-gray to black. Silver is often found as a by-product during the retrieval of copper, lead, zinc, and gold ores.

Silver is used to make jewelry, silverware, electronic equipment, and dental fillings. It is also used to make photographs, in brazing alloys and solders, to disinfect drinking water and water in swimming pools, and as an antibacterial agent. Silver has also been used in lozenges and chewing gum to help people stop smoking.

What happens to silver when is enters the environment?

- Silver may be released into the air and water through natural processes such as the weathering of rocks.
- Human activities such as the processing of ores, cement manufacture, and the burning of fossil fuel may release silver into the air.
- It may be released into water from photographic processing.
- Rain may wash silver out of soil into the groundwater.
- Silver does not appear to concentrate to a significant extent in aquatic animals.

How might I be exposed to silver?

- Breathing low levels in air.
- Swallowing it in food or drinking water.
- Carrying out activities such as jewelry-making, soldering, and photography.
- Using anti-smoking lozenges or other medicines containing it.

How can silver affect my health?

Exposure to high levels of silver for a long period of time may result in a condition called arygria, a blue-gray discoloration of the skin and other body tissues. Lower-level exposures to silver may also cause silver to be deposited in the skin and other parts of the body; however, this is not known to be harmful. Argyria is a permanent effect, but it appears to be a cosmetic problem that may not be otherwise harmful to health.

Exposure to high levels of silver in the air has resulted in breathing problems, lung and throat irritation, and stomach pains. Skin contact with silver can cause mild allergic reactions such as rash, swelling, and inflammation in some people.

Animal studies have shown that swallowing silver results in the deposit of silver in the skin. One study in mice found that the animals exposed to silver in drinking water were less active than unexposed animals.

No studies are available on whether silver affects reproduction or causes developmental problems in people.

How likely is silver to cause cancer?

No studies are available on whether silver may cause cancer in people. The only available animal studies showed both positive and negative results when silver was implanted under the skin.

The EPA has determined that silver is not classifiable as to human carcinogenicity.

Is there a medical test to show whether I've been exposed to silver?

Silver can be measured in the blood, urine, feces, and body tissues of exposed people. Silver builds up in the body, and the best way to learn if past exposure has occurred is to look for silver in samples of skin. Tests for silver are not commonly done at a doctor's office because they require special equipment. Although doctors can find out if a person has been exposed to silver by doing these tests, they cannot tell whether any health effects will occur.

Has the federal government made recommendations to protect human health?

The EPA recommends that the concentration of silver in drinking water not exceed 0.10 milligrams per liter of water (0.10 mg/L) because of the skin discoloration that may occur.

The EPA requires that spills or accidental releases of 1,000 pounds or more of silver be reported to the EPA.

The Occupational Safety and Health Administration (OSHA) limits silver in workplace air to 0.01 milligrams per cubic meter (0.01 mg/m^3) for an 8-hour workday, 40-hour workweek. The National Institute of Occupational Safety and Health (NIOSH) also recommends that workplace air contain no more that 0.01 mg/m^3 silver.

The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that workplace air contain no more than 0.1 mg/m^3 silver metal and 0.01 mg/m^3 soluble silver compounds.

The federal recommendations have been updated as of July 1999.

Glossary

Carcinogenicity: Ability to cause cancer.

CAS: Chemcial Abstracts Service.

Milligram (mg): One thousandth of a gram.

National Priorities List: A list of the nation's worst hazardous waste sites.

Soluble: Capable of being dissolved in water.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1990. Toxicological profile for silver. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone:1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

TETRACHLOROETHYLENE
CAS # 127-18-4

Agency for Toxic Substances and Disease Registry ToxFAQs September 1997

This fact sheet answers the most frequently asked health questions (FAQs) about tetrachloroethylene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Tetrachloroethylene is a manufactured chemical used for dry cleaning and metal degreasing. Exposure to very high concentrations of tetrachloroethylene can cause dizziness, headaches, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death. Tetrachloroethylene has been found in at least 771 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is tetrachloroethylene?

(Pronounced tĕt′rə-klôr′ ō-ĕth′ə-lēn′)

Tetrachloroethylene is a manufactured chemical that is widely used for dry cleaning of fabrics and for metal-degreasing. It is also used to make other chemicals and is used in some consumer products.

Other names for tetrachloroethylene include perchloroethylene, PCE, and tetrachloroethene. It is a nonflammable liquid at room temperature. It evaporates easily into the air and has a sharp, sweet odor. Most people can smell tetrachloroethylene when it is present in the air at a level of 1 part tetrachloroethylene per million parts of air (1 ppm) or more, although some can smell it at even lower levels.

What happens to tetrachloroethylene when it enters the environment?

- Much of the tetrachloroethylene that gets into water or soil evaporates into the air.
- Microorganisms can break down some of the tetrachloroethylene in soil or underground water.
- In the air, it is broken down by sunlight into other chemicals or brought back to the soil and water by rain.
- It does not appear to collect in fish or other animals that live in water.

How might I be exposed to tetrachloroethylene?

- When you bring clothes from the dry cleaners, they will release small amounts of tetrachloroethylene into the air.
- When you drink water containing tetrachloroethylene, you are exposed to it.

How can tetrachloroethylene affect my health?

High concentrations of tetrachloroethylene (particularly in closed, poorly ventilated areas) can cause dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death.

Irritation may result from repeated or extended skin contact with it. These symptoms occur almost entirely in work (or hobby) environments when people have been accidentally exposed to high concentrations or have intentionally used tetrachloroethylene to get a "high."

In industry, most workers are exposed to levels lower than those causing obvious nervous system effects. The health effects of breathing in air or drinking water with low levels of tetrachloroethylene are not known.

Results from some studies suggest that women who work in dry cleaning industries where exposures to tetrachloroethyl-

ene can be quite high may have more menstrual problems and spontaneous abortions than women who are not exposed. However, it is not known if tetrachloroethylene was responsible for these problems because other possible causes were not considered.

Results of animal studies, conducted with amounts much higher than those that most people are exposed to, show that tetrachloroethylene can cause liver and kidney damage. Exposure to very high levels of tetrachloroethylene can be toxic to the unborn pups of pregnant rats and mice. Changes in behavior were observed in the offspring of rats that breathed high levels of the chemical while they were pregnant.

How likely is tetrachloroethylene to cause cancer?

The Department of Health and Human Services (DHHS) has determined that tetrachloroethylene may reasonably be anticipated to be a carcinogen. Tetrachloroethylene has been shown to cause liver tumors in mice and kidney tumors in male rats.

Is there a medical test to show whether I've been exposed to tetrachloroethylene?

One way of testing for tetrachloroethylene exposure is to measure the amount of the chemical in the breath, much the same way breath-alcohol measurements are used to determine the amount of alcohol in the blood.

Because it is stored in the body's fat and slowly released into the bloodstream, tetrachloroethylene can be detected in the breath for weeks following a heavy exposure.

Tetrachloroethylene and trichloroacetic acid (TCA), a breakdown product of tetrachloroethylene, can be detected in the blood. These tests are relatively simple to perform. These tests aren't available at most doctors' offices, but can be performed at special laboratories that have the right equipment.

Because exposure to other chemicals can produce the same breakdown products in the urine and blood, the tests for breakdown products cannot determine if you have been exposed to tetrachloroethylene or the other chemicals.

Has the federal government made recommendations to protect human health?

The EPA maximum contaminant level for the amount of tetrachloroethylene that can be in drinking water is 0.005 milligrams tetrachloroethylene per liter of water (0.005 mg/L).

The Occupational Safety and Health Administration (OSHA) has set a limit of 100 ppm for an 8-hour workday over a 40-hour workweek.

The National Institute for Occupational Safety and Health (NIOSH) recommends that tetrachloroethylene be handled as a potential carcinogen and recommends that levels in workplace air should be as low as possible.

Glossary

Carcinogen: A substance with the ability to cause cancer.

CAS: Chemical Abstracts Service.

Milligram (mg): One thousandth of a gram.

Nonflammable: Will not burn.

References

This ToxFAQs information is taken from the 1997 Toxicological Profile for Tetrachloroethylene (update) produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone:1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

TOLUENE
CAS # 108-88-3

Division of Toxicology ToxFAQs™ February 2001

This fact sheet answers the most frequently asked health questions (FAQs) about toluene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to toluene occurs from breathing contaminated workplace air, in automobile exhaust, some consumer products paints, paint thinners, fingernail polish, lacquers, and adhesives. Toluene affects the nervous system. Toluene has been found at 959 of the 1,591 National Priority List sites identified by the Environmental Protection Agency

What is toluene?

Toluene is a clear, colorless liquid with a distinctive smell. Toluene occurs naturally in crude oil and in the tolu tree. It is also produced in the process of making gasoline and other fuels from crude oil and making coke from coal.

Toluene is used in making paints, paint thinners, fingernail polish, lacquers, adhesives, and rubber and in some printing and leather tanning processes.

What happens to toluene when it enters the environment?

❏ Toluene enters the environment when you use materials that contain it. It can also enter surface water and groundwater from spills of solvents and petrolieum products as well as from leasking underground storage tanks at gasoline stations and other facilities.

❏ When toluene-containing products are placed in landfills or waste disposal sites, the toluene can enter the soil or water near the waste site.

❏ Toluene does not usually stay in the environment long.

❏ Toluene does not concentrate or buildup to high levels in animals.

How might I be exposed to toluene?

❏ Breathing contaminated workplace air or automobile exhaust.

❏ Working with gasoline, kerosene, heating oil, paints, and lacquers.

❏ Drinking contaminated well-water.

❏ Living near uncontrolled hazardous waste sites containing toluene products.

How can toluene affect my health?

Toluene may affect the nervous system. Low to moderate levles can cause tiredness, confusion, weakness, drunken-type actions, memory loss, nausea, loss of appetite, and

hearing and color vision loss. These symptoms usually disappear when exposure is stopped.

Inhaling High levels of toluene in a short time can make you feel light-headed, dizzy, or sleepy. It can also cause unconsciousness, and even death.

High levels of toluene may affect your kidneys.

How likely is toluene to cause cancer?

Studies in humans and animals generally indicate that toluene does not cause cancer.

The EPA has determined that the carcinogenicity of toluene can not be classified.

How can toluene affect children?

It is likely that health effects seen in children exposed to toluene will be similar to the effects seen in adults. Some studies in animals suggest that babies may be more sensitive than adults.

Breathing very high levels of toluene during pregnancy can result in children with birth defects and retard mental abilities, and growth. We do not know if toluene harms the unborn child if the mother is exposed to low levels of toluene during pregnancy.

How can families reduce the risk of exposure to toluene?

❑ Use toluene-containing products in well-ventilated areas.

❑ When not in use, toluene-containing products should be tightly covered to prevent evaporation into the air.

Is there a medical test to show whether I've been exposed to toluene?

There are tests to measure the level of toluene or its breakdown products in exhaled air, urine, and blood. To determine if you have been exposed to toluene, your urine or blood must be checked within 12 hours of exposure. Several other chemicals are also changed into the same breakdown products as toluene, so some of these tests are not specific for toluene.

Has the federal government made recommendations to protect human health?

EPA has set a limit of 1 milligram per liter of drinking water (1 mg/L).

Discharges, releases, or spills of more than 1,000 pounds of toluene must be reported to the National Response Center.

The Occupational Safety and Health Administration has set a limit of 200 parts toluene per million of workplace air (200 ppm).

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for Toluene. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs™ Internet address is http://www.atsdr.cdc.gov/toxfaq.html . ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

TRICHLOROETHYLENE

CAS # 79-01-6

Division of Toxicology ToxFAQs™ July 2003

This fact sheet answers the most frequently asked health questions (FAQs) about trichloroethylene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Trichloroethylene is a colorless liquid which is used as a solvent for cleaning metal parts. Drinking or breathing high levels of trichloroethylene may cause nervous system effects, liver and lung damage, abnormal heartbeat, coma, and possibly death. Trichloroethylene has been found in at least 852 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is trichloroethylene?

Trichloroethylene (TCE) is a nonflammable, colorless liquid with a somewhat sweet odor and a sweet, burning taste. It is used mainly as a solvent to remove grease from metal parts, but it is also an ingredient in adhesives, paint removers, typewriter correction fluids, and spot removers.

Trichloroethylene is not thought to occur naturally in the environment. However, it has been found in underground water sources and many surface waters as a result of the manufacture, use, and disposal of the chemical.

What happens to trichloroethylene when it enters the environment?

- Trichloroethylene dissolves a little in water, but it can remain in ground water for a long time.
- Trichloroethylene quickly evaporates from surface water, so it is commonly found as a vapor in the air.
- Trichloroethylene evaporates less easily from the soil than from surface water. It may stick to particles and remain for a long time.
- Trichloroethylene may stick to particles in water, which will cause it to eventually settle to the bottom sediment.
- Trichloroethylene does not build up significantly in plants and animals.

How might I be exposed to trichloroethylene?

- Breathing air in and around the home which has been contaminated with trichloroethylene vapors from shower water or household products such as spot removers and typewriter correction fluid.
- Drinking, swimming, or showering in water that has been contaminated with trichloroethylene.
- Contact with soil contaminated with trichloroethylene, such as near a hazardous waste site.
- Contact with the skin or breathing contaminated air while manufacturing trichloroethylene or using it at work to wash paint or grease from skin or equipment.

How can trichloroethylene affect my health?

Breathing small amounts may cause headaches, lung irritation, dizziness, poor coordination, and difficulty concentrating.

Breathing large amounts of trichloroethylene may cause impaired heart function, unconsciousness, and death. Breathing it for long periods may cause nerve, kidney, and liver damage.

Drinking large amounts of trichloroethylene may cause nausea, liver damage, unconsciousness, impaired heart function, or death.

Drinking small amounts of trichloroethylene for long periods may cause liver and kidney damage, impaired immune system function, and impaired fetal development in pregnant women, although the extent of some of these effects is not yet clear.

Skin contact with trichloroethylene for short periods may cause skin rashes.

How likely is trichloroethylene to cause cancer?

Some studies with mice and rats have suggested that high levels of trichloroethylene may cause liver, kidney, or lung cancer. Some studies of people exposed over long periods to high levels of trichloroethylene in drinking water or in workplace air have found evidence of increased cancer. Although, there are some concerns about the studies of people who were exposed to trichloroethylene, some of the effects found in people were similar to effects in animals.

In its 9th Report on Carcinogens, the National Toxicology Program (NTP) determined that trichloroethylene is "reasonably anticipated to be a human carcinogen." The International Agency for Research on Cancer (IARC) has determined that trichloroethylene is "probably carcinogenic to humans."

Is there a medical test to show whether I've been exposed to trichloroethylene?

If you have recently been exposed to trichloroethylene, it can be detected in your breath, blood, or urine. The breath test, if it is performed soon after exposure, can tell if you have been exposed to even a small amount of trichloroethylene.

Exposure to larger amounts is assessed by blood and urine tests, which can detect trichloroethylene and many of its breakdown products for up to a week after exposure. However, exposure to other similar chemicals can produce the same breakdown products, so their detection is not absolute proof of exposure to trichloroethylene. This test isn't available at most doctors' offices, but can be done at special laboratories that have the right equipment.

Has the federal government made recommendations to protect human health?

The EPA has set a maximum contaminant level for trichloroethylene in drinking water at 0.005 milligrams per liter (0.005 mg/L) or 5 parts of TCE per billion parts water.

The EPA has also developed regulations for the handling and disposal of trichloroethylene.

The Occupational Safety and Health Administration (OSHA) has set an exposure limit of 100 parts of trichloroethylene per million parts of air (100 ppm) for an 8-hour workday, 40-hour workweek.

Glossary

Carcinogenicity: The ability of a substance to cause cancer.
CAS: Chemical Abstracts Service.
Evaporate: To change into a vapor or gas.
Milligram (mg): One thousandth of a gram.
Nonflammable: Will not burn.
ppm: Parts per million.
Sediment: Mud and debris that have settled to the bottom of a body of water.
Solvent: A chemical that dissolves other substances.

References

This ToxFAQs information is taken from the 1997 Toxicological Profile for Trichloroethylene (update) produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs™ Internet address is http://www.atsdr.cdc.gov/toxfaq.html . ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

VANADIUM
CAS # 7440-62-2

Agency for Toxic Substances and Disease Registry ToxFAQs September 1995

This fact sheet answers the most frequently asked health questions (FAQs) about vanadium. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Everyone is exposed to low levels of vanadium in air, water, and food; however, most people are exposed mainly from food. Breathing high levels of vanadium may cause lung irritation, chest pain, coughing, and other effects. This chemical has been found in at least 385 of 1,416 National Priorities List sites identified by the Environmental Protection Agency.

What is vanadium?

(Pronounced və-nāˈdē-əm)

Vanadium is a compound that occurs in nature as a white-to-gray metal, and is often found as crystals. Pure vanadium has no smell. It usually combines with other elements such as oxygen, sodium, sulfur, or chloride. Vanadium and vanadium compounds can be found in the earth's crust and in rocks, some iron ores, and crude petroleum deposits.

Vanadium is mostly combined with other metals to make special metal mixtures called alloys. Vanadium in the form of vanadium oxide is a component in special kinds of steel that is used for automobile parts, springs, and ball bearings. Most of the vanadium used in the United States is used to make steel. Vanadium oxide is a yellow-orange powder, dark-gray flakes, or yellow crystals. Vanadium is also mixed with iron to make important parts for aircraft engines.

Small amounts of vanadium are used in making rubber, plastics, ceramics, and other chemicals.

What happens to vanadium when it enters the environment?

- Vanadium mainly enters the environment from natural sources and from the burning of fuel oils.
- It stays in the air, water, and soil for a long time.
- It does not dissolve well in water.
- It combines with other elements and particles.
- It sticks to soil sediments.
- Low levels have been found in plants, but it is not likely to build up in the tissues of animals.

How might I be exposed to vanadium?

- Exposure to very low levels in air, water, and food.
- Eating higher levels of it in certain foods.
- Breathing air near an industry that burns fuel oil or coal; these industries release vanadium oxide into the air.
- Working in industries that process it or make products containing it.
- Breathing contaminated air or drinking contaminated water near waste sites or landfills containing vanadium.
- Vanadium is not readily absorbed by the body from the stomach, gut, or contact with the skin.

How can vanadium affect my health?

Exposure to high levels of vanadium can cause harmful health effects. The major effects from breathing high levels of vanadium are on the lungs, throat, and eyes. Workers who breathed it for short and long periods sometimes had lung irritation, coughing, wheezing, chest pain, runny nose, and a

sore throat. These effects stopped soon after they stopped breathing the contaminated air. Similar effects have been observed in animal studies. No other significant health effects of vanadium have been found in people.

We do not know the health effects in people of ingesting vanadium. Animals that ingested very large doses have died. Lower, but still high levels of vanadium in the water of pregnant animals resulted in minor birth defects. Some animals that breathed or ingested vanadium over a long term had minor kidney and liver changes.

The amounts of vanadium given in these animal studies that resulted in harmful effects are much higher than those likely to occur in the environment.

How likely is vanadium to cause cancer?

The Department of Health and Human Services, the International Agency for Research on Cancer, and the Environmental Protection Agency (EPA) have not classified vanadium as to its human carcinogenicity.

No human studies are available on the carcinogenicity of vanadium. No increase in tumors was noted in a long-term animal study where the animals were exposed to vanadium in the drinking water.

Is there a medical test to show whether I've been exposed to vanadium?

There are medical tests available to measure levels of vanadium in urine and blood. These tests are not routinely performed at doctors' offices because they require special equipment, but your doctor can take samples and send them to a testing laboratory. These tests can't determine if harmful health effects will occur from the exposure to vanadium.

Another indicator of high vanadium exposure in people is that their tongues may have a green color on top.

Has the federal government made recommendations to protect human health?

The EPA requires discharges or spills of 1,000 pounds or more of vanadium into the environment to be reported.

The Occupational Safety and Health Administration (OSHA) has set an exposure limit of 0.05 milligrams per cubic meter (0.05 mg/m^3) for vanadium pentoxide dust and 0.1 mg/m^3 for vanadium pentoxide fumes in workplace air for an 8-hour workday, 40-hour workweek.

The American Conference of Governmental Industrial Hygienists (ACGIH) has recommended an occupational exposure limit of 0.05 mg/m^3 for vanadium pentoxide.

The National Institute for Occupational Safety and Health (NIOSH) has recommended that 35 mg/m^3 of vanadium be considered immediately dangerous to life and health. This is the exposure level of a chemical that is likely to cause permanent health problems or death.

Glossary

Carcinogenicity: Ability to cause cancer.

Ingesting: Taking food or drink into your body.

Long-term: Lasting one year or longer.

Milligram (mg): One thousandth of a gram.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1992. Toxicological profile for vanadium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone:1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

VINYL CHLORIDE

CAS # 75-01-4

Division of Toxicology and Environmental Medicine ToxFAQs™ July 2006

This fact sheet answers the most frequently asked health questions (FAQs) about vinyl chloride. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to vinyl chloride occurs mainly in the workplace. Breathing high levels of vinyl chloride for short periods of time can cause dizziness, sleepiness, unconsciousness, and at extremely high levels can cause death. Breathing vinyl chloride for long periods of time can result in permanent liver damage, immune reactions, nerve damage, and liver cancer. This substance has been found in at least 616 of the 1,662 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is vinyl chloride?

Vinyl chloride is a colorless gas. It burns easily and it is not stable at high temperatures. It has a mild, sweet odor. It is a manufactured substance that does not occur naturally. It can be formed when other substances such as trichloroethane, trichloroethylene, and tetrachloroethylene are broken down. Vinyl chloride is used to make polyvinyl chloride (PVC). PVC is used to make a variety of plastic products, including pipes, wire and cable coatings, and packaging materials.

Vinyl chloride is also known as chloroethene, chloroethylene, and ethylene monochloride.

What happens to vinyl chloride when it enters the environment?

❑ Liquid vinyl chloride evaporates easily. Vinyl chloride in water or soil evaporates rapidly if it is near the surface.
❑ Vinyl chloride in the air breaks down in a few days to other substances, some of which can be harmful.
❑ Small amounts of vinyl chloride can dissolve in water.
❑ Vinyl chloride is unlikely to build up in plants or animals that you might eat.

How might I be exposed to vinyl chloride?

❑ Breathing vinyl chloride that has been released from plastics industries, hazardous waste sites, and landfills.
❑ Breathing vinyl chloride in air or during contact with your skin or eyes in the workplace.
❑ Drinking water from contaminated wells.

How can vinyl chloride affect my health?

Breathing high levels of vinyl chloride can cause you to feel dizzy or sleepy. Breathing very high levels can cause you to pass out, and breathing extremely high levels can cause death.

Some people who have breathed vinyl chloride for several years have changes in the structure of their livers. People are more likely to develop these changes if they breathe high levels of vinyl chloride. Some people who work with vinyl chloride have nerve damage and develop immune reactions. The lowest levels that produce liver changes, nerve damage, and immune reaction in people are not known. Some workers exposed to very high levels of vinyl chloride have problems with the blood flow in their hands. Their fingers turn white and hurt when they go into the cold.

The effects of drinking high levels of vinyl chloride are unknown. If you spill vinyl chloride on your skin, it will cause numbness, redness, and blisters.

Animal studies have shown that long-term exposure to vinyl chloride can damage the sperm and testes.

How likely is vinyl chloride to cause cancer?

The U.S. Department of Health and Human Services has determined that vinyl chloride is a known carcinogen. Studies in workers who have breathed vinyl chloride over many years showed an increased risk of liver, brain, lung cancer, and some cancers of the blood have also been observed in workers.

How can vinyl chloride affect children?

It has not been proven that vinyl chloride causes birth defects in humans, but studies in animals suggest that vinyl chloride might affect growth and development. Animal studies also suggest that infants and young children might be more susceptible than adults to vinyl chloride-induced cancer.

How can families reduce the risk of exposure to vinyl chloride?

Tobacco smoke contains low levels of vinyl chloride, so limiting your family's exposure to cigarette or cigar smoke may help reduce their exposure to vinyl chloride.

Is there a medical test to show whether I've been exposed to vinyl chloride?

The results of several tests can sometimes show if you have been exposed to vinyl chloride. Vinyl chloride can be measured in your breath, but the test must be done shortly after exposure. This is not helpful for measuring very low levels of vinyl chloride. The amount of the major breakdown product of vinyl chloride, thiodiglycolic acid, in the urine may give some information about exposure. However, this test must be done shortly after exposure and does not reliably indicate the level of exposure.

Has the federal government made recommendations to protect human health?

Vinyl chloride is regulated in drinking water, food, and air. The EPA requires that the amount of vinyl chloride in drinking water not exceed 0.002 milligrams per liter (mg/L) of water.

The Occupational Safety and Health Administration (OSHA) has set a limit of 1 part vinyl chloride per 1 million parts of air (1 ppm) in the workplace.

The Food and Drug Administration (FDA) regulates the vinyl chloride content of various plastics. These include plastics that carry liquids and plastics that contact food. The limits for vinyl chloride content vary depending on the nature of the plastic and its use.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2006. Toxicological Profile for Vinyl Chloride (Update). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Environmental Medicine, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

ZINC
CAS # 7440-66-6

Division of Toxicology ToxFAQs™ August 2005

This fact sheet answers the most frequently asked health questions (FAQs) about zinc. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Zinc is a naturally occurring element. Exposure to high levels of zinc occurs mostly from eating food, drinking water, or breathing workplace air that is contaminated. Low levels of zinc are essential for maintaining good health. Exposure to large amounts of zinc can be harmful. It can cause stomach cramps, anemia, and changes in cholesterol levels. Zinc has been found in at least 985 of the 1,662 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is zinc?

Zinc is one of the most common elements in the earth's crust. It is found in air, soil, and water, and is present in all foods. Pure zinc is a bluish-white shiny metal.

Zinc has many commercial uses as coatings to prevent rust, in dry cell batteries, and mixed with other metals to make alloys like brass, and bronze. A zinc and copper alloy is used to make pennies in the United States.

Zinc combines with other elements to form zinc compounds. Common zinc compounds found at hazardous waste sites include zinc chloride, zinc oxide, zinc sulfate, and zinc sulfide. Zinc compounds are widely used in industry to make paint, rubber, dyes, wood preservatives, and ointments.

What happens to zinc when it enters the environment?

❏ Some is released into the environment by natural processes, but most comes from human activities like mining, steel production, coal burning, and burning of waste.
❏ It attaches to soil, sediments, and dust particles in the air.
❏ Rain and snow remove zinc dust particles from the air.
❏ Depending on the type of soil, some zinc compounds can move into the groundwater and into lakes, streams, and rivers.
❏ Most of the zinc in soil stays bound to soil particles and does not dissolve in water.
❏ It builds up in fish and other organisms, but it does not build up in plants.

How might I be exposed to zinc?

❏ Ingesting small amounts present in your food and water.
❏ Drinking contaminated water or a beverage that has been stored in metal containers or flows through pipes that have been coated with zinc to resist rust.
❏ Eating too many dietary supplements that contain zinc.
❏ Working on any of the following jobs: construction, painting, automobile mechanics, mining, smelting, and welding; manufacture of brass, bronze, or other zinc-containing alloys; manufacture of galvanized metals; and manufacture of machine parts, rubber, paint, linoleum, oilcloths, batteries, some kind of glass, ceramics, and dyes.

How can zinc affect my health?

Zinc is an essential element in our diet. Too little zinc can cause problems, but too much zinc is also harmful.

Harmful effects generally begin at levels 10-15 times higher than the amount needed for good health. Large doses taken by mouth even for a short time can cause stomach cramps, nausea, and vomiting. Taken longer, it can cause anemia and decrease the levels of your good cholesterol. We do not know if high levels of zinc affect reproduction in humans. Rats that were fed large amounts of zinc became infertile.

Inhaling large amounts of zinc (as dusts or fumes) can cause a specific short-term disease called metal fume fever. We do not know the long-term effects of breathing high levels of zinc.

Putting low levels of zinc acetate and zinc chloride on the skin of rabbits, guinea pigs, and mice caused skin irritation. Skin irritation will probably occur in people.

How likely is zinc to cause cancer?

The Department of Health and Human Services (DHHS) and the International Agency for Research on Cancer (IARC) have not classified zinc for carcinogenicity. Based on incomplete information from human and animal studies, the EPA has determined that zinc is not classifiable as to its human carcinogenicity.

How can zinc affect children?

Zinc is essential for proper growth and development of young children. It is likely that children exposed to very high levels of zinc will have similar effects as adults. We do not know whether children are more susceptible to the effects of excessive intake of zinc than the adults.

We do not know if excess zinc can cause developmental effects in humans. Animal studies have found decreased weight in the offspring of animals that ingested very high amounts of zinc.

How can families reduce the risks of exposure to zinc?

❑ Children living near waste sites that contain zinc may be exposed to higher levels of zinc through breathing contaminated air, drinking contaminated drinking water, touching or eating contaminated soil.

❑ Discourage your children from eating soil or putting their hands in their mouths and teach them to wash their hands frequently and before eating.

❑ If you use medicines or vitamin supplements containing zinc, make sure you use them appropriately and keep them out of the reach of children.

Is there a medical test to determine whether I've been exposed to zinc?

There are tests available to measure zinc in your blood, urine, hair, saliva, and feces. These tests are not usually done in the doctor's office because they require special equipment. High levels of zinc in the feces can mean high recent zinc exposure. High levels of zinc in the blood can mean high zinc consumption and/or high exposure. Tests to measure zinc in hair may provide information on long-term zinc exposure; however, the relationship between levels in your hair and the amount of zinc you were exposed to is not clear.

Has the federal government made recommendations to protect human health?

The EPA recommends that drinking water should contain no more than 5 milligrams per liter of water (5 mg/L) because of taste. The EPA requires that any release of 1,000 pounds (or in some cases 5,000 pounds) into the environment be reported to the agency.

To protect workers, the Occupational Safety and Health Administration (OSHA) has set an average limit of 1 mg/m^3 for zinc chloride fumes and 5 mg/m^3 for zinc oxide (dusts and fumes) in workplace air during an 8-hour workday, 40-hour workweek.

Similarly, the National Institute for Occupational Safety and Health (NIOSH) has set the same standards for up to a 10-hour workday over a 40-hour workweek.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2005. Toxicological Profile for Zinc (Update). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

CHLOROMETHANE
CAS # 74-87-3

Agency for Toxic Substances and Disease Registry ToxFAQs June 1999

This fact sheet answers the most frequently asked health questions (FAQs) about chloromethane. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to high levels of chloromethane can cause serious problems to your nervous system, including convulsions and coma. It can also affect your liver, kidneys, and heart. This substance has been found in at least 172 of the 1,467 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is chloromethane?

(Pronounced klôr′ ō měth′ ān)

Chloromethane is also known as methyl chloride. It is a clear, colorless gas. It has a faint, sweet odor that is noticeable only at levels that may be toxic. It is heavier than air, and it is extremely flammable.

What happens to chloromethane when it enters the environment?

- ❑ Chloromethane is found in air, surface water, groundwater, soil, and sediment.
- ❑ It is present at very low concentrations throughout the atmosphere.
- ❑ Chloromethane breaks down very slowly in air.
- ❑ It breaks down slowly in water, but certain microorganisms can break it down more quickly.
- ❑ Most of the chloromethane in soil will move to air.
- ❑ It does not concentrate in plants, animals, or fish.

How might I be exposed to chloromethane?

- ❑ Some chloromethane is produced by industry.
- ❑ Most of the chloromethane that is released into the environment is from natural sources, such as chemical reactions that occur in the oceans.
- ❑ It is also given off when materials like grass, wood, charcoal, and plastics are burned.
- ❑ It is present in lakes and streams and has been found in drinking water.
- ❑ Chloromethane is an impurity in vinyl chloride; exposure could occur from disposal of vinyl chloride waste.
- ❑ Other sources of exposure are cigarette smoke, polystyrene insulation, aerosol propellants, and chlorinated swimming pools.

How can chloromethane affect my health?

Breathing very high levels, even for a short time, can have serious effects on your nervous system, including convulsions and coma.

Lower exposures can also cause staggering, blurred or double vision, dizziness, fatigue, personality changes, confusion, tremors, nausea, or vomiting. These symptoms can last for several months or years.

Exposure to chloromethane can harm your liver and kidneys. It could also affect your heart rate and blood pressure.

Some animal studies showed that animals that breathed low levels of chloromethane experienced slower growth and had brain damage. In other animal studies, males that were exposed to chloromethane were less fertile, or even sterile, or produced damaged sperm. Females that became pregnant by these males lost their developing young.

How likely is chloromethane to cause cancer?

There is no evidence that chloromethane causes cancer in people. In animal studies, male mice that breathed contaminated air for 2 years developed tumors in their kidneys, but female mice, and male and female rats did not.

The EPA has determined that chloromethane is a possible human carcinogen.

How can chloromethane affect children?

There are no studies on the health effects on children from exposure to chloromethane. We do not know if chloromethane exposure will harm developing fetuses or young children.

Animal studies show that female rats exposed to chloromethane during pregnancy had young that were smaller than normal, with underdeveloped bones, and possibly abnormal hearts (this effect remains uncertain).

How can families reduce the risk of exposure to chloromethane?

- ❑ Keep children away from contaminated areas, such as workplaces that use chloromethane.
- ❑ Properly dispose of the older types of refrigerators that used chlormethane as a refrigerant.
- ❑ Become familiar with safety practices if you work with or near chloromethane.
- ❑ Teach children the dangers of breathing smoke from burning vinyl plastic or silicone rubber products (chloromethane is released).
- ❑ Have your drinking water tested if you are concerned about it.
- ❑ Check product labels for ingredients; contact manufacturers for additional information if you need it.

Is there a medical test to show whether I've been exposed to chloromethane?

There are no known reliable medical tests to determine whether you have been exposed to chloromethane. Symptoms resembling drunkenness and food poisoning, along with a sweet odor of the breath, may suggest to a doctor that a person has been exposed to chloromethane.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) has set a permissible exposure limit for chloromethane of 100 parts per million (100 ppm) for an 8-hour workday in a 40-hour workweek.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1998. Toxicological profile for chloromethane. Atlanta: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

NEWS RELEASE

OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT

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OEHHA Announces Health Goal for Perchlorate in Drinking Water

SACRAMENTO -- The California Environmental Protection Agency's Office of Environmental Health Hazard Assessment (OEHHA) today announced the publication of its Public Health Goal (PHG) for perchlorate, a component of rocket fuel that has been detected in a number of California drinking water sources. The development of the PHG was mandated by state law and is being published this week in compliance with a court order.

The PHG identifies 6 parts per billion as a level of perchlorate in drinking water that does not pose a significant human health risk.

"The completion of this Public Health Goal is a first step in California's efforts to address the presence of perchlorate in our state's drinking water supplies," OEHHA Director Dr. Joan Denton said. "While it is not a regulation, this goal provides scientific guidance to health authorities in setting a regulatory standard for perchlorate in drinking water."

State law next requires the California Department of Health Services (DHS) to set a regulatory drinking water standard for perchlorate that is as close to the PHG as is economically and technically feasible. A PHG is not a regulatory requirement, and it is not a boundary between "safe" and "dangerous" levels of a chemical in drinking water. PHGs are health-protective goals for drinking water contaminants that regulators and suppliers should strive to achieve if it is feasible to do so. OEHHA develops PHGs for all regulated drinking water contaminants.

Perchlorate is produced for use in rocket fuel, explosives, fireworks, road flares and air-bag inflation systems. When ingested in drinking water at significant levels, perchlorate can inhibit the ability of the thyroid gland (a butterfly-shaped gland in the throat) to take up iodide, an essential nutrient. Continuous iodide deficiency can disrupt the thyroid's production of two key hormones that regulate the body's metabolism and physical growth.

Certain populations, such as pregnant women and infants, are particularly susceptible to adverse health effects when thyroid disruption persists. Impairment of thyroid function in pregnant women may affect the fetus and result in delayed development and decreased learning capability. Infants can be similarly affected. Although research has found that perchlorate at high levels can limit the uptake of iodide by the thyroid gland, studies have not directly measured the impact of perchlorate on human metabolism and growth.

In developing the PHG, OEHHA scientists conducted a comprehensive review of all available scientific studies on the health effects of perchlorate. OEHHA based the PHG on data from a highly regarded 2002 study in which human volunteers (all healthy adults) were given perchlorate in drinking water over a 14-day period. Using a well-accepted method, OEHHA scientists added margins of safety to the study's data on adults to calculate a PHG that protects the susceptible populations.

"The PHG was rigorously reviewed before it was finalized," Dr. Denton said. "We submitted our draft PHG documents to the University of California for two separate rounds of external scientific peer review. U.S. Environmental Protection Agency scientists also conducted a peer review. In addition, we held two public comment periods and a public workshop on our draft PHG documents."

The National Academy of Sciences (NAS) is conducting an evaluation of U.S. EPA's 2002 Draft Toxicological and Risk Characterization for Perchlorate. This is an important undertaking that may help guide efforts to study the health effects of perchlorate. When that evaluation is completed, OEHHA will carefully review the NAS conclusions and will revise the PHG as necessary.

OEHHA began development of the perchlorate PHG in 1998 at the direction of then-Governor Pete Wilson. In 2002, the Legislature approved SB 1822, a bill by Senator Byron Sher that set a deadline of January 1, 2003 for publication of a perchlorate PHG. Also in 2002, Lockheed Martin and Kerr McGee sued OEHHA over a procedural issue involving external scientific peer review of the draft PHG. A court order stemming from the lawsuit mandated a second round of peer review by the University of California and required OEHHA to finalize the PHG within 60 days of the peer review's completion, which occurred in January 2004.

In compliance with the court order, the full PHG document for perchlorate will be available on March 12, 2004 with additional information on OEHHA's Web site at www.oehha.ca.gov.

The Office of Environmental Health Hazard Assessment is one of six entities within the California Environmental Protection Agency. OEHHA's mission is to protect and enhance public health and the environment by objective scientific evaluation of risks posed by hazardous substances.

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Public Health Goal for Perchlorate

A fact sheet by Cal/EPA's
Office of Environmental Health Hazard Assessment
March 2004

The Office of Environmental Health Hazard Assessment (OEHHA) has prepared this fact sheet to provide general information about its Public Health Goal (PHG) of 6 parts per billion (ppb) for perchlorate, a drinking water contaminant. OEHHA has determined, based on currently available data, that this level of the contaminant in drinking water does not pose a significant risk to health.

What Is Perchlorate? Perchlorate is a chemical used to facilitate combustion of rocket and missile fuel, explosives, fireworks, and road flares. It may also be used in air-bag inflation systems, lubricating oils, and the manufacture of paints and many industrial goods. In the past, physicians used perchlorate to treat Graves' Disease, a disorder that causes an overproduction of thyroid hormones.

Perchlorate in Ground and Drinking Water. Outdated disposal practices in the decades prior to modern environmental laws allowed perchlorate to contaminate groundwater, particularly near weapons and rocket fuel manufacturing facilities and disposal sites, research facilities, and military bases.

Perchlorate is used in rocket fuel, air bag inflation systems, lubricating oils, and the manufacture of paints and industrial goods.

The Department of Health Services (DHS) in February 2004 reported detections (down to the lowest measurable level of 4 ppb) of perchlorate in 348 drinking water sources in 88 systems in Los Angeles, San Bernardino, Riverside, Orange, Sacramento, Santa Clara, Tulare, Ventura, San Diego and Sonoma counties. Most of the affected sources are groundwater wells, although perchlorate has also been detected in sources containing water from the Colorado River. Of these 348 sources, a total of 24 sources contain perchlorate at levels exceeding 40 ppb. Drinking water suppliers are monitoring their water for perchlorate as required by DHS, and very few drinking water systems are providing water to their customers with perchlorate levels exceeding 4 ppb.

Health Effects of Perchlorate. One of the more serious human health effects observed in scientific studies is perchlorate's disruption of thyroid hormone production. The thyroid produces two principal hormones, triiodothyronine (T3) and thyroxine (T4), which help to regulate the body's metabolism and physical growth. To produce these hormones, the thyroid needs iodide, which the body absorbs from iodized salt, seafood, and other foods. Perchlorate, however, blocks the transport of iodide to the thyroid gland. If the blockage persists and the thyroid's iodide reserves are significantly reduced, the thyroid may decrease its production of T3 and T4. The pituitary gland and the hypothalamus, which regulate thyroid hormones, in turn elevate their own hormone production to compensate for the lowered levels

of T3 and T4. Because T3 and T4 hormones are essential to the body's production of energy and rate of metabolism, as well as to mental performance, any notable imbalance can significantly impair all of these functions. Inhibited thyroid function can result in hypothyroidism.

Pregnant women and their developing fetuses may suffer the most serious health effects from perchlorate contamination in drinking water, particularly in the first and second trimesters of pregnancy. During this period, the fetal thyroid is not yet fully functional, so the mother's thyroid must be able to produce enough extra T4 hormone to enable her baby's brain to develop properly.

Because pregnancy already places a strain on the maternal endocrine system, pregnant women and their fetuses are particularly susceptible to perchlorate's inhibition of iodide intake. The developing fetuses of women with critically low levels of iodide can suffer congenital hypothyroidism, which may stunt the fetus's physical growth and impede proper development of its central nervous system. Even moderate to mild iodide deficiency during pregnancy has been linked to impaired brain development and lower IQs for children born under these conditions. Perchlorate does not directly cause these effects by itself, but it can cause iodide deficiencies that, in turn, can impair the development of the brain and central nervous system.

Infants exposed to perchlorate could be similarly affected. Perchlorate may also affect the beneficial uptake of iodide into breast milk.

Perchlorate Evaluations. Efforts to evaluate perchlorate's health effects for purposes of establishing goals and regulatory standards extend back more than a decade. In 1992, the U.S. Environmental Protection Agency (U.S. EPA) published a provisional "reference dose" for perchlorate exposure that would not be expected to pose a health threat. The reference dose was equivalent to a drinking water concentration of 4 to 18 ppb. In 1997, DHS set a state "action level" (an advisory level for contaminants for which there is no regulatory standard) of 18 ppb for perchlorate. In 1998, Governor Pete Wilson directed OEHHA to begin development of a PHG for perchlorate. In 2002, U.S. EPA released a revised draft perchlorate reference dose (currently under review by the National Academy of Sciences) that corresponds to a drinking water concentration of 1 ppb. Also in 2002, DHS revised the state action level to 4 ppb, and OEHHA released a draft document proposing the PHG be within the range of 2 to 6 ppb. The California Legislature in 2002 passed a bill that formally requires OEHHA to establish a PHG and DHS to establish a regulatory drinking water standard for perchlorate. DHS now intends to revise the state action level to 6 ppb to be consistent with the PHG.

OEHHA published a PHG of 6 ppb to protect the health of pregnant woman and their developing fetuses, the groups with the greatest sensitivity to perchlorate.

Establishing the PHG for Perchlorate. State law requires OEHHA to develop PHGs for chemical contaminants in California's publicly supplied drinking water. A PHG is the level of a chemical contaminant in drinking water that, based upon currently available data, does not pose a significant risk to health. It represents a health-protective level that the state's drinking water providers should strive to achieve if it is possible to do so. State law requires DHS to set regulatory drinking water standards as close to the corresponding PHGs as is economically and technically feasible, placing primary emphasis on the protection of public health.

In developing the PHG for perchlorate, OEHHA conducted a thorough analysis of all available scientific studies on perchlorate's health effects. OEHHA published a PHG of 6 ppb because it determined that this level of perchlorate in drinking water would not pose a hazard to pregnant women and their developing fetuses, the groups with the greatest sensitivity to perchlorate.

Prior to its publication, the PHG for perchlorate underwent a rigorous review process that included two separate rounds of external scientific peer review by the University of California, two public comment periods and a public workshop, as well as a peer review by the U.S. Environmental Protection Agency.

Regulatory Steps. The PHG is a goal, not a regulatory requirement. DHS will use the PHG as the health basis for a regulatory drinking water standard, officially known as a Maximum Contaminant Level (MCL). Publicly supplied drinking water in California will not be allowed to contain perchlorate at levels exceeding the MCL. In establishing the MCL, DHS may consider economic factors such as water-treatment costs and available treatment technologies. OEHHA is prohibited by law from considering any economic or technological factors in establishing a PHG.

There currently is no federal drinking water goal or standard for perchlorate. The federal government has not yet decided whether to develop a national regulatory standard for perchlorate.

For More Information. The PHG document, including OEHHA's responses to comments received during the peer reviews and public comment periods, is available for downloading from OEHHA's Web site at http://www.oehha.ca.gov. The Web site also has a general fact sheet on PHGs and a supplemental fact sheet addressing frequently asked questions about the PHG for perchlorate. Further information on PHGs can be obtained by contacting OEHHA at (916) 324-7572, or by mail at P.O. Box 4010, Sacramento, CA, 95812-4010.

Public Health Goals for
NITRATE AND NITRITE
in Drinking Water

Prepared by

Pesticide and Environmental Toxicology Section
Office of Environmental Health Hazard Assessment
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December 1997

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PREFACE

Drinking Water Public Health Goal of the Office of Environmental Health Hazard Assessment

This Public Health Goal (PHG) technical support document provides information on health effects from contaminants in drinking water. The PHG describes concentrations of contaminants at which adverse health effects would not be expected to occur, even over a lifetime of exposure. PHGs are developed for chemical contaminants based on the best available toxicological data in the scientific literature. These documents and the analyses contained in them provide estimates of the levels of contaminants in drinking water that would pose no significant health risk to individuals consuming the water on a daily basis over a lifetime.

The California Safe Drinking Water Act of 1996 (amended Health and Safety Code, Section 116365) requires the Office of Environmental Health Hazard Assessment (OEHHA) to adopt PHGs for contaminants in drinking water based exclusively on public health considerations. The Act requires OEHHA to adopt PHGs that meet the following criteria:

1. PHGs for acutely toxic substances shall be set at levels at which scientific evidence indicates that no known or anticipated adverse effects on health will occur, plus an adequate margin-of-safety.
2. PHGs for carcinogens or other substances which can cause chronic disease shall be based solely on health effects without regard to cost impacts and shall be set at levels which OEHHA has determined do not pose any significant risk to health.
3. To the extent the information is available, OEHHA shall consider possible synergistic effects resulting from exposure to two or more contaminants.
4. OEHHA shall consider the existence of groups in the population that are more susceptible to adverse effects of the contaminants than a normal healthy adult.
5. OEHHA shall consider the contaminant exposure and body burden levels that alter physiological function or structure in a manner that may significantly increase the risk of illness.
6. In cases of scientific ambiguity, OEHHA shall use criteria most protective of public health and shall incorporate uncertainty factors of noncarcinogenic substances for which scientific research indicates a safe dose-response threshold.
7. In cases where scientific evidence demonstrates that a safe dose-response threshold for a contaminant exists, then the PHG should be set at that threshold.
8. The PHG may be set at zero if necessary to satisfy the requirements listed above.
9. OEHHA shall consider exposure to contaminants in media other than drinking water, including food and air and the resulting body burden.
10. PHGs adopted by OEHHA shall be reviewed periodically and revised as necessary based on the availability of new scientific data.

PHGs adopted by OEHHA are for use by the California Department of Health Services (DHS) in establishing primary drinking water standards (State Maximum Contaminant Levels, or MCLs). Whereas PHGs are to be based solely on scientific and public health considerations without regard to economic cost considerations, drinking water standards adopted by DHS are to consider economic factors and technical feasibility. For this reason PHGs are only one part of the information used by DHS for establishing drinking water standards. PHGs established by

OEHHA exert no regulatory burden and represent only non-mandatory goals. By federal law, MCLs established by DHS must be at least as stringent as the federal MCL if one exists.

PHG documents are developed for technical assistance to DHS, but may also benefit federal, state and local public health officials. While the PHGs are calculated for single chemicals only, they may, if the information is available, address hazards associated with the interactions of contaminants in mixtures. Further, PHGs are derived for drinking water only and are not to be utilized as target levels for the contamination of environmental waters where additional concerns of bioaccumulation in fish and shellfish may pertain. Often environmental water contaminant criteria are more stringent than drinking water PHGs, to account for human exposures to a single chemical in multiple environmental media and from bioconcentration by plants and animals in the food chain.

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SUMMARY

OEHHA developed Public Health Goals (PHGs) of 45 ppm for nitrate (equivalent to 10 ppm nitrate-nitrogen), 1 ppm for nitrite-nitrogen and 10 ppm for joint nitrate/nitrite (expressed as nitrogen) in drinking water. The calculation of these PHGs is based on the protection of infants from the occurrence of methemoglobinemia, the principal toxic effect observed in humans exposed to nitrate or nitrite. The PHGs are equivalent to California's current drinking water standards for nitrate (45 mg/L nitrate), nitrite (1 mg/L nitrite-nitrogen) and 10 mg/L (joint nitrate/nitrite expressed as nitrogen) which were adopted by the California Department of Health Services (DHS) in 1994 from the U.S. Environmental Protection Agency's (U.S. EPA's) Maximum Contaminant Levels (MCLs) promulgated in 1991. Following our review of the current literature and a reevaluation of the bases for calculating the MCLs for these compounds, we determined that there was no scientific basis to propose alternative PHGs. Therefore, OEHHA adopts PHGs of 45 mg/L (45 ppm) for nitrate, 1 mg/L (1 ppm) for nitrite-nitrogen and 10 mg/L (10 ppm) for joint nitrate/nitrite (expressed as nitrogen) in drinking water.

INTRODUCTION

California's current drinking water standard for nitrate is 45 mg nitrate/L (equivalent to 10 mg nitrate-nitrogen/L) and for nitrite is 1 mg nitrite-nitrogen/L. In addition, there is a joint nitrate/nitrite standard of 10 mg/L, expressed on a nitrogen basis. These values were adopted by the DHS in 1994 from U.S. EPA's MCLs promulgated in 1991. The standards are based on the occurrence of methemoglobinemia, the principal toxic effect observed in humans exposed to nitrate or nitrite. In developing PHGs for nitrate and nitrite, we evaluated the basis for U.S. EPA's MCLs. In addition, a search of the scientific literature was conducted to determine if there are any new data that would support the development of numbers different from the current values[1]. It is important to note that Office of Environmental Health Hazard Assessment (OEHHA) staff have conducted peer-reviewed, published evaluations of the hazards of nitrate and nitrite in drinking water that were important to the development of PHGs (Fan *et al.*, 1987; Fan and Steinberg, 1996). The results of our present evaluation are described below.

HUMAN EXPOSURE

Human exposure to nitrates and nitrites results primarily from dietary ingestion, particularly from vegetables and cured meats. The average adult daily intake from food in the United States has been estimated to be 40 to 100 mg for nitrate, and 0.3 to 2.6 mg for nitrite. Exposure estimates indicate that for more than 99% of the adult population in the United States, only 1 to 3% of nitrate and nitrite intake comes from drinking water. Drinking water becomes an important contributor to total nitrate exposure only in areas of notable contamination (NRC, 1981; 1995). For infants, the exposure scenarios are somewhat different. For breast-fed infants, total nitrate exposure is negligible. For bottle-fed infants consuming drinking water used to prepare their formula, drinking water can be a substantial exposure pathway. At the MCL of 10 mg nitrate-nitrogen/L, the daily intake for a 4 kg infant consuming 0.64 L/day of water used to prepare formula would be approximately 1.6 mg/kg-day.

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[1] A copy of the literature review is available to the public upon request.

TOXICOLOGY

Methemoglobinemia

Methemoglobinemia is the primary adverse health effect associated with human exposure to nitrate or nitrite. To cause methemoglobinemia, nitrate must be converted to nitrite. Nitrite causes the oxidation of normal hemoglobin to methemoglobin which is unable to transport oxygen from lungs to tissues. Bacteria in the gastrointestinal system mediate the conversion of nitrate to nitrite. Consequently the risk of methemoglobinemia from ingestion of nitrate depends not only on the dose of nitrate by also on the number and type of enteric bacteria. Low levels of methemoglobin occur in individuals with typical values ranging from 0.5 to 2.0% (NRC, 1981). While methemoglobinemia can be clinically diagnosed at levels of 1%, methemoglobin levels up to 10% are generally not considered adverse. At levels above 10%, methemoglobinemia causes cyanosis, and at higher concentrations, asphyxia (WHO, 1996; U.S. EPA, 1997).

Infants are generally recognized as the subpopulation most susceptible to nitrate induced methemoglobinemia (U.S. EPA, 1990; U.S. EPA, 1997). Several factors make infants particularly sensitive to methemoglobinemia including: 1) infants have a greater total fluid intake per unit body weight than adults, 2) the gastrointestinal system in infants normally has a high pH that allows bacterial proliferation and nitrate catalysis to nitrite, 3) frequent occurrences of infant gastroenteritis may favor the development of methemoglobin when the upper gastrointestinal tract becomes colonized with bacteria, 4) fetal hemoglobin is more readily oxidized than adult hemoglobin and 5) infants have half the methemoglobin reductase activity of older children and adults and are therefore less capable of metabolizing excess methemoglobin (Winton *et al.*, 1971; NRC, 1981; Kross *et al.*, 1992).

There are other individuals who may be predisposed to the development of nitrate-induced methemoglobinemia due to altered physiological states. These include pregnant women and possibly others with glucose-6-phosphate dehydrogenase deficiency, adults with reduced gastric acidity (e.g., from diseases including achlorohydria or atrophic gastritis) and those with a lack of methemoglobin reductase (U.S. EPA, 1997; NRC, 1981).

Since the mid 1950's, more than 2,000 cases of infantile methemoglobinemia have been reported world-wide. Most cases are associated with exposure concentrations greater than 20 mg nitrate-nitrogen/L in drinking water that was used to prepare infant formula. Cases of infantile methemoglobinemia associated with nitrate exposure concentrations of 11 to 20 mg nitrate-nitrogen/L are usually associated with concomitant exposure to water contaminated with bacteria. Thorough reviews of the literature on the occurrence of methemoglobinemia in infants are provided by U.S. EPA (1990), Fan *et al.* (1987), and Fan and Steinberg (1996).

Only two reports were found documenting cases of infantile methemoglobinemia resulting from ingestion of nitrate-contaminated water since the development of the federal standard in 1991. In Wisconsin, a six-week-old girl was found to have a methemoglobin level of 21.4% after having been hospitalized twice, first for dehydration and vomiting, and later for acute weight loss and limited consumption of formula. Water samples taken during the infant's hospitalization contained 9.9 and 58 mg nitrate-nitrogen/L as collected from the reverse-osmosis unit and from the well that supplied water to the house, respectively. In addition, an early morning first draw sample collected from the kitchen faucet contained copper levels six-times the federal MCL. The infant's condition

was attributed to her being given formula mixed with water contaminated with both nitrate and copper (MMWR, 1993). In a recent report from Poland (Lutynski *et al.*, 1996), it was noted that from 1979 to 1992, the Poison Information Center in Krakow documented 239 cases of methemoglobinemia from Krakow and neighboring provinces. Of the 239 cases, 216 involved infants who were fed with nitrate-contaminated well water and carrot soup. Exposure concentrations were not given, and water supplies in the area were characterized as being of very poor quality.

Reproductive and Developmental Toxicity

In a recent report by the National Research Council (NRC, 1995), the authors concluded that while data from recent epidemiological studies have suggested an association between maternal nitrate exposure from drinking water and developmental effects in offspring, a definite conclusion on the cause-and-effect relationship cannot be drawn.

Most of the studies in experimental animals have been conducted with nitrite. Data have shown reproductive and developmental toxicity associated with exposure to nitrite, but the effects occurred mostly at very high exposure concentrations which can also produce maternal methemoglobinemia. Teratogenic effects have not been observed in rats, mice, hamsters or rabbits (Fan *et al.*, 1987; Fan and Steinberg, 1996; NRC, 1995).

Since the development of the federal standard in 1991, one report was identified of spontaneous abortions possibly related to consumption of nitrate-contaminated well water in Indiana (MMWR, 1996). Four women living in close proximity reported a total of eight spontaneous abortions from 1991 to 1994. Nitrate concentrations of 19 to 29 mg nitrate-nitrogen/L were measured in well-water sources. Term births occurred before or after the period when each of the four women consumed nitrate-contaminated water. The investigation did not establish a causal link between nitrate exposure from drinking water and spontaneous abortion, but the findings indicate the need for further assessment of the possible effects of nitrate on human reproduction. Developmental effects were reported in rat pups from dams consuming sodium nitrite (2,000 ppm) in drinking water (Nyakas *et al.*, 1994). The observed effects on behavior and adrenal function were attributed to fetal hypoxia caused by severe methemoglobinemia in the pregnant rats.

Carcinogenicity

Concern has been raised about a possible increased risk of cancer in humans from the endogenous and exogenous formation of N-nitroso compounds from nitrite, many of which are carcinogenic in animals. However, recent epidemiological studies have not supported an association between nitrate or nitrite exposure from drinking water and increased cancer rates in humans. In experimental animals, nitrate and nitrite have not been shown to be carcinogenic. Nitrite has only been shown to be carcinogenic in animals when administered concurrently with nitrosable amines, apparently as a result of the endogenous formation of carcinogenic amines (WHO, 1996; NRC, 1995; Fan and Steinberg, 1996).

In addition to the cancer studies evaluated by the World Health Organization (WHO, 1996), the National Research Council (NRC, 1995) and U.S. EPA (1991), three recent epidemiological studies were identified examining the effects of nitrate exposure on human cancer risk. The results of one case-control study from Germany (Steindorf *et al.*, 1994) suggest the absence of an association between low nitrate levels in drinking water (16 mg nitrate-nitrogen/L) and the risk of

brain tumors. Two studies by Morales-Suarez-Varela were published on the impact of elevated nitrate concentrations in drinking water (greater than 50 ppm) on cancer incidence and mortality in Valencia, Spain (Morales-Suarez-Varela *et al.*, 1993; Morales-Suarez-Varela *et al.*, 1995). The authors suggest a possible association between elevated nitrate concentrations in drinking water and cancer of the bladder and stomach. However, a definite cause-and-effect relationship was not shown. Another case-control study conducted in Nebraska examined nitrate in drinking water and the risk of non-Hodgkin's lymphoma (Ward *et al.*, 1996). Authors reported that long-term exposure to elevated nitrate in drinking water (greater than 50 ppm) may contribute to the risk of non-Hodgkin's lymphoma, but again, no cause-and-effect relationship was shown.

Other Health Effects

Inorganic and organic nitrite compounds can produce hypotension in humans as a result of direct action on smooth muscle. Therapeutic doses of 30 to 60 mg sodium nitrite are typically used to treat angina pectorus. Organic nitrates can also produce hypotension, although through an indirect mechanism of action, while inorganic nitrate does not produce the effect (U.S. EPA, 1990).

DOSE-RESPONSE ASSESSMENT

The current state and federal MCLs for nitrates and nitrites are based on the occurrence of infantile methemoglobinemia resulting from ingestion of nitrate-contaminated water. The two principal studies used as the basis of these standards are described below.

Bosch *et al.* (1950) evaluated 139 cases of cyanosis due to methemoglobinemia reported in Minnesota from 1947 to 1949. The 139 cases, which included 14 deaths, occurred in infants under six months of age. Nitrate concentrations were measured in 129 wells used to supply water to the infants with methemoglobinemia. None of the wells contained nitrate concentrations less than 10 mg nitrate-nitrogen/L. Only two of the wells contained 10 to 20 mg nitrate-nitrogen/L, however in both of these cases the diagnosis of methemoglobinemia was considered questionable. Coliform organisms were detected in 45 of 51 samples tested for bacterial contamination.

Walton (1951) reported results of a survey conducted by the American Public Health Association that identified 278 cases of infantile methemoglobinemia associated with consumption of nitrate-contaminated water. Water nitrate concentrations were available for 214 of the 278 cases. Of the 214 cases, none occurred from water nitrate concentrations less than 10 mg nitrate-nitrogen/L, and only five cases (2%) involved infants exposed to 11 to 20 mg nitrate-nitrogen/L. More than 80% of the infants were exposed to nitrate concentrations greater than 50 mg nitrate-nitrogen/L. Data on bacteriological contamination of the water and/or incidence of gastrointestinal disease among the infants were not reported.

Nitrate

Based primarily on the studies of Bosch *et al.* (1950) and Walton (1951), with support from a large number of additional epidemiological and case studies in humans (including Cornblath and Hartmann, 1948; Simon *et al.*, 1964; Toussaint and Selenka, 1970; Craun *et al.*, 1981; see U.S. EPA, 1990 for descriptions of these and other studies) a no-observed-adverse-effect-level (NOAEL) is identified to be 10 mg nitrate-nitrogen/L. An uncertainty factor of one was applied because the available data provide an adequate NOAEL for the critical toxic effect (methemoglobinemia) in the most sensitive human subpopulation (infants). Therefore, the MCL is

10 mg nitrate-nitrogen/L, or 45 mg nitrate/L (U.S. EPA, 1997), based on early clinical signs of cyanosis associated with methemoglobinemia in infants.

Nitrite

There are no reliable quantitative data on nitrite and methemoglobinemia in humans. While nitrite has been shown to cause methemoglobinemia in animals, humans appear to be more sensitive to nitrite-induced methemoglobin formation. Therefore, the MCL for nitrite was derived by extrapolation of nitrate toxicity data in humans. Based on data which indicate that the fraction of nitrate reduced to nitrite in adults is at least 5%, and knowing that nitrate reduction in infants is significantly greater than in adults (due to the presence of gastrointestinal bacteria), the conversion rate is estimated to be at least 10% in infants (U.S. EPA, 1990).

Using the same NOAEL selected for nitrate of 10 mg nitrate-nitrogen/L (from Bosch *et al.*, 1950; Walton, 1951), an uncertainty factor of one was applied because the NOAEL was of the critical toxic effect (methemoglobinemia) in the most sensitive human subpopulation (infants). In addition, the NOAEL was multiplied by 0.1 to account for the estimated conversion rate of nitrate to nitrite by gastrointestinal tract bacteria in infants, as described above. Therefore, the MCL for nitrite is 1 mg nitrite-nitrogen/L (U.S. EPA, 1990; U.S. EPA, 1997).

Joint Nitrate and Nitrite

U.S. EPA set a joint standard for the sum of the concentration of nitrate and nitrite at 10 mg/L as nitrogen. The combined standard does not replace the individual MCLs for nitrate or nitrite, therefore the maximum contribution from nitrite cannot exceed 1 mg nitrite-nitrogen/L (U.S. EPA, 1991).

CALCULATION OF PHGS

Public health-protective concentrations (C, in mg/L) are calculated using the general formula for noncarcinogenic endpoints:

$$C = \frac{NOAEL \times BW \times RSC}{UF \times L/day} = mg/L$$

where,

NOAEL	=	No-observed-adverse-effect-level (10 mg nitrate-nitrogen/L)
BW	=	Body weight (not applicable)
RSC	=	Relative source contribution (not applicable)
UF	=	Uncertainty factor (one)
L/day	=	Volume of daily drinking water consumption (not applicable).

In the case of nitrate and nitrite, the NOAEL is based on human data for nitrate exposure from drinking water in the most sensitive population (infants). Therefore, the uncertainty factor for human variability is one. No other uncertainty factors are applied. For nitrite, the NOAEL is multiplied by 0.1 to account for the estimated conversion rate of nitrate to nitrite by gastrointestinal tract bacteria in infants, as previously described.

OEHHA staff support U.S. EPA's previous analysis on nitrate and nitrite. The values consider the conversion of nitrate to nitrite, nitrite-induced formation of methemoglobin, and the general absence of methemoglobinemia occurring at nitrate-nitrogen levels below 10 mg/L based on world-wide epidemiological evidence. The values are protective for infants, the most sensitive population. Review of updated information compiled since the development of the MCLs in 1991 support the earlier findings. In addition, no cases of methemoglobinemia occurring at or below the MCL have been identified in the United States. Therefore, OEHHA adopts the following PHGs:

nitrate	=	10 mg nitrate-nitrogen/L (10 ppm nitrate-nitrogen)
	=	45 mg nitrate/L (45 ppm nitrate),
nitrite	=	1 mg nitrite-nitrogen/L (1 ppm) and
joint nitrate/nitrite	=	10 mg/L (10 ppm), expressed on a nitrogen basis.

These PHGs, as well as current federal MCLs for nitrate and nitrite, should be adequately protective against methemoglobinemia in infants, as well as any potential reproductive or developmental effects.

RISK CHARACTERIZATION

Although there are an enormous amount of data on the occurrence of methemoglobinemia in infants ingesting nitrate-contaminated water, there are some uncertainties in the database used for the development for the MCL:

1. The concentration of nitrate is not known in all reported cases of methemoglobinemia, and cases of nitrate-induced infantile methemoglobinemia have been reported in other countries at levels below the MCL. While the reports that indicate cases occurring below the MCL are of uncertain quality (largely due to a lack of controls for the presence of confounding factors), there is the possibility that methemoglobinemia resulting from nitrate ingestion could occur at a nitrate level lower than the MCL.

2. It is possible that methemoglobinemia is more likely associated with nitrate plus bacterial contamination of drinking water. Bacterial contamination favors the conversion of nitrate to nitrite as well as the occurrence of diarrhea, which in infants can increase the risk of methemoglobinemia.

3. There could be unidentified differences among the study populations, including nutritional status, that could contribute to differences in the reported findings. Vitamin C can help reduce the risk of methemoglobinemia from nitrate (NRC, 1995) and some populations have a higher vitamin C intake level than others.

4. There are no known requirements for reporting cases of methemoglobinemia.

5. Infant illness or death from nitrate-induced methemoglobinemia may be misdiagnosed, perhaps as sudden-infant-death-syndrome (Johnson and Kross, 1990).

In light of the above, a particular public health concern regarding the methemoglobinemia data is the finding of a lowest-observed-adverse-effect-level (LOAEL) of 11 to 20 mg nitrate-nitrogen/L with no clear delineation of a NOAEL. It is important to note that, in the United States no cases of methemoglobinemia have been reported at a nitrate concentration at or below the MCL.

Animal experimental data have shown reproductive and developmental toxicity associated with high exposure levels to nitrate and nitrite, which are not likely to be encountered in drinking water. The lowest concentrations associated with developmental effects were reported at 1,000 ppm sodium nitrite in water, with a NOAEL at or around 500 ppm (Roth *et al.*, 1987; Roth and Smith, 1988). At an MCL of 45 ppm nitrate, and assuming a 10% conversion of nitrate to nitrite, the amount of nitrate ingestion from two liters of water would be several hundred times less than this NOAEL (Fan and Steinberg, 1996).

U.S. EPA has adopted a joint standard to account for the possibility of the simultaneous occurrence of nitrate and nitrite in drinking water. The equilibrium of nitrate and nitrite in aqueous environments greatly favors nitrate. Nitrite levels can become significant with bacterial contamination and anaerobic conditions (U.S. EPA, 1990); in such cases nitrite levels would be expected to be high, exceeding the nitrite MCL of 1 mg/L. In light of the environmental characteristics of nitrate and nitrite, and in keeping with U.S. EPA, we have concluded that the joint MCL of 10 mg/L (with the contribution from nitrite not exceeding 1 mg nitrite-nitrogen/L) adequate for the protection of public health.

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Attachment D
RAGS Part D Planning Tables

Table 7a *Calculation of Chemical Cancer Risks and Non-Cancer Hazards*
Well 1469 in Zone 1 PGOU
Baseline Risk Assessment PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Scenario Timeframe:	Future
Receptor Population:	Resident
Receptor Age:	Child and Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations-Child					Non-Cancer Hazard Calculations-Adult				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Domestic Use	Ingestion	1,1-Dichloroethane	1.7E+00	ug/L	2.5E-05	mg/kg-d	5.7E-03	(mg/kg-d)$^{-1}$	1.4E-07	1.1E-04	mg/kg-d	2.0E-01	(mg/kg-d)$^{-1}$	5.4E-04	4.7E-05	mg/kg-d	2.0E-01	(mg/kg-d)$^{-1}$	2.3E-04
Zone 1				1,1-Dichloroethene	3.6E+01	ug/L	5.4E-04	mg/kg-d	NA	(mg/kg-d)$^{-1}$	NA	2.3E-03	mg/kg-d	5.0E-02	(mg/kg-d)$^{-1}$	4.6E-02	9.9E-04	mg/kg-d	5.0E-02	(mg/kg-d)$^{-1}$	2.0E-02
				1,2-Dichloroethane	1.2E+00	ug/L	1.8E-05	mg/kg-d	9.1E-02	(mg/kg-d)$^{-1}$	1.6E-06	7.7E-05	mg/kg-d	2.0E-02	(mg/kg-d)$^{-1}$	3.8E-03	3.3E-05	mg/kg-d	2.0E-02	(mg/kg-d)$^{-1}$	1.6E-03
				1,2-Dichloroethene (cis/trans)	3.0E+01	ug/L	4.5E-04	mg/kg-d	NA	(mg/kg-d)$^{-1}$	NA	1.9E-03	mg/kg-d	1.0E-02	(mg/kg-d)$^{-1}$	1.9E-01	8.2E-04	mg/kg-d	1.0E-02	(mg/kg-d)$^{-1}$	8.2E-02
				1,4-Dioxane	1.0E+01	ug/L	1.5E-04	mg/kg-d	2.7E-02	(mg/kg-d)$^{-1}$	4.0E-06	6.4E-04	mg/kg-d	NA	(mg/kg-d)$^{-1}$	NA	2.7E-04	mg/kg-d	NA	(mg/kg-d)$^{-1}$	NA
				Chloroform	1.8E+00	ug/L	2.7E-05	mg/kg-d	3.1E-02	(mg/kg-d)$^{-1}$	8.3E-07	1.2E-04	mg/kg-d	1.0E-02	(mg/kg-d)$^{-1}$	1.2E-02	4.9E-05	mg/kg-d	1.0E-02	(mg/kg-d)$^{-1}$	4.9E-03
				cis-1,2-Dichloroethene	2.6E+01	ug/L	3.8E-04	mg/kg-d	NA	(mg/kg-d)$^{-1}$	NA	1.6E-03	mg/kg-d	1.0E-02	(mg/kg-d)$^{-1}$	1.6E-01	7.0E-04	mg/kg-d	1.0E-02	(mg/kg-d)$^{-1}$	7.0E-02
				Tetrachloroethene	9.0E+00	ug/L	1.3E-04	mg/kg-d	5.4E-01	(mg/kg-d)$^{-1}$	7.2E-05	5.8E-04	mg/kg-d	1.0E-02	(mg/kg-d)$^{-1}$	5.8E-02	2.5E-04	mg/kg-d	1.0E-02	(mg/kg-d)$^{-1}$	2.5E-02
				Trichloroethene	8.7E+02	ug/L	1.3E-02	mg/kg-d	1.3E-02	(mg/kg-d)$^{-1}$	1.7E-04	5.6E-02	mg/kg-d	3.0E-04	(mg/kg-d)$^{-1}$	1.9E+02	2.4E-02	mg/kg-d	3.0E-04	(mg/kg-d)$^{-1}$	7.9E+01
			Exp. Route Total								2.5E-04					1.9E+01					8.0E+01
			Dermal	1,1-Dichloroethane	1.7E+00	ug/L	2.0E-06	mg/kg-d	5.7E-03	(mg/kg-d)$^{-1}$	1.1E-08	8.5E-06	mg/kg-d	2.0E-01	(mg/kg-d)$^{-1}$	4.2E-05	3.6E-06	mg/kg-d	2.0E-01	(mg/kg-d)$^{-1}$	1.8E-05
				1,1-Dichloroethene	3.6E+01	ug/L	7.4E-05	mg/kg-d	NA	(mg/kg-d)$^{-1}$	NA	3.2E-04	mg/kg-d	5.0E-02	(mg/kg-d)$^{-1}$	6.3E-03	1.4E-04	mg/kg-d	5.0E-02	(mg/kg-d)$^{-1}$	2.7E-03
				1,2-Dichloroethane	1.2E+00	ug/L	8.7E-07	mg/kg-d	9.1E-02	(mg/kg-d)$^{-1}$	8.0E-08	3.7E-06	mg/kg-d	2.0E-02	(mg/kg-d)$^{-1}$	1.9E-04	1.6E-06	mg/kg-d	2.0E-02	(mg/kg-d)$^{-1}$	8.1E-05
				1,2-Dichloroethene (cis/trans)	3.0E+01	ug/L	4.0E-05	mg/kg-d	NA	(mg/kg-d)$^{-1}$	NA	1.7E-04	mg/kg-d	1.0E-02	(mg/kg-d)$^{-1}$	1.7E-02	7.3E-05	mg/kg-d	1.0E-02	(mg/kg-d)$^{-1}$	7.3E-03
				1,4-Dioxane	1.0E+01	ug/L	5.4E-07	mg/kg-d	2.7E-02	(mg/kg-d)$^{-1}$	1.4E-08	2.3E-06	mg/kg-d	NA	(mg/kg-d)$^{-1}$	NA	9.8E-07	mg/kg-d	NA	(mg/kg-d)$^{-1}$	NA
				Chloroform	1.8E+00	ug/L	2.4E-06	mg/kg-d	3.1E-02	(mg/kg-d)$^{-1}$	7.5E-08	1.0E-05	mg/kg-d	1.0E-02	(mg/kg-d)$^{-1}$	1.0E-03	4.5E-06	mg/kg-d	1.0E-02	(mg/kg-d)$^{-1}$	4.5E-04
				cis-1,2-Dichloroethene	2.6E+01	ug/L	3.4E-05	mg/kg-d	NA	(mg/kg-d)$^{-1}$	NA	1.5E-04	mg/kg-d	1.0E-02	(mg/kg-d)$^{-1}$	1.5E-02	6.2E-05	mg/kg-d	1.0E-02	(mg/kg-d)$^{-1}$	6.2E-03
				Tetrachloroethene	9.0E+00	ug/L	7.9E-05	mg/kg-d	5.4E-01	(mg/kg-d)$^{-1}$	4.3E-05	3.3E-04	mg/kg-d	1.0E-02	(mg/kg-d)$^{-1}$	3.3E-02	1.5E-04	mg/kg-d	1.0E-02	(mg/kg-d)$^{-1}$	1.5E-02
				Trichloroethene	8.7E+02	ug/L	2.2E-03	mg/kg-d	1.3E-02	(mg/kg-d)$^{-1}$	2.9E-05	9.3E-03	mg/kg-d	3.0E-04	(mg/kg-d)$^{-1}$	3.1E+01	4.1E-03	mg/kg-d	3.0E-04	(mg/kg-d)$^{-1}$	1.4E+01
			Exp. Route Total								7.1E-05					3.1E+01					1.4E+01
			Inhalation	1,1-Dichloroethane	1.7E+00	ug/L	1.3E-04	mg/kg-d	5.7E-03	(mg/kg-d)$^{-1}$	7.2E-07	5.4E-04	mg/kg-d	2.0E-01	mg/kg-d	2.7E-03	2.3E-04	mg/kg-d	2.0E-01	mg/kg-d	1.2E-03
				1,1-Dichloroethene	3.6E+01	ug/L	2.7E-03	mg/kg-d	NA	(mg/kg-d)$^{-1}$	NA	1.2E-02	mg/kg-d	2.0E-02	mg/kg-d	5.8E-01	4.9E-03	mg/kg-d	2.0E-02	mg/kg-d	2.5E-01
				1,2-Dichloroethane	1.2E+00	ug/L	8.9E-05	mg/kg-d	9.1E-02	(mg/kg-d)$^{-1}$	8.1E-06	3.8E-04	mg/kg-d	1.4E-03	mg/kg-d	2.7E-01	1.6E-04	mg/kg-d	1.4E-03	mg/kg-d	1.2E-01
				1,2-Dichloroethene (cis/trans)	3.0E+01	ug/L	2.2E-03	mg/kg-d	NA	(mg/kg-d)$^{-1}$	NA	9.6E-03	mg/kg-d	1.0E-02	mg/kg-d	9.6E-01	4.1E-03	mg/kg-d	1.0E-02	mg/kg-d	4.1E-01
				1,4-Dioxane	1.0E+01	ug/L	7.4E-04	mg/kg-d	2.7E-02	(mg/kg-d)$^{-1}$	2.0E-05	3.2E-03	mg/kg-d	8.6E-01	mg/kg-d	3.7E-03	1.4E-03	mg/kg-d	8.6E-01	mg/kg-d	1.6E-03
				Chloroform	1.8E+00	ug/L	1.3E-04	mg/kg-d	8.1E-02	(mg/kg-d)$^{-1}$	1.1E-05	5.8E-04	mg/kg-d	1.3E-02	mg/kg-d	4.4E-02	2.5E-04	mg/kg-d	1.3E-02	mg/kg-d	1.9E-02
				cis-1,2-Dichloroethene	2.6E+01	ug/L	1.9E-03	mg/kg-d	NA	(mg/kg-d)$^{-1}$	NA	8.2E-03	mg/kg-d	1.0E-02	mg/kg-d	8.2E-01	3.5E-03	mg/kg-d	1.0E-02	mg/kg-d	3.5E-01
				Tetrachloroethene	9.0E+00	ug/L	6.7E-04	mg/kg-d	2.1E-02	(mg/kg-d)$^{-1}$	1.4E-05	2.9E-03	mg/kg-d	1.0E-02	mg/kg-d	2.9E-01	1.2E-03	mg/kg-d	1.0E-02	mg/kg-d	1.2E-01
				Trichloroethene	8.7E+02	ug/L	6.5E-02	mg/kg-d	7.0E-03	(mg/kg-d)$^{-1}$	4.5E-04	2.8E-01	mg/kg-d	1.7E-01	mg/kg-d	1.6E+00	1.2E-01	mg/kg-d	1.7E-01	mg/kg-d	7.0E-01
			Exp. Route Total								5.1E-04					4.6E+00					2.0E+00
		Exposure Point Total									8.3E-04					2.2E+02					9.5E+01
	Exposure Medium Total										8.3E-04					2.2E+02					9.5E+01
Medium Total											8.3E-04					2.2E+02					9.5E+01

Table 7b ***Calculation of Chemical Cancer Risks and Non-Cancer Hazards***
Well 1469 in Zone 1 PGOU
Baseline Risk Assessment PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Scenario Timeframe:	Future
Receptor Population:	Resident
Receptor Age:	Child and Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations-Child					Non-Cancer Hazard Calculations-Adult				
					Value	Units	Exposure Concen		CSF/Unit Risk		Cancer Risk	Exposure Concen		RfD/RfC		Hazard Quotient	Exposure Concen		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Vapor Intrusion	Inhalation	1,1-Dichloroethane	1.7E+00	ug/L	6.7E-06	mg/kg-d	5.7E-03	$(mg/kg\text{-}d)^{-1}$	3.8E-08	2.9E-05	mg/kg-d	2.0E-01	mg/kg-d	1.4E-04	1.2E-05	mg/kg-d	2.0E-01	mg/kg-d	6.2E-05
Zone 1				1,1-Dichloroethene	3.6E+01	ug/L	8.0E-04	mg/kg-d	NA	$(mg/kg\text{-}d)^{-1}$	NA	3.4E-03	mg/kg-d	2.0E-02	mg/kg-d	1.7E-01	1.5E-03	mg/kg-d	2.0E-02	mg/kg-d	7.3E-02
				1,2-Dichloroethane	1.2E+00	ug/L	1.1E-06	mg/kg-d	9.1E-02	$(mg/kg\text{-}d)^{-1}$	1.0E-07	4.9E-06	mg/kg-d	1.4E-03	mg/kg-d	3.5E-03	2.1E-06	mg/kg-d	1.4E-03	mg/kg-d	1.5E-03
				1,2-Dichloroethene (cis/trans)	3.0E+01	ug/L	8.5E-05	mg/kg-d	NA	$(mg/kg\text{-}d)^{-1}$	NA	3.7E-04	mg/kg-d	1.0E-02	mg/kg-d	3.7E-02	1.6E-04	mg/kg-d	1.0E-02	mg/kg-d	1.6E-02
				1,4-Dioxane	1.0E+01	ug/L	8.6E-08	mg/kg-d	2.7E-02	$(mg/kg\text{-}d)^{-1}$	2.3E-09	3.7E-07	mg/kg-d	8.6E-01	mg/kg-d	4.3E-07	1.6E-07	mg/kg-d	8.6E-01	mg/kg-d	1.8E-07
				Chloroform	1.8E+00	ug/L	6.4E-06	mg/kg-d	8.1E-02	$(mg/kg\text{-}d)^{-1}$	5.1E-07	2.7E-05	mg/kg-d	1.3E-02	mg/kg-d	2.1E-03	1.2E-05	mg/kg-d	1.3E-02	mg/kg-d	9.0E-04
				cis-1,2-Dichloroethene	2.6E+01	ug/L	7.3E-05	mg/kg-d	NA	$(mg/kg\text{-}d)^{-1}$	NA	3.1E-04	mg/kg-d	1.0E-02	mg/kg-d	3.1E-02	1.3E-04	mg/kg-d	1.0E-02	mg/kg-d	1.3E-02
				Tetrachloroethene	9.0E+00	ug/L	1.1E-04	mg/kg-d	2.1E-02	$(mg/kg\text{-}d)^{-1}$	2.3E-06	4.8E-04	mg/kg-d	1.0E-02	mg/kg-d	4.8E-02	2.1E-04	mg/kg-d	1.0E-02	mg/kg-d	2.1E-02
				Trichloroethene	8.7E+02	ug/L	6.6E-03	mg/kg-d	7.0E-03	$(mg/kg\text{-}d)^{-1}$	4.7E-05	2.9E-02	mg/kg-d	1.7E-01	mg/kg-d	1.7E-01	1.2E-02	mg/kg-d	1.7E-01	mg/kg-d	7.1E-02
			Exp. Route Total								5.0E-05					4.6E-01					2.0E-01
		Exposure Point Total									5.0E-05					4.6E-01					2.0E-01
	Exposure Medium Total										5.0E-05					4.6E-01					2.0E-01
Medium Total											5.0E-05					4.6E-01					2.0E-01

Table 9 Summary of Receptor Risks and Hazards for COPCs
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult/Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient (Adult)					Non-Carcinogenic Hazard Quotient (Child)			
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total
Zone 1	Groundwater	Domestic Use	1,1-Dichloroethane	1.4.E-07	–	1.1.E-08	–	1.6.E-07	Kidney	5.4.E-04	–	4.2.E-05	5.9.E-04	2.3.E-04	–	1.8.E-05	2.5.E-04
			1,1-Dichloroethene	NA	–	NA	–	–	Liver / Kidney	4.6.E-02	–	6.3.E-03	5.2.E-02	2.0.E-02	–	2.7.E-03	2.2.E-02
			1,2-Dichloroethane	1.6.E-06	–	8.0.E-08	–	1.7.E-06	Nervous System / Liver / Kidney	3.8.E-03	–	1.9.E-04	4.0.E-03	1.6.E-03	–	8.1.E-05	1.7.E-03
			1,2-Dichloroethene (cis/trans)	NA	–	NA	–	–	Blood	1.9.E-01	–	1.7.E-02	2.1.E-01	8.2.E-02	–	7.3.E-03	8.9.E-02
			1,4-Dioxane	4.0.E-06	–	1.4.E-08	–	4.0.E-06	--	NA	–	NA	–	NA	–	NA	–
			Chloroform	8.3.E-07	–	7.5.E-08	–	9.0.E-07	Liver / Kidney / Testes	1.2.E-02	–	1.0.E-03	1.3.E-02	4.9.E-03	–	4.5.E-04	5.4.E-03
			cis-1,2-Dichloroethene	NA	–	NA	–	–	Blood	1.6.E-01	–	1.5.E-02	1.8.E-01	7.0.E-02	–	6.2.E-03	7.7.E-02
			Tetrachloroethene	7.2.E-05	–	4.3.E-05	–	1.1.E-04	Liver / Kidney	5.8.E-02	–	3.3.E-02	9.1.E-02	2.5.E-02	–	1.5.E-02	3.9.E-02
			Trichloroethene	1.7.E-04	–	2.9.E-05	–	2.0.E-04	Liver / Kidney	1.9.E+02	–	3.1.E+01	2.2.E+02	7.9.E+01	–	1.4.E+01	9.3.E+01
			Chemical Total	2.5.E-04	–	7.1.E-05	–	3.2.E-04		1.9.E+02	–	3.1.E+01	2.2.E+02	8.0.E+01	–	1.4.E+01	9.3.E+01
		Vapor from Domestic Use	1,1-Dichloroethane	–	7.2.E-07	–	–	7.2.E-07	NOEL	–	2.7.E-03	–	2.7.E-03	–	1.2.E-03	–	1.2.E-03
			1,1-Dichloroethene	–	NA	–	–	–	Liver / Kidneys / Development	–	5.8.E-01	–	5.8.E-01	–	2.5.E-01	–	2.5.E-01
			1,2-Dichloroethane	–	8.1.E-06	–	–	8.1.E-06	Nervous System / Liver / Kidney / Heart / Reproductive	–	2.7.E-01	–	2.7.E-01	–	1.2.E-01	–	1.2.E-01
			1,2-Dichloroethene (cis/trans)	–	NA	–	–	–	Central Nervous System / Liver	–	9.6.E-01	–	9.6.E-01	–	4.1.E-01	–	4.1.E-01
			1,4-Dioxane	–	2.0.E-05	–	–	2.0.E-05	Alimentary system / kidney / cardiovascular system	–	3.7.E-03	–	3.7.E-03	–	1.6.E-03	–	1.6.E-03
			Chloroform	–	1.1.E-05	–	–	1.1.E-05	Liver / Kidney / Central Nervous System / Gastrointestinal Tract / Reproduction and Development	–	4.4.E-02	–	4.4.E-02	–	1.9.E-02	–	1.9.E-02
			cis-1,2-Dichloroethene	–	NA	–	–	–	Central Nervous System / Liver	–	8.2.E-01	–	8.2.E-01	–	3.5.E-01	–	3.5.E-01
			Tetrachloroethene	–	1.4.E-05	–	–	1.4.E-05	Central Nervous System / Liver / Kidney	–	2.9.E-01	–	2.9.E-01	–	1.2.E-01	–	1.2.E-01
			Trichloroethene	–	4.5.E-04	–	–	4.5.E-04	Central Nervous System / Liver / Kidney / Cardiovascular System / Hematopoietic System / Reproduction / Eyes	–	1.6.E+00	–	1.6.E+00	–	7.0.E-01	–	7.0.E-01
			Chemical Total	–	5.1.E-04	–	–	5.1.E-04		–	4.6.E+00	–	4.6.E+00	–	2.0.E+00	–	2.0.E+00
		Exposure Point Total						8.3.E-04					2.2.E+02				9.5.E+01

Table 9 *Summary of Receptor Risks and Hazards for COPCs*
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult/Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient (Adult)					Non-Carcinogenic Hazard Quotient (Child)			
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total
Zone 1	Groundwater	Vapor Intrusion	1,1-Dichloroethane	–	3.8.E-08	–	–	3.8.E-08	NOEL	–	1.4.E-04	–	1.4.E-04	–	6.2.E-05	–	6.2.E-05
			1,1-Dichloroethene	–	NA	–	–	–	Liver / Kidneys / Development	–	1.7.E-01	–	1.7.E-01	–	7.3.E-02	–	7.3.E-02
			1,2-Dichloroethane	–	1.0.E-07	–	–	1.0.E-07	Nervous System / Liver / Kidney / Heart / Reproductive	–	3.5.E-03	–	3.5.E-03	–	1.5.E-03	–	1.5.E-03
			1,2-Dichloroethene (cis/trans)	–	NA	–	–	–	Central Nervous System / Liver	–	3.7.E-02	–	3.7.E-02	–	1.6.E-02	–	1.6.E-02
			1,4-Dioxane	–	2.3.E-09	–	–	2.3.E-09	Alimentary system / kidney / cardiovascular system	–	4.3.E-07	–	4.3.E-07	–	1.8.E-07	–	1.8.E-07
	Groundwater	Vapor Intrusion	Chloroform	–	5.1.E-07	–	–	5.1.E-07	Liver / Kidney / Central Nervous System / Gastrointestinal Tract / Reproduction and Development		2.1.E-03		2.1.E-03	–	9.0.E-04	–	9.0.E-04
			cis-1,2-Dichloroethene	–	NA	–	–	–	Central Nervous System / Liver	–	3.1.E-02	–	3.1.E-02	–	1.3.E-02	–	1.3.E-02
			Tetrachloroethene	–	2.3.E-06	–	–	2.3.E-06	Central Nervous System / Liver / Kidney	–	4.8.E-02	–	4.8.E-02	–	2.1.E-02	–	2.1.E-02
			Trichloroethene	–	4.7.E-05	–	–	4.7.E-05	Central Nervous System / Liver / Kidney / Cardiovascular System / Hematopoietic System / Reproduction / Eyes	–	1.7.E-01	–	1.7.E-01	–	7.1.E-02	–	7.1.E-02
			Chemical Total	–	5.0.E-05	–	–	5.0.E-05		–	4.6.E-01	–	4.6.E-01	–	2.0.E-01	–	2.0.E-01
		Exposure Point Total						5.E-05					5.E-01				2.E-01
	Exposure Medium Total							9.E-04					2.E+02				1.E+02
Groundwater Total								9.E-04					2.E+02				1.E+02
Receptor Total							Receptor Risk Total	9.E-04				Receptor HI Total	2.E+02			Receptor HI Total	1.E+02

1 = Primary target organ based on oral value

2 = As agreed with the agencies, the target organ analysis only included constituents with HI greater than 0.1

Total Liver HI Across All Media [2] =	2E+02	1E+02
Total Blood HI Across All Media [2] =	2E+00	8E-01
Total Kidney HI Across All Media [2] =	2E+02	9E+01

Attachment E
Screening-Level Ecological Risk Assessment Tables

Table E-1 Volatile Organic Compounds Detected in Alder Creek Surface Water Samples 17 December 2004 Baseline Risk Assessment for PGOU Groundwater Aerojet Superfund Site Sacramento County, California

Sample Location	Sample Date	Compound	Concentration (µg/L)
Alder Creek 1	12/17/04	Acetone	**2.4 J**
		Chloromethane	**0.19 J**
		Naphthalene	**0.17 J**
Alder Creek 2	12/17/04	Acetone	**3.1 J**
		Chloromethane	<0.14
		Naphthalene	<0.1
Alder Creek 3	12/17/04	Acetone	**3.4 J**
		Chloromethane	<0.14
		Naphthalene	<0.1

Notes and Key:
Detected concentrations are in bold
µg/L = Micrograms per liter
J = Estimated concentration. Reported concentration between laboratory reporting limit and method detection limit.
< = Less than the noted laboratory reporting limit.

The following VOCs were analyzed for, but not detected at the noted laboratory reporting limit:

Compound	Reporting Limit	Compound	Reporting Limit
1,1,1,2-Tetrachloroethane	0.50	Carbon disulfide	5.0
1,1,1-Trichloroethane	0.50	Carbon tetrachloride	0.50
1,1,2,2-Tetrachloroethane	0.50	Chlorobenzene	0.50
1,1,2-Trichloroethane	0.50	Chloroethane	0.50
1,1-Dichloroethane	0.50	Chloroform	0.50
1,1-Dichloroethene	0.50	cis-1,2-Dichloroethene	0.50
1,1-Dichloropropene	0.50	cis-1,3-Dichloropropene	0.50
1,2,3-Trichlorobenzene	0.50	Dibromochloromethane	0.50
1,2,3-Trichloropropane	0.50	Dibromomethane	0.50
1,2,4-Trichlorobenzene	0.50	Dichlorodifluoromethane	0.50
1,2,4-Trimethylbenzene	0.50	Ethylbenzene	0.50
1,2-Dibromo-3-chloropropane	1.0	Freon 113	0.50
1,2-Dibromoethane (EDB)	0.50	Hexachlorobutadiene	0.50
1,2-Dichlorobenzene	0.50	Isopropylbenzene	0.50
1,2-Dichloroethane	0.50	m,p-Xylene	0.50
1,2-Dichloropropane	0.50	Methyl tert-butyl ether	0.50
1,3,5-Trimethylbenzene	0.50	Methylene chloride	0.50
1,3-Dichlorobenzene	0.50	n-Butylbenzene	0.50
1,3-Dichloropropane	0.50	n-Propylbenzene	0.50
1,4-Dichlorobenzene	0.50	o-Xylene	0.50
2,2-Dichloropropane	0.50	p-Isopropyltoluene	0.50
2-Butanone	5.0	sec-Butylbenzene	0.50
2-Chlorotoluene	0.50	Styrene	0.50
2-Hexanone	5.0	tert-Butylbenzene	0.50
4-Chlorotoluene	0.50	Tetrachloroethene	0.50
4-Methyl-2-pentanone	5.0	Toluene	0.50
Benzene	0.50	trans-1,2-Dichloroethene	0.50
Bromobenzene	0.50	trans-1,3-Dichloropropene	0.50
Bromochloromethane	0.50	Trichloroethene	0.50
Bromodichloromethane	0.50	Trichlorofluoromethane	0.50
Bromoform	0.50	Vinyl acetate	5.0
Bromomethane	1.0	Vinyl chloride	0.50

Table E-2 Results of Perchlorate and NDMA Analysis of Alder Creek Surface Water Samples 17 December 2004 Baseline Risk Assessment for PGOU Groundwater Aerojet Superfund Site Sacramento County, California

Sample Location	Sample Date	Perchlorate (µg/L)	NDMA (ng/L)
Alder Creek 1	12/17/04	<4	<2
Alder Creek 2	12/17/04	<4	**14**
Alder Creek 3	12/17/04	<4	NA
Alder Creek 3	12/23/04[1]	NA	<2

Notes and Key:

Detected concentrations are in bold

1 = Bottles with samples collected 17 December 2004 for NDMA broken during transit. Resampled on 23 December 2004.

µg/L = Micrograms per liter

ng/L = Nanograms per liter

NA = Not analyzed

NDMA = N-nitrosodimethylamine

< = Less than the noted laboratory reporting limit.

Table E-3 *Dissolved Metal Concentrations in Alder Creek Surface Water Samples*
17 December 2004
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Sample Location	Sample Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Lead	Magnesium	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
Alder Creek 1	12/17/04	<60	<100	**50**	<1	<10	**24,000**	<10	<7	<10	<75	**16,000**	<0.2	<20	<30	<100	<7	<100	<10	**8 J**
Alder Creek 2	12/17/04	<60	<100	**48**	<1	**2.9 J**	**23,000**	<10	<7	<10	<75	**15,000**	<0.2	<20	<30	**19 J**	<7	<100	<10	**6.6 J**
Alder Creek 3	12/17/04	<60	<100	**46**	<1	**3 J**	**26,000**	<10	<7	**2.6 J**	<75	**17,000**	<0.2	<20	<30	<100	<7	<100	**2.7 J**	<20

Notes and Key:
Concentrations reported in micrograms per liter (µg/L)
Detected concentrations are in bold.
J = Estimated concentration. Reported concentration between reporting limit and method detection limit.
NA = Not applicable/not analyzed
< = Less than the noted laboratory reporting limit.

Table E-4 *Water Quality Parameters for Alder Creek Surface Water Samples*
17 December 2004
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Sample Location	Sample Date	pH[1]	Temp[1] (°C)	Specific Conductivity[1] (µmhos/cm)	Specific Conductivity (µmhos/cm)	Total Suspended Solids (mg/L)	Total Dissolved Solids[1] (g/L)	Total Hardness (as $CaCO_3$) (mg/L)	Dissolved Oxygen[1] (mg/L)
Alder Creek 1	12/17/04	7.5	8.6	196	300	<10	0.186	130	9.5
Alder Creek 2	12/17/04	7.5	9.2	185	300	11	0.172	120	10.4
Alder Creek 3	12/17/04	7.5	9.9	209	310	<10	0.189	130	10.5

Notes and Key:

1 = Field measurement. All other parameters measured in laboratory.

°C = Degrees Celsius
CaCO3 = Calcium carbonate
g/L = Grams per liter
mg/L = Milligrams per liter
Temp = Temperature
µmhos/cum = Micromhos per centimeter at 25° Celsius
< = Less than the noted laboratory reporting limit.

Table E-5 Miscellaneous Constituents Detected in Alder Creek Surface Water Samples Baseline Risk Assessment for PGOU Groundwater Aerojet Superfund Site Sacramento County, California

Sample ID	Sample Date	Perchlorate (µg/L)	Nitrate (as N) (mg/L)	Total Organic Halogen (µg/L)
S-5	1/23/2002	<4	**0.33**	<30
	4/15/2002	<4	<0.011	<30
	7/2/2002	<4	<0.011	<30
	10/7/2002	<4	<0.011	**34**
	1/8/2003	<4	**0.64**	<30
	4/7/2003	<4	**0.022**	<30
	7/2/2003	<4	<0.011	**54**
	10/13/2003	<4	<0.011	<30
	1/12/2004	<4	**1.1**	<30
	4/6/2004	<4	<0.023	<30
	7/12/2004	<4	<0.023	<30
S-6	1/23/2002	<4	**0.094**	<30
	4/15/2002	<4	**0.061**	<30
	7/2/2002	<4	**0.09**	<30
	10/7/2002	**5.5**	**0.096**	<30
	1/8/2003	<4	**0.35**	<30
	4/7/2003	<4	**0.056**	<30
	7/2/2003	**12**	**0.17**	<30
	10/13/2003	**7**	**0.097**	<30
	1/12/2004	<4	**0.74**	<30
	4/6/2004	<4	**0.06**	<30
	7/12/2004	**6.9**	**0.13**	<30

Notes and Key:
Detected concentrations are in bold
µg/L = Micrograms per liter
mg/L = Milligrams per liter
ID = Identifications
N = Nitrogen

The following constituents were analyzed for, but not detected:
Ammonia as N
Chlorine (as Cl)
1,1-Dimethyl Hydrazine
Hydrazine
Methyl Hydrazine
Oil and Grease

Table E-6 *Total and Dissolved Metal Concentrations in Alder Creek Surface Water Samples*
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Sample ID	Sample Date		Aluminum	Arsenic	Barium	Boron	Calcium	Copper	Iron	Lead	Magnesium	Manganese	Potassium	Sodium	Vanadium	Zinc
S-5	01/23/02	Total	**0.068**	<0.005	**0.036**	**0.034**	**26**	**0.0037**	**0.13**	<0.005	**17**	**0.016**	**1.2**	**12**	**0.0016**	<0.025
	01/23/02	Dissolved	<0.050	<0.005	**0.051**	**0.044**	**26**	**0.0024**	<0.075	<0.005	**17**	**0.015**	**1.1**	**13**	<0.0015	**0.034**
	04/15/02	Total	NA	NA	NA	NA	**29**	NA	NA	NA	**19**	NA	<2	14	NA	NA
	07/02/02	Total	<0.050	**0.0033**	**0.051**	**0.032**	**34**	<0.0015	**0.17**	<0.0020	**22**	**0.05**	**0.78**	**16**	**0.0027**	<0.025
	07/02/02	Dissolved	<0.050	**0.0033**	**0.085**	**0.052**	**32**	<0.0015	<0.075	<0.0020	**21**	**0.035**	**0.71**	**16**	**0.0022**	**0.066**
	10/07/02	Total	NA	NA	NA	NA	**32**	NA	NA	NA	**20**	NA	<2	**15**	NA	NA
	01/08/03	Total	<0.050	<0.0020	**0.035**	**0.033**	**24**	**0.0017**	**0.16**	<0.0020	**16**	**0.021**	**1.1**	**12**	**0.0018**	<0.025
	01/08/03	Dissolved	<0.050	<0.0020	**0.061**	**0.048**	**24**	**0.0018**	<0.075	**0.003**	**16**	**0.019**	**1.1**	**12**	**0.0016**	**0.061**
	04/07/03	Total	NA	NA	NA	NA	**24**	NA	NA	NA	**15**	NA	2.2	**12**	NA	NA
	07/02/03	Total	<0.050	**0.0032**	**0.044**	**0.032**	**30**	<0.0015	**0.17**	<0.0020	**21**	**0.025**	**0.95**	**15**	**0.0024**	<0.025
	07/02/03	Dissolved	<0.050	**0.003**	**0.069**	**0.034**	**29**	<0.0015	<0.075	<0.0020	**21**	**0.022**	**1.1**	**15**	**0.0024**	<0.025
	10/13/03	Total	NA	NA	NA	NA	**31**	NA	NA	NA	**21**	NA	<2	**15**	NA	NA
	01/12/04	Total	<0.050	<0.0020	**0.035**	**0.035**	**24**	**0.0023**	**0.15**	<0.0020	**16**	**0.033**	**1.1**	**12**	**0.0017**	<0.025
	01/12/04	Dissolved	<0.050	<0.0020	**0.033**	**0.033**	**23**	**0.002**	<0.075	<0.0020	**15**	**0.027**	**1.1**	**11**	<0.0015	<0.025
	04/06/04	Total	NA	NA	NA	NA	**30**	NA	NA	NA	**20**	NA	<2	**14**	NA	NA
	07/12/04	Total	<0.050	**0.0038**	**0.044**	**0.033**	**30**	<0.0015	**0.18**	<0.0020	**21**	**0.077**	**0.52**	**15**	**0.0023**	<0.025
	07/12/04	Dissolved	<0.050	**0.0035**	**0.043**	**0.031**	**29**	**0.0019**	**0.095**	<0.0020	**21**	**0.067**	**<0.5**	**15**	**0.0019**	<0.025
S-6	01/23/02	Total	<0.050	<0.0050	**0.051**	**0.027**	**20**	**0.0022**	**0.37**	<0.0050	**13**	**0.086**	**1.1**	**12**	**0.0018**	<0.025
	01/23/02	Dissolved	<0.050	0	**0.068**	**0.042**	**20**	**0.0027**	**0.21**	<0.0050	**12**	**0.08**	**0.93**	**12**	<0.0015	**0.041**
	04/15/02	Total	NA	NA	NA	NA	**21**	NA	NA	NA	**13**	NA	<2	14	NA	NA
	07/02/02	Total	<0.050	**0.0023**	**0.065**	**0.03**	**21**	<0.0015	**0.39**	<0.0020	**13**	**0.12**	**0.88**	**13**	**0.0022**	<0.025
	07/02/02	Dissolved	<0.050	**0.0021**	**0.12**	**0.055**	**21**	<0.0015	**0.18**	<0.0020	**12**	**0.085**	**0.85**	**13**	**0.002**	**0.065**
	10/07/02	Total	NA	NA	NA	NA	**26**	NA	NA	NA	**16**	NA	<2	16	NA	NA
	01/08/03	Total	<0.050	<0.0020	**0.055**	**0.03**	**22**	<0.0015	**0.43**	<0.0020	**14**	**0.082**	**0.94**	**13**	**0.0019**	<0.025
	01/08/03	Dissolved	<0.050	<0.0020	**0.053**	**0.031**	**22**	<0.0015	**0.13**	<0.0020	**14**	**0.076**	**1.1**	**13**	**0.0016**	<0.025
	04/07/03	Total	NA	NA	NA	NA	**23**	NA	NA	NA	**14**	NA	<2	13	NA	NA
	07/02/03	Total	<0.050	**0.0025**	**0.08**	**0.042**	**26**	<0.0015	**0.4**	<0.0020	**16**	**0.14**	**1.2**	**17**	**0.0027**	<0.025
	07/02/03	Dissolved	<0.050	<0.0020	**0.076**	**0.04**	**25**	<0.0015	**0.15**	<0.0020	**16**	**0.089**	**1.0**	**17**	**0.0025**	<0.025
	10/13/03	Total	NA	NA	NA	NA	**28**	NA	NA	NA	**18**	NA	<2	17	NA	NA
	01/12/04	Total	<0.050	**0.0023**	**0.051**	**0.03**	**21**	<0.0015	**0.38**	<0.0020	**13**	**0.071**	**0.99**	**12**	**0.0018**	<0.025
	01/12/04	Dissolved	<0.050	<0.0020	**0.049**	**0.03**	**20**	<0.0015	**0.19**	<0.0020	**13**	**0.067**	**0.89**	**12**	<0.0015	<0.025
	04/06/04	Total	NA	NA	NA	NA	**25**	NA	NA	NA	**16**	NA	<2	**15**	NA	NA
	07/12/04	Total	<0.050	**0.0025**	**0.071**	**0.04**	**27**	<0.0015	**0.23**	<0.0020	**18**	**0.034**	**0.74**	**17**	**0.0022**	<0.025
	07/12/04	Dissolved	<0.050	<0.0020	**0.07**	**0.039**	**27**	<0.0015	**0.09**	<0.0020	18	**0.029**	**0.85**	**17**	**0.0024**	<0.025

Notes and Key:
Concentrations reported in milligrams per liter (mg/L)
Detected concentrations are in bold.
ID = Identification
NA = Not applicable/not analyzed

The following metals were analyzed for, but not detected:

Antimony	Cobalt	Nickel
Beryllium	Hexavalent Chromium	Selenium
Cadmium	Mercury	Silver
Chromium	Molybdenum	Thallium

Table E-7 *Water Quality Parameters for Alder Creek Surface Water Samples*
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Sample ID	Sample Date	pH	Temp (°C)	Electrical Conductivity	Turbidity (ntu)	Total Dissolved Solids (mg/L)	Total Hardness (as CaCO3) (mg/L)	Dissolved Oxygen (mg/L)	Chemical Oxygen Demand (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Organic Kjeldahl Nitrogen (mg/L)
S-5	01/23/02	7.9	7	310	1.1	180	130	13	9.9	0.44	0.41
	04/15/02	7.5	17	330	0.77	190	NA	4	12	0.38	0.38
	07/02/02	7.6	24	390	0.93	230	180	6	12	0.29	0.25
	10/07/02	7.7	17.6	390	0.44	240	NA	8.4	9.1	0.26	0.24
	01/08/03	7.4	9	290	1.8	180	130	10	10	0.29	0.27
	04/07/03	8	16	280	2.8	160	NA	10	11	0.39	0.35
	07/02/03	7.9	21	380	0.81	230	160	7.2	11	0.37	0.35
	10/13/03	7.7	16.1	370	1.1	230	NA	8.8	9.7	0.22	0.2
	01/12/04	7.4	11.7	290	1.3	180	120	9.5	12	0.37	0.34
	04/06/04	7.9	18.3	350	1.5	210	NA	10	14	0.42	0.39
	07/12/04	7.7	22.2	400	1.1	220	160	6.2	13	0.38	0.36
S-6	01/23/02	7.6	7	250	1.6	150	100	12	19	0.22	0.2
	04/15/02	7.5	16	250	1.2	150	NA	4.1	13	0.3	0.27
	07/02/02	7.5	23	260	1.7	160	110	6.4	6	0.17	0.13
	10/07/02	7.5	16.6	330	2.1	210	NA	7.3	6.7	0.17	0.15
	01/08/03	7.5	9	270	2.6	170	110	10	<3	0.22	0.2
	04/07/03	7.8	15	280	2	170	NA	9	7.8	0.27	0.25
	07/02/03	7.6	20	330	2.2	210	130	6.4	5.7	0.25	0.23
	10/13/03	7.6	16.1	340	2.3	210	NA	7.6	5.7	0.17	0.16
	01/12/04	7.6	11.7	260	1.8	170	110	10	9.8	0.22	0.2
	04/06/04	7.6	17.2	310	2.7	190	NA	8.7	8.4	0.28	0.25
	07/12/04	7.6	21.2	370	1.7	220	140	5.5	6.9	0.24	0.22

Notes and Key:

°C = Degrees Celsius
CaCO3 = Calcium carbonate
ID = Identification
mg/L = Milligrams per liter
ntu = Nephelometric turbidity units
Temp = Temperature

The following parameters were analyzed for, but not detected:

Total suspended solids

Table E-8 Surface Seep Sample Results
Zone 4 Perimeter Groundwater Operable Unit
Baseline Risk Assessment for PGOU Groundwater
Aerojet Superfund Site
Sacramento County, California

Sample ID	Sample Date	VOCs (µg/L)	NDMA (µg/l)	Perchlorate (µg/l)
6154	02/20/03	<0.50	0.00051 J	<4.0
6155	02/20/03	<0.50	<0.0005	<4.0
Seep No. 3	02/20/03	<0.50	<0.0005	<4.0

Notes and Key:
Concentrations are in micrograms per liter (µg/L)
VOCs = Volatile Organic Compounds
NDMA = N-nitrosodimethylamine
< = less than the indicated laboratory reporting limit
J = Estimated concentration

Attachment F
Bioassessment for Alder Creek

Bioassessment for Alder Creek, Sacramento County, California

February 9, 2005

Prepared for

ERM

Environmental Resources Management

Prepared by

ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

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ALDER CREEK

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1.0 INTRODUCTION

At the request of ERM, Inc. (ERM), ECORP Consulting, Inc. conducted a rapid bioassessment in Alder Creek to evaluate the overall health of the benthic macroinvertebrate community. The bioassessment is one component of the ecological risk assessment (ERA) to be performed for the Aerojet Superfund Site Perimeter Groundwater Operable Unit (PGOU). The Environmental Protection Agency (EPA) requested this investigation to assess the potential effects of PGOU source areas and an adjacent test facility (Test Area A) on the biota of Alder Creek. Samples were collected from three stream locations (two sites upstream and upgradient of the boundary of the Aerojet landfill and one downstream and downgradient of the landfill). The EPA representative (Mr. Ned Black) requested that point source protocols from the California Department of Fish and Game (CDFG) California Stream Bioassessment Procedure (CSBP) be used for this assessment (Appendix A).

1.1 Environmental Setting

Alder Creek is a small, perennial, tributary to the American River. The creek flows from east to west through the northern portion of the site. This creek is identified as a blue-line feature on the "Folsom, California" 7.5-minute quadrangle (U.S. Department of the Interior, Geological Survey, photo revised 1980). The substrate consists primarily of cobble and gravel, with some boulder and fines. Mining in the late 1940's and early 1950's disturbed much of Alder Creek. The original stream course has been altered over time. The creek is heavily shaded by a mature forest canopy and a dense understory. Tree species associated with this community include Fremont cottonwood (*Populus fremontia*), white alder (*Alnus rhombifolia*), Oregon ash (*Fraxinus latifolia*), and interior live oak (*Quercus* sp.). Much of the understory consists primarily of Himalayan blackberry (*Rubus discolor*), but also includes California wild grape (*Vitis californica*), poison oak (*Toxicodendron diversilobum*), and willow (*Salix* spp.). Herbaceous cover was not well developed due to closure of the shrub layer throughout much of the riparian zone. Hydrophytic or moist-soil plants that occur in this community include pennyroyal (*Mentha pulegium*), sedge (*Carex* spp.), bulrush (*Scirpus acutus*), vervain (*Verbena bonariensis*), and cattail (*Typha* spp.). Herbaceous species, such as tall flat sedge, vervain, and smartweed (*Polygonum* spp.), are primarily limited to the creek banks and areas of sediment accumulation and reduced water velocities.

2.0 METHODS

Three BMI (Benthic Macroinvertebrate) sites on Alder Creek were sampled on 17 December 2004 as part of this assessment. Site locations were selected to assess the potential effects of impacted groundwater from the landfill or potential source sites within Aerojet Test Area A on the biota of Alder Creek. The downstream site (Alder-1) was located between the retention pond and the landfill sites, the middle site (Alder-2) was positioned between the landfill sites and the water supply pipeline over crossing from the

city of Folsom, and the upstream reference site (Alder-3) was located just downstream of the Prairie City Road overcrossing and upstream of Test Area A (Figure 1).

The following methods were used to collect, prepare, and store field samples. Laboratory sorting and identification procedures are also described.

2.1 CSBP Protocols

BMI samples were collected and processed using the California Stream Bioassessment Protocols (CSBP) developed by CDFG (2002). Microhabitat data were collected using the CSBP's Physical/Habitat Quality form that rates the sample reach for 12 habitat categories. Each category has a rating scale from 0 to 20; ratings are summed to provide the total Physical Habitat Quality Score (PHQ Score). The CSBP's PHQ Score is the same as the EPA's Physical Habitat Quality Score, which is used throughout the U.S. The PHQ Score is used to define four categories of physical condition:

Category	PHQ Score
• Optimal	180 to 240
• Sub-optimal	120 to 179
• Marginal	60 to 119
• Poor	0 to 59

Water quality data collected during field sampling included; dissolved oxygen (DO), specific conductivity, water temperature, and pH. At each site, physical habitat measurements were recorded including: reach length, riffle length and width, percent canopy, substrate embeddedness, and substrate composition (bedrock, boulder, cobble, gravel, and fines). Habitat data were collected using U.S. Forest Service and CDFG habitat analysis programs/protocols (Flosi and Reynolds, 1994). Substrate complexity was determined based on a combination of epifaunal substrate/available cover and embeddedness, which were also recorded on the Physical Habitat Quality data sheets. The sum of these two parameters provides the substrate complexity score (SC Score), which was determined during field analysis. The range for substrate complexity is 0 to 40 with the following categories:

Category	SC Score
• Optimal	32 to 40
• Sub-optimal	22 to 31
• Marginal	12 to 21
• Poor	0 to 11

2.2 Data Collection

Alder Creek was divided into three reaches based upon the EPA's requested sampling procedure.

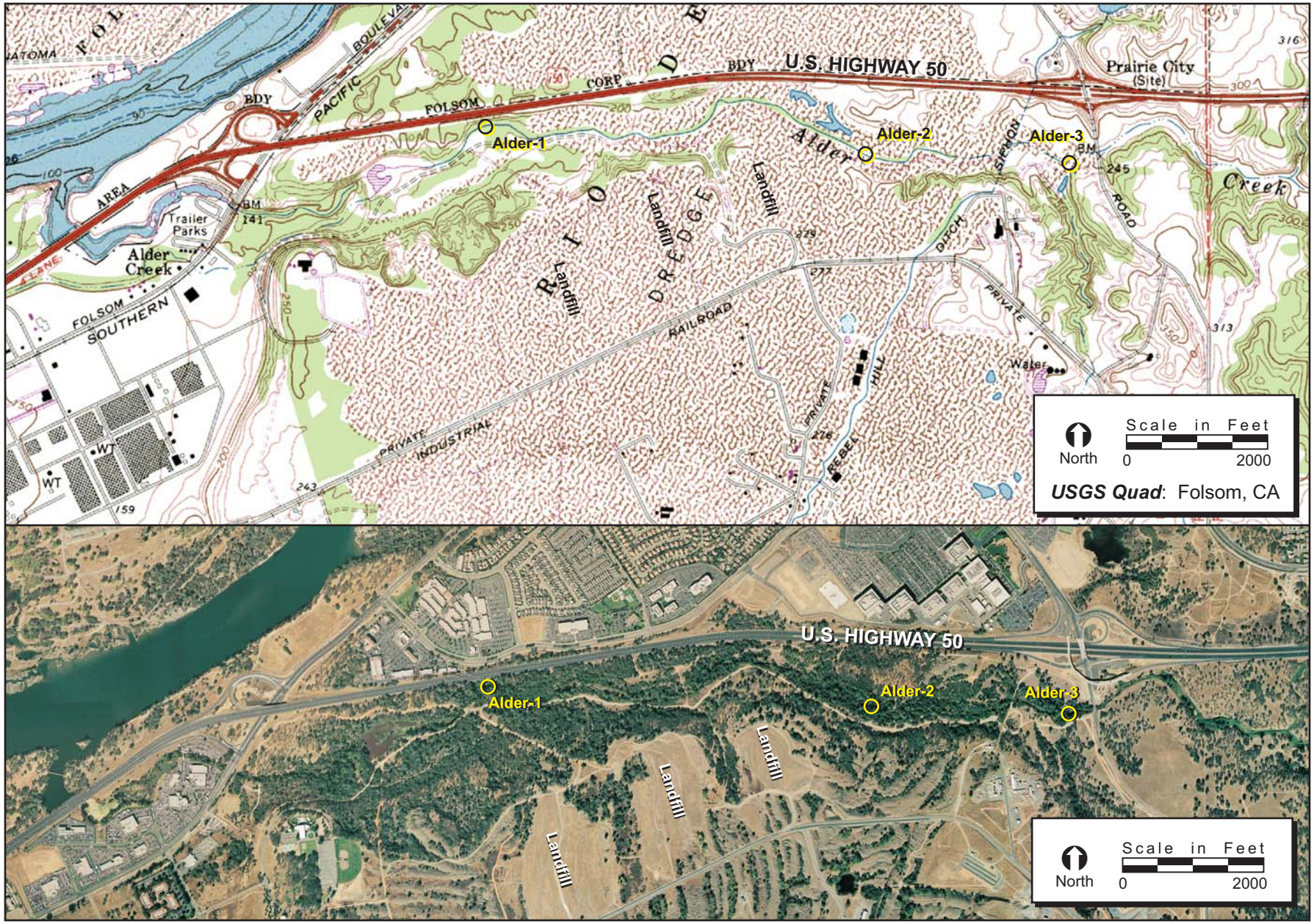

FIGURE 1. Benthic Macroinvertebrate Sampling Locations for Alder Creek

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Alder 1: Lower reach – downstream of the landfill sites to the retention pond
Alder 2: Middle reach – between the landfill sites and the siphon over crossing
Alder 3: Reference reach – upstream of the siphon over crossing (and Test Area A) to Prairie City Road

The Point Source methodology was used at all sites. Detailed methods are described in the following section and the complete CSBP protocols are provided in Appendix A.

2.2.1 Point Source Design

Each BMI site consisted of a representative riffle or riffle-like area. BMI samples were collected from three randomly selected transects within each riffle area. Three locations within each transect were chosen for sampling, two on the side margins of the stream, and one in the center of the stream. A 'D-shaped' kick-net with standard mesh (0.5 mm) was placed on the substrate and a 1x2-foot section of substrate immediately upstream of the net was scrubbed to dislodge all BMI's. All removable rocks were inspected for attached organisms. Samples were collected from all three locations within each transect and then combined in one net as a composite sample. The contents of the net were washed into a #35 sieve; and all large twigs, leaves, and rocks were washed and inspected to ensure all clinging organisms were removed. The sample was then placed into a Whirlpak® bag with labels containing a unique sample identification number, date sample, location, reach number, riffle number, and sample collector. Samples were preserved with 95% ethanol and then double bagged with another identically labeled bag to ensure no loss of sample. These steps were repeated for the next two selected transects. Chain of Custody forms were completed for the samples following completion of field sampling. Samples were stored at the ECORP laboratory facility in Roseville, California, until processing.

2.2.2 Laboratory Procedures

Samples were processed following CSBP protocols (Level I) for sub-sampling, sorting, and identification (see Appendix A). A 10-percent QA/QC program for the entire sample set is included in the current protocol, and the CDFG Water Pollution Control Laboratory will provide the results to ECORP upon completion. The taxonomic keys used for identification included; Cook (1974), Kathmann and Brinkhurst (1998), McAlpine, et al. (1981), McAlpine (1987), Merritt and Cummins (1996), Papp and Darvas (2000), Pennak (1978), Stewart and Starke (1993), Thorpe and Covich (1991), and Wiggins (1977).

2.2.3 Data Analysis

CDFG protocols were used to calculate the BMI community metrics. Data were entered into an Excel macroinvertebrate database supplied by the CDFG Water Pollution Control Laboratory. The database is designed to calculate 24 metrics that constitute the analytical protocol. The metrics use three types of calculations: counts, percentages, and composites, of which most are percent or count metrics. Count metrics are enumerations of taxa composition calculated using single taxa, a group of taxa (i.e. Baetidae), and/or groups (i.e.,

Functional Feeding Groups (FFG)). Percentage metrics are a calculation of the number within a taxon or group compared to the total specimens in the sample. Two of the metrics are composite metrics, Shannon's Diversity Index (SDI) and Weighted Tolerance Values (WTV), which have their own inherent scales.

The SDI is a measure of taxa richness and evenness. The SDI scale is a logarithmic scale that reaches its maximum value when all species are distributed evenly. The Sensitive EPT Index compares the number of EPT taxa with low tolerance values (<3) at a site, to the total numbers of all taxa. The Sensitive EPT Index, when compared to the EPT Index, allows for an assessment of taxa richness. The WTV rates sites on a scale from 1 to 10, based on taxa composition and their assigned tolerance value. The WTV weighs highly tolerant taxa more heavily than sensitive species (lower tolerance values) by multiplying the number of individuals by their tolerance value.

Increases or decreases in any of these indices may indicate environmental degradation. The CSBP lists the indices and effects of impairment on specific metrics (Table 1).

Table 1. Biological metrics and responses to impairment used to describe the results of BMI samples that were collected using the California Stream Bioassessment Procedure (CSBP).

Metric	Description	Response to impairment
Richness Measures		
Total taxa / Taxa richness	Total Number of Taxa (Genus Level)	Decrease
EPT taxa	Number of taxa in the Ephemeroptera, Plecoptera, and Trichoptera orders	Decrease
Ephemeroptera taxa	Number of mayfly taxa (genus or species)	Decrease
Plecoptera taxa	Number of stonefly taxa (genus or species)	Decrease
Trichoptera taxa	Number of caddisfly taxa (genus or species)	Decrease
Dipteran taxa	Number of "true" fly taxa	Increase
Non-Insect taxa	Number of non-insect taxa	Increase
Composition Measures		
EPT Index	Percent composition of EPT taxa	Decrease
Sensitive EPT Index	Percent of EPT taxa with tolerance values of 0-3	Decrease
Shannon Diversity Index	Measure of sample diversity that incorporates richness and evenness (Margurran 1988)	Decrease
Percent Baetidae	Percent composition of mayfly family nymphs	Decrease
Percent Chironomidae	Percent composition of midge larvae	Increase
Percent Hydropsychidae	Percent composition of caddisfly family nymphs	Decrease
Percent Diptera	Percent composition of "true" fly larvae	Increase
Percent Non-Insect taxa	Percent composition of non-insect taxa	Increase
Tolerance / Intolerance Measures		
Tolerance Value	Value between 0 and 10, weighted by abundance of individuals with designated pollution tolerances	Increase
Percent Intolerant Organisms	Number of taxa that are highly intolerant to impairment (values of 0-2)	Decrease

Table 1. Biological metrics and responses to impairment used to describe the results of BMI samples that were collected using the California Stream Bioassessment Procedure (CSBP). (Continued)

Metric	Description	Response to impairment
Percent Tolerant Organisms	Percent of organisms that are highly tolerant to impairment (values of 8-10)	Increase
Percent Dominant Taxa	Percent of sample comprised of most common taxon	Increase
Functional Feeding Groups (Trophic Measures)		
Percent Collector-Gatherers	Percent of macrobenthos that collect or gather fine particulate matter	Increase
Percent Collector-Filterers	Percent of macrobenthos that filter fine particulate matter	Increase
Percent Scrapers	Percent of macrobenthos that graze on periphyton	Variable
Percent Predators	Percent of macrobenthos that feed on other organisms	Variable
Percent Shredders	Percent of macrobenthos that sheds coarse particulate matter	Decrease

Table recreated from California Stream Bioassessment Procedure (Protocol Brief for Biological and Physical/Habitat Assessment in Wadeable Streams), California Department of Fish and Game, Water Pollution Control Laboratory, December 2002.

3.0 RESULTS

3.1 Site Descriptions and Physical Habitat Characteristics

Physical habitat characteristics and water quality data for each site and transect, including overall means, are summarized in Table 2. Dissolved oxygen (D.O.) levels at all sites (range 9.50 to 10.52 mg/L) were above the Regional Water Quality Control Board, Water Quality Standard. Other water quality parameters (e.g., pH, conductivity) were similar to values recorded for streams in nearby watersheds (e.g., Dry Creek) (Dry Creek Conservancy 2004).

Site-specific descriptions and physical habitat data are provided below for each of the three sampling locations.

Alder-1

The riffle at the Alder-1 site is located approximately 7,600 feet west of the overcrossing of the water supply pipeline from the city of Folsom. The downstream sampling site was located upstream of the retention pond near the western edge of the property line. Riparian vegetation consisted of alder, live oak, and willow with an understory dominated by Himalaya blackberry (*Rubus discolor*). Below the riffle, bulrush was present along the west bank of the creek. The substrate consisted primarily of gravel (46.7%) and cobble (43.3%) with 10% fines. The substrate complexity (SC) score was 31 and the Physical habitat quality (PHQ) score was 174, both in the sub-optimal range.

Table 2. Physical habitat and water quality data for Alder Creek benthic macroinvertebrate sampling sites, December 2004.

	Alder Creek 1 - (~7,600 feet west of siphon crossing)				Alder Creek 2 - (~1800 ft west of siphon crossing)				Alder Creek 3 - (~290 ft west of Prairie City Rd crossing)			
	Transect 1	Transect 2	Transect 3	**Mean**	Transect 1	Transect 2	Transect 3	**Mean**	Transect 1	Transect 2	Transect 3	**Mean**
Sampling information												
Date Sampled				**12/17/2004**				**12/17/2004**				**12/17/2004**
Time Sampled				**9:15**				**11:00**				**14:00**
Site characteristics												
Canopy cover (%)	65	50	20	**45**	60	85	65	**70**	95	95	90	**93.3**
Gradient (%)	1.5	1.5	1.5	**2**	2.0	2.0	2.0	**2**	3.0	3.0	3.0	**3**
Transect Location (m)	2.9	4.5	6.3		9.2	14.8	18.4		2.0	4.0	6.0	
Elevation (ft)				**180**				**240**				**241**
Reach Length (m)				**100.0**				**100.0**				**100.0**
Physical characteristics												
Riffle Length (m)				**7.0**				**20.0**				**8.0**
Avg. Riffle Width (m)	5.0	5.0	5.0	**5.0**	1.8	2.5	4.5	**2.9**	3.1	3.2	4	**3.4**
Avg. Riffle Depth (ft)	0.27	0.23	0.29	**0.3**	0.3	0.31	0.27	**0.3**	0.28	0.36	0.3	**0.31**
Riffle Velocity (ft/s)	0.57	0.60	0.44	**0.54**	0.99	0.83	0.46	**0.76**	1.21	1.20	1.39	**1.27**
Substrate Complexity	32	31	30	**31**	34	29	29	**30.7**	31	30	31	**30.7**
Embeddedness (%)	10	15	20	**15**	25	50	50	**41.7**	10	20	10	**13.3**
Substrate Consolidation	Low	Low	Low	**Low**	Med/low	Med	High	**Med**	Low	Med	Low	**Low-Med**
Physical Habitat Quality Score				**174**				**159**				**174**
Estimated Flow (cfs)				**1.8**				**1.5**				**1.9**
TDS (g/L)				**0.186**				**0.172**				**0.189**
Salinity				**0.14**				**0.13**				**0.14**
Specific Conductance (*u* s/cm)				**196**				**185**				**209**
Dissolved Oxygen (mg/l)				**9.50**				**10.41**				**10.52**
Water Temp (C°)				**8.6**				**9.2**				**9.9**
pH				**7.5**				**7.5**				**7.5**
Substrate Composition												
Fines (<0.1")	10	10	10	**10.0**	15	20	25	**20.0**	15	15	20	**16.7**
Gravel (0.1-2")	50	40	50	**46.7**	20	25	30	**25.0**	15	25	40	**26.7**
Cobble (2-10")	40	50	40	**43.3**	35	45	40	**40.0**	45	45	30	**40.0**
Boulder (>10")	0	0	0	**0.0**	30	10	5	**15.0**	25	15	10	**16.7**
Bedrock (solid)	0	0	0	**0.0**	0	0	0	**0.0**	0	0	0	**0.0**

Alder-2

Alder-2 is located approximately 1,800 feet west of the water supply pipeline over crossing. Riparian vegetation at the site consisted of alder, cottonwood, and willow with an understory dominated by Himalaya blackberry. The substrate consisted of a mixture of cobble (40.0%), gravel (25%), fines (20%), and boulder (15%). The SC score was 30.7 and the PHQ score was 159, both in the sub-optimal range.

Alder-3

Alder-3 (reference site) is located approximately 290 feet west of the bridge at Prairie City Road. The riparian vegetation consisted of alder, gray pine, live oak, and willow with an understory of Himalaya blackberry. The substrate was primarily cobble (40%) and gravel (26.7%), with equal amounts of boulder and fines (about 16.7% each).

The SC score was 30.7 and the PHQ score was 174, both in the sub-optimal range.

3.2 BMI Metrics

Selected BMI metrics that provide an assessment of the community structure and health at each of the sampling sites are discussed below. These metrics are also presented graphically for easy comparison between sites and reaches. Site-specific means for all BMI metrics for 2004 are presented in Appendix B. Sample replicate data and associated metrics for 2004 are provided in Appendix C.

Lower abundance values and decreased composition metric values at affected sites, compared to the reference site(s), may indicate impairment. The estimated abundance and calculated composition measures are presented in Table 3.

Abundance values at both the Alder-1 and Alder-2 sites were lower than the value for the reference site (Alder 3) (Figure 2). Taxa Richness (TR) at Alder-1 exceeded the reference value, while Alder-2 was slightly below the reference value (Figure 3). The EPT Index at Alder-1 was similar to the reference site (Alder-3), and Alder-2 was slightly higher than the reference site value (Figure 4). The Sensitive EPT Indices at both Alder-1 and Alder-2 were higher than the reference site value. The Shannon Diversity Indices were similar at all three sites (Figure 5).

Table 3. Abundance and Composition metrics for Alder Creek benthic macroinvertebrate sites, December 2004

Biological Metric	Alder-3	Alder-2	Alder-1
Abundance	818.7	359.7	334.7
Taxa Richness (TR)	18.0	17.3	21.0
Percent EPT (EPT)	33.8	39.5	33.8
Percent Sensitive EPT (SEPT)	0.1	1.1	0.6
Shannon Diversity Index (SDI)	2.2	2.1	2.2

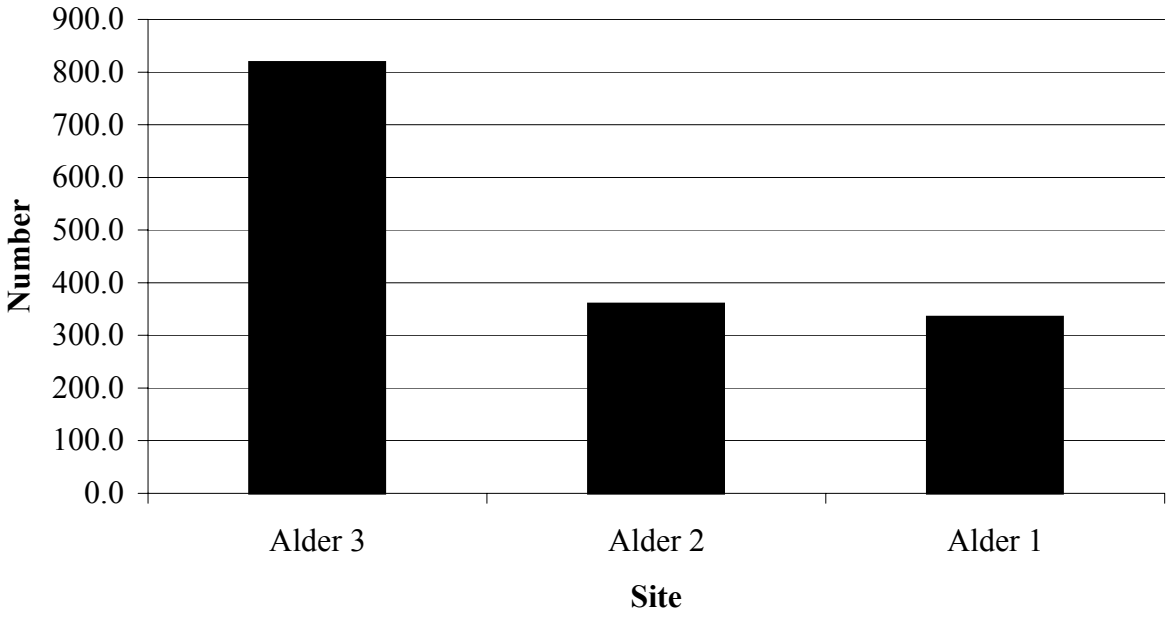

Figure 2. Abundance estimates for Alder Creek benthic macroinvertebrate sites, December 2004.

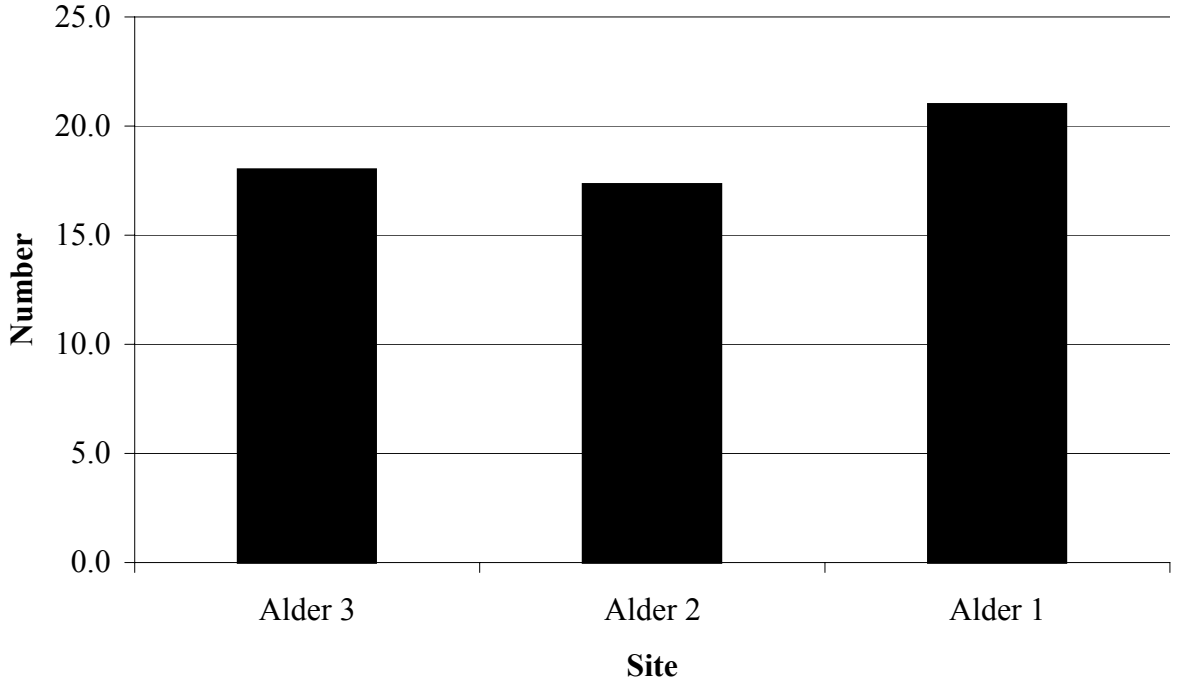

Figure 3. Taxa Richness for Alder Creek benthic macroinvertebrate sites, December 2004.

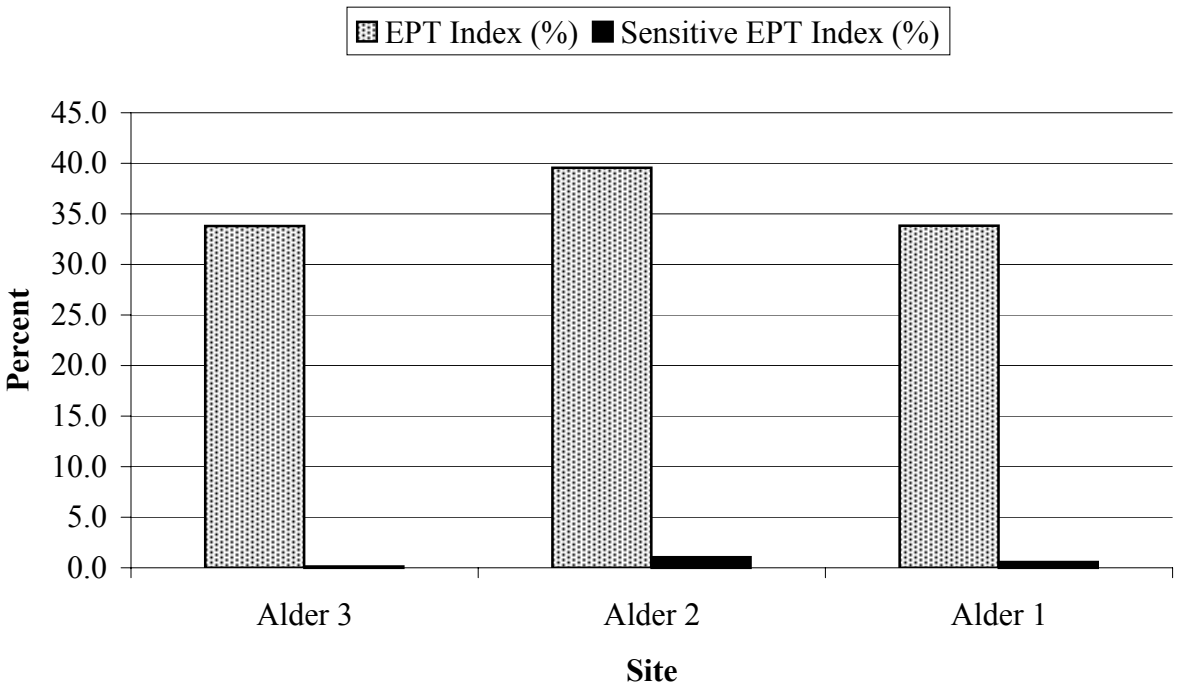

Figure 4. EPT Indices for Alder Creek benthic macroinvertebrate sites, December 2004.

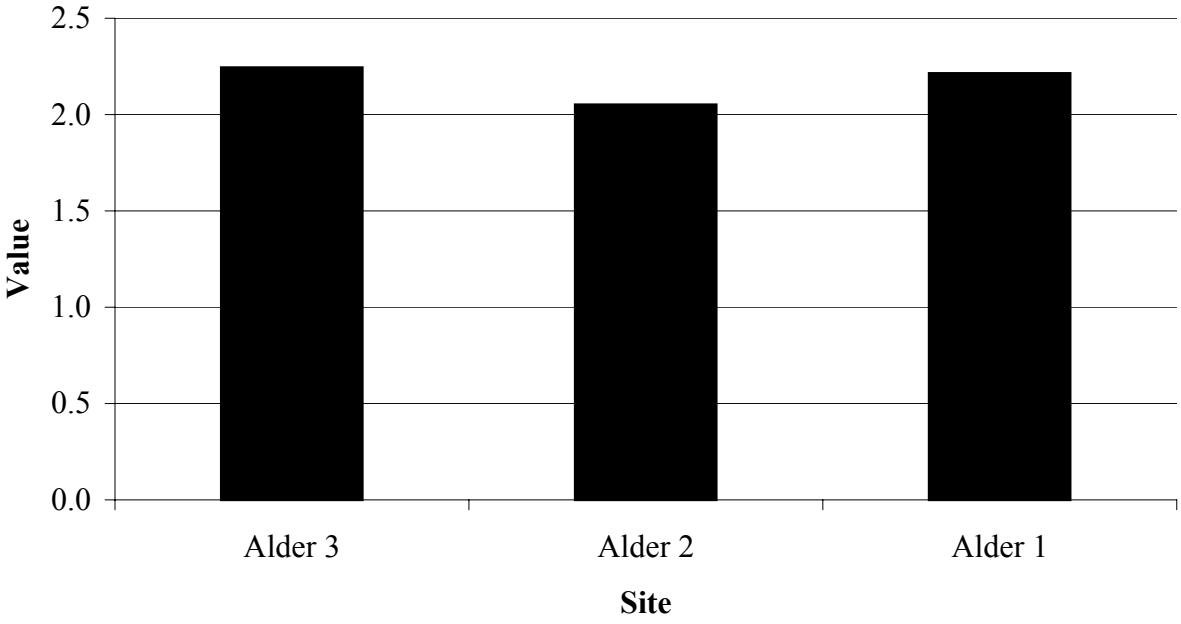

Figure 5. Shannon Diversity Index for Alder Creek benthic macroinvertebrate sites, December 2004.

Functional Feeding Group metrics describe the benthic macroinvertebrate community structure based on food-chain distribution. Three of the FFG metrics can have responses that may indicate impairment when compared to an unaffected reference site(s). An increase in either the Percent Collector-Gatherers and/or Percent Collector-Filterers may indicate an impairment response. Also, a decrease in Percent Shredders may indicate an impairment response. Temporal trends for these metrics can be used to determine if stream conditions are improving or degrading within a study area. The FFG metrics are reported in Table 4.

The FFG metrics for Alder-1 and Alder-2 showed variable responses relative to the reference site (Alder-3) (Figure 6). Collector-Gatherers was lower at Alder-3 than at either Alder-1 or Alder-2; however, Collector-Filterers were higher at Alder-3 than at Alder-1 or Alder-2. Shredders were not collected at either Alder-3 or Alder-2, but were present in very small numbers at Alder-1.

Table 4. Functional Feeding Group metrics for Alder Creek benthic macroinvertebrate sites, December 2004

	Alder 3	**Alder 2**	**Alder 1**
Percent Collector-Gatherers (CG)	68.6	79.4	80.8
Percent Collector-Filterer (CF))	18.2	10.4	11.4
Percent Scrapers (SC)	1.1	1.1	0.8
Percent Predators (P)	11.2	7.3	5.0
Percent Shredders (SH)	0.0	0.0	0.1

Increases in the Tolerance metrics (TV, PTO, and DT) and/or a decrease in PIO may indicate impairment when compared to the reference site(s). The Tolerance metrics at the Alder-1 and Alder-2 sites showed variable responses when compared to the reference site Alder-3 (Table 5). The lowest TV occurred at Alder 2, with higher values at Alder-1 or at the reference site (Alder-3). The PIO values at Alder-1 and Alder-2 exceeded the reference site value, and the PTO value was lower at Alder-2 that at either Alder-3 or Alder-1. Percent DT was highest at Alder-2 and lowest at the reference site (Alder-3) (Figures 7 through 9).

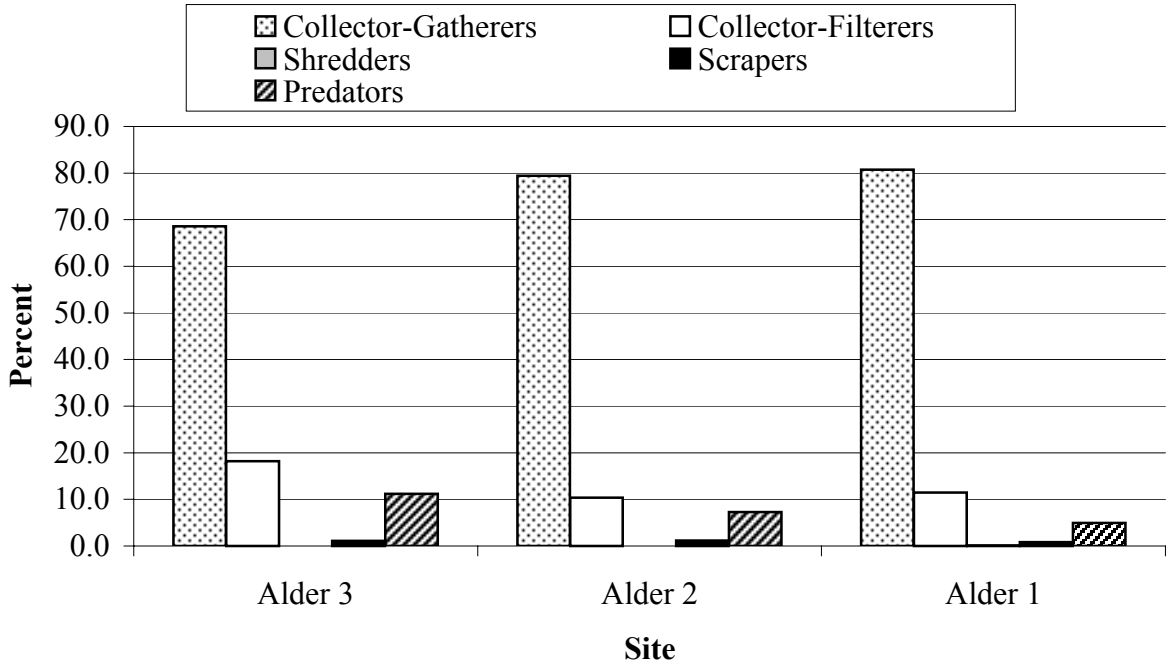

Figure 6. Functional Feeding Group metrics for Alder Creek benthic macroinvertebrate sites, December 2004.

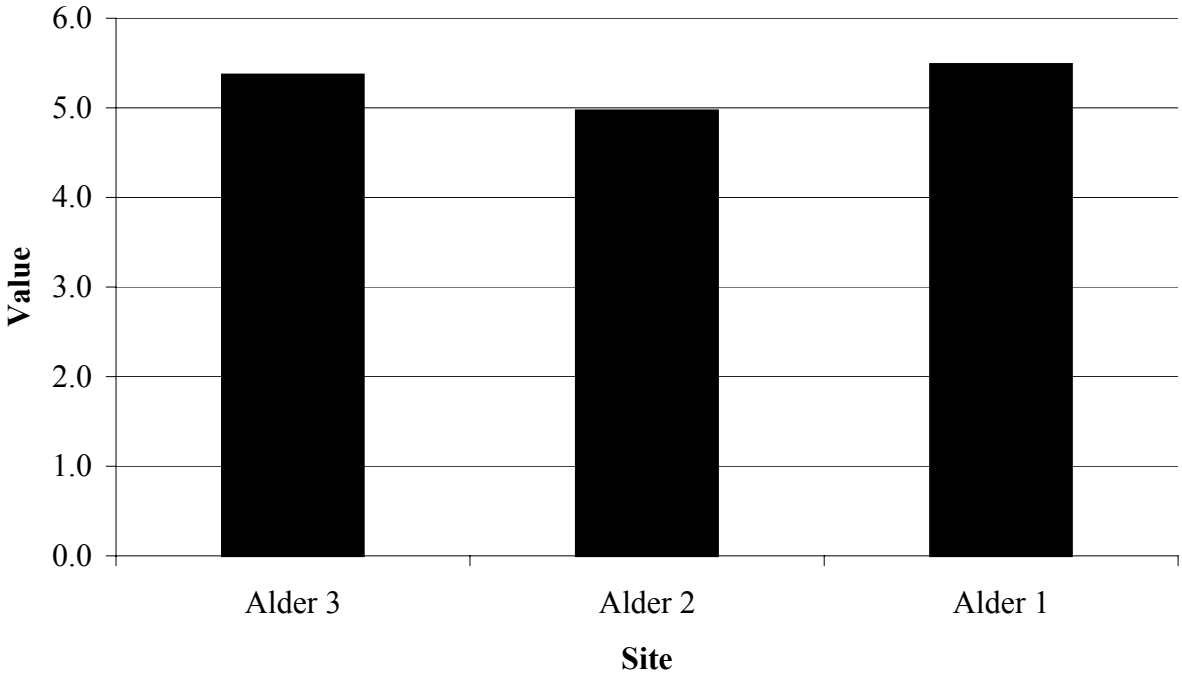

Figure 7. Tolerance Value for Alder Creek benthic macroinvertebrate sites, December 2004.

Table 5. Tolerance metrics for Alder Creek benthic macroinvertebrate sites, December 2004

	Alder 3	**Alder 2**	**Alder 1**
Tolerance Value (TV)	5.4	5.0	5.5
Percent Intolerant Organisms (PIO)	0.0	1.4	0.8
Percent Tolerant Organisms (PTO)	4.6	3.5	12.5
Percent Dominant Taxa (DT)	24.1	35.2	28.9

4.0 DISCUSSION

The high variability and patchiness of benthic macroinvertebrate communities has been well documented in the literature (Hynes 1970, Lake 2000). Hynes (1970) summarized various factors that can affect the fauna of a stream/river, and discusses changes in fauna that are due to substrate differences, including the effects of silt/sand on the benthic community.

The field sampling effort for this assessment was conducted shortly after several storms had passed, which brought significant amounts of precipitation. The high water mark on the creek was more than 3 feet above the water level that was present during the sampling activities, indicating substantial flow increases occurred during the storms. Hynes (1970) noted that the abundance of benthic macroinvertebrates usually decreases following a period of increased stream flows. As a result, some of the metric values obtained at the three sites may be partially due to the variable affects of the increased stream flows at each site, and the general patchy distribution of benthic macroinvertebrates within all streams.

The CSBP, which is a RBP methodology, provides a quick assessment of the benthic macroinvertebrate community. The protocol allows for comparison between a reference site(s) and a potentially affected site(s). A reference site is defined as an undisturbed location or a site with the best possible conditions for the area. The data set for this assessment is limited to three samples collected from three different sites, which only provides a snapshot of the benthic community present at the time of sample collection. The responses for each of the 24 CSBP biologic metrics at the lower Alder Creek sites (Alder-1 and Alder-2) compared with the reference site (Alder-3) is summarized in Table 6.

Comparing the reference site (Alder-3) metrics to the metrics for the two downstream sites (Alder-1 and Alder-2) showed variable responses. The Alder-1 site had 12 positive, 4 equivalent, and 9 negative metric responses when compared to the Alder 3 site. The Alder-2 site had 13 positive, 4 equivalent, and 8 negative metric responses compared to the Alder-3 site.

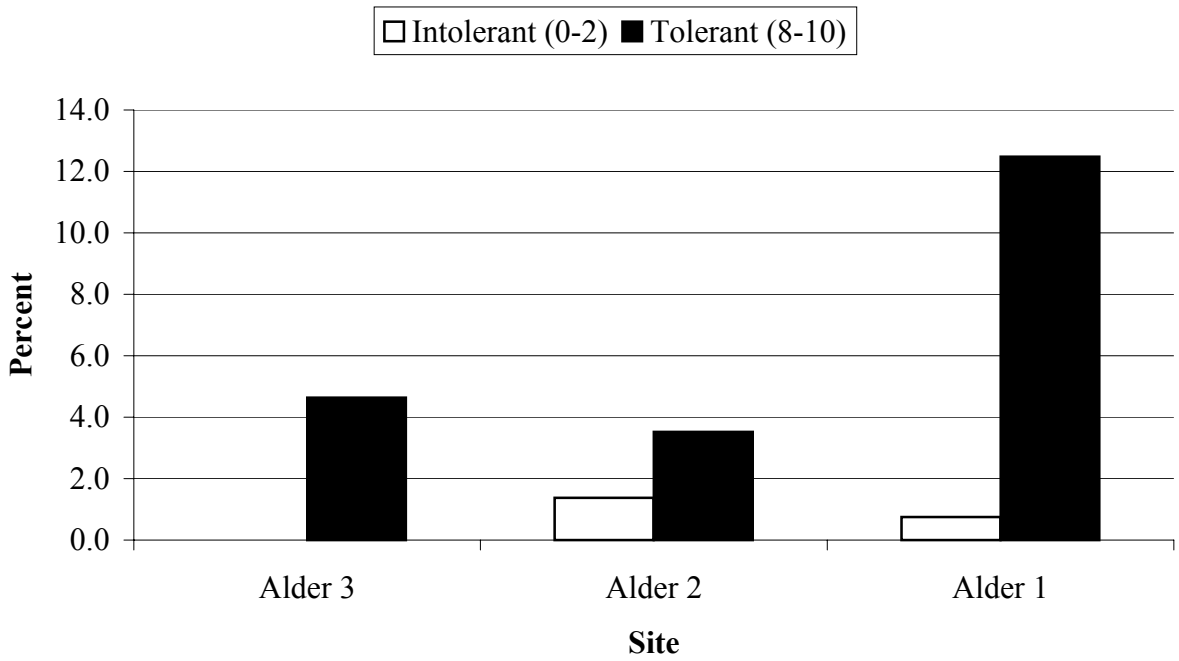

Figure 8. Tolerance Indices for Alder Creek benthic macroinvertebrate sites, December 2004.

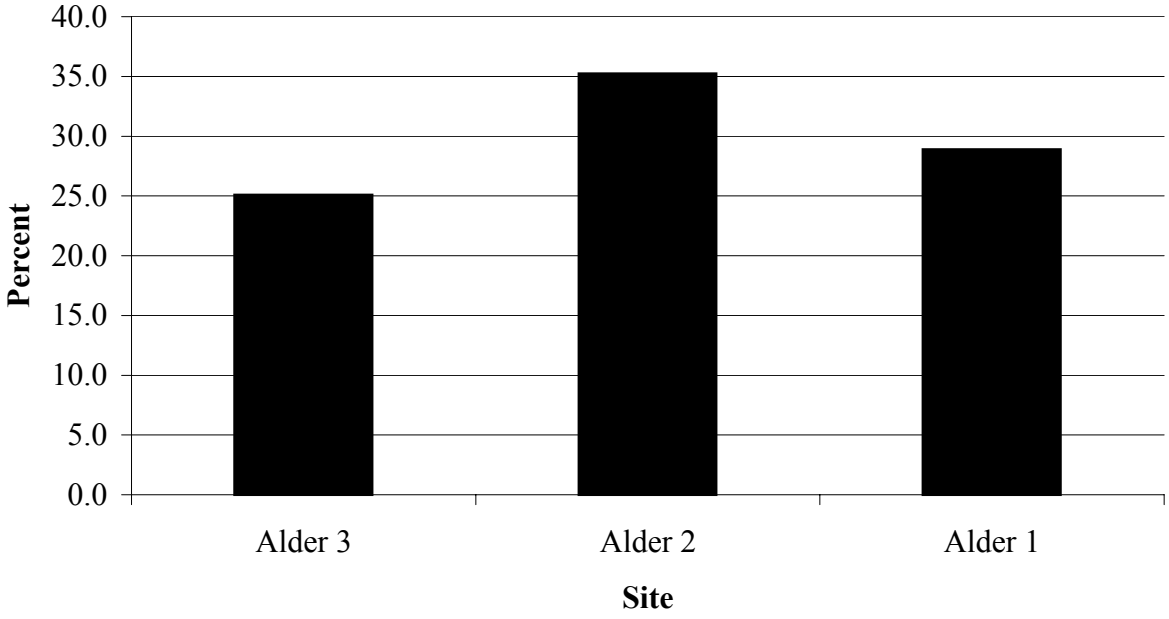

Figure 9. Dominant Taxa Index for Alder Creek benthic macroinvertebrate sites, December 2004.

Table 6. The response of CSBP biological metrics at the lower sites compared to the reference site values.

Metric	Reference Alder 3	Response of metric compared to reference site Alder 2	Alder 1	CSBP Impairment Response
Abundance	818.7	<	<	decrease
Richness Measures				
Taxa Richness	18.0	<	>	decrease
EPT Taxa	3.3	>	>	decrease
Ephemeroptera Taxa	2.0	<	>	decrease
Plecoptera Taxa	0.0	=	=	decrease
Trichoptera Taxa	1.3	>	=	decrease
Dipteran Taxa	5.3	<	>	increase
Non-Insect Taxa	7.3	=	>	increase
Composition Measures				
EPT Index	33.8	>	=	decrease
Sensitive EPT Index	0.1	>	>	decrease
Shannon Diversity	2.2	<	=	decrease
Percent Baetidae	25.1	>	>	decrease
Percent Chironomidae	33.1	<	<	increase
Percent Hydropsychidae	8.1	<	<	decrease
Percent Dipteran	41.6	<	<	increase
Percent Non-Insect	19.0	>	>	increase
Tolerance Measures				
Tolerance Value	5.4	<	>	increase
Percent Intolerant Organisms	0.0	>	>	decrease
Percent Tolerant Organisms	4.6	<	>	increase
Percent Dominant Taxon	25.1	>	>	increase
Functional Feeding Groups				
Percent Collector-Gatherers	68.6	>	>	increase
Percent Collector-Filterers	18.2	<	<	increase
Percent Scrapers	1.1	=	<	variable
Percent Predators	11.2	<	<	variable
Percent Shredders	0.0	=	>	decrease

< or > = negative response

The Physical Habitat Quality scores (all in the sub-optimal category), water quality data, and Substrate Complexity scores were similar at all three sites. The Alder-2 site had the lowest PHQ score; however, the low score was due primarily to the channel characteristics at this site.

Substrate consolidation or the tightness of the substrate components (gravel/cobbles) was lowest at Alder-1 and Alder-3, with medium consolidation at Alder-2. Higher consolidation scores indicate that less interstitial spaces are present between substrate components. These interstitial spaces provide habitat for benthic macroinvertebrates; consequently, decreases in the amount of space available usually corresponds to lowered abundance values. The higher consolidation present at Alder-2 may partially explain the lower abundance value at this site.
Abundance was lower at the Alder-1 site likely due at least partially to the lack of organics (i.e. algae, leaf litter, detrital materials) present in the gravels compared to Alder-3. Canopy cover was the lowest of all sites at Alder-1. Additionally, less canopy cover generally results in less terrestrial leaf litter entering the stream at that site. The samples which were collected from a composited 6 sq. ft. of substrate, differed in quantity of material comprising the sample. The samples at Alder-1 contained less detrital material. The substrate at Alder-1 was loose and may have been 'cleaned' during higher flows in October and November. There were no other obvious differences in either physical habitat or measured water quality parameters at the three sites that might account for the lower abundance value at the Alder-1 and Alder-2 sites.

In general, the benthic macroinvertebrate communities at the Alder-1 and Alder-2 sites were not substantially different from the community present at the Alder-3 reference site. Although the biological metrics indicate that there may be differences in community composition among the sample sites, these mixed responses do not clearly indicate impairment. The noted differences may be due to the natural patchiness and variability seen in benthic communities.

5.0 LITERATURE CITED

Dry Creek Conservancy 2004 Unpublished Data.

Hynes, H.B.N. 1970. The Ecology of running waters. Blackburn Press. Caldwell, N.J. 555 pp.

Lake, P. S. 2000. Disturbance, patchiness, and diversity in streams. J.N.Am. Benthol. Soc., 19(4): 573-592.

LIST OF APPENDICES

Appendix A – CSBP Protocol

Appendix B – Summary CSBP Biological Metrics for Alder Creek Bioassessment, December 2004

Appendix C – Alder Creek Benthic Macroinvertebrate Replicate Data for December 2004

APPENDIX A

CSBP Protocol

CALIFORNIA STREAM BIOASSESSMENT PROCEDURE

(Protocol Brief for Biological and Physical/Habitat Assessment in Wadeable Streams)

The California Stream Bioassessment Procedure (CSBP) is a standardized protocol for assessing biological and physical/habitat conditions of wadeable streams in California. The CSBP is a regional adaptation of the national Rapid Bioassessment Protocols outlined by the U.S. Environmental Protection Agency in "Rapid Bioassessment Protocols for use in Streams and Rivers" (**EPA/841-B-99-002**). The CSBP is a cost-effective tool that utilizes measures of the stream's benthic macroinvertebrate (BMI) community and its physical/habitat characteristics to determine the stream's biological and physical integrity. The purposes of this Protocol Brief are to introduce the techniques of bioassessment to aquatic resource professionals and help standardize data for statewide bioassessment efforts. The Protocol Brief is only a summary and does not contain all the necessary information that may be required to understand the concepts of bioassessment and to implement a successful monitoring program. Additional information and updates on bioassessment can be obtained by visiting the DFG Aquatic Bioassessment Laboratory website at **www.dfg.ca.gov/cabw/cabwhome.html**.

History of the CSBP

The CSBP was originally developed in 1993 to measure biological response from point-source discharges of chemical contaminants, inorganic sediment and elements of organic enrichment. The method was based on sampling the single richest habitat in a stream reach; this was the most common technique at the time (Rosenberg and Resh 1993, Loeb and Spacie 1994, Lenat and Barbour 1994) and consistent with the U.S. EPA's Rapid Bioassessment Protocols (RBP) (Plafkin et al. 1989). In 1995, the CSBP was adapted for use in ambient and non-point source pollution monitoring programs and a Technical Advisory Committee assembled by DFG and the U.S. EPA reviewed this version. The 1996 edition of the CSBP was widely distributed in California and accepted as the state's standardized RBP protocol (Davis et al. 1996 U.S. EPA 2002). A 1999 revision added quality assurance and control (QA/QC) techniques to ensure high quality field collections, laboratory analysis and taxonomic consistency.

As of 2003, the CSBP is the most often used RBP protocol in California (Barbour and Hill, 2003). This unique protocol allows the user to produce biological and physical/habitat data that can be used to measure differences between sites, compare to a regional Index of Biological Integrity (IBI) (Ode *et al.* 2003) and help diagnose response to individual stressors. In addition to the high gradient riffle based procedure, the 2003 edition of the CSBP describes techniques for use in unique channels and a technique for low gradient channels that blends elements of the CSBP with those of a multi-habitat technique recommended by the U.S. EPA (Barbour et al. 1999).

The CSBP 2003 has four notable changes to the existing protocol; 1) the stream reach for the assessment is no longer defined by a set of five pool-riffle sequences, but rather by a discreet length of 100 m (300 ft); 2) the area of benthos sampled has been reduced from 1.6 m^2 (18 ft^2) to 0.8 m^2 (9 ft^2); 3) although 3 independent samples will be collected at each reach, there is now an option to composite the 3 samples in the laboratory and reduce the total number of BMIs identified at each reach from 900 to 500; and 4) there is a new QA/QC procedure to collect a set of duplicate samples at 10% of the reaches for projects with more than 20 sites. These changes were based on experiences gained from several years of field testing, changes in the national RBP (Barbour et al. 1999), recommendations from Barbour and Hill (2003) and methods comparison studies conducted by DFG.

Data collected with these modifications can easily be made compatible with previous CSBP data and these changes make the CSBP more consistent with other BMI protocols used in the western US.

OVERVIEW OF THE CSBP

The CSBP can be used to measure biological and physical/habitat condition in all freshwater lotic environments (streams and rivers) shallow enough to allow safe wading (=1.5 m). The CSBP samples benthic macroinvertebrates with a 0.5mm mesh net from the richest habitat along 3 randomly selected transects within a 100 m (300 ft) reach of stream or river. The 3 transects are placed within shallow-fast water habitat (usually riffle) for high gradient channels and throughout the entire reach for low gradient channels. At each transect, three 0.09 m^2 (1 ft^2) areas of stream benthos are sampled and composited into a single sample. In low gradient channels, the 3 collections along the transect are selected to represent the relative proportions of the different richest habitat categories present (submerged vegetation, hard substrate of natural rock or concrete, soft substrate of sand or mud, stream bank vegetation and woody debris). Physical/habitat is measured using a qualitative U.S. EPA procedure throughout the entire reach and additional quantitative measures within the vicinity of the BMI samples. Taxonomic identification of the BMI samples is performed on a fixed count of 300 organisms from the 3 samples (total of 900 for the entire reach) or 500 from the composite of the 3 samples. There are two standard levels of taxonomic identification: one standardized for the state by the California Bioassessment Laboratory Network (CAMLnet; www.dfg.ca.gov/cabw/camlnetste.pdf) and a more precise level based on the U.S. EPA's Environmental Monitoring and Assessment Program (EMAP).

CALIFORNIA DEPARTMENT OF FISH AND GAME SCIENTIFIC COLLECTING PERMIT

Anyone who collects fish, amphibians, or invertebrates from the waters of the state must have a DFG Scientific Collecting Permit in their possession. The permit can be obtained from the DFG License and Revenue Branch in Sacramento (916-227-2225). Those conducting bioassessment in California should specify on the permit application that they will take freshwater invertebrates (authorization 5), incidental fish (authorization 6) and

amphibians (authorization 8). It is also advisable to contact the local Game Warden and District Fisheries Biologist at the closest Regional Office prior to collecting.

FIELD PROCEDURES FOR COLLECTING BMI SAMPLES

The CSBP can be used to sample BMIs from all streams and rivers where the access and depth (=1.5 m) do not require the use of a boat. The step-by-step procedures described in this document have been divided into three sections: high gradient channels, low gradient channels and considerations for unusual channel conditions. Contact DFG or visit the DFG Aquatic Bioassessment Laboratory website for more information on Rapid Bioassessment procedures for boatable streams and rivers and lentic or still water environments.

CSBP for High Gradient Channels

High gradient channels usually have greater than a 1% slope and will always contain pool-riffle sequences with a ratio high enough to contain at least 3 riffles per 100 m (300 ft) reach. Riffle substrate could be rock, sand or mud, but must be at least 1 m (3 ft) wide with flow velocities greater than 0.3 m/sec (1 ft/sec).

Step 1. Measure a 100 m (300 ft) reach of channel and count the number of riffles greater than 1 m (3 ft) wide and 1 m (3 ft) long. Randomly choose 3 of the riffles within the stream reach.

Step 2. Starting with the downstream riffle, place the measuring tape along the bank of the entire riffle while being careful not to walk in the stream. Select one transect from all possible 1/3 m (1 ft) marks using a random number table. For riffles longer than 10 m (30 ft), randomly place the transect within the top third of the riffle.

Step 3. Inspect the transect before collecting BMIs by imagining a line going from one bank to the other, perpendicular to the flow. Choose 3 locations along that line where you will place your net to collect BMIs. If the substrate is fairly similar and there is no structure along the transect, the 3 locations will be on the side margins and the center of the stream. If the substrate is structurally complex along the transect, then place the 3 collections to reflect it.

Step 4. Collect BMIs at the 3 locations along the transect by placing the D-shaped net on the substrate and disturbing an area as wide as the net and 1 ft upstream. Excavate the 0.09 m^2 (1 ft^2) area to an approximate depth of 10-15 cm (4-6 in) by kicking or by using a tool to loosen the substrate. Pick-up and scrub large rocks by hand under water in front of the net. If the substrate is sand or mud, a hand rake can be used to prevent substrate from filling the net. Maintain a consistent sampling effort (approximately 1-3 minutes) at each area. Combine the 3 collections within the net to make one “composite” sample.

Step 5. Place the contents of the net in a standard size 35 sieve (0.5 mm mesh) or white enameled tray. Remove the larger twigs, leaves and rocks by hand after carefully

inspecting for clinging organisms. If the pan is used, place the material through the sieve to remove excess water before placing the material in the jar. Place the sampled material in a jar and completely fill with 95% ethanol. Never fill a jar more than 2/3 full with course sampled material or 1/2 full with sand or mud. **Gently** agitate jars that contain primarily mud or sand to help mix the alcohol, taking care to not damage any organisms present.

Biological and Physical/Habitat

Equipment List

Measuring tape (300 ft or 100 m)
D-shaped kick net (0.5 mm mesh)
Standard size 35 sieve (0.5 mm)
Wide-mouth 500 ml plastic jars
White enameled pan and forceps
95% ethanol
California Bioassessment Worksheet (CBW)
Physical/Habitat Quality Form
Chain of Custody Form (COC)
Random Number Table
pH, temp, DO and conductivity meter
Stadia rod and hand level or clinometer
Densiometer

Step 6. Place a label containing descriptive information about the sites (see box) in each jar. An additional label can be taped to the outside of the jar to help with the sample log-in process at the laboratory. A Chain of Custody (COC) should accompany the samples during transportation to the laboratory.

Step 7. Proceeding upstream, Repeat Steps 2 through 5 for the next two riffles within the stream reach.

Step 8. **QA/QC Repeat Sampling Procedure. For projects with 20 or more sites, duplicate samples must be collected at 10% of the reaches.** For reaches containing more than six riffles, randomly choose 3 riffles for the primary set of samples and randomly choose 3 more riffles for the duplicate set of samples. For reaches that contain 6 or less riffles, measure the entire length of all riffle habitat and randomly select 3 transects from the total length for the primary samples and randomly select 3 for the duplicate samples. For both methods, start at the downstream riffle or transect, proceeding upstream collecting the 6 samples designating them as primary or duplicate.

CSBP for Low Gradient Channels

Low gradient channels usually have less than a 1% grade and will never have more than two riffles. These channels can be as deep as 1.5 m, but with low enough water velocity to allow safe wading. **Channels greater than 1.5 m deep, with swift water velocities and/or which can not be accessed on at least one bank will require a boat**.

Step 1. Measure a 100 m (300 ft) section of channel trying to avoid large human-made structures such as bridges or dams. The stream reach can be less than 100 m (300 ft) if access or obstacles are a problem, especially if the channel is morphologically homogeneous.

Step 2. Without entering the water, survey the entire reach for approximate percentages of 5 generalized habitat categories:

a. submerged vegetation,
b. hard substrate of natural rock or concrete,
c. soft substrate of sand or mud,
d. stream bank vegetation and e. woody debris. Record the proportions and make note if it was difficult to determine depth and habitat type (e.g. water was highly turbid).

Step 3. Determine how many 2 m (6 ft) intervals can be established along the entire length of the reach. Randomly select 3 of the intervals and using a range finder or measuring tape, locate the three points on the bank of the reach.

Step 4. Starting with the downstream point, establish a transect across the channel perpendicular to the flow. Sample BMIs at 3 locations along that transect, choosing areas representing the generalized habitats identified in Step 2. Collect BMIs by placing the D-shaped kick-net on the substrate or vegetation and disturb a 0.09 m^2 (1 ft^2) portion of habitat upstream of the kick-net. Maintain a consistent sampling effort (approximately 1-3 minutes) at each site. Combine the 3 collections within the kick-net to make one "composite" sample. Note the 3 generalized habitats that were sampled along the transect on the field form.

Bioassessment Sample Label

Project Name:
Site Name/Code:
County:
Riffle/Reach Number:
Transect Number:
Date/Time:
Sampled by:

Step 5. Place the contents of the kick-net in a standard size 35 sieve (0.5 mm mesh) or white enameled tray. Remove the larger twigs, leaves and rocks by hand after carefully inspecting for clinging organisms. If the pan is used, place the material through the sieve

to remove excess water before placing the material in the jar. Place the sampled material and label (see box) in a jar and completely fill with 95% ethanol. Never fill a jar more than 2/3 full with course sampled material or 1/2 full with sand or mud. **Gently** agitate jars that contain primarily mud or sand to help mix the alcohol, taking care to not damage any organisms present.

Step 6. Place a label containing descriptive information about the sites (see page 4 box) in each jar. An additional label can be taped to the outside of the jar to help with the sample log-in process at the laboratory. A Chain of Custody (COC) should accompany the samples during transportation to the laboratory.

Step 7. Proceeding upstream, Repeat Steps 4 and 5 for the next two transects within the reach. Try to choose generalized habitats for the 9 collections (3 areas along 3 transects) in proportion to what was determined in Step 2.

Step 8. **QA/QC Repeat Sampling Procedure. For projects with 20 or more sites, duplicate samples must be collected at 10% of the reaches.** After determining how many 2 m (6 ft) intervals can be established along the entire length of the reach, randomly select 3 of the intervals for collecting the primary samples and randomly select 3 more intervals for the duplicate samples. Starting with the downstream transect, proceed upstream collecting the 6 samples and designating them as primary or duplicate.

PROTOCOL CONSIDERATIONS FOR UNUSUAL CHANNEL CONDITIONS

CSBP for Intermittent or Ephemeral Channels: Intermittent or ephemeral channels will have flowing water during the rainy season and be dry during mid to late summer. These channels can be sampled using the CSBP for high or low gradient streams, but must be sampled in a spring (March through May) index period or at the end of the wet period.

CSBP for No Flow Conditions in High and Low Gradient Channels: Although this is very problematic for sampling BMIs, sometimes sampling areas in high gradient streams have pocket water with little or no flow. In this case, put the net at the downstream portion of the sampling area, disturb the substrate and push the water into the net with vigorous hand motions. Strained water from the surface of a nearby pool with a bucket can be used to move organisms into the net by pouring the water into the pocket area in front of the net. In low gradient channels, low flow or no flow conditions can be quite common. In this case, put the net downstream of the sampling area, get in front of the net and agitate the substrate with a twisting foot motion for 30 seconds. At 5-10 second intervals throughout the agitation, step aside and swiftly move the net in a “figure eight” motion through the cloud of suspended substrate.

CSBP for Bifurcated or Braided Channels: Low gradient channels can have two or more channels flowing through a typically wide riparian corridor. There is no need to extend the transect through islands or sand bars separating these bifurcated or braided high gradient channels. Use the standard procedure for sampling the dominant channel or

randomly selected one channel if there are more than 2 similar channels >1 m (>3 ft) wide.

CSBP for Channels <1 M (3 ft) Wide (the "Spot-Sampling" modification): High gradient channels <1 m (<3 ft) wide can not be sampled using the 1/3 m (1 ft) wide D-frame net at three places along the transect. In this case, divide the channel into an upper, middle and lower section, relative to the flow. Each section should be approximately 30 m long, but could be divided by natural breaks in the morphology of the channel. Survey each section, without stepping into the channel for all 0.09 m^2 (1 ft^2) areas where the substrate and flow resemble a riffle. Randomly select 3 of these "sampleable areas" in the lower section and composite them into one sample. Proceed upstream and repeat for each section.

CSBP for Large Boulder Channels: High gradient channels that are dominated by boulder substrates too large to move, but with enough gravel substrate in patches between the boulder can be sampled similarly to the previous modification. After dividing the channel into three sections, count the patches of substrate small enough to sample and randomly select three patches. Composite the three samples and proceed upstream to sample the next two sections.

CSBP for Channels Immediately Below Water Impoundments: High gradient channels immediately below a water impoundment structure that prevents gravels and fines from moving downstream will often not contain shallow-fast water habitats with gravel or cobble substrates. These channels can be sampled either using the modification for large boulder channels or by using the low gradient procedure where 3 transects are chosen randomly from the entire reach.

CSBP for Cement Channels: Cement channels in urban areas will typically have uniform shape and depth with no natural habitat. These channels should be sampled using the low gradient protocol of 3 randomly selected transects along 100 m (300 ft) of channel. The 3 collections can be simply taken from the left margin, center and right margin of the channel. Try to avoid human made habitats such as shopping carts and other transient debris.

CSBP for Channels with Gradient Controls: Some low gradient urban streams will have low level dams to control the gradient. The channel will be transformed into small impoundments separated by extremely high gradient sections of large boulders to dissipate the energy. Do not sample the high gradient sections. Sample the impounded areas using the low gradient protocol or if the impoundments are too deep to wade, sample along the littoral zone of one bank. Divide the bank into upper, middle and lower sections, randomly pick three points at 1 m (3 ft) intervals and at each point, take a 0.09 m^2 (1ft^2) sweep through the vegetation trying to disturb the sediment if present. Composite the 3 collections and repeat for each section.

CSBP for Channels with Three or Fewer Riffles: High gradient channels that are wider than 1 m (3 ft), but have 3 or fewer riffles within the 100 m (300 ft) reach will not

allow for an independent sample from several riffles. In these cases, measure the entire length of all riffle habitat and select the 3 transects randomly from the total length.

CSBP for Channels with Continuous Riffle Habitat: Stream reaches (usually very high gradient) that have continuous riffle habitat should be sampled using the low gradient procedure where 3 transects are chosen randomly from the entire reach.

CSBP for Channels with Transitional Gradient: Large watersheds can have wide channels where the gradient transitions from high to low. Riffle pool sequences can be present, but further apart than in higher gradient channels. In these cases, expand the reach length to 40 times the average width to allow for an adequate number of riffles to sample. If riffle habitat is limited to one or two riffles in a greater than 100 m (300 ft) transitional gradient reach, then consider the riffle to be hard substrate and use the low gradient procedures.

FIELD PROCEDURES FOR MEASURING CHEMICAL AND PHYSICAL/HABITAT QUALITY

The EPA's physical/habitat scoring criteria is a nationally standardized method (Barbour et al. 1999). It is used to measure the physical integrity of a stream and can provide a stand alone evaluation or used in conjunction with a bioassessment sampling event. DFG recommends that this procedure be conducted on every 100 m (300 ft) reach as part of a bioassessment program. A detailed description of the scoring criteria is available through the DFG Aquatic Bioassessment Laboratory website. **This procedure is an effective measure of a stream's physical/habitat quality, but can produce inconsistent measures if QA/QC measures are not regularly implemented. This procedure requires field training prior to its use and field audits throughout the program.**

The following list of quantitative measures of chemical and physical/habitat characteristics are considered minimal and should be measured when rapid bioassessments are not part of an existing chemical or fisheries habitat program where a more extensive list of parameters are measured. The information produced from measuring chemical and physical/habitat characteristics can be used to classify stream reaches and to help explain data anomalies.

Reach-Wide Parameters:

GPS coordinates at the top and bottom of the reach

Water temperature, specific conductance, pH, alkalinity and dissolved oxygen at the center of the reach using approved standardized procedures and instruments

Reach length, average width and gradient

Visually estimated substrate composition using the following categories:
fines (<0.25 cm) (<0.1in.), gravel (0.25-0.8 cm) (0.1-2 in.), cobble (0.8-25 cm) (2-10 in.), boulder (>25 cm) (>10 in.) and bedrock (solid)

Sample Site Specific Parameters:
Average length, width and depth for each of the 3 randomly chosen riffles (for unmodified high gradient protocol only) Water velocity immediately upstream of the three composite samples along each of the 3 transects Percent cover upstream of the three composite samples along each of the 3 transects.
Measure this parameter using a densiometer 1/3 m (1 ft) above the water surface and averaged for each transect Substrate consolidation at the three sample excavations along the 3 transects. Estimates are obtained while collecting the BMI sample by noting whether the substrate is loosely, moderately or tightly cemented. Pebble count and percent embeddedness immediately upstream of the 3 transects where BMI samples were collected. Measure this parameter by establishing a transect approximately 1/3 m (1 ft) upstream of the sample transect, randomly choosing 10 points along the transect, reaching down to the point at the end of a wooden dowel or tip of the boot and measure the width of the particle. For every third particle (3 on each transect), estimate percent embeddedness by noting how much of the particle was surrounded by fine substrate.

LABORATORY PROCEDURES FOR ANALYZING BMI SAMPLES
DFG recommends that taxonomic identification of BMI samples collected using the CSBP is performed by a professional or permanent university laboratory with extensive experience with California taxa. **These bioassessment laboratories should participate in the California Bioassessment Laboratories Network (CAMLnet) to ensure that they are aware of the standardized level of taxonomy and QA/QC procedures recommended for bioassessments conducted in California.** To ensure a high quality product, all contracts to a bioassessment laboratory should require:

1. A Laboratory Standard Operation Procedure (SOP) document and Quality Assurance Protection Plan (QAPP)
2. A list of all taxonomists that will work on the samples including their education, years of experience and any specialized training they have received.
3. Internal QA/QC documentation for sub-sampling and taxonomic validation (can be specified to provide this information upon request);
4. Be able and willing to perform taxonomy consistent with the CAMLnet Taxonomic Effort Standards (www.dfg.ca.gov/cabw/camlnetste.pdf).

Project managers are encouraged to subject all laboratory data to an external review by an independent laboratory at the rate of 10% to 20% (depending on experience and nature of the project) of the project samples. The DFG Aquatic Bioassessment Laboratory performs this QC procedure and can be contacted about information on the procedure requirements and costs.

Taxonomic Level of BMI Identification

There are two levels of taxonomic identification for samples collected using the CSBP. It is the ultimate responsibly of the contractor or project manager to guarantee that the level of taxonomy reported is consistent with the CSBP standards.

CSBP Level 1 is used for most state-wide rapid bioassessment projects and it is imperative when comparing data to the Southern California IBI. In general, Level 1 taxonomic effort is to genera where possible for most taxonomic groups, order for oligochaetes and family for chironomids.

CSBP Level 2 is based on the taxonomic effort levels established by the U.S. EPA for the Western Pilot EMAP. In general, Level 2 taxonomic effort identifies insects to species level where possible and the Dipteran Family: Chironomidae to genus.

Compositing Samples or Data

There will always be 3 samples collected at each sampling reach when using the CSBP. Depending on the objectives of the project, the samples can be processed as individual samples and subsampled for 300 organisms/sample (900 organisms total per site) or **composited at the laboratory** and subsampled for 500 organisms.

Subsampling

The CSBP requires fixed count subsampling with a +/- 10% accuracy. The total count of BMIs must come from at least 3 randomly selected grids within a subsampling tray. The last grid must be fully counted to get an estimate of relative abundance. The debris from processed grids should be put in a clean "remnant" jar and the remaining contents of the tray should be placed back into the original sample jar. If a "large and rare" survey is preformed on the sample, it should be conducted after the subsampling procedure and counted separately.

Data Production, Storage and Analysis

DFG has developed a Microsoft Access® database based loosely on the U.S. EPA's Environmental Data Analysis System (EDAS). The structure of the CalEDAS database is available through the DFG Aquatic Bioassessment Laboratory website, but it does not currently come with end-user support. Whether using the DFG database or other software, the laboratory analysis should produce a BMI taxa list that is consistent with CAMLnet (see above) for all samples and a list of common or project specific biological metrics. Many common biological metrics are listed in the U.S. EPA's RBP document (Barbour et al 1999) and several other sources of bioassessment literature. When BMI samples are processed independently, there are two options for calculating metrics depending on the needs of the project:

1. Calculate metrics for all three samples independently and calculate metric averages at each site
2. The three samples can be composited in the analysis stage, and a 500 count subsample of the 900
organisms can be used to generate one set of **cumulative** metrics for each site.

QA/QC CONSIDERATIONS FOR USING THE CSBP

All private and public entities conducting bioassessment using the CSBP should have a Standard Operating Procedures document (SOP) and a Quality Assurance Protection Plan (QAPP). Large programs and laboratories can have a quality assurance officer and some smaller operations may only have a field or laboratory supervisor. In either case, those individuals responsible for assuring the quality of samples collected in the field and processed in the laboratory should be trained on all aspects of the CSBP. Two 3-day courses on bioassessment concepts and the use of the CSBP are available through the American Fisheries Society (CalNeva AFS) and the Society of Environmental Toxicology and Chemistry (NorCal and SoCal SETAC). Information on these courses can be found at www.slsii.org. The details of a QAPP should be tailored for particular bioassessment operations. Depending on the nature of the project, appropriate boiler plate for QAPPs may be available through Regional Water Quality Control Boards or the State Water Resources Control Board. These agencies should be contacted before developing a QAPP and initiating a bioassessment program.

REFERENCES USED IN THIS DOCUMENT

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APPENDIX B

Summary CSBP Biological Metrics for Alder Creek Bioassessment, December 2004

Appendix Table B. Summary CSBP biological metrics for Alder Creek bioassessment, December 2004.

	Site 1: Lower - ~ 7,600 ft west of siphon crossing			Site 2: Middle - 1,800 ft. west of siphon crossing			Site 3: Reference - ~290 ft west of Prairie City Rd		
	Mean	CV	Total	Mean	CV	Total	Mean	CV	Total
Abundance	334.7	25.7	1004.0	359.7	68.0	1079.0	818.7	43.0	2456.1
Taxa Richness	21.0	4.8	31.0	17.3	3.3	22.0	18.0	11.1	27.0
Percent Dominant Taxon	28.9	24.5	29.1	35.2	30.7	31.1	25.1	8.5	25.1
EPT Taxa	5.0	20.0	9.0	3.7	15.7	5.0	3.3	45.8	5.0
EPT Index (%)	33.8	24.0	34.9	39.5	34.8	37.9	33.8	15.9	33.8
Sensitive EPT Index (%)	0.6	46.8	0.5	1.1	47.5	1.1	0.1	173.2	0.1
Ephemeroptera Taxa	3.7	15.7	5.0	1.3	43.3	2.0	2.0	50.0	3.0
Plecoptera Taxa	0.0	#DIV/0!	0.0	0.0	#DIV/0!	0.0	0.0	#DIV/0!	0.0
Trichoptera Taxa	1.3	86.6	4.0	2.3	24.7	3.0	1.3	43.3	2.0
Dipteran Taxa	6.0	16.7	9.0	4.3	13.3	5.0	5.3	10.8	9.0
Percent Dipteran	35.3	10.2	35.5	23.2	34.4	24.1	41.6	13.3	41.6
Non-Insect Taxa	8.0	25.0	10.0	7.3	7.9	9.0	7.3	7.9	11.0
Percent Non-Insect	27.8	33.9	26.6	34.5	23.3	35.2	19.0	26.4	19.0
Percent Chironomidae	24.4	34.7	23.7	19.0	46.9	20.1	33.1	15.9	33.1
Percent Hydropsychidae	0.1	173.2	0.1	5.3	72.3	5.5	8.1	39.8	8.1
Percent Baetidae	28.3	29.5	29.2	33.2	45.9	31.3	25.1	8.5	25.1
Shannon Diversity	2.2	5.6	2.3	2.1	10.2	2.2	2.2	5.1	2.3
Tolerance Value	5.5	2.4	5.5	5.0	1.0	5.0	5.4	0.5	5.4
Percent Intolerant (0-2)	0.8	16.6	0.7	1.4	4.0	1.4	0.0	#DIV/0!	0.0
Percent Tolerant (8-10)	12.5	37.3	11.9	3.5	40.1	3.7	4.6	23.3	4.6
Percent Collector-Gatherers	80.8	7.8	80.1	79.4	12.2	78.8	68.6	4.7	68.6
Percent Collector-Filterers	11.4	62.0	12.3	10.4	64.3	10.4	18.2	12.5	18.2
Percent Scrapers	0.8	60.9	0.7	1.1	35.4	1.1	1.1	17.6	1.1
Percent Predators	5.0	24.5	4.8	7.3	64.1	7.8	11.2	10.2	11.2
Percent Shredders	0.1	173.2	0.1	0.0	#DIV/0!	0.0	0.0	#DIV/0!	0.0
Percent Omnivore	0.0	#DIV/0!	0.0	0.0	#DIV/0!	0.0	0.1	173.2	0.1
Percent Macrophyte herbivore	0.1	173.2	0.1	0.9	48.9	1.0	0.0	#DIV/0!	0.0

APPENDIX C

Alder Creek Benthic Macroinvertebrate Replicate Data for December 2004

Appendix C. Alder Creek Benthic Macroinvertebrate Replicate Data for December 2004.

			Alder Creek 1				Alder Creek 2			
			AC 101	AC 102	AC 103		AC 201	AC 202	AC 203	
	CTV	FFG	EC1313	EC1314	EC1315	Total	EC1316	EC1317	EC1318	Total
PHYLUM ARTHROPODA										
Class Insecta										
Coleoptera (Larvae)										
Psephenidae	4	sc								
Eubrianax edwardsii	4	sc					1			1
Psephenus falli	4	sc								
Ptilodactylidae		sh								
Anchycteis velutina		sh		1		1				
Diptera										
Ceratopogonidae	6	p								
Ceratopogonidae pupa	6	p								
Culicoides sp.	6	p								
Chironomidae	6									
Chironominae	6	cg								
Chironominae pupa	6	nf			2	2				
Chironomini	6	cg		1		1				
Tanytarsini	6	cg	12	17	23	52	27	17	25	69
Tanytarsini pupa	6	nf		2		2				
Diamesinae	2	cg	1	1		2				
Orthocladiinae	5	cg	33	65	51	149	54	9	9	72
Orthocladiinae pupa	6	nf	6	4	3	13	5	1		6
Tanypodinae	7	p								
Empididae	6	p								
Chelifera sp.	6	p	2			2				
Psychodidae		cg								
Maruina lanceolata	2	sc						2	1	3
Simuliidae	6	cf								
Simulium sp.	6	cf	51	53	5	109	8	16	2	26
Simulium sp. (pupa)	6	nf								
Tipulidae	3									
Dicranota sp.	3	p								
Odonata										
Coenagrionidae		p								
Argia sp.	7	p	10	7	6	23	12	3	2	17
Lepidoptera										
Pyralidae	5									
Petrophila sp.	5	sc	3	1		4		1	2	3
Ephemeroptera										
Baetidae	4	cg								
Baetis sp.	5	cg	115	111	46	272	46	89	92	227
Diphetor hageni	5	cg	1			1		2		2
Caenidae	7	cg								
Caenis sp.	7	cg		1	1	2				
Ephemerellidae	1	cg								
Attenella sp.	2	cg		2	2	4				
Leptohyphidae	4	cg								
Tricorythodes sp.	4	cg	8	27	8	43				
Trichoptera										
Brachycentridae	1									
Micrasema sp.	1	mh	1			1	4	1	2	7
Hydropsychidae	4	cf								
Hydropsyche sp.	4	cf	1			1	22	16	2	40
Hydroptilidae	4	ph								
Oxyethira sp.	3	ph							1	1
Leptoceridae	4	om								
Oecetis sp	8	p			1	1				
Polycentropodidae	6	p								
Polycentropus sp.	6	p			1	1				
Subphylum Chelicerata										
Class Arachnoidea										
Acari										
Hygrobatidae	8	p								
Atractides sp.	8	p								
Lebertiidae	5	p								
Lebertia sp.	8	p	1	1	1	3	1			1
Sperchontidae	8	p								
Sperchon sp.	8	p	1		1	2		1	1	2

Appendix C. Alder Creek Benthic Macroinvertebrate Replicate Data for December 2004.

			Alder Creek 1				Alder Creek 2			
			AC 101	AC 102	AC 103		AC 201	AC 202	AC 203	
	CTV	FFG	EC1313	EC1314	EC1315	Total	EC1316	EC1317	EC1318	Total
Subphylum Crustacea										
Class Malacostraca										
Amphipoda										
Cragonyctidae	4	cg								
Crangonyx sp.	4	cg	21	21	15	57	67	22	55	144
Hyalellidae	8	cg								
Hyalella sp.	8	cg	27	36	36	99	8	2	3	13
Decapoda										
Astacidae	8	om								
Pacifasticus sp.	6	om								
PHYLUM MOLLUSCA										
Class Gastropoda										
Pulmonata										
Ancylidae	6	sc								
Ferrissia sp.	6	sc			2	2				
Physidae	8	sc								
Physa sp./ Physella sp.	8	sc								
Planorbidae	6	sc								
Gyraulus sp.	8	sc			1	1	1			1
Class Bivalvia										
Pelecypoda	8	cf								
Corbiculidae	10	cf								
Corbicula sp.	10	cf	2		3	5	5	2	3	10
PHYLUM PLATYHELMINTHES										
Class Turbellaria										
Tricladida										
Planariidae	4	p	4	5	4	13	24	7	6	37
PHYLUM ANNELIDA										
Class Oligochaeta	5	cg	25	6	24	55	1	8	17	26
Megadrili	5	cg	3	3	5	11	8	11	4	23
Total			328	365	241	934	294	210	227	731
Taxa Richness			21	20	22	31	17	18	17	22
Percent Dominant Taxon			35.1	30.4	21.2	29.1	22.8	42.4	40.5	31.1
EPT Taxa			5	4	6	9	3	4	4	5
EPT Index (%)			38.4	38.6	24.5	34.9	24.5	51.4	42.7	37.9
Sensitive EPT Index			0.3	0.5	0.8	0.5	1.4	0.5	1.3	1.1
Ephemeroptera Taxa			3.0	4.0	4.0	5.0	1.0	2.0	1.0	2.0
Plecoptera Taxa			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trichoptera Taxa			2.0	0.0	2.0	4.0	2.0	2.0	3.0	3.0
Dipteran Taxa			6.0	7.0	5.0	9.0	4.0	5.0	4.0	5.0
Percent Dipteran			32.0	39.2	34.9	35.5	32.0	21.4	16.3	24.1
Non-Insect Taxa			8.0	6.0	10.0	10.0	8.0	7.0	7.0	9.0
Percent Non-Insect			25.6	19.7	38.2	26.6	39.1	25.2	39.2	35.2
Percent Chironomidae			15.9	24.7	32.8	23.7	29.3	12.9	15.0	20.1
Percent Hydropsychidae			0.3	0.0	0.0	0.1	7.5	7.6	0.9	5.5
Percent Baetidae			35.4	30.4	19.1	29.2	15.6	43.3	40.5	31.3
Shannon Diversity			2.2	2.1	2.4	2.3	2.3	2.1	1.8	2.2
Tolerance Value			5.4	5.4	5.6	5.5	5.0	5.0	4.9	5.0
Percent Intolerant (0-2)			0.6	0.8	0.8	0.7	1.4	1.4	1.3	1.4
Percent Tolerant (8-10)			9.5	10.1	17.8	11.9	5.1	2.4	3.1	3.7
Percent Collector-Gatherers			75.0	79.7	87.6	80.1	71.8	76.2	90.3	78.8
Percent Collector-Filterers			16.5	14.5	3.3	12.3	11.9	16.2	3.1	10.4
Percent Scrapers			0.9	0.3	1.2	0.7	0.7	1.4	1.3	1.1
Percent Predators			5.5	3.6	5.8	4.8	12.6	5.2	4.0	7.8
Percent Shredders			0.0	0.3	0.0	0.1	0.0	0.0	0.0	0.0
Percent Omnivore			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent Macrophyte herbivore			0.3	0.0	0.0	0.1	1.4	0.5	0.9	1.0
Totals			98.2	98.4	97.9	98.2	98.3	99.5	99.6	99.0
Abundance Calculations										
Total Grids			1	2	1		3	1	1	
Grids Picked			1	2	1		2	1	1	
Organisms ID			328	365	241		294	210	227	
Extras			25	45	0		134	0	0	
Organisms ID + Extras			353	410	241		428	210	227	

Appendix C. Alder Creek Benthic Macroinvertebrate Replicate Data for December 2004.

			Alder Creek 1				Alder Creek 2			
			AC 101	AC 102	AC 103		AC 201	AC 202	AC 203	
	CTV	FFG	EC1313	EC1314	EC1315	Total	EC1316	EC1317	EC1318	Total
Total Organisms per Sample			353.0	410.0	241.0	1004.0	642.0	210.0	227.0	1079.0

Appendix C. Alder Creek Benthic Macroinvertebrate Replicate Data for December 2004.

			Alder Creek 3			
			AC 301	AC 302	AC 303	
	CTV	FFG	EC1319	EC1320	EC1321	Total
PHYLUM ARTHROPODA						
Class Insecta						
Coleoptera (Larvae)						
Psephenidae	4	sc				
Eubrianax edwardsii	4	sc				
Psephenus falli	4	sc				
Ptilodactylidae		sh				
Anchycteis velutina		sh				
Diptera						
Ceratopogonidae	6	p				
Ceratopogonidae pupa	6	p				
Culicoides sp.	6	p	1			1
Chironomidae	6					
Chironominae	6	cg				
Chironominae pupa	6	nf		1		1
Chironomini	6	cg				
Tanytarsini	6	cg	41	49	61	151
Tanytarsini pupa	6	nf				
Diamesinae	2	cg				
Orthocladiinae	5	cg	39	43	53	135
Orthocladiinae pupa	6	nf	4	1		5
Tanypodinae	7	p		1		1
Empididae	6	p				
Chelifera sp.	6	p			4	4
Psychodidae		cg				
Maruina lanceolata	2	sc				
Simuliidae	6	cf				
Simulium sp.	6	cf	29	18	22	69
Simulium sp. (pupa)	6	nf				
Tipulidae	3					
Dicranota sp.	3	p			1	1
Odonata						
Coenagrionidae		p				
Argia sp.	7	p	18	18	10	46
Lepidoptera						
Pyralidae	5					
Petrophila sp.	5	sc	1	1	2	4
Ephemeroptera						
Baetidae	4	cg				
Baetis sp.	5	cg	69	81	72	222
Diphetor hageni	5	cg				
Caenidae	7	cg				
Caenis sp.	7	cg	1			1
Ephemerellidae	1	cg				
Attenella sp.	2	cg				
Leptohyphidae	4	cg				
Tricorythodes sp.	4	cg	1	2		3
Trichoptera						
Brachycentridae	1					
Micrasema sp.	1	mh				
Hydropsychidae	4	cf				
Hydropsyche sp.	4	cf	18	35	19	72
Hydroptilidae	4	ph				
Oxyethira sp.	3	ph	1			1
Leptoceridae	4	om				
Oecetis sp	8	p				
Polycentropodidae	6	p				
Polycentropus sp.	6	p				
Subphylum Chelicerata						
Class Arachnoidea						
Acari						
Hygrobatidae	8	p				
Atractides sp.	8	p		1		1
Lebertiidae	5	p				
Lebertia sp.	8	p				
Sperchontidae	8	p				
Sperchon sp.	8	p				

Appendix C. Alder Creek Benthic Macroinvertebrate Replicate Data for December 2004.

			Alder Creek 3			
			AC 301	AC 302	AC 303	
	CTV	FFG	EC1319	EC1320	EC1321	Total
Subphylum Crustacea						
Class Malacostraca						
Amphipoda						
Cragonyctidae	4	cg				
Crangonyx sp.	4	cg	22	8	13	43
Hyalellidae	8	cg				
Hyalella sp.	8	cg	5	7	5	17
Decapoda						
Astacidae	8	om				
Pacifasticus sp.	6	om			1	1
PHYLUM MOLLUSCA						
Class Gastropoda						
Pulmonata						
Ancylidae	6	sc				
Ferrissia sp.	6	sc	1		2	3
Physidae	8	sc				
Physa sp./ Physella sp.	8	sc		2		2
Planorbidae	6	sc				
Gyraulus sp.	8	sc	1			1
Class Bivalvia						
Pelecypoda	8	cf				
Corbiculidae	10	cf				
Corbicula sp.	10	cf	9	6	5	20
PHYLUM PLATYHELMINTHES						
Class Turbellaria						
Tricladida						
Planariidae	4	p	18	11	16	45
PHYLUM ANNELIDA						
Class Oligochaeta	5	cg	13	10	8	31
Megadrili	5	cg	4			4
Total			296	295	294	885
Taxa Richness			20	18	16	27
Percent Dominant Taxon			23.3	27.5	24.5	25.1
EPT Taxa			5	3	2	5
EPT Index (%)			30.4	40.0	31.0	33.8
Sensitive EPT Index			0.3	0.0	0.0	0.1
Ephemeroptera Taxa			3.0	2.0	1.0	3.0
Plecoptera Taxa			0.0	0.0	0.0	0.0
Trichoptera Taxa			2.0	1.0	1.0	2.0
Dipteran Taxa			5.0	6.0	5.0	9.0
Percent Dipteran			38.5	38.3	48.0	41.6
Non-Insect Taxa			8.0	7.0	7.0	11.0
Percent Non-Insect			24.7	15.3	17.0	19.0
Percent Chironomidae			28.4	32.2	38.8	33.1
Percent Hydropsychidae			6.1	11.9	6.5	8.1
Percent Baetidae			23.3	27.5	24.5	25.1
Shannon Diversity			2.4	2.2	2.2	2.3
Tolerance Value			5.4	5.4	5.3	5.4
Percent Intolerant (0-2)			0.0	0.0	0.0	0.0
Percent Tolerant (8-10)			5.1	5.4	3.4	4.6
Percent Collector-Gatherers			65.9	67.8	72.1	68.6
Percent Collector-Filterers			18.9	20.0	15.6	18.2
Percent Scrapers			1.0	1.0	1.4	1.1
Percent Predators			12.5	10.5	10.5	11.2
Percent Shredders			0.0	0.0	0.0	0.0
Percent Omnivore			0.0	0.0	0.3	0.1
Percent Macrophyte herbivore			0.0	0.0	0.0	0.0
Totals			98.3	99.3	100.0	99.2
Abundance Calculations						
Total Grids			3	6	24	
Grids Picked			2	3	7	
Organisms ID			296	295	294	
Extras			70	50	61	
Organisms ID + Extras			366	345	355	

Appendix C. Alder Creek Benthic Macroinvertebrate Replicate Data for December 2004.

			Alder Creek 3			
			AC 301	AC 302	AC 303	
	CTV	FFG	EC1319	EC1320	EC1321	Total
Total Organisms per Sample			549.0	690.0	1217.1	2456.1

Attachment G
USEPA 29 September 2008
Memo – Aerojet Site-Specific
Data for Perchlorate Exposure to
Humans

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 9
75 Hawthorne Street
San Francisco, CA 94105-3901

MEMORANDUM

DATE: September 29, 2008

SUBJECT: Aerojet Site-Specific Data for Perchlorate Exposure to Humans: Examining Preliminary Remediation Goal

FROM: Kevin P. Mayer, RPM, Superfund Site Cleanup Branch Section 2 KPM

THROUGH: Dr. Stan Smucker, Risk Assessor, Superfund Technical Support

TO: Lynn Suer, Chief, Superfund Site Cleanup Section 2

Purpose

This memo transmits and interprets recent site-specific biomonitoring data from 181 women in communities surrounding the Aerojet Superfund Site. The attached report is a preliminary submittal that may be subject to minor corrections. These data quantify the exposure to perchlorate in this sample population and provide an estimate of the current perchlorate exposure for young and middle-aged women in these communities. Using the current EPA reference dose for perchlorate, the exposure assumptions advised in the 2006 guidance to Superfund risk managers and these site-specific data, we can calculate a value for perchlorate concentration in drinking water for these communities that EPA would consider protective of even sensitive subpopulations. EPA risk managers can compare that protective value to the California primary drinking water standard and establish the remediation goal for perchlorate in groundwater at the Aerojet Site. Although not included in the biomonitoring study, perchlorate concentration in the public water supply of these communities has been monitored extensively with the oversight of the State of California and US EPA, providing some insight into the biomonitoring data.

Superfund Cleanup Goals based on both environmental regulations and risk.

US EPA Superfund regulations in the National Contingency Plan, 40 CFR Section 300.430[e][2][i], establish two fundamental factors for developing remediation goals for Superfund sites to protect human health and the environment from unacceptable risks posed by hazardous substances, pollutants or contaminants present at the site.

The remediation goals must comply with applicable or relevant and appropriate requirements (ARARs) under federal environmental or state environmental or facility siting laws. For example, the State of California's primary drinking water standard of 6 micrograms per liter (µg/l or ppb) for perchlorate which was formally adopted in 2007 would be a typical ARAR for cleanup of groundwater that is a source of drinking water.

The remediation goals that the remedy is expected to achieve must also control contaminant levels such that, "… acceptable exposure levels shall represent concentration levels to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety." 40 CFR 300.430[e][2][i]

Calculating risk from perchlorate exposure – historical background.

Relying primarily on toxicological data developed by the Department of Defense and aerospace and defense industry, EPA prepared a draft Toxicological Assessment for perchlorate which underwent external review in 2002. The release of EPA's 2002 Draft Assessment was followed by much debate about the quality of the evidence on perchlorate and how the evidence should be assessed. This prompted an interagency group of federal agencies to request a review of the available science by the National Research Council (NRC), part of the National Academy of Science. The January 2005 NRC report recommended a reference dose of 0.7 micrograms of perchlorate per kilogram body weight per day. A Reference Dose is an estimate of a daily oral exposure to humans, including sensitive subgroups, that is likely to be without appreciable risk of deleterious effects during a lifetime. The dose of 0.7 µg /kg-day was adopted by EPA and included in the Integrated Risk Information System in February 2005. A reference dose must be interpreted using appropriate exposure information or assumptions to calculate a protective concentration. For example, a reference dose usually results in a lower concentration if calculated for an infant or child rather than for an adult, and a wide range of measured or estimated values can be used to account for non-drinking water exposure routes (known as Relative Source Contribution).

The NRC explicitly declined to convert their recommended reference dose to a drinking water concentration or to offer an opinion on an estimate of exposure from non-drinking water sources, pointing out that such determinations or decisions were beyond the scope of their charge. Quantification of the distribution of perchlorate exposure between drinking water and non-drinking water sources was also outside the scope of the biomonitoring study at the Aerojet Site.

California's Public Health Goal and Maximum Contaminant Level for Drinking Water

In 2004 State of California finalized a Public Health Goal for perchlorate in drinking water at 6 ppb, using the same primary human volunteer study as the NRC (Greer et al., 2002) and including a factor for non-drinking water exposure (for example, from food) approximately equivalent to 40 percent of the total protective dose (OEHHA, 2004). Like the NRC recommendation, California also incorporated a single ten-fold uncertainty factor to account for potential effects on sensitive sub-populations because the humans studied were all healthy adults. The human study examined radio-labeled iodine uptake by the thyroid in a total of thirty-seven individuals exposed to a measured dose over a two-week period. The NRC focused on the group of seven adults who were given the lowest dose of about 250 ppb per day. The researchers conducting the study reported no statistically significant effect on iodide uptake into the thyroid at this dose level. The

State of California used a more sophisticated statistical method, using the raw data of the human study to estimate the lower 95 percent confidence interval of a dose that showed a five percent decrease of mean iodine uptake by the thyroid, known as the benchmark dose lower limit (BMDL). California favored this approach over the more traditional point of departure, the No Observed Adverse Effect Level or Lowest Observed Adverse Effect Level because it is a dose that is informed by dose-response information from all dose groups. Using the BMDL methodology, California's estimated a minimal effect level at 100 ppb, contrasting with the NRC's use of 245 ppb which was the No Observed Effect Level reported in the published research paper (Greer et al., 2002).

In October 2007, California promulgated a primary drinking water standard (known as a Maximum Contaminant Level) of 6 ppb for perchlorate. This would typically be considered an ARAR because it is a formal state environmental law.

As of September 2008, EPA has not determined whether perchlorate will be regulated under the Safe Drinking Water Act, so no federal ARAR currently exists.

2006 EPA Guidance to Superfund Project Managers

A January 2006 memo signed by Susan Bodine, EPA's Assistant Administrator for the office that includes the Superfund program, provides guidance to Superfund risk assessors and project managers on interpreting the perchlorate Reference Dose.

The EPA Memo (OSWER, January 2006) states that, "…because the reference dose includes a full ten-fold intraspecies uncertainty factor to protect the most sensitive population, the fetuses of pregnant women who might have hypothyroidism or iodide deficiency, it is also protective of other sensitive populations such as neonates and developing children." Consequently, the guidance advises that the drinking water equivalent level (DWEL) should be calculated using a body weight 70 kg (about 154 pounds) based on women of child-bearing age, and a standard daily water consumption value of 2 liters per day:

> "This reference dose leads to a DWEL of 24.5 ppb. EPA calculates the DWEL using the reference dose (0.7 micrograms per kg body weight per day), multiplied by an adult body weight of 70 kg, and divided by a conservative tap water consumption value of 2 liters per day." (Bodine, OSWER, January 2006)

The guidance does not incorporate any estimate or default value for exposure from food or other non-water sources, and the preliminary remediation goal calculated in the memo (24.5 ppb) implicitly assumes all perchlorate exposure is from drinking water.

Use of Site Specific Information to Modify Preliminary Remediation Goals

The Superfund regulations in the National Contingency Plan provide that "preliminary remediation goals should be modified, as necessary, as more information becomes available during the remedial investigation / feasibility study". (40 CFR 300.430(e)(2)(i).

The EPA memo reiterates this approach for ensuring the protectiveness of the preliminary remediation goals for perchlorate and uses a specific example related to estimating non-water exposure: "For example, the Remedial Investigation may indicate that individuals at a site may be exposed to perchlorate through multiple pathways. In such cases, contribution from non-water sources should be considered based on site-specific data until further national guidance on relative source contribution is developed."

Significant scientific advances have occurred in our understanding of perchlorate exposures and potential effects in humans that had not been available during development of the Reference Dose and the preliminary remediation goals presented in the 2006 OSWER memo. Work sponsored by the US Food and Drug Administration and others provide a general measure of perchlorate in frequently consumed foods. The Centers for Disease Control and Prevention (CDC) have published results of nationwide human biomonitoring studies that can accurately measure perchlorate in blood and urine, and provide a quantitative measure of total oral exposure. (Blount et al., 2007)

EPA Superfund project managers in the Region 9 office sought site-specific information to examine whether the assumptions of the preliminary remediation goal presented in the 2006 Bodine memo could be tested at the Aerojet site using the biomonitoring procedures recently developed by the CDC to examine perchlorate exposure.

Fortuitously, the potential for collaboration between Dr. Gold of the University of California - Davis and Dr. Blount of CDC came to EPA's attention in early 2006. EPA was able to provide a small amount of funding to facilitate the analysis of archived samples from human female volunteers in the vicinity of the Aerojet site. The resulting preliminary assessment of perchlorate exposure is attached. (Memo and tables from Ellen Gold to K. Mayer and B. Blount, *Summary and 2 tables from UCD-CDC-EPA joint perchlorate effort*. May 8, 2008)

<u>Aerojet Site-specific perchlorate exposure and interpretation for risk remediation goals.</u>

One hundred and eighty-one women from 20 to 50 years of age provided permission to analyze previously-collected urine samples for everyday environmental exposures, such as perchlorate. These individuals resided in three communities west and northwest of the Aerojet facility. Daily urine samples pooled over a menstrual cycle were analyzed for perchlorate for the first 181 women, distributed evenly among the three communities.

The sample populations from all three communities had statistically similar urinary concentrations and exposure estimates. Combining the results from all three communities was supported by lack of significant differences in perchlorate exposure expressed in any unit (urine concentration, concentration corrected by creatinine or perchlorate dose in micrograms of perchlorate per kilogram body weight per day). This provided a relatively large sample size with strong statistical power. As a comparison, the statistic that the NAS relied upon to recommend the reference dose later adopted by EPA was based on a subset of only seven human study participants with much greater variability between individuals.

The biomonitoring results (Table II) show that every individual was exposed to perchlorate at a substantial percentage of EPA's reference dose, regardless of municipal water supply source or use of bottled water (see the following section on drinking water quality data). The results provide a site-specific quantitative estimate of background exposure, possibly from food sources, that must be considered in establishing the remediation goal for an actual or potential drinking water source.

EPA's Superfund Program typically establishes site-specific cleanup decisions to provide protection under the reasonable maximum exposure conditions for an individual. The 95th percentile of perchlorate exposure in young and middle-aged women in three communities in the vicinity of the Aerojet Superfund Site was 0.264 µg /kg-day. This value represents about 40 percent of the US EPA reference dose of 0.7 µg /kg-day

After accounting for site-specific background exposure, a dose of 0.44 µg/kg-day from perchlorate-contaminated drinking water would protect an individual from exceeding the total Reference Dose of 0.7 µg /kg-day. This translates to approximately 15 micrograms per liter (ppb) of perchlorate as a protective remediation goal, using the standard assumption for adult body weight (70 kg) and water consumption (2 liters per day) per the EPA guidance. (Bodine, OSWER, January 2006)

The study also reported mean and standard deviation statistics for the perchlorate dose of the participants combined from the three communities and from each community separately (Table II). The median exposure was 0.1 µg /kg-day and the arithmetic mean was 0.12 µg /kg-day, with a standard deviation of 0.067. The upper 95 percent confidence limit (UCL) reported by the researchers was 0.13 µg /kg-day.

Public water supply perchlorate monitoring data

Evidence from water supply monitoring data for these communities indicates that drinking water does not represent an important source of this background exposure. The mean exposure in this study translates to a drinking water equivalent of over 4 ppb in drinking water, and the 95th percentile from the study translates to approximately 10 ppb.

The public water supply wells are routinely monitored for perchlorate in all three communities in the biomonitoring study, with the oversight of the California Regional Water Quality Control Board, Central Valley Region and the US EPA. These unpublished data are collected in the Aerojet Superfund Project database.

All samples of municipal water sources in Fair Oaks sampled from 1998 through 2007 have been less than the 1 ppb detection limit for perchlorate. This indicates that public water supply was a negligible source of perchlorate exposure for the entire duration of the biomonitoring study. Perchlorate in trace amounts less than 4 ppb had been detected in three of the seven water supply wells in Carmichael, although the source appears to be unrelated to Aerojet. These detections have been uncommon and perchlorate in the public water system has been generally below the 1 ppb detection limits throughout the period of the biomonitoring study. The public water supply for the third community,

Ranch Cordova, has been the focus of remedial action commencing prior to the sampling for this study. Perchlorate-contaminated groundwater had been detected beneath Rancho Cordova, but all public water supply wells are currently protected. Wells that had been contaminated by various chemicals from Aerojet, including perchlorate, were no longer in service as supply wells during the time of the biomonitoring study. It is notable that the biomonitoring results for perchlorate in the study participants from Rancho Cordova were statistically undistinguishable from perchlorate values measured in the two other communities which had very few or no detections of perchlorate in samples from public water supply wells (detection limit 1 ppb).

A substantial percentage of the study participants reported drinking bottled water rather than municipal water. Drinking water source (bottled versus municipal) showed no statistically significant effect on perchlorate exposure as measured in this biomonitoring study.

Although it is possible that some exposure is from undetectable amounts of perchlorate in the water supply, it is reasonable to adopt a conservative assumption that the measured exposure is derived entirely from non-drinking water sources, such as food.

Conclusion

The state MCL of 6 ppb would provide adequate health protection based on the US EPA reference dose (0.7 µg /kg-day), the US EPA OSWER memo of January 2006 and reliable site-specific biomonitoring data for a substantial representative sample population of young and middle-aged women in the vicinity of the Aerojet Superfund Site.

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DEPARTMENT OF PUBLIC HEALTH

SCHOOL OF MEDICINE
UNIVERSITY OF CALIFORNIA

May 8, 2008

To: Kevin Mayer
Ben Blount

From: Ellen B. Gold

RE: Summary and 2 tables from UCD-CDC-EPA joint perchlorate effort

Attached are the two tables comparing the characteristics of women from the three communities from which we recruited for participation in our study (Table I) and their perchlorate levels and doses (Table II). Below is a brief summary of the design, followed by a summary of the results of these two tables.

Background Methods. About 7 years ago, we began a community-based cross-sectional study with historical ascertainment of exposure and health outcomes. Households were included from three areas, those: 1) with potential downwind exposure to environmental contaminants which became airborne following open burning of waste materials (Carmichael); 2) in the drinking water plume with potential drinking water exposure to perchlorate, determined by proximity to or likely use of previously contaminated water (Rancho Cordova); and 3) similar households in neighboring areas without such known potential exposures (Fair Oaks). A representative sample of households in the three areas was screened for eligibility for the cross-sectional study until women from 275 households were participating in each of the three areas. Eligibility for the cross-sectional study included both having lived in the house for at least 6 months and being in the age group 20 to 50 years during 1988-1996 (the time of documented contamination of wells). A cross-sectional study in which historical outcomes were ascertained was a reasonable compromise, although residents who had moved away from and who might have a different outcome experience from those who remained are not included; further, the magnitude and direction of any resulting bias that might be introduced cannot be reliably estimated.

We obtained a commercial list of households by block in the three areas from which we randomly sampled blocks and enumerated households in each of the three study areas. The list targeted women who were aged 20-50 years during 1988-1996 and residing in the three study areas: Rancho Cordova, Carmichael and Fair Oaks. The list was constructed from a national database whose sources were: telephone directories, auto registration, public real estate records, and multi-verified proprietary sources, such as credit card files, subscriptions, responses to TRW credit reports, driver licenses, voter registration, and census data. The company supplying the database said it contained 90 percent of households in the country, 96 million households and 170 million individuals. We supplemented our sampling procedure using the Haines database to obtain more complete listings of households on each

randomly selected block in the three study areas. Those selected received a letter from us asking when was best to contact them. If we did not hear from them after three mailings, we contacted them by telephone to ascertain willingness to be screened and best time for the screening. Screening for eligibility was performed on the telephone.

All participants were interviewed in-person about residential, reproductive and medical histories, and lifestyle factors. The women who participated who were premenopausal were asked to complete a daily diary and collect one daily 5 ml first morning urine sample for two menstrual cycles, which are being assayed for urinary metabolites of reproductive hormones and gonadotropins to assess ovarian function. At completion of data collection in December 2007, we had identified nearly 5262 households, screened 1473 women, (1132 of whom were eligible), interviewed 814 eligible women, collected blood samples (assayed for thyroid stimulating hormone and free thyroxine) and dietary food frequency data from the first 450 women and daily urine samples from 323 women. Women stored their daily urine samples in their home freezers until they completed collection, at which time they were picked up by study staff and transported in coolers on dry ice to the UC Davis lab where the samples were stored at -20°C until thawing for pooling (described in the next paragraph).

Current Methods. In January 2007, we entered into an agreement with CDC to analyze the urine samples from one menstrual cycle of the first 178 women who were still menstruating and who provided daily urine samples, corresponding to the first 450 women interviewed who also had blood samples drawn for thyroid function. Over 95% of these urine samples were collected in the four years, 2001-2004. For each woman, we pooled the daily samples to form three groups: follicular phase = days 1-10 of menstrual cycle; periovulatory phase = days 11-17; and luteal phase = days 18-28. Creatinine levels for each of the pools were determined in the UC Davis laboratory. The CDC analyzed each of the three pooled groups for each woman for perchlorate, iodide, thiocyanate and nitrate. Average perchlorate dose was computed based on measured first morning urine perchlorate using the Cockcroft-Gault equation [(1)] as modified by Mage, et al. [(2)].

For the pooled urine samples for these first 178 women with such daily samples, we computed descriptive statistics of their sociodemographic and health characteristics and compared the three study areas. We then compared the study areas for mean and median values of perchlorate.

Summary of Results

- Overall distribution of perchlorate: Perchlorate was found in all urine samples tested, with concentrations ranging from 1.2 to 15.33 μg/L with a median of 5.07 μg/L and concentrations adjusted for creatinine [Cr] ranging from 1.72 to 16.82 μg/g Cr with a median of 4.22 μg/mg Cr.
- Overall distribution of estimated perchlorate <u>dose</u> ranged from 0.034 to 0.42 μg/kg/day with a median of 0.1 μg/kg/day, which is well below the reference dose, of 0.7 μg/kg/day.

Detailed Results

Table I: Characteristics of Participants by Study Area. Women in the three sampled communities differed significantly only in that those in Rancho Cordova:

- were less likely to use a municipal drinking water supply and more likely to use bottled water,
- were more likely to consume fish from the Sacramento River,
- had lived in the area somewhat longer and
- reported somewhat less physical activity than women in the other two communities.

Women in the three communities did not differ significantly by age, race/ethnicity, educational level, marital status, smoking, financial strain, health insurance, self-rated health, annual household income, employment, source of cooking water, duration of residence, weight, or height. The participants were predominantly aged 40-49 years, white, college-educated, married/partnered, non-smoking, insured for

health care, in very good to excellent health, employed, physically active, and overweight (BMI≥25) and had annual household incomes over $35,000, used municipal water supplies, and had lived in the area for over 10 years.

Table II: Descriptive Statistics of Urine Measurements, Unadjusted and Adjusted for Creatinine by Menstrual Cycle Phase and Study Area. No significant differences were observed among study areas in mean, either on an arithmetic or log scale, or median estimated perchlorate dose (μg/kg body weight/day). Dose calculations were based on estimates of 24-hour creatinine excretion and ranged from 0.033 to 0.42 μg/ kg/day. The maximum estimated perchlorate dose (0.42 µg/kg/day) did not exceed the EPA reference dose (0.7 µg/kg/day). No significant differences were observed in means, medians or geometric means across study areas or menstrual cycle phases (data not shown for cycle phases) for unadjusted urinary concentrations of perchlorate or in urinary perchlorate concentrations adjusted for creatinine levels.

Conclusions

- Estimated perchlorate dose did not exceed the reference dose for any study participants. Urinary perchlorate levels (both µg/L and µg/g Cr) were within the range of values observed in NHANES[3]. For comparison, women of reproductive age in NHANES 2001-2002 had estimated perchlorate doses ranging from 0.003 – 3.78 µg/kg/day, with a median of 0.057 µg/kg/day and had urinary perchlorate levels ranging from 0.16 – 250 µg/g Cr with a median of 3.12 µg/g Cr.
- No statistically significant differences in current perchlorate levels or dose were observed among the three study sites or over the three menstrual cycle phases.

Reference List

1. Cockcroft D W; Gault M H. *Nephron* **1976,** *16*(1), 31-41.

2. Mage DT; Allen RH; Gondy G; Smith W; Barr DB.; Needham LL. *J Expo. Anal. Environ. Epidemiol.* **2004,** *14*(6), 457-465.

3. Blount BK, Valentin-Blasini L, Osterloh JD, Mauldin JP, Pirkle JL. *J Exp Sci Environ Epidemiol* **2007,** 17:400-407

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Table I. Characteristics of Participants by Study Area

*P-value is used to determine significance in comparison of cities within each category.

P-values are obtained by ANOVA for continuous variables and chi-square tests for categorical variables, respectively.

[a, b] For between-city comparison, we perfomed post-hoc pairwise comparisons to determine which city signficantly differs from another.

	Rancho Cordova (N=60)			Fair Oaks (N=63)			Carmichael (N=58)			P-value*
Characteristic	**n**	**%**	**Mean (SD)**	**n**	**%**	**Mean (SD)**	**n**	**%**	**Mean (SD)**	
Age (in years)										
<30	2	3%	27.40 (1.71)	2	3%	28.89 (1.02)	2	3%	26.99 (3.62)	0.73
30-39.99	13	22%	35.05 (3.10)	12	19%	35.91 (2.88)	10	17%	37.13 (3.24)	0.29
40-49.99	43	72%	44.82 (3.04)	44	70%	45.38 (2.74)	43	74%	44.81(2.50)	0.55
50-59.99	2	3%	50.92 (0.44)	5	8%	51.96 (0.97)	3	5%	50.61(0.63)	0.12
Race										
Black/African-American/African-Origin	3	5%		1	2%		0	0%		0.62
Caucasian (Non-Hispanic, White)	51	85%		51	81%		53	91%		0.98
Hispanic	3	5%		4	6%		3	5%		1
Asian/Pacific Islander	2	3%		3	5%		0	0%		1
Other/ Mixed	1	2%		4	6%		1	2%		1
Missing	1	2%		2	3%		1	2%		1
Education										
No School/Grade School	0	0%		1	2%		1	2%		1
High School Diploma/GED	10	17%		2	3%		9	16%		0.09
Some College/Vocational School	24	40%		24	38%		24	41%		1
College Grad	19	32%		21	33%		16	28%		0.74
Some Graduate/Professional School	6	10%		12	19%		7	12%		0.31
Doctoral Degree	0	0%		1	2%		0	0%		1
Missing	1	2%		2	3%		1	2%		
Marital Status										
Single/Never Married	11	18%		7	11%		9	16%		0.68
Married/Partnered	43	72%		49	78%		40	69%		0.63
Separated/Divorced/Widowed	5	8%		5	8%		8	14%		0.73
Missing	1	2%		2	3%		1	2%		1
Smoking Status										
Never	41	68%		43	68%		35	60%		0.65
Former	15	25%		13	21%		18	31%		0.69
Current	4	7%		6	10%		5	9%		0.95
Missing	0	0%		1	2%		0	0%		1

Difficulty paying for basics										
1=Very hard	4	7%		3	5%		2	3%		0.92
2=Somewhat hard	13	22%		12	19%		14	24%		0.98
4=Not very hard at all	41	68%		46	73%		41	71%		0.84
Missing	2	3%		2	3%		1	2%		1
Health insurance										
1=Private	55	91.7		56	88.9		49	84.5		0.79
2=Public	4	6.7		4	6.4		6	10.3		0.85
3=None	1	1.7		3	4.7		3	5.2		0.72
Self-rated health status										
1=excellent	13	22%		19	30%		15	26%		0.59
2=very good	24	40%		28	44%		30	52%		0.74
3=good	17	28%		11	17%		10	17%		0.35
4=fair	5	8%		2	3%		1	2%		0.30
5=poor	0	0%		1	2%		1	2%		1
Missing	1	2%		2	3%		1	2%		1
Annual Household Income										
< $35 K	5	8%		3	5%		5	9%		0.83
$35-$75 K	26	43%		20	31%		27	47%		0.58
> $75 K	26	43%		38	60%		24	41%		0.14
Missing	3	5%		2	3%		2	3%		1
Currently employed										
No	13	22%		16	25%		8	14%		0.30
Yes	47	78%		47	75%		50	86%		0.96
Drinking water source										
1=Private well	1	2%		0	0%		0	0%		1
2=Municipal (public) water supply	21	35% [(a)]		39	62% [(a)]		27	47%		0.056
3=Bottled only	21	35%		11	17%		20	34%		0.20
4=Other	17	28%		13	21%		11	19%		0.55
Cooking water source										
1=Private well	1	2%		0	0%		0	0%		1
2=Municipal (public) water supply	44	73%		51	81%		50	86%		0.76
3=Bottled only	4	7%		0	0%		0	0%		1
4=Other	11	18%		11	17%		8	14%		0.83
Missing	0	0%		1	2%		0	0%		1
Duration of residence at this address (years)	60	100%	11.62 (5.36)	63	100%	11.64 (7.65)	58	100%	11.16 (5.92)	0.90

10/3/2008

Revised Table II. Descriptive Statistics of Urine Measurements, by Study Area.

[#]Total for all sites for perchlorate dose was 178, for all other measures was 181

*P-value is used to determine significance comparing cities within each category.

P-values are obtained by ANOVA for continuous variables .

Nonparametric median test was used to test for difference in medians across the 3 study cities.

[(a)] For between-city comparison, we perfomed multiple pairwise comparisons to determine which city signficantly differs from another. (a) indicates the pair of cities that are significantly different.

Measure	All 3 sites[+] (N=181)	Rancho Cordova (n=60)	Fair Oaks (n=63)	Carmichael (n=58)	P-value*
Perchlorate Dose (μg) Adj. for Creatinine/Kg Body Weight					
mean ± sd	0.12 ± 0.067	0.12 ± 0.063	0.13 ± 0.072	0.12 ± 0.064	0.69
95% CI for mean	0.111 - 0.131	0.102 - 0.135	0.109 - 0.145	0.100 - .134	
median	0.1	0.093	0.11	0.1	0.62
95th percentile	0.264	0.246	0.25	0.296	
range (min-max)	(0.034-0.42)	(0.048-0.33)	(0.042-0.42)	(0.034-0.34)	
geometric mean ± sd**	0.108 ± 0.050	0.106 ± 0.048	0.112 ± 0.055	0.105 ± 0.048	
95% CI for geometric mean	0.101-0.115	0.095-0.120	0.099-0.126	0.093-0.118	
Exp Ln Perchlorate Dose (μg) Adj. for Creatinine/Kg Body Weight					
mean ± sd	0.11 ± 1.59	0.11± 1.58	0.11 ± 1.63	0.10 ± 1.58	
95% CI for mean	0.101 - 0.115	0.095 - 0.119	0.099 - 0.126	0.093 - 0.118	
median	0.1	0.093	0.11	0.1	0.62
range(min- max)	(0.034-0.42)	(0.048-0.33)	(0.042-0.42)	(0.034-0.34)	
Perchlorate Concentration (μg/L) Unadjusted for Creatinine					
mean ± sd	5.41 ± 2.58	5.6 ± 2.34	5.36 ± 2.80	5.27 ± 2.59	0.77
95% CI for mean	5.030 - 5.790	5.000 - 6.212	4.654 - 6.067	4.580 - 5.952	
median	5.03	5.23	5.1	4.77	0.55
95th percentile	10.067	9.700	11.967	10.067	
range (min-max)	(1.2-15.33)	(1.2-10.57)	(1.52-15.33)	(1.6-15.0)	
geometric mean ± sd**	4.852 ± 2.302	5.108 ± 2.294	4.736 ± 2.388	4.725 ± 2.222	0.43
95% CI for geometric mean	4.526-5.201	4.555-5.728	4.182-5.364	4.182-5.339	
Perchlorate Concentration Adj. for Creatinine (μg/mg Cr)					
mean ± sd	5.01 ± 3.01	4.88 ± 2.48	5.27 ± 3.83	4.86 ± 2.47	0.70
95% CI for mean	4.567 - 5.456	4.230 - 5.523	4.307 - 6.236	4.208 - 5.519	
median	4.35	4.41	4.61	4.08	0.77
95th percentile	10.001	10.764	9.240	10.001	
range (min-max)	(1.69-30.37)	(2.12-15.18)	(1.88-30.37)	(1.70-14.03)	
geometric mean ± sd**	4.464 ± 2.038	4.423 ± 1.887	4.585 ± 2.258	4.375 ± 1.978	0.78
95% CI for geometric mean	4.175-4.773	3.967-4.932	4.060-5.178	3.890-4.920	

sd** is the approximate standard deviation.