DRAFT FINAL
Engineering Evaluation/ Cost Analysis Report

Mather Former Waste Disposal Area Site
Yosemite National Park

Prepared by Kane Environmental, Inc.
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List of Abbreviations and Acronyms

ADD	average daily dose
ALM	Adult Lead Model
APCD	Air Pollution Control District
ARAR	applicable or relevant and appropriate requirements
bgs	below ground surface
BERA	baseline ecological risk assessment
BTV	background threshold value
CalEPA	California Environmental Protection Agency
CCR	California Code of Regulations
CDC	Centers for Disease Control
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHF	Central Hazardous Materials Fund
CHHSL	California Human Health Screening Level
COC	contaminant of concern
COEC	contaminant of ecological concern
COPC	contaminant of potential concern
COPEC	contaminant of potential ecological concern
CSF	cancer slope factor
CSM	conceptual site model
CST	Contaminated Site Team
CTE	central tendency exposure
CWC	California Water Code
CY	cubic yard
DTSC	Department of Toxic Substances Control
ECM	Environmental Compliance Memorandum
EE/CA	Engineering Evaluation/Cost Analysis
EPC	exposure point concentration
ESV	ecological screening value
ESL	ecological screening level
FGC	California Fish and Game Code
FIR	Facility Investigation Report
FSI	Focused Site Inspection
FWDA	Former Waste Disposal Area
GPS	Global Positioning System
HERO	Human and Ecological Resource Office
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
HSC	California Health and Safety Code
IEUBK	Integrated Exposure Uptake Biokinetic
IUR	inhalation unit risk
LDR	land disposal restriction
LOAEL	low observed adverse effect level
µg/dL	micrograms per deciliter
mg/kg	milligrams per kilogram

NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAEL	no observed adverse effect level
NPS	National Park Service
NTCRA	non-time critical removal action
PAH	polycyclic aromatic hydrocarbon
PbB	blood lead level
PCB	polychlorinated biphenyl
PDI	pre-design investigation
PEF	particulate emission factor
PRG	preliminary removal goal
PRSC	post-removal site control
RAO	removal action objective
RfC	reference concentration
RfD	reference dose
RME	reasonable maximum exposure
RSL	Regional Screening Level
SAP	sampling and analysis plan
SLERA	screening-level ecological risk assessment
S/S	solidification/stabilization
SW	soil washing
SWRCB	California State Water Resources Control Board
TBC	to be considered
TCDD	2,3,7,8-Tetrachlorodibenzodioxin
TEF	toxic equivalency factor
TEQ	2,3,7,8-TCDD toxic equivalency
TN	ton
TPH	total petroleum hydrocarbons
TRV	toxicity reference value
UCL	upper confidence limit
UTL	upper threshold limit
USC	United States Code
USDOI	U.S. Department of the Interior
USEPA	U.S. Environmental Protection Agency
VF	volatilization factor
VOC	volatile organic compound
WASO-ECCB	Washington Support Office-Environmental Compliance and Cleanup Branch
YOSE	Yosemite National Park

Executive Summary

The purpose of the Engineering Evaluation/Cost Analysis (EE/CA) Executive Summary is to highlight the key information contained in the EE/CA Report. The Executive Summary contains a summary of the site description, including investigation results and an updated conceptual site model based on these results. A summary of the risk assessment and of applicable or relevant and appropriate requirements (ARARs) also is included along with the scope and objectives of the removal action. The final sections of the Executive Summary provide information on the removal action alternatives analyzed and the recommended removal action.

ES 1. Introduction and Purpose

The Mather Former Waste Disposal Area Site (the Site) is located within Yosemite National Park, which is owned by the United States and managed by the National Park Service (NPS). The Site is being investigated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). NPS is the lead agency under CERCLA at the Site because the Site is under the jurisdiction, custody, or control of NPS.

This EE/CA has been prepared pursuant to the authorities of Section 104(b) of CERCLA and Section 300.415 (b)(4)(i) of the National Oil and Hazardous Substances Pollution Contingency Plan, commonly called the National Contingency Plan (NCP), which authorize NPS to conduct investigations and studies to characterize the nature and extent of contamination at the Site and to evaluate the need for a response to such contamination to protect public health or welfare or the environment.

The purpose of the EE/CA is to document the release, nature, and extent of hazardous substances at the Site; conduct human health and ecological risk assessments; and, if needed, provide a framework for evaluating removal action alternatives. The EE/CA identifies removal action objectives (RAOs) and analyzes the effectiveness, implementability, and cost of removal action alternatives that may be used to satisfy the RAOs.

ES 2. Site Description, Investigation Results, and Conceptual Site Model

The Site is in the northwest portion of Yosemite National Park, approximately 200 feet south of Hetch Hetchy Road, and 1.25 road miles northeast of the Hetch Hetchy Entrance (Figure 1). The Site is located at approximately N 37º54’07”, W 119º50’09”. The Site is in the Yosemite Wilderness, approximately 100 feet from the boundary of the non-wilderness buffer zone that follows Hetch Hetchy Road. Based on previous investigations of the Site, the Site is approximately 0.5 acres, and is located at an elevation of approximately 5,000 feet above mean sea level. The Site is in a local low area, with a vegetated slope leading down from Hetch Hetchy Road to the north, and sparsely vegetated rock outcrop highlands to the east and south (Figure 2). A gully or seasonal streambed that appears to drain surface water runoff from the Site leads away from the Site to the west (Figure 3).

The Site is located approximately four miles southwest of the O'Shaughnessy Dam. The Hetch Hetchy Road located north of the Site was constructed in 1914-1915, during the initial construction phase of the dam. The Site was originally used as a quarry, a conclusion made based on evidence such as the presence of drilled holes and granite rubble that is present in the rock at the southern area of the Site, and the low-lying shape of the ground surface in these areas, suggesting removal of material. The Site quarry was subsequently used as a waste disposal area.

During environmental sampling activities conducted in 2001 and 2008 by the IT Corporation and Shaw Environmental, Inc. (Shaw) at the Site, debris such as porcelain, metal, glass, rusted cans, batteries, and other waste materials, along with evidence of burned refuse, was noted to be present in soils at the Site. Archeological evidence from a 2001 investigation of the Site suggests that it was likely used for waste disposal between approximately 1941 and 1970. Refuse from the southern portion of the Site was likely accumulated between 1941 and 1952. Refuse from the northern portion of the Site was likely accumulated between 1959 and 1970. Dumped refuse materials at the Site may be a source of a wide variety of contaminants, including metals, petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), and other contaminants. Burning of refuse may generate PAHs, dioxins, furans, and other contaminants.

In 2001, IT Corporation conducted a Focused Site Inspection (FSI) at the Site. This FSI included collection of soil samples from four test pits. Test pits TP01 and TP02 were placed in the southern area of the Site, and test pits TP04 and TP05 were advanced on the northern area of the Site. Buried refuse and ash layers indicative of burning of waste were observed in TP02 and TP05 subsurface soils. An area of petroleum-contaminated soil was identified in TP05. In discrete soil samples collected from these two test pits, contaminants such as arsenic and lead and PAHs including benzo(a)pyrene and dibenz(a,h)anthracene were detected at concentrations exceeding the USEPA Regional Screening Levels (RSLs) for Residential Exposures established at the time. Diesel and heavy oil range total petroleum hydrocarbons (TPH) were detected at elevated levels in the area of oil-contaminated soil, and an elevated concentration of dioxins/furans was detected in a biased soil sample intended to capture an ash layer in TP02.

In 2008, Shaw (formerly IT Corporation) collected additional soil samples at the Site as part of a Facility Investigation Report (FIR). Shaw excavated four "step-out" test pits (YWM06, YWM07, YWM08, and YWM09) around the locations of 2001 test pits TP02 and TP05 to better define the extent of subsurface debris and to collect additional soil samples from these areas. Soil samples collected from these test pits were analyzed for metals, PAHs, TPH, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and/or polychlorinated biphenyls (PCBs). Samples collected from test pits in the area of TP05 contained heavy oil range TPH and PAHs at concentrations in exceedance of USEPA RSLs, while those collected from YWM08 contained lead at concentrations in exceedance of these screening levels.

Human health and ecological risk assessments were performed by Shaw using the data collected in 2001 and 2008. Shaw concluded that while both human and ecological exposure risks at the Site were not deemed to be unacceptable or significant, limited areas of soil removal should be completed in the area where oily material had been identified in test pit TP05, and in the area where elevated concentrations of lead had been identified in test pit YWM09, in order to "further reduce the already low risk associated with this Site".

Apart from the 2001 FSI and 2008 FIR described here, no other environmental investigations have been conducted at the Site. NPS retained Kane Environmental, Inc. (Kane Environmental) to use the data presented in these reports to prepare this EE/CA Report, which includes a human health risk assessment (HHRA) and a baseline ecological risk assessment (BERA).

The framework of the risk assessments conducted at the Site as part of this EE/CA Report is the Conceptual Site Model (CSM), which identifies sources of Site contaminants, migration pathways, exposure media, and potentially complete exposure pathways for human and ecological receptor groups that may be present at the Site (Figures 6 and 7). The CSM for the Site identifies waste disposal and burning at the Site as the primary source of contaminants, with soil as the exposure medium of concern. Human receptors that may be exposed to Site contamination in surface soil include park visitors (both adults and children) and Park workers, who are exposed to soil primarily by the direct contact, incidental ingestion, and dust inhalation pathways. While no soil-disturbing work tasks are currently conducted or planned at the Site, a hypothetical construction or Park restoration worker was also considered as a human receptor that may be exposed to subsurface soil, which contains greater concentrations of certain contaminants. These workers may be present and subject to subsurface soil exposure at the Site during removal actions discussed in this report. Ecological receptors that may be exposed to Site contamination include terrestrial plants, soil invertebrates, birds, and mammals, including burrowing mammals.

ES 3. Risk Assessment Summary

Human Health Risk Assessment

The HHRA was prepared according to USEPA guidance on conducting HHRAs at CERCLA sites (USEPA 1989) and DTSC Human and Ecological Risk Office (HERO) guidance for conducting human health risk assessments. The Site investigation data used for the risk assessment are those data provided in the FIR conducted at the Site by Shaw Environmental (Shaw, 2010), and the FSI conducted by IT Corporation (IT, 2002). Exposures for human and ecological receptors were considered on a Site-wide basis.

As described in Section ES 2 above, soil is the primary exposure media of concern for human receptors at the Site. Current and future park visitors (adults, adolescents, and children) may be exposed to surficial (zero to 6 inches bgs) Site soils by the incidental ingestion, dermal absorption (direct contact), and particulate (dust) inhalation exposure routes. Current and future adult park workers and potentially future site construction or restoration workers (also of adult age) may be exposed to Site surface and subsurface (greater than 6 inches bgs) soils by these exposure routes.

A screening level risk assessment was conducted using residential exposure screening levels (2020 USEPA RSLs and DTSC HERO Note 3 Screening Levels) to identify chemicals of potential concern (COPCs) for human exposure at the Site. This process identified numerous metals and TPH fractions as COPCs in surface and subsurface soil, as well as dioxins/furans in subsurface soil. To further evaluate these COPCs, a Site-specific HHRA was conducted. In the more detailed assessment of human exposures completed in the HHRA, there were no surface soil exposure scenarios that resulted in unacceptable non-cancer hazards (hazard quotient [HQ] greater than 1) or cancer risks (cancer risk greater than 1×10^{-6}). For future construction or NPS worker exposures to subsurface soil, non-cancer risks were slightly in exceedance of acceptable non-cancer risk thresholds due to exposure to diesel and heavy oil-range petroleum hydrocarbons. Therefore, these TPH contaminants were identified as contaminants of concern (COCs) for human receptors. Because lead was identified as a COPC in the screening level risk assessment, a blood lead model was used to further assess risks associated with lead in soil. While no lead-related risks were identified for surface soil exposures, blood lead modeling of future construction worker exposure to subsurface soils suggested potential unacceptable risks. Therefore, lead was also identified as a COC at the Site.

Ecological Risk Assessment

The Ecological Risk Assessment (ERA) included both a Screening Level ERA (SLERA) and a simplified Baseline ERA (BERA), following NPS guidance.

As described in Section ES 2 above, soil is the primary exposure medium of concern for ecological receptors at the Site. In the SLERA, ecological receptors were considered as groups, including terrestrial plants, soil invertebrates, birds, and mammals. These groups are exposed to soil primarily by direct contact with and/or incidental ingestion of soil, or by consumption of food items containing elevated levels of Site contaminants.

The SLERA compares maximum concentrations of contaminants present at the Site to ecological screening values (ESVs) identified by NPS to be appropriate for selection of contaminants of potential ecological concern (COPECs). Based on the SLERA, numerous metals as well as select SVOCs were identified as COPECs in surface soil and subsurface soil. Dioxins/furans were also identified as a COPEC in subsurface soil. A refined SLERA then compared contaminant concentrations to NPS-identified refined SLERA ESVs that are specific to receptor groups. COPECs that did not exceed the receptor group-specific ESVs were removed as COPECs. At the conclusion of the refined SLERA, twelve metals, bis(2-ethylhexyl)phthalate, and dioxins/furans were retained as refined COPECs for further evaluation in the BERA.

The BERA assessed potential risks to ecological receptors based on comparisons of Site refined COPEC concentrations to no observed adverse effect levels (NOAELs) and low observed adverse effect levels (LOAELs), by comparing estimated doses of COPECs to NOAEL and LOAEL-based toxicity values. To assess potential risks to mammals and birds, exposures to contaminants in food items were evaluated for representative herbivorous, insectivorous, and carnivorous species of mammalian and avian receptors.

Exposure to subsurface soils were evaluated for plants, soil invertebrates, and burrowing insectivorous mammals. Due to potentially unacceptable risks posed to one or more ecological receptors as determined in the BERA, the following contaminants were identified as contaminants of ecological concern (COECs) in surface soil: antimony, cadmium, chromium, copper, lead, mercury, vanadium, zinc, and manganese. Similarly, the following contaminants were identified as COECs in subsurface soil: antimony, barium, cadmium, chromium, copper, lead, vanadium, zinc, and dioxins/furans.

The final step of these risk assessments was to determine preliminary removal goals (PRGs) for COCs and COECs. These preliminary removal goals are concentrations calculated for Site-wide exposures that would not result in unacceptable risks to human or ecological receptors; that is, they are concentrations that the removal action should seek to achieve on a Site-wide basis. In the HHRA, PRGs were calculated using NPS "point of departure" risk thresholds—cumulative non-cancer hazard index of 1 and cancer risk of 1×10^{-6}—to determine human health PRGs for COCs other than lead. Lead PRGs were determined using the Adult Lead Model, which was used to assess lead risks to a developing fetus. Adult women of child-bearing age who may work at the Site (i.e., Park employees or workers) were determined to have the highest potential exposures to lead due to the longer duration that they may be present at the Site compared with adult or child visitors. In the BERA, HQ values based on threshold effects level values were used to calculate PRGs for COECs for ecological receptors.

ES 4. Identification and Analysis of Applicable or Relevant and Appropriate Requirements

The identification of applicable or relevant and appropriate requirements (ARARs) is a prerequisite to selecting a cleanup action (USEPA 1992b). "Under circumstances where a non-time-critical removal action is expected to be the first and final action at the site, the selected removal action must satisfy all adopted ARARs" (USDOI 2016).

Other factors to be considered (TBCs) are non-promulgated criteria, advisories, guidance, and proposed standards issued by federal or state governments. The TBCs are not enforceable but may be appropriate to consider in certain circumstances; for example, where there are no ARARs that identify cleanup standards.

There are four basic criteria that define ARARs (NPS 2015a; USEPA 1988). The ARARs are (1) substantive rather than administrative, (2) applicable or relevant and appropriate, (3) promulgated state requirements that are more stringent than comparable federal standards, and (4) categorized as chemical-, location-, or action-specific. Key ARARs are summarized below.

- Chemical-specific: Key chemical-specific ARARs for the Site focus on permissible exposure limits that apply to worker protection during the removal action and hazardous waste determination statutes that determine the disposal facilities that may accept contaminated soils removed from the Site during the removal action.

- Location-specific: Key location-specific ARARs for the Site include ARARs specific to national parks such as the National Park Service Organic Act of 1916, the National Park Service General Authorities Act of 1970, national park regulations pertaining to restrictions on waste disposal sites, the creation of nuisances, and the protection of national park resources, and the Wilderness Act of 1964. Other key location-specific focus on the protection of animal and plant species that are endangered, threatened, or protected at the federal or state level and the protection of historical and cultural resources.

- Action-specific: Key action-specific ARARs are specific to each removal alternative, and include relevant and appropriate requirements on the excavation, on-Site management, transport, and disposal of contaminated soil and other on-Site waste.

Pursuant to its delegated CERCLA lead agency authority, NPS has identified ARARs and TBCs for the Mather Former Waste Disposal Area EE/CA. Other agencies, including the California Environmental Protection Agency (CalEPA) Department of Toxic Substances Control (DTSC), were given the opportunity to provide input about ARARs and TBCs for the Site.

ES 5. Removal Action Objectives and Removal Goals

The removal action objectives (RAOs) define what the removal action is intended to accomplish. The RAOs for this EE/CA are as follows:

Prevent unacceptable risks to human and ecological receptors from exposure to Site contaminants in soil. This RAO aims to reduce exposure to soil that contains contaminant concentrations that are above preliminary risk-based removal goals (PRGs). Meeting PRGs that were developed for COCs and COECs based on risk assessments will fulfill this RAO.

Eliminate or minimize contaminant-related constraints on the full enjoyment and utilization of park resources for operational, scientific, and interpretive purposes consistent with NPS mandates. This RAO addresses the Organic Act directive to conserve and to provide for the enjoyment of the scenery and the natural and historic objects and the wildlife in the park such as to leave them unimpaired for the enjoyment of future generations. This RAO relates to how the human and ecological risk assessments were conducted and the level of protection achieved by the recommended removal goals (RGs) and provides overarching guidance for all technology and alternative evaluations.

Attain all other federal and state ARARs. This RAO assesses whether the removal alternatives attain the federal and state ARARs.

The recommended removal goals (RGs) are selected by comparing the risk-based PRGs with background concentrations and ARARs. For soil, there are no ARARs that define numerical cleanup standards. In some cases, background values exceed the PRGs and, as a result, become the RG because cleanup below background is not possible. The recommended RGs and selection basis are included in Text Table ES 5.

Text Table ES 5 Removal Goal (RG) Selection					
COC or COEC	**Background or Reference Value**	**Human Health PRG**	**Ecological PRG**	**Basis for RG**	**RG**
Surface Soil					
Antimony	*0.242 mg/kg*	*NA*	*1.6 mg/kg*	*Ecological PRG*	*1.6 mg/kg*
Cadmium	*0.41 mg/kg*	*NA*	*1.0 mg/kg*	*Ecological PRG*	*1.0 mg/kg*
Chromium	*7.9 mg/kg**	*NA*	*1.4 mg/kg*	*Ecological PRG*	*1.4 mg/kg**
Copper	*10.0 mg/kg*	*NA*	*123 mg/kg*	*Ecological PRG*	*123 mg/kg*
Lead	*8.8 mg/kg*	*1,162 mg/kg*	*54 mg/kg*	*Ecological PRG*	*54 mg/kg*
Manganese	*267 mg/kg*	*NA*	*574 mg/kg*	*Ecological PRG*	*574 mg/kg*
Mercury	*0.1 mg/kg*	*NA*	*0.19 mg/kg*	*Ecological PRG*	*0.19 mg/kg*
Vanadium	*51.2 mg/kg*	*NA*	*13 mg/kg*	*Background*	*51.2 mg/kg*
Zinc	*52.8 mg/kg*	*NA*	*334 mg/kg*	*Ecological PRG*	*334 mg/kg*
Subsurface Soil					
Antimony	*0.242 mg/kg*	*NA*	*1.6 mg/kg*	*Ecological PRG*	*1.6 mg/kg*
Barium	*64.6 mg/kg*	*NA*	*837 mg/kg*	*Ecological PRG*	*837 mg/kg*
Cadmium	*0.41 mg/kg*	*NA*	*1.0 mg/kg*	*Ecological PRG*	*1 mg/kg*
Chromium	*7.9 mg/kg*	*NA*	*1.4 mg/kg*	*Ecological PRG*	*1.4 mg/kg*
Copper	*10.0 mg/kg*	*NA*	*123 mg/kg*	*Ecological PRG*	*123 mg/kg*
Lead	*8.8 mg/kg*	*1,162 mg/kg*	*192 mg/kg*	*Ecological PRG*	*192 mg/kg*
Vanadium	*51.2 mg/kg*	*NA*	*13 mg/kg*	*Background*	*51.2 mg/kg*
Zinc	*52.8 mg/kg*	*NA*	*334 mg/kg*	*Ecological PRG*	*334 mg/kg*
TPH-Medium MW (TPH-D)	*3 mg/kg*	*2,000 mg/kg*	*None*	*Human Health PRG*	*2,000 mg/kg*
TPH-High MW (TPH-O)	*31 mg/kg*	*40,000 mg/kg*	*None*	*Human Health PRG*	*40,000 mg/kg*
Dioxins/Furans (as TEQ)	*4.3×10^{-8} mg/kg*	*NA*	*7×10^{-6} mg/kg*	*Ecological PRG*	*7×10^{-6} mg/kg*

Notes:
mg/kg = milligrams per kilogram NA = not applicable, does not pose a risk MW = molecular weight
TEQ = Total dioxins and furans concentration as 2,3,7,8-tetrachlorodibenzodioxin (TCDD) Toxic Equivalency concentration
* = The chromium ecological PRG is selected as the RG despite being lower than the listed background value, because the PRG is based on hexavalent chromium toxicity values, while the background value is calculated from total chromium data. See Section 5.2.2 and 5.2.3 below for further discussion.

Comparisons of the RGs established for the Site to concentrations of COCs and COECs detected in soil identify areas where these COCs and COECs are present above RGs. Analytical results for existing soil data for the Site indicate that all samples of surface soil and most samples of subsurface soil contain one or more COCs or COECs above RGs. The extent of soil containing COCs and COECs above RGs are estimated based on these results. The estimated extent of soil containing COCs and COECs at concentrations exceeding RGs are the areas of soil at the Site that will be addressed by removal actions. Areas to be addressed include an area of surface and subsurface soil on the southern area of the Site (274 cubic yards estimated volume), and an area of surface soil with a limited area of subsurface soil on the northern area of the Site (36 cubic yards estimated volume).

ES 6. Identification of Removal Action Alternatives

The removal action alternatives identified as potentially feasible alternatives that could meet the RAOs are listed below:

1. No Action
2. In-Place Capping of Contaminated Soils
3. Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities

Consistent with the NCP, a No Action alternative (Alternative 1) is considered to provide an environmental baseline against which impacts of the other alternatives can be compared.

Alternative 2 is a remedy that would involve installation of protective biointrusion soil caps at the Site to prevent human and ecological receptors from becoming exposed to contaminated soils. Under this alternative, no contaminated soils would be removed from the Site. Monitoring, maintenance, and periodic review of the effectiveness of these caps would be required to ensure that they remain protective. An institutional control may be put in place by NPS to ensure that the caps remain undisturbed by human activity.

Alternative 3 is a remedy that would involve excavation of contaminated soils from the Site and transport of these soils to a licensed disposal facility. An estimated total of approximately 310 cubic yards of soil would need to be removed from the Site and transported to the disposal facility. Excavated areas would be backfilled and restored. Under this alternative, contaminated surface and subsurface soil would be removed from the Site. This remedy is designed as a permanent remedy that will reduce exposure and risk to human and ecological receptors to acceptable levels, eliminating the need for monitoring or other ongoing Site control activities.

ES 7. Comparative Analysis of Removal Action Alternatives

Text Table ES 7 summarizes the evaluation of effectiveness, implementability, and cost for each alternative.

Text Table ES 7 Comparison of Alternatives											
Criterion	**Effectiveness**						**Implementability**				**Cost**
Alternative	**Protective of**		**Complies with ARARs**	**Treatment Reduces Toxicity, Mobility, or Volume**	**Effectiveness**		**Feasibility**		**Acceptance**		**Cost**
	Human Health	**The Environment**			**Short Term Risks to Public/ Environment**	**Long Term Effectiveness**	**Technical**	**Administrative**	**State**	**Community**	
Alternative 1: No Action	***No***	***No***	***No***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	*N/E*	*N/E*	*$0*
Alternative 2: In-Place Capping of Contaminated Soils	***Yes***	***Yes***	***Yes*** *Minimum require-ments analysis may be necessary*	***None***	***Moderate to High*** *This alternative will have very low short term impacts on public health and safety and the environment.*	***Low to Moderate*** *Requires indefinite monitoring and maintenance to prevent long-term risks, not a permanent remedy*	***Moderate to High*** *Readily implemented, low logistical complexity*	***Moderate*** *No permits required, coordination with SHPO and wilderness analysis may be required. IC may be required.*	*N/E*	*N/E*	*$551,000*
Alternative 3: Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities	***Yes***	***Yes***	***Yes*** *Minimum require-ments analysis may be necessary*	***None***	***Moderate*** *This alternative will have low short term impacts on public health and safety, but greater than the impact of Alternative 2*	***High*** *Minimal maintenance to ensure the effectiveness of the remedy is required, full and permanent remedy*	***Moderate to High*** *Readily implemented, low to moderate logistical complexity*	***Moderate*** *No permits required, coordination with SHPO and wilderness analysis may be required*	*N/E*	*N/E*	*$864,000*

The first three columns list Yes/No ratings. A “No” entry indicates failure to achieve an RAO, which renders the alternative unacceptable.
Other columns list preference ratings as follows, from low to high preference: None (least preferred), Low, Low to Moderate, Moderate, Moderate to High, High (most preferred)
N/A = Not applicable N/E = Not evaluated at this time
SHPO = State Historical Preservation Officer IC = Institutional Control
Costs based on 30-year period of analysis

ES. 8 Recommended Removal Action Alternative

Taking into consideration the evaluation criteria presented in this EE/CA, the NPS-recommended removal action alternative for the Site is Alternative 3. Alternative 3 includes excavation of contaminated soil exceeding recommended RGs and disposal at existing licensed solid waste facilities outside the boundaries of the Site. The total estimated present value cost of Alternative 3 is $864,000. Alternative 3 is selected as the recommended removal action alternative based on the results of the comparative analysis completed in Section 7 and summarized in Text Table ES 7 above, showing that Alternative 3 would be protective of human health and the environment, would achieve the RAOs, and would be able to comply with ARARs.

Alternative 3 has similar technical and administrative feasibility to Alternative 2 (in-place capping of areas of contaminated soils), however, Alternative 3 is anticipated to be a complete and permanent removal that will require minimal maintenance and therefore minimal disturbance of the Site, which is located within Yosemite Wilderness. Conversely, Alternative 2 would require maintenance and monitoring indefinitely to ensure that the removal action remains protective of human health and the environment. Therefore, Alternative 3 has greater long-term effectiveness than Alternative 2. This advantage was determined to outweigh the higher estimated cost of Alternative 3.

Once the EE/CA is finalized, it will be made available for public comment for 30 days to allow for public comment on the EE/CA and the Administrative Record supporting this EE/CA. Following receipt and evaluation of public comments, NPS will prepare an Action Memorandum. The Action Memorandum, as the decision document selecting a NTCRA, summarizes the need for the removal action, identifies the selected action, provides the rationale for the action, and addresses significant comments received from the public, including those received from other jurisdictions (e.g., states, tribes, USEPA).

1. Introduction

The purpose of this section is to describe the National Park Service (NPS) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) authority and the purpose of the Engineering Evaluation/Cost Analysis (EE/CA) Report.

This EE/CA Report has been prepared to evaluate the nature and extent of contamination at the Mather Former Waste Disposal Area (FWDA) Site (the Site; see Figure 1), evaluate removal alternatives, and provide the basis for recommending a non-time-critical removal action (NTCRA) for the Site located at Yosemite National Park (the Park) in the state of California. The Site is in the northwest portion of Yosemite National Park, approximately 200 feet south of Hetch Hetchy Road, 1.25 road miles northeast of the Hetch Hetchy Entrance (Figure 1). The Site was formerly used as a quarry which supplied granite blocks for Park construction projects. The quarry was subsequently used as a waste disposal area where waste was disposed and burned, between approximately 1941 and 1970 (NPS, 2003).

1.1. National Park Service CERCLA Authority

The NPS is authorized under CERCLA, 42 United States Code (USC) Section 9601 et seq., to respond as the lead agency to a release or threatened release of hazardous substances, or a release or threatened release of any pollutant or contaminant that may present an imminent and substantial danger to public health or the environment, on NPS-managed land. Section 104(b) of CERCLA, 42 USC Section 9604(b), authorizes NPS to conduct investigations and other studies to characterize the nature and extent of a release or threat of release, determine if response is necessary to protect public health or welfare or the environment, and evaluate response alternatives. Section 104(a) of CERCLA, 42 USC Section 9604(a), authorizes NPS to select and implement a response action when NPS determines a response is necessary.

CERCLA's implementing regulations, codified in the National Oil and Hazardous Substances Pollution Contingency Plan, commonly called the National Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300, establishes the framework for responding to such releases and threatened releases. The NCP authorizes and describes two processes for responding to releases: (1) a removal action process and (2) a remedial action process (see NCP Sections 300.400 through 300.440). Based on preliminary investigations at the Site, NPS determined that Site conditions warranted additional response to address the release or threatened release of hazardous substances and that a NTCRA is appropriate at the Site as specified in 40 CFR Section 300.415(b). This determination was formalized in an EE/CA Approval Memorandum and included in the Administrative Record for the Site.

This EE/CA Report was generated in accordance with CERCLA Section 104(b) and the NCP, 40 CFR Section 300.415(b)(4)(i), the U.S. Environmental Protection Agency (USEPA) *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (USEPA 1993a), and the U.S.

Department of the Interior (USDOI) Environmental Compliance Memorandum (ECM) 16-3 (USDOI 2016).

1.2. EE/CA Purpose and Organizational Structure

This EE/CA Report is organized by the following topical headings, which also represent the overall objectives of the EE/CA:

- Characterize the nature and extent of contamination at the Site and conduct human health and ecological risk assessments (Sections 2 and 3).
- Identify applicable or relevant and appropriate requirements (ARARs) (Section 4).
- Develop removal action objectives (RAOs) and preliminary removal goals (PRGs) (Section 5).
- Identify and analyze potential removal action alternatives (Section 6).
- Conduct a comparative evaluation of the removal action alternatives (Section 7).
- Recommend a removal action alternative (Section 8).

1.2.1. Impact of NPS-Specific Requirements and Policies on EE/CA Development

The NPS has several requirements and policies that must be satisfied when undertaking a response to the release of hazardous substances, or pollutants or contaminants, on NPS-managed land (see NPS 2015), including the NPS Organic Act of 1916 (Organic Act) (54 USC Sections 100101et seq.; 36 CFR Chapter 1, Part 1), which requires that the NPS manages parks to conserve the scenery, natural and historic objects, and wildlife and provide for their enjoyment by such means as will leave them unimpaired for the enjoyment of future generations. In accordance with this mandate, NPS strives to clean up contaminated sites with long-term, comprehensive solutions that do not rely on post-removal site controls (PRSCs) to the maximum extent practicable.

This EE/CA Report will be the basis for selecting what is intended to be a final, permanent response action to address human health risk, ecological risk, and ARARs at the Site. Consequently, in accordance with NPS policy this EE/CA Report includes a baseline human health risk assessment (HHRA), a screening-level ecological risk assessment (SLERA), and a simple baseline ecological risk assessment (BERA).

1.2.2. Park-Specific Considerations during EE/CA Development

This document has been prepared in accordance with the Yosemite National Park Agreement (Agreement) (Docket HWCA: P1-99/00-006) effective date March 6, 2001, between the CalEPA

Department of Toxic Substances Control (DTSC) and the NPS. Pursuant to the terms of the Agreement, this document is intended to comply with the requirements of CERCLA Sections 104 and 120 and of the State of California Hazardous Waste Management Program, which is codified in Chapter 6.5 of Division 20 of the California Health and Safety Code. The DTSC is authorized to administer the state's Hazardous Waste Management Program in lieu of the federal hazardous waste management requirements of the Resource Conservation and Recovery Act (RCRA), 42 USC Section 6901, et. seq.

2. Site Description, Investigation Results, and Conceptual Site Model

The purpose of this section is to provide information on the nature and extent of contamination and the physical characteristics of the Site and to present the conceptual site model (CSM) so that the source and fate and transport of contamination and potential exposure of human and ecological receptors is understood.

This section includes a summary of Site features, operational history, historical sources and releases of contaminants, the specific hazardous substances released at the Site, and other factors that influence contaminant migration such as hydrogeology, hydrology, climate, extent of contaminants in Site media, and contaminant transport pathways and behavior. All these elements contribute to the development of the CSM, which is presented in Section 2.12.

2.1. Site Description

The Site is in the northwest portion of Yosemite National Park, approximately 200 feet south of Hetch Hetchy Road, 1.25 road miles northeast of the Hetch Hetchy Entrance (Figures 1 and 2). The Site is located at approximately N 37º54'07", W 119º50'09". Based on previous investigations of the Site, the Site is approximately 0.5 acres, and is at an elevation of approximately 5,000 feet above mean sea level (Shaw Environmental, Inc. [Shaw], 2010). The Site is centered in a local low area, with a vegetated slope leading down from Hetch Hetchy Road to the north, and sparsely vegetated rock outcrop highlands to the to the east and south. A gully or seasonal streambed that appears to drain surface water runoff from the Site leads away from the Site to the west (Figure 3).

The Site is in an area of pine, black oak, and cedar woodland. Manzanita plants are also prevalent in the understory at the Site and in the vicinity. The Site itself is for the most part sparsely vegetated with manzanita and grasses, with bare sandy and gravelly soils present at the ground surface in much of the area, along with numerous granitic boulders. Pieces of refuse, such as glass, metal, and ceramic fragments, are visible at the Site surface. An abandoned dirt road, now partially overgrown with low vegetation, leads from Hetch Hetchy Road to the Site.

2.2. Site History

2.2.1. History of the Site Vicinity

The first human occupants of the Park were present at least 3,000 to 4,000 years ago. Native American tribes that occupied the northern portion of the park included the Central and Southern Sierra Miwok tribes. The Central Sierra Miwok maintained settlements in the Hetch Hetchy Valley. The Mono Paiute tribe were based on the eastern slopes of the Sierra within the Park, and inhabited the Hetch Hetchy valley and surrounding highlands. Other groups, such as the Washo and Yokut tribes, also lived in or visited the areas now incorporated in the Park (Greene, 1987).

Early mentions of visitation to the Site vicinity by settlers of European descent to the Hetch Hetchy Valley date to the 1850s and 1860s. Joseph Screech was reported to have been the first visitor of European descent to Hetch Hetchy Valley, reportedly arriving in 1850. An 1868 guidebook by J.D. Whitney describes a route to the valley that began via the Big Oak Flat trail, one of the early trails established for access to the area that would become the Park. The valley was first surveyed by the U.S. government in 1879 (Greene, 1987).

2.2.2. Site Operational History

The Site is located near the O'Shaughnessy Dam, which creates the Hetch Hetchy Reservoir. The dam was constructed by the City of San Francisco to provide a water supply to the city; this reservoir continues to provide water to millions of residents of the San Francisco Bay area to the present. The Hetch Hetchy Road was constructed in 1914-1915, during the initial construction phase of the dam, and was used as a road and/or rail line to connect the town of Mather (near the current location of Camp Mather, see Figure 1) with the settlement at the dam site. The route was used by City of San Francisco workers supplying dam construction work (which continued through 1938) and dam maintenance work, and by NPS rangers, staff, and trail maintenance crews, some of whom lived in Mather or at the dam site (Greene, 1987).

The Site was originally used as a quarry, a conclusion made based on evidence such as the presence of drilled holes and granite rubble that is present in the rock at the southern area of the Site, and the low-lying shape of the ground surface in these areas, suggesting removal of soil and rock material. Quarried granite removed from the Site was likely used for projects related to construction along the Hetch Hetchy Road. The Site quarry was subsequently used as a waste disposal area. During environmental sampling activities conducted in 2001 and 2008 at the Site, debris such as porcelain, metal, glass, rusted cans, batteries, and other waste materials, along with evidence of burned debris, was noted on the Site (Shaw, 2010). Dumped refuse materials may be a source of a wide variety of contaminants, including metals, petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), and other contaminants. Burning of refuse may generate PAHs, dioxins, furans, and other contaminants. Photographs of Site conditions are provided in Appendix A.

An NPS archeological report from 2003 described a detailed investigation of the nature of the refuse present at the Site that was conducted concurrently with the initial environmental investigation of the Site in 2001. This investigation indicated that the refuse fragments present at the Site were dominated by food and beverage containers and other types of domestic refuse. Age determination of these materials indicated that the Site was likely used for waste disposal between approximately 1941 and 1970. Refuse from the southern portion of the Site was likely accumulated between 1941 and 1952, with the likely source deemed to be local households (such as those established by NPS or City of San Francisco workers in Mather or at the dam site). Refuse from the northern portion of the Site dated to between 1959 and 1970, with the likely source deemed to be NPS trail crews or other work crews (NPS, 2003).

2.3. Historically and Culturally Significant Features

Refuse present at former waste disposal area sites such as the Site may provide information about the changing habits of consumption by park staff and visitors through the period of their use. As such, some waste disposal area sites in Yosemite are identified as culturally significant places. As part of the archeological study of the Site conducted in 2003, NPS made the determination that further archeological investigation of the waste materials present at the Site was not necessary, and no further archeological or historical investigations of the Site are known to have been conducted (NPS, 2003).

The surrounding area contains other culturally significant features. The Tuolumne River, designated as a National Wild and Scenic River, is located approximately 0.5 miles north of the Site.

2.4. Waste Characteristics

A wide variety of materials were present among the refuse material present at the Site. Most items that could be identified were domestic materials, such as glass or metal food and beverage storage containers, fragments of ceramic food service pieces, or other materials. Structural items such as nails, brick and cinder block fragments, and other hardware were also recovered. Transportation-related waste materials, which might be more clearly identified as sources of environmental contaminants, were relatively rare, though a can of automotive touch-up paint, a brake fluid can, and an engine valve were identified. A small number of tools or related materials were identified, including battery cores and pieces of an electric motor (NPS, 2003). These wastes may serve as the source of a number of contaminants, such as metals (from paint, paint and metal fragments, and battery cores), petroleum hydrocarbons, and PAHs (from automotive chemicals and fluids). Notably, a small area of soil containing a “black, oily substance” with elevated concentrations of petroleum hydrocarbons was observed in the northern investigated area of the Site (Shaw, 2010).

Evidence of waste burning was observed in both the upper and lower portions of the Site, with layers of ash present in test pits TP02 and TP05 (Figure 3; Shaw, 2010). Waste burning can generate contaminants, including PAHs and dioxins and furans (Centers for Disease Control and Prevention [CDC], 2021).

2.5. Geology and Hydrogeology

2.5.1. Regional and Local Geology

According to geologic maps of the Site, the surficial geologic deposit at the Site consists of the Sierra Nevada granitic batholith, specifically within the Cretaceous Bald Mountain Granite shown on the United States Geological Survey Lake Eleanor quadrangle (Dodge and Calk, 1987). While the Hetch Hetchy valley was originally carved by a river, it was expanded to near its current extent by the glaciers of the Sherwin Glaciation, which occurred approximately 1.3 to 1.0 million years ago. This glaciation, and the subsequent Tahoe and Tioga glaciations, were one of the primary forces that shaped the Park's landscapes (Huber, 1987).

Soils encountered at the Site during previous field investigations indicated rocky soil material in a silty sand matrix. The materials are primarily granitic in origin with lesser amounts derived from metamorphic rocks. Bedrock at the Site was not encountered during previous investigations, although it is present in former quarry walls adjacent to the waste disposal area and in massive granite ledges present in the highlands to the east and south of Site (Shaw, 2010). In these areas, bare rock is commonly observed at the ground surface, with no soil present.

2.5.2. Hydrogeology

No Site-specific hydrologic investigations have been conducted at the Site or in its vicinity. No surface water, groundwater, or evidence of ponding were observed at the Mather waste disposal area during the field investigation conducted in August, 2001, and the Site is not located within a floodplain. No groundwater wells exist within or near the boundaries of the Site; therefore, depth to groundwater is unknown at the Site. The Site is in an area of moderate slopes, and the topography of the Site suggests that groundwater is not close to the surface (Shaw, 2010).

Given the limited thickness or complete lack of soils and other unconsolidated surficial materials in many locations within the Site vicinity, most groundwater in this area, if present, likely exists in jointed and fractured bedrock aquifers within the granitic bedrock that underlays the area. The nearest drinking water well, located near the Hetch Hetchy Entrance Station, draws water from primarily granitic bedrock at depths greater than 60 feet below ground surface (bgs).

A spring is documented in USGS topographic maps approximately 0.45 miles north of the Site, on the south wall of the Tuolumne River valley, at an elevation of approximately 3,600 feet.

Groundwater Use

The nearest drinking water well to the Site is located near the Hetch Hetchy Entrance Station, approximately 0.7 miles southwest of the Site. The total depth of this well is 700 feet bgs and is sealed from the ground surface to 60 feet bgs.

2.6. Site Surface Water

The Tuolumne River, located approximately 0.5 miles north of the Site, is the closest major permanent surface water feature. The Tuolumne River is designated as a Wild and Scenic River. The Tuolumne flows into the Don Pedro Reservoir near La Grange, California. Water from the Don Pedro Reservoir is primarily used for irrigation of lands in the vicinity of Turlock and Modesto, California. The New Don Pedro Dam, which forms the reservoir, is used to generate hydroelectric power. Water from the Reservoir provides a portion of the drinking water supply for the city of Modesto, California (Don Pedro Recreation Agency, 2021).

While no surface water was observed at the Site during field sampling efforts, and no perennial surface water features are identified within 0.5 miles of the Site, an ephemeral or seasonal drainage system was observed at the Site during previous investigations (Shaw, 2010). Surface water from heavy rainfall events or snowmelt likely accumulates in this drainage. The approximate pathways of this seasonal drainage are shown in Figure 3, along with arrows indicating the direction of apparent surface water runoff at various locations surrounding the Site. A review of topographic maps suggests that the seasonal drainage at the Site flows away from the Site to the west. This drainage continues under Hetch Hetchy Road, then turns to the south and joins with an intermittent stream located approximately 0.2 miles south of the Site. Approximately 1.25 miles from this point, this intermittent stream flows into the Tuolumne River.

2.7. Local Climate

According to climate data from a weather station located near the Hetch Hetchy Reservoir, the Site vicinity is subject to hot, dry summer months and wet, cool winter months. Most precipitation at the Site falls between December and March when the average monthly total precipitation is 5-6 inches. A portion of this precipitation falls as snow, and accumulated snow may be present on the ground at the Site during these months. Average high temperatures during these months range from 48 to 57 degrees F; average low temperatures range from 29 to 33 degrees F. Conversely, little or no precipitation falls in the months of June to September, less than one inch per month on average. Average high temperatures during these months range from 78 to 86 degrees F; average low temperatures range from 50 to 56 degrees F (Western Regional Climate Center, 2021).

2.8. Ecological Setting

The Site is in an area of ponderosa pine, black and live oak, and incense cedar woodland. Greenleaf and whiteleaf manzanita plants are also prevalent in the understory at the Site and in the vicinity. Much of the Site is sparsely vegetated, with sandy and gravelly soils present at the ground surface, along with numerous granitic cobbles and boulders. As noted above, no areas of standing surface water were observed at the Site during previous investigations.

2.8.1. Special Status Species

According to NPS, approximately 40 animal species with special status are known to occur in the Park, including both Federal and California Endangered, Threatened, and Protected Species, or those of Special Concern (NPS, 2020). A review of the U.S. Fish and Wildlife Service's Information, Planning, and Conservation System for endangered and threatened species identified the following endangered or threatened species that may be present in the Site vicinity (Harris Environmental Group, 2020). These included:

- Pacific fisher (*Martes pennanti*) – Federal Endangered Species, California Threatened Species
- California red-legged frog (*Rana aurora draytonii*) – Federal Threatened Species
- Sierra Nevada yellow-legged frog (*Rana sierrae*) – Federal Endangered Species, California Threatened Species
- Yosemite Toad (*Anaxyrus canorus*) – Federal Threatened Species, California Species of Concern

Further detail regarding Endangered and Threatened species that may occur at or near the Site is provided in NPS (2014). California red-legged frogs rarely occur above 3,500 feet, while Sierra Nevada yellow-legged frogs are not known to occur in the Park. The Yosemite toad is observed in habitats above 7,000 feet. Therefore, these species are not expected to be present at the Site. While no California-designated endangered or threatened species are known to be present at the Site, those that may potentially be present in the Site vicinity include the Great gray owl (*Strix nebulosi*, California endangered). This species prefers montane meadows surrounded by white or red fir forests located at 4,000 to 8,000 feet in elevation, a description matching the Site in elevation but not in habitat type (NPS, 2014). While information in NPS (2014) suggests that Pacific fisher populations are limited to the southern area of the Park, recent evidence suggests that this range has expanded to include the northern area of the Park (personal communication, Dr. Greg Stock, NPS, April 2021).

During previous investigations of the Site, NPS staff conducted inspections of the Site, and determined that no threatened and endangered plants are present at the Site (Shaw, 2010). NPS plans to conduct additional surveys of the Site vicinity for the presence of special status and invasive species prior to completion of the removal action and to specify mitigations for avoidance or soil/seed salvage for any plants found.

2.9. Sensitive Environments

2.9.1. Terrestrial Sensitive Environments

National Parks and Wilderness Areas

National Parks are considered sensitive environments, as they protect areas of unique natural, historic, or cultural values. Federally designated Wilderness Areas are considered sensitive environments, as they are intended to preserve areas of undeveloped, wild landscapes from human influences. As the entirety of the Site is located within both Yosemite National Park and the Yosemite Wilderness, the Site and its terrestrial surroundings are considered as a sensitive environment.

Wetland Areas

Wetlands are sensitive ecosystems that may be home to a diverse range of plants, animals, and other organisms, and as such, are considered sensitive environments. The nearest wetland to the Site is an intermittent stream located approximately 0.2 miles to the south. The U.S. Fish and Wildlife Service classifies this wetland as a Riverine, Intermittent, Streambed, Temporarily Flooded area based on the Cowardin classification system (Harris Environmental Group, 2020). This intermittent stream runs 1.25 miles to the southwest and north before flowing into the Tuolumne River. Based on a review of the topography around the Site, runoff from the Site flows into a small intermittent wash or creek bed south and west of the Site. Over the course of approximately 0.25 miles, this creek bed leads west from the Site, runs under Hetch Hetchy Road, and turns south before joining with this intermittent stream wetland.

2.9.2. Aquatic Sensitive Environments

Wild and Scenic Rivers

The Tuolumne River, located approximately 0.5 miles north of the Site, is a Federally-designated Wild and Scenic River. Approximately 55 total river miles of the river, from its headwaters in the alpine areas of the Park to the western Park boundary (excluding the Hetch Hetchy Reservoir and the area within 500 feet of the O'Shaughnessy Dam), fall under this designation. While the Site does not lie within the river corridor as defined as the area within 0.25 miles of the river by the Tuolumne River Management Plan (NPS, 2014), the Site is located in proximity to the Poopenaut Valley segment of the river, which has been assessed the "Wild" classification.

2.10. Previous Investigations and Response Actions

2.10.1. Summary of Previous Investigations

The Facility Investigation Report prepared by Shaw Environmental, Inc. (formerly the IT Corporation) in 2010 summarizes results and findings from a Focused Site Inspection (FSI) conducted at the Site in 2001 and a Facility Investigation Report (FIR) conducted at the Site in 2008. This report is provided in Appendix B.

In 2001, IT Corporation (IT) conducted an FSI at the Site (IT, 2002). This FSI included collection of soil samples from four test pits (TP01, TP02, TP04, and TP05; see Figures 3, 4, and 5 for locations of test pits and soil samples collected from each test pit). TP01 and TP02 were placed in a lower or southern sampling area which, based on the presence of granite rubble and walls that showed evidence of blasting, had been previously used as a quarry. Surface refuse and evidence of burning of wood and/or waste (charcoal and ash at the ground surface) had been noted on visual inspection in this area. TP04 and TP05 were located upslope of this area, nearer to Hetch Hetchy Road, based on historical photos that showed dumping of refuse materials in this area. In addition, soil samples were collected from three locations identified as up-gradient of the suspected waste disposal areas for background analysis, and from three locations within a seasonal drainage leading away from the Site, for evaluation of contaminant migration.

Refuse materials were identified in subsurface soils in test pits TP02 and TP05. At TP02, waste was noted to be present from the surface to 6 feet bgs (at which depth refusal on large boulders was encountered), and from the surface to 4.5 feet bgs at TP-05. Thin layers of ash, indicative of burning, were also identified in each of these test pits at approximately 1 foot bgs. An area of "black, oily material" was observed in the northern margin of the TP05 pit, at approximately 1 to 1.5 feet bgs. After TP05 was excavated to its illustrated extent, the backhoe was used to dig one-foot deep trenches in a radial pattern outward from the test pit until a debris-free zone was encountered. The areal extent of the debris surrounding TP05 was found to be approximately 20 feet in diameter.

Soil samples collected from these test pits were analyzed for one or more of the following: California Title 22 metals (also known as the California Assessment Manual 17 Metals, or CAM17), hexavalent chromium, petroleum hydrocarbons, PAHs, and dioxins/furans. Metals and petroleum hydrocarbon analyses were completed for most samples; other analyses were completed selectively. PAHs were not analyzed in samples with elevated concentrations of TPH, and dioxins and furans were measured only in two biased soil samples collected from thin layers of ash-rich soil observed in TP02 and TP05. Results of sample analyses indicated that metals such as arsenic and lead, PAHs including benzo(a)pyrene and dibenz(a,h)anthracene, diesel and heavy oil range total petroleum hydrocarbons (TPH), and dioxins/furans were detected at concentrations exceeding the 2008 USEPA Regional Screening Levels (RSLs) for Residential Exposure established at that time. Downgradient soil samples collected from the seasonal drainage leading away from the Site did not contain significantly elevated concentrations of these Site contaminants. Further detail regarding the findings of this investigation are provided in Section 2.10.2 below (IT, 2002).

A report summarizing the findings of the 2001 FSI was submitted to NPS and DTSC for review. Based on comments from DTSC, additional sampling was determined to be required to characterize contamination at the Site.

In 2008, Shaw Environmental (formerly IT Corporation) mobilized to the Site to collect additional soil samples as part of a FIR to address DTSC comments on the 2001 FSI. During this mobilization, four step-out test pits (YWM06, YWM07, YWM08, and YWM09) were excavated around the locations of 2001 test pits TP02 and TP05 to better define the extent of subsurface debris (see Figures 4 and 5 for approximate test pit locations). No subsurface debris was observed in any of these test pits, except for minor debris items in YWM08. Surface debris was observed in all test pits, and its extent was not characterized during the 2001 and 2008 investigations. Soils in the former locations of test pits TP02 and TP05 were resampled in 2008, in test pits YWM02A and YWM05A. Ten additional background samples were collected, from hand-dug test pits YWM101 through YWM110.

Soil samples collected from these test pits were analyzed for one or more of the following contaminant groups: volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), gasoline, diesel, and heavy oil range TPH, PAHs, polychlorinated biphenyls (PCBs), and CAM17 metals. No additional dioxins/furans analyses were completed, nor were any analyses of PAHs in samples containing elevated concentrations of TPH. Samples collected from these step-out test pits in the area of TP05 contained heavy oil range TPH and PAHs at concentrations in exceedance of USEPA RSLs, while those collected from YWM08 contained lead at concentrations in exceedance of these screening levels. Further detail regarding the findings of this investigation are provided in Section 2.10.2 below.

Shaw performed an evaluation of the data collected in 2001 and 2008 to determine the likelihood that inorganics measured in soil were related to releases at the Site. According to the report, aluminum, beryllium, selenium, and vanadium were present at background levels, based on comparisons to concentrations of these metals in background soil samples. Magnesium, potassium, silver, and sodium were determined to be unlikely to be related to Site activities based on a geochemical evaluation. Concentrations of arsenic are known to be present at high concentrations in the Park and its vicinity, due to the relatively elevated concentrations of arsenic in the granitic bedrock that is the source material for these soils. Shaw noted that while some of the soil samples collected at the Site contained concentrations of arsenic that may be determined to be Site-related based on comparison to arsenic concentrations in background samples collected at the Site, all arsenic concentrations measured in Site soil samples are below or within the range of background arsenic concentrations for Tuolumne County. Therefore, the arsenic detections at the Site were considered likely to be a result of variation within the range of natural background concentrations.

Human health and ecological risk assessments were performed by Shaw using the data collected in 2001 and 2008. Shaw identified human receptors likely to be present at the Site as park workers and hikers and did not find unacceptable risk for these receptor groups. In the ecological risk assessment, Shaw identified potential concerns using food chain assessments for terrestrial wildlife indicator species, including the dusky shrew and the American robin. However, by adjusting the toxicity reference value (TRV) uncertainty extrapolation factors from a conservative factor (10) considered by Shaw as likely to be overly conservative to a factor considered likely to be more realistic (1.0), these concerns were abated. Assessment of direct contact exposure risk to terrestrial invertebrates and plants also determined potentially unacceptable exposures for these groups, however, Shaw stated that due to the small size of the Site (approximately 0.5 acres) as established by data included in the FIR, these exposures were unlikely to be ecologically significant. To conclude, Shaw suggested that while both human and ecological exposure risks at the Site were not deemed to be unacceptable or significant, limited areas of soil removal should be completed in the area where oily material had been identified in test pit TP05, and in the area where elevated concentrations of lead had been identified in test pit YWM09, in order to "further reduce the already low risk associated with this Site" (Shaw, 2010).

2.10.2. Data Summary

Samples collected from TP02 during the 2001 sampling contained elevated concentrations of barium, cadmium, chromium, copper, lead, zinc, and other metals, with lead concentrations exceeding the USEPA Regional Screening Level (RSL) for Residential Soil exposures. Arsenic was present above the USEPA RSL in all samples, including background samples. Apart from arsenic, other metals were present at relatively low concentrations in TP05. Benzo(a)pyrene and dibenz(a,h)anthracene were detected in samples collected from TP02; samples from TP05 were not tested for PAHs. Dioxins and furans (evaluated as the 2,3,7,8-tetrachlorodibenzodioxin [TCDD] toxic equivalency [TEQ]) were detected at a concentration above the USEPA RSL in a soil sample collected from TP02 that was targeted to contain ash material; the TEQ concentration in a soil sample collected from TP05 that was targeted to contain ash material were significantly lower. Concentrations of diesel and heavy oil range total petroleum hydrocarbons (TPH) were highly elevated, over 80,000 milligrams per kilogram (mg/kg), in soil samples collected from the area of soil identified in TP05 to contain oily material. No evidence of waste material or soil contamination was observed in TP01 or TP04.

Data from soil samples collected during the 2001 FSI (IT, 2002) with both hexavalent and total chromium results are summarized in Table 2. Samples analyzed for hexavalent chromium include three background soil samples collected from one foot bgs (sample locations UG01-UG03), six soil samples collected from test pits TP01 through TP05 from depths of one to six feet bgs, and three soil samples collected from one foot bgs in the seasonal drainage leading down-gradient from the Site (sample locations DG01 through DG03; IT, 2002). Hexavalent chromium was not detected in any of these samples (detection limits were 0.50 to 0.53 mg/kg); total chromium was detected in all samples tested for hexavalent chromium, at concentrations of 1.7 to 36.4 mg/kg. (Table 2),

In the 2008 investigation, test pit locations were selected with the intent of defining the extent of subsurface refuse material and the contamination associated with refuse. Samples collected from test pits YWM06 and YWM07, "step-out" test pits from TP05, contained heavy oil range TPH and/or PAHs (benzo(a)pyrene and dibenz(a,h)anthracene) at concentrations in exceedance of USEPA RSLs or other screening levels in surficial soil, subsurface soils did not contain elevated concentrations of these contaminants. Test pits YWM06 and YWM07 did not contain significant subsurface refuse. Resampling of the oily material in the former TP05 location confirmed elevated concentrations of diesel and heavy oil range TPH in this material. While no subsurface refuse material was observed in test pits YWM08 and YWM09, elevated concentrations of metals were observed in soil samples collected from YWM09, with lead concentrations well in exceedance of the USEPA RSL (as high as 9,980 mg/kg, at 2.5 feet bgs). Low concentrations of SVOCs, which were not tested for in 2001, were detected in samples near TP02, but were not detected in samples collected near TP05. Surface and near surface samples collected from test pits YWM08 and YWM09 contained bis(2-ethylhexyl)phthalate (BEHP) at concentrations below USEPA RSL, while a sample of surface soils near TP02 contained pentachlorophenol at a concentration below the USEPA RSL (Shaw, 2010).

Table 1 presents the analytical results from the 2001 and 2008 soil investigations (IT, 2002; Shaw, 2010) in comparison to human health and ecological risk assessment screening levels used in the risk assessment conducted as part of this EE/CA (Appendix C). Locations of samples shown in Figures 4 and 5 are approximate. GPS data points were provided by Shaw (2010) only for the 2008 test pit locations. Locations of test pits as provided by Shaw in the maps included with the 2010 FIR (Shaw, 2010) are adjusted in the Figures for this EE/CA based on field photographs from the FIR that show the test pit locations, cross-referenced with observations from a visit to the Site conducted in October 2020.

2.10.3. Previous Cleanup Actions

During the 2008 sampling activities conducted by Shaw Environmental at the Site, apparent battery cores that were observed at the Site on the ground surface were removed by NPS (Shaw, 2010). No other response or removal actions have been conducted at the Site.

2.11. Site Contaminants

2.11.1. Media and Contaminants of Concern

The environmental medium of concern at the Site is soil. The FIR prepared by Shaw (2010) describes soil sampling activities conducted to date at the Site. This sampling has shown the presence of PAHs, metals, TPH, and dioxins/furans at the Site at elevated concentrations. Identification of contaminants of potential concern (COPCs) and contaminants of potential ecological concern (COPECs) are discussed in Sections 3.1 and 3.2, respectively. Project screening levels are presented in Table 1 and Appendix C.

2.12. Site-Specific Contaminant Fate and Transport

Observations collected during previous Site investigations suggest that the source of contaminants observed at the Site is disposal of refuse materials, including solid materials such as those observed at the Site, and other materials that may have degraded since their disposal at the Site. These refuse materials, once placed in the environment, have over time begun to break down, releasing contaminants into the surrounding soils. This process is one of the primary sources of metals, petroleum, and other observed contaminants at the Site. Burning of materials, believed to include refuse and “slash” (cut brush and timber from trail and road maintenance; NPS, 2003) is a process that was conducted at the Site that has also contributed to Site contamination, both in terms of accelerating the breakdown of refuse at the Site, and creating contaminants that may not have been present in the dumped materials (including dioxins/furans and PAHs).

The primary contaminant groups present in Site soil—metals, dioxins/furans, PAHs, and heavy oil range TPH—are all considered to be relatively immobile in soil. Lead and other similar heavy metals encountered at the Site are generally insoluble and immobile in most natural soils, due to sorption on alumnosilicate (i.e., clay) or iron oxide mineral surfaces, both of which occur commonly in soils formed from the breakdown of granitic rock, or by formation of precipitates (ITRC, 2017; Evanko and Dzombak, 1997). PAHs are typically water insoluble and do not readily migrate through soils (ITRC, 2017). Dioxins/furans sorb readily to soil material and once adsorbed are typically not remobilized by natural processes (AEA Technology, 1999).

At the Site, contaminants are encountered in unsaturated soils. No evidence of perennial surface water was observed during previous visits to the Site, and samples of soil collected from seasonal drainage pathways down-gradient of the Site did not contain elevated concentrations of Site contaminants (Shaw, 2010). Therefore, distribution of Site contamination by surface water migration is not considered likely to be occurring.

No evidence of groundwater was observed in test pits excavated at the Site (Shaw, 2010). No activities aimed at determining the depth to groundwater, or the nature of its occurrence in the Site vicinity, have been conducted. Groundwater in the Site vicinity most likely occurs in fractures, joints, or other spaces within the primarily granitic bedrock that underlays the Site. Migration of contaminants from Site soil to groundwater is not considered likely due to the low mobility of the contaminant types present. The nearest groundwater well to the Site, which represents the most likely pathway for exposure for human receptors in groundwater, is located 0.7 miles southwest of the Site, and takes in water at depths greater than 70 feet bgs. Based on the distance separating the Site and this well, and the depth range that this well draws upon, it is considered highly unlikely that contamination in soil at the Site may reach human receptors via this exposure pathway.

2.13. Current/Future Land Uses

The Site is located within the Yosemite Wilderness. According the Park’s Wilderness Management Plan, in Yosemite Wilderness areas, NPS “seeks to preserve an environment in which the natural world along with the processes and events that shape it are largely untouched by human interference”. In the Plan goal statement, it is noted that ecosystems are to be protected in a natural state, free from human disturbances and technology (NPS, 1989). Therefore, the Site’s present and future use is and will be to exist as part of this wilderness area, without human development or interference.

2.14. Conceptual Site Model

Figures 6 and 7 present the CSM for human and ecological exposure risks. These figures display the potential exposure pathways for ecological receptors at the Site. The CSM summarizes the current understanding of how chemical contaminants have been released to the environment, have migrated, and have resulted in exposure to human and ecological receptors. The main features of this CSM and the rationale for the decisions made regarding which receptors and pathways are identified for risk quantification in the risk assessment are discussed below.

2.14.1. Sources of Contamination

As described in Section 2.2.2 above, the Site was formerly used as a waste disposal area. Waste materials disposed of at the Site, which remain in the Site soil, are associated with contamination in surficial and subsurface soil. Contaminants detected at elevated concentrations in Site soil include PAHs, metals, heavy oil-range TPH, and dioxins/furans. PAH and dioxin/furan contamination may also be attributed to burning of waste at the Site. Site soils containing elevated concentrations of these contaminants may serve as a secondary source of contaminants.

2.14.2. Key CSM Assumptions

The following key assumptions, drawn from the Site information presented in the subsections of Section 2 above, are used in creating the Site CSM:

- Surface water is not typically present at the Site, and when present, it is not typically present in large bodies that humans or ecological receptors may be exposed to. Samples of soil collected from dry surface water runoff channels do not indicate significant contaminant transportation by surface water. Therefore, surface water exposure pathways are not considered as potential exposure pathways for human or ecological receptors, and aquatic receptors are not considered as an ecological receptor group.

- As noted in Section 2.12 above, Site contamination is considered unlikely to have reached groundwater. In the unlikely case that groundwater has been affected by Site contamination, based on the distance separating the Site and the nearest drinking water well (0.7 miles), and the depth range that this well draws upon (below 70 feet bgs), it is considered highly unlikely that Site contamination may reach human receptors via groundwater exposure pathways. Therefore, human exposures to groundwater contaminated by the Site are considered incomplete pathways. The Site is located approximately 0.5 miles from the nearest perennial surface water body, the Tuolumne River, and is present at an elevation approximately 1,500 feet above this river, separated by granitic bedrock. No surface water springs or seeps are documented at the Site. The nearest spring is located approximately 0.45 miles north of the Site, at an elevation of approximately 3,600 feet. Given the vertical and lateral distance separating the Site and this spring, it is considered highly unlikely that Site-related contamination has reached groundwater and is present in the water discharging from this spring. Based on this information, exposure of ecological receptors to groundwater via connection to the Tuolumne River, or by exposure to spring or seep water, is also not considered as a potential complete pathway.

- Most human receptors, including Park workers and visitors, will be conducting activities that will expose them only to surficial soils. For human exposures at the Site, surface soils are defined as soils from 0 to 6 inches bgs. Subsurface soil exposures are not considered for park visitors as they are not expected to conduct any activities involving subsurface soil disturbance at the Site. Workers at the Site that conduct digging activities or other activities that may disturb subsurface soil, which may include Park workers or future Site restoration or remediation workers (construction workers) may be exposed to subsurface soils during these activities.

- Most ecological receptors are exposed to surficial soils, which generally contains the vast majority of biological activity (USEPA 2015b). For ecological exposures at the Site, surface soils are defined as soils from 0 to 6 inches bgs. Burrowing animals and invertebrates, deeper-rooted terrestrial plants, and select other ecological receptor groups may also be exposed to subsurface soil. Therefore, subsurface as well as surface soil exposures are considered for ecological receptor groups.

- No significant volatile organic compound contamination was found in soils at the Site, therefore, pathways involving volatilization are not considered as potential complete exposure pathways for human or ecological receptors.

2.14.3. Potentially Complete Human Exposure Pathways

The Site is in a wilderness area, away from any established hiking trails or other features that may attract park visitors. The Site is located approximately 200 feet south of Hetch Hetchy Road and is accessible from the roadway by an abandoned road or trail, however, no maintained or frequently used trails to the Site from the roadway area exist. According to NPS, neither Park staff nor Park visitors typically visit the Site on a regular basis (personal communication, G. Stock, NPS, 10/19/2020). NPS employees could visit the Site as part of occupational activities under both current and future conditions. Although no construction activities are planned at the Site, restoration projects or construction activities could occur in the future; thus, a future Park worker scenario and construction scenario are evaluated. While no visitors are understood to typically frequent the Site area, it is open to human use for activities such as hiking and picnicking. Therefore, Site or Park visitor receptor exposures are evaluated. Site visitor receptors are assumed to consist of young children (less than 6 years old), older children (6 to 16 years old), and adults (greater than 16 years old).

For current human receptors, the most plausible potential exposure routes identified by the CSM include the following:

- Incidental ingestion of surface soil – all human receptors
- Incidental ingestion of subsurface soil – future Park and construction worker
- Dermal (direct) contact with surface soil – all human receptors
- Dermal (direct) contact with subsurface soil – future Park and construction worker
- Inhalation of airborne particles from surface soil (dust) – all human receptors
- Inhalation of airborne particles from subsurface soil (dust) – future Park and construction worker

2.14.4. Potentially Complete Ecological Exposure Pathways

The Site is in an area of ponderosa pine, black and live oak, and incense cedar woodland. Numerous species of mammals, birds, plants, and soil invertebrates may be present at the Site and exposed to Site-related contaminants. For the ecological risk assessment conducted as part of this EE/CA, ecological receptors are evaluated as communities and by trophic levels, rather than individual species. Threatened and endangered species have not been documented at the Site (see Section 2.8.1 above). The following groups were considered as part of the ecological risk assessment:

Terrestrial Plants and Soil Invertebrates:

The structure and function of the terrestrial plant and invertebrate community is important because it provides a significant portion of the energy, organic matter, and nutrient inputs for terrestrial systems. Plant communities also provide habitat and forage for a variety of wildlife species. Terrestrial plants and soil organisms are good indicators of soil condition because they reside directly in the soil and are not mobile.

The primary exposure pathway for soil invertebrates is direct contact with (and ingestion of) contaminated soils. For terrestrial plants, the primary exposure pathway is direct contact of the roots with contaminants in soil. Although most terrestrial plants (e.g., ground cover and grasses) and invertebrates would only be exposed to surface soils (0 to 6 inches bgs), it is possible deeper soils could be encountered by plants with deeper roots (e.g., trees) and burrowing soil invertebrates. Therefore, these subsurface soil exposures are also considered potentially complete exposure pathways.

The most plausible ecological exposure pathways identified for these receptor groups include:

- Terrestrial Plants: direct contact with surficial soil is a potentially complete pathway, direct contact exposure from surficial soil dust on leaf surfaces and direct contact with subsurface soil are considered minor pathways.

- Terrestrial Invertebrates: Direct contact and ingestion of surface and subsurface soil and ingestion of terrestrial biota (plants) are potentially complete pathways, inhalation/dust exposure from surface soils and subsurface soil are considered minor pathways.

Mammals and Birds

Birds and mammals may be exposed to Site-related contaminants by two primary pathways: (1) ingestion of contaminants in or on food items and (2) incidental ingestion of soil while feeding or digging. Direct contact (i.e., dermal exposure) of birds and mammals to soil may occur in some cases, and inhalation exposure to volatile contaminants and airborne dusts is possible for all birds and mammals, but these exposure pathways (i.e., dermal and inhalation) are usually considered to be minor in comparison to exposures from ingestion (USEPA 2005b).

The most plausible ecological exposure pathways identified for these receptor groups include:

- Mammals: Ingestion of surface and (for burrowing mammals) subsurface soil and ingestion of terrestrial biota are potentially complete pathways, direct contact and inhalation of dust from surface and (for burrowing mammals) subsurface soil are considered minor pathways.

- Birds: Ingestion of surface soil and ingestion of terrestrial biota are potentially complete pathways, direct contact and inhalation of dust from surface soil are considered minor pathways.

3. Risk Assessment Summary

The purpose of Section 3 is to summarize the results of the human health and ecological risk assessments described in detail in Appendix C.

Risk assessments provide an estimation of the potential threat to human health and the environment posed by Site contaminants. The results of the risk assessment are used to determine if potential risks are unacceptable and, if so, to establish risk-based PRGs that must be satisfied by the recommended removal action. EE/CA guidance (USEPA 1993a) discusses the use of streamlined risk evaluations for an EE/CA when used for interim response actions. However, when the EE/CA is the basis for selecting a final response action, streamlined risk evaluations are not sufficient. Instead, an HHRA and a SLERA are developed for the Site (USDOI 2016). A BERA may be required if the SLERA identifies the need to refine the ecological risk assessment with site-specific or receptor-specific information. In accordance with risk assessment guidance, a baseline risk assessment is to evaluate potential adverse effects caused by hazardous releases from a site in the absence of any actions to control or mitigate these releases (i.e., under an assumption of no action).

A baseline HHRA, SLERA, and a simple BERA were completed for this Site. The detailed risk assessment report is provided as Appendix C. An overview of the risk assessment approach and risk characterization conclusions is presented in Section 3.1 (HHRA) and Section 3.2 (SLERA and BERA) below.

3.1. Baseline Human Health Risk Assessment

The HHRA was prepared according to USEPA guidance on conducting HHRAs at CERCLA sites (USEPA 1989) and DTSC Human and Ecological Risk Office (HERO) guidance for conducting human health risk assessments. The site investigation data used for the risk assessment are those data provided in the FIR conducted at the Site by Shaw Environmental (Shaw, 2010). The FIR is included as Appendix B to this EE/CA, and the data can be found in Tables 4-1 through 4-4 of the Shaw Environmental (2010) report. These data include those gathered during the 2001 Focused Site Inspection conducted at the Site (IT, 2002), and are summarized in Table 1 of this EE/CA Report.

The HHRA includes the following components (described in detail in the HHRA report; Appendix C):

- Hazard identification
- Exposure assessment
- Toxicity assessment
- Risk characterization

3.1.1. Hazard Identification

The COPCs for human health risk assessment were identified by comparing maximum detected concentrations in each media to the lowest appropriate risk-based screening levels, which were identified in NPS guidance (Appendix C). These screening levels are based on a target excess lifetime cancer risk of one in one million ($1/10^6$ or 1×10^{-6}) and a target non-cancer hazard quotient (HQ) of 0.1 based on exposure assumptions derived for a residential exposure scenario. These conservative screening levels ensure that potential contaminants are not prematurely rejected and are carried through the risk assessment and ARARs analysis specific to the Site. Contaminants detected above these screening levels are identified as COPCs and carried forward in the risk assessment. Consistent with guidance, consideration of background concentrations for naturally occurring analytes (i.e., inorganics) is factored into the final selection of Remedial Goals (RGs) in the risk management section.

Table 3 presents the list of COPCs identified for surface and subsurface soil. As shown, human health COPCs were identified for surface soil and subsurface soil for a range of potential contaminant groups, including metals, PAHs, TPH as diesel fuel and motor oil, and dioxin/furans. There are 12 human health COPCs identified for surface soil: antimony, arsenic, cobalt, lead, thallium, zinc, aluminum, iron, manganese, dibenz(a,h)anthracene, TPH as diesel (TPH-D), and TPH as motor oil (TPH-O). There are 13 human health COPCs identified for subsurface soil. The list of human health COPCs is the same as for surface soil, but with the addition of cadmium, mercury, and dioxins/furans (as TEQ), and the removal of zinc.

3.1.2. Exposure Assessment

The HHRA estimates current and future potential risk to different receptor populations. Human receptor populations are outlined in the CSM for human health (Figure 6) and complete exposure pathways for each population are identified. Several receptors are anticipated to be present at the Site, including current/future NPS employees, current/future park visitors, and a hypothetical future construction worker. As described in Section 2.14.3 above, soil is the primary exposure media of concern for human receptors at the Site. Current and future park visitors (adults, adolescents, and children) may be exposed to surficial (0-6 inches bgs) Site soils by the incidental ingestion, dermal absorption (direct contact), and particulate (dust) inhalation exposure pathways. Current and future adult park workers and potentially future Site construction or restoration workers (also of adult age) may be exposed to Site surface and subsurface (greater than 6 inches bgs) soils by these exposure pathways.

Exposure parameters are related to human behaviors that define the rates, time, frequency, and duration of exposure. It is expected there will be differences in the exposure between different individuals within a given receptor population due to differences in the exposure parameters. There may be a wide range of average daily exposures between different individuals of an exposed population. In the HHRA, attention is focused on exposures near the central portion of the range (e.g., mean, median) and on exposures near the upper end of the range (e.g., 95th percentile). These two exposure estimates are referred to as central tendency exposure (CTE) and reasonable maximum exposure (RME), respectively.

In accordance with applicable guidance, site decisions are based on the RME estimates of exposure and risk. Standard default values for RME exposure parameters (USEPA 1993b, 2014) were used in the HHRA. When standard default values were not available, RME exposure parameters were determined based on other sources (e.g., USEPA 2008, 2011) and best professional judgment. The exposure parameters used in the HHRA are provided in Appendix C; frequency and duration parameters are summarized in Text Table 3.1 below:

Text Table 4.1 Frequency and Duration Parameters for Human Exposures											
		Adult Employee		**Construction Worker**		**Young Child Visitor**		**Older Child Visitor**		**Adult Visitor**	
Exposure Parameter	**Units**	**CTE**	**RME**	**CTE**	**RME**	**CTE**	**RME**	**CTE**	**RME**	**CTE**	**RME**
Exposure frequency	days/yr	12	24	15	30	1	2	5	10	5	10
Exposure duration	yr	5	10	1	3	2	6	5	10	5	10
Exposure time	hr/day	4	8	8	10	0.5	2	0.5	2	0.5	2

Notes:
CTE = central tendency exposure
RME = reasonable maximum exposure

Exposure areas are defined based on the receptor, exposure medium, and the type and frequency of activities (USEPA 1989). The exposure area is the geographical area in which a receptor is randomly exposed to the contaminated medium for the assumed exposure duration, which is based on the frequency of visits to the Site by each type of receptor.

Because risk assessments are based on chronic health effects, the most appropriate expression for the exposure point concentration (EPC) is the long-term average concentration within the exposure area. The EPCs for each medium and each exposure area evaluated in the HHRA are presented in Tables 3-4 and 3-5 of Appendix C.

For most receptors, given the long-term nature of the exposure scenario (i.e., multiple days and years of exposure) and small size of the Site, it is likely that human receptors would be exposed to soils across the Site, rather than preferentially to one part of the Site, with the exception of the construction activities discussed below. Therefore, for surface soil (0 to 6 inches bgs) and subsurface soils (1 to 6 feet bgs), exposures were evaluated on a Site-wide basis. For both surface and subsurface soils, 95UCLs were derived using the USEPA ProUCL program (USEPA, 2015). The EPC was set equal to the recommended 95UCL, unless the 95UCL was higher than the maximum concentration, in which case the maximum value was used.

The amount of a chemical ingested or absorbed through the skin is referred to as “intake” or “dose.” The average daily dose (ADD) is the dose rate averaged over a pathway-specific period of exposure expressed as a daily dose on a per unit body weight basis. Inhalation dose is expressed in terms of an exposure concentration (EC) in air inhaled by the receptor. The calculated ADD and EC values for each receptor and each exposure pathway are provided in Tables B-1 through B-28 of Appendix C.

Lead-specific Exposure Assessment

Exposure to lead is evaluated using a somewhat different approach than for most other chemicals. First, lead is widespread in the environment and exposure can occur by many different pathways. Thus, lead exposure assessment generally includes all exposure pathways rather than just those that are Site-related exposures. Second, studies of lead exposures and resultant health effects in humans are traditionally described in terms of blood lead level, which is expressed in units of micrograms of lead per deciliter of blood (µg/dL).

Lead exposures are typically assessed using an uptake-biokinetic model that predicts blood lead level (PbB) from a specified exposure rather than simply calculating an estimated ADD. The receptor with the potential for highest exposure to lead at the Site was determined to be a Park employee or construction worker woman of child-bearing age rather than adult or child visitors. The Adult Lead Model (ALM) was used for assessing risks to the developing fetus in a woman of child-bearing age who may be exposed to lead at the Site (USEPA 2003). The Integrated Exposure Uptake Biokinetic (IEUBK) model, which is used for predicting the likely range of blood lead levels in a residential population of young children (aged 0 to 84 months), was not used.

Both central tendency exposure (CTE) conditions and reasonable maximum exposure (RME) conditions were evaluated in the HHRA, and the PRGs are based on the RME conditions. Although USEPA guidance suggests using the arithmetic mean as the EPC for lead (USEPA 1994, 2003), this HHRA uses the 95UCL as the EPC, per CalEPA guidance. Further detail on the model inputs to evaluate lead exposures are provided in Section 3.6 and Table 3-10 of the HHRA (Appendix C).

3.1.3. *Toxicity Assessment*

The objective of a toxicity assessment is to describe the adverse health effects caused by a chemical and identify how these adverse effects relate to exposure concentration. In addition, the toxic effects of a chemical frequently depend on the route of exposure (oral, inhalation) and the duration of exposure (subchronic, chronic, or lifetime).

There are typically major differences in the time course of action and the shape of the dose-response curve for cancer and non-cancer effects. Therefore, the toxicity assessment separates the non-cancer effects of chemicals from the cancer effects.

For non-cancer effects, the threshold dose is typically estimated from toxicological data (derived from studies of humans and/or animals) by finding the highest dose that does not produce an observable adverse effect and the lowest dose that does produce an effect. These are referred to as the “no observed adverse effect level” (NOAEL) and the “lowest observed adverse effect level” (LOAEL), respectively. The threshold is presumed to lie in the interval between the NOAEL and the LOAEL. However, to be conservative (protective), non-cancer risk evaluations are not based directly on the threshold exposure level but on a value referred to as the reference dose (RfD) for oral exposures or the reference concentration (RfC) for inhalation exposures. The RfD and RfC are estimates (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

The potential for non-cancer effects was estimated by comparing a calculated exposure (calculated as detailed in Section 3.1.2) to a reference dose (RfD) for oral and dermal exposures or a reference concentration (RfC) for inhalation exposures for each individual chemical. The RfD and RfC represent a daily exposure that is designed to be protective of human health, even for sensitive individuals or subpopulations, over a lifetime of exposure. The most “toxic” contaminants present at the Site (those with the lowest RfD and RfC values) include dioxins and furans, antimony, arsenic, cadmium, mercury, and cobalt (see Table 3-7 of Appendix C).

Chemicals are classified as known, probable, or possible human carcinogens based on a USEPA weight-of-evidence scheme in which chemicals are systematically evaluated for their ability to cause cancer in humans or laboratory animals. Cancer effects are evaluated based on the assumption that any level of exposure to a carcinogenic compound can cause an effect (i.e., it is assumed that the dose-response curve for cancer has no threshold). Thus, the most convenient descriptor of cancer potency is the slope of the dose-response curve at low doses (where the slope is still linear). This is referred to as the slope factor (SF), which has dimensions of risk of cancer per unit dose. For inhalation exposures, cancer risk is characterized by an inhalation unit risk (IUR) value. This value represents the upper-bound excess lifetime cancer risk estimated to result from continuous lifetime exposure to a chemical at a concentration of 1 microgram per cubic meter ($\mu g/m^3$) in air. Of the COPCs at the Site, dioxins and furans have the highest cancer effect factors (cancer SF and IUR), and are thus the most potent carcinogen at the Site COPCs (Table 3-7 of Appendix C).

The USEPA Regional Screening Levels (RSLs) tables (USEPA, 2020) provide the latest toxicity values and physical and chemical properties for individual chemicals. The RfDs, RfCs, SFs, and IURs identified for each COPC are provided in Table 3-7 of Appendix C.

Dioxin/Furan Toxicity

In the case of dioxins/furans, concentration values for soil samples were measured and expressed as concentrations of individual congeners but consolidated into a single toxicity-weighted concentration value. This concentration, referred to as TEQ (2,3,7,8-tetrachlorodibenzodioxin [TCDD] toxic equivalent concentration), is equal to the concentration of TCDD that would be of equivalent toxicity to humans.

The relative potency of an individual congener compared to TCDD is expressed in terms of the toxicity equivalency factor (TEF). The toxicity of any mixture of dioxin/furan congeners in a site medium can be estimated by calculating the TEQ concentration in the medium as the TEF-weighted sum of each of the TCDD-like congeners, as follows:

$TEQ = \sum C_i \cdot TEF_i$

where:

C_i = Concentration of congener ‘i’

TEF_i = Toxicity equivalency factor for congener ‘i’

3.1.4. Risk Characterization

Risk characterization is the process of quantifying the potential for contaminants at the Site to cause adverse health effects. The quantitative estimates are expressed in terms of a probability statement for the potential excess lifetime cancer risk and a hazard quotient (HQ) for the likelihood of adverse non-cancer health effects.

The methodologies used for estimating cancer risks and non-cancer hazards are described in Appendix C.

Non-cancer effects are calculated for each non-carcinogenic chemical in each exposure pathway. The potential for non-cancer effects from Site-related ingestion and dermal contact exposures is evaluated by comparing the estimated exposure from Site media (ADD or EC values) to an exposure level that is believed to be safe (RfD or RFC values), in the form of a ratio of the former to the latter, called a hazard quotient (HQ). A similar process is used to assess the potential for non-cancer effects from inhalation exposures, where the concentration of the non-carcinogen in air is compared to the inhalation reference concentration that is believed to be safe. When there are multiple COPCs that cause non-cancer effects, the cumulative hazard index (HI) is calculated as the sum of HQs.

The excess risk of cancer from exposure to a chemical is described in terms of the probability that an exposed individual will develop cancer because of that exposure. The excess risk of cancer from ingestion and dermal contact exposure to a chemical is approximated by multiplying the average daily dose (ADD) of a carcinogen by the cancer slope factor (SF) for that carcinogen. For inhalation exposures to carcinogens, the excess risk of cancer is calculated by multiplying the exposure concentration (EC) of each carcinogen in air by the inhalation unit risk (IUR).

The NCP describes a potentially acceptable range of lifetime excess cancer risk between 10^{-4} (one in 10,000) and 10^{-6} (one in 1,000,000), and expresses a preference for establishing the acceptable target cancer risk at or near the more protective end of this range. Similarly, non-cancer health effects generally should not exceed an HI of 1. NPS generally considers cancer risks exceeding 10^{-6} or non-cancer risks exceeding an HI of 1 to be unacceptable, absent compelling site-specific factors that preclude achieving these levels of protection.

Table 4 summarizes the non-cancer hazards and Table 5 summarizes the excess cancer risk by exposure media for each current and future human receptor group. For exposures to Site surface soil (see Tables 4 and 5), there were no exposure scenarios that resulted in non-cancer HIs greater than 1 or cancer risks greater than 10^{-6} based on either RME or CTE exposures. This indicates that no unacceptable risk results from exposure of the human receptors considered for this Site to surface soils at the Site. For construction or NPS worker exposures to petroleum hydrocarbons in subsurface soil, non-cancer HIs were slightly in exceedance of 1 for both RME and CTE, indicating a potentially unacceptable non-cancer risk for this human receptor group. No excess cancer risks greater than 10^{-6} were identified for exposures of any human receptor groups to surface or subsurface soil.

Lead Risk Characterization

Table 3-10 of the risk assessment report (Appendix C) presents the estimated lead exposures for construction workers for surface and subsurface soils, under CTE and RME scenarios, as determined by the ALM. The probabilities of PbB values exceeding 5 µg/dL (the target PbB established by the CDC) and 10 µg/dL (the target PbB for USEPA) in the fetuses of pregnant women exposed as construction workers at the Site are also shown. As the table depicts, the probability of exceeding the target PbB of 5 µg/dL is well below 5% for surface soils; however, the probability of exceeding the target PbB due to subsurface soil exposures is 26% and 98% under the CTE and RME scenarios, respectively. These results suggest that risks to a fetus from maternal exposure to subsurface soils under the construction worker scenario at the Site would be at unacceptable levels. Therefore, lead exposure in subsurface soils at the Site is carried forward as an exposure pathway of concern for human receptors at the Site.

3.1.5. Uncertainty Assessment

A summary of the uncertainties inherent to each component of the HHRA process and how they may affect the quantitative risk estimates and conclusions of the risk analysis is provided here. Two types of uncertainty are addressed: (1) measurement uncertainty and (2) informational uncertainty.

Measurement uncertainty refers to the usual variance that accompanies scientific measurements such as the uncertainties associated with sampling and measurement variability.

Informational uncertainty stems from assumptions related to estimates of exposure and chemical toxicity. For example, in the HHRA, to account for uncertainties in the development of exposure assumptions, conservative assumptions are made to ensure estimated risks are protective of sensitive subpopulations or the maximum exposed individuals, resulting in a bias toward over-predicting both cancer and non-cancer risks.

Details of the specific uncertainties and assumptions made in estimating exposures relevant to the HHRA for this Site are described in Appendix C. The list below represents a summary of the uncertainties and assumptions made:

- Exposure Pathways Not Evaluated: Humans may be exposed to Site-related chemicals by several pathways, but not all pathways were evaluated quantitatively in this risk assessment. This is because the contribution of the pathways excluded from the quantitative assessment are believed to be minor compared to one or more other pathways that were evaluated. These assumptions were based on evidence from Site observations, or other lines of evidence.

- Chemicals Not Evaluated Quantitatively: Chemicals for which the maximum detected concentration was below the respective screening level were not retained as COPCs and were not evaluated quantitatively in this assessment. Exclusion of these chemicals is not a significant source of uncertainty because the highest level of the chemical detected did not exceed conservative screening levels.

- Exclusion of Chemicals without Toxicity Factors: Toxicity factors are needed to quantify risks from exposure to chemicals detected in environmental media. Toxicity factors are available for all but a few of the chemicals detected at the Site. Although no strong conclusions can be reached regarding the potential for risk from chemicals without toxicity factors, it is suspected that the magnitude of the error that results from excluding these chemicals is usually likely to be low. This is because the absence of toxicity information for a chemical is most often because toxicological concern over that chemical is low.

- Exposure Point Concentrations: The true mean concentration of any contaminant within an exposure area cannot be calculated based on a limited set of measurements. The quantity of samples collected from the Site that were used the quantify exposure concentrations is relatively limited, which increases the uncertainty in any mean value. The EPCs were calculated as the 95UCL on the mean exposure area value, which ensures there is a low likelihood the true mean is higher than the EPC used in the risk estimates.

- Lack of Exposure Data: There are no measured data on air concentrations at the Site; estimates of airborne dust and volatiles in air derived from soil were estimated using default particulate emission factor (PEF) and volatilization factor (VF) values.

- Human Exposure Parameters: Many of the required exposure parameters are not known with certainty and must be estimated from limited data or knowledge. For example, data are absent on the exposure frequency and amount of actual soil ingested by park visitors to the Site, and the US EPA (2011) *Exposure Factors Handbook* does not present data on recreational visitors, so the values used in the calculations are based mainly on professional judgment. Exposure parameters were chosen to be conservative and values selected are likely to overestimate exposure and risk.

- Chemical Absorption: The risk assessment for the Site assumed 100 percent of the chemical ingested was absorbed, which is likely to result in an overestimation of exposure and risk, especially for metals in soil, which are often present in poorly absorbable forms.

3.2. Ecological Risk Assessment

The SLERA comprises the first two steps in the ecological risk assessment process. The objective of the SLERA is to identify and document conditions that may warrant further evaluation (i.e., potential unacceptable risk). The goal is to eliminate insignificant hazards while identifying contaminants whose concentrations are sufficiently high to potentially pose unacceptable risks to ecological receptors. For a SLERA, it is important to minimize the chances of concluding that there is no risk when in fact a risk exists. Thus, selected exposure (maximum concentrations detected) and screening values and assumptions are consistently biased toward overestimating risk. This ensures sites that might pose an ecological risk are studied further, i.e., a SLERA is deliberately designed to be protective in nature, not predictive of effects.

The SLERA includes the identification of contaminants of potential ecological concern (COPECs), based on a comparison of maximum concentrations to lowest ecological screening values (ESVs). COPECs identified in the SLERA are carried through to a BERA. The level of refinement and evaluation in the BERA depends upon the complexity of the Site. It can range from a “simple” BERA, which characterizes potential ecological risks based only on refined HQ estimates, to a “detailed” BERA, which employs multiple lines of evidence (e.g., refined HQs, toxicity tests, ecological community evaluations) to determine if the weight of evidence indicates the potential for unacceptable ecological risks. A “simple” BERA was performed for this Site, consistent with NPS guidelines.

An ecological risk assessment (both a SLERA and a BERA), regardless of the level of detail, includes the following components (described in detail in the SLERA/BERA report; Appendix C):

- Problem formulation
- Exposure and effects assessment
- Risk characterization (including an uncertainty analysis).

3.2.1. Problem Formulation

Figure 7 presents the CSM for ecological exposures. As described in Section 2.2.2 above, the Site was formerly used as a waste disposal area. Waste materials disposed of at the Site, which remain in the Site soil, are associated with contamination in surficial and subsurface soil. Contaminants detected at elevated concentrations in Site soil include PAHs, metals, heavy oil-range TPH, and dioxins/furans. PAH and dioxin/furan contamination may also be attributed to burning of waste at the Site. Site soils containing elevated concentrations of these contaminants may serve as a secondary source of contaminants.

While ephemeral surface water drainages are present at the Site, no perennial surface water was observed, and surface water is suspected to be present only for short time periods, during or after heavy rainfall events or in periods of snowmelt. Therefore, surface water-involved pathways or aquatic receptor groups are not considered at the Site. As discussed in Section 2.12 above, Site contamination is considered unlikely to have reached groundwater, therefore, groundwater-involved exposure pathways are also not considered as potential ecological exposure pathways at the Site.

Ecological receptor groups that are identified to potentially be present at the Site are as follow: birds, mammals (including burrowing mammals), terrestrial plants, and terrestrial/soil invertebrates.

The most plausible ecological exposure pathways identified for these receptor groups include:

- Terrestrial Plants: direct contact with surface and subsurface soil are potentially complete pathways, direct contact exposure from surface soil dust on leaf surfaces is considered a minor pathway.

- Terrestrial Invertebrates: Direct contact and ingestion of surface and subsurface soil and ingestion of terrestrial biota (plants) are potentially complete pathways, inhalation/dust exposure from surface and subsurface soils are considered minor pathways.

- Mammals: Ingestion of surface (and for burrowing mammals, subsurface) soil and ingestion of terrestrial biota are potentially complete pathways, direct contact and inhalation of dust from surface (and for burrowing mammals, subsurface) soil are considered minor pathways.

- Birds: Ingestion of surface soil and ingestion of terrestrial biota are potentially complete pathways, direct contact and inhalation of dust from surface soil are considered minor pathways.

Ecological receptor groups are outlined in the CSM for ecological exposures (Figure 7), and complete, incomplete, or not applicable pathways are identified.

As noted in Section 2.8.1 above, the only potential threatened or endangered species identified as potentially present at the Site or vicinity are the Pacific fisher, a federal endangered species, and the great grey owl, a California endangered species. While these species has not been specifically observed at the Site, NPS studies of these species have documented their range within the Park to include the Site vicinity. As noted in Section 3.2.3 below, carnivorous bird and carnivorous mammal receptors that are representative of the life habits of these sensitive species are considered in the assessment of wildlife receptors (birds and mammals) in the BERA, therefore, this assessment is protective of these endangered species that may be present at the Site.

During the problem formulation, the goals, breadth, and focus of the ecological risk assessment are established through the selection and description of site-specific assessment and measurement endpoints. Measurement endpoints are quantifiable environmental or ecological characteristics that can be measured, interpreted, and related to the valued ecological components chosen as the assessment endpoints (USEPA 1997). The selected assessment and measurement endpoints for each ecological receptor type are described in Appendix C.

3.2.2. Screening-Level Ecological Risk Assessment

Identification of COPECs

In the SLERA, COPECs are determined by comparing the maximum concentrations of contaminants in environmental media (e.g., water, sediment, soil) to corresponding media-specific ecological screening values (ESVs) as provided in the *NPS Protocol for the Selection and Use of Ecological Screening Values for Non-Radiological Analytes* (NPS 2018). The COPEC Selection ESVs, which are the lowest ESVs across multiple NPS-approved toxicity value sources, are used to identify COPECs. If the maximum concentration of a contaminant detected in soil at the Site is greater than the lowest ESV, then that contaminant is identified as a COPEC.

COPECs were identified separately for surface and subsurface soil by comparing the maximum concentration in soil to the NPS ESVs for COPEC selection (NPS 2018). Table 6 presents the results of the COPEC selection for ecological receptors. COPECs were assessed in surface and subsurface soil separately. In total, there were 16 COPECs identified for surface soil: antimony, arsenic, barium, cadmium, chromium (total), copper, lead, mercury, molybdenum, nickel, thallium, vanadium, zinc, aluminum, manganese, bis(2-ethylhexl) phthalate. There were 18 COPECs identified for subsurface soil. The list of COPECs for subsurface soil is the same as for surface soil, but with the addition of selenium, silver, and dioxins/furans (as TEQ), and the removal of manganese.

Refined SLERA

In the SLERA, the maximum concentration for each COPEC in the environmental media is compared to the NPS COPEC selection ESV, which is the lowest ESV available for all receptor groups in the NPS (2018) compilation. The SLERA is designed to minimize chances of eliminating a COPEC from further consideration when it may pose an actual ecological risk. Thus, the resulting risk calculation is expected to be an overestimate of actual risk. To further refine the list of COPECs, the maximum concentration detected at the Site was compared to the "refined" SLERA NPS ESVs (NPS 2018). These refined SLERA NPS ESVs are specific to receptor groups, and allow for calculation of a receptor group-specific, refined SLERA HQ value. HQs are calculated by dividing the estimated environmental concentration (the maximum concentration detected in surface and subsurface soil is used as a conservative estimate) by the toxicity values for each receptor group (in this case, the refined NPS ESV).

$$HQ = EPC / ESV$$

If the refined SLERA HQ is less than or equal to 1, harmful effects are not likely and the COPEC can be eliminated from further evaluation for the receptor group. If the refined SLERA HQ > 1 for a given contaminant, that contaminant remains in consideration as a refined COPEC and is further evaluated in a BERA.

Tables 7 through 12 summarize the refined SLERA results by exposure media for each receptor group (plants in Tables 7 and 8, soil invertebrates in Tables 9 and 10, and birds and mammals in Tables 11 and 12) and indicate which COPECs have refined SLERA HQs greater than 1 for each receptor group.

The following refined COPECs were identified:

- Terrestrial Plants: barium, chromium, copper, lead, mercury, selenium, vanadium, zinc, manganese
- Soil Invertebrates: barium, chromium, copper, lead, mercury, zinc, and manganese
- Birds: cadmium, copper, lead, mercury, vanadium, zinc, bis(2-ethylhexyl)phthalate
- Mammals: antimony, cadmium, copper, lead, molybdenum, selenium, zinc, and dioxins/furans (as TEQ).

3.2.3. Baseline Ecological Risk Assessment

Refined COPECs identified in the SLERA undergo further assessment in a simple BERA as directed by the NPS Protocols (NPS 2018). Further assessment can include comparing media-specific concentrations to background to determine potential non-site-related concentrations of refined COPECs (both natural and anthropogenic) and/or comparing species-specific estimated exposure doses to toxicity reference values for select receptors of concern.

If the simple BERA shows one or more refined COPECs have the potential to result in unacceptable risks, a more detailed BERA may be performed to further refine the HQs (e.g., incorporating Site EPCs, site-specific bioaccumulation factors or revised toxicity values) and evaluate other lines of evidence as part of the risk characterization. Examples of other lines of evidence may include laboratory or in situ toxicity tests, field-based assessments of community density and diversity, habitat evaluations, and tissue burden estimates. For this Site, a simple BERA was completed and is provided in Appendix C.

The general methodology follows the HQ approach described above for the SLERA, except that wildlife (bird and mammal) risks are estimated through a dose evaluation, which consists of evaluating exposures via ingestion of food items, as described more fully in subsequent sections. The assessment endpoint is based on the sustainability of exposed populations, and risks to some individuals in a population may be acceptable if the population is expected to remain healthy and stable. The HQ approach is intended to characterize population risks by quantifying individual HQ values that are greater than 1 and by the magnitude of the exceedances.

Exposure Assessment

Exposure areas are defined based on the receptor, home range, and area use. The exposure area is the geographical area in which a receptor is randomly exposed to the contaminated medium for the assumed exposure duration.

Exposure Areas and Area Use Factors: The size of the contaminated area at the Site was found to not exceed about 0.5 acre. This size of the contaminated area is consistent with the approximate home range size for a small mammal (e.g., shrew). Because the home range of the smaller receptors that may be exposed to Site soils is similar to the size of the contaminated area, all surface soil data were assumed to represent a single exposure area. Thus, for the purposes of estimating risks to wildlife receptors from incidental ingestion of soil and ingestion of terrestrial prey items, exposures were assumed to occur throughout the Site. Exposures to surface and subsurface soil were considered separately. Receptors were assumed to be exposed to soils and prey only within the Site, such that the area use factor (AUF) used to calculate the chemical dose for each wildlife receptor group was assumed to be 1.0, a conservative assumption given that the Site area is smaller than the home ranges of most of the receptor groups.

EPCs: Wildlife receptors are likely to move at random across an exposure area. Therefore, exposure is best characterized as the arithmetic mean concentration across the entire exposure area. Following USEPA recommendations, the 95UCL of the arithmetic mean concentrations of COPECs was calculated from existing data (Shaw, 2010) for surface and subsurface soils throughout the Site. These 95UCL concentrations were used as EPCs for assessing Site exposures for ecological receptors. All receptor groups were screened for exposure to surface soil in the BERA, while only the burrowing mammal receptor group was screened for exposure to subsurface soil. Tables 4-9 and 4-10 of Appendix C summarize the EPCs determined for COPECs in surface and subsurface soil at the Site, respectively.

Surrogate Receptors: It is not feasible to evaluate exposures and risks for every bird and mammal species potentially present at the Site. For this reason, surrogate species were selected to serve as representatives of several different avian and mammalian feeding guilds. For wildlife groups that ingest terrestrial prey items, the surrogate species selected for evaluation in the EcoSSL guidance (USEPA 2005a) were used in this assessment, including:

- Mammalian herbivore: Meadow vole

- Mammalian carnivore: Long-tailed weasel
- Mammalian insectivore: Short-tailed shrew
- Avian herbivore: Mourning dove
- Avian carnivore: Red-tailed hawk
- Avian insectivore: American woodcock

Dietary Tissue Concentrations: Measured data on concentrations in terrestrial dietary items (plants, small mammals, invertebrates) are not available for the Site. Therefore, dietary concentrations were estimated using uptake factors and/or bioaccumulation models from the literature. In general, tissue concentrations were estimated from soil using the same uptake model sources as those used in the development of the EcoSSLs (USEPA 2007). When EcoSSL uptake models were not available, literature-based bioaccumulation models developed by Los Alamos National Laboratory (LANL) and Oak Ridge National Laboratory for the purposes of establishing wildlife soil screening levels were employed (see Appendix C for a summary of the uptake models).

Toxicity Assessment

In the SLERA, risk estimates were based on the lowest ESV across multiple NPS-approved toxicity value sources. However, in this simple BERA, risk estimates are revised using more species-specific concentrations and/or dose-based toxicity values. Both no observed adverse effect level (NOAEL)-based toxicity reference values (TRVs) and low observed adverse effect level (LOAEL)-based TRVs were identified for receptor groups. Tables 7 through 10 present the toxicity values for terrestrial plants and soil invertebrates, and Tables 4-13 and 4-14 in Appendix C present the toxicity values used for avian and mammalian receptors. All the contaminants ingested by a receptor was assumed to be absorbed (i.e., 100% bioavailability was assumed).

Risk Characterization

There are several different evaluation methods, or lines of evidence, available for determining the impact of site releases on ecological receptors (e.g., HQ estimates, toxicity tests, and habitat and community evaluations).

For this Site, there is one primary line of evidence—the modeled HQs—available for characterizing potential ecological risks, with additional lines of evidence including vegetation and wildlife observations (Harris Environmental Group, 2020) and a qualitative evaluation of the likelihood of exposures by comparison of receptor home range sizes with the size of the Site contamination. Threshold effects-based TRVs were used to calculate HQ values in the BERA. Threshold effects-based TRVs were calculated as the geometric mean of NOAEL and LOAEL TRVs for each receptor group. As with refined SLERA HQ calculations discussed above, an HQ value greater than one indicates a potential for adverse impacts to the given receptor group/feeding guild.

For plants and invertebrates, threshold effects-based HQs were calculated as the ratio of the 95UCL on the Site mean concentration of each refined COPEC to the threshold effects-based value for that refined COPEC. As shown in Table 13, Threshold-based HQ values for several metals detected in both surface and subsurface soils are greater than one. This indicates that the concentrations of these metals are sufficiently elevated throughout the Site to result in potential adverse impacts for terrestrial plants and/or soil invertebrate communities.

BERA wildlife HQ estimates were calculated by dividing the ingested dose (determined from intake calculations) by the threshold effects-based TRV (see Tables D-1 through D-7 in Appendix C). Table 14 summarizes the threshold-based HQs for wildlife receptors.

For mammals and birds, as shown in Table 14, threshold-based HQs were greater than one for several metals. The highest threshold based-HQ was 38, documented for burrowing insectivorous mammal exposure to lead in subsurface soil. Insectivorous receptors have higher HQs than the other two feeding guilds (i.e., herbivores, carnivores). This is not unexpected as bioaccumulation of contaminants into terrestrial invertebrate (earthworm) tissues often tends to be greater than into plants and small mammal tissue. Thus, if risk management decisions are based on this feeding guild, they will be adequately protective of other feeding guilds with lower exposures.

The list of contaminants of ecological concern (COECs) identified in the ecological risk assessment consist of the following:

- Terrestrial Plants: barium, chromium, lead, vanadium, zinc, and manganese
- Soil Invertebrates: chromium, lead, and zinc
- Wildlife: antimony, cadmium, copper, lead, mercury, zinc, and dioxins/furans.

Soil concentrations of all these COECs were higher than background, which suggests on-Site soil concentrations are attributable, at least in part, to Site-related impacts.

3.2.4. Uncertainty

A summary of the uncertainties inherent to each component of the ecological risk assessment process and how they may affect the quantitative risk estimates and conclusions of the risk analysis is provided here. Details of the specific uncertainties and assumptions made in the ecological risk for this Site are described in Appendix C. The list below represents a summary of the uncertainties and assumptions made:

- Exposure Pathways Not Evaluated: Not all exposure pathways and detected chemicals were evaluated quantitatively in the ERA. For example, wildlife exposures via inhalation and dermal contact pathways were not evaluated quantitatively. While these pathways are likely to be minor compared to the ingestion pathways, omission of these pathways will tend to lead to an underestimation of total risk.

- Wildlife Feeding Habits: The ingestion rates for food and soil used to evaluate wildlife exposures were derived from literature sources and these actual intakes will vary daily and seasonally. In addition, it was conservatively assumed all the intake was derived from the Site, which is likely to overestimate exposures for receptors with larger home ranges or migratory species.

- Concentrations in Tissues of Dietary Items: There are no measured data on concentrations in dietary items at the Site. Wildlife exposures were based on default soil-to-tissue uptake models that may not account for site-specific factors that could influence accumulation into biota. Predictions of wildlife exposures based on estimated tissue concentrations are considered uncertain and are likely to overestimate risks.

- Receptors Evaluated: Risks to wildlife were assessed for a selected subset of avian and mammalian species that were representative of feeding guilds (i.e., insectivores, herbivores, carnivores) likely to be present at the Site. Although the wildlife receptors evaluated in the risk assessment were selected to represent species within each feeding guild, they may not represent the full range of sensitivities present in species at the Site. The species selected may be more or less sensitive to chemical exposure than typical species located within the area.

- Toxicity Values for Plants and Invertebrates: The terrestrial plant and soil invertebrate toxicity values used in the risk calculations are usually based on laboratory studies in which soluble forms of contaminants and do not account for variations in environmental factors, such as pH and total organic carbon content, which may influence the toxicity. In addition, toxicological data for certain contaminants at certain effects levels may not be available, necessitating assumptions may be made in application of data from other similar contaminants or for the same contaminant at other effects levels. For example, the available chromium toxicity values for plants (and terrestrial invertebrates) were based on hexavalent chromium, which is more soluble and more phytotoxic than trivalent chromium. However, the relative toxicity of hexavalent chromium to soil invertebrates compared to trivalent chromium is highly uncertain, and hexavalent chromium may be less toxic than the trivalent form. It is likely that the chromium present in Site soils is mostly not in the hexavalent form, since the 2001 soil sampling did not detect any hexavalent chromium (Shaw, 2010). For molybdenum, the low-effect ecological screening level (ESL) for soil organisms is taken from a Dutch compilation and is intended to represent a concentration of high risks, not low effects. The molybdenum ESL has high uncertainty for estimating the potential risk to terrestrial plants and soil invertebrates. For these reasons, confidence in risk estimates is low and risks are likely overestimated.

- Toxicity Values for Wildlife: Available toxicity data for wildlife are usually generated under laboratory conditions, and extrapolation of those data to free-living receptors in the field is uncertain. In addition, uncertainties in wildlife ESVs, such as the use of default uptake models, lack of reliable soil intake rates, and assumption of 100% bioavailability of chemicals from soil, limit the reliability of the risk estimates. As such, predicted HQs are more likely to overestimate than underestimate actual risk.

- Absence of Toxicity Data: Chemicals without toxicity data (e.g., aluminum for plants and soil invertebrates; and molybdenum, silver, thallium, and vanadium for soil invertebrates) cannot be quantitatively evaluated in the risk assessment. The absence of toxicity information for a chemical is most often because toxicological concern over that chemical is low; however, it is possible risks are underestimated due to the exclusion of these chemicals.

- Chemical Interactions: Most toxicity values are derived from studies of the adverse effects of a single contaminant. However, exposures to ecological receptors usually involve multiple contaminants, raising the possibility that synergistic or antagonistic interactions might occur. In accordance with USEPA guidance, effects from different chemicals are not added unless reliable data are available to indicate that the two (or more) chemicals act on the same target tissue by the same mode of action. In this risk assessment, ecological risk estimates were not added across different COPECs.

- Population-Level Effects: Assessment endpoints for the receptors at this Site are based on the sustainability of exposed populations (i.e., the ability of a population to maintain normal levels of diversity and density). The impact of Site-related effects on the population depends on the demographic and life history characteristics of each receptor, thus, predicting actual population-level risks is generally difficult and uncertain.

- Contribution from Background: All of the COECs identified in the BERA have the potential to be present at the Site because they are naturally occurring (e.g., metals and dioxins/furans). In the BERA, risk estimates for Site-specific background samples are not calculated. The comparisons of Site data to background data illustrate that the Site concentrations for many COECs are substantially elevated above background, most by more than 10-fold. This suggests that these exposures are related to releases that have occurred at the Site.

3.3. Development of Preliminary Risk-Based Removal Goals (PRGs)

The purpose of this section is to identify preliminary risk-based removal goals (PRGs). PRGs generally establish the concentrations of contaminants for each exposure medium that will not present unacceptable risk to human health or ecological receptors based on Site-specific conditions.

3.3.1. Selection of Human Health Risk-Based Preliminary Removal Goals

The NCP establishes a risk range for excess cancer risk of between 10^{-6} and 10^{-4} and sets a threshold value for cumulative non-cancer adverse effects at an HI of 1. PRGs related to carcinogenic compounds are initially established at the 10^{-6} level. Final RGs can deviate from this "point of departure," if necessary, based on compelling site-specific factors relevant to risk management decisions. Risk-based PRGs are established using the same exposure parameters and toxicity values used in the HHRA but reversing the risk equation to solve for the EPC. Generally, PRGs are only developed for those chemicals that are identified as COCs in the risk assessment. COCs are defined as those chemicals for which the estimated cancer risk greater than 10^{-6} and/or the HQ greater than 1. The Organic Act does not allow NPS to select response actions that will result in the permanent or long-term impairment of a park's fundamental resources and values. In addition, numerous laws, regulations, and policies require NPS to ensure safe conditions for park visitors and workers. Therefore, without compelling evidence to deviate from the acceptable point of departure (i.e., HI = 1, cancer risk = 1 x 10^{-6}) and thus creating a potentially unsafe, impaired condition with respect to the Organic Act, the point of departure risk threshold values were used calculate human health PRGs for the Site.

The HHRA identified COCs present in subsurface soil (>6 inches bgs) that posed potential risks to hypothetical construction workers or other workers at the Site that were exposed to subsurface soils on a regular basis. These COCs included TPH (aromatic-medium molecular weight, TPH-D, and aromatic-high molecular weight, TPH-O) and lead.

Risks from exposure to TPH contaminants are driven by non-cancer effects; PRGs developed for these TPH fractions that are protective of construction worker exposures to subsurface soil are listed in Table 15. These PRGs are selected as the PRGs for human exposures to these contaminants.

PRGs for construction worker exposures to lead are determined not from a HQ-based approach, but from the ALM, the model that was used to assess potential lead exposure risks. Two target blood lead levels were evaluated in the model: 5 µg/dL and 10 µg/d. Both CTE and RME concentrations were evaluated for these target blood lead levels. Table 16 shows the assumptions used to derive lead PRGs from the lead model, and the PRGs derived using each set of assumptions. To ensure that the selected PRG is protective of human exposures, the PRG derived using the most conservative assumptions (target blood lead level of 5 µg/dL, RME lead concentration) was selected to be applied at the Site.

3.3.2. Selection of Ecological Risk-Based Preliminary Removal Goals

Ecological risk-based PRGs were derived using the same exposure parameters and toxicity values used in the BERA but reversing the risk equation to solve for the EPC. The target ecological HQ value used was 1. For ecological receptors, contaminants of ecological concern (COECs) were identified as eleven metals as well as dioxins/furans in surface and subsurface soils for which the threshold effects-based HQ values exceeded one (see Tables 13 and 14). PRGs were developed for these COECs, and are listed in Table 17. The PRGs for plants and soil invertebrates were based on threshold ecological effects-based values (ESVs), which were calculated as the geometric mean of the LANL low-level ESL and the NPS refined ESV. PRGs for wildlife receptors were calculated using threshold effects based-TRVs, which were calculated as the geometric mean of the NOAEL and LOAEL TRVs.

Final selected risk-based PRGs for the Mather FWDA Site soils are based on the lowest of combined human health-based and ecological-based PRGs. The final combined PRGs are shown in Table 18. Application of the PRGs to Site remedial actions should take into account the background levels of the COCs and COECs. USEPA recommends not cleaning up sites to levels below background. Site-specific background reference values derived as background threshold values (BTVs) from background sample results are provided for the Site COCs and COECs in Table 17. As shown in Table 18, the most conservative PRGs established for both human and ecological receptors are greater than the corresponding BTVs, except in the case of chromium and vanadium. The chromium background value is based on total chromium concentrations, while the chromium PRG is based on hexavalent chromium toxicity data for plants and invertebrates, as total chromium toxicity data are not available for these receptor groups, Hexavalent chromium makes up only a small fraction of the total chromium concentration, therefore, evaluation of this PRG relative to background levels at the Site is not achieved by comparison to the total chromium-based BTV. Use of the chromium PRG is discussed further in Sections 5.2.2 and 5.2.3 below.

3.3.3. Use of Risk-Based PRGs in Remedial Actions

Risk interpretations presented in the risk assessment are based on Site-wide data, under the assumption that both human and ecological receptors may move about the Site and be exposed to soils equally throughout the Site (i.e., that the Site represents a single exposure area). For each receptor, risk estimates were developed based on an EPC, which is usually computed as the 95UCL on the mean concentration of Site-wide data. Because it is derived based on a Site-wide exposure area, the application of a PRG should also be applied on Site-wide basis for each receptor type and interpreted in terms of the 95UCL on the mean. Essentially, the 95UCL on the mean concentration of COC and COEC concentrations from an area equivalent to expected future exposures at the Site based on post-removal sampling should meet the PRG. The confirmation sampling program must consider this application of the PRGs in evaluating post-cleanup conditions.

4. Identification and Analysis of Applicable or Relevant and Appropriate Requirements

The purpose of Section 4 is to identify ARARs for the Site. ARARs include promulgated standards, requirements, criteria, or limitations under federal, or more stringent State, environmental law (CERCLA Section 121 (d)(2)(A)). To be adopted as an ARAR at an NPS CERCLA site, NPS must determine that the requirement is either "applicable" to conditions at the Site or, if not applicable, that it is both "relevant" and "appropriate" based on Site conditions. A requirement is applicable if compliance with it is legally required. A requirement is relevant and appropriate if NPS determines, based on its discretion, that the requirement is well suited to addressing Site conditions. In addition, State requirements are ARARs only if they are identified by the State in a timely manner.

The identification of ARARs is a prerequisite to evaluating and selecting a cleanup action (USEPA 1992b). "Under circumstances where a non-time-critical removal action is expected to be the first and final action at the site, the selected removal action must satisfy all adopted ARARs" (USDOI 2016).

Other factors "to be considered" (TBCs) are non-promulgated criteria, advisories, guidance, and proposed standards issued by federal or state governments. TBCs are not enforceable and a response action is not required to attain TBCs but TBCs may be appropriate in shaping or guiding the development or implementation of a response action in certain circumstances, for example, where ARARs do not provide sufficient direction.

There are four basic criteria that define ARARs (NPS 2015; USEPA 1988). ARARs are (1) substantive rather than administrative, (2) applicable or relevant and appropriate, (3) promulgated, and (4) categorized as one of the following.

- Chemical-specific ARARs that address specific hazardous substances and are typically health or risk-based numerical values that cleanups must achieve.

- Location-specific ARARs that must be achieved because of the specific location of the release and the related response action (e.g., requirements that address the conduct of activities in sensitive areas such as national parks, floodplains, wetlands, and locations where endangered species or significant cultural resources are present). Location-specific ARARs often focus on protecting resources in a specific area. Therefore, NPS-specific ARARs generally fall within this category.

- Action-specific ARARs that are typically technology or activity-based requirements or limitations on actions conducted to respond to the release of specific hazardous substances. Action-specific ARARs generally prescribe how a selected alternative must be implemented rather than what alternative may be selected.

Pursuant to its delegated CERCLA lead agency authority, NPS has identified ARARs and TBCs for the Mather FWDA Site EE/CA. The results of the ARARs analysis, including state ARARs, are summarized in the following Text Tables 4.1, 0, and 4.3.

4.1. Chemical-Specific ARARs

Text Table 4.1 Chemical-Specific ARARs: Mather Former Waste Disposal Area Site			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**
FEDERAL ARAR			
STATE AND COUNTY ARAR			
Permissible Exposure Limits	8 CCR 5155 [29 CFR 1910.1001]	Standards for worker exposure to airborne contaminants.	Applicable to the extent there are airborne contaminants which are readily absorbed through the skin, and that are designated with the “S” notation on the table AC-1 of the cited portion of CCR.
Air Basins and Air Quality Standards	17 CCR Div. 3, Chapter 1, Subchapter 1.5	Establishes California Air Basins and sets limits for air emissions and air quality levels that protect public health.	Applicable to the extent there are air pollutants emitted during the removal action that would trigger regulations.
Hazardous Waste Determination - General	22 CCR Div. 4.5, Chapter 11, Article 1, §66261.2 §66261.3	A waste is classified as a RCRA hazardous waste if appears on a list and originates from either a non- specific or specific source. Defines a waste and outlines the process for determining whether a waste is also a hazardous waste.	Applicable to determine whether a waste generated during the course of the project (i.e., IDW) is a RCRA hazardous waste.
Hazardous Waste Determination - Characteristic of Toxicity	22 CCR Div. 4.5, Chapter 11, Article 4, §66261.24(a)(1) §66261.24(a)(2)	A waste is classified as a RCRA hazardous waste if the extract produced by the Toxicity Characteristic Leaching Procedure (TCLP) exceeds specified levels. A waste is classified as a non-RCRA, State-only hazardous wastes if the total concentration exceeds the Total Threshold Limit Concentration (TTLC) or if the extract produced by application of the Waste Extraction Test (WET) exceeds the Soluble Threshold Limit Concentration (STLC).	Applicable to the extent that the selected alternative generates, removes and disposes of waste off-site.

Text Table 4.1 Chemical-Specific ARARs: Mather Former Waste Disposal Area Site			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**
RCRA Hazardous Waste Determination - Listed Wastes	22 CCR Div. 4.5, Chapter 11, Article 4, §66261.30 §66261.31 §66261.32	A waste is classified as a RCRA hazardous waste if it appears on a list and originates from a either a non-specific or specific source.	Applicable to the determination of whether a waste generated during the course of the project is a hazardous waste.
RCRA Hazardous Waste Determination	22 CCR Div. 4.5, Chapter 11, Article 4.1, §66261.100 §66261.101	Criteria for determining whether a waste is a RCRA, or non-RCRA California, hazardous waste. In order to be characterized as a non-RCRA California hazardous waste it must first be established that the waste is not a RCRA waste.	Applicable to the identification of any hazardous waste generated during the course of the project.
California Land Disposal Restrictions	22 CCR Div. 4.5, Chapter 18, Article 4, §66268.40 §66268.48	Treatment standards that must be attained prior to land disposal of certain wastes. Establishes numerical universal treatment standards by chemical constituent that may not be exceeded under the land disposal restrictions (LDRs). Following excavation, contaminated soil determined to be a hazardous waste may be subject to LDRs if placed on land in a waste management unit outside the Area of Contamination from where the waste was generated.	Applicable to the extent that contaminated soil determined to be hazardous waste is placed on land outside of the area of contamination.
Waste Classification	27 CCR Div. 2, Sub-division 1, Chapter 3, Sub-chapter 2, Article 2 §20210	Definitions of designated waste, non-hazardous waste, and inert waste.	Applicable to the extent that the selected alternative will involve removal and disposal of waste off-site, and therefore require classification of waste for final disposal at an appropriate receiving facility.
Response Action Requirements	H&SC 25356.1.5	In addition to meeting NCP requirements, risk assessments and remedial goals established must include the most current sound scientific methods, knowledge, and practices of public health and environmental professionals.	Relevant and appropriate because CERCLA establishes risk assessment standards for EE/CAs and risk assessments were completed and are included within the EE/CA.

Text Table 4.1 Chemical-Specific ARARs: Mather Former Waste Disposal Area Site			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**
Tuolumne County Air Pollution Control Standards	Tuolumne County Air Pollution Control District (APCD) Rules 202, 205, 207, 209, 210, 413, 414	Establishes rules for visible and/or nuisance emissions. Establishes emission standards for NO_x, CO, and particulate matter.	Applicable to the extent there are air pollutants emitted during the removal action that would trigger regulations.
Tuolumne County Air Pollution Control Standards	APCD Regulation IV	Establishes emission standards for toxic air contaminants	Applicable to the extent there are air pollutants emitted during the removal action that would trigger regulations.
STATE TBC			
Human Health Screening Level Risk Assessment	California Human Health Screening Levels (CHHSLs)	Human health screening levels published by the Cal-EPA Office of Environmental Health Hazard Assessment (OEHHA). The CHHSLs are concentrations of 54 hazardous constituents in soil or soil gas that Cal-EPA considers to be below thresholds of concern for risks to human health.	TBC.
Human Health Risk Assessment	Human and Ecological Risk Office Human (HERO) Guidance for Human Health Risk Assessments	DTSC guidance on human health risk assessments.	TBC.
Human Health Risk Assessment	Human and Ecological Risk Office (HERO) Human Health Risk Assessment (HHRA) Notes 1, 2, and 3	DTSC policy on default human health exposure parameters (Note 1), use of U.S. EPA Regional Screening Levels (Note 2), and source of human health screening levels (Note 3).	TBC.
Ecological Risk Assessment	HERO Guidance for Ecological Risk Assessments	DTSC guidance on ecological risk assessments. Provides for a phased evaluation including a Phase I Predictive Assessment, a Phase II Validation Study and Phase III Impact Assessment.	TBC.

Text Table 4.1 Chemical-Specific ARARs: Mather Former Waste Disposal Area Site			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**
Ecological Risk Assessment	HERO Ecological Risk Assessment EcoNOTES 1 through 6	DTSC policy on various matters relevant to ecological risk assessments.	TBC.

4.2. Location-Specific ARARs

Text Table 4.2 Location-Specific ARARs: Mather Former Waste Disposal Area Site

Standard, Requirement, Criteria, or Limitation	Citation	Requirement Description	Applicable or Relevant and Appropriate or TBC?
FEDERAL ARAR			
NPS mandate to ensure non-impairment of national park resources for the enjoyment of future generations and the non-derogation of national park values and purposes	National Park Service Organic Act of 1916 16 U.S.C. §§ 1 *et seq.* 36 CFR Part 1 General Authorities Act, as amended	The Organic Act directs the National Park Service "to promote and regulate the use of … national parks … by such means and measures as conform to the fundamental purpose of the said parks … which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." The General Authorities Act, Section 1a-1, further provides that "the protection, management, and administration of these areas shall be conducted in light of the high public value and integrity of the National Park System and shall not be exercised in derogation of the values and purposes for which these various areas have been established."	Applicable to all NPS decisions and Site activities that may impact park resources. Prior to selection of a remedy, NPS must determine that the remedy will leave the Site in an unimpaired condition based on an analysis of Section 1.4 of the 2006 NPS Management Policies. Further discussion about compliance with this ARAR is provided in Appendix E.

Text Table 4.2 Location-Specific ARARs: Mather Former Waste Disposal Area Site			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**
Yosemite National Park enabling legislation	16 U.S.C. §§ 47-1 *et seq*.	"The Secretary of the Interior shall make and publish such general rules and regulations as he may deem necessary and proper for the management and care of the park and for the protection of the property therein, especially for the preservation from injury or spoliation of all timber, mineral deposits other than those legally located prior to the date of passage of the respective Acts creating and establishing said parks, natural curiosities or wonderful objects within said parks, and for the protection of the animals in the park from capture or destruction, and to prevent their being frightened or driven from the said parks ."	Applicable to all NPS decisions and Site activities in Yosemite National Park.
Restrictions on solid waste disposal sites in National Parks	16 U.S.C. § 460*l*-22(c) 36 CFR Part 6	Prohibits operation of any solid waste disposal site that was not in operation on September 1, 1984, except for sites used only for disposal of wastes generated within the park unit, so long as such site will not degrade any natural or cultural resources of the park unit. Prohibits the operation of any solid waste disposal site, except as specifically provided for by the regulations. 36 CFR § 6.4 specifies 12 conditions that must be met before a new solid waste disposal site may be authorized in a National Park, including the condition that there will be no disposal of the site of solid waste containing hazardous waste, polychlorinated biphenyls (PCBs), or radioactive materials.	Applicable if creation and operation of solid waste disposal sites within park unit boundaries. Further discussion about compliance with this ARAR is provided in Appendix E.

Text Table 4.2 Location-Specific ARARs: Mather Former Waste Disposal Area Site			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**
NPS restrictions of public use and recreation activities to protect national park resources	36 CFR Part 2: Resource Protection, Public Use and Recreation	Prohibits specific public use and recreational activities in national parks in order to protect park resources. For example, 36 CFR § 2.1(a) prohibits "(1) Possessing, destroying, injuring, defacing, removing, digging, or disturbing from its natural state: (i) wildlife or fish (ii) Plants or the parts or products thereof [or] (2) Introducing plants into a park area ecosystem." 36 CFR § 2.2(a)(2) prohibits "feeding, touching, teasing, frightening or intentional disturbing of wildlife nesting, breeding or other activities." 36 CFR § 2.14(a) prohibits "(1) Disposing of refuse in other than refuse receptacles (6) Polluting or contaminating park area waters or water courses."	Relevant and appropriate to on-site response action activities that may impact park resources or otherwise entail a restricted or prohibited activity. Relevant and appropriate because the restrictions on disposal of refuse is meant to restrict future disposal activities not past disposal actions.
NPS restrictions of commercial and private operations in national parks, including the prohibition of nuisances	36 CFR Part 5 36 CFR § 5.13	Regulates commercial use of national parks and the resources therein (e.g., commercial notices, advertisements, photography, business operations). Prohibits the creation or maintenance of a nuisance upon federal or private lands within a park area.	Relevant and appropriate to on-site response action activities that may create a nuisance or that may involve commercial or private use of a park unit. Relevant and appropriate because there are no commercial or private operations at the Site that have created a nuisance.
National Historic Preservation Act	16 U.S.C. §§ 470 *et seq.* 36 CFR Part 800	Requires federal agencies to consider the effect of any federally assisted undertaking on any district, site building, structure, or object that is included in, or eligible for, the Register of Historic Places and to minimize or mitigate reasonably unavoidable effects. Indian cultural and historical resources must be evaluated, and effects avoided, minimized, or mitigated.	Applicable to the extent that response action activities at the vicinity of the Site impact historic or cultural resources.

Text Table 4.2 Location-Specific ARARs: Mather Former Waste Disposal Area Site			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**
Historic Sites, Buildings, and Antiquities Act	16 U.S.C. §§ 461 *et seq*.	Requires federal agencies to consider the existence and location of historic or prehistoric sites, buildings, objects, and properties of national historical or archaeological significance when evaluating removal alternatives.	Applicable to the extent that response action activities at the vicinity of the Site impact areas of historical or archaeological significance.
Archaeological and Historic Preservation Act	16 U.S.C. §§ 469 *et seq*.	Establishes requirements for evaluation and preservation of historical and archaeological data, including Indian cultural and historic data, which may be destroyed through alteration of terrain as a result of federal construction projects, *inter alia*. If eligible scientific, pre-historical, or archaeological data are discovered during site activities, such data must be preserved in accordance with these requirements.	Applicable to the extent that response action activities at the vicinity of the Site result in the discovery of archeological or historical resources.
Archaeological Resources Protection Act	16 U.S.C. §§ 470aa-ii *et seq*. 43 CFR §§ 7.1 *et seq*.	Provides for the protection of archeological resources located on public and tribal lands. Establishes criteria that must be met for the land manager's approval of any excavation or removal of archaeological resources if a proposed activity involves soil disturbances.	Applicable to the extent that response action activities at the vicinity of the Site result in the discovery of archeological resources.

Text Table 4.2 Location-Specific ARARs: Mather Former Waste Disposal Area Site			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**
Native American Graves Protection and Repatriation Act (NAGPRA)	25 U.S.C. § 3001 25 U.S.C. § 3002(d) 43 CFR §§ 10.1 – 10.17	Provides for the disposition of Native American remains and objects inadvertently discovered on federal or tribal lands after November 1990. If the response activities result in the discovery of Native American human remains or related objects, the activity must stop while the head of the federal land management agency (in this case, NPS) and appropriate Indian tribes are notified of the discovery. After the discovery, the response activity must cease and a reasonable effort must be made to protect the Native American human remains or related objects. The response activity may later resume (43 CFR Section 10.4).	Applicable to the extent that response action activities at the vicinity of the Site find Native American remains and objects.
Endangered Species Act	16 U.S.C. §§ 1531 – 1544 50 CFR Part 402	No federal activity or federally authorized activity may jeopardize the continued existence of any threatened or endangered species known to live or to have lived in the affected environment; nor may any federal activity destroy or adversely modify a critical habitat. This ARAR requires NPS to ensure that the selected remedy is sufficiently protective of the environment containing the threatened or endangered species, with an emphasis on reducing the risks from the contaminants of concern to the listed species described in the ecological risk assessment to an acceptable level, with consideration given to the special status of the listed or threatened species. Also requires that NPS ensure that the selected remedy is implemented in a manner such that effects on any existing threatened or endangered species are avoided or mitigated.	Applicable to the extent that these species and/or their habitat are located on or near the Site. As discussed in the FIR, no federally threatened or endangered species are expected to be present at the Site (See Section 2.8 of the report).

Text Table 4.2 Location-Specific ARARs: Mather Former Waste Disposal Area Site			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**
Wilderness Act	16 U.S.C. §§ 1131 – 1136	Requires that federally-owned, designated Wilderness Areas be administered in such manner as will leave them unimpaired for future use and enjoyment, and to protect and preserve the wilderness character of these areas. Requires that there shall be no commercial enterprise or permanent road within designated wilderness areas, and, except as necessary to meet minimum requirements for the administration of the wilderness area for the purpose of the Act (including emergency measures to protect public health and safety), no temporary roads, use of motorized equipment, landing of aircraft, mechanical transport, or installation of any structures should be used or constructed in these areas.	Applicable, as the Site is located within a designated Wilderness area.

Text Table 4.2 Location-Specific ARARs: Mather Former Waste Disposal Area Site			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**
FEDERAL TBC			
NPS policy on implementation of the non-impairment standard	2006 NPS Management Policies, Section 1.4	**NPS MP § 1.4.5:** "The impairment that is prohibited . . . is an impact that . . . would harm the integrity of the park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. Whether an impact meets this definition depends on the particular resources and values that would be affected; the severity, duration, and timing of the impact, the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts. An impact would be more likely to constitute impairment to the extent that it affects a resource or value whose conservation is: necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park; or key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or identified in the park's general management plan or other relevant NPS planning documents as being of significance. An impact would be less likely to constitute an impairment if it is an	TBC.
NPS and California State Agreement regarding Historic Properties at Yosemite National Park	Programmatic Agreement Among the National Park Service at Yosemite, The California State Historic Preservation Officer, and the Advisory Council on Historic Preservation Regarding Planning, Design, Operations and Maintenance, Yosemite National Park, California, finalized 2020.	Agreement between the Park and SHPO, which acknowledges and allows the Park to evaluate and make determinations regarding the historic significance of properties that may be affected by an undertaking, at its discretion the Park may consult with the signatories to the PA or with other Interested Persons regarding effect determinations for individual undertakings.	TBC.

Text Table 4.2 Location-Specific ARARs: Mather Former Waste Disposal Area Site			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**
Final Tuolumne River Plan/EIS	Tuolumne Wild and Scenic River Final Comprehensive Management Plan and Environmental Impact Statement	The Tuolumne River Plan describes how NPS will fulfill the mandate by the Wild and Scenic Rivers Act to provide comprehensive planning for the Tuolumne River in order to protect the river's free-flowing condition, water quality and outstandingly remarkable values.	TBC.
NPS Policies for Restoration of Natural Systems	2006 MP § 4.1.5 http://www.nps.gov/policy/MP2006.pdf	Section 4.1.5 provides: "The Service will reestablish natural functions and processes in parks unless otherwise directed by Congress. Impacts on natural systems resulting from human disturbances include the introduction of exotic species; the contamination of air, water, and soil; changes to hydrologic patterns and sediment transport; the acceleration of erosion and sedimentation; and the disruption of natural processes. The Service will seek to return such disturbed areas to the natural conditions and processes characteristic of the ecological zone in which the damaged resources are situated. The Service will use the best available technology, within available resources, to restore the biological and physical components of these systems, accelerating both their recovery and the recovery of landscape and biological community structure and function."	TBC.

Text Table 4.2 Location-Specific ARARs: Mather Former Waste Disposal Area Site			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**
NPS Policies for Managing Wildlife and Plant Resources	2006 MP § 4.4.1 http://www.nps.gov/policy/MP2006.pdf	Section 4.4.1 provides that NPS "will maintain as parts of the natural ecosystems of parks all plants and animals native to park ecosystems [by] preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and the communities and ecosystems in which they occur; restoring native plant and animal populations in parks when they have been extirpated by past human- caused actions; and minimizing human impacts on native plants, animals, populations, communities, and ecosystems, and the processes that sustain them."	TBC.
NPS Policies for Managing Species of Special Concern	2006 MP § 4.4.2.3 http://www.nps.gov/policy/MP2006.pdf	Section 4.4.2.3 requires that NPS "inventory, monitor, and manage state and locally listed species in a manner similar to its treatment of federally listed species to the greatest extent possible. The NPS also is required to "inventory other native species that are of special management concern to parks (such as rare, declining, sensitive, or unique species and their habitats) and manage them to maintain their natural distribution and abundance."	TBC.
NPS Policies for Managing Cultural Resources	2006 MP § 5f http://www.nps.gov/policy/MP2006.pdf	Section 5f addresses research on cultural resources and traditional associated peoples; planning to ensure that management processes "integrate information about cultural resources and provide for consultation and collaboration with outside entities;" and reservation, protection, and the making available for public understanding of cultural resources.	TBC.

Text Table 4.2 Location-Specific ARARs: Mather Former Waste Disposal Area Site			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**
NPS Employee Guidance for Managing Cultural Resources	NPS Director's Order #28: Cultural Resource Management NPS-28: Cultural Resource Management Guideline	Director's Order #28 provides that "[t]he NPS will protect and manage cultural resources in its custody through effective research, planning, and stewardship and in accordance with the policies and principles contained in the NPS Management Policies' (Section 3.1) and requires that the NPS comply with the Secretary of Interior's Standards and Guidelines for Archeology and Historic Preservation (Section 3.2). NPS-28 Cultural Resource Management Guideline addresses park cultural resource management programs, compliance with Section 106 of the National Historic Preservation Act, and issues related to archaeological resources, cultural landscapes, structures, museum objects, and ethnographic resources. "Cultural resources" are defined as "the material evidence of past human activities" (NPS-28, Introduction).	TBC.
NPS Employee Guidance of Managing Natural Resources	Reference Manual-77 http://www.nature.nps.gov/rm77	RM-77 offers comprehensive guidance to NPS employees responsible for managing, conserving, and protecting the natural resources found in park units. It addresses management of natural resources (including air, disturbed land, endangered, threatened and rare species, geologic resources, vegetation, etc.), resource uses, and planning (e.g., emergency management and environmental compliance).	TBC.

Text Table 4.2 Location-Specific ARARs: Mather Former Waste Disposal Area Site			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**
STATE ARAR			
Rare or Endangered Native Plants	FGC 1908 (Added by Stats. 1977, c. 1181, p. 3869, section 8) / 14 CCR §670.2	Section 1908 imposes a substantive requirement by prohibiting any person" from taking rare or endangered native plants. California Code of Regulations Title 14 section 670.2 provides a listing of Threatened, Endangered, or Rare plants in California. FGC 67 provides the definition of "person" as any natural person or any partnership, corporation, limited liability company, trust, or other type of association. “Take” or “taking” is defined by FGC 86 to include killing.	Relevant and appropriate only to the extent that there are rare or endangered plants on or near the Site. As discussed in the FIR, no state threatened, endangered, or sensitive plant species are expected to be present at the Site (Shaw 2010).
Endangered Species	FGC 2080 (Added by Stats. 1984, c. 1240, section 2), FGC 2081(b)	This section prohibits the take, possession, purchase or sale within the state, any species (including rare native plant species), or any product thereof, that the commission determines to be an endangered or threatened species, or the attempt of any of these acts. This section prohibits releases and/or actions that would have a deleterious effect on species or their habitat. The Department may authorize, by permit, the take of endangered or threatened species if the take is incidental to an otherwise lawful activity and the impacts are minimized and fully mitigated.	Relevant and appropriate only to the extent that there are State endangered or threatened species and/or their habitat located on or near the Site. No such species or habitat have been identified (see Section 2.8 of the report).
Wildlife Species	FGC 3005 (Stats. 1957, c. 456, p. 1353 section 3005)	This code section prohibits the taking of birds and mammals, including taking by poison. “Poison” is not defined in the code. Although there is no state authority on this point, federal law recognizes that poison, such as Strychnine, may affect incidental taking. (*Defenders of Wildlife v. Administrator, EPA (1989) 882. F. 2d. 1295)*.	Relevant and appropriate only to the extent that birds and mammals in the area are exposed to Site contaminants that have the potential of “poisoning” or “taking” by killing.

Text Table 4.2 Location-Specific ARARs: Mather Former Waste Disposal Area Site			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**
Birds	FGC 3503	This section prohibits the take, possession, or needless destruction of the nest or eggs of any bird, except as otherwise provided by this code or any regulation made pursuant thereto.	Relevant and appropriate only to the extent that birds and/or their habitat are located on or near the Site. Extent is expected to be limited because habitat that supports these species is not known to be present at the Site.
Birds of Prey	FGC 3503.5 (Added by Stats. 1985, c. 1334, section 6)	This section prohibits the take, possession, or destruction of any birds in the orders of Falconiformes or Strigiformes (birds-of-prey) or to take, possess, or destroy the nest or eggs of any such bird except as otherwise provided by this code or any regulation adopted pursuant thereto.	Relevant and appropriate only to the extent that such American Peregrine Falcon, Long-eared Owl, Great Grey Owl, California Spotted Owl, and/or their eggs are located on or near the Site.
Migratory Birds	FGC 3513	This section makes it unlawful to take or possess any migratory nongame bird as designated in the Migratory Bird Treaty Act or any part of such migratory nongame bird except as provided by rules and regulations adopted by the Secretary of the Interior under provisions of the Migratory Bird Treaty Act.	Relevant and appropriate only to the extent that migratory nongame birds are located on or near the Site.
Fully protected bird species / habitat	FGC 3511 (Added by Stats. 1970, c. 1036, p. 1848 section 4)	It is unlawful to take or possess fully protected birds, the following of which have been identified within the Park and may be located on or near the Site: American Peregrine Falcon, Golden Eagle, Southern Bald Eagle	Relevant and appropriate only to the extent that a fully state-protected bird or its habitat are located on or near the Site. Extent is expected to minimal because it is not expected that there is a habitat present at the Site to support these species.

Text Table 4.2 Location-Specific ARARs: Mather Former Waste Disposal Area Site

Standard, Requirement, Criteria, or Limitation	Citation	Requirement Description	Applicable or Relevant and Appropriate or TBC?
Fully protected Mammals	FGC 4700 (Added by Stats. 1970, c. 1036, p. 1848 section 6)	This section prohibits the take or possession of fully protected mammals or their parts. The following are fully protected mammals are located within the Park: Bighorn sheep, California wolverine, Ring-tailed cat.	Relevant and appropriate only to the extent that these fully state-protected mammal species or its habitat are located on or near the Site. Extent is expected to be minimal because it is not expected that there is a habitat present at the Site to support these species.
Specially Protected Mountain Lion	FGC 4800 et. seq.	Mountain lions are specially protected mammals in California. It is unlawful to take, injure, possess, transport, or sell any mountain lion or any part or product thereof.	Relevant and appropriate only to the extent that mountain lions and/or their habitat are located on or near the Site.
Fully protected Reptiles and Amphibians	FGC 5050	Prohibits the take or possession of certain fully protected species of reptiles and amphibians.	Relevant and appropriate to the extent that these species and/or their habitat are located on or near the Site. Relevant and appropriate because it is not expected that there is a habitat present at the Site to support these species.
Furbearing Mammals	14 CCR Div. 1, Sub-division 2, Chapter 5, §460	Regulation makes it unlawful to take fisher, marten, river otter, desert kit fox, and red fox.	Relevant and appropriate only to the extent that these species and/or their habitat are located on or near the Site.

4.3. Action-Specific ARARs

Text Table 4.3 Action-Specific ARARs: Mather Former Waste Disposal Area Site			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**
FEDERAL ARAR			
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR 264 Subpart I (§264.170 - §264.179)	Provides requirements for use and management of containers for storage of RCRA hazardous waste.	Relevant and Appropriate for alternatives that generate waste for storage in containers on Site prior to disposal. Relevant and appropriate because the Site is not by definition a hazardous waste transfer, treatment, storage, and disposal facility.
STATE ARAR			
General Hazardous Waste Disposal Facility Standards	22 CCR, Division 4.5, Chapter 14, Article 2: §66264.15 and §66264.19(c)(1 and 2)	§66264.15 provides substantive general inspection requirements applying to all hazardous waste facilities. §66264.19(c)(1 and2) provides substantive requirements for a Construction Quality Assurance (CQA) program including inspection and testing.	Relevant and Appropriate (for components of removal alternatives that involve construction of covers). Relevant and appropriate because the Site is not by definition a hazardous waste transfer, treatment, storage, and disposal facility
Post-closure Care and Use of Property	22 CCR, Division 4.5, Chapter 14, Article 7 §66264. 117 (b through d)	Provides requirements for post-closure care, security requirements, and restriction on disturbance for facilities, where contaminated materials and contaminated soils are left in place during closure.	Relevant and Appropriate for alternatives that contain waste on Site. Relevant and appropriate because the Site is not by definition a hazardous waste transfer, treatment, storage, and disposal facility.

Text Table 4.3 Action-Specific ARARs: Mather Former Waste Disposal Area Site			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**
Use and Management of Containers	22 CCR, Division 4.5, Chapter 14, Article 9 §66264. 178	Provides requirements for decontamination of remaining containers.	Relevant and Appropriate for alternatives that generate waste for storage in containers prior to disposal. Relevant and appropriate because the Site is not by definition a hazardous waste transfer, treatment, storage, and disposal facility.
Monitoring and Inspection of Landfill	22 CCR, Division 4.5, Chapter 14, Article 14 §66264. 303 (a: 1 through 2)	Provides requirements for monitoring and inspection of landfill during installation and operation	Relevant and Appropriate for alternatives that contain waste in- place with covers at the Site. Relevant and appropriate because the Site is not by definition a hazardous waste transfer, treatment, storage, and disposal facility.
Construction Quality Assurance Requirements	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 2, Article 4, §20324 (e through i)	§20324 (e through i) provides substantive requirements for a Construction Quality Assurance (CQA) program including inspection and testing.	Relevant and Appropriate (for components of removal alternatives that involve construction of covers). Relevant and appropriate because disposal of wastes occurred prior to promulgation of this regulation.
Precipitation and Drainage Controls	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 2, Article 4, §20365 (a, c through d and f)	Provides requirements for precipitation and drainage controls for waste management units and containment structures.	Relevant and Appropriate for alternatives that contain waste in place using covers. Relevant and appropriate because disposal of wastes occurred prior to promulgation of this regulation.

Text Table 4.3 Action-Specific ARARs: Mather Former Waste Disposal Area Site			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**
Seismic Design	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 2, Article 4, §20370	Provides criteria for seismic design structures within waste management unit	Relevant and Appropriate for alternatives that contain waste in place using covers. Relevant and appropriate because disposal of wastes occurred prior to promulgation of this regulation.
General Closure and Post-Closure Maintenance Standards Applicable to Waste Management Units (Units) for Solid Waste	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 5, Article 1, §20950 (d through e)	Provides performance standards and requirements for closure of waste management units for solid waste, including surveying, monuments, and vegetation.	Relevant and Appropriate for alternatives that contain waste in place using vegetative covers. Relevant and appropriate because disposal of wastes occurred prior to promulgation of this regulation.
Closure and Post-Closure Maintenance Requirements for Solid Waste Landfills	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 5, Article 2, §21090	Provides closure and post-closure maintenance requirements for solid waste landfill.	Relevant and Appropriate for alternatives that contain waste in place using covers. Relevant and appropriate because disposal of wastes occurred prior to promulgation of this regulation.
Final Cover	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 5, Article 2, §21140(a)	Provides requirements for final cover for disposal site and landfill	Relevant and Appropriate for alternatives that contain waste in place using covers. Relevant and appropriate because disposal of wastes occurred prior to promulgation of this regulation.

Text Table 4.3 Action-Specific ARARs: Mather Former Waste Disposal Area Site			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**
Final Grading	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 5, Article 2, §21142(a)	Provides requirements for final grading for disposal site and landfill	Relevant and Appropriate for alternatives that contain waste in place using covers. Relevant and appropriate because disposal of wastes occurred prior to promulgation of this regulation.
Slope Stability	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 5, Article 2, §21145(a)	Provides requirements for slope stability for disposal site and landfill	Relevant and Appropriate for alternatives that contain waste in place using covers. Relevant and appropriate because disposal of wastes occurred prior to promulgation of this regulation.
Drainage and Erosion Control	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 5, Article 2, §21150(a and c)	Provides requirements for drainage and erosion control for disposal site and landfill	Relevant and Appropriate for alternatives that contain waste in place using covers. Relevant and appropriate because disposal of wastes occurred prior to promulgation of this regulation.
Post-closure Maintenance	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 5, Article 2, §21180(b)	Provides that non-liquid waste exposed during post-closure maintenance maybe returned to the landfill provided the integrity of the final cover is maintained	Relevant and Appropriate for alternatives that contain waste in place using covers. Relevant and appropriate because disposal of wastes occurred prior to promulgation of this regulation.
Post-closure Land Use	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 5, Article 2, §21190(a (1 and 2) and e (2 and 4 through 7))	Provides requirements for post-closure use of land where the disposal site and landfill is located	Relevant and Appropriate for alternatives that contain waste in place using covers. Relevant and appropriate because disposal of wastes occurred prior to promulgation of this regulation.

5. Removal Action Objectives and Removal Goals

The purpose of Section 5 is to present the RAOs and scope for the non-time-critical removal action (NTCRA) (e.g., remove contaminated soils that pose unacceptable risk to human health and the environment). The RAOs should be as specific as possible but not so specific that the range of alternatives that can be developed is unduly limited.

RAOs define what the removal action is intended to accomplish. Specific RAOs are presented in Section 5.1. Other aspects of the RAOs are described therein and in Section 5.1.2 (Background and Reference Concentrations). An understanding of the Site CSM (Section 2), Site risk levels (Section 3), and ARARs (Section 4) are applied to the scope of the NTCRA as defined in Section 5.1.1 (Determination of Removal Action Scope).

5.1. Identification of Removal Action Objectives

The RAOs for this EE/CA are as follows:

- *Prevent unacceptable risks to human and ecological receptors from exposure to Site contaminants in soil.* This RAO aims to reduce exposure to soil that contains contaminant concentrations that are above target risk goals. The PRGs that were developed based on risk assessments are discussed in Section 5.2. Attainment of PRGs may be achieved through a variety of methods.

- Eliminate or minimize contaminant-related constraints on the full enjoyment and utilization of park resources for operational, scientific, and interpretive purposes consistent with NPS mandates. Unlike the media-specific RAO, this RAO addresses the Organic Act (16 USC Section 1) directive to conserve and to provide for the enjoyment of the scenery and the natural and historic objects and the wildlife in the park such as to leave them unimpaired for the enjoyment of future generations. This RAO relates to how the human and ecological risk assessments were conducted and the level of protection achieved by the recommended removal goals (RGs) and provides overarching guidance for all technology and alternative evaluations.

- *Attain all other federal and state ARARs.* This RAO assesses whether the removal alternatives are able to attain the federal and state ARARs identified in Text Table 4.1 through Text Table 4.3.

5.1.1. Determination of Removal Action Scope

The general objective of a removal action, in accordance with CERCLA and NCP, is to abate, prevent, minimize, stabilize, mitigate, or eliminate the release or threat of release of hazardous substances or pollutants or contaminants to the environment. The CSM for human and ecological exposures (Figure 6 and 7, respectively) at the Site has identified potentially complete exposure pathways involving soil at the Site, and the risk assessment (Appendix C, summarized in Section

3 above) has identified COCs and COECs in Site soil that may pose unacceptable risks to human and ecological receptors. Therefore, the scope of this removal action is to stabilize, remove, or contain contaminated soil at the Site to mitigate human health and ecological risks in a manner that also achieves the other RAOs. It is the objective of this removal action to be the only and last action taken at the Site to address contaminated media at the Site. The areas of the Site recommended for removal action are based on data collected during previous investigations conducted at the Site (Shaw, 2010). Section 5.3 describes and identifies the estimated extent of soils at the Site that exceed removal goals and will be addressed as part of the removal action. An estimated volume of approximately 310 cubic yards of surface and subsurface soil at the Site contain concentrations of COCs and COECs in exceedance of removal goals and are planned to be addressed during the removal action.

5.2. Risk Management: Removal Action Goals Selection

Removal goals (RGs) are selected by comparing all the PRGs and selecting the most stringent. To ensure cleanup will be technically feasible and cost effective, the PRGs also are compared to background for naturally-occurring COCs and COECs.

5.2.1. Preliminary Removal Goals

Site-specific PRGs were determined for the Site in the risk assessment (Appendix C, summarized in Section 3.3 above). The most conservative PRG determined in the risk assessment for each COC or COEC is listed in Text Table 5.2.1 below.

Text Table 5.2.1 Risk-Based PRGs		
COC or COEC	**PRG**	**Basis for PRG**
Surface Soil		
Antimony	*1.6 mg/kg*	*Ecological*
Cadmium	*1.0 mg/kg*	*Ecological*
Chromium	*1.4 mg/kg*	*Ecological*
Copper	*123 mg/kg*	*Ecological*
Lead	*54 mg/kg*	*Ecological*
Mercury	*0.19 mg/kg*	*Ecological*
Vanadium	*13 mg/kg*	*Ecological*
Zinc	*334 mg/kg*	*Ecological*
Manganese	*574 mg/kg*	*Ecological*
Subsurface Soil		
Antimony	*1.6 mg/kg*	*Ecological*
Barium	*837 mg/kg*	*Ecological*
Cadmium	*1.0 mg/kg*	*Ecological*
Chromium	*1.4 mg/kg*	*Ecological*
Copper	*123 mg/kg*	*Ecological*

Text Table 5.2.1 Risk-Based PRGs		
COC or COEC	**PRG**	**Basis for PRG**
Lead	*192 mg/kg*	*Ecological*
Vanadium	*13 mg/kg*	*Ecological*
Zinc	*334 mg/kg*	*Ecological*
TPH-Medium MW (TPH-Diesel, TPH-D)	*2,000 mg/kg*	*Human Health*
TPH-High MW (TPH-Heavy Oil, TPH-O)	*40,000 mg/kg*	*Human Health*
Dioxins/Furans (as TCDD-TEQ)	*7×10^{-6} mg/kg*	*Ecological*

mg/kg = milligrams per kilogram
MW = molecular weight
TEQ = Total dioxins and furans concentration as 2,3,7,8-TCDD Toxicity Equivalent concentration

5.2.2. Background and Reference Concentrations

To ensure cleanup will be technically feasible and cost effective and to reduce the potential for recontamination of clean areas from surrounding sources, the PRGs are compared to background values for naturally occurring constituents (e.g., metals within granitic-based soils, dioxins and furans and PAHs from wildfire) in all media at the Site and may be compared to reference values for environmentally ubiquitous anthropogenic constituents (e.g., polychlorinated biphenyls, dioxins). Only background and reference concentrations for COCs and COECs will be discussed in this Section.

Background Studies

As described in Section 2.10.1, discrete background soil samples were collected during soil sampling investigations conducted in 2001 (3 samples) and 2008 (10 samples) (Shaw, 2010). These samples were collected from 1 foot bgs. The locations of background sample collection are shown in in Figure 4. Analytical results from these samples were used to determine background values applicable to the Site.

Background Comparison Summary

Background comparisons and statistical analyses are summarized in Section 4.3.3 of the risk assessment report conducted for the Site (Appendix C), and in Table 4-16 of the risk assessment report. Site COC and COEC concentrations were compared statistically to concentrations in the background samples collected up-gradient of the Site, using several two-sample hypothesis testing approaches using ProUCL. Site mean concentrations were compared with background mean concentrations, and Site maximum concentrations were compared with background threshold values (BTVs). BTVs determined for the Site are listed in Table 18. BTVs were developed using ProUCL and are based on upper threshold levels (UTLs) or upper prediction limits (UPLs), whichever was recommended in the ProUCL output. The background data UTL is defined as the upper 95th confidence limit on the 95th percentile value, which is designated as UTL 95%-95% or UTL95-95. The UPL95 is a 95% upper prediction limit. BTVs determined from background sample results for COC and COECs are considered representative of the upper range of background concentrations of these constituents in soil in the Site vicinity. These values may be used as background, as CERCLA typically does not permit setting removal goals and concentrations less than the Site background or reference concentrations.

For most metals COCs and COECs, all evaluations of Site data against background suggest that concentrations at the Site are elevated significantly above background. Ratios of mean metals concentrations in Site surface soil samples to mean background metals concentrations and of the maximum metals concentrations in Site surface soil to the metals BTVs are greater than 5 for all metals except chromium (3 for both ratios), molybdenum (2 for both ratios), and vanadium (1). In both surface and subsurface soil, vanadium was the only metal not present in any Site soil samples at a concentration in exceedance of the BTV. Based on this comparison with background values, vanadium concentrations in soil at the Site are considered unlikely to be related to waste disposal and other human activities at the Site. At the opposite end of the spectrum, the greatest ratios between Site and background results were observed for lead. Site mean and maximum lead concentration ratios to background and BTV values were approximately 78 for surface soils (both ratios) and 245 and 1131, respectively, for subsurface soils. Chromium background values provided in Table 18 are based on total chromium results in background soil samples. A hexavalent chromium-specific background value was not calculated due to the absence of hexavalent chromium detections in background samples (Table 2).

Both Site data and background data were limited for dioxins/furans, with only two Site soil samples and one background sample that were analyzed. As noted in Section 2.10, Site soil samples analyzed for dioxins/furans were collected from ash-rich layers of soil within TP02 and TP05, and thus suspected to contain elevated concentrations of dioxins/furans relative to surrounding soils. The soil sample from TP02 and analyzed for dioxins contained a TEQ approximately 250 times the background sample result, suggesting that dioxins/furans in a localized area of this test pit are significantly elevated above background levels.

Most samples at the Site were analyzed for petroleum hydrocarbons, however, only three discrete background samples were analyzed for these contaminants, therefore, the background values established for these analytes are maximum detected concentrations among these results at 3 mg/kg for TPH-D and 31 mg/kg for TPH-O. Most Site soil samples contained concentrations slightly elevated above these background concentrations (one to three times background). Biased samples collected from an area of oily soil identified in test pits TP05 and YWM05A contained highly elevated concentrations of TPH-D and TPH-O, hundreds to thousands of times greater than these background values. Overall, while characterization of background is limited, these results suggest that TPH is present throughout the Site at concentrations in exceedance of background, with acute exceedances identified in an area where petroleum impacts are visually evident.

5.2.3. Removal Goal Selection

The recommended RGs are selected by comparing the risk-based PRGs with any identified ARARs for each COC and COEC, and selecting the lowest value. However, to ensure that cleanup will be technically feasible and cost-effective, the PRGs also are compared to background values for COCs and COECs in all media at the Site.

A comparison of the human health risk-based PRGs, ecological risk-based PRGs, ARARs, and representative background and reference concentrations is presented in Text Table 5.2. When multiple PRGs exist, the lower (i.e., more protective) value was chosen as the RG unless the background concentration of the contaminant in the medium judged to be representative of unimpacted conditions was greater than the PRGs, in which case the background concentration was selected as the RG.

An exception to this use of background concentrations is made for chromium. As noted above, the background concentration for chromium is based on total chromium results. As noted in Section 4.4.4 of Appendix C, toxicity reference values used for plants and soil invertebrates are based on hexavalent chromium toxicity data, because total chromium toxicity values are not available for these receptor groups. These toxicity values were used to calculate the ecological PRG for chromium. Hexavalent chromium typically makes up only a small fraction (up to 10-15%) of the total chromium concentration present in soil, with most of the remaining chromium present in the trivalent state. Therefore, the fact that the total chromium background value is greater than the hexavalent chromium PRG does not imply that this PRG is lower than the background concentration of hexavalent chromium in soil. The detection limit for hexavalent chromium in background samples (0.51 mg/kg) is less than the PRG (1.4 mg/kg), consistent with this conclusion (Table 2). As a result, the hexavalent chromium-based ecological PRG is retained as the chromium RG. Sampling and analysis of soil conducted as part of to further investigations and removal actions that take place at the Site will use hexavalent chromium analyses to assess compliance with this RG (see Section 5.3.3 and discussion of removal action alternatives below).

The selected RGs and the basis for selection are included in Text Table 5.2.

Text Table 5.2 RG Selection

COC or COEC	Background Value	Human Health PRG	Ecological PRG	ARAR	Basis for RG	RG
Surface Soil						
Antimony	*0.242 mg/kg*	*None*	*1.6 mg/kg*	*None*	*Ecological PRG*	*1.6 mg/kg*
Cadmium	*0.41 mg/kg*	*None*	*1.0 mg/kg*	*None*	*Ecological PRG*	*1.0 mg/kg*

Text Table 5.2 RG Selection						
COC or COEC	**Background Value**	**Human Health PRG**	**Ecological PRG**	**ARAR**	**Basis for RG**	**RG**
Chromium	*7.9 mg/kg**	*None*	*1.4** mg/kg*	*None*	*Ecological PRG***	*1.4 mg/kg***
Copper	*10.0 mg/kg*	*None*	*123 mg/kg*	*None*	*Ecological PRG*	*123 mg/kg*
Lead	*8.8 mg/kg*	*1,162 mg/kg*	*54 mg/kg*	*None*	*Ecological PRG*	*54 mg/kg*
Manganese	*267 mg/kg*	*None*	*574 mg/kg*	*None*	*Ecological PRG*	*574 mg/kg*
Mercury	*0.1 mg/kg*	*None*	*0.19 mg/kg*	*None*	*Ecological PRG*	*0.19 mg/kg*
Vanadium	*51.2 mg/kg*	*None*	*13 mg/kg*	*None*	*Background*	*51.2 mg/kg*
Zinc	*52.8 mg/kg*	*None*	*334 mg/kg*	*None*	*Ecological PRG*	*810 mg/kg*
Subsurface Soil						
Antimony	*0.242 mg/kg*	*None*	*1.6 mg/kg*	*None*	*Ecological PRG*	*1.6 mg/kg*
Barium	*64.6 mg/kg*	*None*	*837 mg/kg*	*None*	*Ecological PRG*	*837 mg/kg*
Cadmium	*0.41 mg/kg*	*None*	*1.0 mg/kg*	*None*	*Ecological PRG*	*1 mg/kg*
Chromium	*7.9 mg/kg**	*None*	*1.4 mg/kg***	*None*	*Ecological PRG***	*1.4 mg/kg***
Copper	*10.0 mg/kg*	*None*	*123 mg/kg*	*None*	*Ecological PRG*	*123 mg/kg*
Lead	*8.8 mg/kg*	*1,162 mg/kg*	*192 mg/kg*	*None*	*Ecological PRG*	*192 mg/kg*
Vanadium	*51.2 mg/kg*	*None*	*13 mg/kg*	*None*	*Background*	*51.2 mg/kg*
Zinc	*52.8 mg/kg*	*None*	*334 mg/kg*	*None*	*Ecological PRG*	*334 mg/kg*
TPH-Medium MW (TPH-Diesel, TPH-D)	*3 mg/kg*	*2,000 mg/kg*	*None*	*None*	*Human Health PRG*	*2,000 mg/kg*

Text Table 5.2 RG Selection						
COC or COEC	**Background Value**	**Human Health PRG**	**Ecological PRG**	**ARAR**	**Basis for RG**	**RG**
TPH-High MW (TPH-Heavy Oil, TPH-O)	*31 mg/kg*	*40,000 mg/kg*	*None*	*None*	*Human Health PRG*	*40,000 mg/kg*
Dioxins/Furans (as TCDD-TEQ)	*4.34 x 10^{-8} mg/kg*	*None*	*7.0 x 10^{-6} mg/kg*	*None*	*Ecological PRG*	*7.0 x 10^{-6} mg/kg*

* Chromium background value calculated from total chromium results in Site background soil samples.
** Chromium PRG based on hexavalent chromium toxicity data. Data establishing the background concentration of hexavalent chromium in soil is not available, therefore, in absence of a background concentration appropriate for comparison to the PRG, the chromium PRG is selected as the RG.

These PRGs should be applied to assessment of the Site-wide cleanup as demonstrated by a 95UCL on COCs and COECs in clearance sample results, as described Section 3.3.3.

5.3. Areas of Soil to be Addressed by Removal Action

5.3.1. Extent of Site Soils Exceeding Removal Goals

Figures 8 and 9 show the locations of soil samples collected in previous Site investigations (Shaw, 2010) on the southern area of the Site with results for metals, TPH, and dioxins/furans analyses. Figures 10 and 11 show the locations of soil samples collected on the northern area of the Site with results for metals, TPH, and dioxins/furans analyses.

Figures 8 and 10 show the estimated extents of metals at concentrations exceeding RGs in surficial and subsurface soil, based on limited Site soil data (Shaw, 2010). Metals have only been documented in subsurface soil at concentrations exceeding RGs in the southern sampling area. All surface soil samples collected at the Site contain one or more metals COCs/COECs above RGs, therefore, it is emphasized that the extents of metals in surface soil above RGs shown in these figures (Figures 8 and 10) are estimated, and may vary significantly from the extents shown. The subsurface extent of metals COCs/COECS present above RGs in the southern Site area is similarly uncertain based on existing data and is therefore also estimated (Figure 8).

As noted above, the chromium RG is calculated using hexavalent chromium toxicity values. Therefore, the concentrations of total chromium in Site soil samples are not directly comparable to this RG, as only a fraction of total chromium exists as hexavalent chromium. Based on comparisons in Table 2, which includes total chromium and hexavalent chromium results for all samples with both values available, the mean of the ratios of the hexavalent chromium detection limit in each sample (which may be considered the maximum possible concentration of hexavalent chromium) to the total chromium concentrations in each sample is 0.13. In Table 19, an "estimated maximum hexavalent chromium concentration" is listed for all on-Site soil samples. This concentration is equal to either the hexavalent chromium detection limit (if hexavalent chromium was analyzed in the sample), or is a value calculated by multiplying the total chromium concentration by 0.13 (based on the mean hexavalent to total chromium ratio, Table 2). In samples where this estimated maximum concentration exceeds the chromium RG, it is notable that other metals are also present above RGs (Table 19). This suggests that, even if hexavalent chromium is present in soil samples at these maximum concentrations, it is not the only metal present at concentrations above RGs at these locations, and is therefore is not the only contaminant that determines the estimated area to be addressed by the removal action. In further investigations and the removal action undertaken at the Site, soil samples collected will be analyzed for hexavalent chromium to generate results that are comparable to the RG.

In addition to metals, other COCs/COECs were documented above RGs in apparently limited areas of subsurface soils in the northern and southern Site areas. These areas included an ash-rich soil sample collected from 1.5-2 feet bgs in test pit TP02 in the southern sampling area that contained an elevated concentration of dioxins/furans (see Figure 9), and samples collected from 1-2 feet bgs in test pit TP05 and test pit YWM05A (intended as a re-sampling of TP05, see Figure 11) that were collected from an area of apparent petroleum contamination (Shaw, 2010). Based on field observations from the 2001 and 2008 investigations, extents of these contaminants above RGs are considered likely to be associated with these visible features (ash layers, areas of petroleum contamination) and therefore to be more limited, however, the extents of these contaminants shown in Figures 9 and 11 are not defined by existing data and therefore are also estimated and may vary significantly from the extents shown.

5.3.2. Areas to Be Addressed by Removal Action

To achieve the RAO to prevent unacceptable risks to current and future human and ecological receptors, concentrations of COCs and COECs in soil throughout the Site that these receptors may be exposed to must be reduced, on average, to levels below RGs. As shown in Text Table 5-2 above, removal goals for the Site are set based on ecological receptor exposures, including those for burrowing mammals. Six feet bgs is the maximum depth to which metals COECs have been documented at the Site above RGs (see sample TP02-SO-1046, Figure 9). DTSC guidance regarding risk assessment for burrowing mammals indicates that exposure to soils up to 6 feet bgs must be considered (DTSC, 1998). Methods used to address soil exposure at the Site must therefore address potential ecological exposures to depths of 6 feet bgs. In accordance with this, the estimated extents of COCs and COECs at concentrations above RGs shown in Figures 8 through 11 are identified as the areas to be addressed by removal actions. This is to include surface soil and a limited area of subsurface soil in the northern sampling area, and surface soil and a more extensive area of subsurface soil in the southern sampling area.

5.3.3. *Pre-Design Investigation*

As described in the removal action alternative descriptions below, a pre-design investigation (PDI) is planned to be conducted prior to design and implementation of the removal action. The general objective of the PDI will be to collect additional surface soil data that confirms extents of COCs and COECs in surface soil above RGs in the northern and southern sampling areas at the Site.

For the removal action alternative involving placement of protective soil caps at the Site, a refined understanding of the extent of surficial soil contamination above RGs is necessary to allow for design of protective caps that will prevent exposure to these soils. The PDI conducted as part of the protective soil cap alternative (Alternative 2, see Section 6.2 below) will involve collection of surface soil samples only in both the northern and southern sampling areas. The goal of this sampling will be to confirm the lateral extent of surficial soil contamination and the areas to be covered in order to reduce Site-wide exposure to contaminants in surface soil to levels below RGs.

The PDI conducted as part of the alternative involving soil excavation and disposal at licensed off-Site facilities (Alternative 3, see Section 6.3 below) will include a similar surface soil sampling effort as described for Alternative 2, and will also include limited collection of subsurface soil samples within the estimated areas of subsurface soil contamination (see Figures 8-11), in order to allow for the collection of soil data that will be used to determine the waste classification of these soils and establish disposal profiles. Data from the PDI will be evaluated in combination with results from confirmation soil sampling conducted following the excavation activities with the objective of demonstrating that exposure to both subsurface and surface soil throughout the Site meets RGs.

For both alternatives, the scope of the PDI *does not* include the significant additional sampling of subsurface soil at the Site that would likely be required to confirm the extent of subsurface soil contamination above RGs.

6. Identification of Removal Action Alternatives

The purpose of this section it to present the removal action alternatives proposed to achieve the RAOs identified in Section 5.

The selected removal action must meet the RAOs and comply with ARARs. The location of the Site within a unit of the National Park System must be considered when evaluating removal alternatives. The following potential removal actions were rejected following a preliminary screening of alternatives:

- In- or Ex-Situ Solidification/Stabilization (S/S) of Contaminated Soils: Solidification refers to processes that transform contaminated media into a solid or semi-solid form, encapsulating contaminants by physically binding or cementing the containing media. Stabilization involves chemical reactions that reduce the leachability of contaminants from the media. Solidification and stabilization involve different processes but are similar in their outcomes; both treatment types have been demonstrated to reduce mobility of metals and other contaminants in the environment. This alternative was rejected in the preliminary stage for the following reasons (Evanko and Dzombak, 1997; USEPA, 2018):

    - S/S does not reduce toxicity of contaminants present at the Site. While solidification may reduce the exposure potential for ecological receptors, stabilization does not, as burrowing receptors and plant root systems will still come in direct contact with the contaminated media. Therefore, stabilization would not achieve the risk reduction RAO. Degradation is known to occur in media treated by solidification, such that while solidification may achieve this RAO initially, its effectiveness in this regard may not be permanent.
    - There is relatively little evidence documenting the effectiveness of S/S in treating dioxins/furans and petroleum contamination.
    - In-situ application of S/S, which involves use of large drilling rigs and significant amounts of other equipment, is not feasible in Site soils that contain large particles (cobbles and boulders). Ex-situ application of S/S requires excavation and treatment of soils, before either returning the soils to the Site or disposing offsite. Given the very small scale of the Site and significant mobilization costs associated with S/S, this process is not likely to provide significant cost savings over the alternatives described below, and provides a lesser (and less permanent) reduction in the exposure to potentially toxic material left on-Site.
    - The variety of metals and other contaminants present in Site soil, which respond differently to solidification and especially stabilization treatments, prevents ready implementation of S/S.

- Ex-Situ Washing of Contaminated Soils: Soil washing (SW) uses mobile or fixed base washing equipment to remove contaminants from excavated contaminated soil materials by dissolving or suspending them in a liquid wash or solvent solution, and/or by concentrating them in a smaller volume of soil through particle size separation, gravity separation, or other physical processes. Washed soils contain a lower concentration of contaminants and may be replaced at the Site. Concentrate materials produced by SW, which for the Site may include fine fractions of soil materials that contain higher fractions of Site contaminants, may be treated to remove contaminants before being replaced at the Site, or (as is considered more likely), disposed of off-Site. SW technologies have been applied to sites with metals, diesel fuel, and heavy oil contamination. This alternative was rejected in the preliminary stage for the following reasons (FRTR, 2020; USEPA, 2020):

- Treatment of mixed contaminants (e.g., metals with organics) makes identifying an appropriate washing fluid difficult. Mixed contaminants are present at the Site and must be addressed.
- Available data does not demonstrate that SW would be effective to address Site contamination. Significant treatment testing/pilot studies would be required to gain an understanding of how likely SW would be to achieve RAOs at the Site.
- The level of contaminants in concentrates produced by the SW process are considered likely to qualify as hazardous waste and would likely require additional treatment to meet land disposal restrictions for off-Site disposal or safe re-use on Site.
- The assumption that fine soil particles contain higher concentrations of contaminants, which is important to the feasibility of physical soil washing approaches, may not apply at this Site, where larger fragments of waste material in the soil may contain significant concentrations of contaminants that may continue to leach into surrounding soil if replaced at the Site.
- Given the very small scale of the Site and significant mobilization costs associated with SW equipment and treatments, this process is not likely to provide significant cost savings over the excavation alternatives described below, and provides a lesser reduction in the toxicity of material left on-Site if washed soils are returned to the Site.

The following removal action alternatives were retained for further analysis:

1. No Action
2. In-Place Capping of Contaminated Soils
3. Excavation and Off-Site Disposal of Contaminated Soils

Consistent with the NCP, a No Action alternative is considered to provide an environmental baseline against which impacts of the other alternatives can be compared. Each alternative is described in the following subsections. Cost estimate details for each alternative are provided in Appendix D.

These removal action alternatives are evaluated and compared using the criteria specified in *Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA* (USEPA, 1993a). Evaluation criteria are used to compare removal action alternatives in the areas of effectiveness, implementability, and cost. The evaluation criteria and subcriteria are:

Effectiveness

- Overall Protection of Human Health and the Environment – This subcriterion evaluates how each alternative achieves adequate protection and describes how the alternative will reduce, control, or eliminate risks at the NTCRA area using treatment, engineering, or institutional controls. This evaluation should identify any unacceptable short-term impacts.

- Compliance with ARARs and Other Criteria, Advisories, and Guidance – This subcriterion evaluates how each alternative addresses and complies with federal and state ARARs (statutes) and other criteria, advisories, and guidance that are typically identified as TBC information. A detailed alternative analysis of the compliance with ARARs for each removal alternative is presented in Appendix E.

- Long-Term Effectiveness and Permanence – This subcriterion evaluates the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes in the NTCRA area. Magnitude of risk and adequacy and reliability of controls are specific factors evaluated.

- Reduction in Toxicity, Mobility, or Volume through Treatment – This subcriterion evaluates the USEPA's policy of preference for treatment (e.g., use of technologies that will permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances as their principal element).

- Short-Term Effectiveness – This subcriterion evaluates the effects of the alternative during implementation before the removal objectives have been met. Alternatives should be evaluated with respect to their effects on human health and the environment following implementation. Protection of the community and workers, environmental impacts, and time until response objectives are achieved are specific factors evaluated.

Implementability

- Technical Feasibility – This subcriterion evaluates the ability of the technology to implement the removal action. The reliability of the technology is of concern as technical problems associated with implementation may delay the schedule.

- Administrative Feasibility – This subcriterion evaluates those activities needed to coordinate with other offices and agencies. The administrative feasibility of each alternative should be evaluated, including the need for off-site permits, adherence to applicable non-environmental laws, and concerns of other regulatory agencies. Statutory limits, permits, and waivers are specific factors evaluated.

- Availability of Services and Materials – This subcriterion determines if off-site treatment, storage and disposal capacity, equipment, personnel, services and materials, and other resources necessary to implement an alternative will be available in time to maintain the removal schedule. Availability of funds to meet PRSC requirements is also a factor.

- State Oversight Agency Acceptance – This subcriterion evaluates the State of California's (through the DTSC) anticipated response to and acceptance of a removal action alternative.

- Community Acceptance – This subcriterion evaluates the public's anticipated response to and acceptance of a removal action alternative.

Cost

- Direct Capital Costs, Indirect Capital Costs, and Annual PRSC Costs – This subcriterion evaluates the capital for materials, equipment, and related items. Cost estimates for each removal action alternative were developed in accordance with A Guide to Developing and Documenting Cost Estimates during the Feasibility Study (USEPA, 2000).

The last two subcriteria of implementability—State Acceptance and Community Acceptance—are not directly evaluated in this EE/CA. The state agency acceptance and the community acceptance criteria are evaluated when the Draft Final EE/CA is released for public comment. These two subcriteria are extremely significant; careful planning and consideration are required to gain adequate acceptance.

6.1. Alternative 1: No Action/No Further Action

Consistent with the NCP and CERCLA guidance, a "no action" alternative is considered as a baseline for comparison. Under this alternative, no additional monitoring or maintenance would be performed. This alternative would leave contaminated soil in its current state, and no action would be initiated at the Site to address contaminated soil or otherwise mitigate the associated risks to human health or the environment. Alternative 1 (No Action) would not meet the RAOs for the Site.

6.1.1. Effectiveness

This section evaluates the alternative's ability to meet the RAOs as defined in Section 5. The effectiveness of the alternative is discussed relative to its ability to achieve the criteria of protectiveness of human health and the environment, its ability to eliminate or minimize contaminant-related constraints on the full enjoyment and utilization of park resources, and its ability meet other ARARs.

Overall Protection of Public Health and the Environment

This section provides an evaluation of whether the removal action alternative provides adequate protection of public health and the environment in both short- and long-term time frames. The overall protectiveness of the alternative is evaluated based on its ability to eliminate or acceptably reduce exposure to hazardous substances, pollutants, or contaminants.

- Exposure to contaminated soil exceeding recommended RGs would not be addressed, as contaminated soils would be left in their current condition.

- Contaminated soil exceeding recommended RGs would result in unacceptable exposures to ecological receptors.

- Since removal activities are not performed under this alternative, it does not meet any of the RAOs for contaminated soil.

- This alternative is not protective to human health and environment; however, it is considered as a baseline for comparison to other removal action alternatives.

Compliance with ARARs and Other Criteria, Advisories, and Guidance

This section summarizes the key ARARs. A detailed analysis of all ARARs is presented in Appendix E.

- Chemical-specific and action-specific ARARs would not be pertinent to this alternative since no new response measures would be taken.

- National Park Service Organic Act of 1916, General Authorities Act as amended, and Yosemite National Park enabling legislation: Compliance with the Organic Act and the non-impairment mandate would not be attained since no new response measures would be undertaken to address human health and ecological risks and would not allow for full enjoyment and utilization of park resources.

- Other location-specific ARARs would not be pertinent since no new response measures would be undertaken.

Long-Term Effectiveness and Permanence

Magnitude of Risk

- No removal action would be undertaken to address contaminated soil.

- Contaminated soil exceeding recommended RGs would be left unaddressed and would result in unacceptable exposures to ecological receptors.

Adequacy and Reliability of Controls

- No controls would be put in place under the no action alternative.

Reduction of Toxicity, Mobility, or Volume Through Treatment

- This alternative would not treat contaminated soil; thus, there would be no reduction of toxicity, mobility, or volume of contamination through treatment.

- The preference for treatment as a principal element of the removal action would not be met.

Short-Term Effectiveness

This section provides an evaluation of the effects that may occur during implementation of the alternative before RAOs are been met. The alternative is assessed for each of the factors presented in the following sections.

Protection of the Community

- No further removal action would be undertaken. Thus, there would be no potential adverse community impacts resulting from implementing the alternative.

Protection of Workers

- No removal action would be undertaken. Thus, there would be no potential adverse worker impacts resulting from implementing the alternative.

Environmental Impacts

- No removal action would be undertaken. Thus, there would be no potential adverse environmental impacts resulting from implementing the alternative.

Time Until Response Objectives Are Achieved

- No removal action would be undertaken to address contaminated soil. Thus, protection would not be achieved under this alternative.

6.1.2. Implementability

This section provides an evaluation of the technical and administrative feasibility of implementing the alternative and the materials and services that would be required for its implementation.

Technical Feasibility

- No removal action would be undertaken to address contaminated soil; thus, no technical difficulties would be encountered.

Administrative Feasibility

This section provides an evaluation of the activities needed for coordination with other offices and agencies relative to the factors presented in the following sections.

Statutory Limits on Removal Actions

- NPS will undertake any removal action at this Site as a federal agency, on federal land, using funds appropriated for this purpose. Therefore, CERCLA Section 104(c)(1) limitations on the duration and cost of removal actions will not apply for actions undertaken at the Site.

Permits Required

- No removal action would be undertaken to address contaminated soil; thus, there is no need to obtain approvals or permits from regulatory agencies for off-site activities.

Availability of Services and Materials

This section provides an evaluation of the alternative's ability to meet the removal schedule based on the logistical considerations and the available services and materials.

Off-site Treatment, Storage, and Disposal

- No removal action would be undertaken to address contaminated soil; thus, this criterion is not applicable.

Personnel and Technology, Services and Materials, and Prospective Technologies

- No removal action would be undertaken to address contaminated soil; thus, this criterion is not applicable.

State (Support Agency) Acceptance

- This criterion is not directly evaluated in this EE/CA. For a detailed explanation refer Section 6.5.

Community Acceptance

- This criterion is not directly evaluated in this EE/CA. For a detailed explanation refer Section 6.6.

6.1.3. Cost

No action is taken under Alternative 1, therefore, there is no cost associated with this alternative.

6.2. Alternative 2: In-Place Capping of Contaminated Soils

Alternative 2 provides for protection of human health and the environment through in-place containment (covering with a protective soil cap) of contaminated soils exceeding recommended RGs in conjunction with monitoring of cap integrity. The estimated extents of the proposed cap areas used to formulate cost estimates and evaluate this alternative are shown in Figure 12. The caps would address RAOs by serving as a protective barrier for ecological receptors from exposure to contaminated soil. Surface grading of the caps would direct stormwater run-on and run-off to protect the integrity of the surface cover, though no impermeable layers would be required in the construction to meet RAOs. The capping would cover an area of approximately 4,400 square feet.

Implementation of this removal action is planned to be preceded by a PDI, consisting of the collection of surface soil samples to characterize the extent of contaminated soils at the Site and allow a protective removal action design to be created. Soil samples are planned to be collected using the incremental sampling methodology (ISM; ITRC, 2020). Surface soil samples will be collected in both the northern and southern sampling areas using hand tools. Soil samples will be arranged to attempt to confirm the extent of contaminated surface soil and to verify that the planned extents of the cap areas will be sufficient to address human and ecological exposure risks and meet the RGs based on Site-wide exposures. No subsurface soil samples would be collected. Based on the findings of the PDI, the extents of areas requiring cap coverage may vary from those shown in Figure 12, with impacts on cost and potentially other evaluation criteria.

Protective soil caps would be installed over areas of contaminated soil, in order to reduce the concentrations of COCs and COECs in surface soils throughout the Site to levels below RGs. The contaminated soil surface would be covered with a biointrusion layer followed by a fine layer of pea gravel and an engineered layer of soil. The biointrusion layer, which would consist of crushed rock, would provide a barrier to prevent burrowing mammals and plant root systems, ecological receptors of concern identified in the BERA, from reaching the contaminated soils located beneath this layer. A pea gravel layer would be placed between the crushed rock and overlying subsoil layer to prevent sifting of the overlying soil. A subsoil layer would be placed between the pea gravel and the overlying topsoil in an arrangement mimicking natural conditions, where a subsoil layer underlies the thinner layer of topsoil. The topsoil layer would provide a surface layer that would approximately match the soil types present in the surrounding area. The cap would sit approximately 2.5 feet higher in elevation than the original ground surface height in the capped area, and would be sloped at the margins to meet the surrounding ground surface. The cap surface would be designed to minimize potential for degradation of the cap by erosion.

The cap will be constructed from soil materials sourced within the Park, to the extent that the necessary materials are available. Soils suitable for use as subsoil and topsoil are expected to be available from NPS-managed native soil stockpiles in Yosemite Valley. Soil to be placed as topsoil will be from NPS stockpiles that have been treated by NPS to reduce the prevalence of invasive species. Rock and gravel materials are not expected to be available from Park sources, and will need to be imported from outside of the Park. Imported rock and gravel will be tested to ensure that contamination is not present in these materials. This cap construction process would be refined at the time of design, based on better understanding of Site conditions and removal action requirements.

Prior to the removal action, NPS vegetation staff will document the vegetation present in the area, and collect seed from existing non-invasive plants present at the Site and vicinity. Following completion of the removal action, NPS staff will complete revegetation activities using collected seed, with the goal of restoring the Site to its natural state. Revegetation on the cap surface would be limited to shallow-rooted species not likely to threaten the integrity of the cap. Invasive species control activities will be completed by NPS immediately following the completion of revegetation activities, and annually for three years thereafter.

The caps would be protective of ecological exposure risk by preventing burrow and root intrusion into the capped areas of contaminated soil, as described above. Given the Site's wilderness location, no future soil disturbing activities that may pose exposure risks to park employees or construction workers are anticipated, however, if these activities were to take place, safety protocols and procedures would be established to be protective of these human receptors.

Implementation of this alternative would require clearing and grooming of an existing road trace leading from Hetch Hetchy Road to the areas of contamination at the Site. The tentative route of this road is shown in Figure 12. The road would be required to provide access for equipment and import of earthen materials to the cap installation areas. Following completion of construction for this alternative, the temporary road would be removed, and the disturbed area would be restored to pre-existing conditions as part of the revegetation effort to be conducted by NPS.

In the detailed cost estimates (Appendix D), post-construction monitoring and maintenance costs are included for a 30-year term following cap installation, following requirements in ARARs. Post-construction monitoring and maintenance specific to this alternative would consist of re-surveying of the cap surfaces on a five-year interval, and non-intrusive (surface) visual inspection and repair, as necessary and at a minimum annually, to the caps to maintain their integrity. A cap integrity monitoring and maintenance program would be implemented to ensure the long-term ability of the cap to endure erosion related to precipitation, snowmelt, and wind, as well as degradation that may occur as a result of other natural processes. Maintenance would include placement of additional topsoil and subsoil materials as needed to make up for erosion losses and inspection and care of vegetation on and around the cap surfaces. Cap surface vegetation would be controlled to include non-invasive plant species appropriate for the Site's location within the park, and of a shallow-rooted growth habit that is not likely to threaten cap integrity or effectiveness (e.g., native grasses or small shrubs).

Since contaminated soil would be left in place under this alternative, periodic reviews would be required every five years per CERCLA and state requirements. Monitoring (consisting of a survey of the cap surfaces and detailed non-intrusive visual inspections) would be performed to complete the five-year Site reviews.

Text Table 6.2 provides a summary of the major removal action components for Alternative 2 and the estimated quantities for these components.

Text Table 6.2 Summary of Quantities for Major Removal Action Components – Alternative 2		
Removal Action Component	**Unit**	**Estimated Quantity**
Estimated horizontal extent of in-place capping	SF	4,400 (0.1 acres)
Estimated in-place volume of topsoil layer for cover	CY	82
Estimated in-place volume of sub-soil layer for cover	CY	163
Estimated in-place volume of pea gravel layer for cover	CY	28
Estimated in-place volume of biointrusion layer (crushed rock) for cover	CY	163

Notes:
Quantities summarized in this table and additional quantities for secondary components of alternatives are provided in Appendix D. Although detailed quantities have been provided, they should be considered approximations for EE/CA evaluation purposes only.
CY – cubic yard, SF – square foot

6.2.1. Effectiveness

This section evaluates the alternative's ability to meet the objective of the removal action as defined in Section 5. The effectiveness of the alternative is discussed relative to its ability to achieve the criteria of protectiveness of human health and the environment and its ability meet ARARs while satisfying the project's RAOs.

Overall Protection of Public Health and the Environment

This section provides an evaluation of whether the removal action alternative provides adequate protection of public health and the environment in both short- and long-term time frames. The overall protectiveness of the alternative is evaluated based on its ability to eliminate or acceptably reduce exposure to hazardous substances, pollutants, or contaminants.

- The RAOs would be achieved through in-place capping of contaminated soil in order to reduce potential exposure to contaminants in soil throughout the Site to levels that meet Site RGs. The RAO to eliminate or minimize contaminant-related constraints to the full enjoyment and utilization of park resources would be achieved because, once vegetation was established on the capped areas, these areas would be available for human and ecological use and would not detract from the wilderness character of the Site.

- The biointrusion layers of the protective soil caps would provide an ecological exposure barrier and eliminate exposure to contaminated soils.

- Dust suppression would be performed during cap construction to eliminate contaminant migration during implementation of this alternative.

- The protective cap surfaces would be sloped to promote positive drainage to minimize erosion of the cap materials. The cover and grading/drainage control would reduce the potential risk of surface water impacts from transportation of contaminated soil particles or dissolved contaminants in surface water runoff from areas of surface soil contamination.

- Monitoring and maintenance would be performed after construction to ensure continued protectiveness of the remedy.

Compliance with ARARs and Other Criteria, Advisories, and Guidance

This section summarizes the key ARARs. A detailed analysis of all ARARs is presented in Appendix E.

Compliance with Chemical-specific ARARs

- Permissible Exposure Limits: Standards for worker exposure to airborne contaminants would be complied with during the implementation of the removal action through use of dust control and appropriate personal protective equipment (PPE) as well as other methods.

Compliance with Location-specific ARARs

Location-specific ARARs for the remedy would be addressed during implementation of the removal action.

- National Park Service Organic Act of 1916, General Authorities Act as amended, and Yosemite National Park enabling legislation: Surface grading and capping with a soil cap that includes a biointrusion layer would be compliant with the Organic Act and the non-impairment mandate because it would not restrict nor otherwise limit the enjoyment of the park by future visitors. The Site is located within a wilderness area, therefore, no future improvement or development of the area is planned. Implementation of the soil cap remedy will create slight changes in Site topography, but the surface layer and vegetation cover will be comparable to the current surface layer of the surrounding area, thus resulting in a remedy that addresses the human health and ecological risks while also complying the non-impairment mandate.

- NPS restrictions of public use and recreation activities to protect national park resources: The activities under this alternative would be carried out in a manner compliant with substantive requirements of the 36 CFR Part 2 and Part 7.

- NPS restrictions of commercial and private operations in national parks, including the prohibition of nuisances: The activities under this alternative would be carried out in a manner that compliant with substantive requirements of the 36 CFR Part 5 and 36 CFR Section 5.13.

- NPS policies for restoration of natural systems: Disturbed areas that were previously vegetated would be re-established with native plant species. Revegetation will be completed by NPS staff using processes compliant with these policies. Cap maintenance activities would be tailored to encourage development of non-invasive vegetation in these areas.

- National historic preservation and archeological resources protection: As a FWDA, the Site is known to contain archeological resources. Coordination with NPS and State cultural resources staff and officials will be conducted during remedial design and removal action planning to ensure compliance with these ARARs during the PDI and implementation of the removal action.

- Endangered species: If threatened or endangered species are identified within removal areas, activities will be designed to conserve the species and their habitats.

- Wilderness Act: This alternative requires the use of methods that are prohibited at the Site by this ARAR, except as necessary to meet the minimum requirements for preservation of wilderness values. The removal action is considered necessary to preserve these values. To fully comply with this ARAR, a minimum requirements analysis may be required to document the decision to proceed with a removal action.

- Birds: If birds of prey, fully protected bird species, and/or migratory birds are identified within removal areas, activities will be designed to conserve the birds and their habitats.

- Fully protected mammals: If ring-tailed cat, Sierra Nevada bighorn sheep, and/or their habitats are identified within removal areas, activities will be designed to conserve the mammals and their habitats.

- Fur-bearing mammals: If fisher, marten, river otter, desert kit fox, and red fox, and/or their habitats are identified within removal areas, activities will be designed to conserve the mammals and their habitats.

- Specially protected mountain lion: If mountain lions and/or their habitat are identified within removal areas, activities will be designed to conserve the protected mountain lions and their habitat.

- Fully protected reptiles and amphibians: If certain fully protected species of reptiles and amphibians and/or their habitats are identified within removal areas, activities will be designed to conserve the protected reptiles and amphibians and their habitats.

- Rare or endangered native plants: If rare or endangered native plants are identified within removal areas, activities will be designed to conserve endangered or rare native plants.

Compliance with Action-specific ARARs
Action-specific ARARs for the remedy would be addressed during implementation of the removal action.

- Covering of contaminants, final grading, slope stability, and drainage and erosion control would comply with these ARARs as allowed in 27 California Code of Regulations (CCR) Division 2, Subdivision 1, Chapter 3, Subchapter 5, Article 2 Sections 21140(a), 21142(a), 21145(a), and 21150(a and c)

- Closure and post-closure care, maintenance requirements, surveying, monuments, vegetation, security requirements, and restriction on disturbance of cover would be performed in compliance with the requirements of 22 CCR Division 4.5, Chapter 14, Article 7 Section 66264.117 (b through d), Article 14 Section 66264. 310 (a) (2 through 5) and (b) (1, 4 through 5), and 27 CCR Sub-div. 1, Chapter 3, Sub-chpt. 5, Article 1, Section 20950 (d through e)

- Monitoring and inspection of the cover would comply with 22 CCR, Division 4.5 Chapter 14, Article 14 Section 66264.303 (a: 1 through 2)

Long-Term Effectiveness and Permanence

Magnitude of Risk

- Long-term effectiveness would not be entirely ensured since contaminated soils potentially posing a risk are left on-site (although covered).

- Monitoring would be performed to evaluate long-term effectiveness and permanence of the remedy. Maintenance would be performed as necessary to protect the integrity of the remedy.

- The Site's location in a designated wilderness would minimize the potential for future uses that may compromise the remedy.

- An additional soil management plan would be put in place to provide protection for future construction workers with protocols and safety precautions for any intrusive activities into the capped areas involving impacted soil.

Adequacy and Reliability of Controls

- Contaminated soil would be addressed through in-place containment (capping). The horizontal extent of the covering is approximately 4,400 square feet.

- With proper construction and maintenance, the caps would eliminate exposure of contaminated soil to ecological receptors. Migration of contamination to air would be eliminated and migration of contamination to surface water would be reduced or eliminated.

- Long-term effectiveness and permanence of caps would be dependent on inspection and repair, as necessary, to covers to maintain their integrity. Periodic monitoring and maintenance of caps would need to be performed in perpetuity.

- Long-term effectiveness and permanence of caps may decrease over time if burrowing mammals are able to breach the biointusion layer and penetrate the covers. Preventative maintenance to address potential breaches would be required to maintain integrity.

- Long-term effectiveness and permanence of caps may decrease over time if woody vegetation became established and penetrated the covers. Preventative maintenance to address woody vegetation would be required to maintain integrity.

- The northern cap is in an area of low to moderate slope (10-15 degrees), a factor which may intensify maintenance requirements to address the increased potential for erosion in this area.

Reduction of Toxicity, Mobility, or Volume Through Treatment

"Treatment", for the purposes of this evaluation, is defined as "any method, technique, or process…designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such waste or so as to render such waste nonhazardous, safer for transport, amenable for recovery, amenable for storage, or reduced in volume", following the definition in 42 USC § 6903.

- There is no reduction of toxicity, mobility, or volume through treatment for contaminated soil because the contaminated soil would be solely addressed by in-place capping.

- The preference for treatment as a principal element of the removal action would not be met.

Short-Term Effectiveness

This section provides an evaluation of the effects that may occur during implementation of the alternative before RAOs are been met. The alternative is assessed for each of the factors presented in the following sections.

Protection of the Community

- Short-term impacts to the community include generation of dust, noise, vehicle emission, and traffic during implementation; however, the impacts would be relatively minor as the time and materials required for implementation of the removal action alternative is relatively small.

- Work area restrictions (such as exclusion zones) would be implemented during construction to reduce short-term exposure risks to the community.

- Some degree of traffic congestion may result from implementation of this alternative due to increased truck traffic. Traffic control workers and signage near the entry to the Site off of Hetch Hetchy Road would limit traffic congestion, minimize emissions, and prevent automobile-related accidents.

- Implementation of the alternative would be planned to be performed during low-tourist season to prevent traffic congestion and minimize impact to park visitors.

Protection of Workers

- Surface disturbance of contaminated soils could pose short-term risks to workers installing covers.

- Safety measures such as dust suppression, use of personal protective equipment (PPE), and establishment of work zones would protect workers and the community during implementation.

- Other potential impacts could be from safety hazards during implementation, such as falls and mechanical hazards. These other potential impacts would be mitigated through adherence to safety requirements and standard operating procedures.

Environmental Impacts

- There may be impacts to the environment during the implementation of the removal action due to the use of heavy construction and hauling equipment and import of cover materials from outside the Site. Use of fuel-efficient and low-emission equipment could reduce environmental impacts.

- Implementation of this alternative would require the clearing and grooming of an existing temporary access road for importing materials and equipment to the Site. The extent of these impacts would be mitigated by minimizing the footprint of the access road and avoiding sensitive areas.

- Implementation of this alternative requires use of methods that normally are prohibited in designated wilderness. An analysis of this removal action with respect to the minimum requirements for preservation of the Site's wilderness character may be required to proceed.

- The alternative would involve surface disturbance of contaminated soils that could pose potential adverse impacts through dispersion of dust. Water- or chemical-based suppression would be used for controlling contaminated soil and dust during construction.

Time Until Response Objectives Are Achieved

- The removal action alternative could be implemented in approximately 1 year or less. The duration of construction for this alternative is expected to be less than 1 month.

6.2.2. Implementability

This section provides an evaluation of the technical and administrative feasibility of implementing the alternative and the materials and services that would be required for its implementation.

Technical Feasibility

Technical Difficulties

- Logistics for working with heavy equipment and many trucks at the Site could be difficult to manage, given the Site's small size.

- Delays in the PDI sampling and cap installation could be experienced due to the likely presence of cultural artifacts at the Site and the time required to handle and inspect the potential artifacts.

- Traffic congestion could cause minor delays due to trucking of off-site materials to the Site.

Reliability of Technology

- Construction of caps and implementation of monitoring is relatively straightforward and can be implemented using available equipment and labor resources.

- Some cap construction materials would be required from off-site sources outside the park, which could potentially delay the schedule.

Potential Difficulty to Implement Future Remedial Actions or PRSC Measures

- Capping activities as part of this alternative do not preclude future response actions at the Site.

Ability to Monitor Effectiveness

- Inspection, monitoring, and maintenance of the proposed covers is relatively straightforward and can be easily implemented using available materials, equipment, and labor resources.

Administrative Feasibility

This section provides an evaluation of the activities needed for coordination with other offices and agencies relative to the factors presented in the following sections.

Statutory Limits on Removal Actions

- NPS will undertake any removal action at this Site as a federal agency, on federal land, using funds appropriated for this purpose. Therefore, CERCLA Section 104(c)(1) limitations on the duration and cost of removal actions will not apply for actions undertaken at the Site.

Permits and Other Administrative Actions Required

- The protective cap construction activities of the removal action will be performed within the removal action area inside the boundaries of the Site; thus, no off-site permits would be required.

- The protective soil caps will be installed in a wilderness area within a National Park, and therefore future disturbance of the soil caps is highly unlikely. However, NPS may require institutional controls to be put in place to ensure that no human activity is allow to impact the soil caps.

Coordination with Other Offices and Agencies

- Implementation of this alternative requires use of methods (use of heavy equipment, installation of a short temporary road) that are prohibited in designated wilderness. An analysis of this removal action with respect to the minimum requirements for preservation of the Site's wilderness character may be required to proceed.

- Because of the likely presence of historic and cultural resources at the Site, this alternative would require coordination with the state historic preservation office (SHPO).

- Implementation of this alternative is likely to require occasional traffic stoppages along Hetch Hetchy Road affected by traffic control flaggers in order to allow trucks to enter and leave the Site, which may require coordination with Park offices and other authorities to schedule and approve.

Availability of Services and Materials

This section provides an evaluation of the alternative's ability to meet the removal schedule based on the logistical considerations and the available services and materials.

Off-site Treatment, Storage, and Disposal

- This alternative would not require off-site treatment, storage, and disposal services. Thus, this criterion is not applicable.

Personnel and Technology, Services and Materials, and Prospective Technologies

- Labor, equipment, and materials for cap construction are available.

- Labor, equipment, materials, and laboratory services required for conducting the PDI are available.

- Some cap construction materials are available from NPS-managed sources within the Park. Other cap construction materials would be required from off-Site sources acceptable to NPS.

- Technical equipment and specialists are available for monitoring and maintenance of the covers.

- Technical equipment and specialists are available for site inspections that would be required under five-year Site reviews.

State (Support Agency) Acceptance

- This criterion is not directly evaluated in this EE/CA. For detail explanation refer Section 6.5.

Community Acceptance

- This criterion is not directly evaluated in this EE/CA. For detail explanation refer Section 6.6.

6.2.3. Cost

This section provides an evaluation of the costs associated with implementing the removal action alternative. Evaluation of cost for Alternative 2 is provided in in Text Table 6.2.3 using the evaluation criteria considerations. Detailed cost estimates for this alternative are included in Appendix D.

Text Table 6.2.3 Cost Evaluation Summary – Alternative 2

Evaluation Factors for Cost	Approximate Cost (Dollars)
Total capital cost	$355,000
Total annual PRSC cost	$10,000 annually, plus $26,000 every 5 years
Total cost (excluding present value discounting)	$829,000
Total present value cost	$551,000

Note:
Total costs are for the assumed period of analysis (Years 0 through 30). Costs are rounded to the nearest $1,000.

6.3. Alternative 3: Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities

Alternative 3 provides protection of human health and the environment through excavation and disposal of contaminated soil exceeding recommended RGs to meet the established RAOs for the

Site. Excavation would target contaminated soil exceeding recommended RGs, as identified in Section 5.3. Excavated contaminated soil would be transported and disposed of at existing licensed disposal facilities outside the boundaries of the Site.

Figure 13 illustrates the areas of the Site that would require excavation, along with the estimated depths of excavation anticipated to be required. It is assumed that exceedances of recommended RGs in subsurface soils would necessitate removal action up to a depth of 6 feet. These areas are the basis for the development of costs associated with this alternative. The 6 foot soil removal depth is based on the assumed depth to which burrowing mammals may be exposed (DTSC, 1998). Six feet is also the maximum depth to which contaminated soils containing concentrations of contaminants above Site RGs have been detected. RGs are based on ecological exposure risk-based PRGs, which were lower than human health risk-based PRGs. Therefore, this alternative is developed and evaluated under the assumption that RGs will be complied with throughout the Site and no limitations on use or exposure will need to put in place following implementation of the removal action. The estimated total volume of contaminated soil to be excavated under Alternative 3 is approximately 310 cubic yards (CY). Much of the soil to be exported from the Site is assumed to be profiled as California hazardous waste, while a smaller portion is assumed to be profiled as RCRA hazardous waste. Approximate volumes of each type of waste used in generation of the cost estimate are shown in Text Table 6.3 below.

Design and implementation of this removal action is planned to be preceded by a PDI, consisting of the collection of surficial and subsurface soil samples. In this PDI, surface soil and subsurface soil samples will be collected from both the northern and southern areas of the Site:

- Surface and subsurface samples will be collected from the areas that are planned to be excavated. These samples will be analyzed as required to determine their waste classification and allow for waste disposal profiling. Collection of this data in advance the excavation activities will allow for more efficient completion of the excavation.

- Surface soil samples will also be collected from the areas surrounding the planned excavation areas to confirm the extent of surface soils containing concentrations of contaminants above RGs, thus allowing for design of a protective removal action. No subsurface soil samples will be collected from these areas.

Soil samples are planned to be collected using the incremental sampling methodology (ISM; ITRC, 2020). Subsurface soil samples will be collected using a direct push drilling rig. Surface soil samples will be collected using hand tools. Based on the findings of the PDI, the extents of areas requiring excavation and the volumes of each waste classification anticipated to be removed from the Site may change, with impacts on cost and potentially other evaluation criteria.

Mechanical excavation of contaminated soils would be conducted in areas of identified surface and subsurface soil contamination to depths up to 6 feet bgs, as shown in Figure 13. Following completion of soil excavation activities, confirmation soil samples will be collected from the bottoms and sidewalls of the excavation. Results from these samples will be evaluated along with data collected during the PDI to ensure that, following completion of excavation activities, potential exposure to subsurface and surface soil left in place throughout the Site meets RGs. Excavation would be scheduled during the dry season, to minimize potential surface water or snowmelt runoff concerns. Dust suppression would be maintained to eliminate contaminant migration during implementation of this alternative and reduce the exposure of contaminated soil to workers. Dust suppression would be maintained to eliminate contaminant migration during implementation of this alternative and reduce the exposure of contaminated soil to workers.

Mechanical transportation is assumed to haul contaminated soils for off-site disposal. The contaminated soils would be disposed of at existing licensed disposal facilities. Waste classification would be performed in accordance with Section 20210 of CCR Title 27, using results collected during the PDI. Excavated materials that contain hazardous waste would be transported to a RCRA hazardous waste landfill (permitted to receive, store, and treat landfill RCRA hazardous waste streams) for incidental treatment to meet ARARs (e.g., land disposal restrictions [LDRs]) and for disposal. California hazardous excavated materials would be transported to other appropriate landfill facilities for disposal. At this time, it is estimated that 50% of the subsurface soil volume to be excavated in the southern excavation area (105 CY) will be profiled as RCRA hazardous waste soil, while other soils excavated from the Site will profile as California hazardous waste. Based on the results of the PDI, waste classifications and estimated volumes of each classification to be removed from the Site will be refined.

Following completion of the excavation of the areas shown in Figure 13, confirmation soil sampling will be completed. Soil samples will be collected from the bottoms and sidewalls of the excavations in the northern and southern areas of the Site where excavation was conducted, from surface (ground surface to 6 inches bgs) and subsurface (greater than 6 inches bgs) soil depth ranges. These samples will be submitted for laboratory analysis; analytical results will be compared to Site RGs to verify that the concentrations left in place will not result in an exceedance of the RGs throughout the Site.

Soil used to backfill excavation areas are expected to be available from NPS-managed stockpiles of native soil in Yosemite Valley. Soil to be placed as topsoil in excavation areas will be from NPS stockpiles that have been treated by NPS to reduce the prevalence of invasive species.

Prior to the removal action, NPS vegetation staff will document the vegetation present in the area, and collect seed from existing non-invasive plants present at the Site and vicinity. Following completion of the removal action, NPS staff will complete revegetation activities in areas disturbed during the removal action using collected seed, with the goal of restoring the Site to its natural state. Invasive species control activities will be completed by NPS immediately following the completion of revegetation activities, and annually for three years thereafter.

Implementation of this alternative would require clearing and grooming of an existing road trace leading from Hetch Hetchy Road to the areas of contamination at the Site. The tentative route of this road is shown in Figure 13. The road would be required to provide access for equipment and native fill soils to the excavation areas. Following completion of excavation and backfilling activities for this alternative, the temporary road would be removed, and the disturbed area would be restored to pre-existing conditions as part of the revegetation effort to be conducted by NPS.

Text Table 6.3 provides a summary of the major removal action components for Alternative 3 and the estimated quantities for these components.

Text Table 6.3 Summary of Quantities for Major Removal Action Components – Alternative 3

Removal Action Component	Unit	Estimated Quantity
Estimated surface area of contaminated soils for excavation	SF	2,600
Estimated in-place volume of contaminated soil to be excavated	CY	310
Estimated weight of California hazardous waste for off-site disposal	TN	290
Estimated weight of RCRA hazardous waste for off-site disposal	TN	150
Estimated volume of clean soil for backfill of excavations	CY	400

Notes:
Quantities summarized in this table and additional quantities for secondary components of alternatives are provided in Appendix D. Although detailed quantities have been provided, they should be considered approximations for EE/CA evaluation purposes only.
CY – cubic yards, SF – square feet, TN – tons

6.3.1. Effectiveness

This section evaluates the alternative's ability to meet the objectives of the removal action as defined in Section 5. The effectiveness of the alternative is discussed relative to its ability to achieve the criteria of protectiveness of human health and the environment, and its ability meet ARARs while satisfying the project's RAOs.

<u>**Overall Protection of Public Health and the Environment**</u>

This section provides an evaluation of whether the removal action alternative provides adequate protection of public health and the environment in both short- and long-term time frames. The overall protectiveness of the alternative is evaluated based on its ability to eliminate or acceptably reduce exposure to hazardous substances, pollutants, or contaminants.

- The RAOs would be achieved through excavation of contaminated soils exceeding recommended RGs and off-site disposal at licensed disposal facilities.
- Soil excavation as described in this evaluation is designed to remove soils from the Site in a manner that will reduce potential exposure to contaminants in surface and subsurface soil throughout the Site to levels that meet Site RGs (Figure 13). The estimated extent of soil

containing contaminants above RGs is estimated to reach a maximum depth of 6 feet bgs. This depth is also the maximum depth to which burrowing mammals are assumed to be exposed, therefore, the removal of contaminated soils to 6 feet bgs would address the ecological exposure scenarios for subsurface soil.

- Dust suppression would be performed to eliminate contaminant migration during implementation of this alternative.

- Based on the assumption that removal of these areas of soil reduces that potential for exposure to contaminated soils at the Site to levels that meet RGs, unacceptable risks to humans and ecological receptors from Site soil would be fully and permanently addressed, without need for post-removal Site controls. The effectiveness of this removal action would be confirmed by soil confirmation sampling.

Compliance with ARARs and Other Criteria, Advisories, and Guidance

This section summarizes the key ARARs. A detailed analysis of all ARARs is presented in Appendix E.

Compliance with Chemical-specific ARARs

- Permissible exposure limits: Standards for worker exposure to airborne contaminants would be complied with during the implementation of the removal action.

- Hazardous waste determination: Hazardous waste determination for disposal of contaminated soils off-site will be performed in accordance with the requirements of 22 CCR Division 4.5, Chapter 11, Article 1 Sections 66261.2 through 66261.3; Article 4 Sections 66261.24(a)(1), 66261.24(a)(2), 66261.30 through 66261.32; Article 4.1 Sections 66261.100, 66261.101; Chapter 18, Article 4 Sections 66268.40 66268.48; and 27 CCR Div. 2, Sub-division 1, Chapter 3, Sub-chapter 2, Article 2 Section 20210. Data needed for soil classification and profiling to comply with these ARARs would be gathered as part of the PDI, allowing for more efficient completion of soil excavation due to the lack of a need to pause excavation activities to allow for characterization testing.

Compliance with Location-specific ARARs

Location-specific ARARs for the remedy would be addressed during implementation of the removal action.

- National Park Service Organic Act of 1916, General Authorities Act as amended, and Yosemite National Park enabling legislation: Excavation and off-site disposal of contaminated soils would be compliant with the Organic Act and the non-impairment mandate because it would not restrict or otherwise limit the enjoyment of the park by future visitors. In addition, the backfill and restoration of the excavation areas would include restoring the surface layer to match the current surface conditions, which would result in a remedy that addresses the unacceptable human health and ecological risks while complying with the non-impairment mandate.

- NPS restrictions of public use and recreation activities to protect national park resources: The activities under this alternative would be carried out in a manner compliant with substantive requirements of the 36 CFR Part 2 and Part 7.

- NPS restrictions of commercial and private operations in national parks, including the prohibition of nuisances: The activities under this alternative would be carried out in a manner compliant with substantive requirements of the 36 CFR Part 5 and 36 CFR Section 5.13.

- NPS policies for restoration of natural systems: Disturbed areas that were previously vegetated would be re-vegetated with native plant species. Revegetation will be completed by NPS staff using processes compliant with these policies.

- National historic preservation and archeological resources protection: As a FWDA, the Site is known to contain archeological resources. Coordination with NPS and State cultural resources staff and officials will be conducted during remedial design and removal action planning to ensure compliance with these ARARs during the PDI and implementation of the removal action.

- Wilderness Act: This alternative requires the use of methods that are prohibited at the Site by this ARAR, except as necessary to meet the minimum requirements for preservation of wilderness values. The removal action is considered necessary to preserve these values. To fully comply with this ARAR, a minimum requirements analysis may be required to document the decision to proceed with a removal action.

- Endangered species: If threatened or endangered species are identified within removal areas, activities will be designed to conserve the species and their habitats.

- Birds: If birds of prey, fully protected bird species, and/or migratory birds are identified within removal areas, activities will be designed to conserve the birds and their habitats.

- Fully protected mammals: If ring-tailed cat, Sierra Nevada bighorn sheep, and/or their habitats are identified within removal areas, activities will be designed to conserve the mammals and their habitats.

- Fur-bearing mammals: If fisher, marten, river otter, desert kit fox, and red fox, and/or their habitats are identified within removal areas, activities will be designed to conserve the mammals and their habitats.

- Specially protected mountain lion: If mountain lions and/or their habitat are identified within removal areas, activities will be designed to conserve the protected mountain lions and their habitat.

- Fully protected reptiles and amphibians: If certain fully protected species of reptiles and amphibians and/or their habitats are identified within removal areas, activities will be designed to conserve the protected reptiles and amphibians and their habitats.

- Rare or endangered native plants: If rare or endangered native plants are identified within removal areas, activities will be designed to conserve endangered or rare native plants.

Compliance with Action-specific ARARs
Action-specific ARARs for the remedy would be addressed during implementation of the removal action.

- Yosemite National Park enabling legislation: All activities will be designed to protect all timber, mineral deposits, and animals in the park.

- Storage of hazardous waste generated by this alternative would be performed in compliance with 40 CFR 264 Subpart I (Sections 264.170 through 264.179) and 22 CCR Div. 4.5, Chapter 14, Article 15.5 Section 66264.553 (b) prior to disposal.

Long-Term Effectiveness and Permanence

Magnitude of Risk
Long-term effectiveness and permanence are addressed through excavation of contaminated soils exceeding recommended RGs up to a depth of 6 feet bgs with disposal at off-site licensed disposal facilities and backfilling with uncontaminated soil.

- Excavation of contaminated soils is expected to result in the reduction of exposure to contaminants in surface and subsurface soils throughout the Site that pose unacceptable risks to human and ecological receptors to levels below RGs. This is a permanent removal action that is not expected to require on-going monitoring or periodic review.

Adequacy and Reliability of Controls

- Excavation and disposal at off-site licensed disposal facilities coupled with backfilling excavations with uncontaminated soil is a reliable, permanent remedy.

Reduction of Toxicity, Mobility, or Volume Through Treatment

"Treatment", for the purposes of this evaluation, is defined as "any method, technique, or process…designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such waste or so as to render such waste nonhazardous, safer for transport, amenable for recovery, amenable for storage, or reduced in volume", following the definition in 42 USC § 6903.

- The preference for treatment as a principal element of the removal action will not be met, unless soils require treatment for disposal at licensed off-Site facilities. Contaminated soil disposed of at a Subtitle C solid waste facility would be subject to treatment if required to meet land disposal requirements (LDRs) for landfill placement. Disposal of other soils would not include treatment.

Short-Term Effectiveness

This section provides an evaluation of the effects that may occur during implementation of the alternative before RAOs are been met. The alternative is assessed for each of the factors presented in the following sections.

Protection of the Community

- Short-term impacts to the community include generation of dust, noise, vehicle emission, and traffic during implementation.

- The alternative would involve disturbance of contaminated soil, which could generate dust that may be inhaled by those near the Site. Very few individuals are expected to be present near the Site and therefore risks associated with contaminated dust inhalation during remedy implementation are anticipated to be minimal. Protective measures, such as dust suppression, would be used to address those risks.

- Work area restrictions (such as exclusion zones) would be implemented during construction to reduce short-term exposure risks to the community.

- Hauling of soil materials for backfill of excavated areas and hauling of contaminated soil for disposal could cause additional short-term risks to the community due to increased truck traffic.

- Some degree of traffic congestion may result from implementation of this alternative due to increased truck traffic. Traffic control workers and signage near the entry to the Site off of Hetch Hetchy Road would limit traffic congestion, minimize emissions, and prevent automobile-related accidents.

- Implementation of the alternative would be performed during the low tourist season to prevent traffic congestion and minimize impact to park visitors.

Protection of Workers

- Disturbance of contaminated soils could pose short-term risks to Site workers. Safety measures such as dust suppression, use of PPE, and establishment of work zones would protect workers during remedy implementation.

- Safety hazards from excavation of soils (e.g., sidewall collapse) could be mitigated through the use of sloping and/or shoring.

- Transport of materials for backfill and transport of contaminated soils off-site would pose short-term risks to workers from increased traffic.

- Other potential impacts could be from safety hazards during implementation, such as falls and mechanical hazards. These other potential impacts would be mitigated through adherence to safety requirements and standard operating procedures.

Environmental Impacts

- There may be some impacts to the environment during implementation of the removal action due to use of heavy construction and hauling equipment. Use of fuel-efficient and low-emission equipment could reduce these impacts.

- Implementation of this alternative would require the clearing and grooming of an existing temporary access road for exporting contaminated soil and importing backfill material to the excavation areas at the Site. The extent of these impacts would be mitigated by minimizing the footprint of the access road and avoiding sensitive areas.

- Excavation and transfer of contaminated soil may involve minor spreading of contaminated soil during loading and removal from the Site. Best-management practices for excavation, loading, transportation, and other parts of the excavation process will be implemented to minimize these impacts.

- Implementation of this alternative requires use of methods that normally are prohibited in designated wilderness. An analysis of this removal action with respect to the minimum requirements for preservation of the Site's wilderness character may be required to proceed.

- The alternative would involve disturbance of contaminated soils that could pose potential adverse impacts through dispersion of dust. Water-based dust suppression would be used for controlling contaminated soil and dust during construction.

- Protective measures such as silt fencing and/or other erosion prevention measures would be used to minimize the environmental impacts during construction.

Time Until Response Objectives Are Achieved

- The removal action alternative could be implemented in approximately 1 year or less. The duration of construction for this alternative is expected to be 1 month.

6.3.2. *Implementability*

This section provides an evaluation of the technical and administrative feasibility of implementing the alternative and the materials and services that would be required for its implementation.

Technical Feasibility

Technical Difficulties

- Excavation of contaminated soil and backfill with clean soil could be easily conducted.
- Delays in the PDI sampling and excavation activities could be experienced due to the likely presence of cultural artifacts at the Site and the time required to handle and inspect the potential artifacts.
- Logistics for working with heavy equipment and trucks at the Site could be difficult to manage, given the Site's small size.
- Traffic congestion could cause minor delays due to trucking of off-site materials to the Site and trucking of waste materials away from the Site.
- Off-site disposal of contaminated soils would require coordination with disposal facilities.
- Special management procedures may be required for disposal at the licensed facilities, if some soils are found to require treatment prior to disposal in order to comply with land disposal restrictions (LDRs).

Reliability of Technology

- Excavation and off-site disposal of contaminated soil at off-site licensed disposal facilities is relatively straightforward. However, final acceptance of the contaminated soils would be determined by the individual facilities.

Potential Difficulty to Implement Future Remedial Actions or PRSC Measures

- Excavation, disposal, and backfill activities as part of this alternative do not preclude future response actions at the Site.

Ability to Monitor Effectiveness

- Confirmation sampling to ensure that the removal action has achieved RAOs is relatively straightforward and can be easily implemented using available materials, equipment, and labor resources.

Administrative Feasibility

This section provides an evaluation of the activities needed for coordination with other offices and agencies relative to the factors presented in the following sections.

Statutory Limits on Removal Actions

- NPS will undertake any removal action at this Site as a federal agency, on federal land, using funds appropriated for this purpose. Therefore, CERCLA Section 104(c)(1) limitations on the duration and cost of removal actions will not apply for actions undertaken at the Site.

Permits Required

- Regulatory and facility approvals for off-site disposal at facilities capable of accepting contaminated soil should be obtainable.

Coordination with Other Offices and Agencies

- This alternative would require coordination with disposal facilities regarding acceptance of contaminated soils.

- Implementation of this alternative requires use of methods (use of heavy equipment, installation of a short temporary road) that are prohibited in designated wilderness. An analysis of this removal action with respect to the minimum requirements for preservation of the Site's wilderness character may be required to proceed.

- Because of the likely presence of historic and cultural resources at the Site, this alternative would require coordination with the state historic preservation office (SHPO).

- Implementation of this alternative is likely to require occasional traffic stoppages along Hetch Hetchy Road affected by traffic control flaggers in order to allow trucks to enter and leave the Site, which may require coordination with Park offices and other authorities to schedule and approve.

Availability of Services and Materials

This section provides an evaluation of the alternative's ability to meet the removal schedule based on the logistical considerations and the available services and materials.

Off-site Treatment, Storage, and Disposal

- Off-site licensed disposal facilities are available for disposal and have the capacity to accept the total volume of excavated contaminated soil.

- The estimated in-place volume of excavated hazardous waste for treatment and disposal at a facility accepting RCRA hazardous waste is approximately 105 CY.

- The estimated in-place volume of excavated soil for disposal at a facility accepting California hazardous waste is approximately 205 CY.

Personnel and Technology, Services and Materials, and Prospective Technologies

- Labor, equipment, drilling subcontractors and materials, and laboratory services required for conducting the PDI are available.

- Labor, equipment, and materials for excavation and backfill are available.

- Suitable backfill materials would be obtained from off-Site sources acceptable to NPS.

State (Support Agency) Acceptance

- This criterion is not directly evaluated in this EE/CA. For detail explanation refer Section 6.5.

Community Acceptance

- This criterion is not directly evaluated in this EE/CA. For detail explanation refer Section 6.6.

6.3.3. Cost

This section provides an evaluation of the costs associated with implementing the removal action alternative. Evaluation of cost for Alternative 3 is provided in in Text Table 6.3.3 using the evaluation criteria considerations. Detailed cost estimates for this alternative are included in Appendix D.

Text Table 6.3.3 Cost Evaluation Summary – Alternative 3	
Evaluation Factors for Cost	**Approximate Cost (Dollars)**
Total capital cost	$848,000
Total annual PRSC cost	$6,000 (Years 1-3 only)
Total cost (excluding present value discounting)	$866,000
Total present value cost	$864,000

Note:
Total costs are for the assumed period of analysis (Years 0 through 30). Costs are rounded to the nearest $1,000.

6.4. State Agency Acceptance

The state of California (through DTSC) may have technical and administrative concerns regarding the information presented in this EE/CA. Assessment of the state acceptance will not be completed until comments on the Draft Final EE/CA are submitted to the NPS by the DTSC. The DTSC may review the alternatives, and their concerns will be considered in determining the recommended alternative in the Final EE/CA and in the final selection of the removal action in the Action Memorandum. Thus, state acceptance is not considered in the detailed analysis of alternatives presented in this Draft Final EE/CA.

6.5. Community Acceptance

Assessment of community acceptance will include responses to questions any interested person in the community may have regarding any component of the removal action alternatives presented in this Draft Final EE/CA. This assessment will be completed after NPS receives public comments on the Draft Final EE/CA during the public commenting period. Thus, community acceptance is not considered in the detailed analysis of alternatives presented in this Draft Final EE/CA.

7. Comparative Analysis of Removal Action Alternatives

The purpose of Section 7 is to provide a comparative analysis against each of the evaluation criterion of the alternatives presented in Section 6. This will identify the advantages and disadvantages of each alternative relative to one another.

Pursuant to the NCP, each alternative described above was analyzed using the following evaluation criteria: effectiveness, implementability, and cost. The effectiveness of each alternative was evaluated by each alternative's protectiveness of human health and the environment; attainment of ARARs; reduction of toxicity, mobility, or volume through treatment; long-term effectiveness and permanence; and short-term effectiveness. The implementability criterion addresses the technical feasibility of implementing the response (including availability of services and materials), the administrative feasibility, and State and community acceptance. Projected costs were calculated using direct capital costs, indirect capital costs, and annual post-removal site control costs. Consistent with guidance, the costs presented are estimated using current costs of labor and materials, and actual costs are expected to range from 30 percent below to

50 percent above the costs presented. The projected costs presented for the EE/CA removal action alternatives are estimates only for the sole purpose of comparing alternatives and should not be considered design-level cost estimates. Details that formed the basis for the removal action alternative cost projections are provided in Appendix D.

7.1. Effectiveness

This section evaluates the alternative's ability to meet the RAOs as identified in Section 5; in particular, its ability to achieve the criteria of protectiveness of human health and the environment and to attain ARARs. Other factors that affect the overall protectiveness of a removal action include preference for treatment to reduce contaminant toxicity, mobility, or volume for principal threats, short-term effectiveness, and long-term effectiveness/permanence. Details regarding the effectiveness evaluation criteria are presented in the following subsections.

7.1.1. Overall Protection of Human Health and the Environment

Of the three alternatives, the No Action alternative (i.e., Alternative 1) would fail to provide adequate protection of human health and the environment. Unaddressed contaminated soil exceeding recommended RGs would result in unacceptable exposures to ecological receptors. Construction or restoration workers that regularly disturb subsurface contaminated soil would also be subject unacceptable exposure risks. Since removal activities are not performed under this alternative, it does not meet any of the RAOs.

Alternatives 2 and 3 both meet the RAO for protection of human health and the environment. Alternative 2 would achieve RAOs through in-place capping (covering) of contaminated soil exceeding recommended RGs that would provide an exposure barrier and eliminate ecological exposure to contaminated soils. Alternative 3 would achieve RAOs through excavation of contaminated soils exceeding recommended RGs and off-site disposal at licensed disposal facilities.

7.1.2. Compliance with ARARs

Under Alternative 1, no action would be taken to address the contaminated soil and ecological risks at the Site. Because no action is taken, no chemical- or action-specific ARARs are triggered. However, this alternative would not comply with location-specific ARARs, specifically, the NPS Organic Act non-impairment requirement. This non-impairment requirement is not fulfilled because Site soil presently poses unacceptable ecological and human exposure risks to receptors that may use the Site.

Alternative 2 would comply with chemical-specific ARARs, including permissible exposure limits. Location- and action-specific ARARs for the remedy would be addressed during implementation of the removal action. While PRSC costs are evaluated on a 30-year basis in this EE/CA, a monitoring and maintenance program would be required in perpetuity to ensure that non-impairment requirement of the Organic Act was fulfilled by this alternative. In order to comply with the Wilderness Act, a minimum requirements analysis may be required to demonstrate that this removal action is necessary to protect wilderness values and document the decision to select this alternative.

Alternative 3 would comply with chemical-specific ARARs, including permissible exposure limits and hazardous waste determinations. Location- and action-specific ARARs for the remedy would be addressed during implementation of the removal action. As this alternative proposes to remove soil posing unacceptable risks to ecological receptors, it is considered likely to be a solution that permanently fulfills the non-impairment requirement of the Organic Act. In order to comply with the Wilderness Act, a minimum requirements analysis may be required to demonstrate that this removal action is necessary to protect wilderness values and document the decision to select this alternative.

7.1.3. Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives 1, 2, and 3 would fail to provide a reduction of toxicity, mobility, or volume through treatment since treatment is not a component of these alternatives (see Section 6.3.1 for a definition of "treatment" per the NCP, which is applied here). Thus, these alternatives were given a preference rating of "none" in this category (Text Table 7.4).

7.1.4. Short-Term Effectiveness

Under Alternative 1, no action would be taken to address the contaminated soil and ecological risks at the Site. Thus, there are no short-term risks posed to the community, workers, or environment during implementation of this alternative. Because this alternative does not meet RAOs, it is not evaluated by other preference criteria.

Both Alternative 2 and 3 are considered likely to be completed in a short amount of time, and will share some impacts on the community, workers, and the environment. Alternative 2 is anticipated to have minor short-term impacts on the workers and the environment, mostly related to potential for creation of dust, noise, and equipment emissions during work at the Site. These may be mitigated with dust control practices and other standard practices. Public safety concerns consist primarily of traffic-related concerns associated with truck traffic to and from the Site. This alternative would involve creation of a temporary road, which would have short-term impacts on the environment, but which would be restored following completion of the removal action. Therefore, this alternative was given a preference rating of "moderate to high" in this category (Text Table 7.4).

Alternative 3 would also have minor to moderate short-term impacts on the community, workers, and the environment. These include the impacts documented for Alternative 2, and others. Excavation and transport of contaminated soils presents greater risks for worker exposure, fugitive dust, and spillage and spreading of contaminated soil than those posed by Alternative 2, though these risks could be easily managed using dust control and other management practices.

Truck traffic would be greater at the Site than for Alternative 2, due to export of soil that would occur, which would result in increases in worker safety and public accessibility impacts. Overall, this alternative was given a preference rating of "moderate" in this category (Text Table 7.4).

7.1.5. Long-Term Effectiveness

Alternative 1 fails to provide long-term effectiveness and permanence since no action is taken. Contaminated soil exceeding recommended RGs would be left unaddressed and would result in unacceptable exposures to ecological receptors and the potential for unacceptable construction or Site restoration worker exposures, as well. Because this alternative does not meet RAOs, it is not evaluated by other preference criteria.

Under Alternative 2, long-term effectiveness would be addressed through in-place containment of contaminated soil. With proper construction and regular long-term maintenance, the protective caps would eliminate exposure of contaminated soil to ecological receptors, and as no human soil disturbance would occur in these areas, human exposures would also be eliminated. Long-term effectiveness would not be entirely ensured since contaminated soils potentially posing a risk are left on-site. The long-term protectiveness of this remedy would be entirely dependent on regular inspection and repair of the protective caps. Even with regular inspection and maintenance, protective caps are not likely to be effective into perpetuity without major repair or replacement, and as such, are not a permanent remedy. This alternative was given a preference rating of "low to moderate," primarily due to considerations affecting long-term effectiveness and permanence of monitoring and maintaining the protective caps (Text Table 7.4).

Under Alternative 3, soils that are identified to contain contaminants at concentrations exceeding Site RGs to a maximum of 6 feet bgs are planned to be removed from the Site by excavation. Soil sampling results will confirm that this excavation will reduce the ecological and human exposure risks to surface and subsurface soil at the Site to levels that meet RGs. As the estimated extent of contaminated soils exceeding RGs reaches maximum depth of 6 feet bgs, this action would also serve as a full removal of contaminated soils from the Site. If successful, this would result in a permanent abatement of exposure risks at the Site with no further monitoring or maintenance activities required. Thus, Alternative 3 was given a preference rating of "high."

7.2. Implementability

This section provides an evaluation of the technical and administrative feasibility of implementing the alternative and the materials and services that would be required for its implementation.

7.2.1. Technical Feasibility

Technical Implementation Considerations

Alternative 1 has no action taken. Because this alternative does not meet RAOs, it is not evaluated by other preference criteria.

Alternative 2 is a readily implemented remedy. While some technical consideration may be given to refining the design and structure of the protective cap during the design phase, it is expected to be straightforward to construct. Logistical challenges associated with implementation of the remedy include the wilderness location of the Site and its relatively small size, which may pose challenges for mobilization of materials and use of equipment. These challenges are likely to be minor and may be mitigated by appropriate planning. As the Site soils are known to contain archeological artifacts, cultural resources oversight of the PDI and removal action activities is anticipated to be required, which may cause delays in their completion. Concerns related to traffic congestion may be mitigated by scheduling the project for periods of the year where visitor volume tends to be lower. After consideration of these concerns, Alternative 2 was given a preference rating of "moderate to high" in this category.

Alternative 3 is also considered a readily implemented remedy. Execution of the excavation is expected to be straightforward, given the relatively shallow depths and low soil volumes planned to be removed. Logistical challenges will be similar to those expected for Alternative 2, as similar amounts of equipment and similar daily truck traffic to and from the Site is expected. Significantly more soil will be disturbed during this excavation than for Alternative 2, therefore, the potential effects of cultural resources oversight on removal action activities may be greater. Overall, the technical feasibility of this alternative is considered similar to Alternative 2, and it is therefore also assigned a preference rating of "moderate to high" in this category.

Availability of Services and Materials

Both Alternatives 2 and 3 require similar services and materials: excavating and grading equipment and crews, trucking services, surveying, cultural resources oversight, environmental oversight, earthen material vendors, and traffic control services. Alternative 3 will also require a soil disposal facility/ies. For both alternatives, many of these services are not available in the immediate vicinity of the Site, however, this factor affects both alternatives to a similar extent. Therefore, consideration of the availability of services and materials does not favor one of these alternatives over the other and does not impact the overall technical feasibility preference ratings.

7.2.2. Administrative Feasibility

This section provides an evaluation of the activities needed for coordination with other offices and agencies. Under CERCLA, federal, state, and local permits are not required for on-site CERCLA response actions; however, the substantive requirements of all permits that would otherwise be required must be met (40 CFR Section 300.400(e)).

Alternative 1 has no action taken. Because this alternative does not meet RAOs, it is not evaluated by other preference criteria.

Alternatives will be implemented within the Park, therefore, no permits are anticipated to be required. Both alternatives will require coordination with park archeological resources staff and the SHPO for planning of archeological resources oversight procedures, and both will require coordination with Park offices for arrangement of traffic control limitations.

Alternatives 2 and 3 both involve methods (use of heavy equipment, installation of a short temporary road, and in the case of Alternative 2, protective soil caps that may be considered as “installations” in terms of Wilderness Act limitations) that are prohibited in designated wilderness by the Wilderness Act unless necessary to meet the minimum requirements for preservation or restoration of the Site’s wilderness character. A minimum requirements analysis may be required for implementation of both alternatives.

As part of the implementation of Alternative 2, NPS may require the creation of an institutional control that would ensure that the protective soil caps are not disturbed by future park projects. NPS. Based on the Site location in a wilderness area, the use of this type of control is not likely to impair the purpose, fundamental resources and values, or planned future use of the Site, therefore, this is not considered a significant administrative obstacle. Alternative 3 would require regulatory and facility approvals for off-site disposal at facilities capable of accepting contaminated soil. With characterization data that will be collected during the PDI, these approvals should not be difficult to obtain, and also do not represent a significant administrative obstacle. Therefore, both Alternative 2 and Alternative 3 are assigned a preference rating of “moderate” for this category, after consideration of the potential requirements for minimum requirements analysis and other administrative coordination requirements.

7.2.3. State (Support Agency) Acceptance

An assessment of the state acceptance of removal action alternatives will not be completed until comments on the Draft Final EE/CA are submitted to the NPS by the DTSC.

7.2.4. Community Acceptance

As discussed in Section 6.5, an assessment of the community acceptance will be completed after the NPS receives public comments on the Draft Final EE/CA during the public commenting period.

7.3. Cost

This section provides an evaluation of the costs associated with implementing the removal action alternative. Cost estimates are based on currently available costs and approximate time and materials requirements developed for the sole purpose of comparing alternatives. The EE/CA cost estimates should not be considered design-level estimates. They are representative within −30 to +50 percent.

7.4. Summary of the Alternatives Comparative Analysis

Text Table 7.4 summarizes the results of the evaluation of the effectiveness, implementability, and cost criteria for each alternative.

Text Table 7.4 Comparison of Alternatives											
Criterion	**Effectiveness**						**Implementability**				**Cost**
Alternative	**Protective of**		**Complies with ARARs**	**Treatment Reduces Toxicity, Mobility, or Volume**	**Effectiveness**		**Feasibility**		**Acceptance**		**Cost**
	Human Health	**The Environment**			**Short Term Risks to Public/ Environment**	**Long Term Effectiveness**	**Technical**	**Administrative**	**State**	**Community**	
Alternative 1: No Action	***No***	***No***	***No***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	*N/E*	*N/E*	*$0*
Alternative 2: In-Place Capping of Contaminated Soils	***Yes***	***Yes***	***Yes*** *Minimum require-ments analysis may be necessary*	***None***	***Moderate to High*** *This alternative will have very low short term impacts on public health and safety and the environment.*	***Low to Moderate*** *Requires indefinite monitoring and maintenance to prevent long-term risks, not a permanent remedy*	***Moderate to High*** *Readily implemented, low logistical complexity*	***Moderate*** *No permits required, coordination with SHPO and wilderness analysis may be required, IC may be required*	*N/E*	*N/E*	*$551,000*
Alternative 3: Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities	***Yes***	***Yes***	***Yes*** *Minimum require-ments analysis may be necessary*	***None***	***Moderate*** *This alternative will have low short term impacts on public health and safety, but greater than the impact of Alternative 2*	***High*** *Minimal maintenance to ensure the effectiveness of the remedy is required, full and permanent remedy*	***Moderate to High*** *Readily implemented, low to moderate logistical complexity*	***Moderate*** *Complies with statutory limits, no permits required, coordination with SHPO and wilderness analysis may be required*	*N/E*	*N/E*	*$864,000*

The first three columns list Yes/No ratings. A "No" entry indicates failure to achieve an RAO, which renders the alternative unacceptable.
Other columns list preference ratings as follows, from low to high preference: None (least preferred), Low, Low to Moderate, Moderate, Moderate to High, High (most preferred)
N/A = Not applicable
N/E = Not evaluated at this time
SHPO = State Historical Preservation Officer IC = Institutional Control

8. Recommended Removal Action Alternative

The purpose of Section 8 is to describe the recommended removal action alternative and the reason for the selection. Taking into consideration the evaluation criteria presented in this EE/CA, the NPS-recommended removal action alternative for the Site is Alternative 3. Alternative 3 includes excavation of contaminated soil and disposal at existing licensed solid waste facilities outside the boundaries of the Site. The total estimated present value cost of Alternative 3 is $864,000. Alternative 3 is selected as the recommended removal action alternative based on the results of the comparative analysis completed in Section 7, showing that Alternative 3 would be protective of human health and the environment, would achieve the RAOs, and would be able to comply with ARARs.

Alternative 3 has similar technical and administrative feasibility to Alternative 2 (in-place capping of areas of contaminated soils), however, Alternative 3 is anticipated to be a complete and permanent removal that will require minimal maintenance and therefore minimal disturbance of the Site, which is located within Yosemite Wilderness. Conversely, Alternative 2 will require monitoring indefinitely to ensure that the removal action remains protective of human health and the environment. Therefore, Alternative 3 has greater long-term effectiveness than Alternative 2. This advantage was determined to outweigh the higher estimated cost of Alternative 3. This decision reflects the preference expressed by NPS for alternatives that remove contamination sources and minimize long-term operation and maintenance needs.

Part of the Draft Final EE/CA review process is submission for public review and comment. For the NTCRA identified by this EE/CA, the NCP requires a 30-day public comment period on the EE/CA and any supporting documentation. After the public comment period has ended, a written response to significant comments received during the comment period is prepared. The response to comments is included in the administrative record supplement, typically as part of the Action Memorandum.

The final phase of the NTCRA selection process is to prepare the Action Memorandum. The Action Memorandum, as a primary decision document, substantiates the need for removal action, identifies the proposed action, provides the rationale for the action, and provides a response to significant comments received from the public,

9. References

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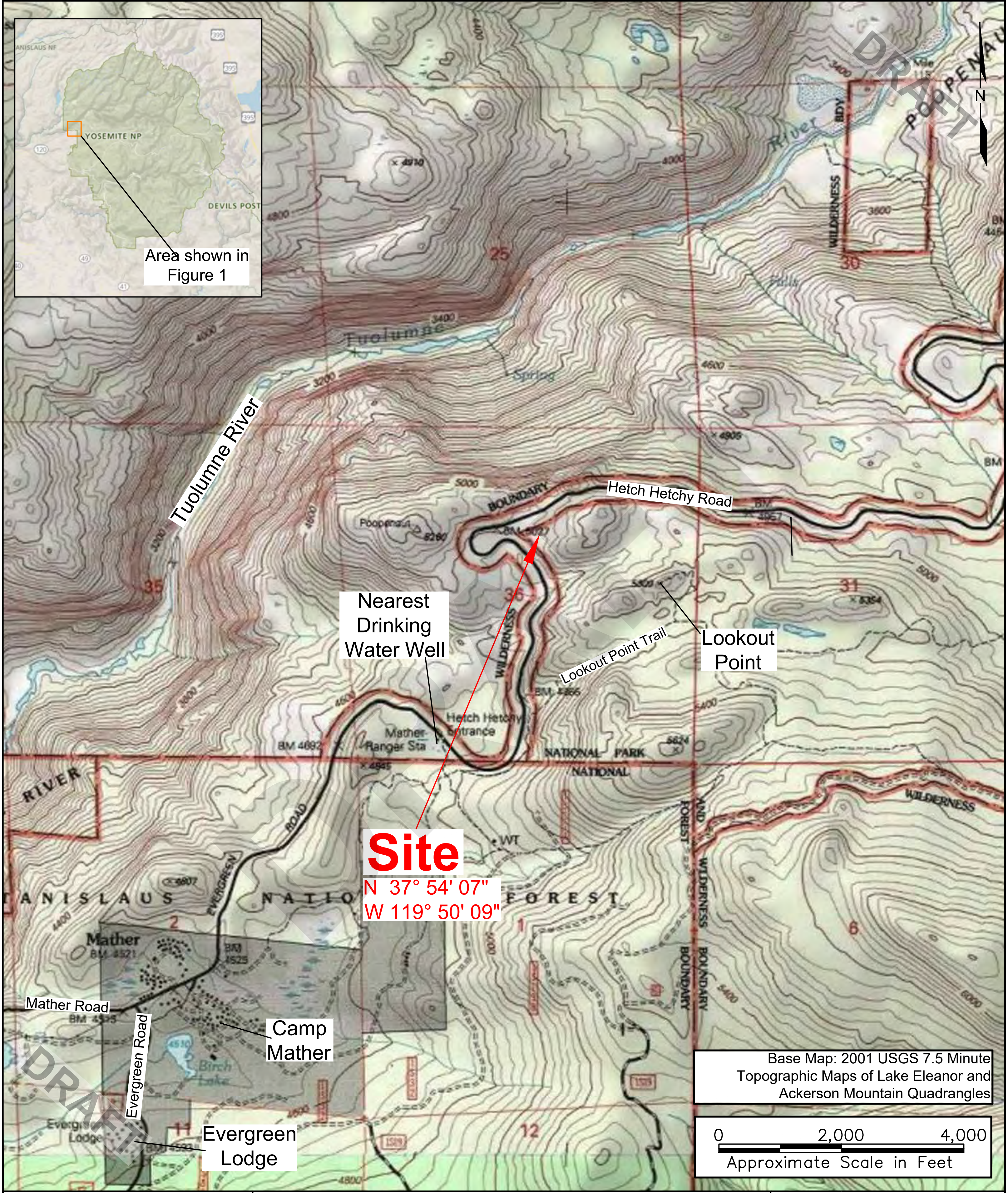
FIGURES



KANE ENVIRONMENTAL INC

Project No. 49723-1

Engineering Evaluation / Cost Analysis
Mather Former Waste Disposal Area
Yosemite National Park, California

Figure 1
Vicinity Map

LEGEND

Approximate Location of Site Boundary

Area Shown in Figure 3

0 125 250

Approximate Scale in Feet

N

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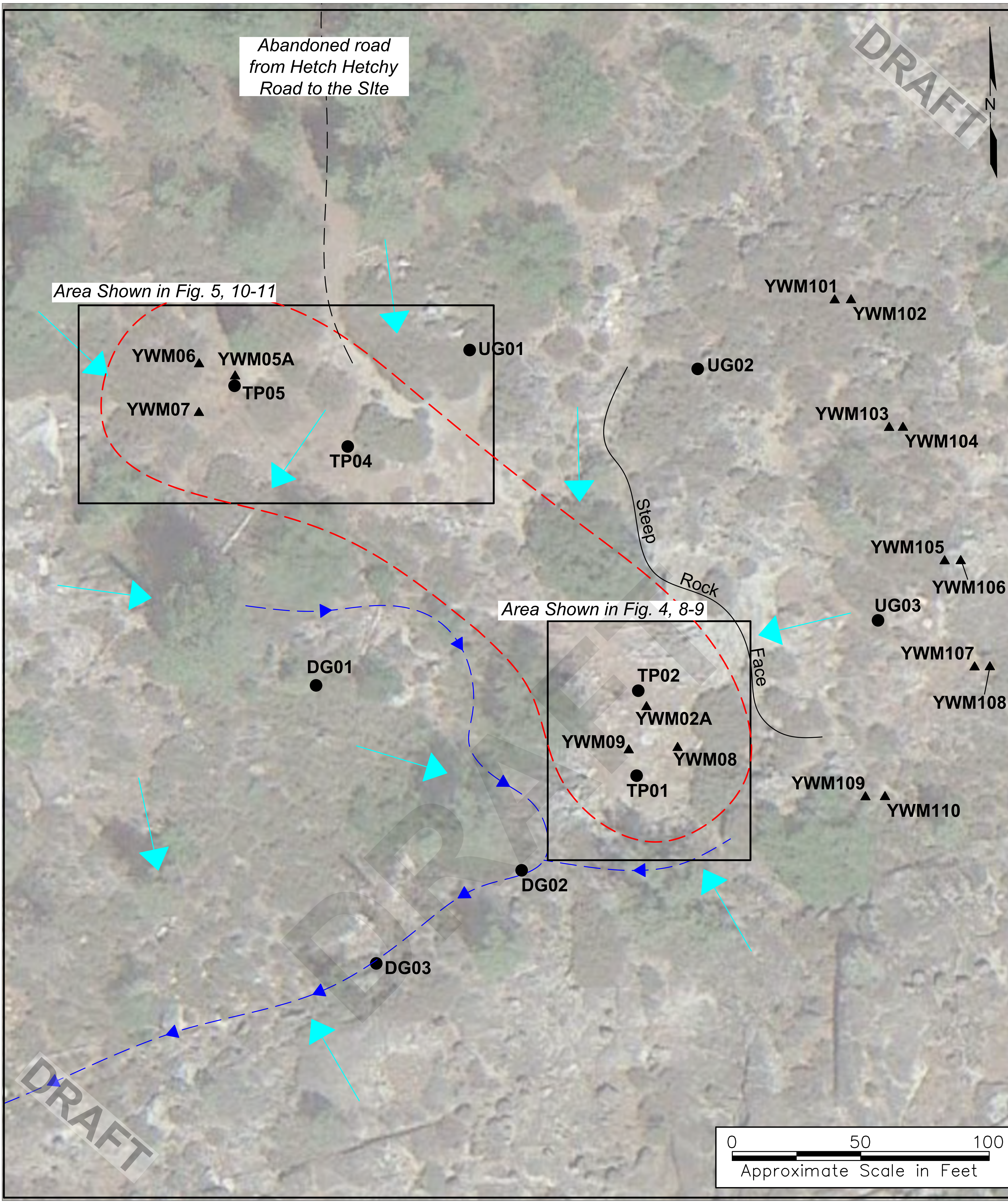
Engineering Evaluation / Cost Analysis
Mather Former Waste Disposal Area
Yosemite National Park, California

Figure 2
Site Plan



LEGEND

Aerial Photo Date: August 2017
Aerial Photo Source: Google Earth

● Approximate location of test pit or sampling location - 2001
- "UGXX" = Background sample location, hand excavated
- "TPXX" = Test pit location, backhoe excavated
- "DGXX" = Sample in dry stream bed, hand excavated

▲ Approximate location of test pit or sampling location - 2008
- "YWM-0X" = Test pit location, backhoe excavated
- "YWM-1XX" = Background sample location, hand excavated

Approximate direction of surface water drainage

Apparent direction of water flow in seasonal stream

Approximate location of Site Boundary

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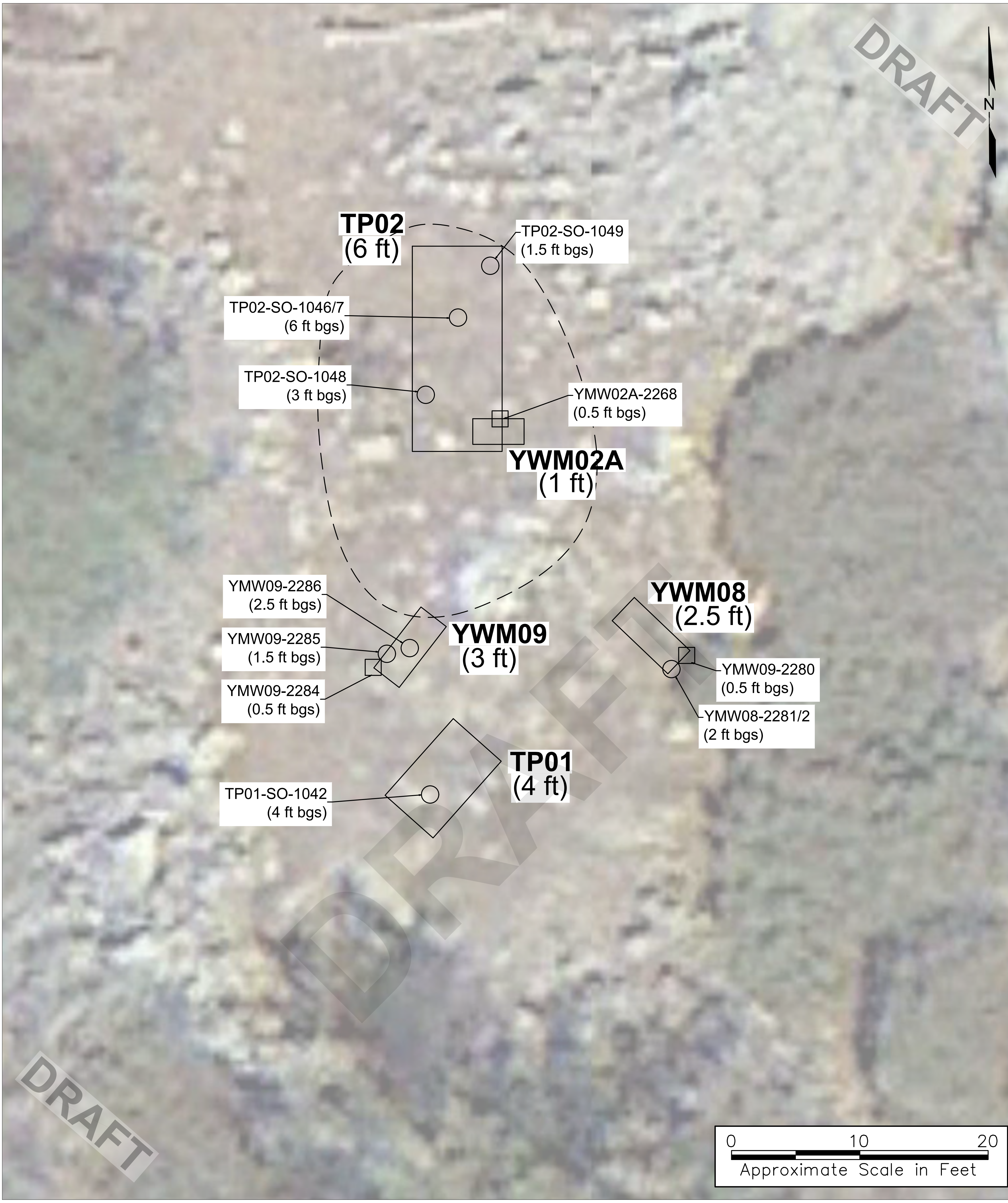
Engineering Evaluation / Cost Analysis
Mather Former Waste Disposal Area
Yosemite National Park, California

Figure 3
Site Plan Detail



LEGEND

Aerial Photo Date: August 2017
Aerial Photo Source: Google Earth

Approximate extent of area of with surficial evidence of burning (Shaw, 2010)

Approximate location of test pit soil sample, with sample ID and depth below ground surface
- Square = surface soil (0.5 ft bgs)
- Circle = subsurface soil (>0.5 ft bgs)

Approximate extent of test pit, with pit ID and total pit depth

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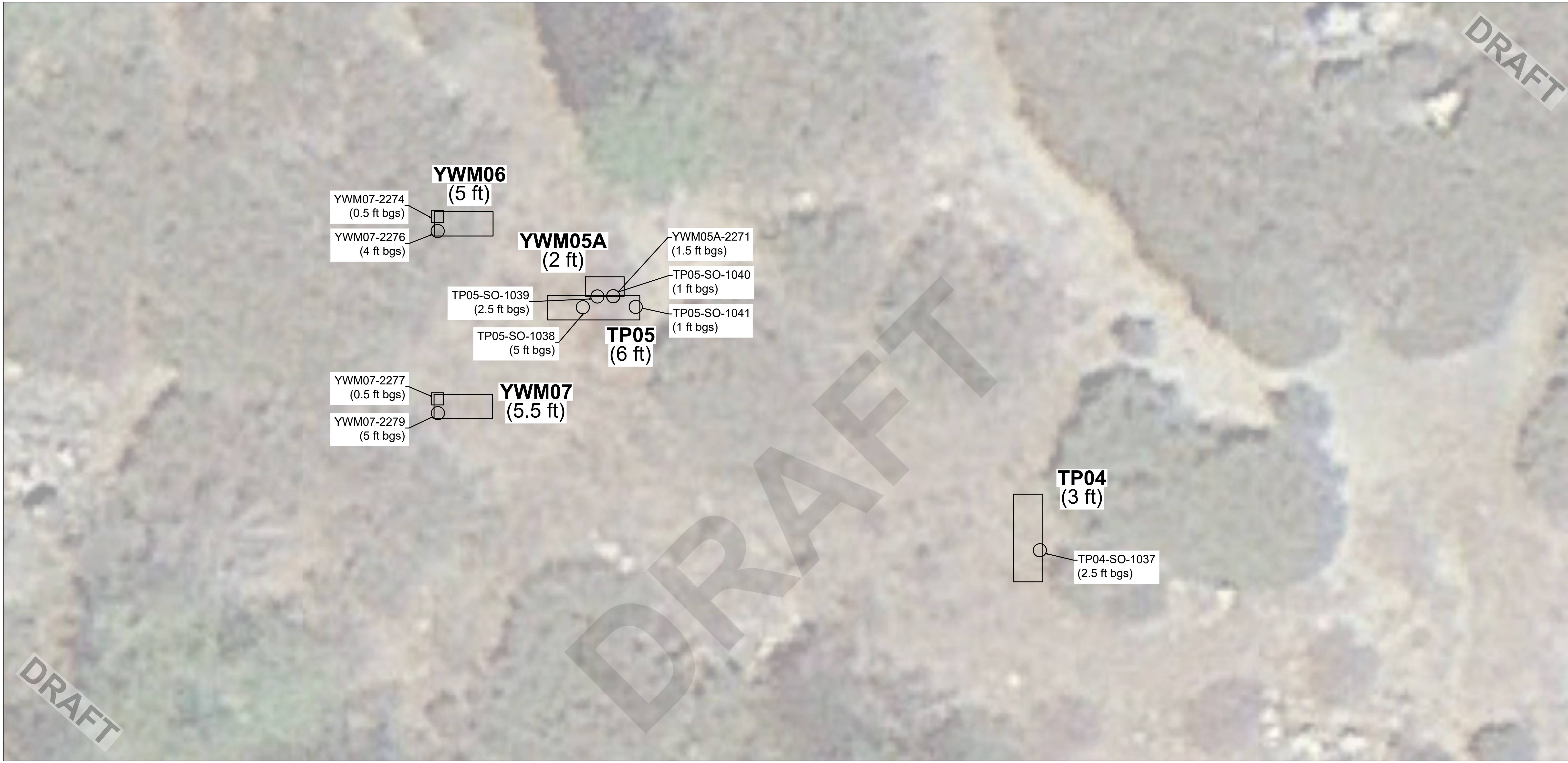
Engineering Evaluation / Cost Analysis
Mather Former Waste Disposal Area
Yosemite National Park, California

Figure 4
South Site Area



LEGEND

○ □ Approximate location of test pit soil sample, with sample ID and depth below ground surface
- Square = surface soil (0.5 ft bgs)
- Circle = subsurface soil (>0.5 ft bgs)

▭ Approximate extent of test pit, with pit ID and total pit depth

0 10 20
Approximate Scale in Feet

N

Aerial Photo Date: August 2017
Aerial Photo Source: Google Earth

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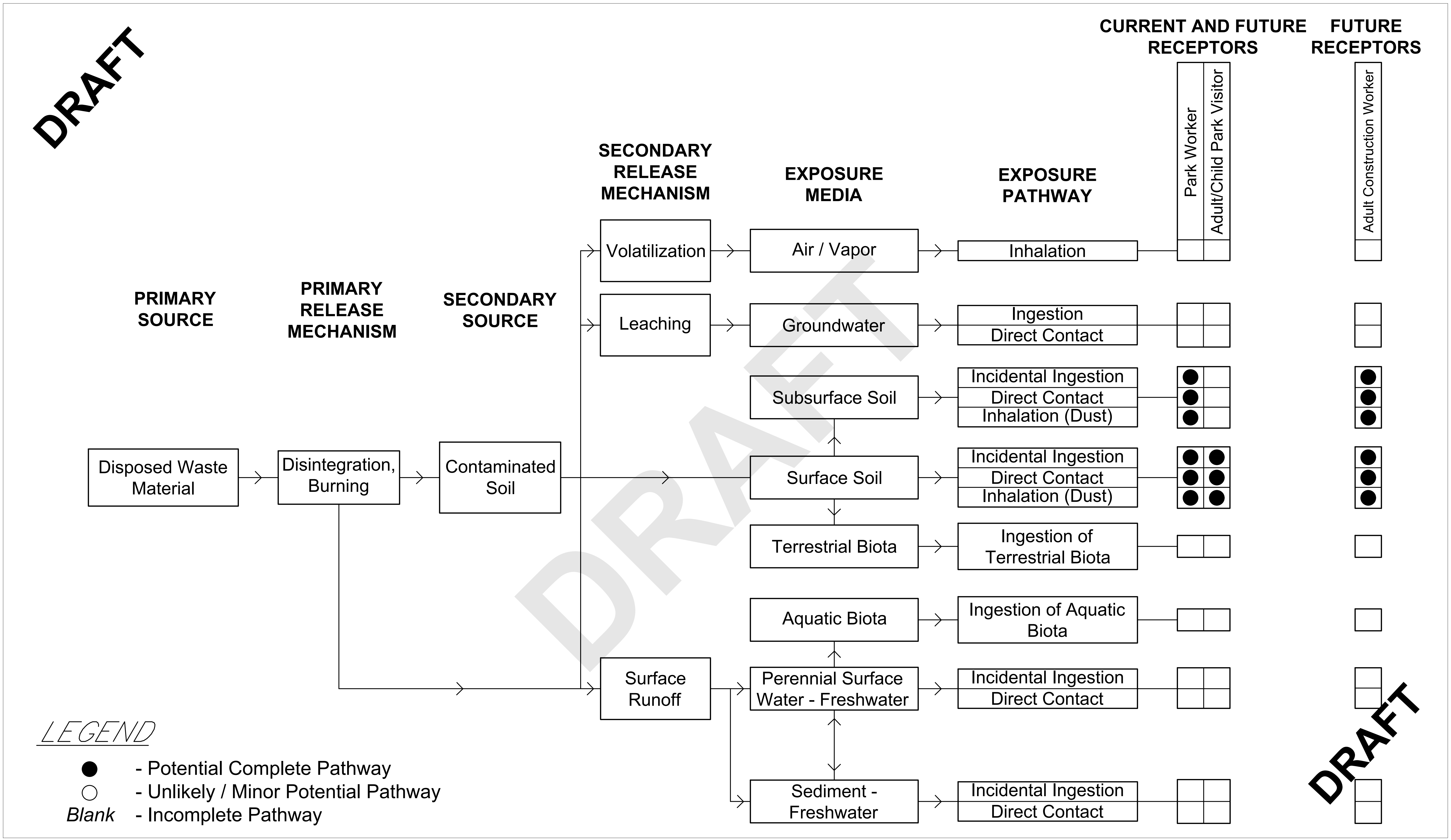
Project No. 47923-1

Engineering Evaluation / Cost Analysis
Mather Former Waste Disposal Area
Yosemite National Park, California

Figure 5
North Site Area



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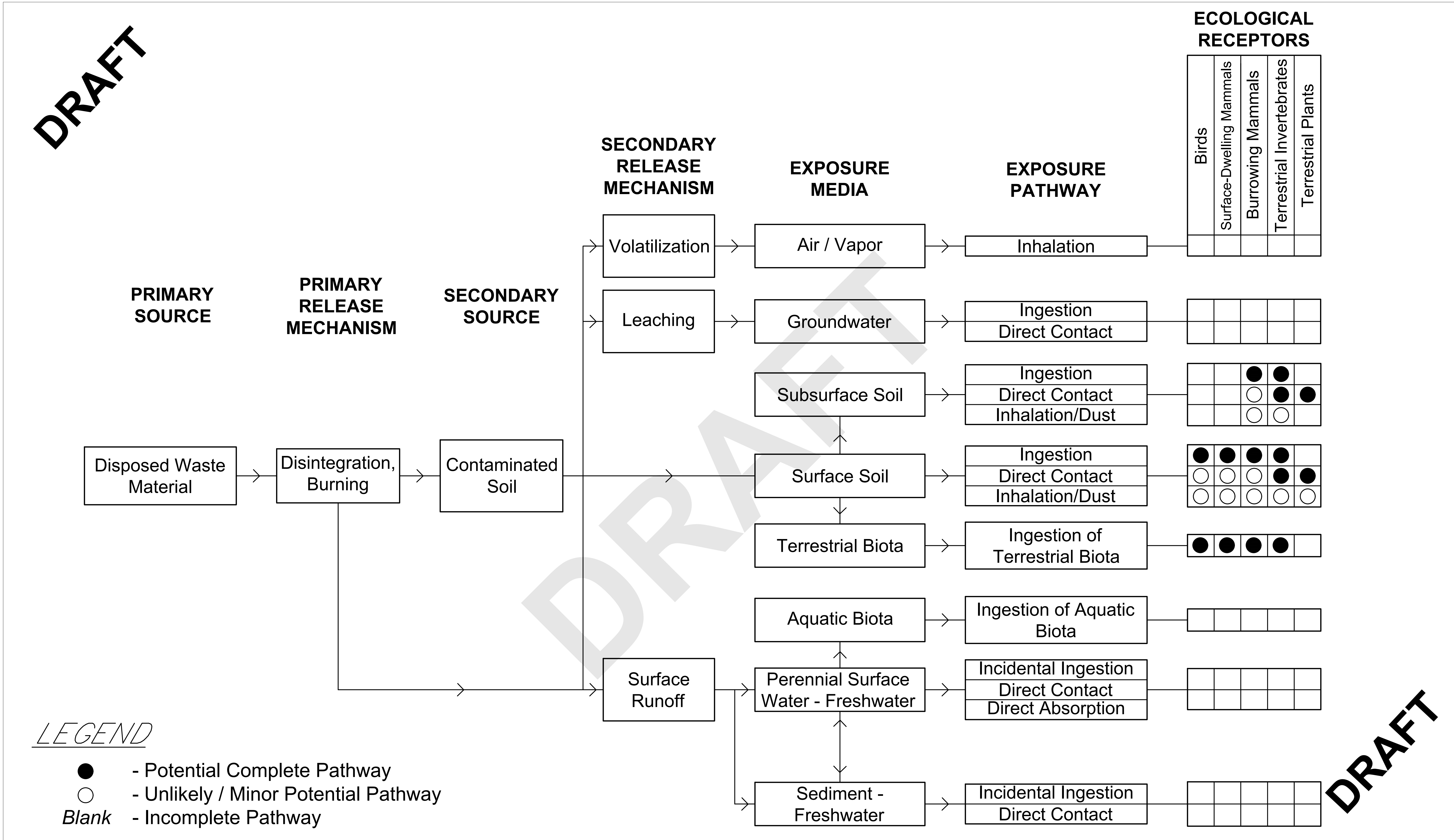
Project #49721

Engineering Evaluation / Cost Analysis
Mather Former Waste Disposal Area Site
Yosemite National Park, California

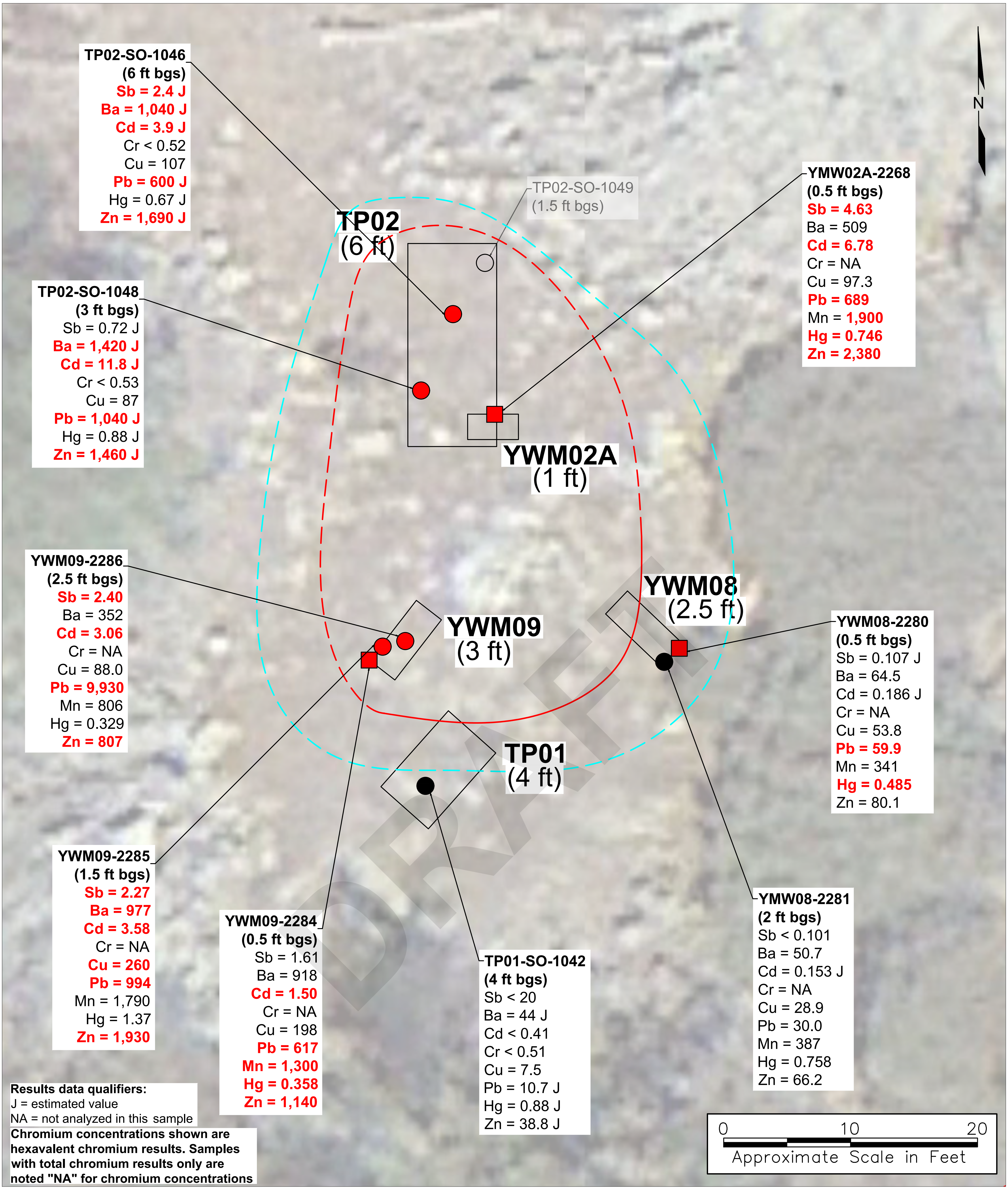
Figure 6
Conceptual Site Model
For Human Exposures



Project #49721

Engineering Evaluation / Cost Analysis
Mather Former Waste Disposal Area Site
Yosemite National Park, California

Figure 7
Conceptual Site Model
For Ecological
Exposures



LEGEND

Aerial Photo Date: August 2017
Aerial Photo Source: Google Earth

Approximate extent of test pit, with pit ID and total pit depth

Surface Sub-Surface

Approximate location of test pit soil sample, with sample ID, depth, and results:
- Black fill/text indicates no exceedances of RG
- Red fill/text indicates one or more metals exceeds of RG
- Open (no) fill indicates samples not analyzed for metals

Estimated extent of surface soil (0-6 inches bgs) containing metal/s above RG/s, dashed where uncertain

Estimated extent of subsurface soil (>6 inches bgs) containing metal/s above RG/s, dashed where uncertain

Removal Goals (RG) (mg/kg) Surface (0-6" bgs) RG / Subsurface (>6" bgs) RG	Background Values (mg/kg)
Antimony (Sb) = 1.6 / 1.6	Antimony (Sb) = 0.242
Barium (Ba) = NV / 837	Barium (Ba) = 64.6
Cadmium (Cd) = 1.0 / 1.0	Cadmium (Cd) = 0.41
Chromium (Cr)* = 1.4* / 1.4*	Chromium (Cr) = 7.9
Copper (Cu) = 123 / 123	Copper (Cu) = 10.0
Lead (Pb) = 54 / 192	Lead (Pb) = 8.8
Manganese (Mn) = 574 / NV	Manganese (Mn) = 267
Mercury (Hg) = 0.19 / NV	Mercury (Hg) = 0.1
Zinc (Zn) = 334 / 334	Zinc (Zn) = 52.8
"NV" = no RG for this depth range * = RG based on hexavalent chromium	No vanadium exceedances of RG in Site soil. Vanadium not shown.

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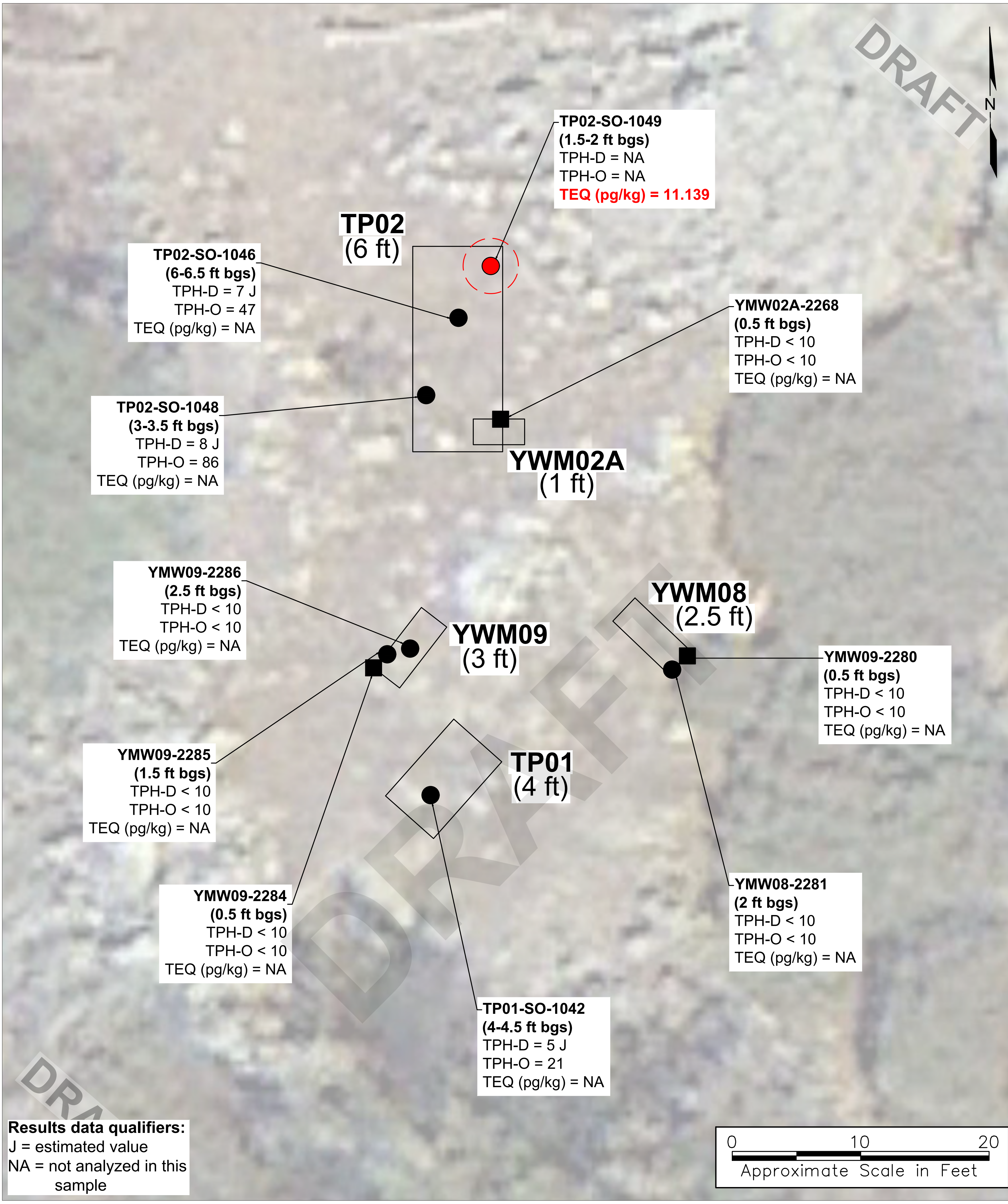
Project No. 49723-1

Engineering Evaluation / Cost Analysis
Mather Former Waste Disposal Area
Yosemite National Park, California

Figure 8
South Site Area
Metals Results



LEGEND

Aerial Photo Date: August 2017
Aerial Photo Source: Google Earth

Approximate extent of test pit, with pit ID and total pit depth

Surface Sub-Surface

Approximate location of test pit soil sample, with sample ID, depth, and results:
- Black fill/text indicates no exceedances of RG
- **Red fill/text** indicates TPH and/or TEQ exceeds RG
- Open (no) fill indicates samples not analyzed for TPH or TEQ

Estimated extent of subsurface soil (>6 inches bgs) containing TPH and/or TEQ above RG/s, dashed where uncertain

Removal Goals (RG)	Background Values
TPH-Medium (TPH-D) = 2,000	TPH-Medium (TPH-D) = 3
TPH-High (TPH-O) = 40,000	TPH-High (TPH-O) = 31
Dioxins and Furans as 2,3,7,8-TCDD TEQ (TEQ) = 7 pg/kg	Dioxins and Furans as 2,3,7,8-TCDD TEQ (TEQ) = 0.0434 pg/kg
"TEQ" = 2,3,7,8-TCDD Toxicity Equivalency Concentration	All values in parts per million (ppm), except TEQ

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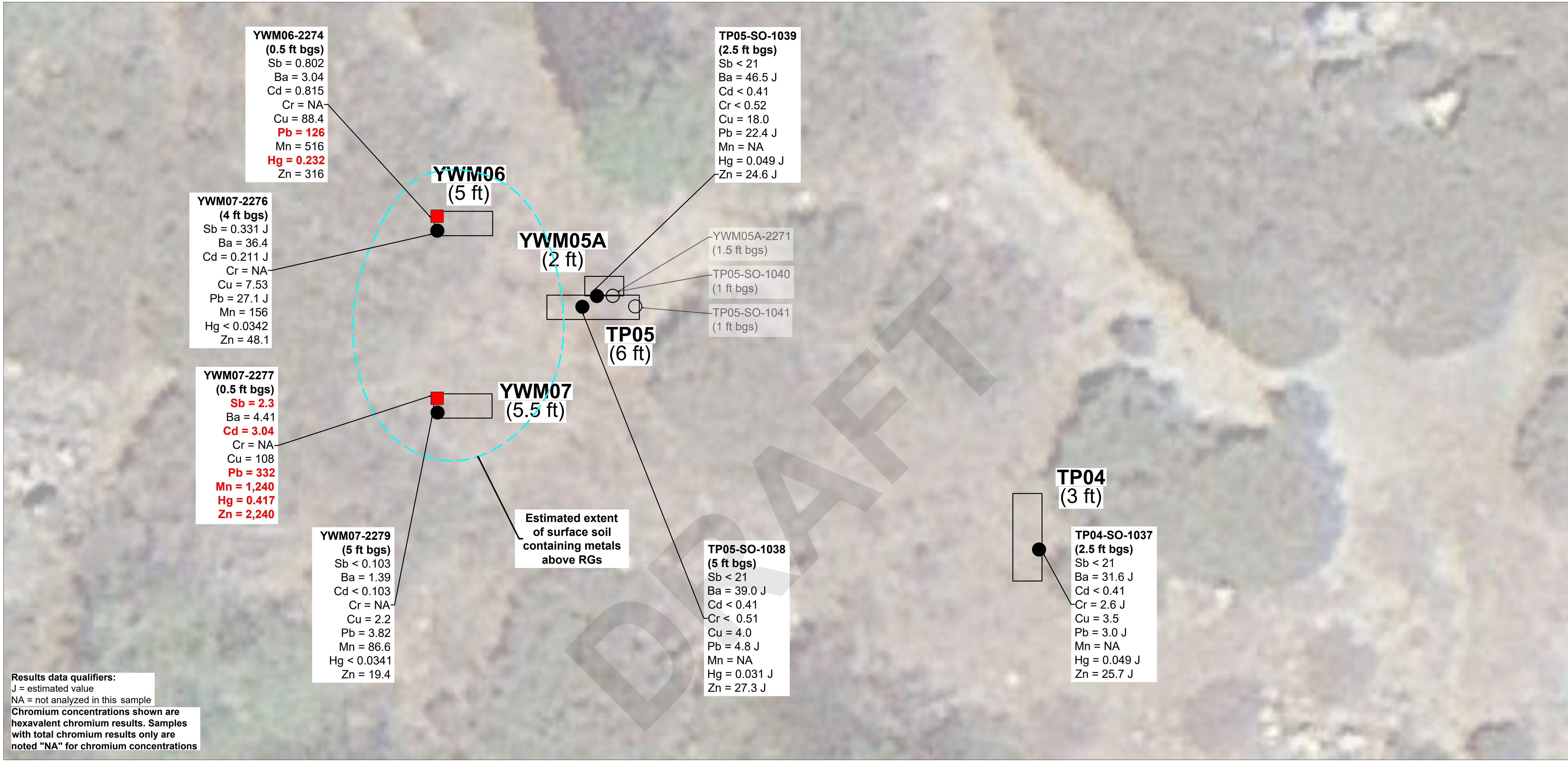
Engineering Evaluation / Cost Analysis
Mather Former Waste Disposal Area
Yosemite National Park, California

DRAFT

Figure 9
South Site Area
TPH and TEQ Results



LEGEND

Surface / Sub-Surface: Approximate location of test pit soil sample, with sample ID, depth, and results:
- Black fill/text indicates no exceedances of RG
- **Red fill/text** indicates one or more metals exceeds of RG
- Open (no) fill indicates samples not analyzed for metals

Approximate extent of test pit, with pit ID and total pit depth

Estimated extent of surface soil (0-6 inches bgs) containing metal/s above RG/s, dashed where uncertain

Removal Goals (RG) (mg/kg) Surface (0-6" bgs) RG / Subsurface (>6" bgs) RG	**Background Values (mg/kg)**
Antimony (Sb) = 1.6 / 1.6	Antimony (Sb) = 0.242
Barium (Ba) = NV / 837	Barium (Ba) = 64.6
Cadmium (Cd) = 1.0 / 1.0	Cadmium (Cd) = 0.41
Chromium (Cr)* = 1.4* / 1.4*	Chromium (Cr) = 7.9
Copper (Cu) = 123 / 123	Copper (Cu) = 10.0
Lead (Pb) = 54 / 192	Lead (Pb) = 8.8
Manganese (Mn) = 574 / NV	Manganese (Mn) = 267
Mercury (Hg) = 0.19 / NV	Mercury (Hg) = 0.1
Zinc (Zn) = 334 / 334	Zinc (Zn) = 52.8
"NV" = no RG for this depth range * = RG based on hexavalent chromium	No vanadium exceedances of RG in Site soil. Vanadium not shown.

0 10 20
Approximate Scale in Feet

N

Aerial Photo Date: August 2017
Aerial Photo Source: Google Earth

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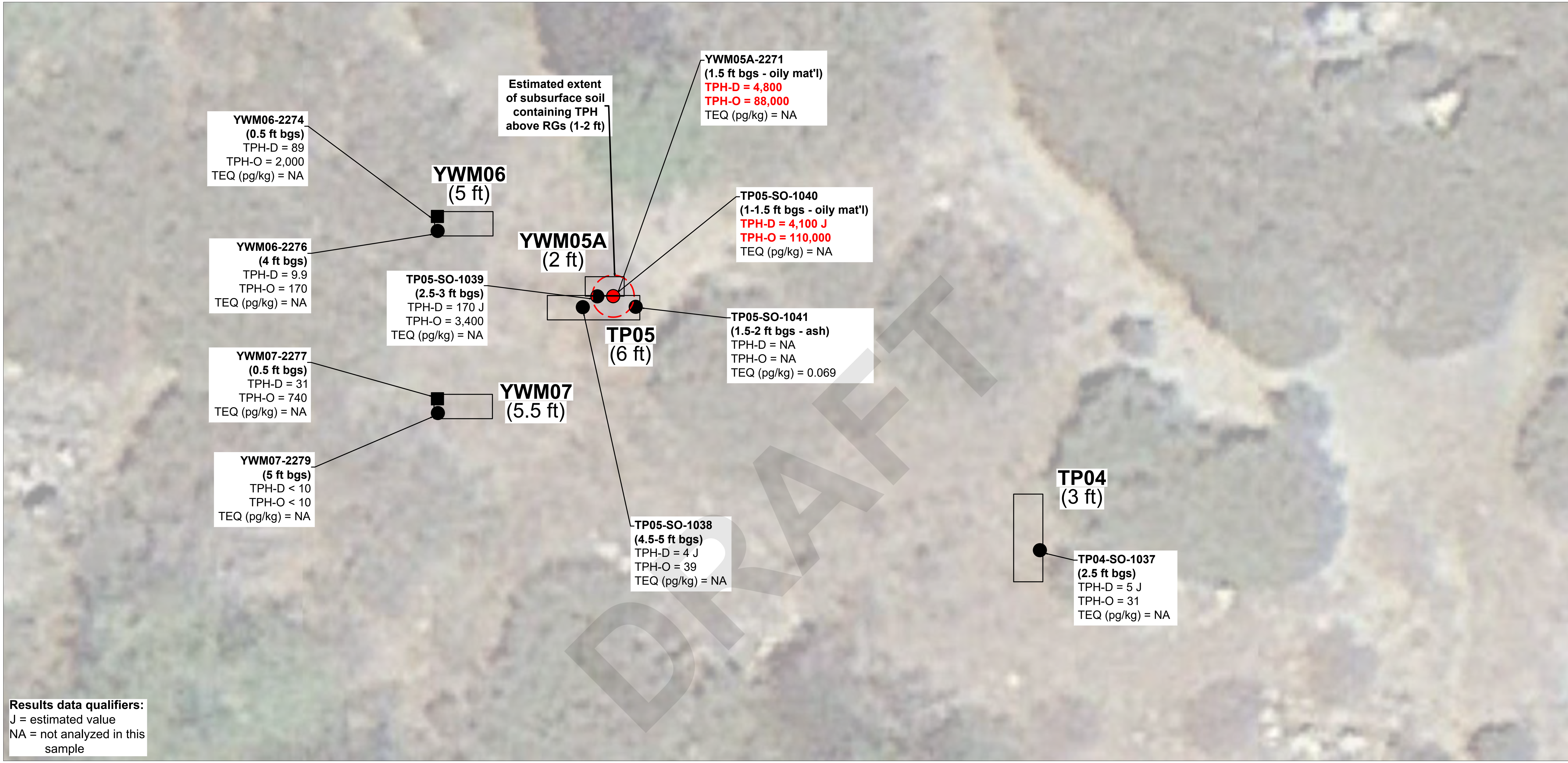
Project No. 47923-1

Engineering Evaluation / Cost Analysis
Mather Former Waste Disposal Area
Yosemite National Park, California

Figure 10
North Site Area
Metals Results



LEGEND

Surface / Sub-Surface

Approximate location of test pit soil sample, with sample ID, depth, and results:
- Black fill/text indicates no exceedances of RG
- **Red fill/text** indicates TPH and/or TEQ exceeds RG
- Open (no) fill indicates samples not analyzed for TPH or TEQ

Approximate extent of test pit, with pit ID and total pit depth

Estimated extent of subsurface soil (>6 inches bgs) containing TPH and/or TEQ above RG/s, dashed where uncertain

Removal Goals (RG)	Background Values
TPH-Medium (TPH-D) = 2,000	TPH-Medium (TPH-D) = 3
TPH-High (TPH-O) = 40,000	TPH-High (TPH-O) = 31
Dioxins and Furans as 2,3,7,8-TCDD TEQ (TEQ) = 7 pg/kg	Dioxins and Furans as 2,3,7,8-TCDD TEQ (TEQ) = 0.0434 pg/kg
"TEQ" = 2,3,7,8-TCDD Toxic Equivalency Concentration	All values in parts per million (ppm), except TEQ

0 10 20
Approximate Scale in Feet

N

Aerial Photo Date: August 2017
Aerial Photo Source: Google Earth

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Project No. 47923-1

Engineering Evaluation / Cost Analysis
Mather Former Waste Disposal Area
Yosemite National Park, California

Figure 11
North Site Area
TPH and TEQ Results

LEGEND

Aerial Photo Date: August 2017
Aerial Photo Source: Google Earth

Estimated extent of contaminated surficial soil (0-1 foot bgs)

Estimated extent of contaminated subsurface soil (>1 foot bgs)

Estimated area to be covered by soil cap for prevention of human and ecological exposures to soil

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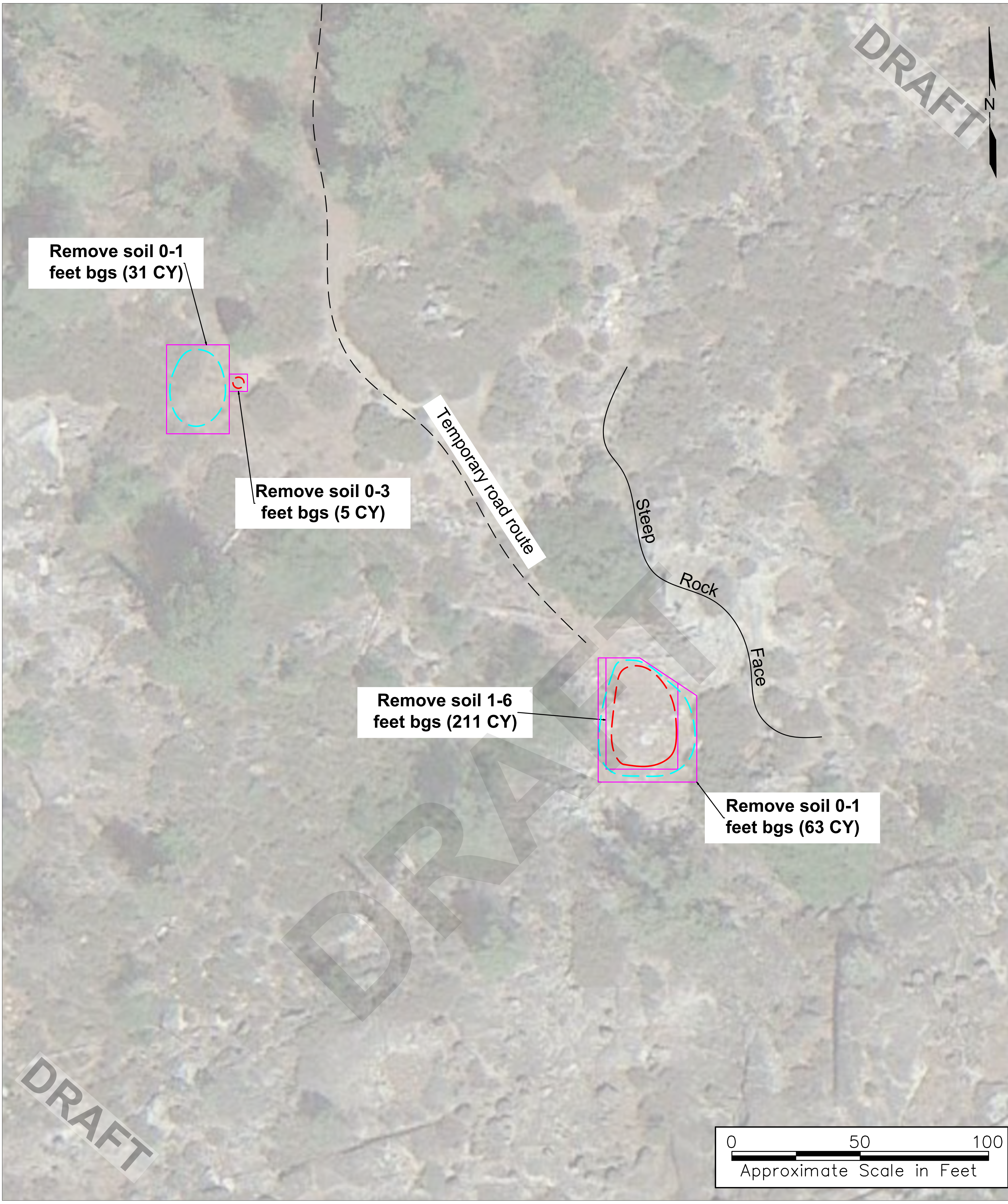
Project No. 49723-1

Engineering Evaluation / Cost Analysis
Mather Former Waste Disposal Area
Yosemite National Park, California

Figure 12
Soil Cap Areas



LEGEND

Aerial Photo Date: August 2017
Aerial Photo Source: Google Earth

Estimated extent of contaminated surficial soil (0-1 foot bgs)

Estimated extent of contaminated subsurface soil (>1 foot bgs)

Area to be excavated, with depth and estimated volume of soil to be removed, in cubic yards (CY)

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Project No. 49723-1

Engineering Evaluation / Cost Analysis
Mather Former Waste Disposal Area
Yosemite National Park, California

Figure 13
Soil Excavation Areas

TABLES

Table 1. Summary of Site Soil Results and Human Health and Ecological Screening Values

				CAM 17 Metals by EPA Methods 6010B, 6020A and 7471A (mg/kg)																	EPA Method 7196A (mg/kg)	Other Metals by EPA Method 6020A (mg/kg)		
Sample Type	Sample ID	Sample Date	Sample Depth (feet bgs)	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium, Total	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc	Hexavalent Chromium	Aluminum	Iron	Manganese
Background	YWM-UG01-SO-1043	8/27/2001	1	20 U	2.4 J	64.6 J	0.82 U	0.41 U	4.7 J	5 J	3.5	3.5 J	0.034 J	0.82 U	3.8 J	2 U	2 U	2 U	27.5	27.1 J	0.51 U	--	--	--
	YWM-UG02-SO-1044	8/27/2001	1	20 U	3.4 J	46.7 J	0.81 U	0.41 U	7.9 J	6.4 J	10	5.1 J	0.081 J	0.39 J	4.4 J	2 U	2 U	2 U	51.2	40.1 J	0.51 U	--	--	--
	YWM-UG03-SO-1045	8/27/2001	1	21 U	2.1 J	53.6 J	0.82 U	0.41 U	4.9 J	6 J	3.9	3.7 J	0.045 J	0.6 J	4.4 J	2.1 U	2.1 U	2.1 U	28.7	52.8 J	0.51 U	--	--	--
	YWM101-2287	8/26/2008	1	0.10 U	2.06	46.4	0.328 J	0.104 U	5.06	3.45	5.39	8.78	0.0343 U	0.65	4.38	0.34 J	0.104 U	0.23 J	24.5	34	--	15,000	12,200	210
	YWM102-2288	8/26/2008	1	0.11 U	1.79	37.1	0.287 J	0.105 U	3.94	2.75	4.6	4.94	0.0348 U	0.652	3.94	0.34 J	0.105 U	0.198 J	21.3	29.3	--	13,200	10,500	171
	YWM103-2289	8/26/2008	1	0.10 U	1.61	55.2	0.278 J	0.102 U	4.66	3.61	5.62	4.41	0.0338 U	0.758	4.49	0.205 J	0.102 U	0.215 J	21.9	37.1	--	12,500	11,300	267
	YWM104-2290	8/26/2008	1	0.10 U	1.33	46.2	0.233 J	0.102 U	3.72	3.1	4.86	3.29	0.0338 U	0.509 J	3.73	0.163 J	0.102 U	0.169 J	19	31.8	--	10,000	9,200	203
	YWM105-2291	8/26/2008	1	0.10 U	5.99	45.8	0.376 J	0.144 J	4.53	2.65	4.46	4.8	0.0341 U	0.793	3.49	0.279 J	0.103 U	0.169 J	23.7	25.5	--	12,300	12,100	167
	YWM106-2292	8/26/2008	1	0.10 U	1.76	41.3	0.332 J	0.118 J	4.26	2.99	4.37	3.99	0.0338 U	0.712	3.57	0.226 J	0.103 U	0.183 J	21.3	26.3	--	12,400	10,400	213
	YWM107-2293	8/26/2008	1	0.10 U	1.52	49.7	0.61	0.103 U	5.15	3.13	4.47	4.54	0.0341 U	0.863	4.2	0.215 J	0.103 U	0.202 J	25.5	26.6	--	13,600	12,700	123
	YWM108-2294	8/26/2008	1	0.14 J	1.94	52.9	0.624	0.144 J	5.65	3.14	4.87	4.84	0.0340 U	1.09	4.45	0.227 J	0.103 U	0.267 J	25.9	26.5	--	15,100	12,500	123
	YWM109-2295	8/26/2008	1	0.11 J	2.84	41.7	0.261 J	0.103 U	5.68	2.92	6.92	4.88	0.0348 U	1.47	4.09	0.402 J	0.103 U	0.259 J	21.6	33.9	--	12,900	13,300	189
	YWM110-2296	8/26/2008	1	0.19 J	3.59	25.6	0.119 J	0.103 U	3.38	2.23	8.81	4.31	0.0808 J	1.02	2.76	0.464 J	0.103 U	0.161 J	16.1	20.3 J	--	14,300	7,120	104
Surface	YWM02A-2268	8/26/2008	0.5	5	6.42	509	0.147 J	6.78	23	5.2	97.3	689	0.746	2.22	12.3	0.155 J	0.915	0.406 J	16.3	2,380	--	7,590	30,500	1,900
	YWM06-2274	8/26/2008	0.5	1	3.04	149	0.165 J	0.815	11	8.36	88.4	126	0.232	1.38	10.1	0.119 J	1.07	0.392 J	37.4	316	--	12,000	28,400	516
	YWM07-2277	8/26/2008	0.5	2.3	4.41	346	0.176 J	3.04	17.9	9.24	108	332	0.417	2.17	19.7	0.155 J	0.776	0.567	27	2,420	--	11,200	40,200	1,240
	YWM08-2280	8/26/2008	0.5	0.1 J	1.47	64.5	0.22 J	0.186 J	4.3	3.7	53.8	59.9	0.485	0.505 J	4.15	0.149 J	0.102 U	0.361 J	21	80.1	--	10,200	13,200	341
	YWM09-2284	8/26/2008	0.5	1.6	7.37	918	0.155 J	1.5	23.6	6.45	198	617	0.358	0.969	27.9	0.197 J	0.719	0.232 J	20.1	1,140	--	8,900	25,300	1,300
Sub- surface	YWM-TP05-SO-1041	8/27/2001	1-1.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	YWM-TP01-SO-1042	8/27/2001	4	20 U	1.9 J	44 J	0.81 U	0.41 U	2.1 J	5.3 J	7.5	10.7 J	0.88 J	0.2 J	2.1 J	2 U	2 U	2 U	20.3	38.8 J	0.51 U	--	--	--
	YWM-TP02-SO-1048	8/27/2001	3	0.72 J	5.7 J	1,420 J	0.21 U	11.8 J	36.4 J	5.7 J	87	1,040 J	0.88 J	0.51	11.9 J	0.53 U	2.6 J	0.53 U	22.1	1,460 J	0.53 U	--	--	--
	YWM-TP02-SO-1046	8/27/2001	6	2.4 J	8.4 J	1,040 J	0.83 U	3.9 J	29 J	6.8 J	107	600 J	1.6 J	2.3	12.5 J	1.1 J	0.75 J	2.1 U	24.1	2,120 J	0.52 U	--	--	--
	YWM-TP02-SO-1049	8/27/2001	1.5-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	YWM-TP04-SO-1037	8/27/2001	2.5	21 U	2 J	31.6 J	0.83 U	0.41 U	2.6 J	3.4 J	3.5	3 J	0.052 J	0.21 J	2.2 J	2.1 U	2.1 U	2.1 U	16.3	25.7 J	0.52 U	--	--	--
	YWM-TP05-SO-1039	8/27/2001	2.5	21 U	2.5 J	46.5 J	0.83 U	0.41 U	3.7 J	3.8 J	18	22.4 J	0.049 J	0.26 J	3.6 J	2.1 U	2.1 U	2.1 U	19.9	24.6 J	0.52 U	--	--	--
	YWM-TP05-SO-1038	8/27/2001	4.5	21 U	2 J	39 J	0.82 U	0.41 U	4.1 J	4.2 J	4	4.8 J	0.031 J	0.61 J	3.2 J	2.1 U	2.1 U	2.1 U	24.2	27.3	0.51 U	--	--	--
	YWM-TP05-SO-1040	8/27/2001	1-1.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	YWM05A-2271		1.5-1.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	YWM06-2276	8/26/2008	4	0.33 J	1.13	36.4	0.234 J	0.211 J	3.39	2.22	7.53	27.1 J	0.0342 U	0.752	2.76	0.204 J	0.113 J	0.249 J	17	48.1	--	9,470	8,530	156
	YWM07-2279	8/26/2008	5	0.10 U	1.39	21.1	0.251 J	0.103 U	3.75	1.78	2.2	3.82	0.0341 U	0.782	2.13	0.156 J	0.103 U	0.281 J	22.4	19.4	--	12,000	10,300	86.6
	YWM08-2281	8/26/2008	2	0.10 U	1.1	66.3	0.171 J	0.153 J	2.66	4.08	28.9	30	1.14	0.384 J	2.12	0.127 J	0.101 U	0.381 J	23.6	66.2	--	8,940	14,600	387
	YWM09-2285	8/26/2008	1.5	2.3	5.23	977	0.192 J	3.58	28.4	5.69	260	994	1.37	1.18	9.93	0.184 J	1.23	0.275 J	22.7	1,930	--	9,960	29,700	1,790
	YWM09-2286	8/26/2008	2.5	2.4	4.08	352	0.232 J	3.06	14.3	4.26	88	9,930	0.329	0.848	7.48	0.159 J	0.854	0.219 J	20.6	807	--	10,300	21,000	938
Down-gradient	YWM-DG01-SO-1050	8/28/2001	1	21 U	1.9 J	59.1 J	0.83 U	0.42 U	4.3 J	4.5 J	7.4	7.9 J	0.049 J	0.9	4.6 J	2.1 U	2.1 U	2.1 U	20.3	38.6 J	0.52 U	--	--	--
	YWM-DG02-SO-1051	8/28/2001	1	20 U	1.2 J	35.5 J	0.8 U	0.4 U	1.7 J	4 J	2.9	3.5 J	0.041 J	0.8 U	1.7 J	2 U	2 U	2 U	15.5	22.5 J	0.5 U	--	--	--
	YWM-DG03-SO-1052	8/28/2001	1	20 U	1.8 J	63.5 J	0.82 U	0.41 U	3.9 J	6	8.6	8.5 J	0.084 J	0.35 J	4 J	2 U	2 U	2 U	23.9	39.5 J	0.51 U	--	--	--
Human Health Screening Levels	USEPA Soil RSL, Residential (Target HQ=0.1, Cancer Risk = 10-6)			3.1	0.7	1,500	16	7.1	12,000	2.3	310	400	2.3	39	150	39	39	0.078	39	2,300	0.3	7,700	5,500	180
	CalEPA DTSC Soil Screening Level, DTSC HERO Note 3			No SL	0.11	No SL	16	71	No SL	No SL	No SL	80	1	No SL	820	No SL	No SL	No SL	No SL	No SL	0.3	No SL	No SL	No SL
Ecological Screening Values	NPS SLERA COPEC Selection ESV for Terrestrial Plants and Invertebrates			5	6.8	110	2.5	4	0.34	13	50	50	0.05	2	30	0.52	2	0.05	2	6.62	No ESV	50	No ESV	220
	NPS SLERA COPEC Selection ESV for Terrestrial Plants and Invertebrates			0.248	0.25	17.2	2.42	0.27	23	76	14	0.94	0.013	0.52	10	0.331	2.6	0.027	0.714	12	7.21	No ESV	No ESV	322
Site Screening Value (Lowest Human/Ecological Screening Value)				0.248	0.11	17.2	2.42	0.27	0.34	2.3	14	0.94	0.013	0.52	10	0.331	2	0.027	0.714	6.62	0.30	50	5,500	180

Notes:
Screening Levels and Ecological Screening Values are the screening levels and values used in the Screening Level Human Health and Ecological Risk Assessments (Appendix C)
Metals, TPH, dioxins and furans concentrations are in milligrams per kilogram. VOCs, SVOCs, and PAHs concentrations are in micrograms per kilogram (µg/kg).
Detected values are in bold.
Bold and Shaded values represent detections greater than the Site Screening Value.
bgs = below ground surface
-- = Not analyzed in this sample
U = Not detected above the listed laboratory detection limit
J = Estimated Value
No SL = No human health screening level established under this criteria
No SV = No ecological screening value established under this criteria
2,3,7,8-TCDD = 2,3,7,8-tetrachlorodibenzodioxin

Table 1. Summary of Site Soil Results and Human Health and Ecological Screening Values

Sample Type	Sample ID	Sample Date	Sample Depth (feet bgs)	VOCs (µg/kg) EPA Method 8260B: Acetone	VOCs: Methylene chloride	SVOCs (µg/kg) EPA Method 8270C: Bis(2-ethylhexyl)phthalate	SVOCs: Pentachlorophenol	PAHS (µg/kg) EPA Methods 8310 and 8270C SIM: Anthracene	PAHs: Benzo(a)anthracene	PAHs: Benzo(a)pyrene	PAHs: Benzo(b)fluoranthene	PAHs: Benzo(g,h,i)perylene	PAHs: Benzo(k)fluoranthene	PAHs: Chrysene	PAHs: Dibenz(a,h)anthracene	PAHs: Fluoranthene	PAHs: Indeno(1,2,3-c,d)pyrene	PAHs: Phenanthrene	PAHs: Pyrene	Petroleum Hydrocarbons (mg/kg) EPA Method 8015B: Total Petroleum Hydrocarbons - Gasoline (TPH-G)	Petroleum Hydrocarbons: Total Petroleum Hydrocarbons - Diesel (with SGC) (TPH-D)	Petroleum Hydrocarbons: Total Petroleum Hydrocarbons - Motor Oil (with SGC) (TPH-O)	Dioxins/Furans (mg/kg) EPA Method 8290: Dioxins and Furans (as 2,3,7,8-TCDD TEQ)
Background	YWM-UG01-SO-1043	8/27/2001	1	--	--	--	--	2 U	2 U	2 U	2 U	2 U	2 U	2 U	5.1 U	2 U	2 U	2 U	2 U	--	**3** J	**11**	--
	YWM-UG02-SO-1044	8/27/2001	1	--	--	--	--	2 U	2 U	2 U	2 U	2 U	2 U	2 U	5.1 U	2 U	2 U	2 U	2 U	--	**3** J	**31**	**4.34E-08**
	YWM-UG03-SO-1045	8/27/2001	1	--	--	--	--	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	5.1 U	2.1 U	2.1 U	2.1 U	2.1 U	--	**3** J	**29**	--
	YWM101-2287	8/26/2008	1	--	--	--	--	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	--	--	--	--
	YWM102-2288	8/26/2008	1	--	--	--	--	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	--	--	--	--
	YWM103-2289	8/26/2008	1	--	--	--	--	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	--	--	--	--
	YWM104-2290	8/26/2008	1	--	--	--	--	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	--	--	--	--
	YWM105-2291	8/26/2008	1	--	--	--	--	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	--	--	--	--
	YWM106-2292	8/26/2008	1	--	--	--	--	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	--	--	--	--
	YWM107-2293	8/26/2008	1	--	--	--	--	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	--	--	--	--
	YWM108-2294	8/26/2008	1	--	--	--	--	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	--	--	--	--
	YWM109-2295	8/26/2008	1	--	--	--	--	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	--	--	--	--
	YWM110-2296	8/26/2008	1	--	--	--	--	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	--	--	--	--
Surface	YWM02A-2268	8/26/2008	0.5	**15**	**2.6** J	170 U	**190** J	2.6 U	2.6 U	2.6 U	2.6 U	**7**	2.6 U	2.6 U	2.6 U	**5.2**	**5.2** J	2.6 U	**4.6** J	1 U	10 U	10 U	--
	YWM06-2274	8/26/2008	0.5	**5.6** J	2.0 U	340 U	350 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	1.2 U	**89**	**2000**	--
	YWM07-2277	8/26/2008	0.5	8.9 U	**7.2** J	350 U	370 U	5.2 U	5.2 U	**62**	5.2 U	**78**	5.2 U	**51**	**49**	5.2 U	5.2 U	5.2 U	**19**	3 U	**31**	**740**	--
	YWM08-2280	8/26/2008	0.5	5.6 U	2.2 U	**240** J	170 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	1.5 U	10 U	10 U	--
	YWM09-2284	8/26/2008	0.5	5.2 U	2.1 U	**720**	180 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	**1.3**	10 U	10 U	--
Sub- surface	YWM-TP05-SO-1041	8/27/2001	1-1.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**6.90E-08**
	YWM-TP01-SO-1042	8/27/2001	4	--	--	--	--	2 U	2 U	2 U	2 U	2 U	2 U	**1** J	5.1 U	2 U	2 U	2 U	2 U	--	**4** J	**21**	--
	YWM-TP02-SO-1048	8/27/2001	3	--	--	--	--	**1** J	**7.2**	**15**	**15**	2.1 U	**9.1**	**17**	**17** J	**31**	**11**	**13**	**44**	--	**8** J	**86**	--
	YWM-TP02-SO-1046	8/27/2001	6	--	--	--	--	2.1 U	**10**	**34**	**28**	2.1 U	2.1 U	**35**	**30**	**39**	**20**	**20**	**39**	--	**7** J	**47**	--
	YWM-TP02-SO-1049	8/27/2001	1.5-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**1.11E-05**
	YWM-TP04-SO-1037	8/27/2001	2.5	--	--	--	--	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	**1** J	5.2 U	2.1 U	2.1 U	2.1 U	2.1 U	--	**5** J	**21**	--
	YWM-TP05-SO-1039	8/27/2001	2.5	--	--	--	--	41 U	41 U	41 U	41 U	41 U	41 U	41 U	100 U	41 U	41 U	41 U	41 U	--	**4** J	**39**	--
	YWM-TP05-SO-1038	8/27/2001	4.5	--	--	--	--	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	5.1 U	2.1 U	2.1 U	2.1 U	2.1 U	--	**170** J	**3400**	--
	YWM-TP05-SO-1040	8/27/2001	1-1.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**4100** J	**110000**	--
	YWM05A-2271		1.5-1.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**4800**	**88000**	--
	YWM06-2276	8/26/2008	4	**44**	2.3 U	170 U	180 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	**1.3**	**9.9**	**170**	--
	YWM07-2279	8/26/2008	5	7.2 U	2.9 U	170 U	180 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	1.3 U	<10 U	<10 U	--
	YWM08-2281	8/26/2008	2	5.5 U	2.2 U	170 U	180 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	1.1 U	<10 U	<10 U	--
	YWM09-2285	8/26/2008	1.5	6.6 U	**2.7**	**290** J	180 U	**6**	**19**	**16**	**24**	**11**	**7.1**	**17**	2.5 U	**50**	**10**	**38**	**40**	1.1 U	<10 U	<10 U	--
	YWM09-2286	8/26/2008	2.5	7.2 U	2.9 U	170 U	180 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	1.2 U	<10 U	<10 U	--
Down-gradient	YWM-DG01-SO-1050	8/28/2001	1	--	--	--	--	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	**6.9**	5.2 U	2.1 U	2.1 U	2.1 U	**7.6**	--	**20** J	**120**	--
	YWM-DG02-SO-1051	8/28/2001	1	--	--	--	--	2 U	2 U	2 U	2 U	2 U	2 U	**1** J	5 U	2 U	2 U	2 U	2 U	--	**4** J	**29**	--
	YWM-DG03-SO-1052	8/28/2001	1	--	--	--	--	2 U	2 U	2 U	2 U	2 U	2 U	**3**	5.1 U	2 U	2 U	2 U	2 U	--	**8** J	**62**	--
Human Health Screening Levels	USEPA Soil RSL, Residential (Target HQ=0.1, Cancer Risk = 10-6)			6,100,000	35,000	39,000	1,000	1,800,000	1,100	110	1,100	No SL	11,000	110,000	110	240,000	1,100	NA	180,000	2,300	9.7	240	4.8E-06
	CalEPA DTSC Soil Screening Level, DTSC HERO Note 3			No SL	2,200	39,000	1,000	17,000,000	1,100	110	1,100	No SL	11,000	110,000	28	2,400,000	1,100	NA	1,800,000	No SL	97.0	2,400	No SL
Ecological Screening Values	NPS SLERA COPEC Selection ESV for Terrestrial Plants and Invertebrates			No SV	1,600,000	No SV	3,000	6,800	18,000	No SV	18,000	No SV	No SV	No SV	No SV	10,000	No SV	5,500	10,000	6.62	No ESV	No ESV	5
	NPS SLERA COPEC Selection ESV for Terrestrial Plants and Invertebrates			1,200	2,600	20	360	210,000	730	1,980	44,000	25,000	71,000	3,100	14,000	22,000	71,000	11,000	23,000	12	No ESV	No ESV	1.99E-07
Site Screening Value (Lowest Human/Ecological Screening Value)				1,200	2,200	20	360	6,800	730	110	1,100	25,000	11,000	3,100	28	10,000	1,100	5,500	10,000	6.62	9.70	240	1.99.E-07

Notes:

Screening Levels and Ecological Screening Values are the screening levels and values used in the Screening Level Human Health and Ecological Risk Assessments (Appendix C)

Metals, TPH, dioxins and furans concentrations are in milligrams per kilogram. VOCs, SVOCs, and PAHs concentrations are in micrograms per kilogram (µg/kg).

Detected values are in bold.

Bold and Shaded values represent detections greater than the Site Screening Value.

bgs = below ground surface

-- = Not analyzed in this sample

U = Not detected above the listed laboratory detection limit

J = Estimated Value

No SL = No human health screening level established under this criteria

No SV = No ecological screening value established under this criteria

2,3,7,8-TCDD = 2,3,7,8-tetrachlorodibenzodioxin

Table 2. Summary of Paired Hexavalent Chromium and Total Chromium Results in Soil

Sample Type	Sample ID	Sample Date	Sample Depth (feet bgs)	Chromium (Cr), Total	Hexavalent Chromium (Cr(VI))	Ratio of Cr(VI) detection limit to Total Cr concentration
Background	YWM-UG01-SO-1043	8/27/2001	1	**4.7 J**	0.51 U	0.11
	YWM-UG02-SO-1044	8/27/2001	1	**7.9 J**	0.51 U	0.06
	YWM-UG03-SO-1045	8/27/2001	1	**4.9 J**	0.51 U	0.10
Background Soil Sample Mean Values				5.8	0.51	0.09
Subsurface	YWM-TP01-SO-1042	8/27/2001	4	**2.1 J**	0.51 U	0.24
	YWM-TP02-SO-1048	8/27/2001	3	**36.4 J**	0.53 U	0.01
	YWM-TP02-SO-1046	8/27/2001	6	**29 J**	0.52 U	0.02
	YWM-TP04-SO-1037	8/27/2001	2.5	**2.6 J**	0.52 U	0.20
	YWM-TP05-SO-1039	8/27/2001	2.5	**3.7 J**	0.52 U	0.14
	YWM-TP05-SO-1038	8/27/2001	4.5	**4.1 J**	0.51 U	0.12
Site Subsurface Soil Sample Mean Values				13.0	0.52	0.04
Down-gradient	YWM-DG01-SO-1050	8/28/2001	1	**4.3 J**	0.52 U	0.12
	YWM-DG02-SO-1051	8/28/2001	1	**1.7 J**	0.50 U	0.29
	YWM-DG03-SO-1052	8/28/2001	1	**3.9 J**	0.51 U	0.13
Downgradient Soil Sample Mean Values				3.3	0.51	0.15
All Soil Sample Mean Values				8.8	0.5	0.13

All results listed in milligrams per kilogram (mg/kg).

Detected values are in bold.

bgs = below ground surface

U = Not detected above the listed laboratory detection limit

J = Estimated Value

Table 3. COPC Selection Summary for Human Health

Chemical Group	Human Health	
	Surface Soil	Subsurface Soil
Metals	Antimony	--
	Arsenic	Arsenic
	--	Cadmium
	Cobalt	Cobalt
	Lead	Lead
	--	Mercury
	Thallium	Thallium
	Zinc	--
	Aluminum	Aluminum
	Iron	Iron
	Manganese	Manganese
PAHs	Dibenz(a,h)anthracene	Dibenz(a,h)anthracene
TPH	TPH Aromatics Medium	TPH Aromatics Medium
	TPH Aromatics High	TPH Aromatics High
Dioxins/Furans	--	TEQ

Notes:

CASRN = Chemical Abstracts Service Registry Number

COPEC - Chemcial of Potential Ecological Concern

EPA = Environmental Protection Agency

Table 4. Summary of Non-cancer Hazard Quotients

Route of Exposure	Adult Park Worker		Construction/Restoration Worker		Young Child Visitor Scenario		Older Child Visitor Scenario		Adult Visitor Scenario	
	CTE	RME	CTE	RME	CTE	RME	CTE	RME	CTE	RME
Surface Soil										
Incidental Ingestion of Surface Soil	0.004	0.02	0.02	0.1	0.004	0.01	0.003	0.01	0.002	0.01
Dermal Contact with Surface Soil	0.00001	0.001	0.002	0.003	0.00004	0.0001	0.00004	0.0001	0.00002	0.0001
Inhalation of Particles from Surface Soil	0.2	0.8	0.5	1	0.000002	0.00001	0.000008	0.00006	0.000008	0.0001
Cumulative Risk Across All Routes of Exposure	0.2	0.8	0.5	1	0.004	0.01	0.003	0.01	0.002	0.007
TPH Cumulative Risk Across All Routes of Exposure	0.002	0.016	0.03	0.07	0.002	0.007	0.002	0.007	0.001	0.004
Subsurface Soil										
Incidental Ingestion of Subsurface Soil	NE	NE	0.01	0.1	NE	NE	NE	NE	NE	NE
Dermal Contact with Subsurface Soil	NE	NE	0.003	0.006	NE	NE	NE	NE	NE	NE
Inhalation of Particles from Subsurface Soil	NE	NE	0.4	1	NE	NE	NE	NE	NE	NE
Cumulative Risk Across All Routes of Exposure	NE	NE	0.4	1	NE	NE	NE	NE	NE	NE
TPH Risks - Subsurface Soil										
Incidental Ingestion of Subsurface Soil	NE	NE	0.3	1.3	NE	NE	NE	NE	NE	NE
Dermal Contact with Subsurface Soil	NE	NE	1.2	2.4	NE	NE	NE	NE	NE	NE
Inhalation of Particles from Subsurface Soil	NE	NE	0.02	0.1	NE	NE	NE	NE	NE	NE
TPH Cumulative Risk Across All Routes of Exposure	NE	NE	**2**	**4**	NE	NE	NE	NE	NE	NE

Notes:

Non-cancer risks are expressed as a Hazard Index, which is the sum of all Hazard Quotients for the particular scenario.

NE - Pathway not evaluated under this exposure scenario.

CTE = Central Tendency Exposure

RME = Reasonable Maximum Exposure

Bold = HQ>1

Table 5. Summary of Excess Lifetime Cancer Risk Estimates

Route of Exposure	Adult Park Worker		Construction/Restoration Worker		Young Child Visitor Scenario		Older Child Visitor Scenario		Adult Visitor Scenario	
	CTE	RME	CTE	RME	CTE	RME	CTE	RME	CTE	RME
Surface Soil										
Incidental Ingestion of Surface Soil	1.5E-08	1.2E-07	1.2E-08	1.5E-07	5.4E-09	6.5E-08	1.1E-08	9.2E-08	6.3E-09	5.0E-08
Dermal Contact with Surface Soil	4.6E-10	4.5E-08	1.1E-08	6.7E-08	5.1E-10	4.3E-09	1.2E-09	9.5E-09	6.7E-10	5.2E-09
Inhalation of Particles from Surface Soil	4.2E-08	3.4E-07	2.1E-08	1.6E-07	1.3E-13	3.1E-12	1.6E-12	2.6E-11	1.6E-12	2.6E-11
Cumulative Risk Across All Routes of Exposure	6.E-08	5.E-07	4.E-08	4.E-07	6.E-09	7.E-08	1.E-08	1.E-07	7.E-09	6.E-08
Subsurface Soil										
Incidental Ingestion of SubSurface Soil	NE	NE	1.1E-08	1.3E-07	NE	NE	NE	NE	NE	NE
Dermal Contact with SubSurface Soil	NE	NE	9.9E-09	6.0E-08	NE	NE	NE	NE	NE	NE
Inhalation of Particles from SubSurface Soil	NE	NE	1.5E-08	1.1E-07	NE	NE	NE	NE	NE	NE
Cumulative Risk Across All Routes of Exposure	NE	NE	4.E-08	3.E-07	NE	NE	NE	NE	NE	NE

Notes:

NE - Pathway not evaluated under this exposure scenario.

Bold - Value exceeds cancer risk threshold of 1 x 10^{-6}.

The excess lifetime cancer risk are rounded to one significant figure.

CTE - Central Tendency Exposure

RME - Reasonable Maximum Exposure

Table 6. COPEC Selection Summary For Ecological Receptors

Chemical Group	Chemical Name	CASRN	Surface Soil		Suburface Soil	
			Plants/Inverts COPEC	Birds/Mammals COPEC	Plants/Inverts COPEC	Birds/Mammals COPEC
Metals	Antimony	7440-36-0		X		X
	Arsenic	7440-38-2	X	X	X	X
	Barium	7440-39-3	X	X	X	X
	Cadmium	7440-43-9	X	X	X	X
	Chromium, total	7440-47-3	X	X	X	X
	Copper	7440-50-8	X	X	X	X
	Lead	7439-92-1	X	X	X	X
	Mercury	7439-97-6	X	X	X	X
	Molybdenum	7439-98-7	X	X	X	X
	Nickel	7440-02-0		X		X
	Selenium	7782-49-2			X	X
	Silver	7440-22-4			X	
	Thallium	7440-28-0	X	X	X	X
	Vanadium	7440-62-2	X	X	X	X
	Zinc	7440-66-6	X	X	X	X
	Aluminum	7429-90-5	X		X	
	Manganese	7439-96-5	X			
SVOCs	Bis(2-ethylhexyl)phthalate	117-81-7		X		X
Dioxins/Furans	TEQ	TEQ				X

Notes:

CASRN = Chemical Abstracts Service Registry Number

COPEC - Chemcial of Potential Ecological Concern

EPA = Environmental Protection Agency

SVOC = semi-volatile organic compound

TEQ = toxic equivalency

Surface soil identified as 0-0.5 fbgs

Subsurface soil identified as 1-6 fbgs

Table 7. Refined COPEC Selection for Terrestrial Plants, Surface Soil

Chemical Group	COPEC	CASRN	Maximum Surface Soil Conc. (mg/kg)	Refined SLERA ESV (mg/kg)	Refined ESV-Based Hazard Quotient	95 UCL Surface Soil Conc. (mg/kg)	LANL Low-Effect ESL (mg/kg)	Threshold ESV (mg/kg)
Metals	Arsenic	7440-38-2	7.37	18	0.4	Not Refined COPEC		
	Barium	7440-39-3	918	500	**2**	720	1400	837
	Cadmium	7440-43-9	6.78	32	0.2	Not Refined COPEC		
	Chromium[a]	7440-47-3	23.6	1	**24**	23.8	4.7	2
	Copper	7440-50-8	198	70	**3**	160	490	185
	Lead	7439-92-1	689	120	**6**	634	570	262
	Mercury	7439-97-6	0.75	0.3	**2**	0.63	64	4
	Molybdenum	7439-98-7	2.22	2	1	Not Refined COPEC		
	Thallium	7440-28-0	0.57	1	0.6	Not Refined COPEC		
	Vanadium	7440-62-2	37.4	2	**19**	32.2	80	13
	Zinc	7440-66-6	2420	160	**15**	2322	810	360
	Aluminum	7429-90-5	12000	(b)	NC	Not Refined COPEC		
	Manganese	7439-96-5	1900	220	**9**	1664	1500	574

Notes:

Refined SLERA ESVs from NPS 2018, except where noted; low-level effect ESLs are from LANL (2017)

Threshold ESLs are calculated as the geometric mean of the Refined ESV and the LANL Low-Level ESL

COPECs selected where Maximum Concentration > Refined ESV

COECs selected where 95 UCL (or maximum if lower) > Threshold-Based ESL

CASRN = Chemical Abstracts Service Registry Number

COPEC = chemical of potential ecological concern

ESL = ecological screening level

ESV = ecological screening value

mg/kg = millgrams per kilogram

SLERA = Screening level ecological risk assessment

NC - Not calculated

a = Chromium concentrations are total chromium values, chromium ESVs are developed based on hexavalent chromium data.

a. Aluminum is selected as a refined COPEC if soil pH<5 (NPS 2018). Data from Shaw (2010) indicate Site soil pH>5.

HQ>1 = refined COPEC

Table 8. Refined COPEC Selection for Terrestrial Plants, Suburface Soil

Chemical Group	COPEC	CASRN	Maximum Suburface Soil Conc. (mg/kg)	Refined SLERA ESV (mg/kg)	Refined ESV-Based Hazard Quotient	95 UCL Subsurface Soil Conc. (mg/kg)	LANL Low-Effect ESL (mg/kg)	Threshold ESV (mg/kg)
Metals	Arsenic	7440-38-2	8.4	18	0.5	Not Refined COPEC		
	Barium	7440-39-3	1420	500	**3**	1420	1400	837
	Cadmium	7440-43-9	11.8	32	0.4	Not Refined COPEC		
	Chromium[a]	7440-47-3	36.4	1	**36**	29.0	4.7	2.2
	Copper	7440-50-8	260	70	**4**	260	490	185
	Lead	7439-92-1	9930	120	**83**	9930	570	262
	Mercury	7439-97-6	1.6	0.3	**5**	0.9	64	4.4
	Molybdenum[a]	7439-98-7	2.3	2	1	Not Refined COPEC		
	Selenium	7782-49-2	1.1	0.52	**2**	0.9	15	2.8
	Silver	7440-22-4	2.6	560	0.005	Not Refined COPEC		
	Thallium	7440-28-0	0.38	1	0.4	Not Refined COPEC		
	Vanadium	7440-62-2	24.2	2	**12**	22.7	80	13
	Zinc	7440-66-6	2120	160	**13**	2120	810	360
	Aluminum	7429-90-5	12000	(b)	NC	Not Refined COPEC		

Notes:

Refined SLERA ESVs from NPS 2018, except where noted; low-level effect ESLs are from LANL (2017)

Threshold ESLs are calculated as the geometric mean of the Refined ESV and the LANL Low-Level ESL

COPECs selected where Maximum Concentration > Refined ESV

COECs selected where 95 UCL (or maximum if lower) > Threshold-Based ESL

CASRN = Chemical Abstracts Service Registry Number

COPEC = chemical of potential ecological concern

ESL = ecological screening level

ESV = ecological screening value

mg/kg = millgrams per kilogram

SLERA = Screening level ecological risk assessment

NC - Not calculated

a = Chromium concentrations are total chromium values, chromium ESVs are developed based on hexavalent chromium data.

b = Aluminum is selected as a refined COPEC if soil pH<5 (NPS 2018). Data from Shaw (2010) indicate Site soil pH>5.

HQ>1 = refined COPEC

Table 9. Refined COPEC Selection for Soil Invertebrates, Surface Soil

Chemical Group	COPEC	CASRN	Maximum Surface Soil Conc. (mg/kg)	Refined SLERA ESV (mg/kg)	Refined ESV-Based Hazard Quotient (HQ)	95 UCL Surface Soil Conc. (mg/kg)	LANL Low-Effect ESL (mg/kg)	Threshold ESV (mg/kg)
Metals	Arsenic	7440-38-2	7.37	60	0.12	Not Refined COPEC		
	Barium	7440-39-3	918	330	**3**	720	3200	1028
	Cadmium	7440-43-9	6.78	140	0.05	Not Refined COPEC		
	Chromium[a]	7440-47-3	23.6	0.4	**59**	23.8	4.7	1.4
	Copper	7440-50-8	198	80	**2**	160	530	206
	Lead	7439-92-1	689	1700	0.41	Not Refined COPEC		
	Mercury	7439-97-6	0.75	0.1	**7**	0.6	390	6.2
	Molybdenum	7439-98-7	2.22	No ESV	NA	Not Refined COPEC		
	Thallium	7440-28-0	0.57	No ESV	NA	Not Refined COPEC		
	Vanadium	7440-62-2	37.4	No ESV	NA	Not Refined COPEC		
	Zinc	7440-66-6	2420	120	**20**	2322	930	334
	Aluminum	7429-90-5	12000	(b)	NA	Not Refined COPEC		
	Manganese	7439-96-5	1900	450	**4**	1664	4500	1423

Notes:

Refined SLERA ESVs from NPS 2018, except where noted; low-level effect ESLs are from LANL (2017)

Threshold ESLs are calculated as the geometric mean of the Refined ESV and the LANL Low-Level ESL

Refined COPECs selected where Maximum Concentration > Refined ESV

COECs selected where 95 UCL (or maximum if lower) > Threshold-Based ESL

CASRN = Chemical Abstracts Service Registry Number

COPEC = chemical of potential ecological concern

ESL = ecological screening level

ESV = ecological screening value

mg/kg = millgrams per kilogram

SLERA = Screening level ecological risk assessment

NA - Not calculated

a = Chromium concentrations are total chromium values, chromium ESVs are developed based on hexavalent chromium data.

b = Aluminum is selected as a refined COPEC if soil pH<5 (NPS 2018). Data from Shaw (2010) indicate Site soil pH>5.

HQ>1 = refined COPEC

Table 10. Refined COPEC Selection for Soil Invertebrates, Suburface Soil

Chemical Group	COPEC	CASRN	Maximum Suburface Soil Conc. (mg/kg)	Refined SLERA ESV (mg/kg)	Refined ESV-Based Hazard Quotient (HQ)	95 UCL Subsurface Soil Conc. (mg/kg)	LANL Low-Effect ESL (mg/kg)	Threshold ESV (mg/kg)
Metals	Arsenic	7440-38-2	8.4	60	0.14	Not Refined COPEC		
	Barium	7440-39-3	1420	330	**4**	1420	3200	1028
	Cadmium	7440-43-9	11.8	140	0.08	Not Refined COPEC		
	Chromium[a]	7440-47-3	36.4	0.4	**91**	29	4.7	1.4
	Copper	7440-50-8	260	80	**3**	260	530	206
	Lead	7439-92-1	9930	1700	**6**	9930	8400	3779
	Mercury	7439-97-6	1.6	0.1	**16**	0.9	390	6.2
	Molybdenum	7439-98-7	2.3	No ESV	NA	Not Refined COPEC		
	Selenium	7782-49-2	1.1	4.1	0.27	Not Refined COPEC		
	Silver	7440-22-4	2.6	No ESV	NA	Not Refined COPEC		
	Thallium	7440-28-0	0.38	No ESV	NA	Not Refined COPEC		
	Vanadium	7440-62-2	24.2	No ESV	NA	Not Refined COPEC		
	Zinc	7440-66-6	2120	120	**18**	2120	930	334
	Aluminum	7429-90-5	12000	(b)	NA	Not Refined COPEC		

Notes:

Refined SLERA ESVs from NPS 2018, except where noted; low-level effect ESLs are from LANL (2017)

Threshold ESLs are calculated as the geometric mean of the Refined ESV and the LANL Low-Level ESL

COPECs selected where Maximum Concentration > Refined ESV

COECs selected where 95 UCL (or maximum if lower) > Threshold-Based ESL

CASRN = Chemical Abstracts Service Registry Number

COPEC = chemical of potential ecological concern

ESL = ecological screening level

ESV = ecological screening value

mg/kg = millgrams per kilogram

SLERA = Screening level ecological risk assessment

NA - Not calculated

a = Chromium concentrations are total chromium values, chromium ESVs are developed based on hexavalent chromium data.

b = Aluminum is selected as a refined COPEC if soil pH<5 (NPS 2018). Data from Shaw (2010) indicate Site soil pH>5.

HQ>1 = refined COPEC

Table 11. Refined COPEC Selection for Birds and Mammals, Surface Soil

Chemical Group	COPEC	CASRN	Maximum Surface Soil Conc. (mg/kg)	Refined SLERA ESV (mg/kg)		Screening Level Hazard Quotient (HQ)	
				Birds	Mammals	Birds	Mammals
Metals	Antimony	7440-36-0	4.63	No ESV	0.27	NA	**17**
	Arsenic	7440-38-2	7.37	43	46	0.2	0.2
	Barium	7440-39-3	918	720	2000	1	0.5
	Cadmium	7440-43-9	6.78	0.77	0.36	**9**	**19**
	Chromium, total	7440-47-3	23.6	23	63	1	0.4
	Copper	7440-50-8	198	28	49	**7**	**4**
	Lead	7439-92-1	689	36.3	56	**19**	**12**
	Mercury	7439-97-6	0.75	0.013	1.7	**57**	0.4
	Molybdenum	7439-98-7	2.22	15	0.52	0.1	**4**
	Thallium	7440-28-0	0.57	4.5	0.42	0.1	1
	Vanadium	7440-62-2	37.4	7.8	280	**5**	0.1
	Zinc	7440-66-6	2420	46	79	**53**	**31**
SVOCs	Bis(2-ethylhexyl)phthalate	117-81-7	0.72	0.02	0.6	**36**	1

Notes:

Refined SLERA ESVs from NPS 2018, except lead ESV for Birds is from Sample et al 2019.

NA = Not applicable, no ESV.

CASRN - Chemical Abstracts Service Registry Number

COPEC - chemical of potential ecological concern

ESV - ecological screening value

mg/kg - millgrams per kilogram

SVOC - semivolatile organic compound

HQ>1 = refined COPEC

Table 12. Refined COPEC Selection for Burrowing Mammals, Suburface Soil

Chemical Group	COPEC	CASRN	Maximum Suburface Soil Conc. (mg/kg)	Refined SLERA ESV (mg/kg)	Screening Level Hazard Quotient (HQ)
Metals	Antimony	7440-36-0	2.4	0.27	**9**
	Arsenic	7440-38-2	8.4	46	0.2
	Barium	7440-39-3	1420	2000	0.7
	Cadmium	7440-43-9	11.8	0.36	**33**
	Chromium, total	7440-47-3	36.4	63	0.6
	Copper	7440-50-8	260	49	**5**
	Lead	7439-92-1	9930	56	**177**
	Mercury	7439-97-6	1.6	1.7	0.9
	Molybdenum	7439-98-7	2.3	0.52	**4**
	Selenium	7782-49-2	1.1	0.63	**2**
	Thallium	7440-28-0	0.38	0.42	0.9
	Vanadium	7440-62-2	24.2	280	0.1
	Zinc	7440-66-6	2120	79	**27**
SVOCs	Bis(2-ethylhexyl)phthalate	117-81-7	0.29	0.6	0.5
Dioxins/Furans	TEQ Mammalian	1746-01-6	1.2E-05	2.9E-07	**40**

Notes:

Refined SLERA ESVs from NPS 2018, except dioxin TEQ Mammalian ESV, which is from LANL 2017

CASRN = Chemical Abstracts Service Registry Number

COPEC = chemical of potential ecological concern

ESV = ecological screening value

mg/kg = millgrams per kilogram

SLERA = Screening level ecological risk assessment

TEQ = toxic equivalency

HQ>1 = refined COPEC

Table 13. Summary of Risks to Plants and Soil Invertebrates, based on Threshold Effects-Based HQ

Refined COPEC		Threshold-Based HQ	
		Plants	**Soil Invertebrates**
Surface Soils (0-0.5 fbgs)			
Metals	Barium	1	0.7
	Chromium	**11**	**17**
	Copper	1	0.8
	Lead	**2**	---- Not a COPEC ----
	Mercury	0.1	0.1
	Vanadium	**3**	---- Not a COPEC ----
	Zinc	**6**	**7**
	Manganese	**3**	1
Subsurface Soils (1-6 fbgs)			
Metals	Barium	**2**	1
	Chromium	**13**	**21**
	Copper	1	1
	Lead	**38**	**3**
	Mercury	0.2	0.1
	Selenium	0.3	---- Not a COPEC ----
	Vanadium	**2**	---- Not a COPEC ----
	Zinc	**6**	**6**

Notes:

Threshold Effects-Based HQ>1 = chemical identified as a COEC

Threshold Effects-Based ESV is equal to the geometric mean of the Refined SLERA ESV and the LANL Low Effect ESV (See Tables 7-10)

Threshold-Based HQ is calculated as the ratio of the 95UCL on the Site mean concentration (or the maximum concentration measured at the Site, if lower than the 95UCL) to the Threshold Effects-Based ESV

fbgs = feet bgs

COPEC - Chemical of Potential Ecological Concern

Table 14. Summary of Risks to Wildlife Receptors, based on Threshold Effects-Based HQ

Chemical Group	Refined COPEC	Threshold-Based HQ					
		Birds			Mammals		
		Herbivore	Insectivore	Carnivore	Herbivore	Insectivore	Carnivore
Surface Soils (0-0.5 fbgs)							
Metals	Antimony		---- Not a COPEC ----		0.07	**3**	0.09
	Cadmium	0.08	1	0.006	0.1	**5**	0.05
	Copper	0.5	**2**	0.075	0.2	**2**	0.2
	Lead	1	**4**	0.140	0.2	**4**	0.3
	Mercury	0.8	**2**	0.022		---- Not a COPEC ----	
	Molybdenum		---- Not a COPEC ----		0.011	0.5	0.01
	Vanadium	0.7	1	0.066		---- Not a COPEC ----	
	Zinc	0.7	**2**	0.048	0.19	1.2	0.08
SVOCs	Bis(2-ethylhexyl)phthalate	0.02	0.07	0.01		---- Not a COPEC ----	
Subsurface Soils (1-6 fbgs)							
Metals	Antimony		NC		NC	**2**	NC
	Cadmium		NC		NC	**5**	NC
	Copper		NC		NC	**3**	NC
	Lead		NC		NC	**38**	NC
	Molybdenum		NC		NC	0.2	NC
	Selenium		NC		NC	0.8	NC
	Zinc		NC		NC	1	NC
Dioxins/Furans	Total TCDD-TEQ		NC		NC	**3**	NC

Notes:

Threshold Effects-Based HQ>1 = chemical identified as a COEC

Threshold Effects-Based ESV is equal to the geometric mean of the NOAEL and LOAEL TRVs (See Tables 4-13 and 4-14 of Appendix C)

Threshold-Based HQ is calculated as the ratio of the total daily dose for the receptor group to the Threshold Effects-Based ESV

fbgs = feet bgs

COPEC - Chemical of Potential Ecological Concern

SVOC - Semi-Volatile Organic Chemical

TEQ = toxic equivalency

NC - Not calculated, not exposed to subsurface soils

Table 15. Soil PRGs for Human Health COCs

COC	Units	Construction Worker RME
TPH-High	mg/kg	40,000
TPH-Medium	mg/kg	2,000

Notes:

PRGs based on non-cancer endpoint, for HQ=1

PRG = preliminary removal goal

Table 16. PRGs for Lead Based on Construction Worker Exposure Scenarios

Variable	Description of Variable	Units	Construction Worker CTE	Construction Worker RME	Construction Worker CTE	Construction Worker RME
$PbB_{fetal, 0.95}$	Target PbB in fetus (e.g., 2-8 µg/dL)	µg/dL	10	10	5	5
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4	0.4	0.4	0.4
GSD_i	Geometric standard deviation PbB	--	1.8	1.8	1.8	1.8
PbB_0	Baseline PbB	µg/dL	0.6	0.6	0.6	0.6
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.165	0.330	0.165	0.330
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12	0.12	0.12	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	15	30	15	30
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365	365	365	365
PRG in Soil for no more than 5% probability that fetal PbB exceeds target PbB		**mg/kg**	**11,138**	**2,784**	**4,647**	**1,162**

Calculations of Preliminary Remediation Goals (PRGs) for Soil in Nonresidential Areas
U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee
Version date 06/14/2017

Table 17. Preliminary Risk-Based Removal Goals for Ecological Receptors

Chemical Group	COEC	Soil PRG (mg/kg) Threshold TRV-Based[a]		Soil PRG (mg/kg) Threshold TRV, HQ=1[b]						Final Soil Ecological PRG (mg/kg)
				Birds			Mammals			
		Plants	Invertebrates	Herbivore	Insectivore	Carnivore	Herbivore	Insectivore	Carnivore	
Surface Soils (0-0.5 fbgs)										
Metals	Antimony	Not a COEC	Not a COEC		---- Not a COEC ----		Not a COEC	1.6	Not a COEC	1.6
	Cadmium	Not a COEC	Not a COEC		---- Not a COEC ----		Not a COEC	1.0	Not a COEC	1.0
	Chromium[c]	2.2	1.4		---- Not a COEC ----			---- Not a COEC ----		1.4
	Copper	Not a COEC	Not a COEC	Not a COEC	125	Not a COEC	Not a COEC	123	Not a COEC	123
	Lead	262	Not a COPEC	279	54	Not a COEC	Not a COEC	192	Not a COEC	54
	Mercury	Not a COEC	Not a COEC	Not a COEC	0.19	Not a COEC		---- Not a COPEC ----		0.19
	Vanadium	13	Not a COEC		---- Not a COEC ----			---- Not a COEC ----		13
	Zinc	360	334	Not a COEC	1754	Not a COEC		---- Not a COEC ----		334
	Manganese	574	Not COPEC		---- Not a COEC ----			---- Not a COEC ----		574
Subsurface Soils (1-6 fbgs)										
Metals	Antimony	Not a COEC	Not a COEC		---- Not a COEC ----		Not a COEC	1.6	Not a COEC	1.6
	Barium	837	Not a COEC		---- Not a COEC ----			---- Not a COEC ----		837
	Cadmium	Not a COEC	Not a COEC		---- Not a COEC ----		Not a COEC	1.0	Not a COEC	1.0
	Chromium[c]	2.2	1.4		---- Not a COEC ----			---- Not a COEC ----		1.4
	Copper	Not a COEC	Not a COEC		---- Not a COEC ----		Not a COEC	123	Not a COEC	123
	Lead	262	3,779		---- Not a COEC ----		Not a COEC	192	Not a COEC	192
	Vanadium	13	Not a COPEC		---- Not a COEC ----			---- Not a COEC ----		13
	Zinc	360	334		---- Not a COEC ----			---- Not a COEC ----		334
Dioxins/Furans	Total TCDD-TEQ	Not a COEC	Not a COEC		---- Not a COEC ----		Not a COEC	7.E-06	Not a COEC	7.E-06

Notes:

PRGs are developed for COECs, which are identified as COPECs with Threshold-Based HQ>1.

PRGs are calculated to result in HQ=1, rounded off to a single significant figure.

COEC - Chemical of Ecological Concern

COPEC - Chemical of Potential Ecological Concern

PRG = Preliminary Removal Goal

TEQ = toxic equivalency

TRV - toxicity reference value

a - Based on the geometric mean of LANL (2017) Low-Effect ESL and NPS (2018) Refined ESV

b - Based on the geometric mean of the NOAEL and LOAEL TRV

Table 18. Summary of Preliminary Removal Goals and Background Values

COC/COEC	PRG (mg/kg)	PRG Basis	Background[a] (mg/kg)	Basis[b]
Surface Soils (0-0.5 fbgs)				
Antimony	1.6	Target HQ of 1 for insectivorous mammal, based on the threshold TRV	0.242	95% KM Chebyshev UPL
Cadmium	1.0	Target HQ of 1 for insectivorous mammal, based on the threshold TRV	0.41	95% UTL with 95% Coverage
Chromium[c]	1.4	Target HQ of 1 for soil invertebrates, based on the threshold TRV	7.9	95% UTL with 95% Coverage
Copper	123	Target HQ of 1 for insectivorous mammal, based on the threshold TRV	10.0	95% UTL with 95% Coverage
Lead	54	Target HQ of 1 for insectivorous birds. based on the threshold TRV	8.8	95% UTL with 95% Coverage
Lead	1,162	Construction worker RME scenario, target blood lead level of 5 µg/dL		
Mercury	0.19	Target HQ of 1 for insectivorous birds. based on the threshold TRV	0.1	95% UTL with 95% Coverage
Vanadium	13	Target HQ of 1 for terrestrial plants, based on the threshold TRV	51.2	95% UTL with 95% Coverage
Zinc	334	Target HQ of 1 for terrestrial plants, based on the threshold TRV	52.8	95% UTL with 95% Coverage
Manganese	574	Target HQ of 1 for terrestrial plants, based on the threshold TRV	267	95% UTL with 95% Coverage
Subsurface Soils (1-6 fbgs)				
Antimony	1.6	Target HQ of 1 for insectivorous mammal, based on the threshold TRV	0.242	95% KM Chebyshev UPL
Barium	837	Target HQ of 1 for terrestrial plants, based on the threshold TRV	64.6	95% UTL with 95% Coverage
Cadmium	1.0	Target HQ of 1 for insectivorous mammal, based on the threshold TRV	0.41	95% UTL with 95% Coverage
Chromium[c]	1.4	Target HQ of 1 for soil invertebrates, based on the threshold TRV	7.9	95% UTL with 95% Coverage
Copper	123	Target HQ of 1 for insectivorous mammal, based on the threshold TRV	10.0	95% UTL with 95% Coverage
Lead	192	Target HQ of 1 for insectivorous mammal, based on the threshold TRV	8.8	95% UTL with 95% Coverage
Lead	1,162	Construction worker RME scenario, target blood lead level of 5 µg/dL		
Vanadium	13	Target HQ of 1 for terrestrial plants, based on the threshold TRV	51.2	95% UTL with 95% Coverage
Zinc	334	Target HQ of 1 for terrestrial plants, based on the threshold TRV	52.8	95% UTL with 95% Coverage
TPH-High	40,000	Construction worker RME scenario, sum of exposure routes, target HQ=1	31	Maximum
TPH-Medium	2,000	Construction worker RME scenario, sum of exposure routes,target HQ=1	3	Maximum
Total TCDD-TEQ	7.E-06	Target HQ of 1 for insectivorous mammal, based on the threshold TRV	4.3E-08	Single Value

Notes:

COC = Chemical of concern

COEC = Chemical of ecological concern

PRG = Preliminary Removal Goal

TEQ = toxic equivalency

TRV = Toxicity Reference Value

a. Background data from 13 upgradient sample locations (1 fbgs):

b. Background based on Background Threshold Values (BTVs) recommended by ProUCL

Table 19. Calculation of Estimated Maximum Hexavalent Chromium Concentrations in Site Soil Samples

Sample Type	Sample ID	Sample Date	Sample Depth (feet bgs)	Chromium, Total (mg/kg)	Hexavalent Chromium (mg/kg)	Estimated Maximum Hexavalent Chromium Concentration** (mg/kg)	Other Metals Exceed RGs?
Surface	YWM02A-2268	8/26/2008	0.5	**23**	--	2.99	Yes
	YWM06-2274	8/26/2008	0.5	**11**	--	1.43	Yes
	YWM07-2277	8/26/2008	0.5	**17.9**	--	2.33	Yes
	YWM08-2280	8/26/2008	0.5	**4.3**	--	0.56	Yes
	YWM09-2284	8/26/2008	0.5	**23.6**	--	3.07	Yes
Subsurface	YWM-TP01-SO-1042	8/27/2001	4	**2.1** J	0.51 U	0.51	No
	YWM-TP02-SO-1048	8/27/2001	3	**36.4** J	0.53 U	0.53	Yes
	YWM-TP02-SO-1046	8/27/2001	6	**29** J	0.52 U	0.52	Yes
	YWM-TP04-SO-1037	8/27/2001	2.5	**2.6** J	0.52 U	0.52	No
	YWM-TP05-SO-1039	8/27/2001	2.5	**3.7** J	0.52 U	0.52	No
	YWM-TP05-SO-1038	8/27/2001	4.5	**4.1** J	0.51 U	0.51	No
	YWM06-2276	8/26/2008	4	**3.39**	--	0.44	No
	YWM07-2279	8/26/2008	5	**3.75**	--	0.49	No
	YWM08-2281	8/26/2008	2	**2.66**	--	0.35	No
	YWM09-2285	8/26/2008	1.5	**28.4**	--	3.69	Yes
	YWM09-2286	8/26/2008	2.5	**14.3**	--	1.86	Yes
					Chromium RG (mg/kg)*	**1.4**	

All results listed in milligrams per kilogram (mg/kg).

Detected values are in bold.

bgs = below ground surface

U = Not detected above the listed laboratory detection limit

J = Estimated Value

* = Chromium RG calcuated based on hexavalent chromium toxicity values.

** = Estimated maximum hexavalent chromium concentration is equal to either:

a) the detection limit listed for a non-detect hexavalent chromium analysis completed for the sample, if available, or

b) the total chromium concentration measured in the sample, multiplied by 0.13, the mean ratio of hexavalent chromium detection limits to total chromium concentrations in each sample from the Site or vicinity with both results available (see Table 2).

Shaded concentrations exceed the chromium RG

APPENDICES

Appendix A – Site Photographs

Photograph 1: Hetch Hetchy Road near the access road trace leading to the Site. Orientation: west.

Photograph 2: View of access road trace to the Site. Orientation: south.


Photograph 3: View of the access road trace leading to the Site. Orientation: north.


Photograph 4: View of area near the approximate location of test pit TP04. Orientation: northwest.

Photograph 5: View of area near the approximate location of test pit TP04. Orientation: south.

Photograph 6: View of the north sampling area at the Site. Orientation: northeast.

Photograph 7: View of the south sampling area at the Site, taken from near the approximate location of test pit TP01. Orientation: south.

Photograph 8: View of the south sampling area at the Site. Note rusted metal debris. Orientation: northwest.

Photograph 9: View of waste fragment types present in soil at the Site, including ceramic, metal, and clay/brick fragments, and an apparent battery core.

Photograph 10: View overlooking the Site, from rocky highlands to the south. Orientation: northwest

Appendix B – Facility Investigation Report

FINAL

FACILITY INVESTIGATION REPORT
MATHER WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK, CALIFORNIA

SACRAMENTO TERC II
USACE CONTRACT NO. DACW05-96-D-0011
CTO NO. 08 - WAD NO. 02

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ac	acre
AF	absorption factor
Amsl	above mean sea level
BAF	bioaccumulation factors
BEHP	bis(2-ethylhexyl)phthalate
bgs	below ground surface
Cal/EPA	California Environmental Protection Agency
CAM	California Assessment Manual
CCME	Canadian Council of Ministers of the Environment
CDFG	California Division of Fish and Game
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHSSLs	California Human Health Screening Levels
COPC	Chemical of Potential Concern
COPEC	constituent of potential ecological concern
CSEM	conceptual site exposure model
DQA	Data Quality Assessment
DTSC	Department of Toxic Substances Control
EcoSSL	Ecological Soil Screening Levels
EEQ	ecological effect quotient
EF	exposure frequency
EPC	exposure point concentration
ERA	ecological risk assessment
FHR	fraction of home range
ft	feet
ha	hectare
HERD	Health and Ecological Risk Division
HHRA	Human Health Risk Assessment
HI	hazard index
HQ	hazard quotient
ILCR	incremental lifetime cancer risk
IRIS	Integrated Risk Information System
IT	IT Corporation
IUR	inhalation unit risk (see also Unit Risk Factor [URF])
kg	kilogram
km^2	square kilometer
K_{ow}	partition coefficient
LD_{50}	median lethal dose
LOAEL	lowest-observed-adverse-effect level
MADEP	Massachusetts Department of Environmental Protection
MDC	maximum detected concentration
mi^2	square mile
µg/g	micrograms per gram
mg/kg	milligrams per kilogram
NOAEL	no observed adverse effect level
NPS	National Park Service
NRC	National Research Council (of the National Academy of Sciences)

LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS (Continued)

OEHHA	Office of Environmental Health Hazard Assessment
ORNL	Oak Ridge National Laboratory
PAH	polynuclear aromatic hydrocarbon
PEA	Preliminary Endangerment Assessment
pg/g	picograms per gram
PQL	practical quantitation limit
PUF	plant uptake factor
QC	quality control
RAGS	Risk Assessment Guidance for Superfund
RBSL	risk based screening levels
RCRA	Resource Conservation and Recovery Act
RME	reasonable maximum exposure
RSL	regional screening level
RWQCB	Regional Water Quality Control Board
Shaw	Shaw Environmental Inc.
SLERA	screening level ecological risk assessment
SSL	soil screening level
TCDD	tetrachloro-p-dioxane
TEF	toxic equivalent factor
TERC	Total Environmental Restoration Contract
TPH	total petroleum hydrocarbon
TRV	toxicity reference value
UCL	upper confidence limit
UCL95	95% upper confidence limit
UF	uncertainty factor
URF	unit risk factor, see also IUR, inhalation unit risk
USEPA	United States Environmental Protection Agency
VC	volatile chemical
VOC	volatile organic compound
WAA	waste accumulation area
WAC	Western Archeological Center
WHO	World Health Organization

EXECUTIVE SUMMARY

The Mather Waste Accumulation Area (WAA) is located in the northwestern portion of Yosemite National Park, California, approximately one mile north of the Mather Ranger Station along the Hetch Hetchy Road. The WAA is associated with waste dumping activities conducted by road crews in the 1920s and 1930s. Debris items observed at the site include glass, rusted metal, battery cores, and other miscellaneous debris. The WAA site was originally used as a quarry, and medium to large granite blocks dominate the site.

IT Corporation (IT) conducted a focused site inspection during August 2001 at the Mather WAA. The inspection was conducted to determine the nature and extent of chemicals in the soil as a result of waste accumulation from the construction and camp activities during the 1920s and 1930s. The results of the inspection were reported in the *Draft Final Report, Focused Site Inspection of Mather Waste Accumulation Area, Yosemite National Park, California* (IT, 2002), which then underwent review by the California Environmental Protection Agency Department of Toxic Substances Control (DTSC). Based on comments by the DTSC, Shaw Environmental Inc. (Shaw) conducted an additional field work and data evaluation at Mather WAA in August 2008. This report presents observations and data acquired during both events.

In both sampling events, a backhoe was used to excavate test pits within the debris zone, and sample technicians collected soil samples from the test pits. Based on field observations during the sampling events, the total volume of subsurface debris in two locations at Mather WAA was estimated to be 85 cubic yards.

For both sampling events, background samples were collected upgradient from the WAA, and in 2001, three downgradient samples were also collected outside the WAA footprint. All background and downgradient locations were dug using hand tools.

Soil samples collected in August 2001 were analyzed for polynuclear aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPH) as diesel and motor oil, metals, hexavalent chromium, and polychlorinated biphenyls (PCBs), and several samples were also analyzed for dioxins/furans. Soil samples collected in 2008 were analyzed for the same suite and also for total organic carbon, pH, cation exchange capacity, and TPH as gasoline. In 2008, hexavalent chromium was omitted and no samples were analyzed for dioxins/furans.

Many of the highest concentrations of detected chemicals were in test pits TP02 and YWM09, in the lower portion of the site. The analytical results for the Mather WAA test pit samples were compared to United States Environmental Protection Agency Regional Screening Levels for residential and industrial soil. Lead concentrations were compared to California Human Health Screening Levels. The TPH detections were compared to risk-based screening levels. Geochemical evaluation determined that several metals in site soils appear to be related to site activities rather than naturally-occurring.

The human health risk assessment determined that both the park hiker receptor and the park employee receptor were found to have a calculated risk/hazard less than the 1E-6 incremental lifetime cancer risk and non-cancer hazard index of 1 for a residential scenario, although both receptors are unlikely to spend enough time on the site to be adversely affected. Arsenic was considered in the human health risk assessment and was found to be present in concentrations above those found in the background samples collected adjacent to the Mather WAA site. However it was also found to be present within the range of concentrations in background samples collected by the U.S. Geological Survey in Tuolumne County.

The ecological risk assessment found a low possibility of impact to wildlife, which would be further mitigated by the small size of the site and limited time any individual would be present within the site.

Based on the observations and data presented in the report, NPS proposes limited soil removal in the area of test pits TP05 to remove the oily mass observed in the northern portion of the site and TP09 to remove the elevated levels of lead detected in the southern portion of the site. Excavation would be followed by confirmation sampling of the excavation soils.

1.0 INTRODUCTION

Shaw Environmental Inc. (Shaw) has prepared this report, which presents the results of two soil sampling and analytical events at the Mather waste accumulation area (WAA) in Yosemite National Park, California. Both inspections were performed for the National Park Service (NPS) under the United States Army Corps of Engineers, Sacramento District, Total Environmental Restoration Contract II, Contract Number DACW05-96-D-0011, Contract Task Order Number 8, Work Authorization Directive Number 2.

In August 2001, IT Corporation (IT) (now Shaw) conducted a focused site inspection of the Mather WAA. The results of the focused site inspection were reported in the *Draft Final Report, Focused Site Inspection, Mather Waste Accumulation Area, Yosemite National Park, California*, (IT, 2002). The report was reviewed by the California Environmental Protection Agency (Cal/EPA) Department of Toxic Substances Control (DTSC), which provided comments and requested additional site data. In August 2008, Shaw performed additional inspection at the site. This report presents the results of both the 2001 and 2008 sampling events.

The work completed in 2001 was conducted in accordance with the *Final Work Plan & Sampling and Analysis Plan for Focused Site Inspection/Initial RCRA Facility Investigation of, Baseline, Mather and Vogelsang Waste Accumulation Areas at Yosemite National Park, California* (Plan) (IT, 2001), which was supplemented in 2008 by Field Work Variance (FWV) 870508-018 for Mather WAA (Shaw, 2007). The Plan presented the objectives, methods, and procedures for the implementation of the initial site subsurface inspection activities. The FWV presented changed or additional field methods to address the comments provided by DTSC. In addition, the *Final Supplemental Work Plan for Risk Assessment at Waste Accumulation Areas, Yosemite National Park, California* (RAWP) (Shaw, 2009) was prepared to guide geochemical evaluation and risk assessment of the site data.

This report is consistent with the Agreement between NPS and DTSC, dated March 6, 2001 (Agreement). Among other conditions and requirements, the Agreement provides that sites subject to the Agreement meet both Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements. Therefore, this report is both RCRA and CERCLA-compliant, supplementing the 2001 Focused Site Inspection. As Federal Land Manager, NPS is the lead agency for purposes of any CERCLA response actions at the site.

1.1 INSPECTION OBJECTIVES AND SCOPE OF WORK

The primary objectives of the Mather WAA inspection were to:

- Determine the lateral and vertical extent of debris within the WAA;
- Make visual observations of the types of waste present;
- Obtain samples of site soils (and groundwater, if found) for laboratory analysis; and
- Evaluate the data to determine whether and to what extent the site is impacted by the waste.

The inspections were performed to determine the nature and extent of waste materials present at the Mather WAA, and to evaluate whether certain analytes present in site soils represent an unacceptable risk to human and ecological receptors. The analytical sample results are used in this report to evaluate whether the Mather WAA may contain hazardous substances, pollutants, or contaminants that require further investigation or remediation pursuant to NPS responsibilities under the Agreement, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), RCRA, or other federal, state, and local requirements.

The scope of this project was to excavate test pits to observe waste distribution within the Mather WAA. The scope of work included the following tasks:

- Collection of soil samples from test pits excavated within the WAA;
- Shipment of samples to the analytical laboratory; and
- Evaluation of analytical results for the samples.

Shaw has prepared this report to present the results obtained in accordance with the project objectives and scope of work.

1.2 REPORT OBJECTIVES

This report presents the inspection methods, summarizes the results, and presents recommendations based on these site results. Specifically, the objectives of this report are to:

- Present site background information including historical data provided by NPS;
- Use the background information for a preliminary assessment of the Mather WAA as a potential hazardous waste site;
- Document the inspection field procedures and methods;
- Present the inspection data and evaluate the quality and completeness of the data;
- Delineate the nature and extent of chemicals detected in soil samples in this inspection; and
- Perform human health and ecological risk assessments for the site based on inspection data.

1.3 REPORT ORGANIZATION

Section 2.0 of this report describes the site's physical characteristics and presents the known history of waste accumulation and investigation activities at the site. Section 3.0 describes field activities and observations during this inspection. Section 4.0 presents analytical data and evaluates the detections of chemical constituents. Section 5.0 presents the human health risk assessment of site data and Section 6.0 presents the screening level ecological risk assessment. Section 7.0 provides a summary and recommendations, and references are listed in Section 8.0.

Test pit logs are contained in Appendix A. The laboratory analytical report summary pages and completed chains of custody are presented in Appendix B, and Appendix C presents the detailed Laboratory Data Quality Assessment (DQA). Appendix D describes the details of geochemical evaluations. Appendices E and F present spreadsheets and descriptions of human health risk assessment (HHRA) models, and Appendix G contains ecological risk assessment spreadsheets.

2.0 SITE DESCRIPTION

The Mather WAA is located on the south side of Hetch Hetchy Road approximately one mile northeast of the Mather Ranger Station (Figure 2-1) at latitude 37°54'07"N and longitude 119°50'09"W, with an elevation of approximately 5,000 feet. The site consists of two portions: an upper area and a lower area. Each area is approximately 50 feet by 75 feet, for a combined surface extent of approximately 7,500 square feet (0.2 acre [ac]).

Historical information for the Mather WAA site was obtained from the *RCRA Facility Assessment, Yosemite National Park* (DTSC, 1999a). The historical information was supplemented by visual observations made during a 2001 site visit to the Mather WAA by IT, NPS, and Tuolumne County Health Department personnel, and by NPS, Shaw, and DTSC personnel in June 2008, as well as observations recorded during both sampling activities.

2.1 PHYSICAL SETTING

The Mather WAA is situated in a montane forest characterized by pine trees and manzanita shrubs. The site is at an elevation of approximately 5,000 feet above mean sea level (amsl). The Mather WAA site is sparsely vegetated with clumps of short grass. A survey by an NPS biologist in July 2001 found no evidence of threatened or endangered plants growing on the WAA surface. The closest surface water occurrence is the Tuolumne River, approximately 1.25 miles from the site. The slope and drainage patterns shown on the topographic map (Figure 2-1) indicate surface flow from the site travels south and then west toward the Tuolumne River. The nearest wetlands occur intermittently along the banks of the Tuolumne River.

During site visits for these inspections, no wildlife was observed at the site, nor were tracks or burrows noted within or near the WAA footprint. Wildlife species likely cross the site occasionally, but there was no indication of permanent habitation observed on the ground surface within or near the site.

The nearest residences are at Evergreen and Camp Mather, which are both located about two miles southwest of the site (Figure 2-1). Both facilities have numerous summer visitors (one to seven days) as well as a few caretakers or permanent residents who are present year-round.

2.2 GEOLOGY AND HYDROLOGY

The Mather WAA is located within the Sierra Nevada granitic batholith, specifically within the Cretaceous Bald Mountain Granite shown on the United States Geological Survey Lake Eleanor quadrangle (Dodge & Calk, 1987). The materials encountered at the site during the field investigation indicated rocky material in a silty sand matrix. The materials are primarily granitic in origin with lesser amounts derived from metamorphic rocks. Bedrock at the Mather WAA was not encountered during the investigation, although it is present in former quarry walls adjacent to the WAA and in massive granite ledges upgradient from the site.

No site-specific hydrologic investigations have been conducted at the Mather WAA. No surface water, groundwater, or evidence of ponding were observed at the Mather WAA during the field investigation conducted in August, 2001, and the site is not located within a floodplain. No groundwater monitoring wells exist within or near the boundaries of the site; therefore, depth to groundwater is unknown at the site. The Mather WAA is located near the top of moderate slopes, and the topography of the sites suggests that groundwater is not close to the surface.

There are no known drinking water wells within the drainage basin that encompasses the site. The nearest permanent surface water indicated on the topographic map (Figure 2-1) is the Tuolumne River, which is approximately one mile from the site to the north. Drainage from the site would flow to the south and west for about three miles to the Tuolumne River.

In April 2008, the NPS proposed installing piezometers at the Yosemite WAAs as part of their regular program of water level monitoring in the park. The piezometers were to be installed by hand, which is the standard procedure for the monitoring program. However, due to shallow bedrock and the sloping topography at the site, the proposed piezometer was not installed at the Mather WAA.

2.3 SITE HISTORY

The Mather WAA site was initially a quarry that supplied granite blocks for Yosemite construction projects. The site was subsequently used by crews building the Hetch Hetchy Road, and received both construction and camp debris in the 1920s and 1930s. The NPS has not completed any previous investigations of this site; however, NPS personnel have observed moderate amounts of porcelain, metal objects, glass, ash, and other related materials at the site (DTSC, 1999a). Debris observed on the surface at the Mather site during site visits in 2001 and 2008 was confined to two areas, referred to as "upper" and "lower" (shown on Photograph 1). The debris included glass, rusted cans, and a few corroded battery cores (shown in Photograph 2), and occurred mostly in the lower area. A slight mound in the lower area contained evidence of burning, including charcoal and melted glass.

No documentation exists for the types and quantities of materials disposed at this site. Historical photographs show that trucks drove onto the upper area to dump debris into the lower area. During this activity, some scattered debris was deposited on the surface of the upper area, although the majority of the debris was emplaced in the lower area. Visual observations noted above indicate the debris in the lower area was burned in place. During mobilization for the August 2001 sampling event, NPS and IT personnel observed an area of old debris adjacent to the upper area which had not previously been noted.

2.4 PREVIOUS INVESTIGATIONS

No known geologic, hydrologic, or analytical investigations have been conducted at the Mather WAA nor in its vicinity prior to these sampling events.

3.0 SITE INSPECTION

The following sections describe the objectives, strategy, and field activities conducted for these site inspections.

3.1 INSPECTION OBJECTIVES

The inspections were intended to

- Assess the lateral and vertical extent of solid waste debris;
- Determine whether CERCLA hazardous substances may have been released at the site; and
- Evaluate potential human health and ecological risks posed by site-related contaminants.

The objectives were developed through application of the data quality objectives process, which was presented in the Plan.

3.2 INSPECTION ACTIVITIES

This section describes the field activities that were performed to conduct the inspections in accordance with the Plan and FWV and their objectives.

3.2.1 Pre-Inspection Activities

Due to the isolated location of the Mather WAA, a utility clearance was not required for the site.

Because of the site's previous use as a quarry, a site inspection for explosives was conducted by NPS personnel immediately prior to the 2001 site inspection. The NPS also provided training to IT personnel in the recognition of NPS explosives prior to beginning the 2001 field work. Awareness of explosive hazards was included in safety briefings during the 2008 inspection and workers were advised to stay away from the quarry walls.

The site was also inspected by NPS biologists to determine if threatened or endangered plants were growing on the WAA surface. No threatened or endangered plants were found on the site. Site personnel were careful to minimize disturbance to the forest floor traversed by the backhoe, and restored the surface to its pre-inspection condition during demobilization.

As was previously noted in Section 2.2, the piezometer installation proposed for the WAA could not be done due to many large subsurface boulders at the site.

3.2.2 Site Access and Restoration

To prevent disturbance of the forest floor cover along the access route, the route was covered with plastic fencing placed flat on a layer of heavy plastic sheeting, as shown on Photograph 3. The backhoe made one trip onto the site and one exit trip upon completion of the test pits. After the backhoe exited the site, the plastic and fencing were removed and personnel used leaf rakes to restore any small areas disturbed during site access.

A large dead tree that lay across the access corridor between the upper and lower portions of the site was cut into sections by the NPS prior to mobilization for this investigation. One section was removed to allow backhoe access to the lower area. During demobilization, that section of the dead tree was returned to its former location.

3.2.3 Sample Location Selection

In 2001, a total of ten test pits were excavated at the site, including four test pits within the Mather WAA, three up-slope background test pits and three down-slope test pits (Figure 3-1).

The Plan designated four test pits within the Mather WAA, two in the lower area (TP01 and TP02) and two in the upper area (TP03 and TP04). Test pits TP01, TP02, and TP04 are shown during excavation in Photographs 4, 5, and 6, respectively. During the site visit in April 2001, surface debris and a mound of burned debris, indicated by melted glass and charcoal, were observed in the lower area. One test pit was planned for the burn pit area and one other test pit was placed in the lower area between the burn area and the lowest point on the perimeter of the site. No surface debris was observed on the upper area; however, historic photographs show trucks parked in the upper area while dumping debris at the site. Two test pits were planned for the upper area to determine if subsurface debris was present.

The first test pit to be excavated was TP04, in the upper area. No debris was observed in the subsurface and the test pit was terminated and sampled at three feet below ground surface (bgs). Test pit TP03 was proposed at a location between TP04 and the lower area. The lack of surface debris at TP03 suggested that there was little likelihood of subsurface debris at that location. During mobilization, a small area of old debris (i.e., rusted and partially covered with soil and grasses) was observed adjacent to the upper area that had been overlooked during the previous site visit. Based on these observations, the NPS representative requested that proposed test pit TP03 be abandoned and a new test pit, TP05, excavated in the debris area. This request was made to better characterize the WAA without increasing the scope of the inspection.

In addition to the test pits within the Mather WAA, three up-slope background test pits were located to the east of the Mather WAA. These pits were designated UG01, UG02, and UG03. Three more test pits were located down-slope of the WAA; these pits were designated DG01, DG02, and DG03. Test pit DG01 was in a broad rill that drains the upper area of the Mather WAA. Test pits DG02 and DG03 were placed in successive locations along a dry stream bed that drains the lower area of the Mather WAA. All test pit locations are shown on Figure 3-1.

In 2008, four step-out test pits (YWM06, YWM07, YWM08, and YWM09) were excavated at Mather WAA to better define the extent of subsurface debris, and former locations TP02 and TP05 were resampled (YWM02A and YWM05A). Photographs 7 and 8 show the excavation and resulting test pit at location YWM06 (including location YWM05A), and Photographs 9 and 10 show the excavation and test pit at location YWM09.

Ten new background locations (YWM101 through YWM110) were excavated and sampled in 2008; locations YWM105 and YWM106 are shown in Photograph 11, and locations YWM109 and YWM110 are shown in Photograph 12. Personnel from DTSC were present at the site during the 2008 inspection and concurred with all of the test pit and background sample locations. These locations are also shown on Figure 3-1.

3.2.4 Excavation and Backfilling of Test Pits

The test pits within the Mather WAA were excavated using a backhoe. Background and down-slope test pits were excavated using hand tools. Several factors determined the final depth of each test pit. Based upon site knowledge and site history, debris was anticipated to begin at a depth no greater than three feet bgs. If debris was not located at that depth, the pit was terminated, sampled, and backfilled. When subsurface debris was encountered in a test pit, the test pit was deepened until the base of the debris layer was reached or the backhoe met refusal on bedrock or boulders.

Test pits TP01, TP02, TP04, and TP05 were excavated in 2001. The debris in TP02 extended from the surface to a depth of six feet bgs, where the pit was terminated due to the presence of large boulders. The debris in TP05 extended from the surface to a depth of 4.5 feet bgs, and the test pit was terminated at five feet bgs. No debris or ash were encountered in test pits TP01 or TP04. Test pit TP01 was excavated to a depth of four feet bgs and TP04 was excavated to a depth of three feet bgs.

In 2008, four additional test pits were excavated and two former test pits were resampled. Test pits YWM06 and YWM07 were stepouts from TP05, to verify that all of the debris area had been identified. TP05 was resampled (designated YWM05A) to verify previous analytical results. Test pits YWM08 and YWM09 were stepouts from TP02, and TP02 was resampled (YWM02A) to verify previous data and to obtain a surface soil sample. No subsurface debris was observed in any of the stepout test pits except for minor debris items in YWM08.

All background and down-slope test pits were excavated to a depth of one foot bgs. No debris, ash, or discoloration were found in any of the background or down-slope test pits.

As each test pit was excavated, the site geologist described the soil exposed in the test pit sidewall on a test pit log. Copies of the logs are presented in Appendix A. The native soil encountered in the test pits was composed mainly of gray to brown silty sand with granitic clasts of varying size. The soils were loose and dry, with low moisture content.

Each test pit was backfilled immediately following completion of soil logging, soil sampling, and debris cataloging. The soil and debris excavated from the pits were returned to the test pit.

3.2.5 Monitoring Activities

Archeologists from the Western Archeological Center (WAC) of the NPS observed the test pit excavations and soil sampling at the Mather WAA in 2001, and catalogued debris items in the excavation spoils. The results of the archeological monitoring in 2001 were to be published in a separate report by the WAC. The archeologists were informed of the additional inspection in 2008 and declined to participate.

Test pits excavated within the WAA debris area were monitored for health and safety purposes, using a field instrument to measure levels of oxygen, carbon monoxide, and hydrogen sulfide. The monitoring found that, throughout the field efforts, oxygen remained at normal levels and there were no detections of carbon monoxide or hydrogen sulfide. A photoionization detector was also used at locations with subsurface debris to measure organic vapors emitted from the soil; none were observed.

3.3 FIELD OBSERVATIONS

Debris visible on the surface in 2001 and 2008 consisted primarily of broken glass and many rusted metal cans, and lesser amounts of broken ceramic items, silverware, and other debris. Specific debris items observed at the site were degraded battery cores, approximately five inches in length and about two inches in diameter (Photograph 2).

During the June 2008 site visit, DTSC personnel recommended that the battery cores be removed during the inspection. Therefore, during the site inspection on August 26, 2008, the NPS packaged the battery cores on absorbent material in a 5-gallon bucket with a lid. The bucket was transported by NPS personnel to the NPS waste handling facility at El Portal, California, for appropriate disposal.

Subsurface debris was encountered only in test pits TP02 and TP05, with a thickness of 4.5 feet and six feet, respectively. The debris consisted primarily of pieces of metal, porcelain, and glass. A small area of ash was encountered in each of these test pits and TP05 also had an occurrence of a black, oily substance. The vertical and lateral extent of debris in these two test pits was used to estimate the volume of debris at the Mather WAA.

Test pit TP02 was excavated in the former burn mound location, in the lower area of the Mather WAA. The burn mound measured 10 feet by 15 feet in area, and debris was noted from the surface down to six feet of depth, where the pit met refusal due to large boulders. The estimated volume of waste at this location is approximately 33 cubic yards (cy).

At test pit TP05 in the Mather WAA upper area, waste was encountered from the surface down to 4.5 feet bgs. After the pit was excavated, the backhoe was used to dig one-foot deep trenches in a radial pattern outward from the test pit until a debris-free zone was encountered. The areal extent of the debris is approximately 20 feet in diameter. This extent of debris was confirmed by the step-out test pits excavated in 2008. Assuming 4.5 feet of depth for the waste, the volume of waste in the vicinity of the TP05 site is estimated at 52 cy.

The up-slope and down-slope test pits (UG01 through UG03, and DG01 through DG03, respectively) of 2001 were excavated to six inches bgs, and the ten background locations of 2008 (YWM101 through YWM110) were excavated to 12 inches bgs; none of these locations had surface or subsurface debris and none encountered bedrock.

3.4 SAMPLING METHODS

Discrete soil samples were collected from each of the test pits excavated within the Mather WAA using the methods described below. One field duplicate sample was collected during each sampling event, and designated samples had extra volume collected for laboratory quality control (QC) analyses.

3.4.1 Soil Sample Collection

When each test pit excavation was completed, the sampling crew collected soil samples from the test pit sidewalls. If subsurface debris was present in a test pit, then one sample was collected from the midpoint of the debris and one from the lowest extent of the debris. If there was no subsurface debris in a test pit, then only one sample was collected, at the lowest extent of the test pit. In some instances, biased samples were also collected from specific locations for analysis of TPH or dioxins/furans.

Test pits TP01 (in the lower area) and TP04 (in the upper area) were both free of debris, ash, or apparent hydrocarbon staining. Samples were collected from the deepest extent of these test pits. Test pits TP02 and TP05 both encountered subsurface waste, and samples were collected from the midpoint and lowest extent of waste in the sidewall of these two test pits. All of these samples were analyzed for TPH, PAHs, metals, and hexavalent chromium. In addition, one biased sample of ash was collected from TP02 at one foot bgs and analyzed for dioxins/furans. Two biased samples were collected from TP05, one from an ash layer at one foot bgs for analysis of dioxins/furans, and one from an area of black, oily material for analysis of TPH.

The background and down-slope test pits were each excavated by hand to a depth of one foot bgs, soil samples were collected from the deepest extent, and then the pits were backfilled.

Sampling personnel working under the direction of the site supervisor collected and shipped soil samples obtained from the test pits. Soil samples were collected from each WAA test pit using a decontaminated trowel. The soil was placed in two 8-ounce glass jars per sample.

3.4.2 Aqueous Sample Collection

Reusable sampling tools used in 2001 required decontamination prior to use for each new sample. One equipment rinse sample was collected in the field at Mather WAA in 2001 following decontamination of the reusable soil sampling equipment. The equipment was assembled in preparation for collecting a soil sample (i.e., a stainless steel sleeve inside the drive sampler), and distilled water was poured through the assembled sampler into sample containers.

In 2001, a source blank sample was collected from the batch of distilled water that was used for the final decontamination rinse and for the equipment rinse sample, to determine whether equipment rinse detections, if any, were related to the water itself.

In 2008, a new disposable plastic scoop was used for each sample collected; therefore, no decontamination was required and no equipment rinse or source blank sample was collected.

3.4.3 Sample Labeling

Samples were labeled in accordance with the system defined in the Plan: *YW* (Yosemite Waste Accumulation Area) *M* (Mather) – *TP01* (test pit number 1) – *SO* (soil) (used only in 2001) – *1147* (unique identification number). Samples collected in 2008 have a modified sample number format: *YWM06* (test pit number 6) – *2274* (unique identification number)

Test pits TP01, TP02, TP04, and TP05 were excavated in 2001, along with upslope and downslope locations, referred to as UG and DG, respectively. These designations are used to refer to the 2001 locations in this report. Test pits YWM05 through YWM09 were added in 2008 as well as ten background locations, numbered YWM101 through YWM110. Also in 2008, sample locations YWM02A and YWM05A indicate resamples of two of the sample locations from 2001.

3.4.4 Sample Handling and Shipment

Immediately following collection, each sample was sealed, labeled, placed in a resealable plastic bag, and stored on ice in a sample cooler. The completed chain of custody form was kept in the cooler with the samples.

In 2001, the samples were picked up by a courier service and transported to a Federal Express facility for overnight shipment to the analytical laboratory. In 2008, a courier service was not available, therefore all samples were taken to a United Parcel Service location by the sampling crew during demobilization from the project, for next-day delivery to the analytical laboratory.

3.5 ANALYTICAL STRATEGY

Soil samples were collected and analyzed for chemicals that may be present within the Mather WAA based upon historical knowledge of site activities, and visual observation of surface debris during site visits. There are no written records of a disposal history or types of waste materials within the site. Debris observed on the surface and in test pits included porcelain, metals, glass, ash, rusted cans, degraded battery cores, and other related material. Soil samples collected from test pits at the Mather WAA were analyzed for the parameters listed below and summarized on the following table. The analytical methods listed below are all described in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846, Update II) (United States Environmental Protection Agency [USEPA], 1998a) unless otherwise noted.

Analyses Requested for Soil Samples, 2001 and 2008

Analysis	SW-846 Method	2001	2008
Volatile Organic Compounds	8260B		X
Semivolatile Organic Compounds	8270C		X
Total Petroleum Hydrocarbons as gasoline	8015B		X
Total Petroleum Hydrocarbons as diesel, motor oil	8015E	X	X
Polynuclear Aromatic Hydrocarbons	8310 SIM	X	X
Polychlorinated biphenyls	8082		X
Dioxins/Furans	8290	X	
Metals	6020A / 7471A	X	X
Major Elements	6020A		X
Hexavalent Chromium	7196A	X	
Total Organic Carbon	Walkley-Black Procedure [a]		X
Cation Exchange Capacity	9081		X
pH	9045		X
Bulk Density	ASTM [b] D2937		X

[a] *Walkley and Black, 1934*
[b] *American Society for Testing and Materials*

During each sampling event (2001 and 2008), one field duplicate sample was collected and analyzed for the same parameters as its collocated test pit sample.

In 2001, biased samples of ash from two test pits (TP02 and TP05) were analyzed for dioxins/furans by USEPA Method 8290. One up-slope sample (UG02) was also analyzed for dioxins/furans to provide background values. One biased sample of a black, oily substance in test pit TP05 was analyzed for TPH as diesel and motor oil.

In 2008, the black oily substance noted in TP05 was re-exposed and re-sampled (YWM05A), and analyzed for TPH as diesel and motor oil and for PCBs. Also in 2008, surface soil sample location YWM02A was excavated adjacent to the 2001 test pit TP02, and a sample was collected for the full analytical suite.

The up-slope and down-slope test pits excavated in 2001 were analyzed for the same parameters as the 2001 test pit samples. The background samples collected in 2008 were analyzed for metals and PAHs only.

The analytical results for the inspection samples are presented in Section 4.0.

3.6 EXPLANATION OF DEVIATIONS FROM THE WORK PLAN

In the August 2001 sampling event, at the request of the NPS, proposed test pit TP03 was not excavated in order to allow excavation of newly-designated test pit TP05 in an area of surface debris that was overlooked during the April 2001 site visit.

Review and revision of the exposure frequency (EF) for occasional adult and child hikers was accomplished during the review of the draft report. The human health risk assessment has been revised for an EF of 7 days/year with a year being an estimated period of 26 weeks per year when the park is accessible to the public.

4.0 DATA EVALUATION

This section presents the analytical results for soil samples collected at the Mather WAA in the August 2001 and August 2008 sampling events.

4.1 SUMMARY OF ANALYTICAL RESULTS

The soil data are summarized in Tables 4-1 (metals and major elements), 4-2 (petroleum hydrocarbons), 4-3 (PAHs) 4-4 (volatile organic compounds [VOCs], and semivolatile organic compounds [SVOCs]) and 4-5 (dioxins/furans). Summary pages from the laboratory analytical reports are presented in Appendix B. All results are reported on a dry weight basis. The practical quantitation limits (PQLs) indicated in the laboratory reports are adjusted for percent moisture and dilutions as appropriate.

Figure 4-1 presents the detections of metals in soil samples collected in 2001 and 2008, overlaid on the site map with sample locations. Figure 4-2 presents detections of organic compounds in soil samples collected in 2001 and 2008, also overlaid on the site sample map.

4.1.1 Metals

Soil samples were analyzed for California Assessment Manual (CAM)-17 metals in 2001 and 2008, and for hexavalent chromium in 2001 only (Table 4-1). Hexavalent chromium was not detected in any soil samples collected in 2001. Based on these results and the lack of any industrial activities in or near the park that typically produce hexavalent chromium, this analysis was removed from the list for the 2008 samples. In 2008, the seven major soil elements (aluminum, calcium, iron, magnesium, manganese, potassium, and sodium) were included in all metals analyses; however, these elements were not analyzed in 2001.

The results were compared to California Regional Screening Levels (RSLs) for residential and industrial soil. Results that exceeded one or both RSLs (residential and industrial) are listed below:

- Arsenic in all 2001 and 2008 samples exceeded its residential regional screening level (RSL) of 0.39 milligrams per kilogram (mg/kg);
- Arsenic exceeded its industrial RSL of 1.6 mg/kg in all but seven of the 34 samples analyzed. The highest arsenic detection was in the field duplicate sample from 6.0 feet (ft) bgs in TP02, which had a concentration of 8.4 mg/kg. The other arsenic detections above the industrial preliminary remediation goal ranged from 1.61 to 7.37 mg/kg;
- Lead was reported above its residential RSL of 400 mg/kg in seven of 34 samples collected in 2001 and 2008. Three of the seven also exceeded the industrial RSL for lead in soil of 800 mg/kg (1,040 mg/kg at 3 ft bgs in TP02; 994 mg/kg at 1.5 ft bgs in YWM09, and 9,070 mg/kg at 2.5 ft bgs in YWM09). All other lead results in Mather test pits, including the thirteen upgradient/background locations, were well below the residential and industrial RSLs; and
- Manganese in one test pit sample (1,900 mg/kg at 0.5 ft bgs in YWM02A) slightly exceeded its residential RSL of 1,800 mg/kg.

In addition, results for lead were compared to the California Human Health Screening Levels (CHSSLs) (Ca/EPA 2009a). Lead was reported above its residential CHSSL of 80 mg/kg in nine of 34 samples collected in 2001 and 2008. Eight of the nine also exceeded the industrial CHSL for lead in soil of 320 mg/kg. All other lead results in Mather test pits, including the thirteen upgradient/background locations, were below the residential and industrial CHSSLs.

All other metals detected in test pit and background samples in 2001 and 2008 were less than both their residential and industrial RSL values.

The detections of metals in Mather WAA test pits are compared to background levels in Appendix D, and the results of the background comparisons are summarized in Section 4.4.

A key finding of the metals background evaluation in Appendix D was that some detection of arsenic may be related to the site; however, all the soil arsenic results were found to be within the range of background arsenic concentrations compiled by Tuolumne County, CA. Based on this Tuolumne County comparison, arsenic risks and hazards were quantified in the human health risk assessment for informational purposes, but these risks and hazards were not included in the summed risk and hazard totals for the Mather WAA. Therefore, HHRA conclusions do not include arsenic risks and hazards, as arsenic in soil is deemed related to background.

4.1.2 Total Petroleum Hydrocarbons

Because there are no RSLs for petroleum hydrocarbons, detections of TPH as diesel and motor oil were compared to the risk-based screening levels (RBSLs) described in this section. The Massachusetts Department of Environmental Protection (MADEP) has established a soil cleanup standard of 5,000 mg/kg for TPH in isolated subsurface soils that may experience a groundwater discharge to surface water (MADEP, 2001). The California Regional Water Quality Control Board (RWQCB) has set forth RBSLs for TPH in soil that are based on ceiling concentrations from MADEP and modified (i.e., lowered) by RWQCB based on odor and general nuisance concerns (Section 4 of Appendix 1 of RWQCB, 2000). The RWQCB RBSLs are 500 mg/kg for diesel and 1,000 mg/kg for motor oil.

In 2001, soil samples from the investigative test pits, upgradient, and downgradient locations were analyzed for TPH diesel and motor oil. In 2008, soil samples from the investigative test pits only were analyzed for TPH gasoline and TPH diesel and motor oil (Table 4-2).

Silica gel cleanup is routinely used during analysis of TPH to remove naturally-occurring hydrocarbons with signatures in the diesel and motor oil chromatogram ranges. In 2001, the Mather WAA soil samples were analyzed for TPH as diesel and motor oil with and without silica gel cleanup, to determine the contribution of naturally-occurring compounds. The use of silica gel cleanup resulted in a lower concentration in about half of the diesel analyses and all of the motor oil analyses, indicating that naturally-occurring hydrocarbons are present in site soils. In 2008 the TPH diesel and motor oil analyses were all performed with silica gel cleanup. Because analysis without silica gel cleanup was not performed, it is not possible to judge the contribution of naturally-occurring hydrocarbons to those samples. Table 4-2 summarizes the analytical results for TPH as diesel and motor oil in soil samples, both with and without silica gel cleanup. This section discusses only those results with silica gel cleanup, as they more accurately represent the presence of diesel and motor oil at the site.

In 2001, diesel was detected below the PQL of 10 mg/kg in all three up-slope background samples from test pits UG01, UG02, and UG03. All test pit samples had diesel concentrations below the PQL except at 2.5 feet bgs in test pit TP05, where diesel was detected at 170 mg/kg. The biased sample of a black, oily substance in TP05 had a diesel concentration of 4,100 mg/kg. In the down-slope test pits, diesel was reported in DG02 and DG03 below the PQL of 10 mg/kg. Diesel was detected at 20 mg/kg in test pit DG01.

In 2001, motor oil was detected above the PQL of 10 mg/kg in all soil samples collected at the site that were analyzed for TPH. The samples obtained from the three up-slope background test pits had motor oil detections ranging from 11 mg/kg to 31 mg/kg. In the WAA test pit samples, motor oil concentrations ranged from 21 mg/kg to 3,400 mg/kg, and the biased sample had a motor oil concentration of 110,000 mg/kg. Motor oil was also detected in all three down-slope test pits, at concentrations ranging from 29 mg/kg to 120 mg/kg.

The highest diesel and motor oil detections were in the biased sample of a black oily substance at one foot bgs in TP05. All of the TPH detections in TP05 were at greater concentrations than in any other test pit. Concentrations detected in soil from 2.5 feet bgs in the same test pit were also elevated, but were lower than the biased sample. All other diesel and motor oil detections at the Mather WAA, including those from five feet bgs in TP05 were much less than the biased sample.

In 2008, diesel was detected in samples from test pits YWM05A, YWM06, and YWM07, at concentrations from 9.9 to 4800 mg/kg, and was not analyzed in background samples. The sample from YWM05A (4,800 mg/kg) was a resample of a black oily substance noted in the 2001 inspection, and is the only sample to exceed the risk based screening levels (RBSL) for diesel of 500 mg/kg.

In 2008, motor oil was detected in samples from test pits YWM05A, YWM06, and YWM07, at concentrations from 170 to 88,000 mg/kg, and was not analyzed in background samples. The sample from YWM05A (88,000 mg/kg) was a resample of a black oily substance noted in the 2001 inspection. Both it and the sample from 0.5 ft bgs in YWM06 exceed the RBSL of 1,000 mg/kg.

Soil samples were analyzed for TPH gasoline in 2008, but not in 2001. Gasoline was reported at very low concentrations in two samples, 1.3 mg/kg at 4.0 ft bgs in test pit YWM06 and 2.5 mg/kg at 0.5 ft bgs in YWM07.

In 2001 and 2008, the highest concentrations of TPH as diesel and motor oil occurred in the biased sample from test pit TP05 (2001) and its resample location YWM05A (2008). Both biased samples and one detection of motor oil at 0.5 ft bgs in YWM06 exceeded RWQCB RBSLs. All other results for TPH as diesel and motor oil were well below their respective RWQCB RBSLs and the MADEP screening limits, as shown on Table 4-2.

4.1.3 Polynuclear Aromatic Hydrocarbons

All samples collected in 2001 and 2008 were analyzed for PAHs. The detections are summarized in Table 4-3 and shown on Figure 4-2, and the laboratory results are presented in Appendix B.

Twelve PAHs (anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)-perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-c,d)pyrene, phenanthrene, and pyrene) were detected in one or more of investigative test pit soil samples collected in 2001 and 2008. PAHs were not detected in any of the 2001 or 2008 background samples. The greatest number of PAHs (eleven) were reported in the samples from TP02 and YWM09 (Table 4-3).

The polynuclear aromatic hydrocarbon (PAH) detections were compared to California RSLs for residential and industrial soil. Results that exceeded one or both RSLs (residential and industrial) are listed below:

- Four of the five detections of benzo(a)pyrene in 2001 and 2008 (shown on Table 4-3) exceeded its residential RSL of 15 micrograms per kilogram (μg/kg) but were below the industrial RSL of 210 μg/kg; and
- All three detections of dibenz(a,h)anthracene exceeded the residential RSL of 15 μg/kg but were below the industrial RSL of 210 μg/kg.

4.1.4 Volatile and Semivolatile Organic Compounds

Three VOCs (2-butanone, acetone, and methylene chloride) were detected in six of the 2008 samples; VOCs were not analyzed in 2001. All of the volatile organic compound (VOC) detections were less than their respective RSLs, where established. Acetone and methylene chloride are commonly observed as laboratory contaminants.

Two SVOCs (bis[2-ethylhexyl]phthalate and pentachlorophenol) were detected in three and one 2008 sample, respectively, but were not analyzed in 2001 samples. All of the detections were well below residential and industrial soil RSLs, as shown on Table 4-3.

4.1.5 Polychlorinated Biphenyls

In 2008, all Mather WAA soil samples (excluding the background samples) were analyzed for PCBs; however, none of these compounds were detected in any of the samples, and they were not analyzed in 2001.

4.1.6 Dioxins/Furans

Dioxins/furans are ubiquitous in soils at low levels as a result of natural processes such as forest fires, which frequently occur in Yosemite National Park. Dioxins/furans are also unwanted by-products formed during incomplete combustion of chlorinated compounds, which could occur during on-site burning of chlorinated compounds in the presence of petroleum products.

Biased samples were collected from ash exposed in test pits TP02 and TP05 and submitted for analysis of dioxins/furans. The sample from UG02 was also selected for dioxins/furans analysis, to represent background values. Results for all three samples are summarized in Table 4-4. Because the other test pits contained no ash deposits and had only low-level detections of TPH, dioxins/furans analysis was not requested for their samples.

Table 4-4 shows the dioxins/furans detections as well as the calculated Toxic Equivalent (TEQ) values. To determine TEQ, the concentration of each dioxin and furan congener is assigned a weighting factor based on its toxicity relative to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD); the factors are shown on Table 4-4. The TEQ expresses the sum of the weighted congener concentrations as 2,3,7,8-TCDD. The TEQ for test pit TP02 is 11.855 picograms per gram (pg/g), which exceeds the residential RSL of 4.5 pg/g but is less than the industrial RSL of 18 pg/g. The TEQ for TP05 is 0.054 pg/g and for upgradient background location UG02 is 0.0375 pg/g; both of these results are well below both RSLs for 2,3,7,8-TCDD TEQ.

4.2 LABORATORY DATA QUALITY ASSESSMENT

A laboratory DQA was performed for samples analyzed in 2001 and 2008. The details of the DQA are presented in Appendix C, and the results are summarized in this section.

The QC analytical results for 2001 that were outside their respective control criteria did not significantly affect data quality and usability. The laboratory data quality for the 2001 sampling event met the quality assurance objectives and project goals specified in the Plan.

In 2008, based on third party and Shaw's internal data review, one significant data quality issue was identified with respect to the rejected PQLs for five VOC compounds. Calibration blank detection; and non-compliant surrogate, matrix spike/matrix spike duplicate and internal standard recoveries, inductively coupled plasma serial dilution and calibrations were also observed and the affected sample results were qualified as non-detected or estimated. With the exception of the rejected PQLs, all other qualified data are usable. The 95% data usability goal was exceeded for the Mather WAA sampling event.

4.3 FIELD QUALITY CONTROL RESULTS

In order to provide for reliability of field sampling procedures and materials, field QC samples were collected for each medium sampled, sample shipment, and sampling event. The field QC samples included an equipment rinse and source blank sample collected in 2001, and two field duplicate samples, one collected during each sampling event. The samples and their results are discussed in Appendix C.

The relative percent difference calculations for the field duplicate samples (Appendix C, DQA Table 5) found some results outside acceptance limits. However, field duplicate imprecision can be caused by sample non-homogeneity and matrix effects. Since the majority of the field duplicate results were within the acceptance limit for precision, the non-compliant field duplicate results have minimal impact on the data quality and usability.

4.4 GEOCHEMICAL EVALUATION

Background soil samples collected at Mather WAA in August 2001 and August 2008 were evaluated and compared to site-specific investigative results from test pit soil samples collected during the two sampling events. Appendix D describes the methodology and detailed results of the geochemical evaluation, and the results are summarized in this section.

4.4.1 Background Characterization

Appendix D describes the methodology that was used to characterize the background distributions of selected elements in surface soil at Mather WAA. Ten background surface soil samples (1 foot bgs) were collected in August 2008 from locations close to the WAA and believed to be uninfluenced by site-related contamination. These samples were submitted to an off-site laboratory for analysis of the California Assessment Manual 17 (CAM 17) metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc) plus the seven major soil elements (aluminum, calcium, iron, magnesium, manganese, potassium, and sodium). The three background soil samples (1 to 1.5 feet bgs) collected in August 2001 were analyzed only for the CAM 17 metals. The 2001 data were evaluated and, where appropriate, combined with the 2008 data to increase the background sample size and therefore improve confidence in the resulting summary statistics.

USEPA and DTSC guidance were used to evaluate distributional assumptions and characterize the distributions. The completed background data set was then used in site-to-background comparisons to identify constituents of concern at Mather WAA and to determine the nature and extent of apparent site-related contamination. In addition, the background data may be used to support human health and ecological risk assessments and proposals for no further action, develop realistic remediation goals, and evaluate the success of remediation efforts.

Of the 24 elements analyzed in the background samples, four (aluminum, iron, magnesium, and potassium – in that order) have the highest median concentrations (Appendix D, Table D-1). Iron in the samples is most likely present as iron oxides, which are common soil-forming minerals that occur as discrete mineral grains or as coatings on silicate minerals (Cornell and Schwertmann, 2003). Aluminum is a primary component of common soil-forming minerals such as clays, feldspars, and micas. Aluminum also substitutes for ferric iron in iron oxide minerals, and it can adsorb on iron oxide surfaces (Cornell and Schwertmann, 2003). Magnesium and potassium are common components of soil-forming minerals such as clays.

Clays and iron oxides are fine-grained minerals that have strong affinities to adsorb specific trace elements. Finer-grained soil samples are therefore expected to contain naturally higher concentrations of aluminum, iron, and associated trace elements, relative to coarser-grained soil samples. If site samples are obtained from finer-grained soils relative to the background locations, then natural exceedances of the background screening values are expected.

4.4.2 Site-to-Background Comparison

Appendix D also provides the methodology and results of the site-to-background comparison for inorganic constituents in the Mather WAA soil samples. Site samples used in the comparison include ten soil samples (obtained at various depths ranging from 0.5 foot bgs to 5 feet bgs) collected in August 2008 and nine soil samples (various depths ranging from 1 to 5 feet bgs) collected in August 2001.

Background distributions and background screening values were established for 24 elements in soil at Mather WAA, which were then used in the site-to-background comparison. The background data set consists of thirteen surface soil samples (depths of 1 foot bgs and 1.5 feet bgs) collected immediately adjacent to and upslope from the WAA.

The methodology used to compare the Mather WAA site and background data sets included a hot measurement test, nonparametric two-sample Wilcoxon rank sum test, and box-and-whisker plots. Details of these analyses are presented in Appendix D. Analytes that failed either of the statistical tests were subjected to geochemical evaluation to determine if the elevated concentrations could be explained by natural processes.

Aluminum, beryllium, selenium, and vanadium in the site data set passed statistical comparison to background. The detected concentrations of these four elements are within their respective background ranges. Antimony, arsenic, barium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, potassium, silver, sodium, thallium, and zinc failed statistical comparison to background and were subjected to geochemical evaluation. Geochemical evaluation could only be performed on the 2008 samples, because the 2001 samples were not analyzed for the major elements. Geochemical evaluation indicates that the detected concentrations of magnesium, potassium, and silver in the 2008 site samples are most likely natural. Anomalously high concentrations of antimony, arsenic, barium, cadmium, calcium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, sodium, thallium, and zinc are present in two to nine samples each. Given the available data, these concentrations cannot be explained as the result of natural processes and they may be present as a result of site activities.

Because they were not analyzed for the major soil elements, the nine 2001 site samples could not be included in the geochemical evaluation to determine if their elevated trace element concentrations have a natural source. In the 2001 data set, antimony, barium, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, silver, and zinc concentrations exceed their respective BSVs in one to five samples each, and these concentrations should be considered suspect. The 2001 samples with element concentrations above BSVs are listed in Table D-5 (Appendix D). The arsenic and cobalt concentrations are below their respective background screening values, so any arsenic or cobalt contamination, if present in these samples, would be insignificant. All of the 2001 site samples are nondetect for thallium.

4.4.3 Arsenic Site-to-Background Comparison

It is worth noting that the site arsenic concentrations are similar to those of background soil concentrations for Tuolumne County. Four soil samples were collected within the county by the U.S. Geological Survey in 1979-1980, as part of a continental-scale study to characterize natural metals concentrations in surficial soils (U.S. Geological Survey, 2010). Arsenic concentrations in these four background samples range from 2.1 to 9.8 mg/kg. While some of the Mather WAA site samples might contain excess arsenic from site-related contamination (as discussed in Appendix D), all of the site arsenic concentrations (1.10 to 8.4 mg/kg) are below or within the range of the Tuolumne County background concentrations. This suggests that any arsenic contamination in the site samples, if present, is not significant.

5.0 HUMAN HEALTH RISK ASSESSMENT

This section describes the HHRA performed for the Mather WAA at Yosemite National Park, California.

5.1 OBJECTIVES AND METHODOLOGY

The HHRA was carried out using the methodology of the Preliminary Endangerment Assessment (PEA) Guidance Manual (DTSC, 1999b) with evaluation algorithms implemented through a Shaw-custom spreadsheet, *PEAspread,* as presented in Appendix E. This produces a conservative, screening risk assessment for the individually-selected chemicals of potential concern (COPCs) in WAA soil, for protection of hikers and park employees. The small size (one-quarter acre) of the Mather WAA obviates the need to identify hot spots, if present, for environmental protection.

The HHRA was conducted as described in the RAWP (Shaw, 2009) with one deviation. Review and revision of the EF for occasional adult and child hikers was accomplished during DTSC's review of the draft report. The human health risk assessment has been revised for an EF of 7 days/year with a year being an estimated period of 26 weeks per year when the park is accessible to the public.

5.2 IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

Identification and selection of COPCs was conducted by a preliminary risk/hazard screening of all detected analytes in the surface soil interval of 0-2 feet bgs to identify those analytes for further evaluation as significant contributors to risk/hazard for the receptors. Detected analytes in the soil interval of 2-3 feet bgs are considered to not be available for human exposure to soil. Volatile chemicals in the 2-3 foot interval are assumed to be dissipated upon volatilization from soil into the ambient air of the site.

In Table 5-1, the maximum concentration of each of the detected analytes is compared to risk-based concentrations for a direct-exposure residential soil exposure pathway. As a National Park, a residential exposure scenario is required for protection of the public health from environmental exposure. The risk-based concentrations are based on either an incremental lifetime cancer risk (ILCR) of 1E-6 as the point of departure for *de minimis* exposure or a hazard index of 0.1 for non-cancer COPCs as a conservative screening threshold for potential cumulative exposure to non-carcinogens. The analytes identified as COPCs are shown in Table 5-1 with notations for the rationale for selection or deletion. Each of the COPCs identified in Table 5-1 as a COPC based on maximum concentration is presented in Table 5-2 showing the results of determination of a 95% upper confidence limit (UCL95) as a representative concentration for the reasonable maximum exposure (RME). These concentrations were carried forward to the HHRA with the following exceptions or modifications.

In some cases, the COPCs do not have supporting physical parameters for risk assessment evaluation. This applies to diesel fuels with silica gel cleanup, TPH as gasoline, and motor oil with silica gel cleanup. In general, petroleum hydrocarbon product detections, made up of mixtures of hydrocarbon chemicals, are valuable indicators for individual chemical analytes that are part of petroleum hydrocarbons. Surprisingly, gasoline is not represented among the detected analytes by benzene, toluene, ethylbenzene, or xylenes that are usual components of gasoline. Of course, the gasoline RME concentration is only a concentration of 1.2 mg/kg and was carried forward as a COPC only because there was not a risk-based concentration to compare. For reference, the Environmental Screening Level (ESL) for gasoline in soil is 100 mg/kg (RWQCB, San Francisco Bay Region, 2008). On this basis, screening for gasoline in soil was not carried forward. Diesel fuels and motor oil are represented among the COPCs by 2,3,7,8- TCDD equivalents, benzo(a)pyrene, benzo(g,h,i)perylene, and phenanthrene that are screened in the HHRA.

In other cases, detected analytes without supporting physical parameters are represented by surrogate chemicals for risk-based evaluation. For instance, benzo(g,h,i)perylene and phenanthrene are represented by pyrene as a surrogate. The inorganic metals detections are assumed to be ionic salt forms of the metals. All of these choices form the rationale for selecting the physical parameters used in *PEAspread* for the evaluation of risk/hazard using the Preliminary Endangerment Assessment (DTSC, 1999b) methodology, as shown in Appendix E.

5.2.1 Background Evaluation

Based on detailed analysis of naturally-occurring inorganic metals in soil in Section 4.4, some of the residual metals analyte concentrations have been identified as being above background levels for further evaluation. These are antimony, arsenic, barium, cadmium, calcium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, sodium, thallium, and zinc. In Table 5-1, a number of these analytes are not carried forward for the HHRA as follows:

- Calcium – a common nutrient;
- Chromium – below the screening level;
- Cobalt – below the screening level;
- Copper – below the screening level;
- Mercury (inorganic) – below the screening level; no elemental mercury observed or detected in the site investigation;
- Molybdenum – below the screening level;
- Nickel – below the screening level; and
- Sodium – a common nutrient.

Screening using the PEA algorithms was conducted for the remaining metals along with the other identified COPCs. Lead was screened based on total exposure models (Cal/EPA Office of Environmental Health Hazard Assessment [OEHHA], 2009; USEPA, 2005) and is discussed in Section 5.5.2.

5.2.2 Exposure Point Concentrations

Table 5-2 indicates the exposure point (representative) concentrations for the COPCs selected by the preliminary screening. A description of the statistical approach used to estimate exposure point concentrations is presented in Section 6.2.2. The development of representative concentrations is described in Appendix E.

5.3 EXPOSURE ASSESSMENT

The end point of the exposure assessment is the calculation of intake dose for each of the receptors via each of the exposure routes. These calculations and the results are presented for each of the COPCs in the tables of Appendix E. The exposure doses in mg per kg-day units are also presented in summary form for each of the exposure routes for each analyte on Tables 5-5 and 5-6.

5.3.1 Characterization of the Exposure Setting

The Mather WAA is located in the northwestern area of Yosemite National Park, on the south side of Hetch Hetchy Road approximately one mile northeast of the Mather Ranger Station, at an elevation of approximately 5,000 feet amsl (Figure 2-1). The site covers approximately 0.2 acre. The lower portion of the Mather WAA was originally a quarry that produced granite blocks for various construction projects in the area. The upper portion of the site was used as a waste dump by workers constructing the Hetch Hetchy Road in the 1920s and 1930s. Boulders of granite are abundant on the lower portion of the site, which is bordered on the north side by the granite wall of the former quarry.

Due to the location of the site in the high backcountry wilderness area, it is unlikely that many hikers visit the site. Park employees do not visit the site on a regular basis. For these reasons, the hiker's and employee's exposure frequency are assumed to be occasional. These facts also support the revision of the exposure frequency for hikers to be seven days per year.

No surface water, domestic groundwater wells, or monitoring wells exist at the site.

5.3.2 Identification of Potential Human Receptors and Exposure Pathways

Activities by the park hiker and park employee are envisioned as being for hiking and park maintenance, respectively. Exposure by incidental ingestion of soil, dermal contact with soil, and inhalation of fugitive dust and volatilization from soil as considered in the PEA algorithms are applicable for screening of the receptors associated with the WAA.

5.3.2.1 Potential Receptors

The receptors for Mather WAA are the park hiker and the park employee. The park hiker is envisioned as a child, conservatively estimated as 0-6 years of age, an adult with 24 years of adult exposure, and a combined child and adult 30-year residential exposure duration. Table 5-5 shows the individually-calculated risk/hazard for an adult (24 years), child (6 years), and combined (child and adult -- 30 year combined exposure), per PEA methodology. The applicable exposure parameters the hiker receptors are listed on Table 5-4. The exposure parameters for the adult park employee are also shown in Table 5-4.

The park hiker, adult and child, is envisioned as being present at the WAA for 7 days per year (see Table 5-3) with the mix of exposure duration for adult, child, and combined receptor as described above. This is a very conservative scenario because the WAA is only 0.2 acre in size, and it is very conservative to assume that a hiker receptor would remain at the WAA when their objective for being at the park is to hike. Nonetheless, a reasonable maximum exposure is envisioned for a hiker who may have a regular meeting place or staging area at the WAA.

The park employee is easier to rationalize as being located at the WAA for 120 days per year and a 25-year exposure duration. This scenario corresponds to a worker stationed at the WAA, perhaps for security, safety, or maintenance reasons.

5.3.2.2 Exposure Pathways – Conceptual Site Exposure Model

Figure 5-1 is the Conceptual Site Exposure Model (CSEM) for the WAA sites, including Mather WAA. As indicated on the CSEM, the pathways for both receptors are envisioned as being related to the soil. No surface water, drinking water wells, or monitoring wells exist at the site. The traditional exposure routes under consideration are incidental ingestion of soil, dermal contact absorption from soil, and inhalation of vapors and fugitive dust from soil. These are the exposure routes contained in the PEA algorithms and *PEAspread*[1] and evaluated for this HHRA.

5.3.2.3 Pathway-Specific Intake Doses

Tables E-1 through E-24 in Appendix E show the calculated pathway-specific (exposure-route-specific) intake doses for each of the COPCs, for each of the receptors, for the soil (direct contact and air) pathway. The calculated values are used directly in the equations of the PEA methodology (DTSC, 1999b) as implemented in PEAspread. The exposure doses are also presented as summarized in Tables 5-5 and 5-6.

5.4 TOXICITY ASSESSMENT

The toxicity values for each of the COPCs are presented in the PEAspread tables with reference to their source and will not be repeated here. PEA risk/hazard algorithms are based on carcinogenic slope factors (SFs) and non-cancer reference doses (RfDs). If an inhalation unit risk factor (IUR or URF) or a reference concentration was the only toxicity value available, it was converted to a slope factor or reference dose, as appropriate, using the following relationships:

Cancer Slope Factor

$$URF\left(Risk * \frac{m^3}{\mu g}\right) * 1000\left(\frac{\mu g}{mg}\right) * \left(\frac{70}{20} * \frac{kg-day}{m^3}\right) = SF_i\left(Risk * \frac{kg-day}{mg}\right)$$

Non-Cancer Reference Dose

$$RfD\left(\frac{mg}{kg-day}\right) = RfC\left(\frac{mg}{m^3}\right) * \frac{20\,\frac{m^3}{day}}{70\,kg}$$

The factor of 70/20 or 20/70 is consistent with standardizing inhalation toxicity factors for PEA methodology based on an adult receptor. While this is at odds with more recent EPA guidance (USEPA, 2009a), it is the practice for PEA screening and, as such, is used throughout *PEAspread*.

5.5 RISK CHARACTERIZATION

The final step in the HHRA is the characterization of potential risks and hazards associated with human exposure to site-specific chemicals. It consists of both quantitative and qualitative assessments of exposure and uncertainty. The PEA methodology supports conducting the assessments on a screening basis, as reported herein.

5.5.1 Cancer Risks

Tables 5-5 and 5-6 are summaries of the quantitative results from *PEAspread* for the park hiker and for the park employee, respectively. Each of the tables indicates that increased lifetime cancer risks, both for individual COPCs and for cumulative risk are less than 1E-6 ILCR. Arsenic risk has been calculated but

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[1] The *PEAspread* tables presented in Appendix E do have a page for the groundwater exposure route, but it is not needed for this risk assessment. The WAA CSEM does not contain the water-ingestion or water-inhalation exposure routes because there is no water associated with Mather WAA.

is not a contributor to site-specific risk, because the concentrations detected are within the regional background concentration range.

5.5.2 Non-Cancer Hazard

Tables 5-5 and 5-6 are also summaries of the quantitative non-cancer results from *PEAspread* for the park hiker and for the park employee, respectively. Each of the tables indicates that non-cancer health hazards, both for individual COPCs (hazard quotient, HQ) and for cumulative hazard (hazard index, HI) are less than 1, the criterion for acceptable exposure (USEPA, 1990). The HIs for both the park hiker and the park employee are also less than 1, indicating acceptable exposure. Arsenic hazard has been calculated, but is not a contributor to site-specific HQ/HI because it is part of the regional background.

Lead

Lead is a selected COPC based on the screening of Table 5-1 but has not been carried through the normal PEA screening because it is evaluated separately using a total exposure model developed by OEHHA and called *Leadspread7* (Cal/EPA OEHHA, 2009). Description of the model and its use is presented in Appendix F. Table F-1 is the Lead Risk Assessment Spreadsheet to confirm the Lead in Soil/Dust concentration for a blood lead change of 1 micrograms per deciliter as the new California Human Health Screening Level (CHHSL) for a child receptor (hiker)[2] at the Mather WAA. Appendix F shows how the CHHSL is modified for an occasional child hiker with 7 days/year exposure in a 26 week year (limited public access because of snow closure). Table F-2 shows the lead risk assessment spreadsheet for the child hiker with the modified CHHSL of 2,000 micrograms per gram (µg/g).

The exposure frequency and individual exposure times (estimated as about an hour per event) are short and apply more to acute exposure than the chronic exposure for which *LeadSpread* is based. For this reason, the modified CHHSL for lead is considered a conservative screening concentration only.

The representative average surface soil lead concentration at the Mather WAA is 286 mg/kg (Table 5-2) which is less than the Child Hiker CHHSL of 2,000 mg/kg. The maximum concentration for lead in surface soil at the Mather WAA is 994 mg/kg. Both of these concentrations are less than the modified CHHSL for a child and are also protective for the adult hiker and adult park employee, because a child will have a greater lead intake per kilogram body weight compared to an adult.

Modeling for a pica [behavior of eating non-food items] child is not considered applicable for the Mather WAA. Such behavior would be expected to have parental control in a home environment, rather than bringing a child with those habits on an outing involving hiking, or, if on such an outing, the parents would be likely to control pica behavior.

These assessments indicate that lead in soil is not a concern for human health at the Mather WAA.

5.5.3 Cumulative Risk/Hazard

The summary tables 5-5 and 5-6 show the cumulative risk (ILCR) and HI from the screening for both the park hiker (adult and child) and the park employee. Risk is less than 1E-6 ILCR which is acceptable

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[2] OEHHA has limited *Leadspread7* for interim use while the spreadsheet is undergoing revision (the reason for portions of Table F-1 [Appendix F] in red being lined out). Currently, only a child receptor may be evaluated for lead exposure, but **the child hiker is protective for screening of an adult hiker or a park worker** (i.e., the child is a conservative surrogate for the adult hiker or park worker).

exposure (1E-6 ILCR or less; USEPA, 1990) for risk to park hikers (Table 5-5) and to the park employee (Table 5-6).

The non-cancer hazard indexes for the park hiker (Table 5-5) and the park employee (Table 5-6) are each less than 1, the criterion for acceptable non-cancer exposure (USEPA, 1990).

These assessments indicate that cumulative risk/hazard is not a concern for human health at the Mather WAA.

5.6 UNCERTAINTY ASSESSMENT

Each one of the component assessments of the risk assessment paradigm of the National Research Council (NRC, 1983, 1994): hazard identification, toxicity assessment, exposure assessment, and risk characterization possesses errors and variations as uncertainties. Throughout the development of this risk assessment, the choices of parameters were deferred toward being conservative with the objective of not underestimating risk/hazard. The result is a conservative, over-estimation of risk/hazard.

5.6.1 Hazard Identification

The advantage and economy of the bounding analysis approach intentionally builds a high bias into the data sets. Samples collected using a knowledge-based (also called *biased*, *authoritative*, *judgmental*, or *purposive)* sampling plan are intended to identify the maximum contamination on the site. Reliance is placed on site history of chemical use in planning the sample locations for focused soil sampling and analysis. Maximum and UCL95 soil concentrations were used to ensure that there has not been an underestimate of the concentration for each COPC representing the site. The overestimate may be as much as an order of magnitude. Overall, the bounding analysis is conservative in estimating risk/hazard.

Determination of an upper-bound concentration is also biased high because the data values used in the limited data set were collected using a biased sampling rationale.

5.6.2 Toxicity Assessment

Uncertainties in the toxicity assessment are accounted for in the uncertainty factors for determining the reference dose (and reference concentration) and in the use of a UCL95 on the slope of the carcinogenic potency factor. The result is expected to be conservative by up to an order of magnitude (USEPA, 1989a, p. 7-5, col. 2, paragraph 4). This is intended so that sensitive subgroups such as the old, the infirm, and the young are protected along with average human receptors.

Toxicity factors based on inhalation unit risks or reference concentrations are converted to slope factors and reference doses using the body weight and breathing rate for an adult, even if the toxicity factors are used to evaluate a child. This step to standardize toxicity factors is also a conservative step for screening and favors false positive over false negative in screening results.

5.6.3 Exposure Assessment

Burmaster and Harris (1993) have identified that the multiplication of the default exposure parameters in the intake equation, with inherent error and variance, yields an exposure intake that lies above the 99th percentile of the distribution of exposure intake that would be obtained from Monte Carlo modeling. Further, the default exposure factors in the equations of the PEA manual (DTSC, 1999b) and *PEAspread* have 90th or 95th percentile-value factors in the equation numerator and average values in the denominator, also biasing the calculated dose and risk/hazard to higher results. The conservativeness of the exposure assessment is thereby assured. As estimated in *Risk Assessment Guidance for Superfund* (RAGS) (USEPA, 1989a), the over-estimation may be one to two orders of magnitude.

5.6.4 Risk Characterization

The calculation of ILCR yields risks that cannot be verified by epidemiology (Milloy, 1995). In fact, Seiler and Alvarez (1994) have demonstrated on theoretical grounds that the standard error in the terms of the equation for risk is on the order of 1E-2 to 1E-3 ILCR. This indicates that the minimum significant risk (ILCR) is 1E-2 to 1E-3, and certainly is not on the order of 1E-6 ILCR. The risk assessment paradigm (NRC, 1983, 1994) addresses this uncertainty by invoking a linear extrapolation from the lowest observed data point in clinical animal testing to the convergence point of zero dose-zero risk, thereby estimating by the slope of the line the relationship of dose to risks that are lower than about 1E-3 ILCR. The remaining uncertainty in the cancer slope factor and thereby the risk is commonly accepted as over-estimation by as much as an order of magnitude. This establishes by policy (rule), the calculation methodology for regulatory compliance on a risk basis.

The summing of chemical-specific HQs carries the assumption that the impact on a human receptor is represented by the addition of the individual impacts of the specific chemical on the respective target organ for the critical effect. It has been pointed out that this is conservative because there are conditions under which summing HQs is not valid or is not warranted (USEPA, 1993a). The summing of carcinogenic risk (ILCRs) is also conservative. While chemical-specific impacts of carcinogens are assumed to attack specific target organs and then the entire system, there is little supporting evidence that summing ILCRs is representative of the effects, especially considering the unverified nature of the risks calculated.

With the inherent over-estimation built into both the toxicity assessment and the exposure assessment, the characterization of risk/hazard is expected to over-estimate the true incremental risk/hazard above background which may, in fact, be zero (USEPA, 1989a, chapter 8).

All of the conservative approaches to the uncertainties described in this section ensure that the calculation of risk/hazard and thereby the decision making based on it are conservative. With this basis, the method protects against false negative results and provides a margin of safety in the decisions made.

5.7 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are based on the results of PEA screening and the *LeadSpread* model.

5.7.1 Conclusions

The HHRA has been completed using the PEA methodology and algorithms. The screening was conducted in a conservative fashion to favor false-positive over false-negative results.

The results indicate that the park hiker receptor has cumulative risk of 9E-8 ILCR and hazard of 0.2 HI. Arsenic was considered but was not included as a COPC, because its concentrations were within the regional background range. The ILCR is less than 1E-6, the *de minimis* risk (USEPA, 1990). The HI is less than 1 which is acceptable exposure.

The park employee receptor has a cumulative risk of 6E-7 ILCR and hazard of 0.6 HI. The HI is below 1 (USEPA, 1990) , indicating acceptable non-cancer exposure.

Lead in soil/dust is less than a site-specific screening concentration for modeled concentrations in the blood of children, and is also protective for a park employee and an adult hiker.

5.7.2 Recommendation

Both the park hiker receptor and the park employee receptor have risk less than 1E-6 ILCR and health hazard less than 1. There is no further concern for human health risk/hazard at the Mather WAA at this time.

6.0 SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

A Screening Level Ecological Risk Assessment (SLERA) was performed to provide an estimate of current and future ecological risk associated with potential hazardous substance releases at Mather WAA. The results of the SLERA contribute to the overall characterization of the site and the scientific/management decision point reached from the SLERA includes one of the following:

- There is adequate information to conclude that ecological risks are negligible and therefore there is no need for further action at the site on the basis of ecological risk;
- The information is not adequate to make a decision at this point and further refinement of data is needed to augment the ecological risk screening; and
- The information collected and presented indicates that a more thorough assessment is warranted.

The SLERA was performed following the RAWP (Shaw, 2009). In addition, *Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities* (DTSC, 1996) was also used, as well as *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (USEPA, 1997).

A tiered-analysis approach is presented in DTSC (DTSC, 1996). This approach may encompass up to three tiers of evaluation. Analysis and risk characterization results from each tier may be used as the basis for scientific/management decisions for No Further Action, immediate corrective measures, and/or to determine the need for implementation of more detailed evaluations of ecological risk (i.e., the next tier).

Currently, only the first tier of ecological risk evaluation was performed for the Mather WAA. Tier 1 is equivalent to the Phase I Predictive Assessment (DTSC, 1996). The results of Tier 1 assessments are HQs, also referred to in this SLERA as ecological effect quotients (EEQs), and cumulative HIs, which are used to evaluate potential site-related risks to receptor populations and, if necessary, to be incorporated into additional levels of ecological risk assessment (ERA) evaluation. If the risk characterization results of Tier 1 are believed to be incomplete or insufficient to make risk management decisions for the Mather WAA, a Tier 2 or Tier 3 evaluation may be completed. A Tier 2 evaluation would be equivalent to a Phase II Validation Study, and a Tier 3 evaluation would be equivalent to a Phase III Impact Assessment, as discussed in DTSC (1996).

The primary objective of the SLERA is to assess whether there is enough information to state that there is the potential for unacceptable risks to ecological receptors as a result of potential hazardous substance releases. Characterizing the ecological communities in the vicinity of Mather WAA, assessing the particular hazardous substances being released, identifying pathways for receptor exposure, and estimating the magnitude and likelihood of potential risk to identified receptors meets this objective. The SLERA addresses the potential for adverse effects to vegetation, the soil invertebrate community, wildlife, endangered and threatened species, and wetlands or other sensitive habitats that may be associated with Mather WAA.

Concentrations of chemicals were measured in soil, which was the only relevant environmental media at Mather WAA. Surface water was not present and groundwater does not discharge to the surface in the immediate vicinity of Mather WAA, so there is no potential exposure for ecological receptors to surface water, sediment, or groundwater at this site. Using available concentration data, a SLERA was performed by following DTSC (DTSC, 1996) and Steps 1, 2, and 3a of USEPA (USEPA, 1997). Step 1 includes a screening-level problem formulation and ecological effects evaluation, and Step 2 includes a screening level preliminary exposure estimate and risk calculation. The addition of Step 3a focuses the outcome of the SLERA, streamlines the review process, and allows one assessment to function as the initial forum for ecological risk management decision making at the site.

The SLERA is organized as follows: Site Characterization (Section 6.1); Identification of constituents of potential ecological concern (COPECs) and Concentration Statistics (Section 6.2); Sources, Release Mechanisms, and Affected Media (Section 6.3); Selection of Assessment and Measurement Endpoints (Section 6.4); Exposure Estimation (Section 6.5); Ecological Effects Characterization (Section 6.6); Risk Characterization (Section 6.7); Uncertainty Analysis (Section 6.8); and, SLERA Results and Conclusions (Section 6.9).

6.1 SITE CHARACTERIZATION

The Mather WAA site characterization section includes a general discussion of Yosemite National Park vegetative communities, a species inventory, and a discussion on threatened and endangered species.

The Park has an elevation range from 2,000 to 13,123 feet above sea level and contains five major vegetation zones: chaparral/oak woodland, lower montane, upper montane, subalpine and alpine (Yosemite National Park, 2004) . The Mather WAA is located within the lower montaine ecological community, as shown in Table 6-1. Mather WAA is approximately 0.2 acres in size.

Yosemite National Park is located within the Sierra Nevada Ecoregion. The Park embraces almost 1,200 square miles (mi$^{2)}$ of scenic wild lands set aside in 1890 to preserve a portion of the central Sierra Nevada that stretches along California's eastern flank. Yosemite is one of the largest and least-fragmented habitat blocks in the Sierra Nevada, and it supports a diversity of plants and wildlife. In Yosemite Valley, heavier precipitation occurs primarily November through March, and the average precipitation is 37.3 inches per year. Average high temperatures range from 90^{o} F in July and August to 48^{o} F in December, and average low temperatures range from 54^{o} F in July to 26^{o} F in December and January (Yosemite National Park, 2006).

6.1.1 Surface Water

There is no surface water or aquatic habitat at the WAA.

6.1.2 Wetlands

There are no wetlands at the WAA.

6.1.3 Vegetative Communities

Vegetation ranges from valley grasslands and woodlands through chaparral-covered slopes to montane coniferous forests and alpine meadows. Of California’s 7,000 plant species, about 50% occur in the Sierra Nevada and more than 20% are found within Yosemite. Suitable habitat is present for more than the 160 documented rare plants in the Park (Yosemite National Park, 2004).

6.1.4 Species Inventory

The five major vegetation zones at Yosemite provide habitat for a variety of wildlife species. Yosemite has more than 300 species of vertebrate animals, and 85 of these are native mammals. Ungulates include large numbers of mule deer. Bighorn sheep formerly populated the Sierra Crest, but have been reduced to several remnant populations. There are 17 species of bats, nine of which are either Federal or California

Species of Special Concern. Over 150 species of birds regularly occur in the Park, including Great Gray Owls (Yosemite National Park, 2004).

6.1.5 Threatened, Rare and Endangered Species Information

Fifty state and federally threatened, endangered and sensitive animal and plant species are found in Yosemite. Some of the Park's threatened, endangered and sensitive animal species include the Yosemite toad, mastiff and spotted bats, the Sierra Nevada red fox, the spotted owl, the California wolverine, the northern goshawk, the willow flycatcher and Bohart's blue butterfly (American Park Network, 2006). However, none of these species are expected at the Mather WAA.

6.2 IDENTIFICATION OF COPECS AND CONCENTRATION STATISTICS

A list of samples used in the SLERA is presented in Table 6-2. COPECs are selected in Table 6-3, and the COPEC selection process is described in more detail in the following subsections. These soil samples were collected from depth ranges of 1.0 to 1.5 ft bgs, 1.5 to 2.0 ft bgs, and specific depths of 0.5, 1.0, 1.5, and 2.0 ft bgs. Up-gradient and background soil samples collected at Mather WAA were not used in the SLERA. However, background samples were used in the background evaluation (Section 4.0), and those inorganic COPECs found to be related to background were not carried forward into the SLERA, per DTSC (1997a) guidance.

6.2.1 Data Organization

Soil measurements are the only data available for Mather WAA that are relevant to ecological exposures. To assess potential ecological impacts, soils from 0 to 2.0 ft bgs have been considered. This approach is consistent with the Work Plan, in which the ecological soil interval is 0 to 2 feet bgs. This depth interval was approved by DTSC (Eichelberger, 2005). A depth interval of 0 to 2 feet bgs is considered appropriate for evaluation of soil COPEC exposures for surface foraging and shallow-burrowing wildlife, as well as for many forage plants (i.e., grasses and forbs) and invertebrates expected at the WAAs. In addition, COPEC concentrations are expected to be elevated in this soil interval, therefore, the selection of 0 to 2 feet bgs is also consistent with DTSC‘s EcoNote No. 1 (DTSC, 1998). It should be noted that additional subsurface soil samples were collected from (2.5 to 6.5 feet bgs) and these results are discussed in Section 6.8.7.

Chemicals that were not detected at least once in soil have not been included in the quantitative risk assessment, however, non-detect results are presented for informational purposes.

The analytical data may have qualifiers from the analytical laboratory quality control or from the data validation process that reflect the level of confidence in the data.

6.2.2 Descriptive Statistics Calculations

Because of the uncertainty associated with characterizing contamination in environmental media, the 95% upper confidence limit (UCL) of the mean has been estimated for chemicals selected as COPECs. The exposure point concentration (EPC) for a soil COPEC is the 95% UCL on the mean or the maximum detection concentration, whichever is lower. For example, if the 95% UCL is calculated to exceed the maximum detected concentration, the maximum detected concentration is used as the EPC. The 95% UCLs was estimated using USEPA’s ProUCL statistical software (USEPA, 2007). One of the strengths of ProUCL is its rigorous parametric and nonparametric statistical methods that can be based on full data sets without nondetects and on data sets with below detection limit or nondetect observations.

Because ProUCL does not address data sets with less than three detected results, for those constituents with one or two detections, Shaw Environmental, Inc. used its proprietary Risk2000 software. Within this software is a Bootstrap procedure, in which repeated samples of size n are drawn with replacement from a given set of observations. The procedure is repeated a large number of times (2,000 times for the current application, to match the sampling procedure used by ProUCL), and each time an estimate of the mean is computed. The Bootstrap t approach by Efron, 1982, was used in the current assessment, and is discussed in EPA, 1997. The Bootstrap t method is a nonparametric method recommended by EPA for censored data and was used to calculate 95% UCLs for the COPEC data sets with one or two detections. These Bootstrap 95% UCLs were calculated for these COPECs as follows (Efron and Tibshirani, 1993):

1. The data set was randomly resampled with replacement;
2. The arithmetic mean of the resampled data set was estimated;
3. Steps 1 and 2 were performed 2,000 times and created a new data set of 2,000 resampled means; and
4. The 95th percentile of the resampled mean data set created during Step 3 was selected. Per Efron and Tibshirani, 1993, the 95th percentile of the resampled mean data set is a good approximation of the 95 percent UCL on the mean of the original data set.

Per a request from DTSC, backup information on Shaw's Risk2000 program was provided to Dr. Eichelberger, including detailed calculation modules in tabular format, as well as computer code. Due to the uncertainty of using estimated 95% UCLs based on Shaw's Risk2000 software, for those chemicals with less than three detected results, DTSC requested that potential hazards using the maximum detected concentration also be evaluated in the Uncertainty Analysis (Section 6.8.8).

6.2.3 Frequency of Detection

Chemicals that are detected infrequently, such as less than five percent, may be artifacts in the data that may not reflect site-related activity or disposal practices. These chemicals, however, have been included in the risk evaluation and a low frequency of detection was not used to deselect COPECs, as less than 20 soil samples were collected.

6.2.4 Natural Site Constituents (Essential Nutrients)

The essential nutrients calcium, magnesium, potassium, and sodium were not assessed in the SLERA, as they are not considered to be toxic.

6.2.5 Selection of COPECs

COPECs were selected as shown in Table 6-3. In general, COPECs were selected for quantitative assessment in the SLERA if they were detected and not found to be related to background concentrations.

Dioxin-like compounds were treated according to procedures provided by USEPA and the World Health Organization (WHO) (Van den Berg et al., 2006; USEPA, 1989b; USEPA, 1994; WHO, 1998). Dioxin-like compounds (pentachlorodibenzodioxins[PCDDs] and pentachlorodibenzofurans [PCDFs]) are present in the environmental media as complex mixtures. PCDDs and PCDFs consist of a family of approximately 75 and 135 congeners, respectively. To simplify the task of screening PCDDs/PCDFs for evaluation in this risk assessment, these compounds were evaluated with respect to a single member of this class of compounds. The concentration of each congener was evaluated on the basis of its concentration relative to that of 2,3,7,8-TCDD, which has been shown to be the most potent congener of the class of PCDDs/PCDFs. For this SLERA the toxicity equivalent factors (TEFs) for mammals, as applied by the analytical laboratory, were used as a simplifying approach (WHO, 1998). However, as more recent TEFs exist, this slightly underestimated the TEFs. This is discussed in more detail in the uncertainty analysis section (Section 6.8.2).

It should be noted that the USEPA recommends that aluminum and iron should only be identified as COPECs for those sites with soil with a pH less than 5.5 (for aluminum) and a pH less than 5.0 (for iron) (USEPA, 2009b). The technical basis for this rationale is that soluble and toxic forms of aluminum and iron are present in soil with soil pH values of less than 5.5 and 5.0, respectively. Mather WAA surface soil samples were analyzed for pH in sample (YWM08-2282 with a pH of 5.72). However, aluminum was found to be background-related, and was dropped for further consideration. As discussed in Section 6.5, all COPECs are conservatively assumed to be 100% bioavailable.

6.2.6 Summary of COPEC Selection

Table 6-3 has been prepared for constituents in soil with the following information:

- CAS number;
- Chemical name;
- Range of detected concentrations, and associated qualifiers;
- Concentration units;
- Location of maximum detected concentration;
- Frequency of detection;
- Range of detection limits;
- COPEC selection conclusion: YES or NO; and
- Rationale for selection or rejection of the COPEC.

Footnotes in the tables provide the rationale for selecting or rejecting a chemical as a COPEC.

Thirty-six COPECs have been selected for soil (Table 6-3).

Exposure point concentrations based on the statistical procedures discussed in Section 6.2.2 are presented in Table 6-4. Arithmetic mean concentrations are presented for informational purposes.

6.3 SOURCES, RELEASE MECHANISMS, AND AFFECTED MEDIA

Sources of potential environmental contamination at the WAA are generally related to waste disposal activities and associated burning over the years. Media affected by constituent releases from these activities could include soils, surface water, sediment, groundwater, air, and/or biota.

Due to the fact that (1) the primary source of contaminants at Mather WAA is related to waste disposal activities and associated burning; and (2) it has been decades since such disposal and/or burning occurred, VOCs are only a minor concern at the WAA. At Mather WAA, only two VOCs were detected (acetone and methylene chloride), and the detections of these VOCs were well below their respective residential and industrial soil RSLs. Therefore, the inhalation pathway is not a concern, as exposure to VOC vapors is deemed to be toxicologically insignificant. In addition, as both of these chemicals are known laboratory contaminants and given their high volatility and the number of years (ca 70) since the dump was used, it is very likely that laboratory contamination is a source for the three detections of acetone and the one detection of methylene chloride. However, as a conservative approach, both of these VOCs were carried forward to the SLERA.

Direct groundwater pathways are incomplete for terrestrial wildlife receptors. Air exposure routes (i.e., inhalation of volatiles as discussed above or particulates), as well as dermal exposures, will be evaluated qualitatively.

At Mather WAA, only soil and biota are considered to be relevant for this SLERA. The Phase I Predictive Assessment (this SLERA) thus quantitatively assesses representative receptor exposures to contaminated soil and biota.

6.4 SELECTION OF ASSESSMENT AND MEASUREMENT ENDPOINTS

The RAGS document (USEPA, 1997) states: “For the screening-level ecological risk assessment, assessment endpoints are any adverse effects on ecological receptors, where receptors are plant and animal populations and communities, habitats, and sensitive environments. Adverse effects on populations can be inferred from measures related to impaired reproduction, growth, and survival. Adverse effects on communities can be inferred from changes in community structure or function. Adverse effects on habitats can be inferred from changes in composition and characteristics that reduce the habitats' ability to support plant and animal populations and communities.”

Thus, ecological risks are expressed in terms of a definite endpoint, which is defined as an environmental value to be protected. Assessment endpoints are "explicit expressions of the actual environmental value that is to be protected" (USEPA, 1998b). The assessment endpoints provide a transition between broad management or policy goals and the specific endpoints used in the assessment. In this SLERA, the general assessment endpoint is the potential reduction in the receptor species due to exposure to WAA-related chemicals in affected media. This general assessment endpoint applies to all levels of the ERA hierarchy. The assessment endpoints are addressed through the survival, growth, and reproduction of receptor populations at each Yosemite WAA. The assessment endpoints are evaluated using measures of effect (i.e., measurement endpoints) (Section 6.6) intended to reflect constituent concentrations in environmental media that do not threaten the survival, growth, and reproduction of receptor populations at the WAAs.

The specific assessment endpoints for Mather WAA are stated as the protection of long-term survival and reproductive capabilities for populations of herbivorous, insectivorous, and carnivorous mammals, and omnivorous and carnivorous birds. The corresponding null hypothesis (H_o) for each of the assessment endpoints is stated as: the presence of site contaminants within soil, vegetation, and prey will have no adverse effect on the survival, growth, or reproductive capabilities of populations of herbivorous, insectivorous, and carnivorous mammals, and omnivorous and carnivorous birds. In addition, assessment endpoints for the base of the food chain are stated as the protection of long-term survival and reproduction of terrestrial plants and soil invertebrates.

Measurement endpoints are frequently numerical expressions of observations (e.g., toxicity test results or community diversity indices) that can be compared statistically to detect adverse responses to a site contaminant (USEPA, 1997). In this SLERA, measurement endpoints include estimates of mortality, reproduction, and/or growth via the calculation of hazard quotients (also referred to as ecological effects quotients) by dividing estimated wildlife COPEC intakes by COPEC toxicity reference values.

The ecological assessment endpoints and measurement endpoints are summarized in Table 6-5.

As several of the selected receptor species (Section 6.4.1.2) feed on terrestrial invertebrates, a reduction in the abundance of these invertebrates could result in an adverse impact due to food shortages. Therefore, the direct contact toxicity of COPECs to soil invertebrates was selected as a measurement endpoint for protection of long-term survival and reproductive capabilities for populations of insectivorous mammals and omnivorous birds.

A food web CSEM was developed to illustrate how the selected terrestrial species are ecologically linked. For terrestrial invertebrates, small prey items and plants, partitioning coefficients and simple empirical uptake models were employed to estimate COPEC concentrations within tissues (Section 6.5). These tissue concentrations were then used as input values for exposure to higher trophic level receptors through the dietary route of exposure.

6.4.1 Selection of Receptor Species

Representative receptor species were identified for each of the assessment endpoints as shown in Table 6-5. These receptors are non-domesticated wildlife species that may reasonably be expected to reside or regularly forage at Mather WAA, given current and anticipated future site conditions. Based on current and expected future land uses at Yosemite, ecological receptors are those terrestrial animals that would inhabit Yosemite habitats.

6.4.1.1 Vegetation and Invertebrates

Vegetation at Yosemite consists of a variety of vegetative communities (Section 6.1.3). Based on the assumed absence of any special-status plant species at Mather WAA (Section 6.1.5), plants are generally evaluated as an exposure medium (i.e., a food source) for wildlife receptors. Because there is limited phytotoxicity information in the available technical literature for many chemicals, quantitatively assessing risk to plants from constituent concentrations has high uncertainty. However, when appropriate toxicity data are available, soil COPECs are screened against these benchmarks to assess risks to plants. However, some plants can accumulate high quantities of constituents in their tissues, without harm to the plant. The uncertainties associated with the lack of available toxicity data for the direct assessment of plants is discussed in Section 6.8. Mather WAA has been significantly disturbed, which has caused more physical stress to plants than chemical stress. Because herbivores are evaluated directly, it can be inferred that the success of these receptors reflects the overall health of the plant communities that support them. Similarly, soil invertebrates (i.e., insects) are evaluated as potential indirect exposure media for higher-trophic level consumers. Therefore, no primary producer or detritivore receptor species are identified; rather, the plant assemblages representing the dominant cover types present at Mather WAA and a general terrestrial invertebrate group is evaluated as biotransfer media, assuming that all plants and soil invertebrates have the capacity to take up constituents from soils. Such plants and invertebrates then may serve as food for other animals.

As shown in Table 6-5, the terrestrial plant and invertebrate communities are selected as Measurement Receptors, and potential impacts to upper trophic level receptors (such as birds and/or mammals) are assessed via the potential reduction in this base of the food chain resource (i.e., loss of food source for higher feeding guilds).

6.4.1.2 Terrestrial Wildlife

At minimally developed WAAs including Mather, terrestrial fauna could include invertebrates (i.e., insects), reptiles, birds, small mammals (i.e., rodents), and larger carnivorous, omnivorous, and/or browsing mammals (i.e., mule deer). The representative receptor species selected for evaluation in the SLERAs either have been observed at, or are likely to be present in the vicinity of WAAs with appropriate habitat conditions. Guidelines considered in selecting receptors from the potentially exposed community included the following:

- Representativeness of assessment endpoints;
- Limited home range relative to the Site or area of interest;
- Role in local food chains;
- Potential high abundance and wide distribution at the WAAs;
- Sufficient toxicological information available in the literature for comparative and interpretive purposes; and
- Sensitivity to COPECs.

Wildlife receptors were selected to represent the trophic levels and habitat characteristics of the areas being assessed. Based on available ecological information representative species were selected for use as assessment endpoints in the SLERA representative of terrestrial ecological receptors potentially exposed to constituents in soil and/or biota.

The selected terrestrial wildlife species are intended to represent the dominant terrestrial trophic levels related to the vegetative communities present at evaluated WAAs (Eichelberger, 2005, 2008). A general terrestrial food web model has been developed (Figure 6-1) to illustrate these trophic levels. While the ecological communities at the individual WAAs may have multiple species with desirable characteristics for use as receptor species, most of these species have not been used for toxicological testing. The overall representativeness (i.e., protectiveness) of the selected representative receptors presents a source of uncertainty in the risk assessment. This uncertainty is discussed in the uncertainty section (Section 6.8).

The representative terrestrial wildlife species identified for the Yosemite WAAs are the dusky shrew, the marmot, the long-tailed weasel, the montane vole, and the American robin, based on Yosemite National Park wildlife species information provided by Thompson (2002) and discussions with Eichelberger (2005, 2008). The representative receptor species are shown within the food web model in Figure 6-1. The selected species are considered to be representative of current and future ecological receptors at Mather WAA, and have been documented to occur at Yosemite. In addition, when coupled with plants and invertebrates as biotransfer media, the species selected represent important food chains, as demonstrated in Figure 6-1.

A lack of toxicity data precludes adequate quantitative evaluation of risks to lizards and snakes; therefore they are not included as receptors for quantitative evaluation in the SLERAs. The uncertainties associated with eliminating ecological receptors from quantitative evaluation due to a lack of toxicity (or other) data is discussed in the uncertainty section (Section 6.8). It is assumed that if neither bird nor mammal hazards are elevated (above 1.0), then reptile hazards would also not be expected to be elevated. However, if bird and/or mammal hazards are elevated, then reptiles will be qualitatively assumed to be potentially at risk. However, in this case, it is understood that Health and Ecological Risk Division (HERD) would not expect any specific field studies or action to address potential reptile hazards (Eichelberger, 2008).

Habitat, dietary requirements, behavioral traits, and other data are summarized below for the selected terrestrial wildlife receptors. This information is used to develop wildlife exposures (Section 6.5).

Dusky Shrew

The dusky shrew (*Sorex monticolus*) is found in the high Sierra Nevada and in isolated populations in mountains of San Bernardino and Los Angeles counties. The shrew is common in montane riparian and alpine dwarf-shrub habitats; fairly common in subalpine conifer, wet meadow, and high-elevation fresh emergent wetland habitats; uncommon in ponderosa pine, mixed conifer, red fir, Jeffrey pine, lodgepole pine, annual grass, and perennial grassland habitats (George, 1999). Also found in similar habitats in Oregon and Washington (Ingles, 1965), Canada (Wrigley et al., 1979), Alaska, and in western hemlock in Washington (Terry, 1981). Preferred foods include adult, pupal, and larval insects, arachnids, snails, and earthworms (Whitaker and Maser, 1976). The shrew uses logs extensively for feeding (Thomas, 1979). The shrew will eat five or six termites and incapacitate 50 to 60 for future use. Ingles, 1965, suggested they may have poison in their saliva. The shrew captures prey on the ground. It forages among debris on the forest floor (Terry, 1981). Winter feeding is undocumented. Some plant matter is also eaten (Ingles, 1965). The shrew requires moist soil for cover, and tall sedges, stumps, logs, or litter also provide cover (Ingles, 1965). The shrew is restricted to a layer of debris on the forest floor (Terry, 1981). Decaying logs are often used (Thomas, 1979). The shrew uses burrows frequently for reproduction (Thomas, 1979). The shrew breeds February through October, with a peak in late spring-early summer, and nests in logs, stumps, litter, or in holes in the ground (Ingles, 1965). The shrew is rarely found more than a few meters from water in the summer (Ingles, 1965). The shrew uses riparian and wet meadow habitats within Jeffrey pine, red fir, and lodgepole pine forests are preferred. The shrew is active year long; and does not hibernate. There is a rhythmic activity behavior pattern with three peak periods of activity: morning, sunset, and during the coldest hours of early morning (Ingles, 1960, 1965). The shrew is least active on warm summer afternoons. The shrew is active in winter under the snow. Activity patterns are basically circadian (Ingles, 1965) Thomas, 1979, indicated that suitable habitat (home range) of at least 2 hectare (ha) (5 ac) is required to support a population of shrews. Size of home range averages 0.04 ha (0.1 ac) (Hawes, 1977) but varies greatly. Diameter may vary from 12-75 m (40-250 ft) (Ingles,1965). The shrews are notoriously solitary, but home ranges may overlap. At Huntington Lake, California, 11 shrews had home ranges on 0.3 ha (0.7 ac) one summer (Ingles 1965, Hawes, 1977). Young individuals are somewhat territorial, not only with conspecifics, but also with other members of the genus (George, 1999). Predators of shrews in general include owls, Steller's jays, and trout (Ingles, 1965). The dusky shrew is also commonly known as the montane shrew (George,1999). (Information extracted from the California Department of Fish and Game [CDFG], 2008).

Marmot

The yellow-bellied Marmot (*Marmota flaviventris*) is common and widespread in rocky areas of Sierra Nevada. Optimum habitats are alpine dwarf-shrub, perennial grassland, wet meadow, subalpine conifer, and open stands of lodgepole pine forest. This herbivore generally forages on the ground and feeds on seeds, flowers, leaves, and stems of a wide variety of grasses, forbs, and shrubs. This species digs a burrow system as a refuge and hibernaculum. The burrow usually is under rocks, but also may be under tree roots or buildings. This species prefers rocky outcrops and talus slopes with nearby grasses and forbs and requires a nearby water source. This species is diurnal and hibernates from September or October to April or May (CDFG, 2008). Home ranges in Colorado varied from 2.2-10 hectares (ha) (4.9-24.7 acres) (Armitage, 1974). Single litters usually produce 4-6 young, but can range from 3-8 young. At high elevations females may reproduce in alternate years. This species is preyed upon by badgers, coyotes, eagles, owls, and wolverines (CDFG, 2008). Body weight ranges from 1.5 to 3.7 kilograms (kg) (Verts and Carraway, 1998 in Nagorsen, 2002), and a weight of 3.19 kg was used in the WAA SLERAs, from Nagy (2001).

Long-Tailed Weasel

The long-tailed weasel (*Mustela frenata*) is a common to uncommon, permanent resident of most habitats, except xeric brush, shrub, and scrub in the Mojave and Colorado deserts (Grinnell et al., 1937). It mostly uses intermediate cover stages of conifer and deciduous habitats, interspersed with lower seral stages and open forest, woodland areas and shrubs, from sea level to alpine meadows. Long-tailed weasels are carnivorous. They eat small mammals, such as mice, gophers, chipmunks, ground squirrels, and rabbits. They also take birds, some insects, salamanders, and small amounts of fruit. Foraging occurs on ground, among rocks, in snags, stumps, logs, wood piles, in brush, and occasionally in trees. They search along runways and in burrows of prey, and hunt day and night, searching, pursuing, and then killing by biting prey at the base of the skull. Small cavities in the ground, rock areas, logs, snags, stumps, and burrows of prey and other mammals are used for cover. Nests are often located in burrows of chipmunks, ground squirrels, gophers, moles, or mountain beavers. They also nest in cavities in trees, snags, logs, and under rocks or human structures. Long-tailed weasels probably require drinking water, but little information is available on water needs (Hall, 1951). Long-tailed weasels use a mixture of intermediate cover stages of conifer and deciduous habitats for breeding, and lower successional stages and open forest, woodland, and shrub habitats for feeding. The weasel is active year long; nocturnal and diurnal, and is non-migratory. Little information is available on home range; males probably have larger home ranges than females. Quick, 1951, and Burt and Grossenheider, 1980, suggested home ranges of 10-20 ha (25-50 ac). In good habitat, the average density may be 1 weasel/square kilometer (km^2) (2.6/square mile [mi^2]), with a maximum of about 7/km^2 (18/mi^2). In eastern Oregon, the suggested minimum area required by a pair of long-tailed weasels is approximately 259 ha (640 ac). The weasel may be territorial, and mates in July or August. Long-tailed weasel populations respond to small mammal population numbers.

They are major predators of voles and mice, and they, themselves are preyed upon occasionally by minks, martens, fishers, bobcats, coyotes, red foxes, and gray foxes. Hensley and Fisher, 1975, found major increases in long-tailed weasel numbers when gray foxes were controlled intensively, and Powell, 1973, suggested that raptors sometimes control weasel numbers. The weasels are tolerant of most human activities. (Information extracted from the CDFG, 2008).

California Vole

The California vole (*Microtus californicus*) occurs from the Sierra Nevada and Cascades west to the Pacific Coast, and from Trinity, Mendocino, and Shasta Counties south to San Diego County. It is absent from northern Humboldt and Del Norte Counties., and from the southern deserts. The vole occurs in the Owens Valley and in disjunct populations in Inyo, Siskiyou, and Humboldt Counties. It occurs in a wide variety of habitats, but is most abundant in early seral stages of montane riparian, dense annual grassland, and wet meadow. The vole feeds mainly on leafy parts of grasses, sedges, and herbs. It forages on the ground, clipping grasses and forbs at the bases, forming a network of runways leading from the burrow (Gill, 1977). The vole seeks cover in dense grass, beneath plant residues, in brush piles, beneath logs, and in underground burrows. Burrows are constructed in soft soil. A nest of dried grass is built in a shallow underground burrow for reproduction. The vole drinks water in captivity, but under natural conditions water can be obtained from succulent vegetation. The vole is active year round, with circadian activity. Mean home range size in Monterey County was 0.15 ha (0.37 ac), varying from 0.1 to 1.0 ha (0.25 to 2.5 ac) (Fisler, 1962). In Contra Costa County, most activity was within a 5 m (16 ft) radius, varying up to 15 m (49 ft), or more (Pearson, 1960). Brant, 1962, found movements of up to 34 m (110 ft) between recaptures. Territorial behavior is weak; the size of area defended is unknown. The vole breeds throughout the year, reaching peaks whenever food and cover are abundant. The California vole is a widespread and common herbivore in California. Its abundance and widespread distribution, along with daylong activity, make it an important prey. Predators include nocturnal and diurnal birds of prey, predatory mammals, and snakes. (Information extracted from the CDFG, 2008).

American Robin

The American robin (*Turdus migratorius*) is an omnivore that feeds on both plants (primarily fruit) and terrestrial invertebrates including earthworms. The robin occurs throughout most of the continental United States and Canada during the breeding season and winters in the southern half of the United States and Mexico and Central America. They live in a variety of habitats, including woodlands, wetlands, suburbs and parks. Robins are likely to forage throughout Yosemite and are present year-round. Most robins build nests of mud and vegetation on the ground or in the crotches of trees or shrubs. Robins forage primarily on the ground and in low vegetation by probing and gleaning. They are approximately 25 centimeters in size, have a body weight range of 63 to 103 grams, and an average home range of 1.2 acres (USEPA, 1993b). DTSC's Guidance for Ecological Risk Assessments EcoNotes (DTSC, 2009) presents individual body weights for this species documented in California, with body weights ranging from 45 to 110 grams and an average of 88 grams (n = 99). An average body weight of 88 grams will be used in the WAA SLERAs. The average longevity of a robin that survives to its first January is from 1.3 to 1.4 years (USEPA, 1993b).

6.5 EXPOSURE ESTIMATION

This section includes a discussion of how COPEC exposures were quantified, including intake (Section 6.5.1) and bioaccumulation (Section 6.5.2).

An estimate of the nature, extent, and magnitude of potential exposure of assessment receptors to COPECs that are present at or migrating from the site was developed, considering both current and reasonably plausible future use scenarios

Ecological routes of exposure for biota may be direct (bioconcentration) or through the food web via the consumption of contaminated organisms (bioaccumulation). Food web exposure can occur when terrestrial or aquatic fauna consume contaminated biota. Direct exposure routes include dermal contact, absorption, inhalation, and ingestion. Examples of direct exposure include animals incidentally ingesting contaminated soil or sediment; animals ingesting surface water; plants absorbing contaminants by uptake from contaminated soil or sediment; and the dermal contact of aquatic organisms with contaminated surface water or sediment. In addition, as discussed in Section 6.3, dermal contact and inhalation exposures are considered insignificant compared to other quantified routes of exposure.

Bioavailability of a chemical is an important contaminant characteristic that influences the degree of chemical-receptor interaction. As discussed in Section 6.2.5, the surface soil pH at Mather WAA was 5.72 (based on one sample, YWM08-2282). For purposes of the SLERAs, bioavailability is conservatively assumed to be 100 percent.

For terrestrial (and aquatic) faunal receptors, calculation of exposure rates relies upon determination of an organism's exposure to COPECs found in surface soil, surface water, or sediment, and on transfer factors used for food-chain exposure. Exposure rates for terrestrial wildlife receptors in the Mather WAA SLERA are based solely upon ingestion of contaminants from these media and from consumption of other organisms.

6.5.1 Intake

The first step in estimating exposure rates for terrestrial wildlife involves the calculation of food ingestion and drinking water intake rates for site receptors. USEPA, 1993b, includes a variety of exposure information for a number of avian and mammalian species. Information regarding feeding rates, watering rates and dietary composition are available for many species, or may be estimated using allometric equations (Nagy, 1987 for water intake, Nagy, 2001 for food intake). Data have also been gathered on incidental ingestion of soil, and are incorporated for the receptor species. This information is summarized in Table 6-6.

Average reported food and water ingestion rates and average reported adult body weights are used in exposure dose estimations for terrestrial wildlife. Dietary composition has been estimated using reported percentages of food types ingested for each receptor species, including an incidental soil ingestion estimate. The receptors are initially assigned a conservative fraction of home range (FHR) of 1.0 (also referred to as area use factor), however, an additional evaluation is performed using a site-specific FHR between 0 and 1, based upon the average range a species exhibits in gathering food relative to the exposure areas associated with the WAA. For receptors whose average home or foraging range is less than the size of the WAA, a FHR of 1 is assigned.

Terrestrial wildlife receptor exposures are estimated using the algorithm presented in DTSC, 1996, to calculate exposure for terrestrial vertebrates, as shown as follows.

$$DailyIntake = \frac{CM * CR * FI * AF}{BW}$$

where:

Daily intake	=	Intake in units of milligrams per kilogram (mg/kg) per day.
CM	=	Concentration of COPEC in media of concern (mg/kg).
CR	=	Contact rate (i.e., ingestion rate).
FI	=	Fractional intake or the fraction of time spent in contact with affected media. The FI term is equivalent to the FHR.
AF	=	Absorption factor (assumed to be 100% for each COPEC, unless information exists to suggest otherwise)
BW	=	Body weight of the animal (kg).

6.5.2 Bioaccumulation

Bioaccumulation is a chemical-specific property that is used in calculating wildlife exposure rates for COPECs. Bioaccumulation is the uptake and retention of a substance by an organism from all pathways including its food and its surrounding medium.

Not all toxic substances present in the environment occur in a bioavailable form. Chemical bioavailability of a constituent is one of the factors that determine a receptor's reaction to exposure to that constituent. Only chemicals present in a form that a receptor can assimilate (i.e., absorb) and react to are bioavailable. Bioavailability depends upon physical and chemical environmental factors (i.e., soil pH, moisture, and organic carbon), and is an important consideration when evaluating many chemicals. Therefore, exposure evaluations should account for this characteristic. Influencing factors that cannot be quantified easily are qualitatively considered in the risk characterization portion of the SLERA.

The exposure assessment accounts for accumulation of constituents through the trophic levels. For the selected indicator species, bioaccumulation is evaluated by means of constituent-specific soil-to-plant uptake factors (PUFs) and prey bioaccumulation factors (BAFs). PUFs and BAFs are selected from the technical literature or derived using appropriate uptake models.

Soil-to-plant bioaccumulation factors (BAF) values are based on information from USEPA (2007, 2009c), Efroymson (2001), Baes et al. (1984), International Atomic Energy Agency (1994), and Bechtel Jacobs (1998). Regression equations, if available, that produce a BAF value that scales in a non-linear fashion with soil COPEC concentration are used as a first choice to estimate the most accurate BAF. It should be noted that as the regression equation predicts COPEC concentrations in plants, the actual BAF value is estimated by dividing the estimated plant COPEC concentration by the soil COPEC concentration. If a regression equation is not available or not recommended for a particular COPEC, a USEPA-recommended value is used. For organic COPEC without available BAF values, the partition coefficient (K_{ow}) regression equation from USEPA (2007, 2009c) is used, as shown as follows:

$$Log\ BAF / BCF = -0.4057 \times Log\ K_{ow} + 1.781$$

where:

Log K_{ow} = log octanol-water partition coefficient

Soil-to-earthworm BAF values are based on information from Sample et al. (1998a), Sample et al. (1999), USEPA (2007, 2009c), and Beyer (1990). Earthworms are used as a surrogate species to represent terrestrial invertebrates including insects. BAF values are based on regression equations, if available, that produce a BAF value that scales in a non-linear fashion with soil COPEC concentrations. If a regression equation is not available or not recommended for a particular COPEC, a USEPA recommended value is used. It should be noted that as the regression equation predicts COPEC concentrations in earthworms, the actual BAF value is estimated by dividing the earthworm COPEC concentration by the soil COPEC concentration.

For the organic COPECs at the WAA, an equation from USEPA, 2007, is used to estimate the soil-to-earthworm BAF, if no other literature value is available, along with COPEC-specific Kow and fraction of \organic carbon information. The approach for estimating soil pore water to earthworm bioaccumulation for organic chemicals is based on laboratory and field studies (Jager, 1998). This approach uses the same method proposed by Connell and Markwell, 1990, for the soil solution-earthworm system which was used in the USEPA (2007, 2009c) guidance, but uses a more realistic earthworm lipid fraction of 4 to 6% (Jager, 1998).

The regression equation from Jager, 1998 is as follows:

$$Log\ BAF = 0.87 * log\ K_{ow} - 2.00\ (r^2 = 0.84, n = 69)$$

This relationship is then used in USEPA (2007, 2009c) as follows:

$$BAF = \frac{10^{(0.87 \log Kow - 2.00)}/0.16}{F_{oc} * K_{oc}}$$

where:

Log K_{ow} = log octanol-water partition coefficient
0.16 = Conversion from wet weight to dry weight assuming 16% solids (Jager, 1998)
F_{oc} = fraction of organic carbon
K_{oc} = soil organic carbon to water partitioning coefficient

Earthworms are used as a surrogate species to represent terrestrial invertebrates including insects. Values are based on Ecological Soil Screening Levels (EcoSSLs) uptake values or regression equations, if available. If a regression equation or recommended uptake value is not available for a particular COPEC, an alternative value is used. It should be noted that as the regression equation predicts COPEC concentrations in earthworms, the actual BAF value is estimated by dividing the earthworm COPEC concentration by the soil COPEC concentration.

Soil-to-small mammal and small bird BAF values are based on information from USEPA (2007, 2009c), Sample et al., 1998b, and Brandt (2002). Values are based on regression equations (USEPA, 2009b, 2009c, Brandt, 2002) or alternative BAF values if no regression equation is available. If no organic surrogate soil uptake value is available, a conservative default BAF of 0.5 is used for non-chlorinated pesticides, whereas for chlorinated pesticides, a default BAF of 1.0 is used.

As no soil-to-small bird BAF values are not readily available, soil-to-small mammal BAFs have been used as surrogate values. This is discussed further in Section 6.8.3.

Uptake factors are presented in Tables 6-7, 6-8, and 6-9, for soil to plant, soil to earthworm, and soil to small mammal and birds, respectively.

6.6 ECOLOGICAL EFFECTS CHARACTERIZATION

The effects assessment defines and evaluates the potential adverse (i.e., toxic) ecological effects of COPECs on selected assessment and measurement endpoints. The effects assessment includes the derivation of toxicity reference values (TRVs) that are the basis of the evaluation. The results of the effects assessment are used to identify ecological hazards and to characterize ecological risk.

Toxicity information pertinent to identified receptors was researched for those constituents identified as COPECs. Because the measures of effect range from No Observed Adverse Effect Levels (NOAELs) (or No Observed Effect Concentrations [NOECs]) to Lowest Observed Adverse Effect Levels (LOAELs) (or Lowest Observed Effect Concentrations [LOECs]), preference was given to chronic studies noting concentrations at which no adverse effects were observed and to those for which the lowest concentrations associated with adverse effects relevant to the assessment endpoints were observed. The preferred toxicological endpoints used are growth, reproduction, and survival. It is assumed that these endpoints are reflective of significant effects at either the population or individual organism level.

TRVs are receptor- and chemical-specific derivations of the prescribed measurement endpoints. The order of taxonomic preference when choosing TRVs is data from studies using 1) native species potentially present at the exposure area, or 2) proxy species, such as commonly studied laboratory species of the same family or order. The preferred toxicity test is the lowest appropriate chronic no observed adverse effect level (NOAEL) for growth, reproductive, or survival effects. When values are not available for these effects appropriate NOAEL TRVs may be derived from NOAELs for lethal effects or LOAELs for non-lethal or lethal toxic effects, as available. If NOAEL and lowest-observed-adverse-effect level (LOAEL) data are not available for a constituent, a median lethal dose (LD_{50}) in diet will be used to derive the toxicity reference value (TRV).

Uncertainty factors (UFs) from California EPA (DTSC, 1996) are used as follows:

TRV Adjustment	UF	Example
To adjust from less sensitive endpoint (*i.e.*, mortality) to chronic NOAEL	500	LD50 to NOAEL Chronic
To adjust from acute LOAEL to chronic NOAEL	10	LOAEL Acute to NOAEL Chronic
To adjust from observable effect (LOAEL) to NOAEL	5	LOAEL Chronic to NOAEL Chronic

For certain classes of chemicals, a toxicity value for one of the compounds may have been substituted for another compound through the use of a surrogate chemical approach.

TRV sources include the following, with DTSC TRVs and USEPA Region 9 TRVs considered to be the primary sources of choice:

- DTSC, 2000, Eco Note 4 and TRVs recommended by USEPA Region 9 Biological Technical Assistance Group (USEPA, 2002; USEPA, 2009b);
- NOAEL TRVs used for USEPA Ecological Soil Screening Levels (SSL) (USEPA, 2009c);
- LOAEL TRVs presented in USEPA Ecological Soil Screening Levels (USEPA, 2009c);

- Oak Ridge National Laboratory databases of screening benchmarks for ecological risk assessment (Sample et al., 1996);
- Los Alamos National Laboratory database (2005);
- U.S. Fish and Wildlife Service synoptic reviews of hazards to fish, wildlife, and invertebrates (Eisler, 1987); and
- USEPA's Integrated Risk Information System database (USEPA, 2009d).

The TRVs developed for the Mather WAA are presented in Tables 6-10 and 6-11.

To account for potential uncertainties in extrapolating TRVs between laboratory test species and wildlife receptors, UFs recommended by DTSC, 1996, have been used. The general approach for these UFs is summarized below, with details presented in Table 6-12.

- Extrapolation between the same family (F) or genus (G) = uncertainty factor of 1;
- Extrapolation between the same order (O) = uncertainty factor of 5; and
- Extrapolation between two different orders (O) = uncertainty factor of 10.

Only TRV extrapolations within the mammalian class and within the avian class have been performed, as interclass extrapolations between classes are too uncertain (Hull et al., 2007).

6.7 RISK CHARACTERIZATION

The risk characterization phase integrates information on exposure, exposure-effects relationships, and defined or presumed target populations. The result is a determination of the likelihood, severity, and characteristics of adverse effects to environmental stressors present at a site. Qualitative and semi quantitative approaches have been taken to estimate the likelihood of adverse effects occurring as a result of exposure of the selected site receptors to COPECs.

For this assessment, TRVs and exposure rates have been calculated and are used to generate HQs (DTSC, 1996), by dividing the receptor exposure rate (i.e., dose) for each COPEC by the TRV. Environmental effects quotients (EEQs) or HQs are a means of estimating the potential for adverse effects to organisms at a WAA, and for assessing the potential that toxicological effects may occur for site receptors.

6.7.1 Terrestrial Plant Impact Assessment

Signs of vegetative stress can indicate impact of COPEC concentrations in surface soil on terrestrial plant species. During site visits and inspections at Mather WAA in 2001 and 2008, no signs of vegetative stress were noted. The overall health of the vegetative community at the WAA was comparable to the vegetation in the surrounding area. A terrestrial plant impact screening assessment is presented in Section 6.7.3. It should be noted that plants (and invertebrates) are included in the SLERA as media through which the wildlife receptors may be exposed indirectly to COPECs in the soil by means of the food chain.

6.7.2 Predictive Risk Estimation for Terrestrial Wildlife

The potential wildlife risks associated with Mather WAA are estimated in this SLERA. The risk estimation has been performed through a series of quantitative HQ calculations that compare receptor-specific exposure values with TRVs. The EEQs (or HQs) are compared to HQ guidelines for assessing the risk posed from contaminants. It should be noted that HQs are not measures of risk, are not population-based statistics, and are not linearly-scaled statistics, and therefore an HQ above 1, even exceedingly so, does not guarantee that there is even one individual expressing the toxicological effect associated with a given chemical to which it was exposed (Allard et al., 2007; Tannenbaum, 2001; Bartell, 1996).

The simple HQ ratios are summed to provide conservative HI estimates for chemicals and exposure pathways for a given receptor. The criterion used to decide if HQ summation is appropriate and scientifically defensible includes those chemicals that have a similar mode of toxicological action. While individual contaminants may affect distinct target organs or systems within an organism, classes of chemicals may act in similar ways, thus being additive in effect.

The summation of HQs into an HI was performed in this SLERA as a conservative approach. To assess whether or not individual COPEC HQs should be segregated based on dissimilar modes of toxicological action, individual COPEC effects were evaluated. However, as risk drivers resulted in HQs ranging from less than one to over 7,000 (see following paragraphs), segregation of COPECs by mode of toxicological action was not necessary.

Worst case and more realistic (Tier 1 and Tier 2) individual COPEC EEQs and hazard indices (summed EEQs) for terrestrial receptors at Mather WAA are presented in risk characterization tables (Appendix G, Tables G-1 through G-10) for the five selected receptor species. The summed EEQs are presented in Table 6-13 (generally rounded to two significant figures), along with the hazard driver [COPEC(s) contributing the majority of the total estimated EEQ] and the exposure pathway of concern (the pathway contributing the most to the total estimated EEQ).

As shown in Table 6-13, Tier 1 total EEQs ranged from approximately 2.0 to 11,986 for the five receptor species, using TRVs based on either NOAEL or LOAEL values. The American robin was predicted to be the most impacted, followed by the dusky-tailed shrew, the long-tailed weasel, the yellow-bellied marmot, and the California vole, respectively. Inorganic constituents including cadmium, barium, lead, and zinc; and the organic constituent bis(2-ethylhexyl)phthalate [BEHP] were the COPECs contributing the most to the total EEQs for the receptors. Exposure pathways of most concern, based on the results of the food-chain modeling, were terrestrial invertebrate, plant, small mammal, and incidental soil ingestion.

More realistic Tier 2 total EEQs were elevated, especially values based on NOAEL TRVs, which ranged from less than 0.54 to 2,127. However, Tier 2 total EEQs were much lower than Tier 1 total EEQs. NOAEL-based Tier 2 total EEQs for the long-tailed weasel and yellow-bellied marmot were less than one, but greater than one for the shrew, robin, and vole. Tier 2 LOAEL EEQs were less than one for the long-tailed weasel and yellow-bellied marmot, but greater than one for the shrew, robin, and vole, as summarized in Table 6-13 and shown in detail in Appendix G.

The specific results of the Tier 2 risk estimation for the California vole, dusky shrew, and American robin are presented below. The specific results for the long-tailed weasel and yellow-bellied marmot are not presented because the summed EEQs are below one.

<u>California Vole</u>. The total EEQs for both NOAEL and LOAEL TRVs exceeded one (16 and 1.2, respectively). Four COPECs had individual NOAEL-based EEQs that exceeded one (EEQ in parenthesis): zinc (5.0), lead (4.4), cadmium (2.3), and manganese (1.3). No constituents had a LOAEL-based EEQ that exceeded one. The primary exposure pathway was the ingestion of plants. The results of the Tier 2 risk evaluation for California voles are presented in Appendix G, Table G-2.

Dusky Shrew. The total EEQs for both NOAEL and LOAEL TRVs exceeded one (2,127 and 57, respectively). Sixteen COPECs had individual NOAEL-based EEQs that exceeded one (EEQ in parenthesis): cadmium (643), lead (618), nickel (287), zinc (269), 2,3,7,8-TCDD TEQ (97), copper (60), antimony (48), manganese (31), bis(2-ethylhexyl)phthalate (29), molybdenum (11), mercury (8.1), arsenic (7.2), chromium (5.9), barium (4.9), cobalt (2.4), and pentachlorophenol (2.0).

Twelve COPECs had individual LOAEL-based EEQs that exceeded one (EEQ in parenthesis): cadmium (15), 2,3,7,8-TCDD TEQ (9.79), zinc (6.3), chromium (5.0), antimony (4.8), bis(2-ethylhexyl)phthalate (2.9), manganese (2.7), lead (2.6), barium (2.1), pentachlorophenol (1.8), nickel (1.2), and molybdenum (1.1). The primary exposure pathway was the ingestion of terrestrial invertebrates. The results of the dusky shrew Tier 2 risk evaluation is presented in Appendix G, Table G-4.

American Robin. The total EEQs for both NOAEL and LOAEL TRVs exceeded one (1,998 and 12, respectively). Eight COPECs had individual NOAEL based EEQs that exceeded one (EEQ in parenthesis): lead (1,960), bis(2-ethylhexyl)phthalate (20), zinc (8.9), copper (3.6), mercury (3.2), cadmium (2.5), nickel (1.2), and barium (1.2).

Three COPECs had individual LOAEL-based EEQs that exceeded one (EEQ in parenthesis): bis(2-ethylhexyl)phthalate (4.0), lead (3.1), and cadmium (1.7).

The results of the Tier 2 risk evaluation for American robins are presented in Appendix G, Table G-6.

6.7.3 Evaluation of Direct Contact Soil Toxicity

To evaluate direct contact exposure, for those organisms that live within an environmental medium, COPEC media concentrations are compared with direct-contact screening benchmarks. Intake is not calculated because potential adverse effects are assessed by evaluating the COPEC concentrations in soil.

The process used to assess direct contact soil toxicity was as follows. First, the maximum detected soil concentration (MDC) was compared with the following five direct contact screening values:

- Dutch Intervention Value (Netherland Ministry of Housing, 2000);
- Canadian Council of Ministers of the Environment (CCME) Environmental Quality Guideline values (CCME, 2003);
- Lowest EcoSSL for invertebrate or plant toxicity (USEPA, 2009b);
- Oak Ridge National Laboratory (ORNL) Benchmarks for Plants (ORNL, 1997a); and
- ORNL Benchmarks for Soil Invertebrates (ORNL, 1997b).

Based on the results of this initial step, six COPECs were found to have an MDC that exceeded more than 50 percent of the available screening benchmarks (Table 6-14). The 50 percent exceedance threshold was selected as potentially significant, based on a weight of evidence approach. Based on this finding, the individual exceedances for these six COPECs are discussed in more detail as follows:

- The MDC for 2,3,7,8-TCDD TEQ exceeded the CCME screening value for the protection of agricultural soil. However, as the WAA is not used for agricultural purposes, the importance of this exceedance is deemed not significant enough to recommend further action at Mather WAA;
- The barium MDC and EPC exceeded all four available benchmarks (the Dutch Intervention value, the CCME value, the EcoSSL value, and the ORNL value for plants);

- The copper MDC exceeded all five available benchmarks and the EPC exceeded four of the available benchmarks;
- The lead MDC and EPC exceeded all five available benchmarks (the Dutch Intervention value, the CCME value, the USEPA EcoSSL, the ORNL value for plants, and the ORNL value for invertebrates);
- The manganese MDC and EPC exceeded the two available benchmarks (the USEPA EcoSSL for plants and the ORNL value for plants); and
- The zinc MDC and EPC exceeded all five available benchmarks (the Dutch Intervention value, the CCME value, the USEPA EcoSSL, the ORNL value for plants, and the ORNL value for invertebrates).

These results suggest that direct contact toxicity in soil is a concern for the following five COPECs:

- Barium;
- Copper;
- Lead;
- Manganese; and
- Zinc.

It should also be noted that toxicity to terrestrial invertebrates is assessed indirectly, as terrestrial invertebrates such as earthworms are included in the food-chain models used in the assessments.

6.8 UNCERTAINTY ANALYSIS

The results of the SLERA are influenced to some degree by variability and uncertainty. In theory, investigators might reduce variability by increasing sample size of the media or species sampled. Alternatively, uncertainty within the risk analysis can be reduced by using species-specific and site-specific data (i.e., to better quantify contamination of media, vegetation, and prey through: direct field measurements, toxicity testing of site-specific media, and field studies using site-specific receptor species). Detailed media, prey, and receptor field studies are costly; thus, the analyses of risk have been conducted to limit the use of these resource-intensive techniques. Since assessment criteria were developed based on conservative assumptions, the result of the assessment errs on the side of conservatism. This has the effect of maximizing the likelihood of accepting a false positive (Type I error: the rejection of a true null hypothesis) and simultaneously minimizing the likelihood of accepting a true negative (Type II error: the acceptance of a false null hypothesis).

6.8.1 TRV Species Extrapolation Uncertainty

The elevated dusky shrew Tier 2 LOAEL-based EEQs, that ranged from a high of 15 for cadmium to a low of 1.2 for nickel (excluding those COPECs with EEQs less than 1) were all estimated using a TRV extrapolation uncertainty factor (UF) of 10 (Table 6-12 and Appendix G Table G-4). The use of this UF may be considered overly conservative, and if it were removed, the estimated Tier 2 LOAEL-based EEQs would drop to 1.5 for cadmium, and the rest of the EEQs would drop below 1.0.

The elevated American robin Tier 2 LOAEL-based EEQs, that ranged from a high of 4.0 for BEHP to a low of 1.7 for cadmium (excluding those COPECs with EEQs less than 1) were also all estimated using a TRV extrapolation UF of 10 (Table 6-12 and Appendix G Table G-6). The use of this UF may be considered overly conservative, and if it were removed, the estimated Tier 2 LOAEL-based EEQs would all drop below 1.0.

6.8.2 2,3,7,8-TCDD TEQ Uncertainty

Adoption of 2,3,7,8-TCDD TEQs calculated by the analytical laboratory, using human health TEFs from DTSC (1997b), for the SLERA results in some uncertainty, as ecological-specific TEFs exist (WHO, 1998; 2005). If the more conservative (numerically higher) alternative TEFs for birds and mammals had been used, the 2,3,7,8-TCDD TEQ EPC concentration would have increased from 11.14 pg/g (1.11E-05 mg/kg; Table 4-4) to 17.7 pg/g (1.77E-05 mg/kg), an increase of approximately 59 percent, as shown below for sample YWM-TP02-SO-1049 (the sample with the maximum concentration that was used as the EPC due to the limited dioxin/furan sample size):

Compound	Result (pg/g)	TEF	2378-TCDD TEQ (pg/g)	Alt. TEF	Alt 2378-TCDD TEQ (pg/g)
1234678-HpCDD	210	0.01	2.1	0.01	2.1
123478-HxCDD	3.8	0.1	0.38	0.1	0.38
123678-HxCDD	14	0.1	1.4	0.1	1.4
123789-HxCDD	10	0.1	1	0.1	1
12378-PeCDD	3.7	0.5	1.85	1	3.7
2378-TCDD	0.9	1	0.9	1	0.9
OCDD	580	0.001	0.58	0.0003	0.174
1234678-HpCDF	16	0.01	0.16	0.01	0.16
1234789-HpCDF	ND	0.01	0	0.01	0
123478-HxCDF	3.3	0.1	0.33	0.1	0.33
123678-HxCDF	2.6	0.1	0.26	0.1	0.26
123789-HxCDF	ND	0.1	0	0.1	0
12378-PeCDF	2.9	0.05	0.145	0.1	0.29
234678-HxCDF	ND	0.1	0	0.1	0
23478-PeCDF	3.3	0.5	1.65	1	3.3
2378-TCDF	3.7	0.1	0.37	1	3.7
OCDF	14	0.001	0.014	0.0003	0.0042
Total			11.14		17.7

6.8.3 Bioaccumulation Uncertainty

It is important to note that the BEHP soil-to-earthworm BAF that was estimated to be 3,745 (Table 6-8) was based on a log K_{ow} and K_{oc} regression equation, and this BAF is very likely overestimated. This is because the log K_{ow} and K_{oc} regression equation (USEPA, 2009b, 2009c) appears to have been based on a training data set that did not include the very elevated log K_{ow} and K_{oc} values for BEHP (8.39 and 165,400, respectively). As shown in Figure 6-2, if a BEHP BAF regression equation existed that scaled with BEHP soil concentrations (similar to what is available for PCBs), it is likely that the BEHP soil-to-earthworm BAF would drop by approximately 6- to 23-fold. This would reduce the BEHP BAF of 3,745 to approximately 163 to 624, and would reduce the dusky shrew and American robin BEHP EEQs by a similar amount. This BAF adjustment would likely reduce the American robin BEHP Tier 2 LOAEL-based EEQ of 4.0 to less than 1, and would reduce the dusky shrew BEHP Tier 2 LOAEL-based EEQ of 2.9 to less than 1.

The nickel BAF/BCF for soil to earthworms has been withdrawn by USEPA (2007), due to a lack of sufficient data to support an uptake factor. Rather than have a data gap, this SLERA used the nickel BAF values from Sample et al., 1998a, 1999. There is some uncertainty associated with this approach which resulted in a nickel soil to earthworm BAF of 2.2 (Appendix G).

The BAF value used for chromium uptake by earthworms in the current assessment is 0.306 (Table 6-8). An alternative chromium BAF value may be estimated from data presented in the *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (USEPA, 1999). This guidance presents an alternative chromium BAF of 0.01. The alternative BAF value for chromium is 31-fold lower than the BAF value used in the current assessment. This would reduce the dusky shrew Tier 2 LOAEL-based EEQ from 5.0 to less than 1.

As stated previously, as no soil-to-small bird BAF values were not readily available, soil-to-small mammal BAFs have been used as surrogate values. This adds some uncertainty to the SLERA. It is unknown if small birds would bioaccumulate COPECs to a greater or lesser degree from soil, compared with small mammals. Factors influencing uptake would include, but not be limited to the following: wildlife lipid content, metabolic rate, diet, gastrointestinal tract pH, and feeding strategy (i.e., many birds regurgitate pellets, while mammals do not).

6.8.4 Overall Conservatism as Shown by Comparison to Background

The overly conservative nature of the SLERA approach is apparent when average site-specific background inorganic soil concentrations are used to estimate receptor hazards. As shown in Table 6-15, estimated wildlife background EEQs are above 1.0 for 11 of 13 inorganic COPECs, using the Tier 2 NOAEL-based EEQ approach. Some of the background EEQs are quite elevated, such as EEQs of 78 for nickel, 21 for cadmium, 9.3 for lead, and 5.6 for molybdenum.

6.8.5 Uncertainty Related to Lack of Benchmarks and TRVs

Some uncertainty results from a lack of direct contact plant toxicity values for many COPECs. As shown in Table 6-14, five COPECs have no direct contact screening benchmarks at all, and 20 COPECs have no plant toxicity screening benchmarks.

There is also some uncertainty associated with a lack of TRVs for some COPECs. As shown in Table 6-10 and Table 6-11, TRVs are lacking for one COPEC for mammals and are lacking for four COPECs for birds (excluding TPH COPECs such as diesel, gasoline, and motor oil). Given the total number of COPECs, however, this data gap is not considered significant.

6.8.6 Uncertainty Related to Receptor Species Selection

There is some uncertainty associated with the selection of wildlife receptor species. The selection of more species would allow the assessment of additional ecological niches and trophic levels, however, the five species selected are deemed adequate for this SLERA. It is important to note that the selection of the dusky shrew, with a home range of only 0.1 acres, limits the use of the Tier 2 FHR approach, as the Mather WAA size of 0.20 acres exceed the home range of this receptor.

6.8.7 Uncertainty Related to Receptor Exposure to Only Surface Soil

There is some uncertainty associated with the assumption that wildlife receptor species and their food items are only exposed to surface soil (0-2 feet). Although this assumption is generally true, some burrowing mammals and some deep rooted plants may be exposed to containments deeper than two feet. The direct exposures to COPECs at deeper soil depths are not presented in previous SLERA sections;

however, the total soil EPC data are compared to the surface soil EPCs presented in Table 6-16 to assess the potential consequences of wildlife exposure to COPECs other than just surface soil. Calculated EPCs based on total soil both increased and decreased relative to the surface soil EPCs. EPCs ranged from a decrease of 39% (chrysene) to an increase of 482% (lead). The substantial increase in the lead EPC (from 994 mg/kg to 5790 mg/kg) results is due to the inclusion of the elevated concentration of lead in the 2.5 ft bgs sample YWM09-2286 with a reported concentration of 9930 mg/kg. Use of this alternative lead EPC of 5790 mg/kg would result in an estimated LOAEL-based EEQ for the dusky shrew of approximately 12. However, using the rationale as discussed in Section 6.8.1, if the interspecies uncertainty factor of 10 is removed, the estimated lead EEQ would drop from 12 to 1.2, which is essentially 1 when rounded to one significant figure. Thus, if dusky shrews were burrowing to depths of 2.5 ft bgs (and deeper), estimated hazards would be greater for exposure to lead (compared with just exposure to surface soil) but still essentially equal to 1, based on use of the LOAEL TRV. Is should also be noted that dusky shrew population densities range from 37 to 40 individuals per hectare (Solano County Water Agency, 2008), therefore, the 0.2 acre WAA would support approximately three individual shrews. Even if all of these individuals were exposed to the elevated lead found at depth, it is highly unlikely adverse impacts to shrew populations would occur, as three individuals would not be expected to represent a breeding population. Therefore, SLERA conclusions related to lead would not be expected to change even if exposure of wildlife receptors to lead in deeper soil intervals was quantitatively included.

6.8.8 Uncertainty Related to Exposure to Chemicals with Few Detections

As discussed in Section 6.2.2, per a request for DTSC, due to the uncertainty of using estimated 95% UCLs based on Shaw's Risk2000 software for those 11 chemicals with less than three detected results, potential hazards using maximum detected concentration are evaluated herein (instead of using estimated 95% UCLs). As shown in Table 6-17, estimated hazards for the most exposed wildlife receptor (the dusky shrew) would increase for all 11 COPECs if the maximum detected concentration was used instead of the 95% UCL. However, none of the estimated hazards, which would range from 0.00027 to 0.076, would exceed 1.0. Therefore, the effect of the uncertainty associated with using 95% UCLs compared with maximum detected concentrations, for the 11 chemicals with less than three detected results, is minimal.

6.8.9 General Summary of SLERA Uncertainty

An uncertainty analysis is presented in Table 6-18 and lists some of the major assumptions made for the SLERA; the direction of bias caused by each assumption (i.e., if the uncertainty results in an overestimate or underestimate of risk); the likely magnitude of impact (quantitative [percent difference], or qualitative [high, medium, low, or unknown]); if possible, a description of recommendations for minimizing the identified uncertainties if the SLERA progresses to higher level assessment phases; and the ease of implementing the recommendation (USEPA, 1997).

The uncertainty analysis identifies and, if possible, quantifies the uncertainty in the individual preliminary scoping assessment, problem formulation, exposure and effects assessment, and risk characterization phases of this SLERA. Based on this uncertainty analysis, the most important biases that may result in an overestimation of risk include the following:

- Assuming that COPECs are 100 percent bioavailable;
- Using some laboratory-derived or empirically-estimated partitioning and transfer factors to predict COPEC concentrations in plants, invertebrates, prey species;
- Using toxicity data from laboratory studies not based on a chronic exposure period, and/or without an NOAEL endpoint, thereby requiring the use of large uncertainty factors; and

- Use of the hazard quotient method to estimate risks to populations or communities.

6.9 SLERA RESULTS AND CONCLUSIONS

The data, results, and conclusions of the SLERA evaluated risks to ecological populations potentially inhabiting Mather WAA. Conclusions are derived from the risk assessment and are based on the responses to the assessment hypotheses and assessment endpoints. The assessment results for food chain exposure are summarized in Table 6-13, and direct contact exposure results for terrestrial invertebrates, which may serve as a food source for wildlife are summarized in Table 6-14 and discussed in Section 6.7.3.

The Tier 2 LOAEL-based food chain assessment results suggest potential adverse impacts to terrestrial wildlife (COPEC drivers in parenthesis), such as the dusky shrew (cadmium, 2,3,7,8-TCDD TEQ, zinc, chromium, antimony, bis(2-ethylhexyl)phthalate, manganese, lead, barium, pentachlorophenol, and nickel) and the American robin (bis(2-ethylhexyl)phthalate, lead, cadmium, zinc, and mercury), via terrestrial invertebrate ingestion and/or incidental soil ingestion, as estimated EEQs were all above one. However, when interspecies TRV extrapolation factors are reduced from 10 to 1, no individual Tier 2 LOAEL COPEC EEQs are above 1 (after rounding to one significant figure, Section 6.8.1). As discussed previously, BEHP's EEQ is likely overestimated due to the BAF estimation approach used (Section 6.8.3). It is important to note that the overall conservatism of the SLERA approach is apparent for several inorganic COPECs, as even naturally-occurring background soil concentrations would result in elevated hazard estimates (EEQ greater than one) for wildlife exposure to nickel, cadmium, lead, molybdenum, arsenic, manganese, zinc, antimony, copper, chromium, cobalt (Section 6.8.4). Although an elevated concentration of lead was detected at 2.5 ft bgs, slightly deeper than the typical 2 ft depth of exposure assumed for the dusky shrew, even if deeper soil lead concentrations were included in the estimation of the lead EPC, the projected LOAEL-based EEQ for the shrew would be essentially 1 with discounting of the conservative interspecies extrapolation factor and rounding to one significant figure (Section 6.8.7).

The direct contact assessment results for soil invertebrates and/or plants suggest that a reduction in wildlife food supply is possible due to barium, copper, lead, manganese, and zinc in surface soil. However, due to the small size of the WAA (0.2 acres), this finding is not deemed to be ecologically significant.

Based on the results of the SLERA conducted at Mather WAA, further actions solely to address ecological concerns are not recommended for soil. This recommendation is based on the estimated EEQs, the overly conservative SLERA approach, and the small size of the WAA. If further action is conducted to address human health concerns, residual ecological hazards that are estimated to remain at the WAA following such a cleanup should be assessed. It is anticipated that a cleanup to address human health concerns would reduce estimated ecological hazards to a significant degree, such that additional clean up solely for ecological concerns would not be warranted. This is predicated on an assumption that many ecological and human health COPECs/COPCs are collocated in soil at the WAA, and that the small size of the Site (0.2 acre), even with some residual ecological hazard, is unlikely to have a significant ecological impact on wildlife populations.

The SLERA assessment results may serve as the foci of discussions with risk managers and regulatory agencies. It is very important to note that many conservative assumptions and modeling approaches were used in the assessment, and actual hazards to wildlife may be orders of magnitude lower than predicted herein.

7.0 SUMMARY AND RECOMMENDATIONS

This section summarizes the results of two focused site inspections at Mather WAA in Yosemite National Park, California, and makes recommendations based on those results. The inspection met the project objectives of collecting soil samples from test pits and obtaining laboratory analytical data for the samples. The field inspection and sample collection activities were conducted in accordance with the Plan.

The inspection also met the objective of observing the nature and extent of the waste present in the WAA. An approximate volume of 85 cubic yards of debris-laden soil was estimated using measurements of vertical extent in test pits and observations of the lateral extent of waste on the ground surface.

7.1 CHEMICAL DETECTIONS AND EVALUATION

Elevated lead concentrations were reported for test pit TP02 and nearby test pit YWM09, at depths ranging from the surface to three feet bgs. The oily residue in TP05 is confirmed to be petroleum hydrocarbons, but no PCBs were detected in it. Furthermore, the oily residue is limited to a small extent that is not exposed at the surface.

Statistical and geochemical evaluations were performed to compare site sample concentrations of metal detections to their respective (site-specific) background concentrations. The evaluations concluded that the concentrations of most metals within the WAA footprint could not be explained as the result of natural processes and thus may be related to site activities. The human health risk assessment identified arsenic as a COPC with an ILCR greater than 1E-6 (see Tables 5-5 and 5-6). It is worth noting, however, that the site arsenic concentrations are similar to those of background soil concentrations for Tuolumne County. Four soil samples were collected within the county by the U.S. Geological Survey in 1979-1980, as part of a continental-scale study to characterize natural metals concentrations in surficial soils (U.S. Geological Survey, 2010). Arsenic concentrations in these four background samples range from 2.1 to 9.8 mg/kg. While some of the Mather WAA site samples might contain excess arsenic from site-related contamination (as discussed in Appendix D), all of the site arsenic concentrations (1.10 to 8.4 mg/kg) are below or within the range of the Tuolumne County background concentrations. This suggests that any arsenic contamination in the site samples, if present, is not significant.

7.2 HUMAN HEALTH RISK ASSESSMENT

Both the park hiker receptor and the park employee receptor were found to have a calculated risk above 1E-6 ILCR residential scenario and hazard below 1 HI. Lead in soil/dust is less than screening concentrations for modeled concentrations in the blood of both adults and children and is therefore protective of both receptors. Arsenic is the COPC causing the ILCR above the 1E-6 *de minimis* risk (USEPA, 1990).

However, the isolated location, small size of the WAA, and infrequency of visitation serve to mitigate the results of the HHRA screening. The values derived from human health risk assessment calculations are based on visitation assumptions that exceed the amount of time that would be expected for this site. Arsenic, the risk driver for the human health risk assessment, was found to be present in concentrations above those found in the background samples collected adjacent to the Mather WAA site; however, it was also found to be present within the range of concentrations in background samples collected by the U.S. Geological Survey in Tuolumne County. Although removal of the areas with the greatest arsenic concentrations would mitigate the potential for exposure to soil-bound COPCs, the results of the HHRA indicate a low risk to human health even if the site is left unchanged.

7.3 ECOLOGICAL RISK ASSESSMENT

The Tier 2 LOAEL-based food chain assessment results suggest potential adverse impacts to terrestrial wildlife via terrestrial invertebrate ingestion and/or incidental soil ingestion, as estimated EEQs were all above one. However, when interspecies TRV extrapolation factors are reduced from 10 to 1, no individual Tier 2 LOAEL COPEC EEQs are above 1.

Although an elevated concentration of lead was detected at 2.5 ft bgs, slightly deeper than the typical 2 ft depth of exposure assumed for the dusky shrew, even if deeper soil lead concentrations were included in the estimation of the lead EPC, the projected LOAEL-based EEQ for the shrew would be essentially 1 with discounting of the conservative interspecies extrapolation factor and rounding to one significant figure. It should also be noted that the 0.2 acre WAA would be expected to support approximately three individual shrews, based on typical density information. Even if all of these individuals were exposed to the elevated lead found at the 2.5 ft depth, it is highly unlikely adverse impacts to shrew populations would occur, as three individuals would not be expected to represent a breeding population.

The direct contact assessment results for soil invertebrates and/or plants suggest that a reduction in wildlife food supply is possible due to barium, copper, lead, manganese, and zinc in surface soil. However, due to the small size of the WAA (0.2 acres), this finding is not deemed to be ecologically significant.

It is important to note that the overall conservatism of the SLERA approach is apparent for several inorganic COPECs, as even naturally-occurring background soil concentrations would result in elevated hazard estimates (EEQ greater than one) for wildlife exposure to nickel, cadmium, lead, molybdenum, arsenic, manganese, zinc, antimony, copper, chromium, cobalt.

Based on the results of the SLERA conducted at Mather WAA, further actions solely to address ecological concerns are not recommended for soil. This recommendation is based on the estimated EEQs, the overly conservative SLERA approach, and the small size of the WAA. In addition, it should be noted that many conservative assumptions and modeling approaches were used in the assessment, and actual hazards to wildlife may be orders of magnitude lower than predicted herein.

7.4 RECOMMENDATIONS

The results of geochemical and statistical evaluation, as well as the HHRA and SLERA findings, indicate that apparent site-related chemicals, primarily metals, could pose a threat to receptors that are present at the site continuously over long periods of time. In a more realistic scenario, humans are rarely, if ever, present at the site, and wildlife would likely avoid the site due to shallow bedrock and numerous rock outcrops, which are not conducive to burrowing or browsing activities. Thus, because of its isolated location and lack of visitation, and based on the observations, data, and conclusions presented in this report, it is likely that the Mather WAA site could be left “as is” without adversely impacting human health or the environment.

However, in order to further reduce the low risks described in this report, the site would benefit from limited soil removal in the area of test pits TP05 to remove the oily mass observed in the northern portion of the site and TP09 to remove the elevated levels of lead detected in the southern portion of the site. Based on the shallow depth to bedrock and limited areal extent, it is estimated that three to five cubic yards of debris-laden waste soil would be generated. The soil removal would also require confirmation soil sampling and evaluation of the results (geochemical, human health and ecological risk). It is likely that this limited removal action would further reduce the already low risk associated with this site.

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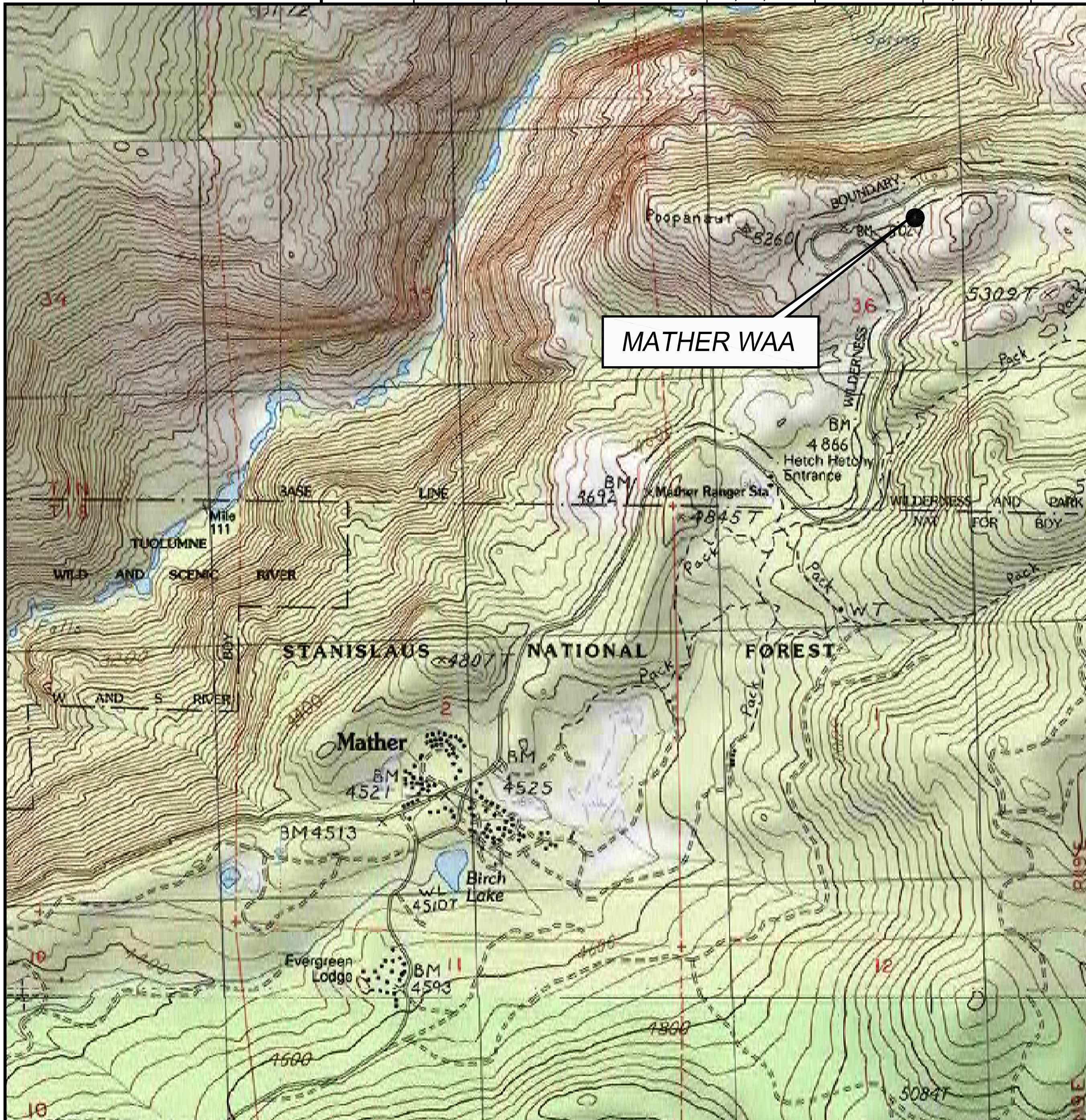
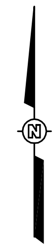
FIGURES

IMAGE	X-REF	OFFICE	DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
MATHER	---	Concord	SCHAEFFER	2/24/10	BAM	2/24/10	APC	2/24/10	870508-A162





SCALE

0 2000 4000 FEET

REFERENCE:
7.5' USGS TOPOGRAPHIC MAP OF "LAKE ELEANOR, CA; DATED 1992; SCALE = 1:24000.

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FIGURE 2-1
LOCATION OF MATHER
WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK
CALIFORNIA

IMAGE	X-REF	OFFICE	DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
GRWEA	---	Concord	SCHAEFFER	2/24/10	BAM	2/24/10	APC	2/24/10	870508–A153

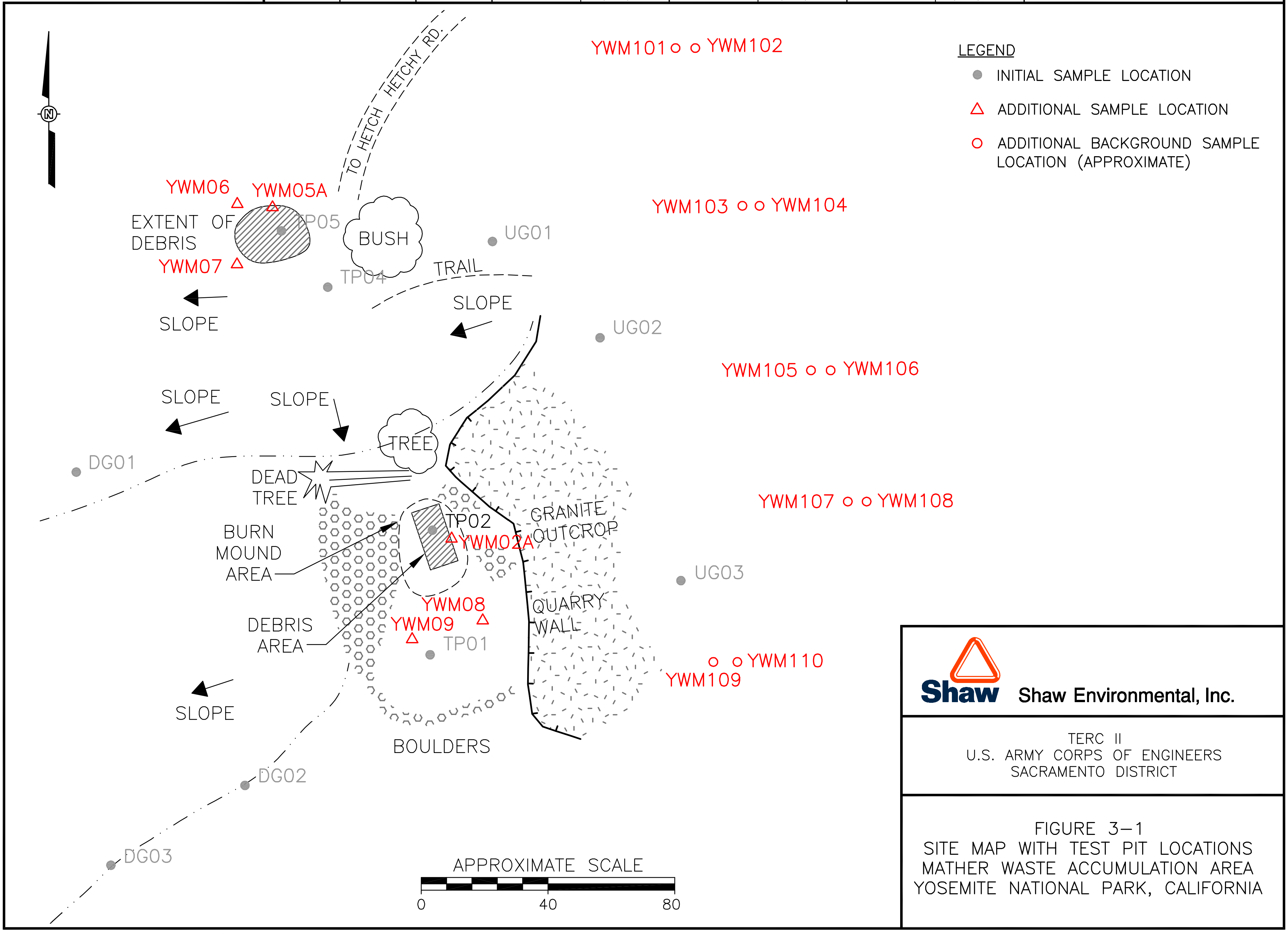

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FIGURE 3–1
SITE MAP WITH TEST PIT LOCATIONS
MATHER WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK, CALIFORNIA

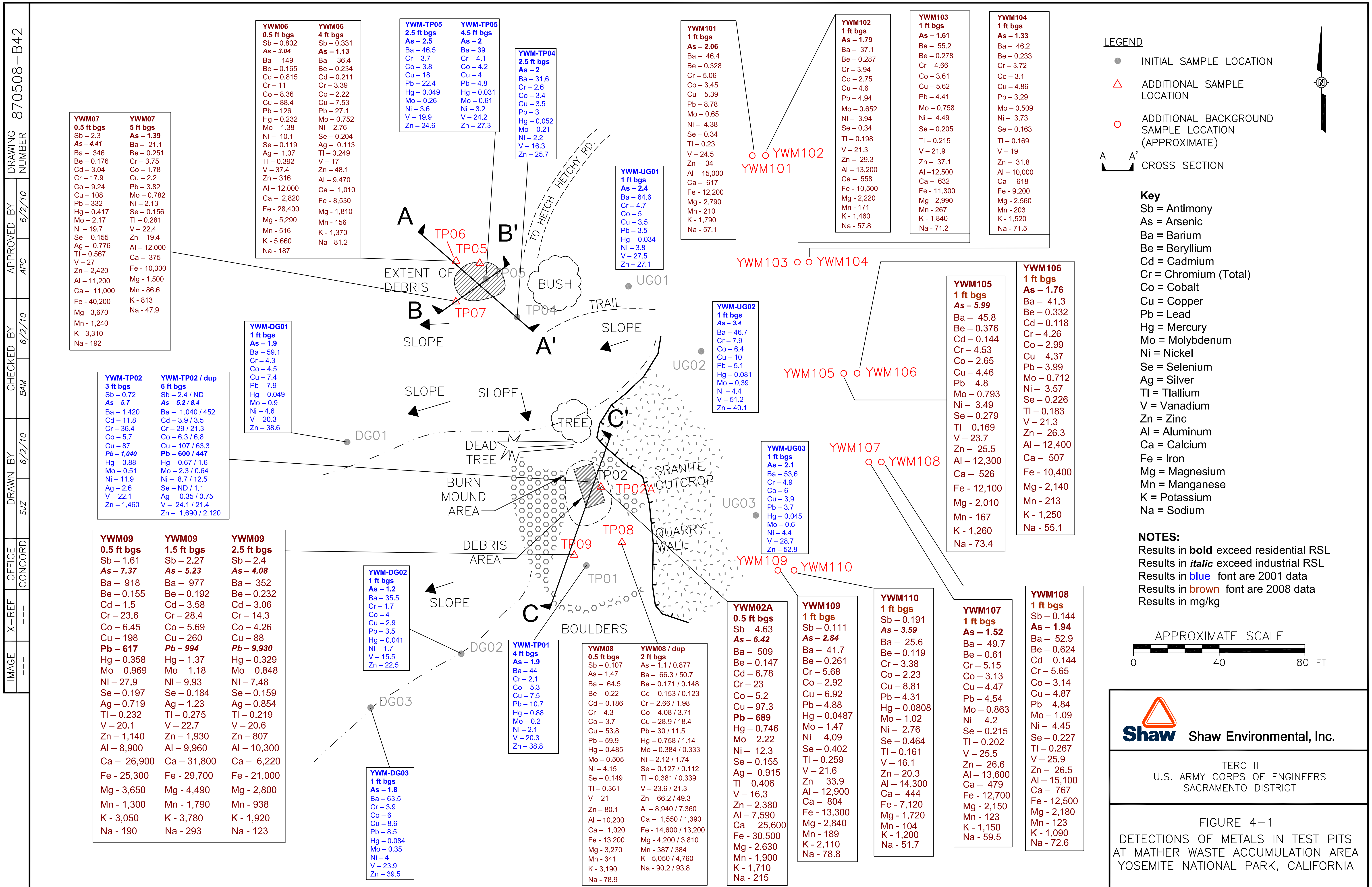
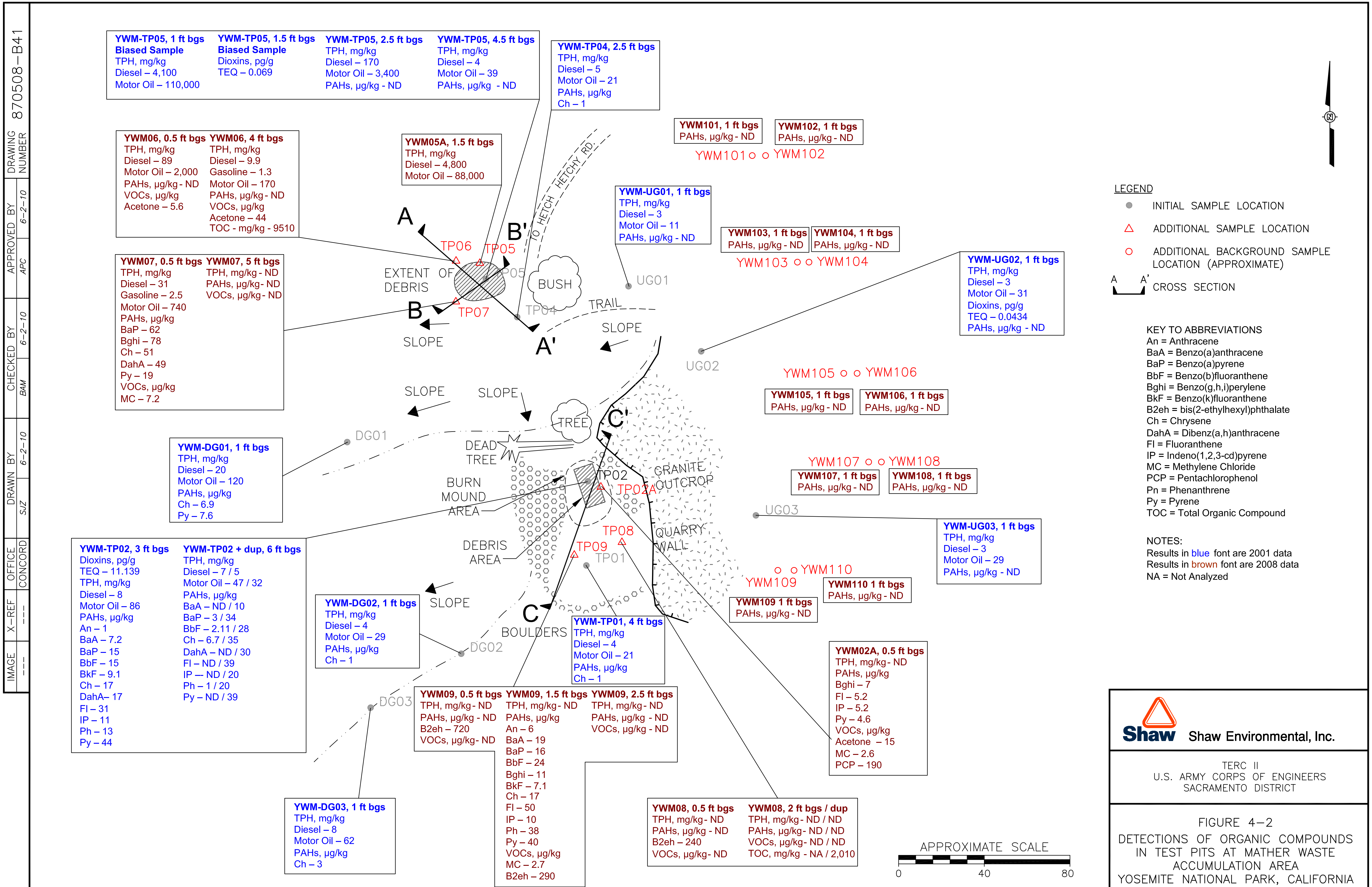


FIGURE 4–1
DETECTIONS OF METALS IN TEST PITS AT MATHER WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK, CALIFORNIA



DRAWING NUMBER 870508-B41
APPROVED BY APC 6-2-10
CHECKED BY BAM 6-2-10
DRAWN BY SJZ 6-2-10
OFFICE CONCORD
X-REF ---
IMAGE ---
YWM-TP05, 1 ft bgs
Biased Sample
TPH, mg/kg
Diesel – 4,100
Motor Oil – 110,000
YWM-TP05, 1.5 ft bgs
Biased Sample
Dioxins, pg/g
TEQ – 0.069
YWM-TP05, 2.5 ft bgs
TPH, mg/kg
Diesel – 170
Motor Oil – 3,400
PAHs, µg/kg - ND
YWM-TP05, 4.5 ft bgs
TPH, mg/kg
Diesel – 4
Motor Oil – 39
PAHs, µg/kg - ND
YWM-TP04, 2.5 ft bgs
TPH, mg/kg
Diesel – 5
Motor Oil – 21
PAHs, µg/kg
Ch – 1
YWM06, 0.5 ft bgs
TPH, mg/kg
Diesel – 89
Motor Oil – 2,000
PAHs, µg/kg - ND
VOCs, µg/kg
Acetone – 5.6
YWM06, 4 ft bgs
TPH, mg/kg
Diesel – 9.9
Gasoline – 1.3
Motor Oil – 170
PAHs, µg/kg - ND
VOCs, µg/kg
Acetone – 44
TOC - mg/kg - 9510
YWM05A, 1.5 ft bgs
TPH, mg/kg
Diesel – 4,800
Motor Oil – 88,000
YWM101, 1 ft bgs
PAHs, µg/kg - ND
YWM102, 1 ft bgs
PAHs, µg/kg - ND
YWM101 YWM102
YWM-UG01, 1 ft bgs
TPH, mg/kg
Diesel – 3
Motor Oil – 11
PAHs, µg/kg - ND
YWM103, 1 ft bgs
PAHs, µg/kg - ND
YWM104, 1 ft bgs
PAHs, µg/kg - ND
YWM103 YWM104
YWM07, 0.5 ft bgs
TPH, mg/kg
Diesel – 31
Gasoline – 2.5
Motor Oil – 740
PAHs, µg/kg
BaP – 62
Bghi – 78
Ch – 51
DahA – 49
Py – 19
VOCs, µg/kg
MC – 7.2
YWM07, 5 ft bgs
TPH, mg/kg - ND
PAHs, µg/kg- ND
VOCs, µg/kg- ND
YWM-UG02, 1 ft bgs
TPH, mg/kg
Diesel – 3
Motor Oil – 31
Dioxins, pg/g
TEQ – 0.0434
PAHs, µg/kg - ND
A
B'
TP06
TP05
EXTENT OF DEBRIS
BUSH
TO HETCH HETCHY RD.
UG01
TRAIL
B
TP07
TP04
SLOPE
A'
UG02
YWM105 YWM106
YWM105, 1 ft bgs
PAHs, µg/kg - ND
YWM106, 1 ft bgs
PAHs, µg/kg - ND
TREE
C'
DG01
DEAD TREE
YWM-DG01, 1 ft bgs
TPH, mg/kg
Diesel – 20
Motor Oil – 120
PAHs, µg/kg
Ch – 6.9
Py – 7.6
BURN MOUND AREA
TP02
TP02A
GRANITE OUTCROP
YWM107 YWM108
YWM107, 1 ft bgs
PAHs, µg/kg - ND
YWM108, 1 ft bgs
PAHs, µg/kg - ND
UG03
YWM-UG03, 1 ft bgs
TPH, mg/kg
Diesel – 3
Motor Oil – 29
PAHs, µg/kg - ND
YWM-TP02, 3 ft bgs
Dioxins, pg/g
TEQ – 11.139
TPH, mg/kg
Diesel – 8
Motor Oil – 86
PAHs, µg/kg
An – 1
BaA – 7.2
BaP – 15
BbF – 15
BkF – 9.1
Ch – 17
DahA– 17
Fl – 31
IP – 11
Ph – 13
Py – 44
YWM-TP02 + dup, 6 ft bgs
TPH, mg/kg
Diesel – 7 / 5
Motor Oil – 47 / 32
PAHs, µg/kg
BaA – ND / 10
BaP – 3 / 34
BbF – 2.11 / 28
Ch – 6.7 / 35
DahA – ND / 30
Fl – ND / 39
IP – ND / 20
Ph – 1 / 20
Py – ND / 39
DEBRIS AREA
TP08
TP09
TP01
QUARRY WALL
YWM109
YWM110
YWM110 1 ft bgs
PAHs, µg/kg - ND
YWM109 1 ft bgs
PAHs, µg/kg - ND
YWM-DG02, 1 ft bgs
TPH, mg/kg
Diesel – 4
Motor Oil – 29
PAHs, µg/kg
Ch – 1
C
BOULDERS
DG02
YWM-TP01, 4 ft bgs
TPH, mg/kg
Diesel – 4
Motor Oil – 21
PAHs, µg/kg
Ch – 1
YWM02A, 0.5 ft bgs
TPH, mg/kg- ND
PAHs, µg/kg
Bghi – 7
Fl – 5.2
IP – 5.2
Py – 4.6
VOCs, µg/kg
Acetone – 15
MC – 2.6
PCP – 190
DG03
YWM09, 0.5 ft bgs
TPH, mg/kg- ND
PAHs, µg/kg - ND
B2eh – 720
VOCs, µg/kg- ND
YWM09, 1.5 ft bgs
TPH, mg/kg- ND
PAHs, µg/kg
An – 6
BaA – 19
BaP – 16
BbF – 24
Bghi – 11
BkF – 7.1
Ch – 17
Fl – 50
IP – 10
Ph – 38
Py – 40
VOCs, µg/kg
MC – 2.7
B2eh – 290
YWM09, 2.5 ft bgs
TPH, mg/kg- ND
PAHs, µg/kg - ND
VOCs, µg/kg - ND
YWM-DG03, 1 ft bgs
TPH, mg/kg
Diesel – 8
Motor Oil – 62
PAHs, µg/kg
Ch – 3
YWM08, 0.5 ft bgs
TPH, mg/kg- ND
PAHs, µg/kg - ND
B2eh – 240
VOCs, µg/kg- ND
YWM08, 2 ft bgs / dup
TPH, mg/kg- ND / ND
PAHs, µg/kg- ND / ND
VOCs, µg/kg- ND / ND
TOC, mg/kg - NA / 2,010
LEGEND
INITIAL SAMPLE LOCATION
ADDITIONAL SAMPLE LOCATION
ADDITIONAL BACKGROUND SAMPLE LOCATION (APPROXIMATE)
A A' CROSS SECTION
KEY TO ABBREVIATIONS
An = Anthracene
BaA = Benzo(a)anthracene
BaP = Benzo(a)pyrene
BbF = Benzo(b)fluoranthene
Bghi = Benzo(g,h,i)perylene
BkF = Benzo(k)fluoranthene
B2eh = bis(2-ethylhexyl)phthalate
Ch = Chrysene
DahA = Dibenz(a,h)anthracene
Fl = Fluoranthene
IP = Indeno(1,2,3-cd)pyrene
MC = Methylene Chloride
PCP = Pentachlorophenol
Pn = Phenanthrene
Py = Pyrene
TOC = Total Organic Compound
NOTES:
Results in blue font are 2001 data
Results in brown font are 2008 data
NA = Not Analyzed
APPROXIMATE SCALE
0 40 80
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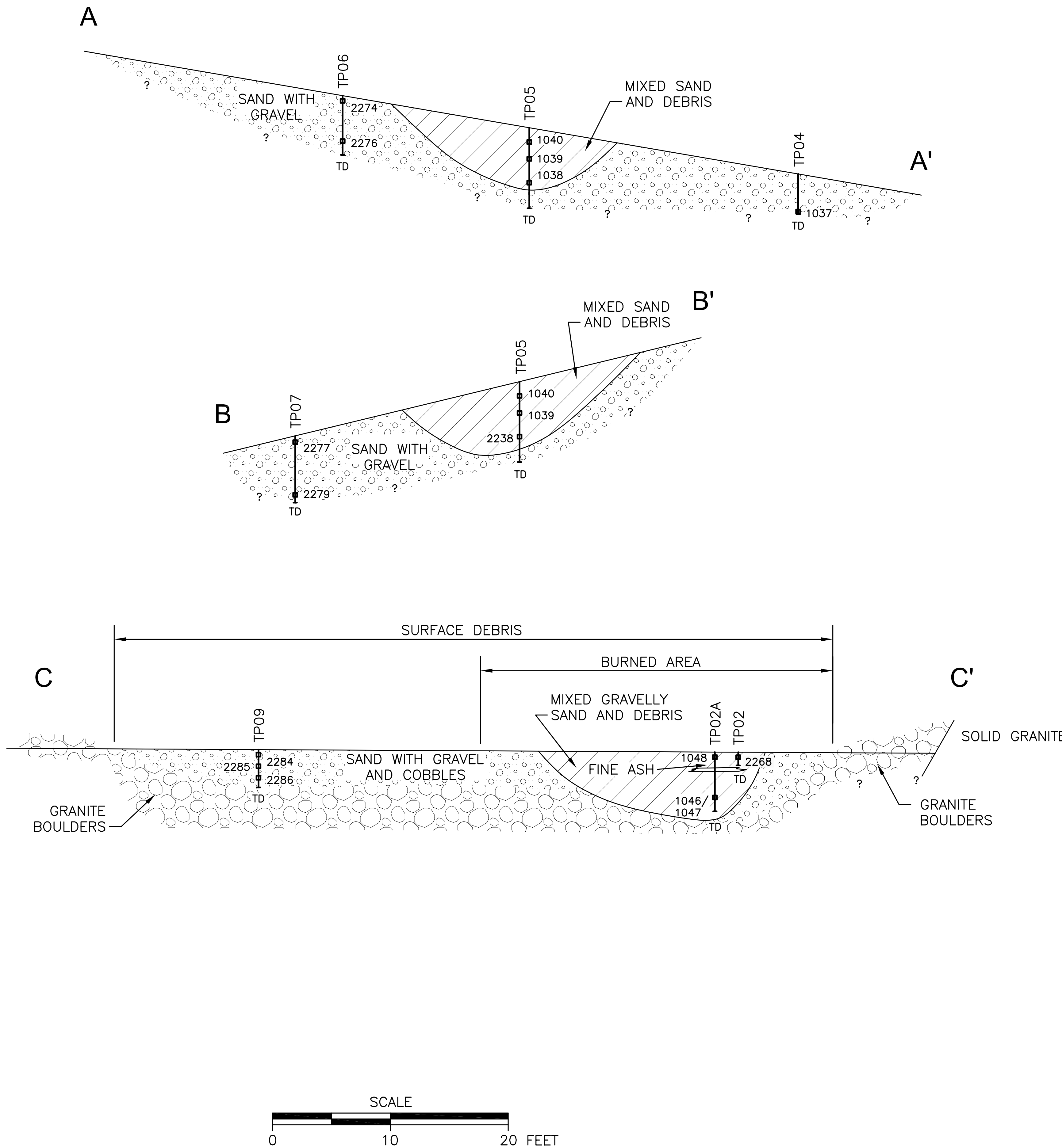
SACRAMENTO DISTRICT
FIGURE 4–2
DETECTIONS OF ORGANIC COMPOUNDS IN TEST PITS AT MATHER WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK, CALIFORNIA



LEGEND

TD TOTAL DEPTH

TP01 TEST PIT LOCATION

1058 ■ SOIL SAMPLE LOCATION AND NUMBER

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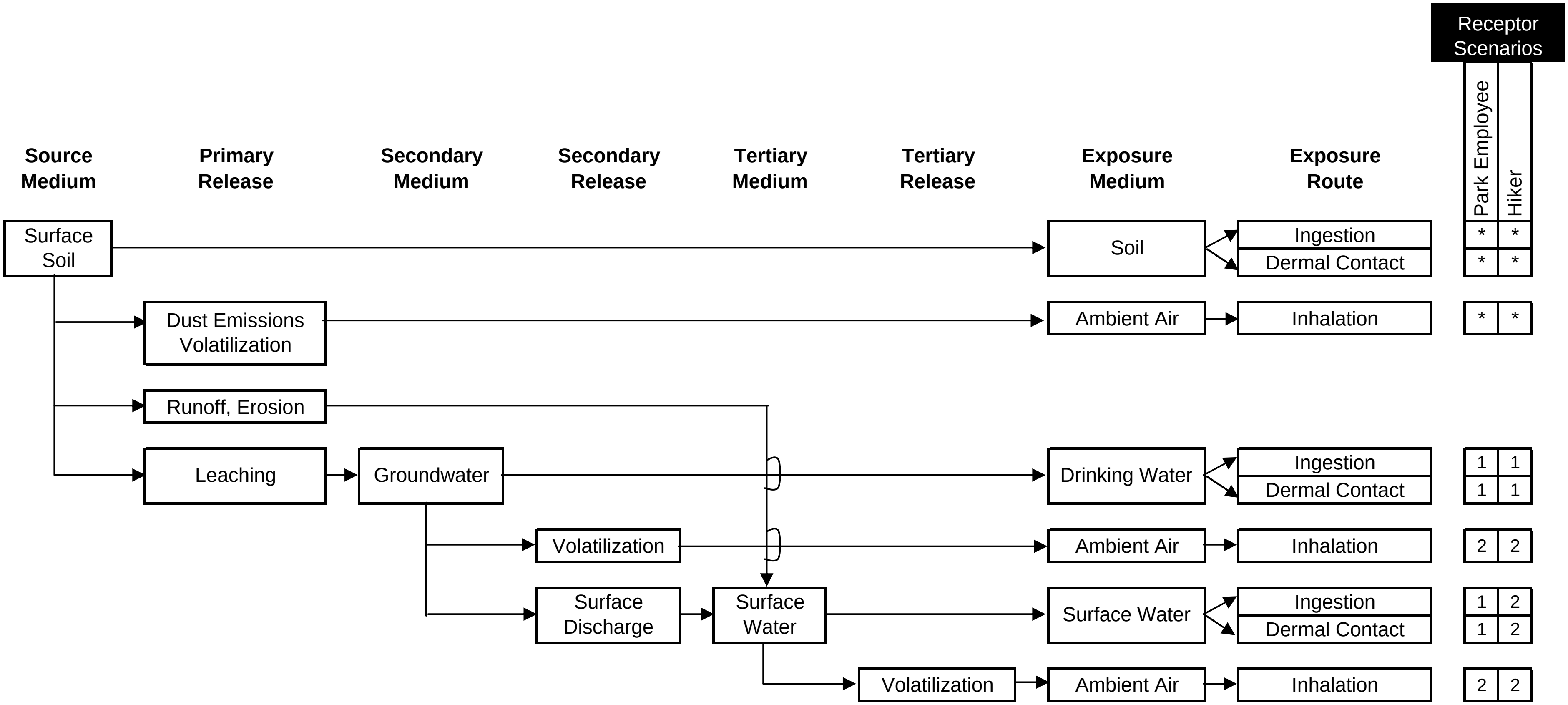
FIGURE 4–3

CROSS SECTIONS A–A', B–B' AND C–C'
MATHER WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK
CALIFORNIA

DRAWING NUMBER	APPROVED BY	CHECKED BY	DRAWN BY	OFFICE	X-REF	IMAGE
870508-B110	APC 2-23-10	BAM 2-23-10	BJ 2-23-10	CONC	---	---

Figure 5-1
Human Health Conceptual Site Exposure Model for Waste Accumulation Areas
Yosemite National Park, California



* = Complete exposure pathway evaluated in the risk assessment.
1 = Incomplete exposure pathway.
2 = Although theoretically complete, this pathway is judged to be insignificant and is not evaluated in the risk assessment.

Figure 6-1

Terrestrial Food Web Model

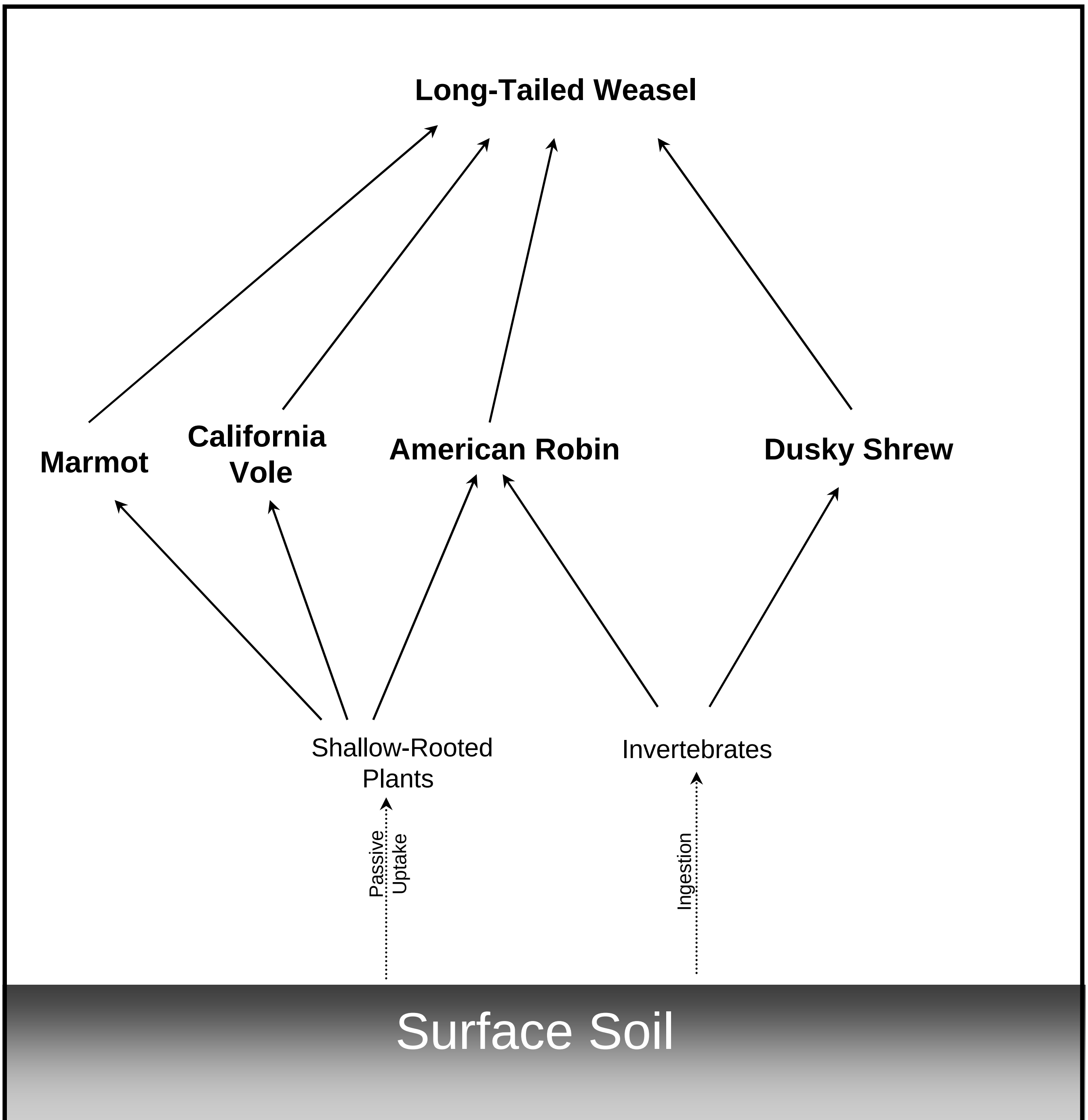
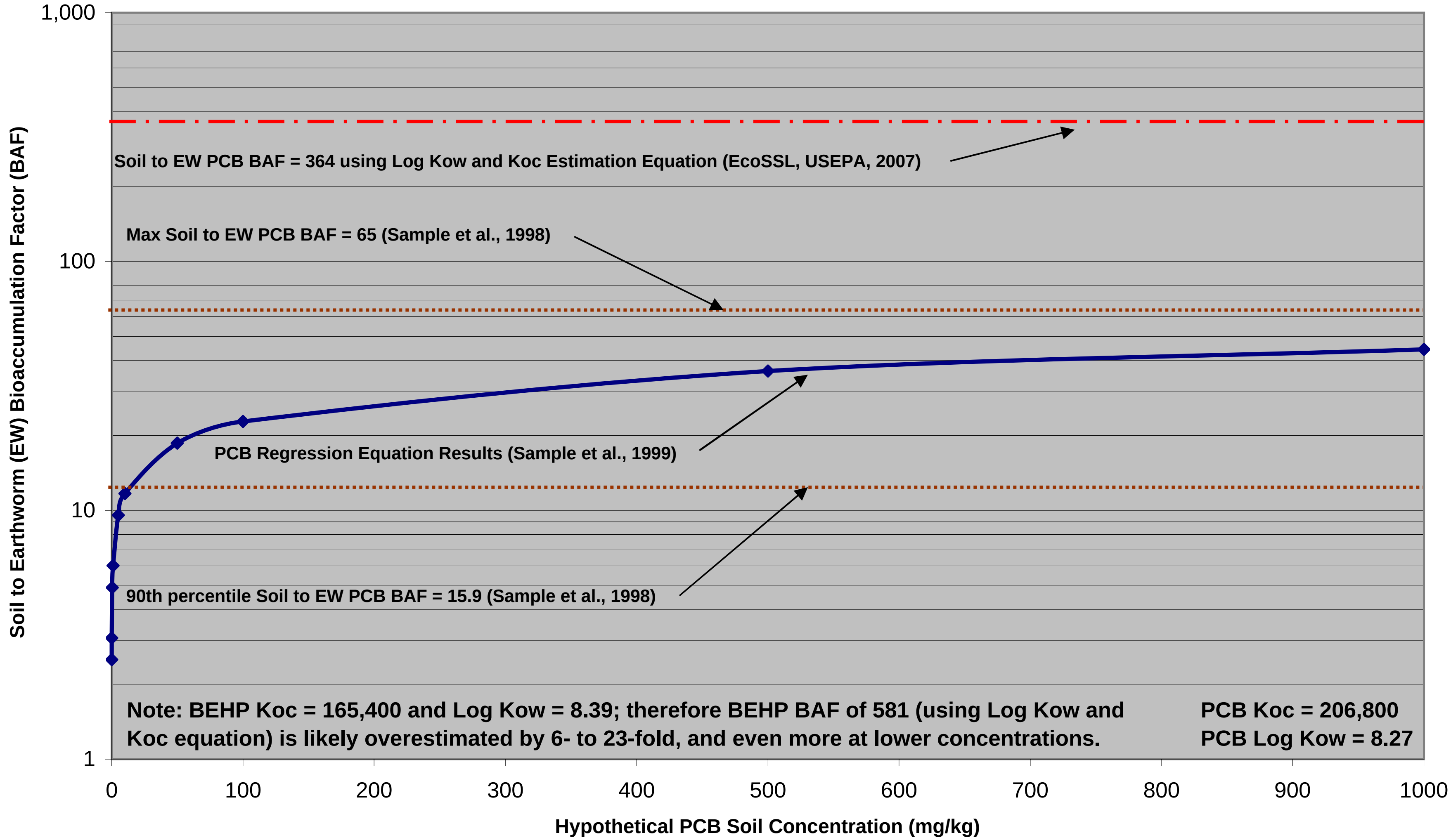


Figure 6-2. Evaluation of Soil to Earthworm Bioaccumulation Factors for Organics - Polychlorinated biphenyls (PCBs) and bis(2-ethylhexyl)phthalate (BEHP)



TABLES

TABLE 4-1: INORGANIC ANALYTICAL RESULTS FOR SOIL SAMPLES COMPARED TO REGIONAL SCREENING LEVELS
MATHER WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK, CALIFORNIA

			CAM 17 Metals by EPA Methods 6010B, 6020A and 7471A (mg/kg)																	EPA Method 7196A (mg/kg)	Other Metals by EPA Method 6020A (mg/kg)							EPA Method 9081 (MEQ/ 100gm)	EPA Method 9045
Location ID	Sample Date	Sample Depth (fbgs)	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium, Total	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc	Hexavalent Chromium	Aluminum	Calcium	Iron	Magnesium	Manganese	Potassium	Sodium	CEC	pH
YWM-UG01-SO-1043	8/27/2001	1	<20	**2.4 J**	**64.6 J**	<0.82	<0.41 UJ	**4.7 J-**	**5 J**	**3.5**	**3.5 J**	**0.034 J**	<0.82 U	**3.8 J**	<2	<2	<2 UJ	**27.5**	**27.1 J**	<0.51 UJ	--	--	--	--	--	--	--	--	--
YWM-UG02-SO-1044	8/27/2001	1	<20	**3.4 J**	**46.7 J**	<0.81	<0.41 UJ	**7.9 J-**	**6.4 J**	**10**	**5.1 J**	**0.081 J**	**0.39 J^**	**4.4 J**	<2	<2	<2 UJ	**51.2**	**40.1 J**	<0.51 UJ	--	--	--	--	--	--	--	--	--
YWM-UG03-SO-1045	8/27/2001	1	<21	**2.1 J**	**53.6 J**	<0.82	<0.41 UJ	**4.9 J-**	**6 J**	**3.9**	**3.7 J**	**0.045 J**	**0.6 J^**	**4.4 J**	<2.1	<2.1	<2.1 UJ	**28.7**	**52.8 J**	<0.51 UJ	--	--	--	--	--	--	--	--	--
YWM-TP01-SO-1042	8/27/2001	4	<20	**1.9 J**	**44 J**	<0.81	<0.41 UJ	**2.1 J-**	**5.3 J**	**7.5**	**10.7 J**	**0.88 J**	**0.2 J^**	**2.1 J**	<2	<2	<2 UJ	**20.3**	**38.8 J**	<0.51 UJ	--	--	--	--	--	--	--	--	--
YWM-TP02-SO-1048	8/27/2001	3	**0.72 J^**	**5.7 J**	**1,420 J**	<0.21	**11.8 J-**	**36.4 J-**	**5.7 J**	**87**	**1,040 J**	**0.88 J**	**0.51**	**11.9 J**	<0.53	**2.6**	<0.53 UJ	**22.1**	**1,460 J**	<0.53 UJ	--	--	--	--	--	--	--	--	--
YWM-TP02-SO-1046	8/27/2001	6	**2.4 J^**	**5.2 J**	**1,040 J**	<0.83	**3.9 J-**	**29 J-**	**6.3 J**	**107**	**600 J**	**0.67 J**	**2.3**	**8.7 J**	<2.1	**0.35 J^**	<2.1 UJ	**24.1**	**1,690 J**	<0.52 UJ	--	--	--	--	--	--	--	--	--
YWM-TP02-SO-1047 (FD)	8/27/2001	6	<21	**8.4 J**	**452 J**	<0.82	**3.5 J-**	**21.3 J-**	**6.8 J**	**63.3**	**447 J**	**1.6 J**	**0.64 J^**	**12.5 J**	**1.1 J^**	**0.75 J^**	<2.1 UJ	**21.4**	**2,120 J**	<0.51 UJ	--	--	--	--	--	--	--	--	--
YWM-TP04-SO-1037	8/27/2001	2.5	<21	**2 J**	**31.6 J**	<0.83	<0.41 UJ	**2.6 J-**	**3.4 J**	**3.5**	**3 J**	**0.052 J**	**0.21 J^**	**2.2 J**	<2.1	<2.1	<2.1 UJ	**16.3**	**25.7 J**	<0.52 UJ	--	--	--	--	--	--	--	--	--
YWM-TP05-SO-1039	8/27/2001	2.5	<21	**2.5 J**	**46.5 J**	<0.83	<0.41 UJ	**3.7 J-**	**3.8 J**	**18**	**22.4 J**	**0.049 J**	**0.26 J^**	**3.6 J**	<2.1	<2.1	<2.1 UJ	**19.9**	**24.6 J**	<0.52 UJ	--	--	--	--	--	--	--	--	--
YWM-TP05-SO-1038	8/27/2001	4.5	<21	**2 J**	**39 J**	<0.82	<0.41 UJ	**4.1 J-**	**4.2 J**	**4**	**4.8 J**	**0.031 J**	**0.61 J^**	**3.2 J**	<2.1	<2.1	<2.1 UJ	**24.2**	**27.3**	<0.51 UJ	--	--	--	--	--	--	--	--	--
YWM-DG01-SO-1050	8/28/2001	1	<21	**1.9 J**	**59.1 J**	<0.83	<0.42 UJ	**4.3 J-**	**4.5 J**	**7.4**	**7.9 J**	**0.049 J**	**0.9**	**4.6 J**	<2.1	<2.1	<2.1 UJ	**20.3**	**38.6 J**	<0.52 UJ	--	--	--	--	--	--	--	--	--
YWM-DG02-SO-1051	8/28/2001	1	<20	**1.2 J**	**35.5 J**	<0.8	<0.4 UJ	**1.7 J-**	**4 J**	**2.9**	**3.5 J**	**0.041 J**	<0.8 U	**1.7 J**	<2	<2	<2 UJ	**15.5**	**22.5 J**	<0.5 UJ	--	--	--	--	--	--	--	--	--
YWM-DG03-SO-1052	8/28/2001	1	<20	**1.8 J**	**63.5 J**	<0.82	<0.41 UJ	**3.9 J-**	**6 J**	**8.6**	**8.5 J**	**0.084 J**	**0.35 J^**	**4 J**	<2	<2	<2 UJ	**23.9**	**39.5 J**	<0.51 UJ	--	--	--	--	--	--	--	--	--
YWM02A-2268	8/26/2008	0.5	**4.63**	**6.42**	**509**	**0.147 J^**	**6.78**	**23**	**5.2**	**97.3**	**689**	**0.746**	**2.22**	**12.3**	**0.155 J^**	**0.915**	**0.406 J^**	**16.3**	**2,380**	--	**7,590**	25,600	**30,500**	2,630	**1,900**	1,710	215	--	--
YWM06-2274	8/26/2008	0.5	**0.802**	**3.04**	**149**	**0.165 J^**	**0.815**	**11**	**8.36**	**88.4**	**126**	**0.232**	**1.38**	**10.1**	**0.119 J^**	**1.07**	**0.392 J^**	**37.4**	**316**	--	**12,000**	2,820	**28,400**	5,290	**516**	5,660	187	--	--
YWM06-2276	8/26/2008	4	**0.331 J-**	**1.13**	**36.4**	**0.234 J^**	**0.211 J^**	**3.39**	**2.22**	**7.53**	**27.1 J-**	<0.104	**0.752**	**2.76**	**0.204 J^**	**0.113 J^**	**0.249 J^**	**17**	**48.1**	--	**9,470**	1,010	**8,530**	1,810	**156**	1,370	81.2 J^	16.2	6.02
YWM07-2277	8/26/2008	0.5	**2.3**	**4.41**	**346**	**0.176 J^**	**3.04**	**17.9**	**9.24**	**108**	**332**	**0.417**	**2.17**	**19.7**	**0.155 J^**	**0.776**	**0.567**	**27**	**2,420**	--	**11,200**	11,000	**40,200**	3,670	**1,240**	3,310	192	--	--
YWM07-2279	8/26/2008	5	<0.517	**1.39**	**21.1**	**0.251 J^**	<0.31	**3.75**	**1.78**	**2.2**	**3.82**	<0.103	**0.782**	**2.13**	**0.156 J^**	<0.517	**0.281 J^**	**22.4**	**19.4**	--	**12,000**	375	**10,300**	1,500	**86.6**	813	47.9 J^	--	--
YWM08-2280	8/26/2008	0.5	**0.107 J^**	**1.47**	**64.5**	**0.22 J^**	**0.186 J^**	**4.3**	**3.7**	**53.8**	**59.9**	**0.485**	**0.505 J^**	**4.15**	**0.149 J^**	<0.509	**0.361 J^**	**21**	**80.1**	--	**10,200**	1,020	**13,200**	3,270	**341**	3,190	78.9 J^	--	--
YWM08-2281	8/26/2008	2	<0.503	**1.1**	**66.3**	**0.171 J^**	**0.153 J^**	**2.66**	**4.08**	**28.9**	**30**	**0.758**	**0.384 J^**	**2.12**	**0.127 J^**	<0.503	**0.381 J^**	**23.6**	**66.2**	--	**8,940**	1,550	**14,600**	4,200	**387**	5,050	90.2 J^	--	--
YWM08-2282 (FD)	8/26/2008	2	<0.503	**0.877**	**50.7**	**0.148 J^**	**0.123 J^**	**1.98**	**3.71**	**18.4**	**11.5**	**1.14**	**0.333 J^**	**1.74**	**0.112 J^**	<0.503	**0.339 J^**	**21.3**	**49.3**	--	**7,360**	1,390	**13,200**	3,810	**384**	4,760	93.8 J^	7.11	5.72
Regional Screening Level (Residential Soil):			31	0.39	15000	160	70	280	23	3100	400	4.3	390	1500	390	390	5.1	550	23000	230	77000	NE	55000	NE	1800	NE	NE	NE	NE
Regional Screening Level (Industrial Soil			410	1.6	190000	2000	800	1400	300	41000	800	24	5100	20000	5100	5100	66	7200	310000	1400	990000	NE	720000	NE	23000	NE	NE	NE	NE

CEC: Cation-Exchange Capacity
(FD): field duplicate
fbgs: feet below ground surface

J^ Reported between method detection limit and practical quantitation limit
J The analyte was positively identified; associated numerical value is its approximate concentration in the sample.
UJ The analyte was not detected above the reporting limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
\- Bias low
NE None established

Detections shown in bold if there is an associated Regional Screening Level, circled if equal to or above Residential Regional Screening Level and boxed if equal to or above Industrial Regional Screening Level. Regional Screening Levels are from April, 2009.

TABLE 4-1: INORGANIC ANALYTICAL RESULTS FOR SOIL SAMPLES COMPARED TO REGIONAL SCREENING LEVELS
MATHER WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK, CALIFORNIA

			CAM 17 Metals by EPA Methods 6010B, 6020A and 7471A (mg/kg)																	EPA Method 7196A (mg/kg)	Other Metals by EPA Method 6020A (mg/kg)							EPA Method 9081 (MEQ/100gm)	EPA Method 9045
Location ID	Sample Date	Sample Depth (fbgs)	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium, Total	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc	Hexavalent Chromium	Aluminum	Calcium	Iron	Magnesium	Manganese	Potassium	Sodium	CEC	pH
YWM09-2284	8/26/2008	0.5	1.61	7.37	918	0.155 J^	1.5	23.6	6.45	198	617	0.358	0.969	27.9	0.197 J^	0.719	0.232 J^	20.1	1,140	--	8,900	26,900	25,300	3,650	1,300	3,050	190	--	--
YWM09-2285	8/26/2008	1.5	2.27	5.23	977	0.192 J^	3.58	28.4	5.69	260	994	1.37	1.18	9.93	0.184 J^	1.23	0.275 J^	22.7	1,930	--	9,960	31,800	29,700	4,490	1,790	3,780	293	--	--
YWM09-2286	8/26/2008	2.5	2.4	4.08	352	0.232 J^	3.06	14.3	4.26	88	9,930	0.329	0.848	7.48	0.159 J^	0.854	0.219 J^	20.6	807	--	10,300	6,220	21,000	2,800	938	1,920	123	--	--
YWM101-2287	8/26/2008	1	<0.52	2.06	46.4	0.328 J^	<0.312	5.06	3.45	5.39	8.78	<0.104	0.65	4.38	0.34 J^	<0.52	0.23 J^	24.5	34	--	15,000	617	12,200	2,790	210	1,790	57.1 J^	--	--
YWM102-2288	8/26/2008	1	<0.527	1.79	37.1	0.287 J^	<0.316	3.94	2.75	4.6	4.94	<0.105	0.652	3.94	0.34 J^	<0.527	0.198 J^	21.3	29.3	--	13,200	558	10,500	2,220	171	1,460	57.8 J^	--	--
YWM103-2289	8/26/2008	1	<0.512	1.61	55.2	0.278 J^	<0.307	4.66	3.61	5.62	4.41	<0.102	0.758	4.49	0.205 J^	<0.512	0.215 J^	21.9	37.1	--	12,500	632	11,300	2,990	267	1,840	71.2 J^	--	--
YWM104-2290	8/26/2008	1	<0.512	1.33	46.2	0.233 J^	<0.307	3.72	3.1	4.86	3.29	<0.102	0.509 J^	3.73	0.163 J^	<0.512	0.169 J^	19	31.8	--	10,000	618	9,200	2,560	203	1,520	71.5 J^	--	--
YWM105-2291	8/26/2008	1	<0.517	5.99	45.8	0.376 J^	0.144 J^	4.53	2.65	4.46	4.8	<0.103	0.793	3.49	0.279 J^	<0.517	0.169 J^	23.7	25.5	--	12,300	526	12,100	2,010	167	1,260	73.4 J^	--	--
YWM106-2292	8/26/2008	1	<0.513	1.76	41.3	0.332 J^	0.118 J^	4.26	2.99	4.37	3.99	<0.103	0.712	3.57	0.226 J^	<0.513	0.183 J^	21.3	26.3	--	12,400	507	10,400	2,140	213	1,250	55.1 J^	--	--
YWM107-2293	8/26/2008	1	<0.516	1.52	49.7	0.61	<0.31	5.15	3.13	4.47	4.54	<0.103	0.863	4.2	0.215 J^	<0.516	0.202 J^	25.5	26.6	--	13,600	479	12,700	2,150	123	1,150	59.5 J^	--	--
YWM108-2294	8/26/2008	1	0.144 J^	1.94	52.9	0.624	0.144 J^	5.65	3.14	4.87	4.84	<0.103	1.09	4.45	0.227 J^	<0.515	0.267 J^	25.9	26.5	--	15,100	767	12,500	2,180	123	1,090	72.6 J^	--	--
YWM109-2295	8/26/2008	1	0.111 J^	2.84	41.7	0.261 J^	<0.308	5.68	2.92	6.92	4.88	<0.103 U	1.47	4.09	0.402 J^	<0.513	0.259 J^	21.6	33.9	--	12,900	804	13,300	2,840	189	2,110	78.8 J^	--	--
YWM110-2296	8/26/2008	1	0.191 J^	3.59	25.6	0.119 J^	<0.31	3.38	2.23	8.81	4.31	0.0808 J^	1.02	2.76	0.464 J^	<0.517	0.161 J^	16.1	20.3 J-	--	14,300	444	7,120	1,720	104	1,200	51.7 J^	--	--
Regional Screening Level (Residential Soil):			31	0.39	15000	160	70	280	23	3100	400	4.3	390	1500	390	390	5.1	550	23000	230	77000	NE	55000	NE	1800	NE	NE	NE	NE
Regional Screening Level (Industrial Soil			410	1.6	190000	2000	800	1400	300	41000	800	24	5100	20000	5100	5100	66	7200	310000	1400	990000	NE	720000	NE	23000	NE	NE	NE	NE

CEC: Cation-Exchange Capacity
(FD): field duplicate
fbgs: feet below ground surface

J^ Reported between method detection limit and practical quantitation limit
J The analyte was positively identified; associated numerical value is its approximate concentration in the sample.
UJ The analyte was not detected above the reporting limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
\- Bias low
NE None established

Detections shown in bold if there is an associated Regional Screening Level, circled if equal to or above Residential Regional Screening Level and boxed if equal to or above Industrial Regional Screening Level. Regional Screening Levels are from April, 2009.

TABLE 4-2: TOTAL PETROLEUM HYDROCARBONS IN SOIL SAMPLES
MATHER WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK, CALIFORNIA

Location ID	Sample Date	Sample Depth (fbgs)	EPA METHOD 8015B (mg/kg)				
			TPH-diesel	TPH-diesel (SGC)	TPH-motor oil	TPH-motor oil (SGC)	TPH-gasoline
YWM-UG01-SO-1043	8/27/2001	1-1.5	<10	**3 J^**	**18**	**11**	--
YWM-UG02-SO-1044	8/27/2001	1-1.5	**3 J^**	**3 J^**	**41**	**31**	--
YWM-UG03-SO-1045	8/27/2001	1-1.5	<10	**3 J^**	**35**	**29**	--
YWM-TP01-SO-1042	8/27/2001	4-4.5	<10	**4 J^**	**22**	**21**	--
YWM-TP02-SO-1048	8/27/2001	3-3.5	**9 J^**	**8 J-**	**110**	**86**	--
YWM-TP02-SO-1046	8/27/2001	6-6.5	**9 J^**	**7 J^**	**57**	**47**	--
YWM-TP02-SO-1047 (FD)	8/27/2001	6-6.5	**3 J^**	**5 J^**	**37**	**32**	--
YWM-TP04-SO-1037	8/27/2001	2.5-3	**6 J^**	**5 J^**	**32**	**21**	--
YWM-TP05-SO-1040	8/27/2001	1-1.5	**5,800 J^**	**4,100 J^**	**140,000**	**110,000**	--
YWM-TP05-SO-1039	8/27/2001	2.5-3	**230**	**170 J^**	**4,290**	**3,400**	--
YWM-TP05-SO-1038	8/27/2001	4.5-5	**3 J^**	**4 J^**	**46**	**39**	--
YWM-DG01-SO-1050	8/28/2001	1-1.5	**73**	**20 J^**	**250**	**120**	--
YWM-DG02-SO-1051	8/28/2001	1-1.5	**4 J^**	**4 J^**	**50**	**29**	--
YWM-DG03-SO-1052	8/28/2001	1-1.5	**16**	**8 J^**	**110**	**62**	--
YWM02A-2268	8/26/2008	0.5	--	<10	--	<10	<1
YWM05A-2271	8/26/2008	1.5	--	**4,800**	--	**88,000**	--
YWM06-2274	8/26/2008	0.5	--	**89**	--	**2,000**	<1.2
YWM06-2276	8/26/2008	4	--	**9.9 J^**	--	**170**	**1.3**

	TPH-diesel	TPH-diesel (SGC)	TPH-motor oil	TPH-motor oil (SGC)	TPH-gasoline
MADEP Cleanup Standards for soil:	5,000	5,000	5,000	5,000	5,000
RWQCB Risk Based Screening Level:	500	500	1,000	1,000	1,000

(FD): field duplicate
fbgs: feet below ground surface
SGC: with silica gel cleanup
MADEP: Massachusetts Department of Environmental Protection
RWQCB: Regional Water Quality Control Board

J^ Reported between method detection limit and practical quantitation limit

Detections shown in bold, circled if equal to or above either regulatory limit.

TABLE 4-2: TOTAL PETROLEUM HYDROCARBONS IN SOIL SAMPLES
MATHER WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK, CALIFORNIA

Location ID	Sample Date	Sample Depth (fbgs)	EPA METHOD 8015B (mg/kg)				
			TPH-diesel	TPH-diesel (SGC)	TPH-motor oil	TPH-motor oil (SGC)	TPH-gasoline
YWM07-2277	8/26/2008	0.5	--	**31**	--	**740**	**2.5**
YWM07-2279	8/26/2008	5	--	<10	--	<10	<1.3
YWM08-2280	8/26/2008	0.5	--	<10	--	<10	<1.5
YWM08-2281	8/26/2008	2	--	<10	--	<10	<1.1
YWM08-2282 (FD)	8/26/2008	2	--	<10	--	<10	<1.1
YWM09-2284	8/26/2008	0.5	--	<10	--	<10	<1.3
YWM09-2285	8/26/2008	1.5	--	<10	--	<10	<1.1
YWM09-2286	8/26/2008	2.5	--	<10	--	<10	<1.2

MADEP Cleanup Standards for soil:	5,000	5,000	5,000	5,000	5,000
RWQCB Risk Based Screening Level:	500	500	1,000	1,000	1,000

(FD): field duplicate
fbgs: feet below ground surface
SGC: with silica gel cleanup
MADEP: Massachusetts Department of Environmental Protection
RWQCB: Regional Water Quality Control Board

J^ Reported between method detection limit and practical quantitation limit

Detections shown in bold, circled if equal to or above either regulatory limit.

TABLE 4-3: ORGANIC ANALYTICAL RESULTS FOR SOIL SAMPLES COMPARED TO REGIONAL SCREENING LEVELS
MATHER WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK, CALIFORNIA

Location ID	Sample Date	Sample Depth (fbgs)	VOCs (µg/kg) EPA Method 8260B		SVOCs (µg/kg) EPA Method 8270C		PAHS (µg/kg) EPA Methods 8310 and 8270C SIM												TOC (mg/kg) Method WBLACK
			Acetone	Methylene chloride	Bis(2-ethylhexyl) phthalate	Pentachlorophenol	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene	Total Organic Carbon
YWM-UG01-SO-1043	8/27/2001	1-1.5	--	--	--	--	<2	<2	<2	<2	<2	<2	<2	<5.1	<2	<2	<2	<2	--
YWM-UG02-SO-1044	8/27/2001	1-1.5	--	--	--	--	<2	<2	<2	<2	<2	<2	<2	<5.1	<2	<2	<2	<2	--
YWM-UG03-SO-1045	8/27/2001	1-1.5	--	--	--	--	<2.1	<2.1	<2.1	<2.1	<2.1	<2.1	<2.1	<5.1	<2.1	<2.1	<2.1	<2.1	--
YWM-TP01-SO-1042	8/27/2001	4-4.5	--	--	--	--	<2	<2	<2	<2	<2	<2	**1 J^**	<5.1	<2	<2	<2	<2	--
YWM-TP02-SO-1049	8/27/2001	1.5-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
YWM-TP02-SO-1048	8/27/2001	3-3.5	--	--	--	--	**1 J^**	**7.2**	**15**	**15**	<2.1	**9.1**	**17**	**17 J-**	**31**	**11**	13	**44**	--
YWM-TP02-SO-1046	8/27/2001	6-6.5	--	--	--	--	<2.1	<2.1	**3**	**2.11**	<2.1	<2.1	**6.7**	<5.2	<2.1	<2.1	1 J^	<2.1	--
YWM-TP02-SO-1047 (FD)	8/27/2001	6-6.5	--	--	--	--	<10	**10**	**34**	**28**	<10	<10	**35**	**30**	**39**	**20**	20	**39**	--
YWM-TP04-SO-1037	8/27/2001	2.5-3	--	--	--	--	<2.1	<2.1	<2.1	<2.1	<2.1	<2.1	**1 J^**	<5.2	<2.1	<2.1	<2.1	<2.1	--
YWM-TP05-SO-1041	8/27/2001	1-1.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
YWM-TP05-SO-1039	8/27/2001	2.5-3	--	--	--	--	<41	<41	<41	<41	<41	<41	<41	<100	<41	<41	<41	<41	--
YWM-TP05-SO-1038	8/27/2001	4.5-5	--	--	--	--	<2.1	<2.1	<2.1	<2.1	<2.1	<2.1	<2.1	<5.1	<2.1	<2.1	<2.1	<2.1	--
YWM-DG01-SO-1050	8/28/2001	1-1.5	--	--	--	--	<2.1	<2.1	<2.1	<2.1	<2.1	<2.1	**6.9**	<5.2	<2.1	<2.1	<2.1	**7.6**	--
YWM-DG02-SO-1051	8/28/2001	1-1.5	--	--	--	--	<2	<2	<2	<2	<2	<2	**1 J^**	<5	<2	<2	<2	<2	--
YWM-DG03-SO-1052	8/28/2001	1-1.5	--	--	--	--	<2	<2	<2	<2	<2	<2	**3**	<5.1	<2	<2	<2	<2	--
YWM02A-2268	8/26/2008	0.5-0.5	**15**	**2.6 J^**	<340	**190 J^**	<5.2	<5.2	<5.2	<5.2	7	<5.2	<5.2	<5.2	**5.2**	**5.2**	<5.2	**4.6 J^**	--
YWM05A-2271	8/26/2008	1.5-1.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
YWM06-2274	8/26/2008	0.5-0.5	**5.6 J+**	<10	<660	<1,300	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	--
YWM06-2276	8/26/2008	4-4	**44**	<11	<340	<680	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	9510
YWM07-2277	8/26/2008	0.5-0.5	<18 UJ	**7.2 J+**	<690	<1,400	<10	<10	**62**	<10	78	<10	**51**	**49**	<10	<10	<10	**19**	--
YWM07-2279	8/26/2008	5-5	<14	<14	<340	<680	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	--
Regional Screening Level (Residential Soil):			61000000	11000	35000	3000	17000000	150	15	150	NE	1500	15000	15	2300000	150	NE	1700000	NE
Regional Screening Level (Industrial Soil):			610000000	54000	120000	9000	170000000	2100	210	2100	NE	21000	210000	210	22000000	2100	NE	17000000	NE

WBLACK: Walkley-Black
(FD): field duplicate
fbgs: feet below ground surface

J^ Reported between method detection limit and practical quantitation limit
J The analyte was positively identified; associated numerical value is its approximate concentration in the sample.
UJ The analyte was not detected above the reporting limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
-/+ Bias low or bias high, respectively
NE None established

Detections shown in bold if there is an associated Regional Screening Level, circled if equal to or above Residential Regional Screening Level and boxed if equal to or above Industrial Regional Screening Level. Regional Screening Levels are from April, 2009.

TABLE 4-3: ORGANIC ANALYTICAL RESULTS FOR SOIL SAMPLES COMPARED TO REGIONAL SCREENING LEVELS
MATHER WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK, CALIFORNIA

			VOCs (µg/kg) EPA Method 8260B		SVOCs (µg/kg) EPA Method 8270C		PAHS (µg/kg) EPA Methods 8310 and 8270C SIM												TOC (mg/kg) Method WBLACK
Location ID	**Sample Date**	**Sample Depth (fbgs)**	Acetone	Methylene chloride	Bis(2-ethylhexyl) phthalate	Pentachlorophenol	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene	Total Organic Carbon
YWM08-2280	8/26/2008	0.5-0.5	<11	<11	**240 J^**	<670	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	--
YWM08-2281	8/26/2008	2-2	<11	<11	<330	<660	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	--
YWM08-2282 (FD)	8/26/2008	2-2	<11	<11	<330	<660	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	2010
YWM09-2284	8/26/2008	0.5-0.5	<10	<10	**720**	<690	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	--
YWM09-2285	8/26/2008	1.5-1.5	<13	**2.7 J+**	**290 J^**	<670	**6**	**19**	**16**	**24**	11	**7.1**	**17**	<5.1	**50**	**10**	38	**40**	--
YWM09-2286	8/26/2008	2.5-2.5	<14	<14	<340	<680	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	--
YWM101-2287	8/26/2008	1-1	--	--	--	--	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	--
YWM102-2288	8/26/2008	1-1	--	--	--	--	<5.3	<5.3	<5.3	<5.3	<5.3	<5.3	<5.3	<5.3	<5.3	<5.3	<5.3	<5.3	--
YWM103-2289	8/26/2008	1-1	--	--	--	--	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	--
YWM104-2290	8/26/2008	1-1	--	--	--	--	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	--
YWM105-2291	8/26/2008	1-1	--	--	--	--	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	--
YWM106-2292	8/26/2008	1-1	--	--	--	--	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	--
YWM107-2293	8/26/2008	1-1	--	--	--	--	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	--
YWM108-2294	8/26/2008	1-1	--	--	--	--	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	--
YWM109-2295	8/26/2008	1-1	--	--	--	--	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	--
YWM110-2296	8/26/2008	1-1	--	--	--	--	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	--
Regional Screening Level (Residential Soil):			61000000	11000	35000	3000	17000000	150	15	150	NE	1500	15000	15	2300000	150	NE	1700000	NE
Regional Screening Level (Industrial Soil):			610000000	54000	120000	9000	170000000	2100	210	2100	NE	21000	210000	210	22000000	2100	NE	17000000	NE

WBLACK: Walkley-Black
(FD): field duplicate
fbgs: feet below ground surface

J^ Reported between method detection limit and practical quantitation limit
J The analyte was positively identified; associated numerical value is its approximate concentration in the sample.
UJ The analyte was not detected above the reporting limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
-/+ Bias low or bias high, respectively
NE None established

Detections shown in bold if there is an associated Regional Screening Level, circled if equal to or above Residential Regional Screening Level and boxed if equal to or above Industrial Regional Screening Level. Regional Screening Levels are from April, 2009.

TABLE 4-4: DIOXINS AND FURANS IN SOIL SAMPLES AND 2,3,7,8-TCDD TOXIC EQUIVALENCE CALCULATIONS MATHER WASTE ACCUMULATION AREA YOSEMITE NATIONAL PARK, CALIFORNIA

Location ID	Sample Date	Analyte Group	Compound	Result		TEQ Factor	TEQ Result	Units
YWM-UG02-SO-1044	**8/27/2001**							
		Dioxins	1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin	3.5		0.01	0.035	PG/G
			1,2,3,4,7,8-hexachlorodibenzo-p-dioxin	0	ND	0.1	0	PG/G
			1,2,3,6,7,8-hexachlorodibenzo-p-dioxin	0	ND	0.1	0	PG/G
			1,2,3,7,8,9-hexachlorodibenzo-p-dioxin	0	ND	0.1	0	PG/G
			1,2,3,7,8-pentachlorodibenzo-p-dioxin	0	ND	0.5	0	PG/G
			2,3,7,8-tetrachlorodibenzo-p-dioxin	0	ND	1	0	PG/G
			Octachlorodibenzo-p-Dioxin	8.4		0.001	0.0084	PG/G
						Dioxins SubTotal:	0.0434	PG/G
		Furans	1,2,3,4,6,7,8-heptachlorodibenzofuran	0	ND	0.01	0	PG/G
			1,2,3,4,7,8,9-heptachlorodibenzofuran	0	ND	0.01	0	PG/G
			1,2,3,4,7,8-hexachlorodibenzofuran	0	ND	0.1	0	PG/G
			1,2,3,6,7,8-hexachlorodibenzofuran	0	ND	0.1	0	PG/G
			1,2,3,7,8,9-hexachlorodibenzofuran	0	ND	0.1	0	PG/G
			1,2,3,7,8-pentachlorodibenzofuran	0	ND	0.05	0	PG/G
			2,3,4,6,7,8-hexachlorodibenzofuran	0	ND	0.1	0	PG/G
			2,3,4,7,8-pentachlorodibenzofuran	0	ND	0.5	0	PG/G
			2,3,7,8-tetrachlorodibenzofuran	0	ND	0.1	0	PG/G
			Octachlorodibenzofuran	0	ND	0.001	0	PG/G
						Furans SubTotal:	0	PG/G
						YWM-UG02-SO-1044 TEQ:	**0.0434**	**PG/G**
Regional Screening Level (Residential soil):						**2,3,7,8-tetrachlorodibenzo-p-dioxin:**	**4.5**	**PG/G**
Regional Screening Level (Industrial soil):						**2,3,7,8-tetrachlorodibenzo-p-dioxin:**	**18**	**PG/G**

TABLE 4-4: DIOXINS AND FURANS IN SOIL SAMPLES AND 2,3,7,8-TCDD TOXIC EQUIVALENCE CALCULATIONS MATHER WASTE ACCUMULATION AREA YOSEMITE NATIONAL PARK, CALIFORNIA

Location ID	Sample Date	Analyte Group	Compound	Result		TEQ Factor	TEQ Result	Units
YWM-TP02-SO-1049	**8/27/2001**							
		Dioxins	1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin	210		0.01	2.1	PG/G
			1,2,3,4,7,8-hexachlorodibenzo-p-dioxin	3.8		0.1	0.38	PG/G
			1,2,3,6,7,8-hexachlorodibenzo-p-dioxin	14		0.1	1.4	PG/G
			1,2,3,7,8,9-hexachlorodibenzo-p-dioxin	10		0.1	1	PG/G
			1,2,3,7,8-pentachlorodibenzo-p-dioxin	3.7		0.5	1.85	PG/G
			2,3,7,8-tetrachlorodibenzo-p-dioxin	0.9		1	0.9	PG/G
			Octachlorodibenzo-p-Dioxin	580		0.001	0.58	PG/G
						Dioxins SubTotal:	8.21	PG/G
		Furans	1,2,3,4,6,7,8-heptachlorodibenzofuran	16		0.01	0.16	PG/G
			1,2,3,4,7,8,9-heptachlorodibenzofuran	0	ND	0.01	0	PG/G
			1,2,3,4,7,8-hexachlorodibenzofuran	3.3		0.1	0.33	PG/G
			1,2,3,6,7,8-hexachlorodibenzofuran	2.6		0.1	0.26	PG/G
			1,2,3,7,8,9-hexachlorodibenzofuran	0	ND	0.1	0	PG/G
			1,2,3,7,8-pentachlorodibenzofuran	2.9		0.05	0.145	PG/G
			2,3,4,6,7,8-hexachlorodibenzofuran	0	ND	0.1	0	PG/G
			2,3,4,7,8-pentachlorodibenzofuran	3.3		0.5	1.65	PG/G
			2,3,7,8-tetrachlorodibenzofuran	3.7		0.1	0.37	PG/G
			Octachlorodibenzofuran	14		0.001	0.014	PG/G
						Furans SubTotal:	2.929	PG/G
						YWM-TP02-SO-1049 TEQ:	**11.139**	**PG/G**
Regional Screening Level (Residential soil):						**2,3,7,8-tetrachlorodibenzo-p-dioxin:**	**4.5**	**PG/G**
Regional Screening Level (Industrial soil):						**2,3,7,8-tetrachlorodibenzo-p-dioxin:**	**18**	**PG/G**

TABLE 4-4: DIOXINS AND FURANS IN SOIL SAMPLES AND 2,3,7,8-TCDD TOXIC EQUIVALENCE CALCULATIONS MATHER WASTE ACCUMULATION AREA YOSEMITE NATIONAL PARK, CALIFORNIA

Location ID	Sample Date	Analyte Group	Compound	Result		TEQ Factor	TEQ Result	Units
YWM-TP05-SO-1041	**8/27/2001**							
		Dioxins	1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin	4.7		0.01	0.047	PG/G
			1,2,3,4,7,8-hexachlorodibenzo-p-dioxin	0	ND	0.1	0	PG/G
			1,2,3,6,7,8-hexachlorodibenzo-p-dioxin	0	ND	0.1	0	PG/G
			1,2,3,7,8,9-hexachlorodibenzo-p-dioxin	0	ND	0.1	0	PG/G
			1,2,3,7,8-pentachlorodibenzo-p-dioxin	0	ND	0.5	0	PG/G
			2,3,7,8-tetrachlorodibenzo-p-dioxin	0	ND	1	0	PG/G
			Octachlorodibenzo-p-Dioxin	22		0.001	0.022	PG/G
						Dioxins SubTotal:	0.069	PG/G
		Furans	1,2,3,4,6,7,8-heptachlorodibenzofuran	0	ND	0.01	0	PG/G
			1,2,3,4,7,8,9-heptachlorodibenzofuran	0	ND	0.01	0	PG/G
			1,2,3,4,7,8-hexachlorodibenzofuran	0	ND	0.1	0	PG/G
			1,2,3,6,7,8-hexachlorodibenzofuran	0	ND	0.1	0	PG/G
			1,2,3,7,8,9-hexachlorodibenzofuran	0	ND	0.1	0	PG/G
			1,2,3,7,8-pentachlorodibenzofuran	0	ND	0.05	0	PG/G
			2,3,4,6,7,8-hexachlorodibenzofuran	0	ND	0.1	0	PG/G
			2,3,4,7,8-pentachlorodibenzofuran	0	ND	0.5	0	PG/G
			2,3,7,8-tetrachlorodibenzofuran	0	ND	0.1	0	PG/G
			Octachlorodibenzofuran	0	ND	0.001	0	PG/G
						Furans SubTotal:	0	PG/G
						YWM-TP05-SO-1041 TEQ:	**0.069**	**PG/G**
Regional Screening Level (Residential soil):						**2,3,7,8-tetrachlorodibenzo-p-dioxin:**	**4.5**	**PG/G**
Regional Screening Level (Industrial soil):						**2,3,7,8-tetrachlorodibenzo-p-dioxin:**	**18**	**PG/G**

NOTES:

PG/G: picograms per gram
ND: Non-detect result
TEQ: Toxicity Equivalence (Risk Based). See Reference (Cancer Potency Factor Update DTSC/Sacramento CalEPA, 1997)

TABLE 5-1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil

CAS Number	Chemical Units mg/kg except where specified	Minimum Concentration mg/kg	Maximum Concentration* mg/kg	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Bkgd Value (1)	Screening Toxicity Value mg/kg	Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (2)
Exposure Point: Soil, 0-2 feet											
--	2,3,7,8-TCDD TEQ	6.90E-08	**1.11E-05**	YWM-TP02-SO-1049	2/2	N/A	N/A	4.60E-06	A-ca	**Yes**	DET, TEQ, ASL
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran	1.60E-05	**1.60E-05**	YWM-TP02-SO-1049	1/2	4.60E-07 - 4.60E-07	N/A	N/A	N/A	No	TEQ
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	4.70E-06 J	**2.10E-04**	YWM-TP02-SO-1049	2/2	N/A	N/A	N/A	N/A	No	TEQ
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran				0/2	1.80E-07 - 1.10E-06	N/A	N/A	N/A	No	TEQ
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran	3.30E-06 J	**3.30E-06 J**	YWM-TP02-SO-1049	1/2	1.60E-07 - 1.60E-07	N/A	N/A	N/A	No	TEQ
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	3.80E-06 J	**3.80E-06 J**	YWM-TP02-SO-1049	1/2	1.80E-07 - 1.80E-07	N/A	N/A	N/A	No	TEQ
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran	2.60E-06 J	**2.60E-06 J**	YWM-TP02-SO-1049	1/2	1.60E-07 - 1.60E-07	N/A	N/A	N/A	No	TEQ
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1.40E-05	**1.40E-05**	YWM-TP02-SO-1049	1/2	3.90E-07 - 3.90E-07	N/A	N/A	N/A	No	TEQ
72918-21-9	1,2,3,7,8,9-Hexachlorodibenzofuran				0/2	1.90E-07 - 2.30E-07	N/A	N/A	N/A	No	TEQ
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1.00E-05	**1.00E-05**	YWM-TP02-SO-1049	1/2	4.10E-07 - 4.10E-07	N/A	N/A	N/A	No	TEQ
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran	2.90E-06 J	**2.90E-06 J**	YWM-TP02-SO-1049	1/2	1.90E-07 - 1.90E-07	N/A	N/A	N/A	No	TEQ
40321-76-4	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	3.70E-06 J	**3.70E-06 J**	YWM-TP02-SO-1049	1/2	4.20E-07 - 4.20E-07	N/A	N/A	N/A	No	TEQ
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran	3.70E-06	**3.70E-06**	YWM-TP02-SO-1049	1/2	2.10E-07 - 2.10E-07	N/A	N/A	N/A	No	TEQ
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran				0/2	1.70E-07 - 2.40E-06	N/A	N/A	N/A	No	TEQ
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran	3.30E-06 J	**3.30E-06 J**	YWM-TP02-SO-1049	1/2	1.80E-07 - 1.80E-07	N/A	N/A	N/A	No	TEQ
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin	9.00E-07 J	**9.00E-07 J**	YWM-TP02-SO-1049	1/2	1.70E-07 - 1.70E-07	N/A	N/A	N/A	No	TEQ
37871-00-4	HPCDD	7.90E-06	**3.60E-04**	YWM-TP02-SO-1049	2/2	N/A	N/A	N/A	N/A	No	TEQ
38998-75-3	HPCDF	2.80E-05	**2.80E-05**	YWM-TP02-SO-1049	1/2	7.10E-07 - 7.10E-07	N/A	N/A	N/A	No	TEQ
34465-46-8	HXCDD	1.10E-04	**1.10E-04**	YWM-TP02-SO-1049	1/2	7.50E-07 - 7.50E-07	N/A	N/A	N/A	No	TEQ
55684-94-1	HXCDF	1.70E-05	**1.70E-05**	YWM-TP02-SO-1049	1/2	1.90E-07 - 1.90E-07	N/A	N/A	N/A	No	TEQ
3268-87-9	OCDD	2.20E-05	**5.80E-04**	YWM-TP02-SO-1049	2/2	N/A	N/A	N/A	N/A	No	TEQ
39001-02-0	OCDF	1.40E-05	**1.40E-05**	YWM-TP02-SO-1049	1/2	1.30E-06 - 1.30E-06	N/A	N/A	N/A	No	TEQ
36088-22-9	PECDD	5.30E-05	**5.30E-05**	YWM-TP02-SO-1049	1/2	4.20E-07 - 4.20E-07	N/A	N/A	N/A	No	TEQ
30402-15-4	PECDF	2.60E-05	**2.60E-05**	YWM-TP02-SO-1049	1/2	2.40E-07 - 2.40E-07	N/A	N/A	N/A	No	TEQ
41903-57-5	TCDD	1.40E-06	**5.50E-05**	YWM-TP02-SO-1049	2/2	N/A	N/A	N/A	N/A	No	TEQ
30402-14-3	TCDF	5.50E-05	**5.50E-05**	YWM-TP02-SO-1049	1/2	2.10E-07 - 2.10E-07	N/A	N/A	N/A	No	TEQ
67-64-1	Acetone	5.60E-03 J	**1.50E-02**	YWM02A-2268	2/7	1.00E-02 - 1.80E-02	N/A	1,400	B-nc	No	DET, J, BSL

TABLE 5-1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil

CAS Number	Chemical Units mg/kg except where specified	Minimum Concentration mg/kg	Maximum Concentration* mg/kg	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Bkgd Value (1)	Screening Toxicity Value mg/kg	Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (2)
7429-90-5	Aluminum	7.59E+03	**1.20E+04**	YWM06-2274	7/7	N/A	N/A	7,700	C-nc	No	DET, ASL, BKG
120-12-7	Anthracene	6.00E-03	**6.00E-03**	YWM09-2285	1/10	2.00E-03 - 1.00E-02	N/A	2.20E+04	A-nc	No	DET, BSL
7440-36-0	Antimony	1.07E-01 J	**4.63E+00**	YWM02A-2268	6/10	5.03E-01 - 2.10E+01	N/A	3	A-nc	**Yes**	DET, ASL
7440-38-2	Arsenic	9.89E-01	**7.37E+00**	YWM09-2284	10/10	N/A	N/A	0.07	A-ca	**Yes**	DET, ASL
7440-39-3	Barium	3.55E+01 J	**9.77E+02**	YWM09-2285	10/10	N/A	N/A	520	A-nc	**Yes**	DET, ASL
56-55-3	Benzo(a)anthracene	1.90E-02	**1.90E-02**	YWM09-2285	1/10	2.00E-03 - 1.00E-02	N/A	0.62	B-ca	No	DET, BSL
50-32-8	Benzo(a)pyrene	1.60E-02	**6.20E-02**	YWM07-2277	2/10	2.00E-03 - 1.00E-02	N/A	3.80E-02	A-ca	**Yes**	DET, ASL
205-99-2	Benzo(b)fluoranthene	2.40E-02	**2.40E-02**	YWM09-2285	1/10	2.00E-03 - 1.00E-02	N/A	0.62	B-ca	No	DET, BSL
191-24-2	Benzo(g,h,i)perylene	7.00E-03	**7.80E-02**	YWM07-2277	3/10	2.00E-03 - 1.00E-02	N/A	N/A	NL	**Yes**	DET
207-08-9	Benzo(k)fluoranthene [CAL-modified]	7.10E-03	**7.10E-03**	YWM09-2285	1/10	2.00E-03 - 1.00E-02	N/A	0.38	B-ca	No	DET, BSL
7440-41-7	Beryllium	1.47E-01 J	**2.20E-01 J**	YWM08-2280	7/10	8.00E-01 - 8.30E-01	N/A	15	A-nc	No	J, BSL, BKG
117-81-7	bis(2-Ethylhexyl) phthalate	2.40E-01 J	**7.20E-01**	YWM09-2284	3/7	3.30E-01 - 6.90E-01	N/A	35	B-ca	No	DET, BSL
7440-43-9	Cadmium	1.38E-01 J	**6.78E+00**	YWM02A-2268	7/10	4.00E-01 - 4.20E-01	N/A	1.7	A-ca	**Yes**	DET, ASL
7440-70-2	Calcium	1.02E+03	**3.18E+04**	YWM09-2285	7/7	N/A	N/A	N/A	NL	No	NUT
7440-47-8	Chromium (total)	1.70E+00 J	**2.84E+01**	YWM09-2285	10/10	N/A	N/A	10,000	A-nc	No	J, DET, BSL
218-01-9	Chrysene [CAL-Modified]	1.00E-03 J	**5.10E-02**	YWM07-2277	5/10	5.00E-03 - 1.00E-02	N/A	3.8	B-ca	No	DET, BSL
7440-48-4	Cobalt	3.70E+00	**9.24E+00**	YWM07-2277	10/10	N/A	N/A	66	A-nc	No	DET, BSL
7440-50-8	Copper	2.90E+00	**2.60E+02**	YWM09-2285	10/10	N/A	N/A	300	A-nc	No	DET, BSL
53-70-3	Dibenz(a,h)anthracene	4.90E-02	**4.90E-02**	YWM07-2277	1/10	5.00E-03 - 1.00E-02	N/A	0.062	B-ca	No	DET, BSL
YWM-01	Diesel fuel (with silica gel cleanup)	4.00E+00 J	**4.80E+03**	YWM05A-2271	7/12	1.00E+01 - 1.00E+01	N/A	N/A	NL	**Yes**	DET
YWM-02	Diesel fuel (without silica gel cleanup)	4.00E+00 J	**5.80E+03 J**	YWM-TP05-SO-1040	4/4	N/A	N/A	N/A	NL	No	J, GEL
206-44-0	Fluoranthene	5.20E-03	**5.00E-02**	YWM09-2285	2/10	2.00E-03 - 1.00E-02	N/A	230	B-nc	No	DET, BSL
193-39-5	Indeno(1,2,3-cd)pyrene	5.20E-03	**1.00E-02 U**	YWM07-2277	2/10	2.00E-03 - 1.00E-02	N/A	0.62	B--ca	No	ND
7439-89-6	Iron	1.32E+04	**4.02E+04**	YWM07-2277	7/7	N/A	N/A	2,300	B-nc	**Yes**	DET, ASL
7439-92-1	Lead	3.50E+00 J	**9.94E+02**	YWM09-2285	10/10	N/A	N/A	15	A-nc	**Yes**	DET, ASL
7439-95-4	Magnesium	2.63E+03	**5.29E+03**	YWM06-2274	7/7	N/A	N/A	N/A		No	NUT, GEO
7439-96-5	Manganese	3.41E+02	**1.90E+03**	YWM02A-2268	7/7	N/A	N/A	180	B-nc	**Yes**	DET, ASL
7439-97-6	Mercury (Inorganic)	4.10E-02 J	**1.37E+00**	YWM09-2285	10/10	N/A	N/A	1.8	A-nc	No	DET, BSL

TABLE 5-1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil

CAS Number	Chemical Units mg/kg except where specified	Minimum Concentration mg/kg	Maximum Concentration* mg/kg	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Bkgd Value (1)	Screening Toxicity Value mg/kg	Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (2)
75-09-2	Methylene chloride	2.60E-03 J	**7.20E-03 J**	YWM07-2277	3/7	1.00E-02 - 1.10E-02	N/A	9.1	B-ca	No	J, DET, BSL
7439-98-7	Molybdenum	3.50E-01 J	**2.22E+00**	YWM02A-2268	9/10	8.00E-01 - 8.00E-01	N/A	38	A-nc	No	J, DET, BSL
YWM-03	Motor Oils (with silica gel cleanup)	2.90E+01	**1.10E+05**	YWM-TP05-SO-1040	7/12	1.00E+01 - 1.00E+01	N/A	N/A		**Yes**	DET
YWM-04	Motor Oils (without silica gel cleanup)	5.00E+01	**1.40E+05**	YWM-TP05-SO-1040	4/4	N/A	N/A	N/A	NL	No	DET, GEL
7440-02-0	Nickel	1.70E+00 J	**2.79E+01**	YWM09-2284	10/10	N/A	N/A	160	A-nc	No	DET, BSL
87-86-5	Pentachlorophenol	1.90E-01 J	**1.90E-01 J**	YWM02A-2268	1/7	6.60E-01 - 1.40E+00	N/A	3	B-ca	No	J, DET, BSL
85-01-8	Phenanthrene	3.80E-02	**3.80E-02**	YWM09-2285	1/10	2.00E-03 - 1.00E-02	N/A	N/A	NL	**Yes**	DET
7440-09-7	Potassium	1.71E+03	**5.66E+03**	YWM06-2274	7/7	N/A	N/A	N/A	NL	No	NUT, GEO
129-00-0	Pyrene	4.60E-03 J	**4.00E-02**	YWM09-2285	4/10	2.00E-03 - 1.00E-02	N/A	230	B-nc	No	DET, BSL
7782-49-2	Selenium	1.19E-01 J	**1.97E-01 J**	YWM09-2284	7/10	2.00E+00 - 2.10E+00	N/A	38	A-nc	No	J, DET, BKG
7440-22-4	Silver	7.19E-01	**1.23E+00**	YWM09-2285	5/10	5.03E-01 - 2.10E+00	N/A	38	A-nc	No	DET, BSL, GEO
7440-23-5	Sodium	7.89E+01 J	**2.93E+02**	YWM09-2285	7/7	N/A	N/A	N/A	NL	No	NUT
7440-28-0	Thallium	2.32E-01 J	**5.67E-01**	YWM07-2277	7/10	2.00E+00 - 2.10E+00	N/A	0.5	A-nc	**Yes**	DET, ASL
YWM-05	TPH-gasoline	2.50E+00	**2.50E+00**	YWM07-2277	1/7	1.00E+00 - 1.50E+00	N/A	N/A	NL	**Yes**	DET
7440-62-2	Vanadium	1.55E+01	**3.74E+01**	YWM06-2274	10/10	N/A	N/A	53	A-nc	No	DET, BKG
7732-18-5	Water (Units = percent)	2.00E+00	**7.10E+00**	YWM-TP05-SO-1040	3/4	5.00E-01 - 5.00E-01	N/A	N/A	NL	No	NC
7440-66-6	Zinc	2.25E+01 J	**2.42E+03**	YWM07-2277	10/10	N/A	N/A	2,300	A-nc	**Yes**	DET, ASL
71-55-6	1,1,1-Trichloroethane				0/7	5.00E-03 - 8.90E-03	N/A	120	B-sat	No	ND
79-34-5	1,1,2,2-Tetrachloroethane				0/6	5.00E-03 - 6.60E-03	N/A	0.41	B-ca	No	ND
79-00-5	1,1,2-Trichloroethane				0/7	5.00E-03 - 8.90E-03	N/A	0.73	B-ca	No	ND
75-34-3	1,1-Dichloroethane [CAL-Mod]				0/7	5.00E-03 - 8.90E-03	N/A	2.8	B-ca	No	ND
75-35-4	1,1-Dichloroethene				0/7	5.00E-03 - 8.90E-03	N/A	12	B-nc	No	ND
120-82-1	1,2,4-Trichlorobenzene				0/7	3.30E-01 - 6.90E-01	N/A	6.2	B-nc	No	ND
95-50-1	1,2-Dichlorobenzene				0/6	5.00E-03 - 6.60E-03	N/A	60	B-sat	No	ND
107-06-2	1,2-Dichloroethane				0/7	5.00E-03 - 8.90E-03	N/A	0.28	B-ca	No	ND
78-87-5	1,2-Dichloropropane				0/7	5.00E-03 - 8.90E-03	N/A	0.34	B-ca	No	ND
541-73-1	1,3-Dichlorobenzene				0/6	5.00E-03 - 6.60E-03	N/A	53	B-nc	No	ND
106-46-7	1,4-Dichlorobenzene				0/6	5.00E-03 - 6.60E-03	N/A	3.4	B-ca	No	ND

TABLE 5-1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil

CAS Number	Chemical Units mg/kg except where specified	Minimum Concentration mg/kg	Maximum Concentration* mg/kg	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Bkgd Value (1)	Screening Toxicity Value mg/kg	Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (2)
95-95-4	2,4,5-Trichlorophenol				0/7	3.30E-01 - 6.90E-01	N/A	61	B-nc	No	ND
88-06-2	2,4,6-Trichlorophenol				0/7	3.30E-01 - 6.90E-01	N/A	6.9	B-ca	No	ND
120-83-2	2,4-Dichlorophenol				0/7	3.30E-01 - 6.90E-01	N/A	18	B-nc	No	ND
105-67-9	2,4-Dimethylphenol				0/7	3.30E-01 - 6.90E-01	N/A	120	B-nc	No	ND
51-28-5	2,4-Dinitrophenol				0/7	6.60E-01 - 1.40E+00	N/A	12	B-nc	No	ND
121-14-2	2,4-Dinitrotoluene				0/7	3.30E-01 - 6.90E-01	N/A	12	B-nc	No	ND
606-20-2	2,6-Dinitrotoluene				0/7	3.30E-01 - 6.90E-01	N/A	6.1	B-nc	No	ND
78-93-3	2-Butanone				0/7	1.00E-02 - 1.80E-02	N/A	2,200	B-nc	No	ND
91-58-7	2-Chloronaphthalene (β)				0/7	3.30E-01 - 6.90E-01	N/A	490	B-nc	No	ND
95-57-8	2-Chlorophenol				0/7	3.30E-01 - 6.90E-01	N/A	6.3	B-nc	No	ND
591-78-6	2-Hexanone (n-Hexane surrogate)				0/7	1.00E-02 - 1.80E-02	N/A	11	B-sat	No	ND
91-57-6	2-Methylnaphthalene				0/10	5.00E-02 - 6.90E-01	N/A	31	C-nc	No	ND
88-74-4	2-Nitroaniline				0/7	3.30E-01 - 6.90E-01	N/A	18	B-nc	No	ND
88-75-5	2-Nitrophenol				0/7	3.30E-01 - 6.90E-01	N/A	NL	B,C	No	ND
91-94-1	3,3'-Dichlorobenzidine				0/7	3.30E-01 - 6.90E-01	N/A	1.1	B-ca	No	ND
99-09-2	3-Nitroaniline				0/7	3.30E-01 - 6.90E-01	N/A	1.8	B-nc	No	ND
534-52-1	4,6-Dinitro-o-cresol				0/7	6.60E-01 - 1.40E+00	N/A	0.61	B-nc	No	ND
101-55-3	4-Bromophenyl phenylether				0/7	3.30E-01 - 6.90E-01	N/A	NL	B,C	No	ND
7005-72-3	4-Chlorophenyl phenylether				0/7	3.30E-01 - 6.90E-01	N/A	NL	B,C	No	ND
108-10-1	4-Methyl-2-pentanone (MIBK)				0/7	1.00E-02 - 1.80E-02	N/A	530	B-nc	No	ND
100-01-6	4-Nitroaniline				0/7	3.30E-01 - 6.90E-01	N/A	23	B-ca	No	ND
100-02-7	4-Nitrophenol				0/7	6.60E-01 - 1.40E+00	N/A	NL	B,C	No	ND
83-32-9	Acenaphthene				0/10	5.00E-03 - 5.20E-02	N/A	370	B-nc	No	ND
208-96-8	Acenaphthylene				0/10	5.00E-03 - 2.10E-02	N/A	NL	B,C	No	ND
12674-11-2	Aroclor 1016				0/8	5.00E-02 - 5.30E-02	N/A	0.39	B-nc	No	ND
11104-28-2	Aroclor 1221				0/8	5.00E-02 - 5.30E-02	N/A	0.39	B-nc	No	ND
11141-16-5	Aroclor 1232				0/8	5.00E-02 - 5.30E-02	N/A	0.39	B-nc	No	ND

TABLE 5-1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil

CAS Number	Chemical Units mg/kg except where specified	Minimum Concentration mg/kg	Maximum Concentration* mg/kg	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Bkgd Value (1)	Screening Toxicity Value mg/kg	Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (2)
53469-21-9	Aroclor 1242				0/8	5.00E-02 - 5.30E-02	N/A	0.39	B-nc	No	ND
12672-29-6	Aroclor 1248				0/8	5.00E-02 - 5.30E-02	N/A	0.089	A-ca	No	ND
11097-69-1	Aroclor 1254				0/8	5.00E-02 - 5.30E-02	N/A	0.089	A-ca	No	ND
11096-82-5	Aroclor 1260				0/8	5.00E-02 - 5.30E-02	N/A	0.089	A-ca	No	ND
71-43-2	Benzene				0/7	5.00E-03 - 8.90E-03	N/A	0.64	B-ca	No	ND
111-91-1	bis(2-Chloroethoxy)methane				0/7	3.30E-01 - 6.90E-01	N/A	18	C-nc	No	ND
111-44-4	bis(2-Chloroethyl)ether				0/7	3.30E-01 - 6.90E-01	N/A	0.22	B-ca	No	ND
108-60-1	bis(2-Chloroisopropyl)ether				0/7	3.30E-01 - 6.90E-01	N/A	3	B-ca	No	ND
75-27-4	Bromodichloromethane				0/7	5.00E-03 - 8.90E-03	N/A	0.82	B-ca	No	ND
74-83-9	Bromomethane				0/7	1.00E-02 - 1.80E-02	N/A	0.39	B-nc	No	ND
85-68-7	Butyl benzyl phthalate				0/7	3.30E-01 - 6.90E-01	N/A	1,200	B-nc	No	ND
75-15-0	Carbon disulfide				0/7	5.00E-03 - 8.90E-03	N/A	36	B-nc	No	ND
56-23-5	Carbon tetrachloride				0/7	5.00E-03 - 8.90E-03	N/A	0.25	B-ca	No	ND
108-90-7	Chlorobenzene				0/7	5.00E-03 - 8.90E-03	N/A	15	B-nc	No	ND
75-00-3	Chloroethane				0/7	5.00E-03 - 8.90E-03	N/A	3.0	B-ca	No	ND
67-66-3	Chloroform				0/7	5.00E-03 - 8.90E-03	N/A	0.22	B-ca	No	ND
74-87-3	Chloromethane				0/7	1.00E-02 - 1.80E-02	N/A	4.7	B-nc	No	ND
18540-29-9	Chromium (VI)				0/3	5.00E-01 - 5.20E-01	N/A	30	B-ca	No	ND
156-59-2	cis-1,2-Dichloroethene				0/7	5.00E-03 - 8.90E-03	N/A	4.3	B-nc	No	ND
10061-01-5	cis-1,3-Dichloro-1-propene				0/7	5.00E-03 - 8.90E-03	N/A	0.78	B-ca	No	ND
132-64-9	Dibenzofuran				0/7	3.30E-01 - 6.90E-01	N/A	15	B-nc	No	ND
124-48-1	Dibromochloromethane				0/7	5.00E-03 - 8.90E-03	N/A	1.1	B-ca	No	ND
75-71-8	Dichlorodifluoromethane				0/7	1.00E-02 - 1.80E-02	N/A	9.4	B-nc	No	ND
84-66-2	Diethyl phthalate				0/7	3.30E-01 - 6.90E-01	N/A	4,900	B-nc	No	ND
131-11-3	Dimethylphthalate				0/7	3.30E-01 - 6.90E-01	N/A	10,000	B-max	No	ND
84-74-2	Di-n-butyl phthalate				0/7	3.30E-01 - 6.90E-01	N/A	610	C-nc	No	ND
117-84-0	Di-n-octyl phthalate				0/7	3.30E-01 - 6.90E-01	N/A	240	B-nc	No	ND

TABLE 5-1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil

CAS Number	Chemical Units mg/kg except where specified	Minimum Concentration mg/kg	Maximum Concentration* mg/kg	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Bkgd Value (1)	Screening Toxicity Value mg/kg	Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (2)
100-41-4	Ethylbenzene				0/7	5.00E-03 - 8.90E-03	N/A	5.7	C-ca	No	ND
86-73-7	Fluorene				0/10	2.00E-03 - 1.00E-02	N/A	270	B-nc	No	ND
118-74-1	Hexachlorobenzene				0/7	3.30E-01 - 6.90E-01	N/A	0.3	B-ca	No	ND
87-68-3	Hexachlorobutadiene				0/7	3.30E-01 - 6.90E-01	N/A	6.2	B-ca	No	ND
77-47-4	Hexachlorocyclopentadiene				0/7	3.30E-01 - 6.90E-01	N/A	37	B-nc	No	ND
67-72-1	Hexachloroethane				0/7	3.30E-01 - 6.90E-01	N/A	35	B-ca	No	ND
78-59-1	Isophorone				0/7	3.30E-01 - 6.90E-01	N/A	510	B-ca	No	ND
ICF87	m+p-Xylenes				0/7	1.00E-02 - 1.80E-02	N/A	27	B-nc	No	ND
1634-04-4	Methyl tert-butyl ether				0/7	5.00E-03 - 8.90E-03	N/A	17	B-ca	No	ND
91-20-3	Naphthalene [CAL Mod]				0/10	5.00E-03 - 5.20E-02	N/A	1.7	B-ca	No	ND
98-95-3	Nitrobenzene				0/7	3.30E-01 - 6.90E-01	N/A	20	B-nc	No	ND
621-64-7	n-Nitroso-di-n-propylamine				0/7	3.30E-01 - 6.90E-01	N/A	0.069	B-ca	No	ND
86-30-6	n-Nitrosodiphenylamine				0/7	3.30E-01 - 6.90E-01	N/A	99	B-ca	No	ND
95-48-7	o-Cresol				0/7	3.30E-01 - 6.90E-01	N/A	310	C-nc	No	ND
95-47-6	o-Xylene				0/7	5.00E-03 - 8.90E-03	N/A	27	B-nc	No	ND
106-47-8	p-Chloroaniline (4-chloroaniline)				0/7	3.30E-01 - 6.90E-01	N/A	24	B-nc	No	ND
59-50-7	p-Chloro-m-cresol				0/7	3.30E-01 - 6.90E-01	N/A	NL	B,C	No	ND
106-44-5	p-Cresol				0/7	3.30E-01 - 6.90E-01	N/A	31	C-nc	No	ND
108-95-2	Phenol				0/7	3.30E-01 - 6.90E-01	N/A	1,800	B-nc	No	ND
100-42-5	Styrene				0/7	5.00E-03 - 8.90E-03	N/A	170	B-sat	No	ND
127-18-4	Tetrachloroethene				0/7	5.00E-03 - 8.90E-03	N/A	0.48	B-ca	No	ND
108-88-3	Toluene				0/7	5.00E-03 - 8.90E-03	N/A	52	B-sat	No	ND
156-60-5	trans-1,2-Dichloroethene				0/7	5.00E-03 - 8.90E-03	N/A	6.9	B-nc	No	ND
10061-02-6	trans-1,3-Dichloropropene				0/7	5.00E-03 - 8.90E-03	N/A	0.78	B-ca	No	ND
75-25-2	Tribromomethane (bromoform)				0/6	5.00E-03 - 6.60E-03	N/A	62	B-ca	No	ND
79-01-6	Trichloroethene [CAL-Mod]				0/7	5.00E-03 - 8.90E-03	N/A	2.9	B-ca	No	ND
75-69-4	Trichlorofluoromethane				0/7	5.00E-03 - 8.90E-03	N/A	390	B-nc	No	ND

TABLE 5-1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil

CAS Number	Chemical Units mg/kg except where specified	Minimum Concentration mg/kg	Maximum Concentration* mg/kg	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Bkgd Value (1)	Screening Toxicity Value mg/kg	Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (2)
75-01-4	Vinyl Chloride (adult & child)				0/7	5.00E-03 - 8.90E-03	N/A	0.079	B-ca	No	ND

***Maximum concentration (in bold font above) used for screening**

(1) N/A - Refer to supporting information for background discussion.

(2) Rationale Codes:

Selection Reason: Detected (DET)
Above Screening Level (ASL)

Deletion Reason: Infrequent Detection (≤ 5%, IFD)
Background Related (BKG)
Dioxin/Furan specific congener results available, and 2,3,7,8-TCDD toxic equivalency used (TEQ)
Not Detected (ND)
Essential Nutrient (NUT)
Results from Silica Gel Clean Up Used (*e.g.* , Diesel, Motor Oil) (GEL)
Geochemical evaluation for natural background concentrations (GEO)
Non-Chemical Result (*e.g.* , total organic carbon) (NC)

(3) Screening toxicity values based on target risk of 1E-6 and target hazard quotient of 0.1.

Sources of screening toxicity values: A -- CHHSLs (DTSC, 2005)
B -- PRGs (EPA, 2004)
C -- RSLs (EPA, 2009)

ca = cancer toxicity basis for value
nc = non-cancer basis for value

Highlighted COPCs exceeded screening criteria and are carried forward to evaluation via PEAspread

Definitions: N/A = Not Applicable or Not Available
COPC = Chemical of Potential Concern
J = Estimated Value Below the Reporting Limit
U = not detected above the Reporting Limit

TABLE 5-2: MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION FOR HUMAN HEALTH RISK ASSESSMENT SUMMARY FOR SURFACE SOIL, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil

Chemical of Potential Concern	Units	Arithmetic Mean of Detects	Multiple Detection Limits? (Yes/No) [1]	95% UCL (Distribution) [2]	Maximum Concentration	Exposure Point Concentration			
						Value	Units	Statistic [3]	Rationale [4]
Exposure Point: Surface Soil									
2,3,7,8-TCDD TEQ	mg/kg	5.60E-06	N/A	N/A	1.11E-05	1.11E-05	mg/kg	Max	Test (7)
Antimony	mg/kg	1.95E+00	Yes	2.81E+00 (N)	4.63E+00	2.81E+00	mg/kg	95% KM-t	Test (4)
Arsenic	mg/kg	3.38E+00	No	4.73E+00 (N)	7.37E+00	4.73E+00	mg/kg	95% Student's-t	Test (4)
Barium	mg/kg	3.18E+02	No	6.91E+02 (G)	9.77E+02	6.91E+02	mg/kg	95% Approx. Gamma	Test (6)
Benzo(a)pyrene [5]	mg/kg	3.90E-02	N/A	1.59E-02 (NP)	6.20E-02	1.59E-02	mg/kg	95% UCL Bst	Test (8)
Benzo(g,h,i)perylene	mg/kg	3.20E-02	Yes	7.80E-02 (N)	7.80E-02	7.80E-02	mg/kg	95% KM-% Btstrp	Test (1)
Cadmium	mg/kg	2.29E+00	Yes	2.96E+00 (N)	6.78E+00	2.96E+00	mg/kg	95% KM-t	Test (1)
Diesel fuel (with silica gel cleanup)	mg/kg	1.29E+03	No	1.61E+03 (G)	4.80E+03	1.61E+03	mg/kg	95% KM BCA	Test (6)
Iron	mg/kg	2.59E+04	No	3.29E+04 (N)	4.02E+04	3.29E+04	mg/kg	95% Student's-t	Test (4)
Lead	mg/kg	2.86E+02	No	1.03E+03 (G)	9.94E+02	9.94E+02	mg/kg	Max	Test (2)
Manganese	mg/kg	1.07E+03	No	1.55E+03 (N)	1.90E+03	1.55E+03	mg/kg	95% Student's-t	Test (4)
Motor Oils (with silica gel cleanup)	mg/kg	2.87E+04	No	4.04E+04 (G)	1.10E+05	4.04E+04	mg/kg	95% KM BCA	Test (6)
Phenanthrene [5]	mg/kg	3.80E-02	N/A	9.94E-03 (NP)	3.80E-02	9.94E-03	mg/kg	95% UCL Bst	Test (8)
Thallium	mg/kg	3.70E-01	Yes	4.45E-01 (N)	5.67E-01	4.45E-01	mg/kg	95% KM-t	Test (1)
TPH-gasoline [5]	mg/kg	2.50E+00	N/A	1.20E+00 (NP)	2.50E+00	1.20E+00	mg/kg	95% UCL Bst	Test (8)
Zinc	mg/kg	8.42E+02	No	2.38E+03 (G)	2.42E+03	2.38E+03	mg/kg	95% Approx. Gamma	Test (6)

[Yellow highlight] Surface soil COPCs evaluated in PEAspread with the exception of Lead, which is evaluated via Leadspread7; non-highlighted COPCs are discussed in the text.

Refer to footnotes on following page.

TABLE 5-2: MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION FOR HUMAN HEALTH RISK ASSESSMENT SUMMARY FOR SURFACE SOIL, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Notes:

N/A = Not applicable

[1] ProUCL software (version 4.0, USEPA, 2007) recommends use of Kaplan-Meier method if there are multiple detection limits.

[2] Statistical Distribution and 95% UCL as determined by ProUCL (unless otherwise noted): (G) the data were determined to follow gamma distribution; (L) the data were determined to follow lognormal distribution; (NP) the data were determined to be non-parametric; (N) the data were determined to be normally distributed.

[3] Statistic: Maximum Detected Value (Max); 95% KM Chebyshev (95% KM-Cheby); 97.5% KM Chebyshev (97.5% KM-Cheby); 99% KM Chebyshev (99% KM-Cheby); 95% KM Percentile Bootstrap (95% KM-% Btstrp); 95% KM-t (95% KM-t); 95% KM-BCA (95% KM-BCA); 95% H-UCL (95% H-UCL); 95% Chebyshev -Mean, SD- UCL (95% Cheby, Mean, SD);
97.5% Chebyshev -Mean, SD- UCL (97.5% Cheby, Mean, SD); 99% Chebyshev -Mean, SD- UCL (99% Cheby, Mean, SD); 95% UCL of Log-transformed Data (95% UCL-T)
95% Student's-t (95% Student's-t); 95% Modified-t (95% Modified-t); 95% UCL based on bootstrap statistic (95% UCL-Bst); 95% Approximate Gamma UCL (95% Approx. Gamma);
95% Adjusted Gamma UCL (95% Adjusted Gamma); 95% KM Chebyshev-MVUE (95% KM-Cheby-MVUE).

[4] Unless otherwise noted, ProUCL EPC selection rationale based on, detection limit values, distribution, standard deviation, and sample size (see ProUCL output in appendix for further details):

Test (1): Kaplan-Meier method recommended by ProUCL due to multiple detection limits.
Test (2): The 95% UCL exceeds the maximum detected concentration, therefore, maximum concentration used for EPC.
Test (3): Shapiro-Wilk W test, Kolmogorov-Smirnov (K-S), and Anderson-Darling (A-D) tests, indicate data follow nonparametric distribution.
Test (4): Shapiro-Wilk W test indicates data are normally distributed.
Test (5): Shapiro-Wilk W test indicates data are log-normally distributed.
Test (6): Kolmogorov-Smirnov (K-S) and/or Anderson-Darling (A-D) tests indicate data follow gamma distribution.
Test (7): Sample size is less than or equal to 5, therefore, maximum concentration used for EPC.
Test (8): 95% UCL estimated by a non-Pro-UCL bootstrap method.

[5] Infrequent detection resulted in ProUCL modeling error for this constituent, therefore distribution, average, and UCL determined using non-ProUCL bootstrap method with random numbers for NDs.

TABLE 5-3: EXPOSURE FREQUENCIES FOR HUMAN HEALTH RISK ASSESSMENT AT MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

WAA Sites	Exposure Frequency (EF) [(a)], days per year				
	Park		Hikers		
	Employees			Adult	Child
Mather	**Occasional**	**120**	**Occasional**	**7**	**7**

<u>NOTES</u>:
(a) References listed on Table 5-4.

TABLE 5-4: EXPOSURE FACTORS FOR HUMAN HEALTH RISK ASSESSMENT AT WASTE ACCUMULATION AREAS, YOSEMITE NATIONAL PARK, CALIFORNIA

		Park		Hikers			
Exposure Parameter	**Units**	**Employees**	**Reference (a)**	**Adult**	**Reference (a)**	**Child**	**Reference (a)**
Averaging Time (AT)							
Carcinogenic	years	70	3	70	3	70	3
Noncarinogenic	years	25	1, 5	24	1, 5	6	1, 5
Exposure Frequency (EF)							
Frequent	days/year	250	1, 5	120	1, 5	120	1, 5
Occasional	days/year	120	PJ	7	PJ	7	PJ
Exposure Duration (ED)	years	25	1, 5	24	1, 5	6	1, 5
Body Weight (BW)	kg	70	1, 5	70	1, 5	15	1, 5
Soil Ingestion Rate (IR)	mg/kg	50	3	100	1, 3	200	1, 3
Fraction of Soil Ingested (FI)	unitless	1	1, 3	1	1, 3	1	1, 3
Skin Surface Area (SA)	cm^2/day	3400	3	5800	2	2900	4
Soil-to-Skin Adherence Factor (AF)	mg/cm^2	0.8	2	0.23	4	0.3	4
Event Frequency (EV)	events/day	1	A	1	A	1	A
Skin Absorption Factor (ABS)	unitless	CSV		CSV		CSV	
Inhalation Rate (InhR)	m^3/day	20	6	20	6	10	6

Refer to footnotes on following page.

TABLE 5-4: EXPOSURE FACTORS FOR HUMAN HEALTH RISK ASSESSMENT AT WASTE ACCUMULATION AREAS, YOSEMITE NATIONAL PARK, CALIFORNIA

Notes:

A	=	Assumed
cm^2	=	centimeter squared
CSV	=	Chemical Specific Value
kg	=	kilogram
mg/kg	=	milligram per kilogram
PJ	=	Professional Judgment

(a) References:

1. Department of Toxic Substances Control (DTSC), 1996. Supplemental Guidance for Human Health Multimedia Risk Assessment of Hazardous Waste Sites and Permitted Facilities. August.
2. DTSC, 2000. Draft Guidance for the Dermal Exposure Pathway Memo, January 7.
3. USEPA, 1997. "Exposure Factors Handbook". USEPA/600/P-95/002Fa. Office of Research and Development. Washington, D.C. August.
4. USEPA, 1998. RAGS, Volume 1, Human Health Evaluation Manual, Supplemental Guidance: Dermal Risk Assessment, Interim Guidance. NCEA-W-0364. Office of Emergency and Remedial Response. Washington, D.C., May.
5. USEPA, 1991. RAGS, Human Health Evaluation Manual, Part B: Development of Risk-Based Preliminary Remediation Goals. Directive 9285.7-01B. Office of Solid Waste and Emergency Response. Washington, D.C., December.
6. DTSC, 2005, Human Health Risk Assessment (HHRA) Note, HERD HHRA Note Number 1, California Department of Toxic Substances Control (DTSC) Human and Ecological Risk Division (HERD), October 27, http://www.dtsc.ca.gov/AssessingRisk.

TABLE 5-5: OCCASIONAL ON-SITE EXPOSURE SCENARIO FOR ADULT AND CHILD PARK HIKER FOR SITE SCREENING
PEASPREAD SUMMARY TABLE FOR HYPOTHETICAL EXPOSURE TO CHEMICAL IN SOIL (0-2 FEET BGS)
MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

24-year Adult 6-year Child Combined 30-year Receptor		**Pathway-Specific Doses and Risk/Hazard**															
		Incidental Soil Ingestion				**Dermal Contact Absorption**				**Inhalation**				**Receptor Sums**			
Chemical of Potential Concern	Representiative Concentration mg/kg	ILCR Dose mg/kg-day	**Risk (ILCR)**	Non-cancer Dose mg/kg-day	**Hazard Quotient (HQ)**	ILCR Dose mg/kg-day	**Risk (ILCR)**	Non-cancer Dose mg/kg-day	**Hazard Quotient (HQ)**	ILCR Dose mg/kg-day	**Risk (ILCR)**	Non-cancer Dose mg/kg-day	**Hazard Quotient (HQ)**	ILCR Dose mg/kg-day	**Risk (ILCR)**	Non-cancer Dose mg/kg-day	**Hazard Quotient (HQ)**
2,3,7,8-TCDD equivalents	1.11E-05																
Adult		1E-13	**1E-8**	3E-13	**no RfD**	5E-14	**5E-9**	7E-13	**no RfD**	2E-15	**2E-10**	5E-15	**no RfD**	2E-13	**2E-8**	1E-12	**no RfD**
Child		2E-13	**2E-8**	3E-12	**no RfD**	3E-14	**3E-9**	4E-13	**no RfD**	9E-16	**9E-11**	1E-14	**no RfD**	2E-13	**2E-8**	3E-12	**no RfD**
Combined		3E-13	**3E-8**	3E-12	**no RfD**	8E-14	**8E-9**	1E-12	**no RfD**	3E-15	**3E-10**	2E-14	**no RfD**	4E-13	**4E-8**	4E-12	**no RfD**
Antimony & compounds	2.81																
Adult		3E-8	**no SF**	8E-8	**2E-4**	5E-9	**no SF**	1E-8	**3E-5**	3E-10	**no SF**	8E-10	**no RfD**	4E-8	**no SF**	9E-8	**2E-4**
Child		6E-8	**no SF**	7E-7	**2E-3**	3E-9	**no SF**	3E-8	**8E-5**	2E-10	**no SF**	2E-9	**no RfD**	6E-8	**no SF**	7E-7	**2E-3**
Combined		9E-8	**no SF**	8E-7	**2E-3**	8E-9	**no SF**	4E-8	**1E-4**	5E-10	**no SF**	3E-9	**no RfD**	1E-7	**no SF**	8E-7	**2E-3**
Arsenic, inorganic (regional background)	4.73																
Adult		4E-8	**4E-7**	1E-7	**4E-4**	2E-8	**2E-7**	7E-8	**2E-4**	4E-10	**5E-9**	1E-9	**2E-4**	6E-8	**6E-7**	2E-7	**8E-4**
Child		1E-7	**1E-6**	1E-6	**4E-3**	1E-8	**1E-7**	2E-7	**5E-4**	3E-10	**3E-9**	3E-9	**4E-4**	1E-7	**1E-6**	1E-6	**5E-3**
Combined		1E-7	**1E-6**	1E-6	**4E-3**	3E-8	**3E-7**	3E-7	**7E-4**	7E-10	**8E-9**	4E-9	**6E-4**	2E-7	**2E-6**	1E-6	**6E-3**
Barium	691																
Adult		6E-6	**no SF**	2E-5	**3E-4**	1E-6	**no SF**	3E-6	**5E-5**	6E-8	**no SF**	2E-7	**1E-3**	7E-6	**no SF**	2E-5	**1E-3**
Child		2E-5	**no SF**	2E-4	**3E-3**	7E-7	**no SF**	8E-6	**1E-4**	4E-8	**no SF**	4E-7	**3E-3**	2E-5	**no SF**	2E-4	**6E-3**
Combined		3E-5	**no SF**	2E-4	**3E-3**	2E-6	**no SF**	1E-5	**2E-4**	1E-7	**no SF**	6E-7	**4E-3**	3E-5	**no SF**	2E-4	**7E-3**
Benzo(a)pyrene	0.0159																
Adult		1E-10	**2E-9**	4E-10	**no RfD**	4E-10	**5E-9**	1E-9	**no RfD**	1E-12	**6E-12**	4E-12	**no RfD**	5E-10	**7E-9**	1E-9	**no RfD**
Child		3E-10	**4E-9**	4E-9	**no RfD**	2E-10	**3E-9**	3E-9	**no RfD**	9E-13	**3E-12**	1E-11	**no RfD**	5E-10	**7E-9**	7E-9	**no RfD**
Combined		4E-10	**6E-9**	4E-9	**no RfD**	6E-10	**8E-9**	4E-9	**no RfD**	2E-12	**9E-12**	1E-11	**no RfD**	1E-9	**1E-8**	8E-9	**no RfD**
Benzo(g,h,i)perylene (Pyrene surrogate)	0.078																
Adult		7E-10	**no SF**	2E-9	**7E-8**	2E-9	**no SF**	6E-9	**2E-7**	7E-12	**no SF**	2E-11	**7E-10**	3E-9	**no SF**	8E-9	**3E-7**
Child		2E-9	**no SF**	2E-8	**7E-7**	1E-9	**no SF**	1E-8	**4E-7**	4E-12	**no SF**	5E-11	**2E-9**	3E-9	**no SF**	3E-8	**1E-6**
Combined		3E-9	**no SF**	2E-8	**8E-7**	3E-9	**no SF**	2E-8	**6E-7**	1E-11	**no SF**	7E-11	**3E-9**	6E-9	**no SF**	4E-8	**1E-6**
Cadmium	2.96																
Adult		3E-8	**1E-8**	8E-8	**2E-4**	5E-10	**2E-10**	1E-9	**3E-6**	3E-10	**4E-9**	8E-10	**1E-16**	3E-8	**1E-8**	8E-8	**2E-4**
Child		6E-8	**2E-8**	8E-7	**2E-3**	3E-10	**1E-10**	3E-9	**7E-6**	2E-10	**2E-9**	2E-9	**3E-16**	6E-8	**2E-8**	8E-7	**2E-3**
Combined		9E-8	**3E-8**	9E-7	**2E-3**	8E-10	**3E-10**	4E-9	**1E-5**	5E-10	**6E-9**	3E-9	**4E-16**	9E-8	**4E-8**	9E-7	**2E-3**
Iron compounds	32,900																
Adult		3E-4	**no SF**	9E-4	**3E-3**	5E-5	**no SF**	2E-4	**5E-4**	3E-6	**no SF**	9E-6	**no VC**	4E-4	**no SF**	1E-3	**4E-3**
Child		7E-4	**no SF**	8E-3	**3E-2**	3E-5	**no SF**	4E-4	**1E-3**	2E-6	**no SF**	2E-5	**no VC**	7E-4	**no SF**	8E-3	**3E-2**
Combined		1E-3	**no SF**	9E-3	**3E-2**	8E-5	**no SF**	6E-4	**2E-3**	5E-6	**no SF**	3E-5	**no VC**	1E-3	**no SF**	1E-2	**3E-2**
Manganese	1,550																
Adult		1E-5	**no SF**	4E-5	**2E-3**	3E-6	**no SF**	7E-6	**3E-4**	1E-7	**no SF**	4E-7	**3E-2**	1E-5	**no SF**	5E-5	**3E-2**
Child		3E-5	**no SF**	4E-4	**2E-2**	1E-6	**no SF**	2E-5	**7E-4**	8E-8	**no SF**	1E-6	**7E-2**	3E-5	**no SF**	4E-4	**9E-2**
Combined		4E-5	**no SF**	4E-4	**2E-2**	4E-6	**no SF**	3E-5	**1E-3**	2E-7	**no SF**	1E-6	**1E-1**	4E-5	**no SF**	5E-4	**1E-1**
Phenanthrene (Pyrene surrogate)	0.00994																
Adult		9E-11	**no SF**	3E-10	**9E-9**	2E-10	**no SF**	7E-10	**2E-8**	9E-13	**no SF**	3E-12	**9E-11**	3E-10	**no SF**	1E-9	**3E-8**
Child		2E-10	**no SF**	3E-9	**8E-8**	1E-10	**no SF**	2E-9	**6E-8**	5E-13	**no SF**	6E-12	**2E-10**	3E-10	**no SF**	5E-9	**1E-7**
Combined		3E-10	**no SF**	3E-9	**9E-8**	3E-10	**no SF**	3E-9	**8E-8**	1E-12	**no SF**	9E-12	**3E-10**	6E-10	**no SF**	6E-9	**2E-7**

TABLE 5-5: OCCASIONAL ON-SITE EXPOSURE SCENARIO FOR ADULT AND CHILD PARK HIKER FOR SITE SCREENING
PEASPREAD SUMMARY TABLE FOR HYPOTHETICAL EXPOSURE TO CHEMICAL IN SOIL (0-2 FEET BGS)
MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

24-year Adult 6-year Child Combined 30-year Receptor		**Pathway-Specific Doses and Risk/Hazard**															
		Incidental Soil Ingestion				**Dermal Contact Absorption**				**Inhalation**				**Receptor Sums**			
Chemical of Potential Concern	Representiative Concentration mg/kg	ILCR Dose mg/kg-day	**Risk (ILCR)**	Non-cancer Dose mg/kg-day	**Hazard Quotient (HQ)**	ILCR Dose mg/kg-day	**Risk (ILCR)**	Non-cancer Dose mg/kg-day	**Hazard Quotient (HQ)**	ILCR Dose mg/kg-day	**Risk (ILCR)**	Non-cancer Dose mg/kg-day	**Hazard Quotient (HQ)**	ILCR Dose mg/kg-day	**Risk (ILCR)**	Non-cancer Dose mg/kg-day	**Hazard Quotient (HQ)**
Thallium	0.445																
Adult		4E-9	**no SF**	1E-8	**2E-4**	7E-10	**no SF**	2E-9	**3E-5**	4E-11	**no SF**	1E-10	**no VC**	5E-9	**no SF**	1E-8	**2E-4**
Child		1E-8	**no SF**	1E-7	**2E-3**	4E-10	**no SF**	5E-9	**7E-5**	2E-11	**no SF**	3E-10	**no VC**	1E-8	**no SF**	1E-7	**2E-3**
Combined		1E-8	**no SF**	1E-7	**2E-3**	1E-9	**no SF**	7E-9	**1E-4**	6E-11	**no SF**	4E-10	**no VC**	2E-8	**no SF**	1E-7	**2E-3**
Zinc	2,380																
Adult		2E-5	**no SF**	7E-5	**2E-4**	4E-6	**no SF**	1E-5	**4E-5**	2E-7	**no SF**	7E-7	**no VC**	2E-5	**no SF**	8E-5	**2E-4**
Child		5E-5	**no SF**	6E-4	**2E-3**	2E-6	**no SF**	3E-5	**9E-5**	1E-7	**no SF**	2E-6	**no VC**	5E-5	**no SF**	6E-4	**2E-3**
Combined		7E-5	**no SF**	7E-4	**2E-3**	6E-6	**no SF**	4E-5	**1E-4**	3E-7	**no SF**	3E-6	**no VC**	8E-5	**no SF**	7E-4	**2E-3**
Exposure Route Summed Risk			**7E-8**				**2E-8**				**6E-9**						
Exposure Route Summed Hazard					**0.1**				**0.003**				**0.1**				
Soil Pathway Summed Risk-Adult															4E-8		
Soil Pathway Summed Risk-Child															5E-8		
Soil Pathway Summed Hazard-Adult																	0.04
Soil Pathway Summed Hazard-Child																	0.14
Soil Pathway Combined Summed Risk															**9E-8**		
Soil Pathway Combined Summed Hazard																	**0.2**

Bold font has been applied to risk and hazard columns only for visual identification compared to the dose columns

arsenic is part of the regional background and is included for informational purposes only; risk/hazard for arsenic is not included in the summations for cumulative risk/hazard

Point of Departure for increased lifetime cancer risk (ILCR) is 1E-6: ILCR risk management range is 1E-6 - 1E-4

Hazard index (HI) for acceptable exposure is 1 or less; concern for health effects increases as individual chemical hazard quotient (HQ) or cumulative or aggregate HI increases above 1.

Lead, Diesel fuel (with silica gel cleanup), Motor oil (with silica gel cleanup), and TPH-gasoline are COPCs addressed in the report text.

SF = cancer slope factor; RfD = non-cancer reference dose; VC = volatile chemical

TABLE 5-6: OCCASIONAL ON-SITE EXPOSURE SCENARIO FOR ADULT PARK EMPLOYEE FOR SITE SCREENING
PEASPREAD SUMMARY TABLE FOR HYPOTHETICAL EXPOSURE TO CHEMICAL IN SOIL (0-2 FEET BGS)
MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Adult 25-year Receptor		Pathway-Specific Doses and Risk/Hazard															
		Incidental Soil Ingestion				**Dermal Contact Absorption**				**Inhalation**				**Receptor Sums**			
Chemical of Potential Concern	Representiative Concentration mg/kg	ILCR Dose mg/kg-day	**Risk (ILCR)**	Non-cancer Dose mg/kg-day	**Hazard Quotient (HQ)**	ILCR Dose mg/kg-day	**Risk (ILCR)**	Non-cancer Dose mg/kg-day	**Hazard Quotient (HQ)**	ILCR Dose mg/kg-day	**Risk (ILCR)**	Non-cancer Dose mg/kg-day	**Hazard Quotient (HQ)**	ILCR Dose mg/kg-day	**Risk (ILCR)**	Non-cancer Dose mg/kg-day	**Hazard Quotient (HQ)**
2,3,7,8-TCDD equivalents	1.11E-05																
Adult		9E-13	**9E-8**	2E-12	**no RfD**	2E-12	**2E-7**	4E-12	**no RfD**	3E-14	**3E-9**	8E-14	**no RfD**	3E-12	**3E-7**	6E-12	**no RfD**
Antimony	2.81																
Adult		2E-7	**no SF**	7E-7	**2E-3**	1E-7	**no SF**	4E-7	**9E-4**	5E-9	**no SF**	1E-8	**no RfD**	3E-7	**no SF**	1E-6	**3E-3**
Arsenic, inorganic (regional background)	4.73																
Adult		4E-7	**4E-6**	1E-6	**4E-3**	6E-7	**6E-6**	2E-6	**6E-3**	8E-9	**1E-7**	2E-8	**3E-3**	1E-6	**1E-5**	3E-6	**1E-2**
Barium	691																
Adult		6E-5	**no SF**	2E-4	**2E-3**	3E-5	**no SF**	9E-5	**1E-3**	1E-6	**no SF**	3E-6	**2E-2**	9E-5	**no SF**	3E-4	**2E-2**
Benzo(a)pyrene	0.0159																
Adult		1E-9	**2E-8**	4E-9	**no RfD**	1E-8	**1E-7**	3E-8	**no RfD**	3E-11	**1E-10**	7E-11	**no RfD**	1E-8	**1E-7**	3E-8	**no RfD**
Benzo(g,h,i)perylene (Pyrene surrogate)	0.078																
Adult		7E-9	**no SF**	2E-8	**6E-7**	5E-8	**no SF**	1E-7	**5E-6**	1E-10	**no SF**	4E-10	**1E-10**	6E-8	**no SF**	1E-7	**6E-6**
Cadmium	2.96																
Adult		2E-7	**9E-8**	7E-7	**1E-3**	1E-8	**5E-9**	4E-8	**8E-5**	5E-9	**7E-8**	1E-8	**2E-15**	2E-7	**2E-7**	8E-7	**1E-3**
Iron compounds	32,900																
Adult		3E-3	**no SF**	8E-3	**3E-2**	2E-3	**no SF**	4E-3	**1E-2**	6E-5	**no SF**	2E-4	**no VC**	5E-3	**no SF**	1E-2	**4E-2**
Manganese compounds	1,550																
Adult		1E-4	**no SF**	4E-4	**2E-2**	7E-5	**no SF**	2E-4	**8E-3**	3E-6	**no SF**	7E-6	**5E-1**	2E-4	**no SF**	6E-4	**5E-1**
Phenanthrene	0.00994																
Adult		8E-10	**no SF**	2E-9	**8E-8**	7E-9	**no SF**	2E-8	**6E-7**	2E-11	**no SF**	5E-11	**2E-9**	8E-9	**no SF**	2E-8	**7E-7**
Thallium compounds	0.445																
Adult		4E-8	**no SF**	1E-7	**2E-3**	2E-8	**no SF**	6E-8	**9E-4**	7E-10	**no SF**	2E-9	**no VC**	6E-8	**no SF**	2E-7	**3E-3**
Zinc compounds	2,380																
Adult		2E-4	**no SF**	6E-4	**2E-3**	1E-4	**no SF**	3E-4	**1E-3**	4E-6	**no SF**	1E-5	**no VC**	3E-4	**no SF**	9E-4	**3E-3**
Exposure Route Summed Risk			**2E-7**				**3E-7**				**7E-8**						
Exposure Route Summed Hazard					**0.1**				**0.02**				**0.5**				
Soil Pathway Summed Risk-Adult															6E-7		
Soil Pathway Summed Hazard-Adult																	0.61
Soil Pathway Summed Risk															**6E-7**		
Soil Pathway Summed Hazard																	**0.6**

Bold font has been applied to risk and hazard columns only for visual identification compared to the dose columns

(grey)	arsenic is part of the regional background and is included for informational purposes only; risk/hazard for arsenic is not inclulded in the summations for cumulative risk/hazard
(yellow)	Point of Departure for increased lifetime cancer risk (ILCR) is 1E-6: ILCR risk management range is 1E-6 - 1E-4
(blue)	Hazard index (HI) for acceptable exposure is 1 or less; concern for health effects increases as individual chemical hazard quotient (HQ) or cumulative or aggregate HI increases above 1.

Lead, Diesel fuel (with silica gel cleanup), Motor oil (with silica gel cleanup), and TPH-gasoline are COPCs addressed in the report text.

SF = cancer slope factor; RfD = non-cancer reference dose; VC = volatile chemical

TABLE 6-1: LOCATION OF WASTE ACCUMULATION AREAS IN ECOLOGICAL COMMUNITIES AT YOSEMITE NATIONAL PARK, CALIFORNIA

Waste Accumulation Area	Elevation (feet above mean sea level)	Vegetation Zone		
		Lower Montane	Upper Montane	Subalpine
Baseline	5,562		X	
Camp Six	3,960	X		
Cascade	3,980	X		
El Capitan	3,950	X		
Gaylor	8,600		X	
Mather	**5,000**	**X**		
Pohono	4,000	X		
South Pit	4,000	X		
Taft Toe	3,968	X		
Vogelsang	10,100			X

TABLE 6-2: SOIL SAMPLES USED IN THE SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Sample Number	Date Collected	Depth, ft bgs	Analytes	Sample Type
YWM02A-2268	8/26/2008	0.5	VOCs, Metals, PCBs, PAHs, TPH	Normal Sample
YWM05A-2271	8/26/2008	1.5	TPH, PCBs	Normal Sample
YWM06-2274	8/26/2008	0.5	VOCs, Metals, PCBs, PAHs, TPH	Normal Sample
YWM07-2277	8/26/2008	0.5	VOCs, Metals, PCBs, PAHs, TPH	Normal Sample
YWM08-2280	8/26/2008	0.5	VOCs, Metals, PCBs, PAHs, TPH	Normal Sample
YWM08-2281	8/26/2008	2.0	VOCs, Metals, PCBs, PAHs, TPH	Normal Sample
YWM08-2282	8/26/2008	2.0	VOCs, Metals, PCBs, PAHs, TPH	Field Duplicate
YWM09-2284	8/26/2008	0.5	VOCs, Metals, PCBs, PAHs, TPH	Normal Sample
YWM09-2285	8/26/2008	1.5	VOCs, Metals, PCBs, PAHs, TPH	Normal Sample
YWM-DG01-SO-1050	8/27/2001	1.5	Metals, TPH, PAHs	Normal Sample
YWM-DG02-SO-1051	8/27/2001	1.5	Metals, TPH, PAHs	Normal Sample
YWM-DG03-SO-1052	8/27/2001	1.5	Metals, TPH, PAHs	Normal Sample
YWM-TP02-SO-1049	8/27/2001	2.0	Dioxin, Furans	Normal Sample
YWM-TP05-SO-1040	8/27/2001	1.5	TPH	Normal Sample
YWM-TP05-SO-1041	8/27/2001	1.5	Dioxin, Furans	Normal Sample

Note:
ft bgs = feet below ground surface.

TABLE 6-3: OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN
MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil

CAS Number	Chemical Units = mg/kg except where specified	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Bkgd Value (1)	COPEC Flag (Y/N)	Rationale for Selection or Deletion (2)
Exposure Point: Soil (0-2 feet)									
--	2,3,7,8-TCDD TEQ	6.90E-08	1.11E-05	YWM-TP02-SO-1049	2/2	N/A	N/A	**Yes**	DET
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran	1.60E-05	1.60E-05	YWM-TP02-SO-1049	1/2	4.60E-07 - 4.60E-07	N/A	No	TEQ
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	4.70E-06 J	2.10E-04	YWM-TP02-SO-1049	2/2	N/A	N/A	No	TEQ
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran				0/2	1.80E-07 - 1.10E-06	N/A	No	TEQ
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran	3.30E-06 J	3.30E-06 J	YWM-TP02-SO-1049	1/2	1.60E-07 - 1.60E-07	N/A	No	TEQ
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	3.80E-06 J	3.80E-06 J	YWM-TP02-SO-1049	1/2	1.80E-07 - 1.80E-07	N/A	No	TEQ
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran	2.60E-06 J	2.60E-06 J	YWM-TP02-SO-1049	1/2	1.60E-07 - 1.60E-07	N/A	No	TEQ
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1.40E-05	1.40E-05	YWM-TP02-SO-1049	1/2	3.90E-07 - 3.90E-07	N/A	No	TEQ
72918-21-9	1,2,3,7,8,9-Hexachlorodibenzofuran				0/2	1.90E-07 - 2.30E-07	N/A	No	TEQ
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1.00E-05	1.00E-05	YWM-TP02-SO-1049	1/2	4.10E-07 - 4.10E-07	N/A	No	TEQ
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran	2.90E-06 J	2.90E-06 J	YWM-TP02-SO-1049	1/2	1.90E-07 - 1.90E-07	N/A	No	TEQ
40321-76-4	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	3.70E-06 J	3.70E-06 J	YWM-TP02-SO-1049	1/2	4.20E-07 - 4.20E-07	N/A	No	TEQ
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran	3.70E-06	3.70E-06	YWM-TP02-SO-1049	1/2	2.10E-07 - 2.10E-07	N/A	No	TEQ
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran				0/2	1.70E-07 - 2.40E-06	N/A	No	TEQ
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran	3.30E-06 J	3.30E-06 J	YWM-TP02-SO-1049	1/2	1.80E-07 - 1.80E-07	N/A	No	TEQ
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin	9.00E-07 J	9.00E-07 J	YWM-TP02-SO-1049	1/2	1.70E-07 - 1.70E-07	N/A	No	TEQ
37871-00-4	HPCDD	7.90E-06	3.60E-04	YWM-TP02-SO-1049	2/2	N/A	N/A	No	TEQ
38998-75-3	HPCDF	2.80E-05	2.80E-05	YWM-TP02-SO-1049	1/2	7.10E-07 - 7.10E-07	N/A	No	TEQ
34465-46-8	HXCDD	1.10E-04	1.10E-04	YWM-TP02-SO-1049	1/2	7.50E-07 - 7.50E-07	N/A	No	TEQ
55684-94-1	HXCDF	1.70E-05	1.70E-05	YWM-TP02-SO-1049	1/2	1.90E-07 - 1.90E-07	N/A	No	TEQ
3268-87-9	OCDD	2.20E-05	5.80E-04	YWM-TP02-SO-1049	2/2	N/A	N/A	No	TEQ
39001-02-0	OCDF	1.40E-05	1.40E-05	YWM-TP02-SO-1049	1/2	1.30E-06 - 1.30E-06	N/A	No	TEQ
36088-22-9	PECDD	5.30E-05	5.30E-05	YWM-TP02-SO-1049	1/2	4.20E-07 - 4.20E-07	N/A	No	TEQ
30402-15-4	PECDF	2.60E-05	2.60E-05	YWM-TP02-SO-1049	1/2	2.40E-07 - 2.40E-07	N/A	No	TEQ
41903-57-5	TCDD	1.40E-06	5.50E-05	YWM-TP02-SO-1049	2/2	N/A	N/A	No	TEQ
30402-14-3	TCDF	5.50E-05	5.50E-05	YWM-TP02-SO-1049	1/2	2.10E-07 - 2.10E-07	N/A	No	TEQ
67-64-1	Acetone	5.60E-03 J	1.50E-02	YWM02A-2268	2/7	1.00E-02 - 1.80E-02	N/A	**Yes**	DET
7429-90-5	Aluminum	7.59E+03	1.20E+04	YWM06-2274	7/7	N/A	N/A	No	BKG
120-12-7	Anthracene	6.00E-03	6.00E-03	YWM09-2285	1/10	2.00E-03 - 1.00E-02	N/A	**Yes**	DET

TABLE 6-3: OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN
MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

CAS Number	Chemical Units = mg/kg except where specified	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Bkgd Value (1)	COPEC Flag (Y/N)	Rationale for Selection or Deletion (2)
Exposure Point: Soil (0-2 feet)									
7440-36-0	Antimony	1.07E-01 J	4.63E+00	YWM02A-2268	6/10	5.03E-01 - 2.10E+01	N/A	**Yes**	DET
7440-38-2	Arsenic	9.89E-01	7.37E+00	YWM09-2284	10/10	N/A	N/A	**Yes**	DET
7440-39-3	Barium	3.55E+01 J	9.77E+02	YWM09-2285	10/10	N/A	N/A	**Yes**	DET
56-55-3	Benzo(a)anthracene	1.90E-02	1.90E-02	YWM09-2285	1/10	2.00E-03 - 1.00E-02	N/A	**Yes**	DET
50-32-8	Benzo(a)pyrene	1.60E-02	6.20E-02	YWM07-2277	2/10	2.00E-03 - 1.00E-02	N/A	**Yes**	DET
205-99-2	Benzo(b)fluoranthene	2.40E-02	2.40E-02	YWM09-2285	1/10	2.00E-03 - 1.00E-02	N/A	**Yes**	DET
191-24-2	Benzo(g,h,i)perylene	7.00E-03	7.80E-02	YWM07-2277	3/10	2.00E-03 - 1.00E-02	N/A	**Yes**	DET
207-08-9	Benzo(k)fluoranthene	7.10E-03	7.10E-03	YWM09-2285	1/10	2.00E-03 - 1.00E-02	N/A	**Yes**	DET
7440-41-7	Beryllium	1.47E-01 J	2.20E-01 J	YWM08-2280	7/10	8.00E-01 - 8.30E-01	N/A	No	BKG
117-81-7	bis(2-Ethylhexyl) phthalate	2.40E-01 J	7.20E-01	YWM09-2284	3/7	3.30E-01 - 6.90E-01	N/A	**Yes**	DET
7440-43-9	Cadmium	1.38E-01 J	6.78E+00	YWM02A-2268	7/10	4.00E-01 - 4.20E-01	N/A	**Yes**	DET
7440-70-2	Calcium	1.02E+03	3.18E+04	YWM09-2285	7/7	N/A	N/A	No	NUT
7440-47-8	Chromium (total)	1.70E+00 J	2.84E+01	YWM09-2285	10/10	N/A	N/A	**Yes**	DET
218-01-9	Chrysene	1.00E-03 J	5.10E-02	YWM07-2277	5/10	5.00E-03 - 1.00E-02	N/A	**Yes**	DET
7440-48-4	Cobalt	3.70E+00	9.24E+00	YWM07-2277	10/10	N/A	N/A	**Yes**	DET
7440-50-8	Copper	2.90E+00	2.60E+02	YWM09-2285	10/10	N/A	N/A	**Yes**	DET
53-70-3	Dibenz(a,h)anthracene	4.90E-02	4.90E-02	YWM07-2277	1/10	5.00E-03 - 1.00E-02	N/A	**Yes**	DET
YWM-01	Diesel fuel (with silica gel cleanup)	4.00E+00 J	4.80E+03	YWM05A-2271	7/12	1.00E+01 - 1.00E+01	N/A	**Yes**	DET
YWM-02	Diesel fuel (without silica gel cleanup)	4.00E+00 J	5.80E+03 J	YWM-TP05-SO-1040	4/4	N/A	N/A	No	GEL
206-44-0	Fluoranthene	5.20E-03	5.00E-02	YWM09-2285	2/10	2.00E-03 - 1.00E-02	N/A	**Yes**	DET
193-39-5	Indeno(1,2,3-cd)pyrene	5.20E-03	1.00E-02	YWM09-2285	2/10	2.00E-03 - 1.00E-02	N/A	**Yes**	DET
7439-89-6	Iron	1.32E+04	4.02E+04	YWM07-2277	7/7	N/A	N/A	**Yes**	DET
7439-92-1	Lead	3.50E+00 J	9.94E+02	YWM09-2285	10/10	N/A	N/A	**Yes**	DET
7439-95-4	Magnesium	2.63E+03	5.29E+03	YWM06-2274	7/7	N/A	N/A	No	NUT, BKG
7439-96-5	Manganese	3.41E+02	1.90E+03	YWM02A-2268	7/7	N/A	N/A	**Yes**	DET
7439-97-6	Mercury	4.10E-02 J	1.37E+00	YWM09-2285	10/10	N/A	N/A	**Yes**	DET
75-09-2	Methylene chloride	2.60E-03 J	7.20E-03 J	YWM07-2277	3/7	1.00E-02 - 1.10E-02	N/A	**Yes**	DET
7439-98-7	Molybdenum	3.50E-01 J	2.22E+00	YWM02A-2268	9/10	8.00E-01 - 8.00E-01	N/A	**Yes**	DET
YWM-03	Motor Oils (with silica gel cleanup)	2.90E+01	1.10E+05	YWM-TP05-SO-1040	7/12	1.00E+01 - 1.00E+01	N/A	**Yes**	DET
YWM-04	Motor Oils (without silica gel cleanup)	5.00E+01	1.40E+05	YWM-TP05-SO-1040	4/4	N/A	N/A	No	GEL
7440-02-0	Nickel	1.70E+00 J	2.79E+01	YWM09-2284	10/10	N/A	N/A	**Yes**	DET
87-86-5	Pentachlorophenol	1.90E-01 J	1.90E-01 J	YWM02A-2268	1/7	6.60E-01 - 1.40E+00	N/A	**Yes**	DET
85-01-8	Phenanthrene	3.80E-02	3.80E-02	YWM09-2285	1/10	2.00E-03 - 1.00E-02	N/A	**Yes**	DET

TABLE 6-3: OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN
MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

CAS Number	Chemical Units = mg/kg except where specified	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Bkgd Value (1)	COPEC Flag (Y/N)	Rationale for Selection or Deletion (2)
Exposure Point: Soil (0-2 feet)									
7440-09-7	Potassium	1.71E+03	5.66E+03	YWM06-2274	7/7	N/A	N/A	No	NUT, BKG
129-00-0	Pyrene	4.60E-03 J	4.00E-02	YWM09-2285	4/10	2.00E-03 - 1.00E-02	N/A	**Yes**	DET
7782-49-2	Selenium	1.19E-01 J	1.97E-01 J	YWM09-2284	7/10	2.00E+00 - 2.10E+00	N/A	No	BKG
7440-22-4	Silver	7.19E-01	1.23E+00	YWM09-2285	5/10	5.03E-01 - 2.10E+00	N/A	**Yes**	DET
7440-23-5	Sodium	7.89E+01 J	2.93E+02	YWM09-2285	7/7	N/A	N/A	No	NUT
7440-28-0	Thallium	2.32E-01 J	5.67E-01	YWM07-2277	7/10	2.00E+00 - 2.10E+00	N/A	**Yes**	DET
YWM-05	TPH-gasoline	2.50E+00	2.50E+00	YWM07-2277	1/7	1.00E+00 - 1.50E+00	N/A	**Yes**	DET
7440-62-2	Vanadium	1.55E+01	3.74E+01	YWM06-2274	10/10	N/A	N/A	No	BKG
7732-18-5	Water (Units = percent)	2.00E+00	7.10E+00	YWM-TP05-SO-1040	3/4	5.00E-01 - 5.00E-01	N/A	No	NC
7440-66-6	Zinc	2.25E+01 J	2.42E+03	YWM07-2277	10/10	N/A	N/A	**Yes**	DET
71-55-6	1,1,1-Trichloroethane				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
79-34-5	1,1,2,2-Tetrachloroethane				0/6	5.00E-03 - 6.60E-03	N/A	No	ND
79-00-5	1,1,2-Trichloroethane				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
75-34-3	1,1-Dichloroethane				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
75-35-4	1,1-Dichloroethene				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
120-82-1	1,2,4-Trichlorobenzene				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
95-50-1	1,2-Dichlorobenzene				0/6	5.00E-03 - 6.60E-03	N/A	No	ND
107-06-2	1,2-Dichloroethane				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
78-87-5	1,2-Dichloropropane				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
541-73-1	1,3-Dichlorobenzene				0/6	5.00E-03 - 6.60E-03	N/A	No	ND
106-46-7	1,4-Dichlorobenzene				0/6	5.00E-03 - 6.60E-03	N/A	No	ND
95-95-4	2,4,5-Trichlorophenol				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
88-06-2	2,4,6-Trichlorophenol				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
120-83-2	2,4-Dichlorophenol				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
105-67-9	2,4-Dimethylphenol				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
51-28-5	2,4-Dinitrophenol				0/7	6.60E-01 - 1.40E+00	N/A	No	ND
121-14-2	2,4-Dinitrotoluene				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
121-14-2	2,4-Dinitrotoluene				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
606-20-2	2,6-Dinitrotoluene				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
606-20-2	2,6-Dinitrotoluene				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
78-93-3	2-Butanone				0/7	1.00E-02 - 1.80E-02	N/A	No	ND
91-58-7	2-Chloronaphthalene				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
95-57-8	2-Chlorophenol				0/7	3.30E-01 - 6.90E-01	N/A	No	ND

TABLE 6-3: OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN
MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

CAS Number	Chemical Units = mg/kg except where specified	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Bkgd Value (1)	COPEC Flag (Y/N)	Rationale for Selection or Deletion (2)
Exposure Point: Soil (0-2 feet)									
591-78-6	2-Hexanone				0/7	1.00E-02 - 1.80E-02	N/A	No	ND
91-57-6	2-Methylnaphthalene				0/10	5.00E-02 - 6.90E-01	N/A	No	ND
88-74-4	2-Nitroaniline				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
88-75-5	2-Nitrophenol				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
91-94-1	3,3'-Dichlorobenzidine				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
99-09-2	3-Nitroaniline				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
534-52-1	4,6-Dinitro-o-cresol				0/7	6.60E-01 - 1.40E+00	N/A	No	ND
101-55-3	4-Bromophenyl phenylether				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
7005-72-3	4-Chlorophenyl phenylether				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
108-10-1	4-Methyl-2-pentanone				0/7	1.00E-02 - 1.80E-02	N/A	No	ND
100-01-6	4-Nitroaniline				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
100-02-7	4-Nitrophenol				0/7	6.60E-01 - 1.40E+00	N/A	No	ND
83-32-9	Acenaphthene				0/10	5.00E-03 - 5.20E-02	N/A	No	ND
208-96-8	Acenaphthylene				0/10	5.00E-03 - 2.10E-02	N/A	No	ND
12674-11-2	Aroclor 1016				0/8	5.00E-02 - 5.30E-02	N/A	No	ND
11104-28-2	Aroclor 1221				0/8	5.00E-02 - 5.30E-02	N/A	No	ND
11141-16-5	Aroclor 1232				0/8	5.00E-02 - 5.30E-02	N/A	No	ND
53469-21-9	Aroclor 1242				0/8	5.00E-02 - 5.30E-02	N/A	No	ND
12672-29-6	Aroclor 1248				0/8	5.00E-02 - 5.30E-02	N/A	No	ND
11097-69-1	Aroclor 1254				0/8	5.00E-02 - 5.30E-02	N/A	No	ND
11096-82-5	Aroclor 1260				0/8	5.00E-02 - 5.30E-02	N/A	No	ND
71-43-2	Benzene				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
111-91-1	bis(2-Chloroethoxy)methane				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
111-44-4	bis(2-Chloroethyl)ether				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
108-60-1	bis(2-Chloroisopropyl)ether				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
75-27-4	Bromodichloromethane				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
74-83-9	Bromomethane				0/7	1.00E-02 - 1.80E-02	N/A	No	ND
85-68-7	Butyl benzyl phthalate				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
75-15-0	Carbon disulfide				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
56-23-5	Carbon tetrachloride				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
108-90-7	Chlorobenzene				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
75-00-3	Chloroethane				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
67-66-3	Chloroform				0/7	5.00E-03 - 8.90E-03	N/A	No	ND

TABLE 6-3: OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN
MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

CAS Number	Chemical Units = mg/kg except where specified	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Bkgd Value (1)	COPEC Flag (Y/N)	Rationale for Selection or Deletion (2)
Exposure Point: Soil (0-2 feet)									
74-87-3	Chloromethane				0/7	1.00E-02 - 1.80E-02	N/A	No	ND
18540-29-9	Chromium (VI)				0/3	5.00E-01 - 5.20E-01	N/A	No	ND
156-59-2	cis-1,2-Dichloroethene				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
10061-01-5	cis-1,3-Dichloro-1-propene				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
132-64-9	Dibenzofuran				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
124-48-1	Dibromochloromethane				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
75-71-8	Dichlorodifluoromethane				0/7	1.00E-02 - 1.80E-02	N/A	No	ND
84-66-2	Diethyl phthalate				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
131-11-3	Dimethylphthalate				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
84-74-2	Di-n-butyl phthalate				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
117-84-0	Di-n-octyl phthalate				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
100-41-4	Ethylbenzene				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
86-73-7	Fluorene				0/10	2.00E-03 - 1.00E-02	N/A	No	ND
118-74-1	Hexachlorobenzene				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
87-68-3	Hexachlorobutadiene				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
77-47-4	Hexachlorocyclopentadiene				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
67-72-1	Hexachloroethane				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
78-59-1	Isophorone				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
ICF87	m+p-Xylenes				0/7	1.00E-02 - 1.80E-02	N/A	No	ND
1634-04-4	Methyl tert-butyl ether				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
91-20-3	Naphthalene				0/10	5.00E-03 - 5.20E-02	N/A	No	ND
98-95-3	Nitrobenzene				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
621-64-7	n-Nitroso-di-n-propylamine				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
86-30-6	n-Nitrosodiphenylamine				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
95-48-7	o-Cresol				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
95-47-6	o-Xylene				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
106-47-8	p-Chloroaniline				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
59-50-7	p-Chloro-m-cresol				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
106-44-5	p-Cresol				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
108-95-2	Phenol				0/7	3.30E-01 - 6.90E-01	N/A	No	ND
100-42-5	Styrene				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
127-18-4	Tetrachloroethene				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
108-88-3	Toluene				0/7	5.00E-03 - 8.90E-03	N/A	No	ND

TABLE 6-3: OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

CAS Number	Chemical Units = mg/kg except where specified	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Bkgd Value (1)	COPEC Flag (Y/N)	Rationale for Selection or Deletion (2)
Exposure Point: Soil (0-2 feet)									
156-60-5	trans-1,2-Dichloroethene				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
10061-02-6	trans-1,3-Dichloropropene				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
75-25-2	Tribromomethane				0/6	5.00E-03 - 6.60E-03	N/A	No	ND
79-01-6	Trichloroethene				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
75-69-4	Trichlorofluoromethane				0/7	5.00E-03 - 8.90E-03	N/A	No	ND
75-01-4	Vinyl Chloride				0/7	5.00E-03 - 8.90E-03	N/A	No	ND

NOTES:

(1) N/A - Refer to supporting information for background discussion.

(2) Rationale Codes:

Selection Reason: Detected (DET)

Deletion Reason: Infrequent Detection (≤ 5%, IFD)
Background Related (BKG)
Dioxin/Furan specific congener results available, and 2,3,7,8-TCDD toxic equivalency used (TEQ)
Not Detected (ND)
Essential Nutrient (NUT)
Results from Silica Gel Clean Up Used (e.g., Diesel, Motor Oil) (GEL)
Non-Chemical Result (e.g., total organic carbon) (NC)

Definitions:

N/A = Not Applicable or Not Available
COPEC = Chemical of Potential Ecological Concern
J = Estimated Value

TABLE 6-4: MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY FOR SURFACE SOIL, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil

Chemical of Potential Concern Units = mg/kg	Arithmetic Mean of Detects	Multiple Detection Limits? (Yes/No) [1]	95% UCL (Distribution) [2]	Maximum Concentration	Exposure Point Concentration			
					Value	Units	Statistic [3]	Rationale [4]
Exposure Point: Surface Soil								
2,3,7,8-TCDD TEQ	5.60E-06	N/A	N/A	1.11E-05	1.11E-05	mg/kg	Max	Test (7)
Acetone [5]	1.03E-02	N/A	1.04E-02 (NP)	1.50E-02	1.04E-02	mg/kg	95% UCL Bst	Test (8)
Anthracene [5]	6.00E-03	N/A	4.16E-03 (NP)	6.00E-03	4.16E-03	mg/kg	95% UCL Bst	Test (8)
Antimony	1.95E+00	Yes	2.81E+00 (N)	4.63E+00	2.81E+00	mg/kg	95% KM-t	Test (4)
Arsenic	3.38E+00	No	4.73E+00 (N)	7.37E+00	4.73E+00	mg/kg	95% Student's-t	Test (4)
Barium	3.18E+02	No	6.91E+02 (G)	9.77E+02	6.91E+02	mg/kg	95% Approx. Gamma	Test (6)
Benzo(a)anthracene [5]	1.90E-02	N/A	6.06E-03 (NP)	1.90E-02	6.06E-03	mg/kg	95% UCL Bst	Test (8)
Benzo(a)pyrene [5]	3.90E-02	N/A	1.59E-02 (NP)	6.20E-02	1.59E-02	mg/kg	95% UCL Bst	Test (8)
Benzo(b)fluoranthene [5]	2.40E-02	N/A	7.07E-03 (NP)	2.40E-02	7.07E-03	mg/kg	95% UCL Bst	Test (8)
Benzo(g,h,i)perylene	3.20E-02	Yes	7.80E-02 (N)	7.80E-02	7.80E-02	mg/kg	95% KM-% Btstrp	Test (1)
Benzo(k)fluoranthene [5]	7.10E-03	N/A	4.40E-03 (NP)	7.10E-03	4.40E-03	mg/kg	95% UCL Bst	Test (8)
bis(2-Ethylhexyl) phthalate	4.17E-01	Yes	4.78E-01 (N)	7.20E-01	4.78E-01	mg/kg	95% KM-t	Test (1)
Cadmium	2.29E+00	Yes	2.96E+00 (N)	6.78E+00	2.96E+00	mg/kg	95% KM-t	Test (1)
Chromium (total)	1.20E+01	No	1.80E+01 (N)	2.84E+01	1.80E+01	mg/kg	95% Student's-t	Test (4)
Chrysene	1.58E-02	Yes	2.02E-02 (N)	5.10E-02	2.02E-02	mg/kg	95% KM-% Btstrp	Test (1)
Cobalt	5.70E+00	No	6.80E+00 (N)	9.24E+00	6.80E+00	mg/kg	95% Student's-t	Test (4)
Copper	8.48E+01	No	1.35E+02 (N)	2.60E+02	1.35E+02	mg/kg	95% Student's-t	Test (4)
Dibenz(a,h)anthracene [5]	4.90E-02	N/A	1.22E-02 (NP)	4.90E-02	1.22E-02	mg/kg	95% UCL Bst	Test (8)

TABLE 6-4: MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY FOR SURFACE SOIL, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Chemical of Potential Concern Units = mg/kg	Arithmetic Mean of Detects	Multiple Detection Limits? (Yes/No) [1]	95% UCL (Distribution) [2]	Maximum Concentration	Exposure Point Concentration			
					Value	Units	Statistic [3]	Rationale [4]
Exposure Point: Surface Soil								
Diesel fuel (with silica gel cleanup)	1.29E+03	No	1.61E+03 (G)	4.80E+03	1.61E+03	mg/kg	95% KM BCA	Test (6)
Fluoranthene [5]	2.76E-02	N/A	1.25E-02 (NP)	5.00E-02	1.25E-02	mg/kg	95% UCL Bst	Test (8)
Indeno(1,2,3-cd)pyrene [5]	7.60E-03	N/A	5.38E-03 (NP)	1.00E-02	5.38E-03	mg/kg	95% UCL Bst	Test (8)
Iron	2.59E+04	No	3.29E+04 (N)	4.02E+04	3.29E+04	mg/kg	95% Student's-t	Test (4)
Lead	2.86E+02	No	1.03E+03 (G)	9.94E+02	9.94E+02	mg/kg	Max	Test (2)
Manganese	1.07E+03	No	1.55E+03 (N)	1.90E+03	1.55E+03	mg/kg	95% Student's-t	Test (4)
Mercury	4.73E-01	No	7.25E-01 (N)	1.37E+00	7.25E-01	mg/kg	95% Student's-t	Test (4)
Methylene chloride	4.17E-03	Yes	7.11E-03 (L)	7.20E-03	7.11E-03	mg/kg	95% KM-t	Test (1)
Molybdenum	1.12E+00	No	1.46E+00 (N)	2.22E+00	1.46E+00	mg/kg	95% KM-t	Test (4)
Motor Oils (with silica gel cleanup)	2.87E+04	No	4.04E+04 (G)	1.10E+05	4.04E+04	mg/kg	95% KM BCA	Test (6)
Nickel	9.63E+00	No	1.46E+01 (N)	2.79E+01	1.46E+01	mg/kg	95% Student's-t	Test (4)
Pentachlorophenol [5]	1.90E-01	N/A	5.92E-01 (NP)	1.90E-01	1.90E-01	mg/kg	Max	Test (2)
Phenanthrene [5]	3.80E-02	N/A	9.94E-03 (NP)	3.80E-02	9.94E-03	mg/kg	95% UCL Bst	Test (8)
Pyrene	1.78E-02	Yes	2.32E-02 (N)	4.00E-02	2.32E-02	mg/kg	95% KM-% Btstrp	Test (1)
Silver	9.42E-01	Yes	1.05E+00 (N)	1.23E+00	1.05E+00	mg/kg	95% KM-% Btstrp	Test (1)
Thallium	3.70E-01	Yes	4.45E-01 (N)	5.67E-01	4.45E-01	mg/kg	95% KM-t	Test (1)
TPH-gasoline [5]	2.50E+00	N/A	1.20E+00 (NP)	2.50E+00	1.20E+00	mg/kg	95% UCL Bst	Test (8)
Zinc	8.42E+02	No	2.38E+03 (G)	2.42E+03	2.38E+03	mg/kg	95% Approx. Gamma	Test (6)

Refer to footnotes on following page.

TABLE 6-4: MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY FOR SURFACE SOIL, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Notes:

N/A = Not applicable.

[1] ProUCL software (version 4.0, USEPA, 2007) recommends use of Kaplan-Meier method if there are multiple detection limits.

[2] Statistical Distribution and 95% UCL as determined by ProUCL (unless otherwise noted): (G) the data were determined to follow gamma distribution; (L) the data were determined to follow lognormal distribution; (NP) the data were determined to be non-parametric; (N) the data were determined to be normally distributed.

[3] Statistic: Maximum Detected Value (Max); 95% KM Chebyshev (95% KM-Cheby); 97.5% KM Chebyshev (97.5% KM-Cheby); 99% KM Chebyshev (99% KM-Cheby); 95% KM Percentile Bootstrap (95% KM-% Btstrp); 95% KM-t (95% KM-t); 95% KM-BCA (95% KM-BCA); 95% H-UCL (95% H-UCL); 95% Chebyshev -Mean, SD- UCL (95% Cheby, Mean, SD); 97.5% Chebyshev -Mean, SD- UCL (97.5% Cheby, Mean, SD); 99% Chebyshev -Mean, SD- UCL (99% Cheby, Mean, SD); 95% UCL of Log-transformed Data (95% UCL-T)
95% Student's-t (95% Student's-t); 95% Modified-t (95% Modified-t); 95% UCL based on bootstrap statistic (95% UCL-Bst); 95% Approximate Gamma UCL (95% Approx. Gamma);
95% Adjusted Gamma UCL (95% Adjusted Gamma); 95% KM Chebyshev-MVUE (95% KM-Cheby-MVUE).

[4] Unless otherwise noted, ProUCL EPC selection rationale based on, detection limit values, distribution, standard deviation, and sample size (see ProUCL output in appendix for further details):

Test (1): Kaplan-Meier method recommended by ProUCL due to multiple detection limits.
Test (2): The 95% UCL exceeds the maximum detected concentration, therefore, maximum concentration used for EPC.
Test (3): Shapiro-Wilk W test, Kolmogorov-Smirnov (K-S), and Anderson-Darling (A-D) tests, indicate data follow nonparametric distribution.
Test (4): Shapiro-Wilk W test indicates data are normally distributed.
Test (5): Shapiro-Wilk W test indicates data are log-normally distributed.
Test (6): Kolmogorov-Smirnov (K-S) and/or Anderson-Darling (A-D) tests indicate data follow gamma distribution.
Test (7): Sample size is less than or equal to 5, therefore, maximum concentration used for EPC.
Test (8): 95% UCL estimated by a non-Pro-UCL bootstrap method.

[5] Infrequent detection resulted in ProUCL modeling error for this constituent, therefore distribution, average, and UCL determined using non-ProUCL bootstrap method with random numbers for NDs.

TABLE 6-5: ASSESSMENT AND MEASUREMENT ENDPOINTS FOR SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Assessment Endpoints	Measurement Endpoints	Measurement Receptor	Information Provided
Terrestrial Habitats			
Protection of trophic level 2 herbivore populations	Mortality; reproduction, growth as measured by NOAEL and LOAEL based TRVs	Yellow-bellied marmot, California vole	Impacts resulting from direct exposure and indirect exposure via food chains
Protection of trophic level 3 omnivore populations	Mortality; reproduction, growth as measured by NOAEL and LOAEL based TRVs	To be selected, if necessary	Impacts resulting from direct exposure and indirect exposure via food chains
Protection of trophic level 3 insectivore populations	Mortality; reproduction, growth as measured by NOAEL and LOAEL based TRVs	Dusky shrew, American robin	Impacts resulting from direct exposure and indirect exposure via food chains
Protection of trophic level 4 carnivore populations	Mortality; reproduction, growth as measured by NOAEL and LOAEL based TRVs	Long-tailed weasel	Impacts resulting from direct exposure and indirect exposure via food chains
Preservation of the viability of upper trophic level receptors utilizing the plant community as habitat, food source, and/or energy transfer.	Mortality; reproduction, growth as measured by receptor-specific benchmark concentrations	Terrestrial plant community	Impacts resulting from potential loss of food source.
Preservation of the viability of upper trophic level receptors utilizing the invertebrate community as habitat, food source, and/or energy transfer.	Mortality; reproduction, growth as measured by receptor-specific benchmark concentrations	Terrestrial invertebrate community	Impacts resulting from potential loss of food source.

Notes:

COPEC = constituent of potential ecological concern
LOAEL = lowest-observed-adverse-effect level
NOAEL = no-observed-adverse-effect level
TRV = toxicity reference value

Table 6-6
Exposure [a] Factors for Selected Measurement Receptors
Mather Waste Accumulation Area, Yosemite National Park, California

Indicator Species	Body Weight Range (average) (kg)	Average Home Range (ha) [ac]	Dietary Intake[b] (kg[DMI]/day)	Soil Intake[c] (%Diet) (kg[dw]/day)	Average Water Intake[d] (L/day)	Trophic Level	Dietary Composition
Dusky shrew (*Sorex monticolus*)	0.0055-0.0070 (0.0062) [e]	0.04 [0.1] [f]	0.00116	(10.4%) 0.00012	0.0010	Insectivore	Terr. Inverts: 100%
American robin (*Turdus migratorius*)	0.045-0.11 (0.088) [g]	0.48 [1.2]	0.0111	(4%) 0.00044	0.012	Omnivore	Plants: 62% Terr Inverts: 38%
Yellow-bellied Marmot (*Marmota flaviventris*)	3.19 [h]	2.2-10 [4.9-24.7] [i]	0.243	(2.4%) 0.0058	0.28	Herbivore	Plants: 100%
Long-tailed weasel (*Mustela frenata*)	0.099-0.297 (0.202) [g]	10-20 [25-50] [f]	0.0128	(2.8%) 0.00036	0.023	Carnivore	Mammals: 80% Birds: 20%
California vole (*Microtus californicus)*	0.0204-0.0809 (0.0424) [g]	0.15 [0.37] [f]	0.00904	(2.4%) 0.00022	0.0058	Herbivore	Plants: 100%

Notes:

[a] From USEPA (1993), except as noted.
[b] Dietary intake based on receptor-specific dry matter intake (DMI) value when available or class/guild appropriate regression equation as presented in Nagy (2001) [see page 2].
[c] Soil ingestion rate based on estimated percent soil in diet (dry weight) and dietary intake (DMI).
[d] Average water intake based on appropriate allometric equation using average body weight.
[e] Smith, M.E. and M.C. Belk, 1996, *Sorex monticolus*, Mammalian Species, No. 528, pp. 1-5.
[f] California Dept. of Fish and Game, Wildlife Habitat Relationship System, Data Base v. 8.2 (2008).
[g] California DTSC (2009), http://oehha.ca.gov/scripts/cal_ecotox/exposurefactordescription.
[h] Nagy (2001).
[i] Armitage (1974).

Table 6-6 continued
Exposure[a] Factors for Selected Measurement Receptors
Mather Waste Accumulation Area, Yosemite National Park, California

Summary of Food Intake Rates:

Receptor	Class	Feeding Guild	Regression Equation Input a	b	body mass (g)	Food Intake Result y (g DMI/d)
California Vole	Mammal	Herbivore	0.859	0.628	42.4	9.04
Dusky Shrew	Mammal	Insectivore	0.373	0.622	6.2	1.16
American Robin	Bird	Omnivorous	0.67	0.627	88	11.10
Long-tailed Weasel	Mammal	Carnivore	0.153	0.834	202	12.80
Yellow-bellied Marmot	Mammal	Herbivore	NA	NA	NA	*use species specific intake (Nagy, 2001)*

Regression equation and input values from Tables 2 (mammal) and 3 (bird): $y = a*(\text{body mass})^b$ from Nagy 2001.
NA = Not applicable.

Summary of Soil Ingestion Rate Assumptions:

1. The soil ingestion rate for the shrew set equal to the rate for the American woodcock (10.4% of diet), as both species feed predominantly on earthworms.
2. The soil ingestion rate for the American robin set equal to 48% of the American woodcock value (0.38 x 10.4% = 4%), based on a robin diet of 38% invertebrates (earthworms).
3. The soil ingestion rate for the marmot and vole set equal to the rate for the meadow vole (2.4% of diet), as both species feed predominantly on vegetation.
4. The soil ingestion rate for the weasel set equal to the rate for the red fox (2.8% of diet), as both species are carnivores.

kg = kilograms
L = liters
ha = hectare
ac = acre (hectare = 2.471 acres).

TABLE 6-7: RECOMMENDED BIOACCUMULATION/BIOCONCENTRATION FACTORS OR REGRESSION EQUATIONS UTILIZED FOR THE SOIL-TO-PLANT PATHWAY, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Constituent	USEPA (2007) Eco-SSL Uptake Equation [a]	Alternate Regression Equation [b, c]	Alternate BAF/BCF	Recommended BAF/BCF	Rationale for Recommended BAF/BCF
2,3,7,8-TCDD TEQ	--[d]	Log (PC)= -0.4057(Log[Kow])+1.781	--	9.41E-02	EcoSSL K_{ow} Regression Eq.
Acetone	--	Log (PC)= -0.4057(Log[Kow])+1.781	--	7.56E+01	EcoSSL K_{ow} Regression Eq.
Anthracene	ln (Pc)= 0.7784(ln[soil])-0.9887	--	--	Regression Eq.	Recommended Equation (USEPA 2007)
Benzo(a)anthracene	ln (Pc)= 0.5944(ln[soil])-2.7078	--	--	Regression Eq.	Recommended Equation (USEPA 2007)
Benzo(a)pyrene	ln (Pc)= 0.9750(ln[soil])-2.0615	--	--	Regression Eq.	Recommended Equation (USEPA 2007)
Benzo(b)fluoranthene	Pc= 0.31(soil)	--	--	3.10E-01	Recommended BAF from USEPA (2007)
Benzo(g,h,i)perylene	ln (Pc)= 1.1829(ln[soil])-0.9313	--	--	Regression Eq.	Recommended Equation (USEPA 2007)
Benzo(k)fluoranthene	ln (Pc)= 0.8595(ln[soil])-2.1579	--	--	Regression Eq.	Recommended Equation (USEPA 2007)
Bis(2-ethylhexyl)phthalate	--	Log (PC)= -0.4057(Log[Kow])+1.781	--	2.38E-02	EcoSSL K_{ow} Regression Eq.
Chrysene	ln (Pc)= 0.5944(ln[soil])-2.7078	--	--	Regression Eq.	Recommended Equation (USEPA 2007)
Dibenz(a,h)anthracene	Pc= 0.13(soil)	--	--	1.30E-01	Recommended BAF from USEPA (2007)
Diesel Fuel	--	--	--	--	--
Fluoranthene	Pc= 0.50(soil)	--	--	5.00E-01	Recommended BAF from USEPA (2007)
Gasoline	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	Pc= 0.11(soil)	--	--	1.10E-01	Recommended BAF from USEPA (2007)
Methylene chloride	--	Log (PC)= -0.4057(Log[Kow])+1.781	--	1.73E+01	EcoSSL K_{ow} Regression Eq.
Motor Oil	--	--	--	--	--
Pentachlorophenol	Pc= 5.93(soil)	--	--	5.93E+00	Recommended BAF from USEPA (2007)
Phenanthrene	ln (Pc)= 0.6203(ln[soil])-0.1665	--	--	Regression Eq.	Recommended Equation (USEPA 2007)
Pyrene	Pc= 0.72(soil)	--	--	7.20E-01	Recommended BAF from USEPA (2007)
Antimony	ln (Pc)= 0.938(ln[soil])-0.3.233	--	--	Regression Eq.	Recommended Equation (USEPA 2007)
Arsenic	Pc= 0.03752(soil)	--	--	3.75E-02	Recommended BAF from USEPA (2007)
Barium	Pc= 0.156(soil)	--	--	1.56E-01	Recommended BAF from USEPA (2007)
Cadmium	ln (Pc)= 0.546(ln[soil])-0.475	--	--	Regression Eq.	Recommended Equation (USEPA 2007)
Chromium	Pc= 0.041(soil)	--	--	4.10E-02	Recommended BAF from USEPA (2007)
Cobalt	Pc= 0.0075(soil)	--	--	7.50E-03	Recommended BAF from USEPA (2007)

TABLE 6-7: RECOMMENDED BIOACCUMULATION/BIOCONCENTRATION FACTORS OR REGRESSION EQUATIONS UTILIZED FOR THE SOIL-TO-PLANT PATHWAY, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Constituent	USEPA (2007) Eco-SSL Uptake Equation [a]	Alternate Regression Equation [b, c]	Alternate BAF/BCF	Recommended BAF/BCF	Rationale for Recommended BAF/BCF
Copper	ln (Pc)= 0.394(ln[soil])+0.668	--	--	Regression Eq.	Recommended Equation (USEPA 2007)
Iron	--	--	--	--	--
Lead	ln (Pc)= 0.561(ln[soil])-1.328	--	--	Regression Eq.	Recommended Equation (USEPA 2007)
Manganese	Pc= 0.079(soil)	--	--	7.90E-02	Recommended BAF from USEPA (2007)
Mercury	--	ln (Pc)=0.54(ln[soil])-1.00	--	Regression Eq.	Efroymson, et al. Regression Equation
Molybdenum	--	--	--	--	--
Nickel	ln (Pc)= 0.748(ln[soil])-2.223	--	--	Regression Eq.	Recommended Equation (USEPA 2007)
Silver	Pc= 0.014(soil)	--	--	1.40E-02	Recommended BAF from USEPA (2007)
Thallium	--	--	--	--	--
Zinc	ln (Pc)= 0.554(ln[soil])+1.575	--	--	Regression Eq.	Recommended Equation (USEPA 2007)

Notes:

Pc (plant tissue concentration [mg/kg d.w.]); soil (concentration in soil [mg/kg d.w.]); BAF/BCF (bioaccumulation/bioconcentration factor); log K_{ow} (octanol/water partition coefficient). If a soil to plant BAF/BCF was not available from USEPA, 2007, Ecological Soil Screening Level Guidance, an alternate value was used (see below).

[a] USEPA, 2007, Ecological Soil Screening Level Guidance, Soil to Plant Uptake Equations, OSWER Directive 9285.7-55.

[b] For organic chemicals, BAF estimated using EcoSSL (2007) K_{ow} regression equation, with log K_{ow} from USEPA, 2007, Estimation Programs Interface (EPI) Suite, v3.20).

Constituent	Log K_{ow}	BAF/BCF	Reference for Low K_{ow}
2,3,7,8-TCDD TEQ	6.92	9.41E-02	USEPA EPI Suite, 2007
Acetone	-0.24	7.56E+01	USEPA EPI Suite, 2007
Bis(2-ethylhexyl)phthalate	8.39	2.38E-02	USEPA EPI Suite, 2007
Methylene chloride	1.34	1.73E+01	USEPA EPI Suite, 2007

[c] for inorganic chemicals: Efroymson, R.A., et. al., 2001, Uptake of Inorganic Chemicals from Soil by Plant Leaves: Regressions of Field Data, Environ. Tox. Chem., 20:2561-2571.

[d] -- indicates that a BAF/BCF or regression equation is not available or not applicable.

TABLE 6-8: RECOMMENDED BIOACCUMULATION/BIOCONCENTRATION FACTORS OR REGRESSION EQUATIONS UTILIZED FOR THE SOIL-TO-EARTHWORM PATHWAY, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Constituent	USEPA (2007) Eco-SSL Uptake Equation [a]	Sample, et al. 1998 [b]			Sample et al. 1999 [c] Regression Equation	Recommended BAF/BCF	Rationale for Recommended BAF/BCF
		Median BAF/BCF	90th Percentile BAF/BCF	Maximum BAF/BCF			
2,3,7,8-TCDD-TEQ	-- [d]	11.011	22.229	42.068	ln (EW)=1.18(ln[soil])+3.53	Regression Eq.	Chemical-specific Regression Eq.
Acetone	--	--	--	--	--	9.7	Kow Regression Eq., using arith-mean TOC
Anthracene	(EW)= 2.42(soil)	--	--	--	--	2.42	Recommended BAF (USEPA 2007)
Benzo(a)anthracene	(EW)= 1.59(soil)	--	--	--	--	1.6	Recommended BAF (USEPA 2007)
Benzo(a)pyrene	(EW)= 1.33(soil)	--	--	--	--	1.3	Recommended BAF (USEPA 2007)
Benzo(b)fluoranthene	(EW)= 2.6(soil)	--	--	--	--	2.6	Recommended BAF (USEPA 2007)
Benzo(g,h,i)perylene	(EW)= 2.94(soil)	--	--	--	--	2.9	Recommended BAF (USEPA 2007)
Benzo(k)fluoranthene	(EW)= 2.6(soil)	--	--	--	--	2.6	Recommended BAF (USEPA 2007)
Bis(2-ethylhexyl)phthalate	--	--	--	--	--	3745	Kow Regression Eq., using arith-mean TOC
Chrysene	(EW)= 2.29(soil)	--	--	--	--	2.29	Recommended BAF (USEPA 2007)
Dibenz(a,h)anthracene	(EW)= 2.31(soil)	--	--	--	--	2.31	Recommended BAF (USEPA 2007)
Diesel Fuel	--	--	--	--	--	--	--
Fluoranthene	(EW)= 3.04(soil)	--	--	--	--	3.0	Recommended BAF (USEPA 2007)
Gasoline	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	(EW)= 2.86(soil)	--	--	--	--	2.86	Recommended BAF (USEPA 2007)
Methylene chloride	--	--	--	--	--	19.2	Kow Regression Eq., using arith-mean TOC
Motor Oil	--	--	--	--	--	--	--
Pentachlorophenol	(EW)= 14.63(soil)	--	--	--	--	14.63	Recommended BAF (USEPA 2007)
Phenanthrene	(EW)= 1.72(soil)	--	--	--	--	1.7	Recommended BAF (USEPA 2007)
Pyrene	(EW)= 1.75(soil)	--	--	--	--	1.8	Recommended BAF (USEPA 2007)
Antimony	(EW)= 1.0 (soil)	--	--	--	--	1.0	Recommended BAF (USEPA 2007)
Arsenic	ln (EW)= 0.706(ln[soil])-1.421	--	--	--	--	Regression Eq.	Recommended Equation (USEPA 2007)
Barium	(EW)= 0.091(soil)	--	--	--	--	0.091	Recommended BAF (USEPA 2007)
Cadmium	ln (EW)= 0.795(ln[soil])+2.114	--	--	--	--	Regression Eq.	Recommended Equation (USEPA 2007)
Chromium	(EW)= 0.306(soil)	--	--	--	--	0.306	Recommended BAF (USEPA 2007)
Cobalt	(EW)= 0.122(soil)	--	--	--	--	0.122	Recommended BAF (USEPA 2007)
Copper	(EW)= 0.515(soil)	--	--	--	--	0.515	Recommended BAF (USEPA 2007)
Iron	--	0.036	0.078	0.100	--	0.036	Median BAF
Lead	ln (EW)= 0.807(ln[soil])-0.218	--	--	--	--	Regression Eq.	Recommended Equation (USEPA 2007)

TABLE 6-8: RECOMMENDED BIOACCUMULATION/BIOCONCENTRATION FACTORS OR REGRESSION EQUATIONS UTILIZED FOR THE SOIL-TO-EARTHWORM PATHWAY, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Constituent	USEPA (2007) Eco-SSL Uptake Equation [a]	Sample, et al. 1998 [b]			Sample et al. 1999 [c] Regression Equation	Recommended BAF/BCF	Rationale for Recommended BAF/BCF
		Median BAF/BCF	90th Percentile BAF/BCF	Maximum BAF/BCF			
Manganese	ln (EW)= 0.682(ln[soil])-0.809	--	--	--	--	Regression Eq.	Recommended Equation (USEPA 2007)
Mercury	--	1.693	20.625	33	ln (EW)=0.33(ln[soil])+0.078	Regression Eq.	Chemical-specific Regression Eq.
Molybdenum	--	0.953	2.091	2.091	--	0.953	Median BAF
Nickel	--	1.059	4.73	7.8	ln (EW)= -1.54(ln[soil])+7.03	Regression Eq.	Chemical-specific Regression Eq.
Silver	(EW)= 2.045(soil)	--	--	--	--	2.045	Recommended BAF (USEPA 2007)
Thallium	--	--	--	--	--	--	--
Zinc	ln (EW)= 0.328(ln[soil])+4.449	--	--	--	--	Regression Eq.	Recommended Equation (USEPA 2007)

Notes: EW (earthworm tissue concentration [mg/kg d.w.]); soil (concentration in soil [mg/kg d.w.]); BAF/BCF (bioaccumulation/bioconcentration factor); log Kow (octanol/water partition coefficient);

Hierarchy for Selection of BAFs:

[a] USEPA, 2007, Ecological Soil Screening Level Guidance (Eco-SSL), Soil to Earthworm Uptake Equations, OSWER Directive 9285.7-55.

[b] Sample, B. E, et. al., 1998. Development and Validation of Bioaccumulation Models for Earthworms, ES/ER/TM-220.

[c] Sample, B.E, et. al., 1999, Literature-Derived Bioaccumulation Models for Earthworms: Development and Validation, Environ. Toxicol. Chem., 18(9): 2110-2120 (models from Table 3 of publication).

[d] -- indicates that a BAF/BCF or regression equation is not available or not applicable.

[e] USEPA, 2007, EcoSSL regression equation using site specific TOC values and chemical specific log Kow and Koc values. Equation details provided below.

Log Kow values and Koc values are from: USEPA, 2007, Estimation Programs Interface (EPI) Suite, v3.20.

Total Organic Carbon (TOC) values collected at Mather WAA were utilized as follows: Arithmetic mean of surface soil TOC =**0.201%** (fraction of organic carbon [foc]).

TOC values:	Sample ID	Area / Matrix	Analyte	Result	Units
	YWM08-2282	Mather WAA - SS	Total Organic Cart	2,010	mg/kg
			Arithmetic Mean =	**2,010**	**mg/kg**

Equation:

$$\text{BAF} = \frac{(10^{(0.87*\log Kow-2)})/0.16)}{foc * Koc}$$

Log Kow, Koc, BAF/BCF 1	Constituent	Koc	Log Kow	BAF/BCF
	Acetone	1.98	-0.24	9.71
	Bis(2-ethylhexyl)phthalate	165400	8.39	3744.97
	Methylene chloride	23.74	1.34	19.19

Table 6-9
Recommended Bioaccumulation/Bioconcentration Factors Utilized for the Soil-to-Small Mammal and Bird Pathways
Mather Waste Accumulation Area, Yosemite National Park, California

Constituent	USEPA (2007) Eco-SSL Uptake Equation [a]	Sample et al., 1998 [b]						Recommended BAF/BCF	Rationale for Recommended BAF/BCF
		Insectivore Median BAF/BCF	Herbivore Median BAF/BCF	Omnivore Median BAF/BCF	General [c] Median BAF/BCF	General [c] Maximum BAF/BCF	General [c] 90th percentile BAF/BCF		
2,3,7,8-TCDD TEQ	--[d]	--	1.2857	0.7783	1.07	2.2	2.2	2.2	General 90th percentile value
Acetone	--	--	--	--	--	--	--	0.5 [e]	Conservative value for organics see footnote "f"
Anthracene	Mam = 0 [f] (0.64) [g]	--	--	--	--	--	--	0.64	Uptake based on regression equation (Brandt, 2002)
Benzo(a)anthracene	Mam = 0 [f] (0.35) [g]	--	--	--	--	--	--	0.35	Uptake based on regression equation (Brandt, 2002)
Benzo(a)pyrene	Mam = 0 [f] (0.28) [g]	--	--	--	--	--	--	0.28	Uptake based on regression equation (Brandt, 2002)
Benzo(b)fluoranthene	Mam = 0 [f] (0.28) [g]	--	--	--	--	--	--	0.28	Uptake based on regression equation (Brandt, 2002)
Benzo(g,h,i)perylene	Mam = 0 [f] (0.24) [g]	--	--	--	--	--	--	0.24	Uptake based on regression equation (Brandt, 2002)
Benzo(k)fluoranthene	Mam = 0 [f] (0.29) [g]	--	--	--	--	--	--	0.29	Uptake based on regression equation (Brandt, 2002)
Bis(2-ethylhexyl)phthalate	--	--	--	--	--	--	--	0.5 [e]	Conservative value for organics see footnote "f"
Chrysene	Mam = 0 [f] (0.35) [g]	--	--	--	--	--	--	0.35	Uptake based on regression equation (Brandt, 2002)
Dibenz(a,h)anthracene	Mam = 0 [f] (0.20) [g]	--	--	--	--	--	--	0.20	Uptake based on regression equation (Brandt, 2002)
Diesel Fuel	--	--	--	--	--	--	--	--	--
Fluoranthene	Mam = 0 [f] (0.50) [g]	--	--	--	--	--	--	0.50	Uptake based on regression equation (Brandt, 2002)
Gasoline	--	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	Mam = 0 [f] (0.23) [g]	--	--	--	--	--	--	0.23	Uptake based on regression equation (Brandt, 2002)
Methylene chloride	--	--	--	--	--	--	--	0.5 [e]	Conservative value for organics see footnote "f"
Motor Oil	--	--	--	--	--	--	--	--	--
Pentachlorophenol	(mam)= 0.00452*(diet)+0.198			--	--	--	--	--	Recommended Uptake Eq. (USEPA 2007)
Phenanthrene	Mam = 0 [f] (0.60) [g]	--	--	--	--	--	--	0.60	Uptake based on regression equation (Brandt, 2002)
Pyrene	Mam = 0 [f] (0.52) [g]	--	--	--	--	--	--	0.52	Uptake based on regression equation (Brandt, 2002)
Antimony	(mam)= 0.001 * 50 *(diet)	--	--	--	--	--	--	Uptake Eq.	Recommended Uptake Eq. (USEPA 2007)
Arsenic	ln(mam)= 0.8188(ln[soil])-4.8471	--	--	--	--	--	--	Regression Eq.	Recommended Regression Eq. (USEPA 2007)
Barium	(mam)= 0.00015 * 50 *(diet)	--	--	--	--	--	--	Uptake Eq.	Recommended Uptake Eq. (USEPA 2007)
Cadmium	ln(mam)= 0.4723(ln[soil])-1.2571	--	--	--	--	--	--	Regression Eq.	Recommended Regression Eq. (USEPA 2007)
Chromium	ln(mam)= 0.7338(ln[soil])-1.4599	--	--	--	--	--	--	Regression Eq.	Recommended Regression Eq. (USEPA 2007)
Cobalt	ln(mam)= 1.307(ln[soil])-4.4669	--	--	--	--	--	--	Regression Eq.	Recommended Regression Eq. (USEPA 2007)
Copper	ln(mam)= 0.144(ln[soil])+2.042	--	--	--	--	--	--	Regression Eq.	Recommended Regression Eq. (USEPA 2007)
Iron	--	--	0.0126	0.0124	0.0124	0.031	0.0171	0.0171	General 90th percentile value
Lead	ln(mam)= 0.4422(ln[soil])+0.0761	--	--	--	--	--	--	Regression Eq.	Recommended Regression Eq. (USEPA 2007)

Table 6-9
Recommended Bioaccumulation/Bioconcentration Factors Utilized for the Soil-to-Small Mammal and Bird Pathways
Mather Waste Accumulation Area, Yosemite National Park, California

Constituent	USEPA (2007) Eco-SSL Uptake Equation [a]	Sample et al., 1998 [b] Insectivore Median BAF/BCF	Herbivore Median BAF/BCF	Omnivore Median BAF/BCF	General [c] Median BAF/BCF	General [c] Maximum BAF/BCF	General [c] 90th percentile BAF/BCF	Recommended BAF/BCF	Rationale for Recommended BAF/BCF
Manganese	(mam)= 0.0205(soil)	--	--	--	--	--	--	0.0205	Recommended BAF (USEPA 2007)
Mercury	--	1.046	0.0239	0.0543	0.0543	1.046	0.192	0.192	General 90th percentile value
Molybdenum	--	--	--	--	--	--	--	--	--
Nickel	ln(mam)= 0.4658(ln[soil])-0.2462	--	--	--	--	--	--	Regression Eq.	Recommended Regression Eq. (USEPA 2007)
Silver	(mam)= 0.004(soil)	--	--	--	--	--	--	0.004	Recommended BAF (USEPA 2007)
Thallium	--	--	--	0.1124	0.1124	0.123	0.1227	0.1227	General 90th percentile value
Zinc	ln(mam)= 0.0706(ln[soil])+4.3632	--	--	--	--	--	--	Regression Eq.	Recommended Regression Eq. (USEPA 2007)

Notes: mam (mammal or bird tissue concentration [mg/kg d.w.]); diet (concentration in diet [mg/kg d.w.] assuming 100% earthworm consumption); soil (concentration in soil [mg/kg d.w.])
BAF/BCF (bioaccumulation/bioconcentration factor).
Bird BAF/BCF values were based on the recommended small mammal BAF/BCF values, as bird uptake values are not readily available. See text for discussion.

[a] USEPA, 2007, Ecological Soil Screening Level Guidance, Soil to Small Mammal Uptake Equations, OSWER Directive 9285.7-55, unless otherwise noted

[b] Sample et al., 1998, Development and Validation of Bioaccumulation Models for Small Mammals, ES/ER/TM-219

[c] General = combination dataset used for insectivore, herbivore, and omnivore receptors to estimate a "general" receptor BAF/BCF value

[d] "--" indicates that a BAF/BCF is not available or not applicable

[e] Known bioaccumulative organics (TCDD and TCDF) have BAFs/BCFs of 1.1 and 0.13 (median) and 2.2 and 0.16 (maximum) from Sample et al. (1998).
Conservative BAF/BCF default value of 0.5 was selected for other non-chlorinated pesticide organics at the site, as they are not expected to be as bioaccumulative as TCDD/TCDF.
For chlorinated pesticides, a BAF/BCF default value of 1.0 was used.

[f] Uptake assumed to be negligible (USEPA 2007).

[g] PAH BAFs estimated using log Kows and number of alkyl groups, based on regression equation presented in Brandt et al. (2002), Distribution of polycyclic aromatic hydrocarbons in soils and terrestrial biota after a spill of crude oil in Trecate, Italy, Environmental Toxicology and Chemistry, Vol. 21 (8): 1638-1643. See next page for calculations.

Table 6-9
Recommended Bioaccumulation/Bioconcentration Factors Utilized for the Soil-to-Small Mammal and Bird Pathways
Mather Waste Accumulation Area, Yosemite National Park, California

Estimation of Biota Soil Accumulation Factors (BSAFs) (Uptake Factors) for PAHs:

PAH	Log Kow	No. Alkyl Groups	Log Mouse BSAF	Mouse BSAF
1-Methylnaphthalene	3.72	1	0.32	1.38
2-Methylnaphthalene	3.72	1	0.32	1.38
Acenaphthene	3.98	0	-0.22	0.80
Acenaphthylene	4.07	0	-0.26	0.77
Anthracene	4.45	0	-0.45	0.64
Benz(a)anthracene	5.66	0	-1.04	0.35
Benzo(a)pyrene	6.16	0	-1.28	0.28
Benzo(b)fluoranthene	6.12	0	-1.26	0.28
Benzo(g,h,i)perylene	6.5	0	-1.45	0.24
Benzo(k)fluoranthene	6.06	0	-1.23	0.29
Chrysene	5.66	0	-1.04	0.35
Dibenz(a,h)anthracene	6.84	0	-1.61	0.20
Fluoranthene	4.95	0	-0.69	0.50
Fluorene	4.18	0	-0.32	0.73
Indeno(1,2,3-cd)pyrene	6.58	0	-1.48	0.23
Naphthalene	3.3	0	0.11	1.12
Phenanthrene	4.57	0	-0.51	0.60
Pyrene	4.88	0	-0.66	0.52

Log Kow values from ATSDR, 1995, Toxicological Profile for PAHs; ATSDR, 1995, Toxicological Profile for Naphthalene; and USEPA Epiweb (KowWIN, v. 1.67) for methylnaphthalenes.

Regression Equation: Log mouse BSAF = 1.72 - 0.487 * LogKow + 0.411 * No. of Alkyl Groups

Brandt, C.A., J.M. Brecker, and A. Porta, 2002, *Distribution of PAHs in Soils and Terrestrial Biota after a Spill of Crude Oil in Trecate, Italy* ,
Environmental Toxicology and Chemistry, Vol. 21, No. 8: 1638-1643.

TABLE 6-10: NOAEL TOXICITY REFERENCE VALUES USED TO DERIVE WILDLIFE TOXICITY BENCHMARKS FOR COPECs, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Constituent of Potential Ecological Concern	Mammalian Data				Avian Data			
	Toxicity Value	NOAEL (mg/kg/d)	Test Species	Reference	Toxicity Value	NOAEL (mg/kg/d)	Test Species	Reference
Organics								
2,3,7,8-TCDD-TEQ	--	1.00E-06	rat	Sample, et. al. (1996)	--	1.40E-05	ring-necked pheasant	Sample, et al. (1996)
Acetone	--	1.00E+01	rat	LANL (2005)	--	2.01E+02	Japanese quail	LANL, 2005
Anthracene	--	6.56E+01	rat	EcoSSL (EPA, 2009)		5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Benzo(a)anthracene	--	6.15E-01	mouse	EcoSSL (EPA, 2009)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Benzo(a)pyrene	--	1.31E+00	mouse	USEPA Region 9 BTAG (2002)	--	5.53E+02	mallard duck	Eisler (1987)
Benzo(b)fluoranthene	--	6.15E-01	mouse	EcoSSL (EPA, 2009)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Benzo(g,h,i)perylene	--	6.15E-01	mouse	EcoSSL (EPA, 2009)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Benzo(k)fluoranthene	--	6.15E-01	mouse	EcoSSL (EPA, 2009)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Bis(2-ethylhexyl)phthalate	--	1.83E+01	mouse	Sample et. al. (1996)	--	1.10E+00	ringed dove	Sample et al., (1996)
Chrysene	--	6.15E-01	mouse	EcoSSL (EPA, 2009)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Dibenz(a,h)anthracene	--	6.15E-01	mouse	EcoSSL (EPA, 2009)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Diesel		NA				NA		
Fluoranthene	--	6.56E+01	rat	EcoSSL (EPA, 2009)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Gasoline	--	NA				NA		
Indeno(1,2,3-cd)pyrene	--	6.15E-01	mouse	EcoSSL (EPA, 2009)		5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Methylene chloride	--	5.85E+00	rat	Sample, et. al. (1996)	--	NA		
Motor Oil		NA				NA		
Pentachlorophenol	--	8.42E+00	mink, sheep, rat, mouse	EcoSSL (EPA, 2009)		6.73E+00	chicken	EcoSSL (EPA, 2009)
Phenanthrene	--	6.56E+01	rat	EcoSSL (EPA, 2009)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Pyrene	--	6.15E-01	mouse	EcoSSL (EPA, 2009)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Inorganics								
Antimony	--	1.25E-01	mouse	Sample, et. al. (1996)		NA		
Arsenic	--	3.20E-01	rat	USEPA Region 9 BTAG (2002)	--	5.50E+00	mallard duck	USEPA Region 9 BTAG (2009)
Barium		5.18E+01	mouse & rat	EcoSSL (EPA, 2009)	--	2.08E+01	chicks	Sample, et. al. (1996)
Cadmium	--	6.00E-02	mouse	USEPA Region 9 BTAG (2002)	--	7.00E-01	wood duck	USEPA Region 9 BTAG (2009)
Chromium	--	2.40E+00	mouse, pig, cattle	EcoSSL (EPA, 2009)	--	2.66E+00	chicken, black duck, turkey	EcoSSL (EPA, 2009)
Cobalt	--	1.20E+00	rat	USEPA Region 9 BTAG (2002)	--	7.61E+00	chicks, ducks	EcoSSL (EPA, 2009)

TABLE 6-10: NOAEL TOXICITY REFERENCE VALUES USED TO DERIVE WILDLIFE TOXICITY BENCHMARKS FOR COPECs, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Constituent of Potential Ecological Concern	Mammalian Data				Avian Data			
	Toxicity Value	NOAEL (mg/kg/d)	Test Species	Reference	Toxicity Value	NOAEL (mg/kg/d)	Test Species	Reference
Copper	--	2.67E+00	mouse	USEPA Region 9 BTAG (2002)	--	2.30E+00	chicks	USEPA Region 9 BTAG (2009)
Iron		NA				NA		
Lead	--	1.00E+00	rat	USEPA Region 9 BTAG (2002)	--	1.40E-02	Japanese quail	USEPA Region 9 BTAG (2009)
Manganese	--	1.37E+01	mouse	USEPA Region 9 BTAG (2002)	--	7.76E+01	Japanese quail	USEPA Region 9 BTAG (2009)
Mercury	--	2.70E-02	mink	USEPA Region 9 BTAG (2002)	--	3.90E-02	mallard duck	USEPA Region 9 BTAG (2009)
Mercury	--	2.50E-01	rat	USEPA Region 9 BTAG (2002)		NA		
Molybdenum	--	2.60E-01	mouse	Sample, et. al. (1996)	--	3.50E+00	chicks	Sample, et al. (1996)
Nickel	--	1.33E-01	rat	USEPA Region 9 BTAG (2002)	--	1.38E+00	mallard duck	USEPA Region 9 BTAG (2009)
Silver	--	6.02E+00	pig	EcoSSL (EPA, 2009)	--	2.02E+00	turkey	EcoSSL (EPA, 2009)
Thallium	--	4.80E-01	rat	USEPA Region 9 BTAG (2002)	--	3.50E-01	starling	LANL, 2005
Zinc	--	9.60E+00	mouse	USEPA Region 9 BTAG (2002)	--	1.72E+01	mallard duck	USEPA Region 9 BTAG (2009)

NOTES:
COPEC = Constituent of Potential Ecological Concern
NA indicates that the information is not available.
NOAEL = No observable adverse effect level

As recommended by DTSC. (1996), the following adjustments were made to toxicity data when chronic NOAEL data were not available:
- Acute LOAELs were converted to chronic NOAELs by dividing by a factor of 10.
- LOAELs were converted to NOAELs by dividing by a factor of 5.
- LD_{50} concentrations were converted to chronic NOAELs by dividing by a factor of 500.

Methodology for Selection of TRVs:
- DTSC (2000) Eco Note 4 and TRVs recommended by USEPA Region 9 Biological Technical Assistance Group (2002, 2009);
- TRVs used for USEPA Ecological Soil Screening Levels (USEPA, 2009);
- Oak Ridge National Laboratory screening benchmarks for ecological risk assessment (Sample et al., 1997);
- Los Alamos National Laboratory database (2005);
- U.S. Fish and Wildlife Service synoptic reviews of hazards to fish, wildlife, and invertebrates (Eisler);
- USEPA's Integrated Risk Information System database (2009).

Note: Mercury TRV for mink used for long-tailed weasel, wherease TRV for rat used for other mammalian site receptors.

TABLE 6-11: LOAEL TOXICITY REFERENCE VALUES USED TO DERIVE WILDLIFE TOXICITY BENCHMARKS FOR COPECs, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Constituent of Potential Ecological Concern	Mammalian Data				Avian Data			
	Toxicity Value	LOAEL [a] (mg/kg/d)	Test Species	Reference	Toxicity Value	LOAEL [a] (mg/kg/d)	Test Species	Reference
Organics								
2,3,7,8-TCDD-TEQ	--	1.00E-05	rat	Sample, et. al. (1996)	--	1.40E-04	ring-necked pheasant	Sample, et al. (1996)
Acetone	--	5.00E+01	rat	LANL (2005)	201 (NOAEL)	1.01E+03	Japanese quail	LANL, 2005
Anthracene	--	1.10E+02	rat	EcoSSL (EPA, 2009)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Benzo(a)anthracene	--	3.07E+00	mouse	EcoSSL (EPA, 2009)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Benzo(a)pyrene	--	3.28E+01	mouse	USEPA Region 9 BTAG (2002)	553 (NOAEL)	2.77E+03	mallard duck	Eisler (1987)
Benzo(b)fluoranthene	--	3.07E+00	mouse	EcoSSL (EPA, 2009)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Benzo(g,h,i)perylene	--	3.07E+00	mouse	EcoSSL (EPA, 2009)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Benzo(k)fluoranthene	--	3.07E+00	mouse	EcoSSL (EPA, 2009)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Bis(2-ethylhexyl)phthalate	--	1.83E+02	mouse	Sample et. al. (1996)	1.1 (NOAEL)	5.50E+00	ringed dove	Sample et al., (1996)
Chrysene	--	3.07E+00	mouse	EcoSSL (EPA, 2009)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Dibenz(a,h)anthracene	--	3.07E+00	mouse	EcoSSL (EPA, 2009)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Diesel		NA				NA		
Fluoranthene	--	1.10E+02	rat	EcoSSL (EPA, 2009)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Gasoline	--	NA				NA		
Indeno(1,2,3-cd)pyrene	--	3.07E+00	mouse	EcoSSL (EPA, 2009)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Methylene chloride	--	5.00E+01	rat	Sample, et. al. (1996)	--	NA		
Motor Oil		NA				NA		
Pentachlorophenol	--	9.45E+00	rat	EcoSSL (EPA, 2009)	--	2.25E+01	chicken	EcoSSL (EPA, 2009)
Phenanthrene	--	1.10E+02	rat	EcoSSL (EPA, 2009)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Pyrene	--	3.07E+00	mouse	EcoSSL (EPA, 2009)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Inorganics								
Antimony	--	1.25E+00	mouse	Sample, et. al. (1996)		NA		
Arsenic	--	4.70E+00	rat	USEPA Region 9 BTAG (2002)	--	2.20E+01	mallard duck	USEPA Region 9 BTAG (2009)
Barium		1.21E+02	rat	EcoSSL (EPA, 2009)	--	4.17E+01	chicks	Sample, et. al. (1996)
Cadmium	--	2.64E+00	mouse	USEPA Region 9 BTAG (2002)	--	1.00E+00	mallard duck	USEPA Region 9 BTAG (2009)
Chromium	--	2.82E+00	rat	EcoSSL (EPA, 2009)	--	2.78E+00	black duck	EcoSSL (EPA, 2009)
Cobalt	--	2.00E+01	rat	USEPA Region 9 BTAG (2002)	--	7.80E+00	chicks	EcoSSL (EPA, 2009)

TABLE 6-11: LOAEL TOXICITY REFERENCE VALUES USED TO DERIVE WILDLIFE TOXICITY BENCHMARKS FOR COPECs, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Constituent of Potential Ecological Concern	Mammalian Data				Avian Data			
	Toxicity Value	LOAEL [a] (mg/kg/d)	Test Species	Reference	Toxicity Value	LOAEL [a] (mg/kg/d)	Test Species	Reference
Copper	--	6.32E+02	mouse	USEPA Region 9 BTAG (2002)	--	5.23E+01	chicks	USEPA Region 9 BTAG (2009)
Iron		NA				NA		
Lead	--	2.41E+02	mouse	USEPA Region 9 BTAG (2002)	--	8.75E+00	chicken	USEPA Region 9 BTAG (2009)
Manganese	--	1.59E+02	mouse	USEPA Region 9 BTAG (2002)	--	7.76E+02	Japanese quail	USEPA Region 9 BTAG (2009)
Mercury	--	2.70E-01	mink	USEPA Region 9 BTAG (2002)	--	1.80E-01	mallard duck	USEPA Region 9 BTAG (2009)
Mercury	--	4.00E+00	rat	USEPA Region 9 BTAG (2002)		NA		
Molybdenum	--	2.60E+00	mouse	Sample, et. al. (1996)	--	3.53E+01	chicks	Sample, et al. (1996)
Nickel	--	3.16E+01	rat	USEPA Region 9 BTAG (2002)	--	5.63E+01	mallard duck	USEPA Region 9 BTAG (2009)
Silver	--	6.02E+01	pig	EcoSSL (EPA, 2009)	--	2.02E+01	turkey	EcoSSL (EPA, 2009)
Thallium	--	1.43E+00	rat	USEPA Region 9 BTAG (2002)	0.35 (NOAEL)	1.75E+00	starling	LANL, 2005
Zinc	--	4.11E+02	rat	USEPA Region 9 BTAG (2002)	--	1.72E+02	mallard duck	USEPA Region 9 BTAG (2009)

NOTES:

NA indicates that the information is not available.
LOAEL = lowest observable adverse effect level
COPEC = constituent of potential ecologixal concern

[a] LOAELs from USEPA Region 9 BTAG (2002, 2009) are based on TRV-High values that may represent the mid-point of a variety of adverse effects.

As recommended by DTSC. (1996), the following adjustments were made to toxicity data when chronic LOAEL data were not available:
- Acute LOAELs were converted to chronic NOAELs by dividing by a factor of 10.
- Chronic NOAELs were converted to chronic LOAELs by multiplying by a factor of 5.0 (based on DTSC [1996] reasoning).

Methodology for Selection of TRVs:
- DTSC (2000) Eco Note 4 and TRVs recommended by USEPA Region 9 Biological Technical Assistance Group (2002, 2009);
- TRVs presented in USEPA Ecological Soil Screening Levels (USEPA, 2009);
- Oak Ridge National Laboratory screening benchmarks for ecological risk assessment (Sample et al., 1997);
- Los Alamos National Laboratory database (2005);
- U.S. Fish and Wildlife Service synoptic reviews of hazards to fish, wildlife, and invertebrates (Eisler);
- USEPA's Integrated Risk Information System database (2009).

Note: Mercury TRV for mink used for long-tailed weasel, wherease TRV for rat used for other mammalian site receptors.

TABLE 6-12: UNCERTAINTY FACTORS[a] FOR ECOLOGICAL TOXICITY REFERENCE VALUE EXTRAPOLATIONS[b], MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Laboratory Animals (toxicity data base)		**Selected Site Receptor Species**	
Rat	G: *Rattus* F: Muridae O: Rodentia	California vole	G: *Microtus* F: Muridae O: Rodentia
Mouse	G: *Mus* F: Muridae O: Rodentia	Dusky shrew	G: *Sorex* F: Soricidae O: Soricomorpha
Mink	G: *Mustela* F: Mustelidae O: Carnivora	American robin	G: *Turdus* F: Muscicapidae O: Passeriformes
Pheasant	G: *Phasianus* F: Phasianidae O: Galliformes	Long-tailed weasel	G: *Mustela* F: Mustelidae O: Carnivora
Chick, Hens, Poultry	G: *Gallus* F: Phasianidae O: Galliformes	Yellow-bellied marmot	G: *Marmota* F: Sciuridae O: Rodentia
Red-winged blackbird	G: *Agelaius* F: Icteridae O: Passeriformes		
Sheep	G: *Ovis* F: Bovidae O: Artiodactyla		
Cow	G: *Bos* F: Bovidae O: Artiodactyla		
Pig	G: *Sus* F: Suidae O: Artiodactyla		

TABLE 6-12: UNCERTAINTY FACTORS[a] FOR ECOLOGICAL TOXICITY REFERENCE VALUE EXTRAPOLATIONS[b], MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Black, Mallard, and Wood duck	G: *Anas* and *Aix* F: Anatidae O: Anseriformes
Laboratory Animals (toxicity data base)	
Turkey	G: *Meleagris* F: Meleagrididae O: Galliformes
Ringed dove	G: *Streptopelia* F: Columbidae O: Columbiformes
European starling	G: *Sturnus* F: Sturnidae O: Passeriformes

[a] From California EPA (DTSC, 1996*)*
[b] Interclass extrapolations not performed; only within bird class or within mammal class.

<u>The Uncertainty Factors Used for TRV Extrapolations are Summarized Below:</u>

- Extrapolation between the same family (F) or genus (G) = uncertainty factor of 1
- Extrapolation between the same order (O) = uncertainty factor of 5
- Extrapolation between two different orders (O) = uncertainty factor of 10

Thus, for all extrapolations used in the SLERA food chain model an uncertainty factor of 10 was used, except for the following:

- o Rat or mouse toxicity values extrapolated to the California vole where an uncertainty factor of 1 was used;
- o Rat or mouse toxicity values extrapolated to the Yellow-bellied marmot where an uncertainty factor of 5 was used;
- o Mink toxicity values extrapolated to the Long-tailed weasel where an uncertainty factor of 1 was used;
- o Dog toxicity values extrapolated to the Long-tailed weasel where an uncertainty factor of 5 was used; and
- o Red-winged blackbird or European starling toxicity values extrapolated to the American robin where an uncertainty factor of 5 was used.

Table 6-13
Wildlife Ecological Effects Quotient Hazard Summary
Mather Waste Accumulation Area, Yosemite National Park, California

Receptor	**Tier 1**[a]		**Tier 2** [b]	
	NOAEL-Based EEQ	LOAEL-Based EEQ	NOAEL-Based EEQ	LOAEL-Based EEQ
California vole	30	2.1	16	1.2
NOAEL Hazard Driver(s)[c]:	Lead and zinc; Soil and plant ingestion.			
LOAEL Hazard Driver(s)[c]:	All individual EEQs <1.			
Dusky shrew	2,127	57	2,127	57
NOAEL Hazard Driver(s)[c]:	Cadmium and lead; Invertebrate and soil ingestion.			
LOAEL Hazard Driver(s)[c]:	Cadmium; Invertebrate ingestion.			
American robin	11,986	70	1,998	12
NOAEL Hazard Driver(s)[c]:	Lead; Invertebrate ingestion.			
LOAEL Hazard Driver(s)[c]:	BEHP and lead; Invertebrate and soil ingestion.			
Long-tailed weasel	100	5.3	0.54	0.03
NOAEL Hazard Driver(s)[c]:	Lead; Soil and small mammal ingestion.			
LOAEL Hazard Driver(s)[c]:	Barium; Small mammal ingestion.			
Yellow-bellied marmot	52	2.0	0.70	0.03
NOAEL Hazard Driver(s)[c]:	Zinc and lead; Plant and soil ingestion.			
LOAEL Hazard Driver(s)[c]:	All individual EEQs <1.			

NOTES:
[a] Tier 1 = Maximum EEQ using FHR =1
[b] Tier 2 = Realistic EEQ using calculated FHR less than or equal to 1.
[c] Hazard drivers are those chemicals contributing the most to the total estimated EEQ, and the primary route(s) of exposure associated with this driver.
EEQ = Ecological Effects Quotient
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
FHR = Fraction home range

TABLE 6-14: DIRECT TOXICITY EVALUATION FOR SURFACE SOIL, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Chemical (1)	Detection Frequency (1)	Maximum Concentration (1)	Exposure Point Concentration (2)	Dutch Intervention Value (3)	CCME Value (4)	USEPA EcoSSL Direct Contact Value (5)	ORNL Screening Benchmark for Plants (6)	ORNL Screening Benchmark for Invertebrates (7)	COPEC Weight of Evidence Summary - Number of Direct Contact Benchmarks Exceeded Using MDC	Comment
2,3,7,8-TCDD TEQ	2/2	1.11E-05	1.11E-05	NVA	4.00E-06	NVA	NVA	NVA	1/1	
Acetone	2/7	1.50E-02	1.04E-02	NVA	NVA	NVA	NVA	NVA	NVA	
Anthracene	1/10	6.00E-03	4.16E-03	40	0.1	29 (LMW)	NVA	NVA	0/3	
Benzo(a)anthracene	1/10	1.90E-02	6.06E-03	40	0.1	18 (HMW)	NVA	NVA	0/3	
Benzo(a)pyrene	2/10	6.20E-02	1.59E-02	40	0.1	18 (HMW)	NVA	NVA	0/3	
Benzo(b)fluoranthene	1/10	2.40E-02	7.07E-03	40	0.1	18 (HMW)	NVA	NVA	0/3	
Benzo(g,h,i)perylene	3/10	7.80E-02	7.80E-02	40	0.1	18 (HMW)	NVA	NVA	0/3	
Benzo(k)fluoranthene	1/10	7.10E-03	4.40E-03	40	0.1	18 (HMW)	NVA	NVA	0/3	
bis(2-ethylhexyl) phthalate	3/7	7.20E-01	4.78E-01	60	30	NVA	NVA	NVA	0/2	
Chrysene	5/10	5.10E-02	2.02E-02	40	0.1	18 (HMW)	NVA	NVA	0/3	
Dibenz(a,h)anthracene	1/10	4.90E-02	1.22E-02	40	0.1	18 (HMW)	NVA	NVA	0/3	
Diesel fuels with Silica Gel Cleanup	7/12	4.80E+03	1.61E+03	NVA	NVA	NVA	NVA	NVA	NVA	
Fluoranthene	2/10	5.00E-02	1.25E-02	40	0.1	29 (LMW)	NVA	NVA	0/3	
Gasoline	1/7	2.50E+00	1.20E+00	NVA	NVA	NVA	NVA	NVA	NVA	
Indeno(1,2,3-cd)pyrene	2/10	1.00E-02	5.38E-03	40	0.1	18 (HMW)	NVA	NVA	0/3	
Methylene chloride	3/7	7.20E-03	7.11E-03	10	0.1	NVA	NVA	NVA	0/2	
Motor Oil with Silica Gel Clean Up	7/12	1.10E+05	4.04E+04	NVA	NVA	NVA	NVA	NVA	NVA	
Pentachlorophenol	1/7	1.90E-01	1.90E-01	NVA	7.6	5	3	6	0/4	
Phenanthrene	1/10	3.80E-02	9.94E-03	40	0.1	29 (LMW)	NVA	NVA	0/3	
Pyrene	4/10	4.00E-02	2.32E-02	40	0.1	18 (HMW)	NVA	NVA	0/3	
Antimony	6/10	4.63E+00	2.81E+00	15	20	78	5	NVA	0/4	
Arsenic	10/10	7.37E+00	4.73E+00	55	12	18	10	60	0/5	
Barium	10/10	9.77E+02	6.91E+02	625	500	330	500	NVA	4/4	
Cadmium	7/10	6.78E+00	2.96E+00	12	1.4	32	4	20	2/5	
Chromium (Cr III tox)	10/10	2.84E+01	1.80E+01	380	64	NVA [(8)]	1	0.4	2/4	
Cobalt	10/10	9.24E+00	6.80E+00	240	40	13	20	NVA	0/4	
Copper	10/10	2.60E+02	1.35E+02	190	63	70	100	50	5/5	
Iron	7/7	4.02E+04	3.29E+04	NVA	NVA	pH dependent	NVA	NVA	NVA	pH > 5.0 [(9)]
Lead	10/10	9.94E+02	9.94E+02	530	70	120	50	500	5/5	

TABLE 6-14: DIRECT TOXICITY EVALUATION FOR SURFACE SOIL, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Chemical (1)	Detection Frequency (1)	Maximum Concentration (1)	Exposure Point Concentration (2)	Dutch Intervention Value (3)	CCME Value (4)	USEPA EcoSSL Direct Contact Value (5)	ORNL Screening Benchmark for Plants (6)	ORNL Screening Benchmark for Invertebrates (7)	COPEC Weight of Evidence Summary - Number of Direct Contact Benchmarks Exceeded Using MDC	Comment
Manganese	7/7	1.90E+03	1.55E+03	NVA	NVA	220	500	NVA	2/2	Plant tox
Mercury	10/10	1.37E+00	7.25E-01	10	6.6	NVA	0.3	0.1	2/4	
Molybdenum	9/10	2.22E+00	1.46E+00	200	5	NVA	2	NVA	1/3	
Nickel	10/10	2.79E+01	1.46E+01	210	50	38	30	200	0/5	
Silver	5/10	1.23E+00	1.05E+00	NVA	20	560	2	NVA	0/3	
Thallium	7/10	5.67E-01	4.45E-01	NVA	1	NVA	1	NVA	0/2	
Zinc	10/10	2.42E+03	2.38E+03	720	200	120	50	200	5/5	Plant tox

NOTES:

All values presented in mg/kg.
NVA = No Value Available
LMW = Low Molecular Weight PAH
HMW = High Molecular Weight PAH
(1) COPECs, detection frequencies, and maximum concentrations are from Table 7-3.
(2) Exposure Point Concentrations are 95% UCLs, from Table _____.
(3) Dutch Intervention Values are from the Netherlands Ministry of Housing, Spacial Planning and Environment (February 2000).
(4) Canadian Council of Ministers of the Environment (CCME), Canadian Environmental Quality Guidelines, December 2003.
(5) Lowest EcoSSL value for direct contact toxicity for either plants or terrestrial invertebrates (USEPA, 2007).
(6) Screening benchmarks for plants from ORNL (1997, ES/ER/TM-85/R3).
(7) Screening benchmarks for earthworms from ORNL (1997, ES/ER/TM-126/R2).
(8) Not enough data to derive Eco-SSL
(9) Soil pH value = 5.72 (based on surface soil sample YWM06-2276).

Table 6-15
Estimated Wildlife Hazards Associated with Background Soil
Mather Waste Accumulation Area, Yosemite National Park, California

Inorganic	Average Background Concentration (mg/kg) [a]	Wildlife Receptor	Tier 2 NOAEL EEQ [b]	Site EPC (mg/kg) [c]	Estimated Background EEQ [d]
Lead	4.70	Robin	1,960	994	9.3
Cadmium	0.096	Shrew	643	2.96	21
Nickel	3.98	Shrew	287	14.6	78
Zinc	31.64	Shrew	269	2380	3.6
Copper	5.52	Shrew	60	135	2.5
Antimony	0.15	Shrew	48	2.81	2.6
Manganese	177	Shrew	31	1550	3.5
Molybdenum	0.744	Shrew	11	1.46	5.6
Mercury	0.043	Shrew	8.1	0.725	0.5
Arsenic	2.49	Shrew	7.2	4.73	3.8
Chromium	4.89	Shrew	5.9	18	1.6
Barium	46.68	Shrew	4.9	691	0.3
Cobalt	3.64	Shrew	2.4	6.8	1.3

[a] Average concentration from 13 site-specific background soil samples.

[b] EEQ (HQ) estimated for wildlife receptor using Tier 2 (realistic FHR) and NOAEL TRV approach (**Appendix G**).

[c] Soil exposure point concentrations from **Table 6-4**.

[d] Background EEQ (HQ) estimated by scaling background concentration to Site EPC.

FHR = fraction of home range
EEQ = ecological effects quotient
HQ = hazard quotient
EPC = exposure point concentration
ND = nondetect
NOAEL = no observed adverse effect level

TABLE 6-16: SOIL DEPTH EXPOSURE POINT CONCENTRATION COMPARISON FOR SURFACE SOIL, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil

Chemical of Potential Concern	Units	Surface Soil Exposure Point Concentration			Total Soil Exposure Point Concentration			Percent Increase/ Decrease of EPC
		EPC	Statistic [1]	Rationale [2]	EPC	Statistic [1]	Rationale [2]	
Exposure Point: Surface Soil								
2,3,7,8-TCDD TEQ	mg/kg	1.11E-05	Max	Test (7)	1.11E-05	Max	Test (7)	0.0%
Acetone	mg/kg	1.04E-02	95% UCL Bst	Test (8)	1.87E-02	95% KM-t	Test (1)	79.6%
Anthracene	mg/kg	4.16E-03	95% UCL Bst	Test (8)	4.92E-03	95% UCL Bst	Test (8)	18.2%
Antimony	mg/kg	2.81E+00	95% KM-t	Test (4)	2.83E+00	95% KM-t	Test (1)	1.0%
Arsenic	mg/kg	4.73E+00	95% Student's-t	Test (4)	4.25E+00	95% Approx. Gamma	Test (6)	-10.2%
Barium	mg/kg	6.91E+02	95% Approx. Gamma	Test (6)	1.26E+03	99% Cheby, Mean, SD	Test (3)	81.7%
Benzo(a)anthracene	mg/kg	6.06E-03	95% UCL Bst	Test (8)	1.90E-02	95% KM-% Btstrp	Test (1)	213.4%
Benzo(a)pyrene	mg/kg	1.59E-02	95% UCL Bst	Test (8)	2.50E-02	95% KM-% Btstrp	Test (1)	57.4%
Benzo(b)fluoranthene	mg/kg	7.07E-03	95% UCL Bst	Test (8)	1.65E-02	95% KM-t	Test (1)	133.5%
Benzo(g,h,i)perylene	mg/kg	7.80E-02	95% KM-% Btstrp	Test (1)	7.80E-02	95% KM-% Btstrp	Test (1)	0.0%
Benzo(k)fluoranthene	mg/kg	4.40E-03	95% UCL Bst	Test (8)	5.38E-03	95% UCL Bst	Test (8)	22.4%
bis(2-Ethylhexyl) phthalate	mg/kg	4.78E-01	95% KM-t	Test (1)	7.20E-01	95% KM-% Btstrp	Test (1)	50.6%
Cadmium	mg/kg	2.96E+00	95% KM-t	Test (1)	3.37E+00	95% KM BCA	Test (1)	13.9%
Chromium (total)	mg/kg	1.80E+01	95% Student's-t	Test (4)	3.64E+01	Max	Test (2)	102.4%
Chrysene	mg/kg	2.02E-02	95% KM-% Btstrp	Test (1)	1.23E-02	95% KM-t	Test (1)	-39.1%
Cobalt	mg/kg	6.80E+00	95% Student's-t	Test (4)	5.71E+00	95% Student's-t	Test (4)	-16.1%
Copper	mg/kg	1.35E+02	95% Student's-t	Test (4)	1.07E+02	95% Approx. Gamma	Test (6)	-20.9%
Dibenz(a,h)anthracene	mg/kg	1.22E-02	95% UCL Bst	Test (8)	4.90E-02	95% KM-% Btstrp	Test (1)	300.3%
Diesel fuel (with silica gel cleanup)	mg/kg	1.61E+03	95% KM BCA	Test (6)	3.38E+03	99% KM-Cheby	Test (3)	110.7%
Fluoranthene	mg/kg	1.25E-02	95% UCL Bst	Test (8)	3.30E-02	95% KM-% Btstrp	Test (1)	164.3%
Indeno(1,2,3-cd)pyrene	mg/kg	5.38E-03	95% UCL Bst	Test (8)	1.06E-02	95% KM-% Btstrp	Test (1)	97.0%
Iron	mg/kg	3.29E+04	95% Student's-t	Test (4)	2.81E+04	95% Student's-t	Test (4)	-14.5%
Lead	mg/kg	9.94E+02	Max	Test (2)	5.79E+03	95% Cheby, MVUE	Test (5)	482.3%
Manganese	mg/kg	1.55E+03	95% Student's-t	Test (4)	1.25E+03	95% Student's-t	Test (4)	-19.3%
Mercury	mg/kg	7.25E-01	95% Student's-t	Test (4)	8.65E-01	95% KM-Cheby	Test (1)	19.3%
Methylene chloride	mg/kg	7.11E-03	95% KM-t	Test (1)	7.20E-03	95% KM-% Btstrp	Test (1)	1.3%
Molybdenum	mg/kg	1.46E+00	95% KM-t	Test (4)	1.46E+00	95% KM-Cheby	Test (6)	0.1%
Motor Oils (with silica gel cleanup)	mg/kg	4.04E+04	95% KM BCA	Test (6)	7.55E+04	95% KM-Cheby	Test (3)	86.7%

TABLE 6-16: SOIL DEPTH EXPOSURE POINT CONCENTRATION COMPARISON FOR SURFACE SOIL, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Chemical of Potential Concern	Units	Surface Soil Exposure Point Concentration			Total Soil Exposure Point Concentration			Percent Increase/ Decrease of EPC
		EPC	Statistic [1]	Rationale [2]	EPC	Statistic [1]	Rationale [2]	
Exposure Point: Surface Soil								
Nickel	mg/kg	1.46E+01	95% Student's-t	Test (4)	1.07E+01	95% Approx. Gamma	Test (6)	-26.4%
Pentachlorophenol	mg/kg	1.90E-01	Max	Test (2)	1.90E-01	Max	Test (2)	0.0%
Phenanthrene	mg/kg	9.94E-03	95% UCL Bst	Test (8)	3.80E-02	95% KM-% Btstrp	Test (1)	282.4%
Pyrene	mg/kg	2.32E-02	95% KM-% Btstrp	Test (1)	2.27E-02	95% KM-% Btstrp	Test (1)	-2.2%
Silver	mg/kg	1.05E+00	95% KM-% Btstrp	Test (1)	1.04E+00	95% KM-% Btstrp	Test (1)	-0.2%
Thallium	mg/kg	4.45E-01	95% KM-t	Test (1)	3.87E-01	95% KM-t	Test (1)	-13.0%
TPH-gasoline	mg/kg	1.20E+00	95% UCL Bst	Test (8)	1.10E+00	95% UCL Bst	Test (8)	-8.4%
Zinc	mg/kg	2.38E+03	95% Approx. Gamma	Test (6)	2.72E+03	99% Cheby, Mean, SD	Test (3)	14.1%

NOTES:

N/A = Not applicable

(L) the data were determined to follow lognormal distribution; (NP) the data were determined to be non-parametric; (N) the data were determined to be normally distributed.

[1] Statistic: Maximum Detected Value (Max); 95% KM Chebyshev (95% KM-Cheby); 97.5% KM Chebyshev (97.5% KM-Cheby); 99% KM Chebyshev (99% KM-Cheby); 95% KM Percentile Bootstrap (95% KM-% Btstrp); 95% KM-t (95% KM-t); 95% KM-BCA (95% KM-BCA); 95% H-UCL (95% H-UCL); 95% Chebyshev -Mean, SD- UCL (95% Cheby, Mean, SD); 97.5% Chebyshev -Mean, SD- UCL (97.5% Cheby, Mean, SD); 99% Chebyshev -Mean, SD- UCL (99% Cheby, Mean, SD); 95% UCL of Log-transformed Data (95% UCL-T)
95% Student's-t (95% Student's-t); 95% Modified-t (95% Modified-t); 95% UCL based on bootstrap statistic (95% UCL-Bst); 95% Approximate Gamma UCL (95% Approx. Gamma); 95% Adjusted Gamma UCL (95% Adjusted Gamma); 95% KM Chebyshev-MVUE (95% KM-Cheby-MVUE); 99% Chebyshev-MVUE (95% Cheby, MVUE).

[2] Unless otherwise noted, ProUCL EPC selection rationale based on, detection limit values, distribution, standard deviation, and sample size (see ProUCL output in appendix for further details):

Test (1): Kaplan-Meier method recommended by ProUCL due to multiple detection limits.
Test (2): The 95% UCL exceeds the maximum detected concentration, therefore, maximum concentration used for EPC.
Test (3): Shapiro-Wilk W test, Kolmogorov-Smirnov (K-S), and Anderson-Darling (A-D) tests, indicate data follow nonparametric distribution.
Test (4): Shapiro-Wilk W test indicates data are normally distributed.
Test (5): Shapiro-Wilk W test indicates data are log-normally distributed.
Test (6): Kolmogorov-Smirnov (K-S) and/or Anderson-Darling (A-D) tests indicate data follow gamma distribution.
Test (7): Sample size is less than or equal to 5, therefore, maximum concentration used for EPC.
Test (8): 95% UCL estimated by a non-Pro-UCL bootstrap method.

Table 6-17
Use of MDCs for COPECs with Limited Detected Concentrations in Surface Soil
Mather Waste Accumulation Area, Yosemite National Park, California

Chemical of Potential Concern	95% UCL using Shaw Bootstrap (mg/kg)	Most Exposed Receptor	Tier 2 LOAEL EEQ	Maximum Detected Concentration (mg/kg)	Estimated EEQ Using MDC
Exposure Point: Surface Soil					
Acetone [a]	1.04E-02	Dusky shrew	6.5E-04	1.50E-02	9.4E-04
Anthracene [a]	4.16E-03	Dusky shrew	1.9E-04	6.00E-03	2.7E-04
Benzo(a)anthracene [a]	6.06E-03	Dusky shrew	6.5E-03	1.90E-02	2.0E-02
Benzo(a)pyrene [a]	1.59E-02	Dusky shrew	1.3E-03	6.20E-02	5.1E-03
Benzo(b)fluoranthene [a]	7.07E-03	Dusky shrew	1.2E-02	2.40E-02	4.1E-02
Benzo(k)fluoranthene [a]	4.40E-03	Dusky shrew	7.5E-03	7.10E-03	1.2E-02
Dibenz(a,h)anthracene [a]	1.22E-02	Dusky shrew	1.9E-02	4.90E-02	7.6E-02
Fluoranthene [a]	1.25E-02	Dusky shrew	6.8E-04	5.00E-02	2.7E-03
Indeno(1,2,3-cd)pyrene [a]	5.38E-03	Dusky shrew	1.0E-02	1.00E-02	1.9E-02
Phenanthrene [a]	9.94E-03	Dusky shrew	3.2E-04	3.80E-02	1.2E-03
TPH-gasoline [a]	1.20E+00	Dusky shrew	NA	2.50E+00	NA

Notes:

[a] Infrequent detection resulted in ProUCL modeling error for this constituent, therefore UCL determined using non-ProUCL bootstrap method with random numbers for NDs.

NA = not available.

Table 6-18
Uncertainty Analysis for Screening Level Ecological Risk Assessment

Component	Bias	Magnitude	Ways to Minimize Uncertainty	Additional Comments
Use of 95% UCL as source-term concentration	Overestimates Risk	Medium	Use central tendency	Easy to implement, but may not be acceptable to Agency.
Use of representative receptor species for site ecological community	Underestimates Risk	Low	Select additional receptor species	Easy to implement, but unlikely to change conclusions.
Use of conservative foraging factors (i.e., 100%) for some species	Overestimates Risk	Medium	Use more site-specific foraging factors, i.e., less than 100%	May be difficult to obtain site-specific foraging factors.
Assumption that COPECs are 100% bioavailable	Overestimates Risk	Medium to High	Obtain medium- and COPEC-specific bioavailability factors	Would be very difficult and costly to obtain these bioavailability factors.
Discounting of dermal and inhalation exposure routes	Underestimates Risk	Low	Include dermal and inhalation routes of exposure	Would be difficult to quantify these routes of exposure.
Use of partitioning and transfer factors to estimate COPEC concentrations in plants, invertebrates, and prey items.	Overestimates Risk	Medium to High	Measure COPEC concentrations in site plants, invertebrates, and/or other prey species.	Would be costly to implement, but could significantly reduce EEQs.
Use of safety factors to convert LOAEL and LD_{50} toxicity data to NOAELs	Overestimates Risk	Medium	Obtain COPEC-specific NOAEL data	Would be costly to implement, unless data available in the literature.
Use of uncertainty factors of 5 and 10 to extrapolate TRVs between the same taxonomic order and different order, respectively	Overestimates Risk	Medium	1) Assume TRVs similar for species in the same order; or 2) obtain species-specific NOAEL data	1) May not be accepted by Agency. 2) Would be very difficult to obtain species-specific TRV data.
Use of surrogate constituents to estimate toxicity for those COPECs without available toxicity data	Overestimates Risk	Low to Medium	Obtain COPEC-specific toxicity data	Would be very costly to obtain COPEC-specific toxicity data, unless available in the literature.
Use of hazard quotient method to estimate risks to populations or communities may be biased	Overestimates Risk	High	Perform population or community studies	Would be very costly to perform.

PHOTOGRAPHS

Client: National Park Service, Yosemite National Park
Location: Mather Waste Accumulation Area

Prepared by: Shaw Environmental, Inc.
Photographer: B.Matz (Shaw)

Photograph 1 – Overview of Mather Waste Accumulation Area

Description: View from location of TP01 and TP09 in lower area, looking north toward upper area. Visible test pit locations are indicated.

Date Taken: June 2008

Client: National Park Service, Yosemite National Park
Location: Mather Waste Accumulation Area

Prepared by: Shaw Environmental, Inc.
Photographer: B.Matz (Shaw)

Photograph 2 – Debris at Mather Waste Accumulation Area

Description: Some of the types of debris items observed at Mather WAA, including degraded battery cores, rusted metal, glass, and brick.

Date Taken: June 2008

Client: National Park Service, Yosemite National Park
Location: Mather Waste Accumulation Area

Prepared by: Shaw Environmental, Inc.
Photographer: B.Matz (Shaw)

Photograph 3 – Backhoe entering Mather Waste Accumulation Area

Description: In 2001 NPS requested protection of forest floor, which was accomplished using a plastic snow fence over plastic sheeting. In 2008 protection was not used but backhoe traveled slowly and left no impact on the ground.

Date Taken: August 2001

Client: National Park Service, Yosemite National Park
Location: Mather Waste Accumulation Area

Prepared by: Shaw Environmental, Inc.
Photographer: B.Matz (Shaw)

Photograph 4 – Excavation of Test Pit TP01

Description: View from atop quarry wall of backhoe beginning excavation of TP01. Note backfilled and restored surface of TP02 (beneath loader bucket).

Date Taken: August 2001

Client: National Park Service, Yosemite National Park
Location: Mather Waste Accumulation Area

Prepared by: Shaw Environmental, Inc.
Photographer: B.Matz (Shaw)

Photograph 5 – Excavation of Test Pit TP02

Description: View from atop quarry wall of TP02 excavation, with sampling personnel and NPS archeologists at work.

Date Taken: August 2001

Client: National Park Service, Yosemite National Park
Location: Mather Waste Accumulation Area

Prepared by: Shaw Environmental, Inc.
Photographer: B.Matz (Shaw)

Photograph 6 – Excavation of Test Pit TP05

Description: Beginning of excavation of TP05 in upper area of Mather WAA, where surface debris was observed.

Date Taken: August 2001

Client: National Park Service, Yosemite National Park
Location: Mather Waste Accumulation Area

Prepared by: Shaw Environmental, Inc.
Photographer: B.Matz (Shaw)

Photograph 7 – Excavation of Test Pit YWM06

Description: Excavation of TP06, adjacent to former TP05 (marked by wooden stake).

Date Taken: August 2008

Client: National Park Service, Yosemite National Park
Location: Mather Waste Accumulation Area

Prepared by: Shaw Environmental, Inc.
Photographer: B.Matz (Shaw)

Photograph 8 – View of Sample Locations YWM06 and YWM05A

Description: View of TP06, and TP05A in sidewall. Sample for TP05A (YMW05A) was taken from a one-foot diameter ball of oily material that was dislodged from location TP05A during excavation. Test pit TP06 was planned to be downhill from TP05/TP05A; however, the slope was too unstable for the backhoe so the strategy was adjusted accordingly. Sample from TP06 (YMW06) was collected from the corner of the trench closest to the planned location (indicated).

Date Taken: August 2008

Client: National Park Service, Yosemite National Park
Location: Mather Waste Accumulation Area

Prepared by: Shaw Environmental, Inc.
Photographer: B.Matz (Shaw)

Photograph 9 – Excavation of Test Pit YWM09

Description: Beginning excavation of TP09, between former test pits TP01 and TP02.

Date Taken: August 2008

Client: National Park Service, Yosemite National Park
Location: Mather Waste Accumulation Area

Prepared by: Shaw Environmental, Inc.
Photographer: B.Matz (Shaw)

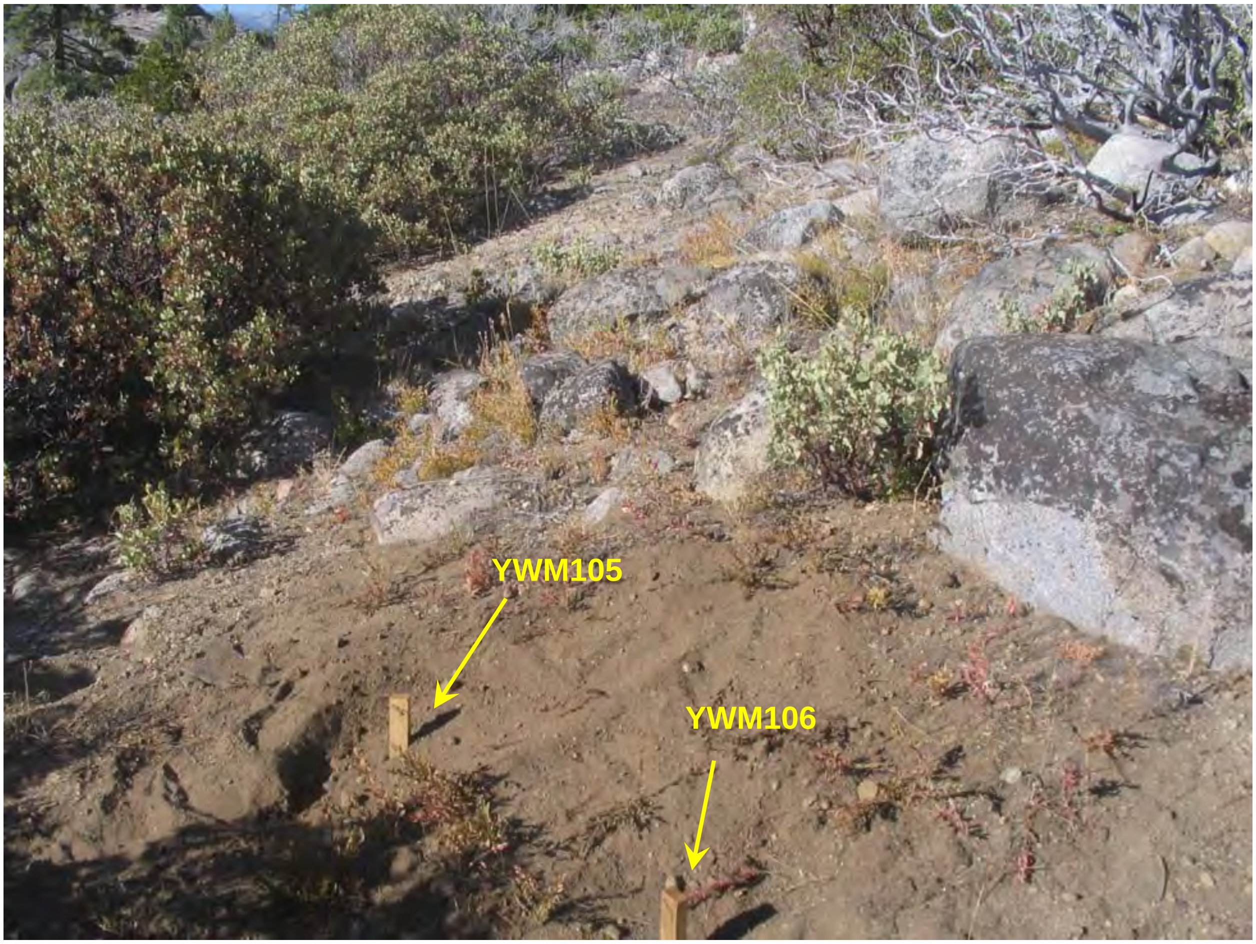
Photograph 10 – View of test pit YWM09

Description: View of test pit TP09 at completion of excavation. Note many large angular cobbles in the subsurface, and a few debris items, primarily rusted metal near lower right corner.

Date Taken: August 2008

Client: National Park Service, Yosemite National Park
Location: Mather Waste Accumulation Area

Prepared by: Shaw Environmental, Inc.
Photographer: B.Matz (Shaw)



Photograph 11 – View of background locations YWM105 and YWM106

Description: Location of paired background samples YWM105 and YWM106, in areas of granite outcrop above Mather WAA.

Date Taken: August 2008

Client: National Park Service, Yosemite National Park
Location: Mather Waste Accumulation Area

Prepared by: Shaw Environmental, Inc.
Photographer: B.Matz (Shaw)

Photograph 12 – View of background locations YWM109 and YWM110

Description: Location of paired background samples YWM109 and YWM110, in areas of granite outcrop above Mather WAA.

Date Taken: August 2008

APPENDIX A
TEST PIT SOIL LOGS

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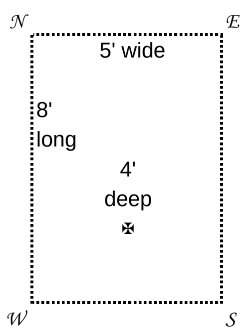
TEST PIT SOIL LOG

PROJECT NUMBER: 870508.02122		PROJECT NAME: NPS Yosemite -- Mather WAA	
BORING NUMBER: YWM-TP01	COORDINATES: unknown -- not surveyed		DATE: 8/27/2001
ELEVATION amsl: unknown	GWL Depth na	Date/Time na	TIME STARTED: 1530
ENGINEER/GEOLOGIST: C. Ladd	Depth na	Date/Time na	COMPLETED: 1540
METHOD: backhoe			PAGE 1 OF 1

DEPTH (ft)	SAMPLE DEPTH.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	✠	na	na	grey-brown GRAVELLY SAND, very fine to coarse-grained, well-graded, loose, dry, with gravel (sub-angular to angular) to boulders (up to 2' diameter). No debris.		na	na	Sample #: YWM-TP01-SO-1042
5 10				TD = 4 feet bgs 				

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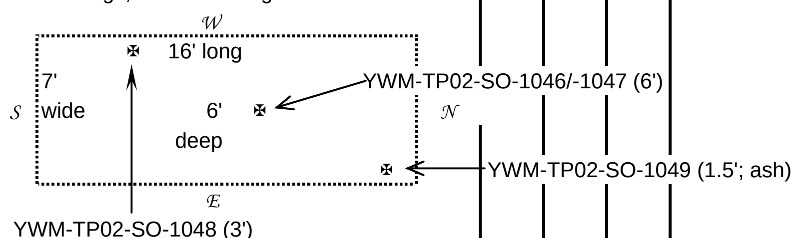
TEST PIT SOIL LOG

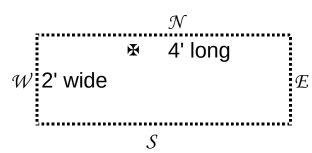
PROJECT NUMBER: 870508.02122		PROJECT NAME: NPS Yosemite -- Mather WAA	
BORING NUMBER: YWM-TP02	COORDINATES: unknown -- not surveyed		DATE: 8/27/2001
ELEVATION amsl: unknown	GWL Depth na	Date/Time na	TIME STARTED: 1600
ENGINEER/GEOLOGIST: C. Ladd	Depth na	Date/Time na	COMPLETED: 1630
METHOD: backhoe			PAGE 1 OF 1

DEPTH (ft)	SAMPLE DEPTH.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
		na	na	grey GRAVELLY SAND, fine-grained, loose, dry.		na	na	Sample #
	✠			white ASH layer (3-4 in. thick) at 1.5 feet bgs				YWM-TP02-SO-1049
	✠			Boulders (to 3' diam) throughout profile				YWM-TP02-SO-1048
				Debris: fragments of glass, ceramics, wire,				
5				bottles, broken light bulbs; to TD				YWM-TP02-SO-1046 (primary)
	✠							YWM-TP02-SO-1047 (duplicate)
				TD = 6 feet bgs; refusal on large boulders				
10								
15								



TEST PIT SOIL LOG

PROJECT NUMBER: 870508.02122		PROJECT NAME: NPS Yosemite -- Mather WAA	
BORING NUMBER: YWM-TP02A	COORDINATES: unknown -- not surveyed		DATE: 8/26/2008
ELEVATION amsl: unknown	GWL Depth na	Date/Time na	TIME STARTED:
ENGINEER/GEOLOGIST: B. Matz	Depth na	Date/Time na	COMPLETED:
METHOD: backhoe			PAGE 1 OF 1

DEPTH (ft)	SAMPLE DEPTH.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	✠	na	na	grey GRAVELLY SAND, fine-grained, loose, dry.		na	na	Sample # YWM02A-2268
				TD = 1 feet bgs; only surface sample required				
				Debris: fragments of glass, ceramics, rusted metal				
5								
10								
15								

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TEST PIT SOIL LOG

PROJECT NUMBER: 870508.02122		PROJECT NAME: NPS Yosemite -- Mather WAA	
BORING NUMBER: YWM-TP03	COORDINATES: unknown -- not surveyed		DATE: 8/27/2001
ELEVATION amsl: unknown	GWL Depth na Date/Time na		TIME STARTED: na
ENGINEER/GEOLOGIST: C. Ladd	Depth na Date/Time na		COMPLETED: na
METHOD: backhoe			PAGE 1 OF 1

DEPTH (ft)	SAMPLE DEPTH.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Test pit not excavated -- TP05 substituted.				
5								
10								

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TEST PIT SOIL LOG

PROJECT NUMBER: 870508.02122		PROJECT NAME: NPS Yosemite -- Mather WAA	
BORING NUMBER: YWM-TP04	COORDINATES: unknown -- not surveyed		DATE: 8/27/2001
ELEVATION amsl: unknown	GWL Depth na	Date/Time na	TIME STARTED: 1345
ENGINEER/GEOLOGIST: C. Ladd	Depth na	Date/Time na	COMPLETED: 1400
METHOD: backhoe			PAGE 1 OF 1

DEPTH (ft)	SAMPLE DEPTH.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	✠	na	na	grey-brown GRAVELLY SAND, well-graded, very fine to coarse-grained, subangular to angular, loose, dry, with gravel and boulders (to 1 foot diam) No debris in test pit excavation.		na	na	Sample # YWM-TP04-SO-1037
5 10				TD = 3 feet bgs (no debris) W 9' long 3' wide S 3' deep N ✠ YWM-TP04-SO-1037 E				

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TEST PIT SOIL LOG

PROJECT NUMBER: 870508.02122		PROJECT NAME: NPS Yosemite -- Mather WAA	
BORING NUMBER: YWM-TP05	COORDINATES: unknown -- not surveyed		DATE: 8/27/2001
ELEVATION amsl: unknown	GWL Depth na	Date/Time na	TIME STARTED: 1420
ENGINEER/GEOLOGIST: C. Ladd	Depth na	Date/Time na	COMPLETED: 1440
METHOD: backhoe			PAGE 1 OF 1

DEPTH (ft)	SAMPLE DEPTH.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
		na	na	grey-brown GRAVELLY SAND, vf to coarse,		na	na	Sample #
	✠✠			loose, dry, with gravel and boulders (to 1 foot diam)				YWM-TP05-SO-1041 (ash)
				1 foot bgs: 3-4" white ash layer (E side) and				YWM-TP05-SO-1040 (oily subst)
	✠			dk brown to black oily substance (N side)				TP05A (oily subst resample)
	✠							YWM-TP05-SO-1039
				Debris: fragments of glass, ceramics, wire,				
				bottles, cans and other ferrous metal debris				
	✠							YWM-TP05-SO-1038
5								
				No debris below 5.5 feet bgs				
				TD = 6.5 feet bgs (below bottom of debris layer)				
10								

N YWM-TP05-SO-1040 (1', oily subst); TP05A (1.5', oily subst resample)

9.5' long ✠ ✠

2.5' YWM-TP05-SO-1039 (2.5')

W wide 6.5' deep ✠ E

✠ YWM-TP05-SO-1041 (1', ash)

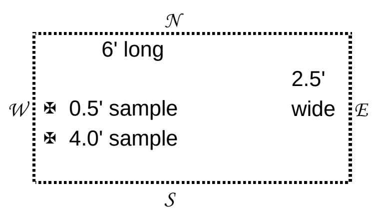
YWM-TP05-SO-1038 (5')

S

TEST PIT SOIL LOG

PROJECT NUMBER: 870508.02122		PROJECT NAME: NPS Yosemite -- Mather WAA	
BORING NUMBER: YWM-TP06	COORDINATES: GPS 37.90233N, 119.83617W		DATE: 8/26/2008
ELEVATION amsl: 5,057 ft amsl	GWL Depth na	Date/Time na	TIME STARTED:
ENGINEER/GEOLOGIST: B. Matz	Depth na	Date/Time na	COMPLETED:
METHOD: backhoe			PAGE 1 OF 1

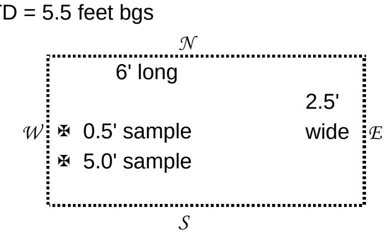
DEPTH (ft)	SAMPLE DEPTH.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	✠	na	na	0'-4' -- brown SAND, loose, dry, with gravel (3-5%)		na	na	Sample # YWM06-2274
				NO debris in test pit				
	✠			4'-5' -- yellow-brown fine SAND, damp, loose				YWM06-2276
5				TD = 5.0 feet bgs				



TEST PIT SOIL LOG

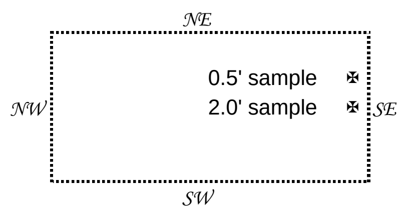
PROJECT NUMBER: 870508.02122		PROJECT NAME: NPS Yosemite -- Mather WAA	
BORING NUMBER: YWM-TP07	COORDINATES: GPS 37.90233N, 119.83617W		DATE: 8/26/2008
ELEVATION amsl: 5,057 ft amsl	GWL Depth na Date/Time na		TIME STARTED:
ENGINEER/GEOLOGIST: B. Matz	Depth na Date/Time na		COMPLETED:
METHOD: backhoe			PAGE 1 OF 1

DEPTH (ft)	SAMPLE DEPTH.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	✠	na	na	0'-3' -- brown SAND, loose, dry, with gravel (3-5%)		na	na	Sample # YWM07-2277
				NO debris in test pit				
				3'-5' -- yellow-brown fine SAND, damp, loose				
5	✠							YWM07-2279
				TD = 5.5 feet bgs				



TEST PIT SOIL LOG

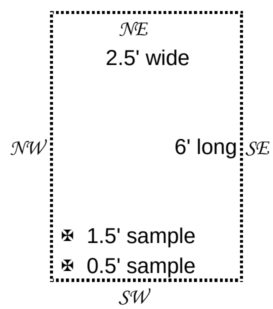
PROJECT NUMBER: 870508.02122		PROJECT NAME: NPS Yosemite -- Mather WAA	
BORING NUMBER: YWM-TP08	COORDINATES: GPS 37.90233N, 119.83575W		DATE: 8/26/2008
ELEVATION amsl: 5,017 ft amsl	GWL Depth na	Date/Time na	TIME STARTED:
ENGINEER/GEOLOGIST: B. Matz	Depth na	Date/Time na	COMPLETED:
METHOD: backhoe			PAGE 1 OF 1

DEPTH (ft)	SAMPLE DEPTH.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	✠ ✠	na	na	0'-2.5', greyish brown SILTY SAND, dry, loose w/ angular cobbles to small boulders (1.5 ft diam) DEBRIS only in upper 0.5 ft, glass and metal pieces		na	na	Sample # YWM08-2280 YWM08-2281, 2282
5				TD = 2.5 feet bgs; refusal on boulders 				

TEST PIT SOIL LOG

PROJECT NUMBER: 870508.02122		PROJECT NAME: NPS Yosemite -- Mather WAA	
BORING NUMBER: YWM-TP09	COORDINATES: GPS 37.90197N, 119.83581W		DATE: 8/26/2008
ELEVATION amsl: 5,018 ft amsl	GWL Depth na	Date/Time na	TIME STARTED:
ENGINEER/GEOLOGIST: B. Matz	Depth na	Date/Time na	COMPLETED:
METHOD: backhoe			PAGE 1 OF 1

DEPTH (ft)	SAMPLE DEPTH.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	✠	na	na	0'-3' -- brown SANDY SILT, loose, dry, with many large angular blocky granite boulders to 3' diam.		na	na	Sample #
	✠							YWM09-2284
								YWM09-2285
				DEBRIS is widely scattered pieces of glass and metal				
	✠							YWM09-2286
				TD = 3.0 feet bgs				
5								



TEST PIT SOIL LOG

PROJECT NUMBER: 870508.02122		PROJECT NAME: NPS Yosemite -- Mather WAA	
BORING NUMBER: YWM101, YWM102	COORDINATES: GPS 37.90239N, 119.83633W		DATE: 8/26/2008
ELEVATION amsl: 5,040 ft amsl	GWL Depth na	Date/Time na	TIME STARTED:
ENGINEER/GEOLOGIST: B. Matz	Depth na	Date/Time na	COMPLETED:
METHOD: hand-dig			PAGE 1 OF 1

DEPTH (ft)	SAMPLE DEPTH.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	✠	na	na	grey brown SANDY GRAVEL, dry, loose		na	na	Sample # YWM101-2287, YWM102-2288
				TD = 1 foot bgs Description for background test pits YWM101 and YWM102, located approx. 3 ft apart.				
5								

TEST PIT SOIL LOG

PROJECT NUMBER: 870508.02122		PROJECT NAME: NPS Yosemite -- Mather WAA	
BORING NUMBER: YWM103, YWM104	COORDINATES: GPS 37.90274N, 119.83550W		DATE: 8/26/2008
ELEVATION amsl: 5,080 ft amsl	GWL Depth na Date/Time na		TIME STARTED:
ENGINEER/GEOLOGIST: B. Matz	Depth na Date/Time na		COMPLETED:
METHOD: hand-dig			PAGE 1 OF 1

DEPTH (ft)	SAMPLE DEPTH.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	✠	na	na	grey brown SANDY GRAVEL, dry, loose		na	na	Sample # YWM103-2289, YWM104-2290
5				TD = 1 foot bgs Description for background test pits YWM103 and YWM104, located approx. 3 ft apart.				

TEST PIT SOIL LOG

PROJECT NUMBER: 870508.02122	PROJECT NAME: NPS Yosemite -- Mather WAA		
BORING NUMBER: YWM105, YWM106	COORDINATES: GPS 37.90264N, 119.83528W		DATE: 8/26/2008
ELEVATION amsl: 5,092 ft amsl	GWL Depth na	Date/Time na	TIME STARTED:
ENGINEER/GEOLOGIST: B. Matz	Depth na	Date/Time na	COMPLETED:
METHOD: hand-dig			PAGE 1 OF 1

DEPTH (ft)	SAMPLE DEPTH.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	✠	na	na	grey brown SANDY GRAVEL, dry, loose		na	na	Sample # YWM105-2291, YWM106-2292
5				TD = 1 foot bgs Description for background test pits YWM105 and YWM106, located approx. 3 ft apart.				

TEST PIT SOIL LOG

PROJECT NUMBER: 870508.02122		PROJECT NAME: NPS Yosemite -- Mather WAA	
BORING NUMBER: YWM107,YWM108	COORDINATES: GPS 37.90256N, 119.83536W		DATE: 8/26/2008
ELEVATION amsl: 5,088 ft amsl	GWL Depth na	Date/Time na	TIME STARTED:
ENGINEER/GEOLOGIST: B. Matz	Depth na	Date/Time na	COMPLETED:
METHOD: hand-dig			PAGE 1 OF 1

DEPTH (ft)	SAMPLE DEPTH.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	✠	na	na	brown SANDY SILT, damp, loose		na	na	Sample # YWM07-2293, YWM08-2294
5				TD = 1 foot bgs Description for background test pits YWM107 and YWM108, located approx. 3 ft apart.				

TEST PIT SOIL LOG

PROJECT NUMBER: 870508.02122		PROJECT NAME: NPS Yosemite -- Mather WAA	
BORING NUMBER: YWM109, YWM110	COORDINATES: GPS 37.90203N, 119.83542W		DATE: 8/26/2008
ELEVATION amsl: 5,091 ft amsl	GWL Depth na Date/Time na		TIME STARTED:
ENGINEER/GEOLOGIST: B. Matz	Depth na Date/Time na		COMPLETED:
METHOD: hand-dig			PAGE 1 OF 1

DEPTH (ft)	SAMPLE DEPTH.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	✠	na	na	med brown SANDY SILT, moist, sl firm		na	na	Sample # YWM109-2295, YWM110-2296
5				TD = 1 foot bgs Description for background test pits YWM109 and YWM110, located approx. 3 ft apart.				

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TEST PIT SOIL LOG

PROJECT NUMBER: 870508.02122		PROJECT NAME: NPS Yosemite -- Mather WAA	
BORING NUMBER: YWM-UG01	COORDINATES: unknown -- not surveyed		DATE: 8/27/2001
ELEVATION amsl: unknown	GWL Depth na Date/Time na		TIME STARTED: 1500
ENGINEER/GEOLOGIST: C. Ladd	Depth na Date/Time na		COMPLETED: 1510
METHOD: hand shovel			PAGE 1 OF 1

DEPTH (ft)	SAMPLE DEPTH.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	✠	na	na	med brown GRAVELLY SAND, well graded, dry, loose subang fine sand, 30% gravel to 0.5" diam, rootlets		na	na	Sample # YWM-UG01-SO-1043
				TD = 1 foot bgs				
5								
10								

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TEST PIT SOIL LOG

PROJECT NUMBER: 870508.02122		PROJECT NAME: NPS Yosemite -- Mather WAA	
BORING NUMBER: YWM-UG02	COORDINATES: unknown -- not surveyed		DATE: 8/27/2001
ELEVATION amsl: unknown	GWL Depth na	Date/Time na	TIME STARTED: 1515
ENGINEER/GEOLOGIST: C. Ladd	Depth na	Date/Time na	COMPLETED: 1525
METHOD: hand shovel			PAGE 1 OF 1

DEPTH (ft)	SAMPLE DEPTH.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	✠	na	na	med red-brown GRAVELLY SAND, dry, loose subang fine sand, 20% gravel to 0.3" diam, rootlets		na	na	Sample # YWM-UG02-SO-1044
				TD = 1 foot bgs				
5								
10								

TEST PIT SOIL LOG

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PROJECT NUMBER: 870508.02122		PROJECT NAME: NPS Yosemite -- Mather WAA	
BORING NUMBER: YWM-UG03	COORDINATES: unknown -- not surveyed		DATE: 8/27/2001
ELEVATION amsl: unknown	GWL Depth na	Date/Time na	TIME STARTED: 1530
ENGINEER/GEOLOGIST: C. Ladd	Depth na	Date/Time na	COMPLETED: 1540
METHOD: hand shovel			PAGE 1 OF 1

DEPTH (ft)	SAMPLE DEPTH.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	✠	na	na	med brown GRAVELLY SAND, dry, loose subang fine sand, 20% gravel to 0.2" diam, rootlets		na	na	Sample # YWM-UG03-SO-1045
				TD = 1 foot bgs				
5								
10								

IT CORPORATION
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TEST PIT SOIL LOG

PROJECT NUMBER: 870508.02122		PROJECT NAME: NPS Yosemite -- Mather WAA	
BORING NUMBER: YWM-DG01	COORDINATES: unknown -- not surveyed		DATE: 8/28/2001
ELEVATION amsl: unknown	GWL Depth na Date/Time na		TIME STARTED: 0855
ENGINEER/GEOLOGIST: B. Matz	Depth na Date/Time na		COMPLETED: 0900
METHOD: hand shovel			PAGE 1 OF 1

DEPTH (ft)	SAMPLE DEPTH.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	✠	na	na	med brown SILTY SAND, dry, loose w/ 30% fine gravel, rootlets		na	na	Sample # YWM-DG01-SO-1050
				TD = 1 foot bgs				
5								
10								

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TEST PIT SOIL LOG

PROJECT NUMBER: 870508.02122		PROJECT NAME: NPS Yosemite -- Mather WAA	
BORING NUMBER: YWM-DG02	COORDINATES: unknown -- not surveyed		DATE: 8/28/2001
ELEVATION amsl: unknown	GWL Depth na	Date/Time na	TIME STARTED: 0905
ENGINEER/GEOLOGIST: B. Matz	Depth na	Date/Time na	COMPLETED: 0907
METHOD: hand shovel			PAGE 1 OF 1

DEPTH (ft)	SAMPLE DEPTH.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	✠	na	na	grey brown SANDY GRAVEL, dry, loose		na	na	Sample # YWM-DG02-SO-1051
				TD = 1 foot bgs				
5								
10								

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TEST PIT SOIL LOG

PROJECT NUMBER: 870508.02122		PROJECT NAME: NPS Yosemite -- Mather WAA	
BORING NUMBER: YWM-DG03	COORDINATES: unknown -- not surveyed		DATE: 8/28/2001
ELEVATION amsl: unknown	GWL Depth na	Date/Time na	TIME STARTED: 0910
ENGINEER/GEOLOGIST: C. Ladd	Depth na	Date/Time na	COMPLETED: 0912
METHOD: backhoe			PAGE 1 OF 1

DEPTH (ft)	SAMPLE DEPTH.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	✠	na	na	grey brown SANDY GRAVEL, dry, loose		na	na	Sample # YWM-DG03-SO-1052
				TD = 1 foot bgs				
5								
10								

APPENDIX B
ANALYTICAL DATA REPORT SUMMARY PAGES AND CHAIN OF CUSTODY FORMS

EMAX
LABORATORIES, INC.
1835 W. 205th Street
Torrance, CA 90501
Tel: (310) 618-8889
Fax: (310) 618-0818

Date: 09-19-2008
EMAX Batch No.: 08H299

Attn: Susan Huang

Shaw E&I
4005 Port Chicago Highway
Concord CA 94520-1120

Subject: Laboratory Report
Project: NPS WAA Mather

Enclosed is the Laboratory report for samples received on 08/28/08.
The data reported include :

Sample ID	Control #	Col Date	Matrix	Analysis
YWM02A-2268	H299-01	08/26/08	SOIL	METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM
				POLYCHLORINATED BIPHENYLS (PCBS)
				SEMIVOLATILE ORGANICS BY GCMS
				TPH DIESEL & MOTOR OIL
				MOISTURE CONTENT DETERMINATION
				MERCURY
				TPH GASOLINE
				VOLATILE ORGANICS BY GC/MS
YWM05A-2271	H299-02	08/26/08	SOIL	POLYCHLORINATED BIPHENYLS (PCBS)
				TPH DIESEL & MOTOR OIL
				MOISTURE CONTENT DETERMINATION
YWM06-2274	H299-03	08/26/08	SOIL	METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM
				POLYCHLORINATED BIPHENYLS (PCBS)
				SEMIVOLATILE ORGANICS BY GCMS
				TPH DIESEL & MOTOR OIL
				TPH GASOLINE
				VOLATILE ORGANICS BY GC/MS

Sample ID	Control #	Col Date	Matrix	Analysis
				MOISTURE CONTENT DETERMINATION
				MERCURY
YWM06-2276	H299-04	08/26/08	SOIL	CATION EXCHANGE CAPACITY
				METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM
				POLYCHLORINATED BIPHENYLS (PCBS)
				PH
				SEMIVOLATILE ORGANICS BY GCMS
				TOTAL ORGANIC CARBON
				TPH DIESEL & MOTOR OIL
				TPH GASOLINE
				VOLATILE ORGANICS BY GC/MS
				MOISTURE CONTENT DETERMINATION
				MERCURY
YWM07-2277	H299-05	08/26/08	SOIL	METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM
				POLYCHLORINATED BIPHENYLS (PCBS)
				SEMIVOLATILE ORGANICS BY GCMS
				TPH DIESEL & MOTOR OIL
				TPH GASOLINE
				VOLATILE ORGANICS BY GC/MS
				MOISTURE CONTENT DETERMINATION
				MERCURY
YWM07-2279	H299-06	08/26/08	SOIL	METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM
				POLYCHLORINATED BIPHENYLS (PCBS)
				SEMIVOLATILE ORGANICS BY GCMS
				TPH DIESEL & MOTOR OIL
				TPH GASOLINE
				VOLATILE ORGANICS BY GC/MS
				MOISTURE CONTENT DETERMINATION
				MERCURY
YWM08-2280	H299-07	08/26/08	SOIL	METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM
				POLYCHLORINATED BIPHENYLS (PCBS)
				SEMIVOLATILE ORGANICS BY GCMS
				TPH DIESEL & MOTOR OIL
				TPH GASOLINE
				VOLATILE ORGANICS BY GC/MS
				MOISTURE CONTENT DETERMINATION
				MERCURY

Sample ID	Control #	Col Date	Matrix	Analysis
YWM08-2281	H299-08	08/26/08	SOIL	METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM
				POLYCHLORINATED BIPHENYLS (PCBS)
				SEMIVOLATILE ORGANICS BY GCMS
				TPH DIESEL & MOTOR OIL
				TPH GASOLINE
				VOLATILE ORGANICS BY GC/MS
				MOISTURE CONTENT DETERMINATION
				MERCURY
YWM08-2282	H299-09	08/26/08	SOIL	CATION EXCHANGE CAPACITY
				METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM
				POLYCHLORINATED BIPHENYLS (PCBS)
				PH
				SEMIVOLATILE ORGANICS BY GCMS
				TOTAL ORGANIC CARBON
				TPH DIESEL & MOTOR OIL
				TPH GASOLINE
				VOLATILE ORGANICS BY GC/MS
				MOISTURE CONTENT DETERMINATION
				MERCURY
YWM09-2284	H299-10	08/26/08	SOIL	METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM
				POLYCHLORINATED BIPHENYLS (PCBS)
				SEMIVOLATILE ORGANICS BY GCMS
				TPH DIESEL & MOTOR OIL
				TPH GASOLINE
				VOLATILE ORGANICS BY GC/MS
				MOISTURE CONTENT DETERMINATION
				MERCURY
YWM09-2285	H299-11	08/26/08	SOIL	METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM
				POLYCHLORINATED BIPHENYLS (PCBS)
				SEMIVOLATILE ORGANICS BY GCMS
				TPH DIESEL & MOTOR OIL
				TPH GASOLINE
				VOLATILE ORGANICS BY GC/MS
				MOISTURE CONTENT DETERMINATION
				MERCURY
YWM09-2286	H299-12	08/26/08	SOIL	METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM

Sample ID	Control #	Col Date	Matrix	Analysis
				POLYCHLORINATED BIPHENYLS (PCBS)
				SEMIVOLATILE ORGANICS BY GCMS
				TPH DIESEL & MOTOR OIL
				TPH GASOLINE
				VOLATILE ORGANICS BY GC/MS
				MOISTURE CONTENT DETERMINATION
				MERCURY
YWM101-2287	H299-13	08/26/08	SOIL	METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM
				MOISTURE CONTENT DETERMINATION
				MERCURY
YWM102-2288	H299-14	08/26/08	SOIL	METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM
				MOISTURE CONTENT DETERMINATION
				MERCURY
YWM103-2289	H299-15	08/26/08	SOIL	METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM
				MOISTURE CONTENT DETERMINATION
				MERCURY
YWM104-2290	H299-16	08/26/08	SOIL	METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM
				MOISTURE CONTENT DETERMINATION
				MERCURY
YWM105-2291	H299-17	08/26/08	SOIL	METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM
				MOISTURE CONTENT DETERMINATION
				MERCURY
YWM106-2292	H299-18	08/26/08	SOIL	METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM
				MOISTURE CONTENT DETERMINATION
				MERCURY
YWM107-2293	H299-19	08/26/08	SOIL	METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM
				MOISTURE CONTENT DETERMINATION
				MERCURY
YWM108-2294	H299-20	08/26/08	SOIL	METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM
				MOISTURE CONTENT DETERMINATION
				MERCURY
YWM109-2295	H299-21	08/26/08	SOIL	METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM

Sample ID	Control #	Col Date	Matrix	Analysis
				MOISTURE CONTENT DETERMINATION
				MERCURY
YWM110-2296	H299-22	08/26/08	SOIL	METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM
				MOISTURE CONTENT DETERMINATION
				MERCURY
YWM06-2276MS	H299-04M	08/26/08	SOIL	CATION EXCHANGE CAPACITY
				METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM
				POLYCHLORINATED BIPHENYLS (PCBS)
				SEMIVOLATILE ORGANICS BY GCMS
				TOTAL ORGANIC CARBON
				TPH DIESEL & MOTOR OIL
				TPH GASOLINE
				VOLATILE ORGANICS BY GC/MS
				MERCURY
YWM06-2276MSD	H299-04S	08/26/08	SOIL	CATION EXCHANGE CAPACITY
				METALS, TOTAL BY ICP-MS
				SEMIVOLATILE ORGANICS SIM
				POLYCHLORINATED BIPHENYLS (PCBS)
				SEMIVOLATILE ORGANICS BY GCMS
				TPH DIESEL & MOTOR OIL
				TPH GASOLINE
				VOLATILE ORGANICS BY GC/MS
				MERCURY
YWM06-2276DUP	H299-04D	08/26/08	SOIL	PH
				TOTAL ORGANIC CARBON

The results are summarized on the following pages.

Please feel free to call if you have any questions concerning these results.

Sincerely yours,

Caspar J. Pang
Acting Laboratory Director

EMAX certifies that the results included in this report meet all NELAC requirements unless noted in the Case Narrative.

SH_0839_

Chain Of Custody

08H299

COC # 471

PROJ NO.	PROJECT NAME	
870508	NATIONAL PARK SERVICE	YOSEMITE: WAA Mather - NPS 37
SHAW Contact (Name and Phone Number)	Susan Huang - (925) 288-2099	
NAME OF SAMPLER:	B.Matz, J.Shack, N.Hanelt	

Cooler Temperature:
Cooler: 1 of 5
Ship Date: 8/27/08
PO: 410355
~~FedEx/Airborne~~ No: UPS
Cost Code: 870508-02103150

Lab Contact: Ye Myint, Project Manager
EMAX Laboratories, Inc.
1835 W 205th. St.
Torrance, CA 90501
Phone: (310) 618-8889 x121
Fax: (310) 618-0818

	Location ID	Sample DATE (mmddyy)	Sample TIME	EPA 8260B VOCs	EPA 8015B TPH-g	EPA 8015B TPH-d, mo with Silica Gel Cleanup	EPA 8270C SVOCs	EPA 8310 PAHs	EPA 9060 TOC/Walkley Black	EPA 8082 PCBs	EPA 9045C pH	EPA 6020A /7471A Metals	EPA 9080/9081 CEC	MATRIX A=Aqueous or S=Solid	Please Mark 1 MS/MSD per MATRIX per shipment COMMENTS
				3 x 5g Enc	2 x 5g Enc	2 x 8-ounce glass jar									
				Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice		
	Temperature Blank														One 40 mL in each cooler
1	YWM02A-2268	082608	1500	—	—	X	X	X	X	X	X	X	X	S	(No Encores this one)
2	YWM05A-2271	082608	1600	X	X	X	X	X	X	X	X	X	X	S	
3	YWM06-2274		1610	X	X	X	X	X	X	X	X	X	X	S	
4	YWM06-2276		1545	X	X	X	X	X	X	X	X	X	X	S	
5	YWM07-2277		1630	X	X	X	X	X	X	X	X	X	X	S	
6	YWM07-2279		1620	X	X	X	X	X	X	X	X	X	X	S	
7	YWM08-2280		1500	X	X	X	X	X	X	X	X	X	X	S	
8	YWM08-2281	↓	1445	X	X	X	X	X	X	X	X	X	X	S	

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
B.Matz	8/27/08 1630			8/28/08 10:00	[signature]
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)

U:\National Park Service\database\Pre-Sampling\COCs Access.mdb\ rpt_WaaMatherCOC-EMAX

Cooler #1 T=2.8°C Cooler #2 T=3.7°C

Chain Of Custody 08H299

COC # 472

PROJ NO.	PROJECT NAME	
870508	NATIONAL PARK SERVICE	YOSEMITE: WAA Mather - NPS 37
SHAW Contact (Name and Phone Number)	Susan Huang - (925) 288-2099	
NAME OF SAMPLER:	B. Matz, J. Strack, N. Harnett	

Cooler Temperature: ☐
Cooler: 1 of 5
Ship Date: 8/27/08
PO: 410355
~~FedEx/Airborne~~ No: UPS
Cost Code: 870508-02103150

Lab Contact: Ye Myint, Project Manager
EMAX Laboratories, Inc.
1835 W 205th. St.
Torrance, CA 90501
Phone: (310) 618-8889 x121
Fax: (310) 618-0818

	Location ID	Sample DATE (mmddyy)	Sample TIME	EPA 8260B VOCs (3 x 5g Enc, Ice)	EPA 8015B TPH-g (2 x 5g Enc, Ice)	EPA 8015B TPH-d, mo with Silica Gel Cleanup (2 x 8-ounce glass jar, Ice)	EPA 8270C SVOCs (Ice)	EPA 8310 PAHs (Ice)	EPA 9060 TOC/Walkley Black (Ice)	EPA 8082 PCBs (Ice)	EPA 9045C pH (Ice)	EPA 6020A /7471A Metals (Ice)	EPA 9080/9081 CEC (Ice)	MATRIX A=Aqueous or S=Solid	Please Mark 1 MS/MSD per MATRIX per shipment COMMENTS
	Temperature Blank														One 40 mL in each cooler
9	YWM08-2282	082608	1440	X	X	X	X	X	X	X	X	X	X	S	
10	YWM09-2284	↓	1400	X	X	X	X	X	X	X	X	X	X	S	
11	YWM09-2285		1340	X	X	X	X	X	X	X	X	X	X	S	
12	YWM09-2286	↓	1335	X	X	X	X	X	X	X	X	X	X	S	
13	YWM101-2287		1120					X				X		S	
14	YWM102-2288		1122					X				X		S	
15	YWM103-2289		1130					X				X		S	
16	YWM104-2290	↓	1132					X				X		S	

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
BMatz 8/27/08	1630			8/28/08 1000	[signature]
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)

Chain Of Custody 08H299

COC # 473

PROJ NO.	PROJECT NAME	
870508	NATIONAL PARK SERVICE	YOSEMITE: WAA Mather - NPS 37

SHAW Contact (Name and Phone Number) Susan Huang - (925) 288-2099

NAME OF SAMPLER: B. Matz, J. Strack, N. Hanelt

Cooler Temperature:
Cooler: 1 of 5
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Phone: (310) 618-8889 x121
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	Location ID	Sample DATE (mmddyy)	Sample TIME	EPA 8260B VOCs (3 x 5g Enc, Ice)	EPA 8015B TPH-g (2 x 5g Enc, Ice)	EPA 8015B TPH-d, mo with Silica Gel Cleanup (2 x 8-ounce glass jar, Ice)	EPA 8270C SVOCs (Ice)	EPA 8310 PAHs (Ice)	EPA 9060 TOC/Walkley Black (Ice)	EPA 8082 PCBs (Ice)	EPA 9045C pH (Ice)	EPA 6020A /7471A Metals (Ice)	EPA 9080/9081 CEC (Ice)	MATRIX A=Aqueous or S=Solid	COMMENTS (Please Mark 1 MS/MSD per MATRIX per shipment)
	Temperature Blank														One 40 mL in each cooler
7	YWM105-2291	082608	1140					X				X			
8	YWM106-2292	↓	1142					X				X			
19	YWM107-2293	↓	1150					X				X			
20	YWM108-2294	↓	1152					X				X			
21	YWM109-2295	↓	1200					X				X			
22	YWM110-2296	↓	1202					X				X			
				LAST LINE											

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
B. Matz 8/27/08	8/27/08 1630			8/28/08 10:00	[signature]

EMAX LABORATORIES, INC.

SAMPLE RECEIPT FORM 1

Type of Delivery	Delivered By/Airbill	ECN 08 H299
☐ EMAX Courier		Recepient I PATEL
☐ Client Delivery		Date 8-28-08
~~☐ Third Party~~ ups track #	1266V5450198675638 1266V5450198563820	Time 10:00 A

COC Inspection

~~☐ Client Name~~ ~~☐ Client PM/FC~~ ~~☐ Sampler Name~~ ~~☐ Sampling Date/Time/Location~~ ~~☐ Sample ID~~ ~~☐ Matrix~~

~~☐ Address~~ ~~☐ Tel # / Fax #~~ ☐ Courier Signature ~~☐ Analysis Required~~ ~~☐ Preservative (if any)~~ ☐ TAT

Safety Issues

~~☐ None~~ ☐ High concentrations expected ☐ Superfund Site samples ☐ Rad screening required

Comments:

Packaging Inspection

Container	~~☐ Cooler~~	☐ Box	☐ Other		
Condition	☐ Custody Seal	~~☐ Intact~~	☐ Damaged		
Packaging	~~☐ Bubble Pack~~	☐ Styrofoam	☐ Popcorn	~~☐ Sufficient~~	☐ Plastic Bag
Temperatures	~~☐ Cooler 1~~ 2.8 °C	☐ Cooler 2 3.7 °C	☐ Cooler 3 ___ °C	☐ Cooler 4 ___ °C	☐ Cooler 5 ___ °C
	☐ Cooler 6 ___ °C	☐ Cooler 7 ___ °C	☐ Cooler 8 ___ °C	☐ Cooler 9 ___ °C	☐ Cooler 10 ___ °C

Comments: ☐ **PM was informed on non-compliant coolers imediately.**

DISCREPANCIES

LSID	LSCID	Sample Label ID/COC ID	Discrepancy Code	Corrective Action Code
-04		YWM06-2276	Rec'd (4) JARS. But	R5
			NO MS/MSD on Coc.	
			Requested.	
~~01 TO 22~~			~~A2~~ @ 8/28/08	
-02 TO 12			No Encores for VOC	Will receive on 8/29/08
			& gasoline	and tag same lab ID.
17 TO 22			NO MATRIX Info.	
-02		YWM05A-2271	Encore Not Rec'd	R6 per client.
-03 TO 012			(5) Encores Each Bag.	
			Rec'd on 8/29/08	
			Collected on 8/26/08	

REVIEWS

Sample Labeling [signature] Date 8-28-08

SRF [signature] Date 8/28/08

PM [signature] Date 8/28/08

LEGEND:

Code	Description- Sample Management	Code	Description-Sample Management	Code	Description-Project Management
A1	Analysis is not indicated in COC	E1	Preservative needed; sample has no preservative	R1	Hold sample(s); wait for further instructions
A2	Analysis is not indicated in label	E2	Preservative not needed but sample is preserved	R2	Proceed as indicated in COC
A3	Analysis is inconsistent in COC vis-à-vis label	F1	Not enough quantity of samples	R3	Refer to attached instruction
B1	Sample ID is not indicated in COC	F2	Bubble is> 6mm	R4	Cancel the analysis
B2	Sample ID is not indicated in label	G1	Temperature is out of range (4 +_ 2°C)	R5	Perform MS/MSD
B3	Sample ID is inconsistent in COC vis-à-vis label	G2	Out of Holding Time	R6	Analyze Diesel & PCB only - Cancel the rest.
C1	Wrong container	G3	>20 % solid particle		
C2	Broken container	H1			
C3	Leaking container	H2			
D1	Date and/or time is not indicated in COC				
D2	Date and/or time is not indicated in label				
D3	Date and/or time is inconsistent in COC vis-à-vis label				

Ye Myint

From: Huang, Susan [Susan.Huang@shawgrp.com]
Sent: Friday, August 29, 2008 12:30 PM
To: Ye Myint
Subject: Revised COC for WAA Mather

Hi Ye;

Attached please find the revised COC for the WAA Mather site.

For sample YWM02A-2268; please also analyze VOC and TPH gasoline. Due to site conditions, we were unable to take the Encore samples. Could you please analyze VOC and gasoline from the jar?

For sample YWM05A-2271, please analyze TPH diesel with silica gel cleanup and PCBs. Please cancel the remaining analyses indicated on the COC.

Thanks

Susan Huang
Shaw Environmental & Infrastructure
4005 Port Chicago Highway
Concord, CA 94520
(925) 288-2099 direct
(925) 288-0888 fax
www.shawgrp.com

Ye Myint

From: Huang, Susan [Susan.Huang@shawgrp.com]
Sent: Friday, August 29, 2008 2:14 PM
To: Ye Myint
Subject: Required Analyses for NPS Baseline and Mather Sites

Ye;

WAA Baseline
Please perform TOC, pH, CEC for samples
YWB05-2241
YWB08-2251
Please cancel TOC, pH, CEC analyses for all other samples from this site.

WAA Mather
Please perform TOC, pH and CEC for samples
YWM06-2276
YWM08-2282
Please cancel TOC, pH and CEC analyses for other samples from this site.

If analysis is already performed or being performed, please let me know.

Thanks

Susan Huang
Shaw Environmental & Infrastructure
4005 Port Chicago Highway
Concord, CA 94520
(925) 288-2099 direct
(925) 288-0888 fax
www.shawgrp.com

RON FIORE
9252889898
CONCORD 66V545
4005 PORT CHICAGO HWY
CONCORD CA 94520

45 LBS

4 OF 4

SHIP TO:
YE MYINT
310.618.8889 1234
EMAX LABORATORIES
1835 W. 205TH ST.
TORRANCE CA 90501-1510

CA 908 9-02

UPS NEXT DAY AIR 1

TRACKING #: 1Z 66V 545 01 9867 5638

BILLING: P/P

Business Unit or Job Number: 00501.870508.4[illegible]
Senders Name: Suan Huang
CS 10.5.18.
WXPIE60 78.0A 04/2008

TM

International Shipping Notice - Carriage hereunder may be subject to the rules relating to liability and other terms and/or conditions established by the Convention for the Unification of Certain Rules Relating to International Carriage by Air (the "Warsaw Convention") and/or the Convention on the Contract for the International Carriage of Goods by Road (the "CMR Convention"). These commodities, technology or software were exported from the U.S. in accordance with the Export Administration Regulations. Diversion contrary to U.S. law prohibited. For shipping prices, call 1-800-782-7892 United Parcel Service, Louisville KY

RON FIORE
9252889898
CONCORD 66V545
4005 PORT CHICAGO HWY
CONCORD CA 94520

45 LBS

3 OF 4

SHIP TO:
YE MYINT
310.618.8889 1234
EMAX LABORATORIES
1835 W. 205TH ST.
TORRANCE CA 90501-1510

CA 908 9-02

UPS NEXT DAY AIR 1

TRACKING #: 1Z 66V 545 01 9856 3820

BILLING: P/P

Business Unit or Job Number: 00501.870508.4[illegible]
Senders Name: Susan Huang
CS 10.5.18.
WXPIE60 78.0A 04/2008

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REPORTING CONVENTIONS

DATA QUALIFIERS:

Lab Qualifier	AFCEE Qualifier	Description
J	F	Indicates that the analyte is positively identified and the result is less than RL but greater than MDL.
N		Indicates presumptive evidence of a compound.
B	B	Indicates that the analyte is found in the associated method blank as well as in the sample at above QC level.
E	J	Indicates that the result is above the maximum calibration range.
*	*	Out of QC limit.

Note: The above qualifiers are used to flag the results unless the project requires a different set of qualification criteria.

ACRONYMS AND ABBREVIATIONS:

CRDL	Contract Required Detection Limit
RL	Reporting Limit
MRL	Method Reporting Limit
PQL	Practical Quantitation Limit
MDL	Method Detection Limit
DO	Diluted out

DATES

The date and time information for leaching and preparation reflect the beginning date and time of the procedure unless the method, protocol, or project specifically requires otherwise.

LABORATORY REPORT FOR

SHAW E&I

NPS WAA MATHER

METHOD 5035/8260B
VOLATILE ORGANICS BY GC/MS

SDG#: 08H299

CASE NARRATIVE

CLIENT: SHAW E&I

PROJECT: NPS WAA MATHER

SDG: 08H299

METHOD 5035/8260B
VOLATILE ORGANICS BY GC/MS

Eleven (11) soil samples were received on 08/28/08 for Volatile Organic analysis by Method 5035/8260B in accordance with USEPA SW846, 3rd edition and DOD QSM, v. 3.

1. **Holding Time**

   Analytical holding time was met.

2. **Tuning and Calibration**

   Tuning and calibration were carried out at 12-hour interval. All QC requirements were met.

3. **Method Blank**

   As per DOD QSM v. 3, method blanks were free of contamination at half of the reporting limit for target analytes with the exception of common laboratory contaminants wherein the criteria is no detection above reporting limit.

4. **Surrogate Recovery**

   Recoveries were within QC limit except for the following:

   Note that many samples had non-soil particulate matter (potentially dried plant-like material, although there is no way to confirm) that may contribute to low internal standard and surrogate recoveries.

Sample	Surrogate	% Recovery	QC Limit
H299-03	1,2 Dichloroethane-d4	153%	70-140
	4-BFB	126%	85-120
H299-03R	Toluene-d8	117%	85-115
	4-BFB	126%	85-120

Comment: Last internal standard response was low and two surrogates were biased high. Sample reanalyzed and QC deficiencies remained. Results are confirmed.

Sample	Surrogate	% Recovery	QC Limit
H299-04U	4-BFB	123%	85-120

Comment: Other target analyte recoveries in MS were within limits.

Sample	Surrogate	% Recovery	QC Limit
H299-05	1,2 Dichloroethane-d4	225%	70-140
	Toluene-d8	207%	85-115
H299-05R	1,2 Dichloroethane-d4	160%	70-140
	Toluene-d8	166%	85-115
	4-BFB	126%	85-120

Comment: All internal standards had low response, causing surrogate elevation. Reanalysis confirmed results and QC deficiencies remained.

Sample	Surrogate	% Recovery	QC Limit
H299-07	4-BFB	142%	85-120
	Toluene-d8	121%	85-115
H299-07R	1,2 Dichloroethane-d4	728%	70-140
	Toluene-d8	185%	85-115

Comment: In H299-07, last internal standard response was low. Reanalysis showed all three internal standard responses as extremely low. Due to very low IS response in reanalysis, all results are biased high.

Sample	Surrogate	% Recovery	QC Limit
H299-11R	Toluene-d8	117%	85-115

Comment: Initial analysis had low IS response.

Sample	Surrogate	% Recovery	QC Limit
H299-12	1,2 Dichloroethane-d4	157%	70-140
	Toluene-d8	133%	85-115
	4-BFB	134%	85-120
H299-12R	Toluene-d8	116%	85-115
	4-BFB	124%	85-120

Comment: Initial analysis had low last two internal standard response. Reanalysis continued to have low internal standard deficiency.

5. Lab Control Sample/Lab Control Sample Duplicate

Recoveries were within QC limit.

6. Matrix Spike/Matrix Spike Duplicate

H299-04 was spiked. All analytes except the following were within QC limit.

Sample	Surrogate	% Recovery	RPD	QC Limit
H299-4U	Bromoform	136%	15	50-135
	1,1,2,2 -Tetrachloroethane	133%	14	55-130

RPD was within limits and all analytes recoveries were within limits in H299-04S.

7. Sample Analysis

Note that many samples had non-soil particulate matter (potentially dried plant-like material, although there is no way to confirm) that may contribute to low internal standard and surrogate recoveries.

H299-01 was analyzed from a Jar since no encores were provided.

Samples were analyzed according to the prescribed QC procedures. All criteria were met with the aforementioned exceptions.

LAB CHRONICLE
VOLATILE ORGANICS BY GC/MS

Client : SHAW E&I
Project : NPS WAA MATHER

SDG NO. : 08H299
Instrument ID : T-003

SOIL

Client Sample ID	Laboratory Sample ID	Dilution Factor	% Moist	Analysis DateTime	Extraction DateTime	Sample Data FN	Calibration Data FN	Prep. Batch	Notes
MBLK1S	V003H70Q	1	NA	08/30/0802:38	08/30/0802:38	RHB774	RFB753	V003H70	Method Blank
LCS1S	V003H70L	1	NA	08/30/0800:59	08/30/0800:59	RHB771	RFB753	V003H70	Lab Control Sample (LCS)
LCD1S	V003H70C	1	NA	08/30/0801:32	08/30/0801:32	RHB772	RFB753	V003H70	LCS Duplicate
YWM06-2274	H299-03	1.0	0.7	08/30/0805:25	08/30/0805:25	RHB779	RFB753	V003H70	Field Sample
YWM07-2277	H299-05	1.8	4.5	08/30/0806:00	08/30/0806:00	RHB780	RFB753	V003H70	Field Sample
YWM07-2279	H299-06	1.4	3.2	08/30/0806:34	08/30/0806:34	RHB781	RFB753	V003H70	Field Sample
YWM08-2280	H299-07	1.1	1.7	08/30/0807:09	08/30/0807:09	RHB782	RFB753	V003H70	Field Sample
YWM08-2281	H299-08	1.1	0.6	08/30/0807:45	08/30/0807:45	RHB783	RFB753	V003H70	Field Sample
YWM08-2282	H299-09	1.1	0.5	08/30/0808:20	08/30/0808:20	RHB784	RFB753	V003H70	Field Sample
YWM09-2286	H299-12	1.4	2.6	08/30/0810:04	08/30/0810:04	RHB787	RFB753	V003H70	Field Sample
MBLK2S	V003I01Q	1	NA	09/02/0815:15	09/02/0815:15	RIB007	RFB753	V003I01	Method Blank
LCS2S	V003I01L	1	NA	09/02/0813:40	09/02/0813:40	RIB004	RFB753	V003I01	Lab Control Sample (LCS)
LCD2S	V003I01C	1	NA	09/02/0814:11	09/02/0814:11	RIB005	RFB753	V003I01	LCS Duplicate
YWM06-2276	H299-04R	1.1	3.4	09/02/0815:46	09/02/0815:46	RIB008	RFB753	V003I01	Field Sample
YWM06-2276MS	H299-04U	1.0	3.4	09/02/0816:19	09/02/0816:19	RIB009	RFB753	V003I01	Matrix Spike Sample (MS)
YWM06-2276MSD	H299-04V	1.1	3.4	09/02/0816:50	09/02/0816:50	RIB010	RFB753	V003I01	MS Duplicate (MSD)
MBLK3S	V003I03Q	1	NA	09/03/0812:15	09/03/0812:15	RIB031	RFB753	V003I03	Method Blank
LCS3S	V003I03L	1	NA	09/03/0810:39	09/03/0810:39	RIB028	RFB753	V003I03	Lab Control Sample (LCS)
LCD3S	V003I03C	1	NA	09/03/0811:12	09/03/0811:12	RIB029	RFB753	V003I03	LCS Duplicate
YWM02A-2268	H299-01R	1.0	4.1	09/03/0815:26	09/03/0815:26	RIB037	RFB753	V003I03	Field Sample
YWM06-2274RE	H299-03R	1.3	0.7	09/03/0815:58	09/03/0815:58	RIB038	RFB753	V003I03	Field Sample
YWM07-2277RE	H299-05R	1.7	4.5	09/03/0816:30	09/03/0816:30	RIB039	RFB753	V003I03	Field Sample
YWM08-2280RE	H299-07R	1.5	1.7	09/03/0817:01	09/03/0817:01	RIB040	RFB753	V003I03	Field Sample
YWM09-2284	H299-10R	1.0	4.2	09/03/0817:33	09/03/0817:33	RIB041	RFB753	V003I03	Field Sample
YWM09-2285	H299-11R	1.3	1.4	09/03/0818:05	09/03/0818:05	RIB042	RFB753	V003I03	Field Sample
YWM09-2286RE	H299-12R	1.4	2.6	09/03/0818:37	09/03/0818:37	RIB043	RFB753	V003I03	Field Sample

FN - Filename
% Moist - Percent Moisture

SAMPLE RESULTS

SW 5030B/8260B
VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/03/08 15:26
Sample ID:	YWM02A-2268	Date Analyzed:	09/03/08 15:26
Lab Samp ID:	H299-01R	Dilution Factor:	1.0
Lab File ID:	RIB037	Matrix	: SOIL
Ext Btch ID:	V003I03	% Moisture	: 4.1
Calib. Ref.:	RFB753	Instrument ID	: T-003

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,1,1-TRICHLOROETHANE	ND	5.2	2.1
1,1,2,2-TETRACHLOROETHANE	ND	5.2	2.1
1,1,2-TRICHLOROETHANE	ND	5.2	2.1
1,1-DICHLOROETHANE	ND	5.2	2.1
1,1-DICHLOROETHENE	ND	5.2	2.1
1,2-DICHLOROBENZENE	ND	5.2	2.1
1,2-DICHLOROETHANE	ND	5.2	2.1
1,2-DICHLOROPROPANE	ND	5.2	2.1
1,3-DICHLOROBENZENE	ND	5.2	2.1
1,4-DICHLOROBENZENE	ND	5.2	2.1
2-BUTANONE	ND	10	5.2
2-HEXANONE	ND	10	5.2
4-METHYL-2-PENTANONE	ND	10	5.2
ACETONE	15	10	5.2
BENZENE	ND	5.2	2.1
BROMODICHLOROMETHANE	ND	5.2	2.1
BROMOFORM	ND	5.2	2.1
BROMOMETHANE	ND	10	2.1
CARBON DISULFIDE	ND	5.2	2.1
CARBON TETRACHLORIDE	ND	5.2	2.1
CHLOROBENZENE	ND	5.2	2.1
CHLOROETHANE	ND	5.2	2.1
CHLOROFORM	ND	5.2	2.1
CHLOROMETHANE	ND	10	2.1
CIS-1,2-DICHLOROETHENE	ND	5.2	2.1
CIS-1,3-DICHLOROPROPENE	ND	5.2	2.1
DIBROMOCHLOROMETHANE	ND	5.2	2.1
DICHLORODIFLUOROMETHANE	ND	10	2.1
ETHYLBENZENE	ND	5.2	2.1
M/P-XYLENES	ND	10	2.1
METHYLENE CHLORIDE	2.6J	10	2.1
MTBE	ND	5.2	2.1
O-XYLENE	ND	5.2	2.1
STYRENE	ND	5.2	2.1
TETRACHLOROETHYLENE	ND	5.2	2.1
TOLUENE	ND	5.2	2.1
TRANS-1,2-DICHLOROETHENE	ND	5.2	2.1
TRANS-1,3-DICHLOROPROPENE	ND	5.2	2.1
TRICHLOROETHENE	ND	5.2	2.1
TRICHLOROFLUOROMETHANE	ND	5.2	2.1
VINYL CHLORIDE	ND	5.2	2.1

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
1,2-DICHLOROETHANE-D4	124	70-140
TOLUENE-D8	112	85-115
4-BROMOFLUOROBENZENE	116	85-120

RL: Reporting Limit

SW 5035/8260B
VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	08/30/08 05:25
Sample ID:	YWM06-2274	Date Analyzed:	08/30/08 05:25
Lab Samp ID:	H299-03	Dilution Factor:	1.0
Lab File ID:	RHB779	Matrix :	SOIL
Ext Btch ID:	VO03H70	% Moisture :	0.7
Calib. Ref.:	RFB753	Instrument ID :	T-003

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,1,1-TRICHLOROETHANE	ND	5.0	2.0
1,1,2,2-TETRACHLOROETHANE	ND	5.0	2.0
1,1,2-TRICHLOROETHANE	ND	5.0	2.0
1,1-DICHLOROETHANE	ND	5.0	2.0
1,1-DICHLOROETHENE	ND	5.0	2.0
1,2-DICHLOROBENZENE	ND	5.0	2.0
1,2-DICHLOROETHANE	ND	5.0	2.0
1,2-DICHLOROPROPANE	ND	5.0	2.0
1,3-DICHLOROBENZENE	ND	5.0	2.0
1,4-DICHLOROBENZENE	ND	5.0	2.0
2-BUTANONE	ND	10	5.0
2-HEXANONE	ND	10	5.0
4-METHYL-2-PENTANONE	ND	10	5.0
ACETONE	5.6J	10	5.0
BENZENE	ND	5.0	2.0
BROMODICHLOROMETHANE	ND	5.0	2.0
BROMOFORM	ND	5.0	2.0
BROMOMETHANE	ND	10	2.0
CARBON DISULFIDE	ND	5.0	2.0
CARBON TETRACHLORIDE	ND	5.0	2.0
CHLOROBENZENE	ND	5.0	2.0
CHLOROETHANE	ND	5.0	2.0
CHLOROFORM	ND	5.0	2.0
CHLOROMETHANE	ND	10	2.0
CIS-1,2-DICHLOROETHENE	ND	5.0	2.0
CIS-1,3-DICHLOROPROPENE	ND	5.0	2.0
DIBROMOCHLOROMETHANE	ND	5.0	2.0
DICHLORODIFLUOROMETHANE	ND	10	2.0
ETHYLBENZENE	ND	5.0	2.0
M/P-XYLENES	ND	10	2.0
METHYLENE CHLORIDE	ND	10	2.0
MTBE	ND	5.0	2.0
O-XYLENE	ND	5.0	2.0
STYRENE	ND	5.0	2.0
TETRACHLOROETHYLENE	ND	5.0	2.0
TOLUENE	ND	5.0	2.0
TRANS-1,2-DICHLOROETHENE	ND	5.0	2.0
TRANS-1,3-DICHLOROPROPENE	ND	5.0	2.0
TRICHLOROETHENE	ND	5.0	2.0
TRICHLOROFLUOROMETHANE	ND	5.0	2.0
VINYL CHLORIDE	ND	5.0	2.0

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
1,2-DICHLOROETHANE-D4	153*	70-140
TOLUENE-D8	113	85-115
4-BROMOFLUOROBENZENE	126*	85-120

RL: Reporting Limit

SW 5035/8260B
VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/03/08 15:58
Sample ID:	YWM06-2274RE	Date Analyzed:	09/03/08 15:58
Lab Samp ID:	H299-03R	Dilution Factor:	1.3
Lab File ID:	RIB038	Matrix :	SOIL
Ext Btch ID:	VOO3I03	% Moisture :	0.7
Calib. Ref.:	RFB753	Instrument ID :	T-003

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,1,1-TRICHLOROETHANE	ND	6.5	2.6
1,1,2,2-TETRACHLOROETHANE	ND	6.5	2.6
1,1,2-TRICHLOROETHANE	ND	6.5	2.6
1,1-DICHLOROETHANE	ND	6.5	2.6
1,1-DICHLOROETHENE	ND	6.5	2.6
1,2-DICHLOROBENZENE	ND	6.5	2.6
1,2-DICHLOROETHANE	ND	6.5	2.6
1,2-DICHLOROPROPANE	ND	6.5	2.6
1,3-DICHLOROBENZENE	ND	6.5	2.6
1,4-DICHLOROBENZENE	ND	6.5	2.6
2-BUTANONE	ND	13	6.5
2-HEXANONE	ND	13	6.5
4-METHYL-2-PENTANONE	ND	13	6.5
ACETONE	ND	13	6.5
BENZENE	ND	6.5	2.6
BROMODICHLOROMETHANE	ND	6.5	2.6
BROMOFORM	ND	6.5	2.6
BROMOMETHANE	ND	13	2.6
CARBON DISULFIDE	ND	6.5	2.6
CARBON TETRACHLORIDE	ND	6.5	2.6
CHLOROBENZENE	ND	6.5	2.6
CHLOROETHANE	ND	6.5	2.6
CHLOROFORM	ND	6.5	2.6
CHLOROMETHANE	ND	13	2.6
CIS-1,2-DICHLOROETHENE	ND	6.5	2.6
CIS-1,3-DICHLOROPROPENE	ND	6.5	2.6
DIBROMOCHLOROMETHANE	ND	6.5	2.6
DICHLORODIFLUOROMETHANE	ND	13	2.6
ETHYLBENZENE	ND	6.5	2.6
M/P-XYLENES	ND	13	2.6
METHYLENE CHLORIDE	ND	13	2.6
MTBE	ND	6.5	2.6
O-XYLENE	ND	6.5	2.6
STYRENE	ND	6.5	2.6
TETRACHLOROETHYLENE	ND	6.5	2.6
TOLUENE	ND	6.5	2.6
TRANS-1,2-DICHLOROETHENE	ND	6.5	2.6
TRANS-1,3-DICHLOROPROPENE	ND	6.5	2.6
TRICHLOROETHENE	ND	6.5	2.6
TRICHLOROFLUOROMETHANE	ND	6.5	2.6
VINYL CHLORIDE	ND	6.5	2.6

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
1,2-DICHLOROETHANE-D4	137	70-140
TOLUENE-D8	117*	85-115
4-BROMOFLUOROBENZENE	126*	85-120

RL: Reporting Limit

SW 5035/8260B
VOLATILE ORGANICS BY GC/MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/02/08 15:46
Sample ID: YWM06-2276	Date Analyzed: 09/02/08 15:46
Lab Samp ID: H299-04R	Dilution Factor: 1.1
Lab File ID: RIB008	Matrix : SOIL
Ext Btch ID: VO03I01	% Moisture : 3.4
Calib. Ref.: RFB753	Instrument ID : T-003

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,1,1-TRICHLOROETHANE	ND	5.7	2.3
1,1,2,2-TETRACHLOROETHANE	ND	5.7	2.3
1,1,2-TRICHLOROETHANE	ND	5.7	2.3
1,1-DICHLOROETHANE	ND	5.7	2.3
1,1-DICHLOROETHENE	ND	5.7	2.3
1,2-DICHLOROBENZENE	ND	5.7	2.3
1,2-DICHLOROETHANE	ND	5.7	2.3
1,2-DICHLOROPROPANE	ND	5.7	2.3
1,3-DICHLOROBENZENE	ND	5.7	2.3
1,4-DICHLOROBENZENE	ND	5.7	2.3
2-BUTANONE	ND	11	5.7
2-HEXANONE	ND	11	5.7
4-METHYL-2-PENTANONE	ND	11	5.7
ACETONE	44	11	5.7
BENZENE	ND	5.7	2.3
BROMODICHLOROMETHANE	ND	5.7	2.3
BROMOFORM	ND	5.7	2.3
BROMOMETHANE	ND	11	2.3
CARBON DISULFIDE	ND	5.7	2.3
CARBON TETRACHLORIDE	ND	5.7	2.3
CHLOROBENZENE	ND	5.7	2.3
CHLOROETHANE	ND	5.7	2.3
CHLOROFORM	ND	5.7	2.3
CHLOROMETHANE	ND	11	2.3
CIS-1,2-DICHLOROETHENE	ND	5.7	2.3
CIS-1,3-DICHLOROPROPENE	ND	5.7	2.3
DIBROMOCHLOROMETHANE	ND	5.7	2.3
DICHLORODIFLUOROMETHANE	ND	11	2.3
ETHYLBENZENE	ND	5.7	2.3
M/P-XYLENES	ND	11	2.3
METHYLENE CHLORIDE	ND	11	2.3
MTBE	ND	5.7	2.3
O-XYLENE	ND	5.7	2.3
STYRENE	ND	5.7	2.3
TETRACHLOROETHYLENE	ND	5.7	2.3
TOLUENE	ND	5.7	2.3
TRANS-1,2-DICHLOROETHENE	ND	5.7	2.3
TRANS-1,3-DICHLOROPROPENE	ND	5.7	2.3
TRICHLOROETHENE	ND	5.7	2.3
TRICHLOROFLUOROMETHANE	ND	5.7	2.3
VINYL CHLORIDE	ND	5.7	2.3

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
1,2-DICHLOROETHANE-D4	107	70-140
TOLUENE-D8	102	85-115
4-BROMOFLUOROBENZENE	115	85-120

RL: Reporting Limit

SW 5035/8260B
VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	08/30/08 06:00
Sample ID:	YWM07-2277	Date Analyzed:	08/30/08 06:00
Lab Samp ID:	H299-05	Dilution Factor:	1.8
Lab File ID:	RHB780	Matrix :	SOIL
Ext Btch ID:	V003H70	% Moisture :	4.5
Calib. Ref.:	RFB753	Instrument ID :	T-003

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,1,1-TRICHLOROETHANE	ND	9.4	3.8
1,1,2,2-TETRACHLOROETHANE	ND	9.4	3.8
1,1,2-TRICHLOROETHANE	ND	9.4	3.8
1,1-DICHLOROETHANE	ND	9.4	3.8
1,1-DICHLOROETHENE	ND	9.4	3.8
1,2-DICHLOROBENZENE	ND	9.4	3.8
1,2-DICHLOROETHANE	ND	9.4	3.8
1,2-DICHLOROPROPANE	ND	9.4	3.8
1,3-DICHLOROBENZENE	ND	9.4	3.8
1,4-DICHLOROBENZENE	ND	9.4	3.8
2-BUTANONE	ND	19	9.4
2-HEXANONE	ND	19	9.4
4-METHYL-2-PENTANONE	ND	19	9.4
ACETONE	160	19	9.4
BENZENE	ND	9.4	3.8
BROMODICHLOROMETHANE	ND	9.4	3.8
BROMOFORM	ND	9.4	3.8
BROMOMETHANE	ND	19	3.8
CARBON DISULFIDE	ND	9.4	3.8
CARBON TETRACHLORIDE	ND	9.4	3.8
CHLOROBENZENE	ND	9.4	3.8
CHLOROETHANE	ND	9.4	3.8
CHLOROFORM	ND	9.4	3.8
CHLOROMETHANE	ND	19	3.8
CIS-1,2-DICHLOROETHENE	ND	9.4	3.8
CIS-1,3-DICHLOROPROPENE	ND	9.4	3.8
DIBROMOCHLOROMETHANE	ND	9.4	3.8
DICHLORODIFLUOROMETHANE	ND	19	3.8
ETHYLBENZENE	ND	9.4	3.8
M/P-XYLENES	ND	19	3.8
METHYLENE CHLORIDE	4.3J	19	3.8
MTBE	ND	9.4	3.8
O-XYLENE	ND	9.4	3.8
STYRENE	ND	9.4	3.8
TETRACHLOROETHYLENE	ND	9.4	3.8
TOLUENE	ND	9.4	3.8
TRANS-1,2-DICHLOROETHENE	ND	9.4	3.8
TRANS-1,3-DICHLOROPROPENE	ND	9.4	3.8
TRICHLOROETHENE	ND	9.4	3.8
TRICHLOROFLUOROMETHANE	ND	9.4	3.8
VINYL CHLORIDE	ND	9.4	3.8

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
1,2-DICHLOROETHANE-D4	225*	70-140
TOLUENE-D8	207*	85-115
4-BROMOFLUOROBENZENE	116	85-120

RL: Reporting Limit

SW 5035/8260B
VOLATILE ORGANICS BY GC/MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/03/08 16:30
Sample ID: YWM07-2277RE	Date Analyzed: 09/03/08 16:30
Lab Samp ID: H299-05R	Dilution Factor: 1.7
Lab File ID: RIB039	Matrix : SOIL
Ext Btch ID: VOO3I03	% Moisture : 4.5
Calib. Ref.: RFB753	Instrument ID : T-003

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,1,1-TRICHLOROETHANE	ND	8.9	3.6
1,1,2,2-TETRACHLOROETHANE	ND	8.9	3.6
1,1,2-TRICHLOROETHANE	ND	8.9	3.6
1,1-DICHLOROETHANE	ND	8.9	3.6
1,1-DICHLOROETHENE	ND	8.9	3.6
1,2-DICHLOROBENZENE	ND	8.9	3.6
1,2-DICHLOROETHANE	ND	8.9	3.6
1,2-DICHLOROPROPANE	ND	8.9	3.6
1,3-DICHLOROBENZENE	ND	8.9	3.6
1,4-DICHLOROBENZENE	ND	8.9	3.6
2-BUTANONE	ND	18	8.9
2-HEXANONE	ND	18	8.9
4-METHYL-2-PENTANONE	ND	18	8.9
ACETONE	ND	18	8.9
BENZENE	ND	8.9	3.6
BROMODICHLOROMETHANE	ND	8.9	3.6
BROMOFORM	ND	8.9	3.6
BROMOMETHANE	ND	18	3.6
CARBON DISULFIDE	ND	8.9	3.6
CARBON TETRACHLORIDE	ND	8.9	3.6
CHLOROBENZENE	ND	8.9	3.6
CHLOROETHANE	ND	8.9	3.6
CHLOROFORM	ND	8.9	3.6
CHLOROMETHANE	ND	18	3.6
CIS-1,2-DICHLOROETHENE	ND	8.9	3.6
CIS-1,3-DICHLOROPROPENE	ND	8.9	3.6
DIBROMOCHLOROMETHANE	ND	8.9	3.6
DICHLORODIFLUOROMETHANE	ND	18	3.6
ETHYLBENZENE	ND	8.9	3.6
M/P-XYLENES	ND	18	3.6
METHYLENE CHLORIDE	7.2J	18	3.6
MTBE	ND	8.9	3.6
O-XYLENE	ND	8.9	3.6
STYRENE	ND	8.9	3.6
TETRACHLOROETHYLENE	ND	8.9	3.6
TOLUENE	ND	8.9	3.6
TRANS-1,2-DICHLOROETHENE	ND	8.9	3.6
TRANS-1,3-DICHLOROPROPENE	ND	8.9	3.6
TRICHLOROETHENE	ND	8.9	3.6
TRICHLOROFLUOROMETHANE	ND	8.9	3.6
VINYL CHLORIDE	ND	8.9	3.6

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
1,2-DICHLOROETHANE-D4	160*	70-140
TOLUENE-D8	166*	85-115
4-BROMOFLUOROBENZENE	126*	85-120

RL: Reporting Limit

SW 5035/8260B
VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	08/30/08 06:34
Sample ID:	YWM07-2279	Date Analyzed:	08/30/08 06:34
Lab Samp ID:	H299-06	Dilution Factor:	1.4
Lab File ID:	RHB781	Matrix :	SOIL
Ext Btch ID:	VO03H70	% Moisture :	3.2
Calib. Ref.:	RFB753	Instrument ID :	T-003

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,1,1-TRICHLOROETHANE	ND	7.2	2.9
1,1,2,2-TETRACHLOROETHANE	ND	7.2	2.9
1,1,2-TRICHLOROETHANE	ND	7.2	2.9
1,1-DICHLOROETHANE	ND	7.2	2.9
1,1-DICHLOROETHENE	ND	7.2	2.9
1,2-DICHLOROBENZENE	ND	7.2	2.9
1,2-DICHLOROETHANE	ND	7.2	2.9
1,2-DICHLOROPROPANE	ND	7.2	2.9
1,3-DICHLOROBENZENE	ND	7.2	2.9
1,4-DICHLOROBENZENE	ND	7.2	2.9
2-BUTANONE	ND	14	7.2
2-HEXANONE	ND	14	7.2
4-METHYL-2-PENTANONE	ND	14	7.2
ACETONE	ND	14	7.2
BENZENE	ND	7.2	2.9
BROMODICHLOROMETHANE	ND	7.2	2.9
BROMOFORM	ND	7.2	2.9
BROMOMETHANE	ND	14	2.9
CARBON DISULFIDE	ND	7.2	2.9
CARBON TETRACHLORIDE	ND	7.2	2.9
CHLOROBENZENE	ND	7.2	2.9
CHLOROETHANE	ND	7.2	2.9
CHLOROFORM	ND	7.2	2.9
CHLOROMETHANE	ND	14	2.9
CIS-1,2-DICHLOROETHENE	ND	7.2	2.9
CIS-1,3-DICHLOROPROPENE	ND	7.2	2.9
DIBROMOCHLOROMETHANE	ND	7.2	2.9
DICHLORODIFLUOROMETHANE	ND	14	2.9
ETHYLBENZENE	ND	7.2	2.9
M/P-XYLENES	ND	14	2.9
METHYLENE CHLORIDE	ND	14	2.9
MTBE	ND	7.2	2.9
O-XYLENE	ND	7.2	2.9
STYRENE	ND	7.2	2.9
TETRACHLOROETHYLENE	ND	7.2	2.9
TOLUENE	ND	7.2	2.9
TRANS-1,2-DICHLOROETHENE	ND	7.2	2.9
TRANS-1,3-DICHLOROPROPENE	ND	7.2	2.9
TRICHLOROETHENE	ND	7.2	2.9
TRICHLOROFLUOROMETHANE	ND	7.2	2.9
VINYL CHLORIDE	ND	7.2	2.9

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
1,2-DICHLOROETHANE-D4	123	70-140
TOLUENE-D8	99	85-115
4-BROMOFLUOROBENZENE	104	85-120

RL: Reporting Limit

SW 5035/8260B
VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	08/30/08 07:09
Sample ID:	YWM08-2280	Date Analyzed:	08/30/08 07:09
Lab Samp ID:	H299-07	Dilution Factor:	1.1
Lab File ID:	RHB782	Matrix :	SOIL
Ext Btch ID:	VO03H70	% Moisture :	1.7
Calib. Ref.:	RFB753	Instrument ID :	T-003

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,1,1-TRICHLOROETHANE	ND	5.6	2.2
1,1,2,2-TETRACHLOROETHANE	ND	5.6	2.2
1,1,2-TRICHLOROETHANE	ND	5.6	2.2
1,1-DICHLOROETHANE	ND	5.6	2.2
1,1-DICHLOROETHENE	ND	5.6	2.2
1,2-DICHLOROBENZENE	ND	5.6	2.2
1,2-DICHLOROETHANE	ND	5.6	2.2
1,2-DICHLOROPROPANE	ND	5.6	2.2
1,3-DICHLOROBENZENE	ND	5.6	2.2
1,4-DICHLOROBENZENE	ND	5.6	2.2
2-BUTANONE	ND	11	5.6
2-HEXANONE	ND	11	5.6
4-METHYL-2-PENTANONE	ND	11	5.6
ACETONE	ND	11	5.6
BENZENE	ND	5.6	2.2
BROMODICHLOROMETHANE	ND	5.6	2.2
BROMOFORM	ND	5.6	2.2
BROMOMETHANE	ND	11	2.2
CARBON DISULFIDE	ND	5.6	2.2
CARBON TETRACHLORIDE	ND	5.6	2.2
CHLOROBENZENE	ND	5.6	2.2
CHLOROETHANE	ND	5.6	2.2
CHLOROFORM	ND	5.6	2.2
CHLOROMETHANE	ND	11	2.2
CIS-1,2-DICHLOROETHENE	ND	5.6	2.2
CIS-1,3-DICHLOROPROPENE	ND	5.6	2.2
DIBROMOCHLOROMETHANE	ND	5.6	2.2
DICHLORODIFLUOROMETHANE	ND	11	2.2
ETHYLBENZENE	ND	5.6	2.2
M/P-XYLENES	ND	11	2.2
METHYLENE CHLORIDE	ND	11	2.2
MTBE	ND	5.6	2.2
O-XYLENE	ND	5.6	2.2
STYRENE	ND	5.6	2.2
TETRACHLOROETHYLENE	ND	5.6	2.2
TOLUENE	ND	5.6	2.2
TRANS-1,2-DICHLOROETHENE	ND	5.6	2.2
TRANS-1,3-DICHLOROPROPENE	ND	5.6	2.2
TRICHLOROETHENE	ND	5.6	2.2
TRICHLOROFLUOROMETHANE	ND	5.6	2.2
VINYL CHLORIDE	ND	5.6	2.2

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
1,2-DICHLOROETHANE-D4	121	70-140
TOLUENE-D8	121*	85-115
4-BROMOFLUOROBENZENE	142*	85-120

RL: Reporting Limit

SW 5035/8260B
VOLATILE ORGANICS BY GC/MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/03/08 17:01
Sample ID: YWM08-2280RE	Date Analyzed: 09/03/08 17:01
Lab Samp ID: H299-07R	Dilution Factor: 1.5
Lab File ID: RIB040	Matrix : SOIL
Ext Btch ID: VO03I03	% Moisture : 1.7
Calib. Ref.: RFB753	Instrument ID : T-003

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,1,1-TRICHLOROETHANE	ND	7.6	3.1
1,1,2,2-TETRACHLOROETHANE	ND	7.6	3.1
1,1,2-TRICHLOROETHANE	ND	7.6	3.1
1,1-DICHLOROETHANE	ND	7.6	3.1
1,1-DICHLOROETHENE	ND	7.6	3.1
1,2-DICHLOROBENZENE	ND	7.6	3.1
1,2-DICHLOROETHANE	ND	7.6	3.1
1,2-DICHLOROPROPANE	ND	7.6	3.1
1,3-DICHLOROBENZENE	ND	7.6	3.1
1,4-DICHLOROBENZENE	ND	7.6	3.1
2-BUTANONE	ND	15	7.6
2-HEXANONE	ND	15	7.6
4-METHYL-2-PENTANONE	ND	15	7.6
ACETONE	1300	15	7.6
BENZENE	ND	7.6	3.1
BROMODICHLOROMETHANE	ND	7.6	3.1
BROMOFORM	ND	7.6	3.1
BROMOMETHANE	ND	15	3.1
CARBON DISULFIDE	ND	7.6	3.1
CARBON TETRACHLORIDE	ND	7.6	3.1
CHLOROBENZENE	ND	7.6	3.1
CHLOROETHANE	ND	7.6	3.1
CHLOROFORM	ND	7.6	3.1
CHLOROMETHANE	ND	15	3.1
CIS-1,2-DICHLOROETHENE	ND	7.6	3.1
CIS-1,3-DICHLOROPROPENE	ND	7.6	3.1
DIBROMOCHLOROMETHANE	ND	7.6	3.1
DICHLORODIFLUOROMETHANE	ND	15	3.1
ETHYLBENZENE	ND	7.6	3.1
M/P-XYLENES	ND	15	3.1
METHYLENE CHLORIDE	110	15	3.1
MTBE	ND	7.6	3.1
O-XYLENE	ND	7.6	3.1
STYRENE	ND	7.6	3.1
TETRACHLOROETHYLENE	ND	7.6	3.1
TOLUENE	ND	7.6	3.1
TRANS-1,2-DICHLOROETHENE	ND	7.6	3.1
TRANS-1,3-DICHLOROPROPENE	ND	7.6	3.1
TRICHLOROETHENE	ND	7.6	3.1
TRICHLOROFLUOROMETHANE	ND	7.6	3.1
VINYL CHLORIDE	ND	7.6	3.1

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
1,2-DICHLOROETHANE-D4	728*	70-140
TOLUENE-D8	185*	85-115
4-BROMOFLUOROBENZENE	117	85-120

RL: Reporting Limit

SW 5035/8260B
VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	08/30/08 07:45
Sample ID:	YWM08-2281	Date Analyzed:	08/30/08 07:45
Lab Samp ID:	H299-08	Dilution Factor:	1.1
Lab File ID:	RHB783	Matrix	: SOIL
Ext Btch ID:	V003H70	% Moisture	: 0.6
Calib. Ref.:	RFB753	Instrument ID	: T-003

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,1,1-TRICHLOROETHANE	ND	5.5	2.2
1,1,2,2-TETRACHLOROETHANE	ND	5.5	2.2
1,1,2-TRICHLOROETHANE	ND	5.5	2.2
1,1-DICHLOROETHANE	ND	5.5	2.2
1,1-DICHLOROETHENE	ND	5.5	2.2
1,2-DICHLOROBENZENE	ND	5.5	2.2
1,2-DICHLOROETHANE	ND	5.5	2.2
1,2-DICHLOROPROPANE	ND	5.5	2.2
1,3-DICHLOROBENZENE	ND	5.5	2.2
1,4-DICHLOROBENZENE	ND	5.5	2.2
2-BUTANONE	ND	11	5.5
2-HEXANONE	ND	11	5.5
4-METHYL-2-PENTANONE	ND	11	5.5
ACETONE	ND	11	5.5
BENZENE	ND	5.5	2.2
BROMODICHLOROMETHANE	ND	5.5	2.2
BROMOFORM	ND	5.5	2.2
BROMOMETHANE	ND	11	2.2
CARBON DISULFIDE	ND	5.5	2.2
CARBON TETRACHLORIDE	ND	5.5	2.2
CHLOROBENZENE	ND	5.5	2.2
CHLOROETHANE	ND	5.5	2.2
CHLOROFORM	ND	5.5	2.2
CHLOROMETHANE	ND	11	2.2
CIS-1,2-DICHLOROETHENE	ND	5.5	2.2
CIS-1,3-DICHLOROPROPENE	ND	5.5	2.2
DIBROMOCHLOROMETHANE	ND	5.5	2.2
DICHLORODIFLUOROMETHANE	ND	11	2.2
ETHYLBENZENE	ND	5.5	2.2
M/P-XYLENES	ND	11	2.2
METHYLENE CHLORIDE	ND	11	2.2
MTBE	ND	5.5	2.2
O-XYLENE	ND	5.5	2.2
STYRENE	ND	5.5	2.2
TETRACHLOROETHYLENE	ND	5.5	2.2
TOLUENE	ND	5.5	2.2
TRANS-1,2-DICHLOROETHENE	ND	5.5	2.2
TRANS-1,3-DICHLOROPROPENE	ND	5.5	2.2
TRICHLOROETHENE	ND	5.5	2.2
TRICHLOROFLUOROMETHANE	ND	5.5	2.2
VINYL CHLORIDE	ND	5.5	2.2

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
1,2-DICHLOROETHANE-D4	121	70-140
TOLUENE-D8	105	85-115
4-BROMOFLUOROBENZENE	113	85-120

RL: Reporting Limit

SW 5035/8260B
VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected	: 08/26/08
Project	: NPS WAA MATHER	Date Received	: 08/28/08
Batch No.	: 08H299	Date Extracted	: 08/30/08 08:20
Sample ID	: YWM08-2282	Date Analyzed	: 08/30/08 08:20
Lab Samp ID	: H299-09	Dilution Factor	: 1.1
Lab File ID	: RHB784	Matrix	: SOIL
Ext Btch ID	: VO03H70	% Moisture	: 0.5
Calib. Ref.	: RFB753	Instrument ID	: T-003

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,1,1-TRICHLOROETHANE	ND	5.5	2.2
1,1,2,2-TETRACHLOROETHANE	ND	5.5	2.2
1,1,2-TRICHLOROETHANE	ND	5.5	2.2
1,1-DICHLOROETHANE	ND	5.5	2.2
1,1-DICHLOROETHENE	ND	5.5	2.2
1,2-DICHLOROBENZENE	ND	5.5	2.2
1,2-DICHLOROETHANE	ND	5.5	2.2
1,2-DICHLOROPROPANE	ND	5.5	2.2
1,3-DICHLOROBENZENE	ND	5.5	2.2
1,4-DICHLOROBENZENE	ND	5.5	2.2
2-BUTANONE	ND	11	5.5
2-HEXANONE	ND	11	5.5
4-METHYL-2-PENTANONE	ND	11	5.5
ACETONE	ND	11	5.5
BENZENE	ND	5.5	2.2
BROMODICHLOROMETHANE	ND	5.5	2.2
BROMOFORM	ND	5.5	2.2
BROMOMETHANE	ND	11	2.2
CARBON DISULFIDE	ND	5.5	2.2
CARBON TETRACHLORIDE	ND	5.5	2.2
CHLOROBENZENE	ND	5.5	2.2
CHLOROETHANE	ND	5.5	2.2
CHLOROFORM	ND	5.5	2.2
CHLOROMETHANE	ND	11	2.2
CIS-1,2-DICHLOROETHENE	ND	5.5	2.2
CIS-1,3-DICHLOROPROPENE	ND	5.5	2.2
DIBROMOCHLOROMETHANE	ND	5.5	2.2
DICHLORODIFLUOROMETHANE	ND	11	2.2
ETHYLBENZENE	ND	5.5	2.2
M/P-XYLENES	ND	11	2.2
METHYLENE CHLORIDE	ND	11	2.2
MTBE	ND	5.5	2.2
O-XYLENE	ND	5.5	2.2
STYRENE	ND	5.5	2.2
TETRACHLOROETHYLENE	ND	5.5	2.2
TOLUENE	ND	5.5	2.2
TRANS-1,2-DICHLOROETHENE	ND	5.5	2.2
TRANS-1,3-DICHLOROPROPENE	ND	5.5	2.2
TRICHLOROETHENE	ND	5.5	2.2
TRICHLOROFLUOROMETHANE	ND	5.5	2.2
VINYL CHLORIDE	ND	5.5	2.2

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
1,2-DICHLOROETHANE-D4	120	70-140
TOLUENE-D8	100	85-115
4-BROMOFLUOROBENZENE	108	85-120

RL: Reporting Limit

SW 5035/8260B
VOLATILE ORGANICS BY GC/MS

Client : SHAW E&I		Date Collected:	08/26/08
Project : NPS WAA MATHER		Date Received:	08/28/08
Batch No. : 08H299		Date Extracted:	09/03/08 17:33
Sample ID: YWM09-2284		Date Analyzed:	09/03/08 17:33
Lab Samp ID: H299-10R		Dilution Factor:	1.0
Lab File ID: RIB041		Matrix :	SOIL
Ext Btch ID: VO03I03		% Moisture :	4.2
Calib. Ref.: RFB753		Instrument ID :	T-003

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,1,1-TRICHLOROETHANE	ND	5.2	2.1
1,1,2,2-TETRACHLOROETHANE	ND	5.2	2.1
1,1,2-TRICHLOROETHANE	ND	5.2	2.1
1,1-DICHLOROETHANE	ND	5.2	2.1
1,1-DICHLOROETHENE	ND	5.2	2.1
1,2-DICHLOROBENZENE	ND	5.2	2.1
1,2-DICHLOROETHANE	ND	5.2	2.1
1,2-DICHLOROPROPANE	ND	5.2	2.1
1,3-DICHLOROBENZENE	ND	5.2	2.1
1,4-DICHLOROBENZENE	ND	5.2	2.1
2-BUTANONE	ND	10	5.2
2-HEXANONE	ND	10	5.2
4-METHYL-2-PENTANONE	ND	10	5.2
ACETONE	ND	10	5.2
BENZENE	ND	5.2	2.1
BROMODICHLOROMETHANE	ND	5.2	2.1
BROMOFORM	ND	5.2	2.1
BROMOMETHANE	ND	10	2.1
CARBON DISULFIDE	ND	5.2	2.1
CARBON TETRACHLORIDE	ND	5.2	2.1
CHLOROBENZENE	ND	5.2	2.1
CHLOROETHANE	ND	5.2	2.1
CHLOROFORM	ND	5.2	2.1
CHLOROMETHANE	ND	10	2.1
CIS-1,2-DICHLOROETHENE	ND	5.2	2.1
CIS-1,3-DICHLOROPROPENE	ND	5.2	2.1
DIBROMOCHLOROMETHANE	ND	5.2	2.1
DICHLORODIFLUOROMETHANE	ND	10	2.1
ETHYLBENZENE	ND	5.2	2.1
M/P-XYLENES	ND	10	2.1
METHYLENE CHLORIDE	ND	10	2.1
MTBE	ND	5.2	2.1
O-XYLENE	ND	5.2	2.1
STYRENE	ND	5.2	2.1
TETRACHLOROETHYLENE	ND	5.2	2.1
TOLUENE	ND	5.2	2.1
TRANS-1,2-DICHLOROETHENE	ND	5.2	2.1
TRANS-1,3-DICHLOROPROPENE	ND	5.2	2.1
TRICHLOROETHENE	ND	5.2	2.1
TRICHLOROFLUOROMETHANE	ND	5.2	2.1
VINYL CHLORIDE	ND	5.2	2.1

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
1,2-DICHLOROETHANE-D4	113	70-140
TOLUENE-D8	108	85-115
4-BROMOFLUOROBENZENE	115	85-120

RL: Reporting Limit

SW 5035/8260B
VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/03/08 18:05
Sample ID:	YWM09-2285	Date Analyzed:	09/03/08 18:05
Lab Samp ID:	H299-11R	Dilution Factor:	1.3
Lab File ID:	RIB042	Matrix :	SOIL
Ext Btch ID:	VO03I03	% Moisture :	1.4
Calib. Ref.:	RFB753	Instrument ID :	T-003

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,1,1-TRICHLOROETHANE	ND	6.6	2.6
1,1,2,2-TETRACHLOROETHANE	ND	6.6	2.6
1,1,2-TRICHLOROETHANE	ND	6.6	2.6
1,1-DICHLOROETHANE	ND	6.6	2.6
1,1-DICHLOROETHENE	ND	6.6	2.6
1,2-DICHLOROBENZENE	ND	6.6	2.6
1,2-DICHLOROETHANE	ND	6.6	2.6
1,2-DICHLOROPROPANE	ND	6.6	2.6
1,3-DICHLOROBENZENE	ND	6.6	2.6
1,4-DICHLOROBENZENE	ND	6.6	2.6
2-BUTANONE	ND	13	6.6
2-HEXANONE	ND	13	6.6
4-METHYL-2-PENTANONE	ND	13	6.6
ACETONE	ND	13	6.6
BENZENE	ND	6.6	2.6
BROMODICHLOROMETHANE	ND	6.6	2.6
BROMOFORM	ND	6.6	2.6
BROMOMETHANE	ND	13	2.6
CARBON DISULFIDE	ND	6.6	2.6
CARBON TETRACHLORIDE	ND	6.6	2.6
CHLOROBENZENE	ND	6.6	2.6
CHLOROETHANE	ND	6.6	2.6
CHLOROFORM	ND	6.6	2.6
CHLOROMETHANE	ND	13	2.6
CIS-1,2-DICHLOROETHENE	ND	6.6	2.6
CIS-1,3-DICHLOROPROPENE	ND	6.6	2.6
DIBROMOCHLOROMETHANE	ND	6.6	2.6
DICHLORODIFLUOROMETHANE	ND	13	2.6
ETHYLBENZENE	ND	6.6	2.6
M/P-XYLENES	ND	13	2.6
METHYLENE CHLORIDE	2.7J	13	2.6
MTBE	ND	6.6	2.6
O-XYLENE	ND	6.6	2.6
STYRENE	ND	6.6	2.6
TETRACHLOROETHYLENE	ND	6.6	2.6
TOLUENE	ND	6.6	2.6
TRANS-1,2-DICHLOROETHENE	ND	6.6	2.6
TRANS-1,3-DICHLOROPROPENE	ND	6.6	2.6
TRICHLOROETHENE	ND	6.6	2.6
TRICHLOROFLUOROMETHANE	ND	6.6	2.6
VINYL CHLORIDE	ND	6.6	2.6

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
1,2-DICHLOROETHANE-D4	113	70-140
TOLUENE-D8	117*	85-115
4-BROMOFLUOROBENZENE	116	85-120

RL: Reporting Limit

SW 5035/8260B
VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	08/30/08 10:04
Sample ID:	YWM09-2286	Date Analyzed:	08/30/08 10:04
Lab Samp ID:	H299-12	Dilution Factor:	1.4
Lab File ID:	RHB787	Matrix :	SOIL
Ext Btch ID:	V003H70	% Moisture :	2.6
Calib. Ref.:	RFB753	Instrument ID :	T-003

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,1,1-TRICHLOROETHANE	ND	7.2	2.9
1,1,2,2-TETRACHLOROETHANE	ND	7.2	2.9
1,1,2-TRICHLOROETHANE	ND	7.2	2.9
1,1-DICHLOROETHANE	ND	7.2	2.9
1,1-DICHLOROETHENE	ND	7.2	2.9
1,2-DICHLOROBENZENE	ND	7.2	2.9
1,2-DICHLOROETHANE	ND	7.2	2.9
1,2-DICHLOROPROPANE	ND	7.2	2.9
1,3-DICHLOROBENZENE	ND	7.2	2.9
1,4-DICHLOROBENZENE	ND	7.2	2.9
2-BUTANONE	17	14	7.2
2-HEXANONE	ND	14	7.2
4-METHYL-2-PENTANONE	ND	14	7.2
ACETONE	90	14	7.2
BENZENE	ND	7.2	2.9
BROMODICHLOROMETHANE	ND	7.2	2.9
BROMOFORM	ND	7.2	2.9
BROMOMETHANE	ND	14	2.9
CARBON DISULFIDE	ND	7.2	2.9
CARBON TETRACHLORIDE	ND	7.2	2.9
CHLOROBENZENE	ND	7.2	2.9
CHLOROETHANE	ND	7.2	2.9
CHLOROFORM	ND	7.2	2.9
CHLOROMETHANE	ND	14	2.9
CIS-1,2-DICHLOROETHENE	ND	7.2	2.9
CIS-1,3-DICHLOROPROPENE	ND	7.2	2.9
DIBROMOCHLOROMETHANE	ND	7.2	2.9
DICHLORODIFLUOROMETHANE	ND	14	2.9
ETHYLBENZENE	ND	7.2	2.9
M/P-XYLENES	ND	14	2.9
METHYLENE CHLORIDE	ND	14	2.9
MTBE	ND	7.2	2.9
O-XYLENE	ND	7.2	2.9
STYRENE	ND	7.2	2.9
TETRACHLOROETHYLENE	ND	7.2	2.9
TOLUENE	ND	7.2	2.9
TRANS-1,2-DICHLOROETHENE	ND	7.2	2.9
TRANS-1,3-DICHLOROPROPENE	ND	7.2	2.9
TRICHLOROETHENE	ND	7.2	2.9
TRICHLOROFLUOROMETHANE	ND	7.2	2.9
VINYL CHLORIDE	ND	7.2	2.9

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
1,2-DICHLOROETHANE-D4	157*	70-140
TOLUENE-D8	133*	85-115
4-BROMOFLUOROBENZENE	134*	85-120

RL: Reporting Limit

SW 5035/8260B
VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/03/08 18:37
Sample ID:	YWM09-2286RE	Date Analyzed:	09/03/08 18:37
Lab Samp ID:	H299-12R	Dilution Factor:	1.4
Lab File ID:	RIB043	Matrix :	SOIL
Ext Btch ID:	VOO3I03	% Moisture :	2.6
Calib. Ref.:	RFB753	Instrument ID :	T-003

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,1,1-TRICHLOROETHANE	ND	7.2	2.9
1,1,2,2-TETRACHLOROETHANE	ND	7.2	2.9
1,1,2-TRICHLOROETHANE	ND	7.2	2.9
1,1-DICHLOROETHANE	ND	7.2	2.9
1,1-DICHLOROETHENE	ND	7.2	2.9
1,2-DICHLOROBENZENE	ND	7.2	2.9
1,2-DICHLOROETHANE	ND	7.2	2.9
1,2-DICHLOROPROPANE	ND	7.2	2.9
1,3-DICHLOROBENZENE	ND	7.2	2.9
1,4-DICHLOROBENZENE	ND	7.2	2.9
2-BUTANONE	ND	14	7.2
2-HEXANONE	ND	14	7.2
4-METHYL-2-PENTANONE	ND	14	7.2
ACETONE	ND	14	7.2
BENZENE	ND	7.2	2.9
BROMODICHLOROMETHANE	ND	7.2	2.9
BROMOFORM	ND	7.2	2.9
BROMOMETHANE	ND	14	2.9
CARBON DISULFIDE	ND	7.2	2.9
CARBON TETRACHLORIDE	ND	7.2	2.9
CHLOROBENZENE	ND	7.2	2.9
CHLOROETHANE	ND	7.2	2.9
CHLOROFORM	ND	7.2	2.9
CHLOROMETHANE	ND	14	2.9
CIS-1,2-DICHLOROETHENE	ND	7.2	2.9
CIS-1,3-DICHLOROPROPENE	ND	7.2	2.9
DIBROMOCHLOROMETHANE	ND	7.2	2.9
DICHLORODIFLUOROMETHANE	ND	14	2.9
ETHYLBENZENE	ND	7.2	2.9
M/P-XYLENES	ND	14	2.9
METHYLENE CHLORIDE	ND	14	2.9
MTBE	ND	7.2	2.9
O-XYLENE	ND	7.2	2.9
STYRENE	ND	7.2	2.9
TETRACHLOROETHYLENE	ND	7.2	2.9
TOLUENE	ND	7.2	2.9
TRANS-1,2-DICHLOROETHENE	ND	7.2	2.9
TRANS-1,3-DICHLOROPROPENE	ND	7.2	2.9
TRICHLOROETHENE	ND	7.2	2.9
TRICHLOROFLUOROMETHANE	ND	7.2	2.9
VINYL CHLORIDE	ND	7.2	2.9

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
1,2-DICHLOROETHANE-D4	108	70-140
TOLUENE-D8	116*	85-115
4-BROMOFLUOROBENZENE	124*	85-120

RL: Reporting Limit

LABORATORY REPORT FOR

SHAW E&I

NPS WAA MATHER

METHOD 3550B/8270C
SEMI VOLATILE ORGANICS BY GC/MS

SDG#: 08H299

CASE NARRATIVE

CLIENT: SHAW E&I

PROJECT: NPS WAA MATHER

SDG: 08H299

METHOD 3550B/8270C
SEMI VOLATILE ORGANICS BY GC/MS

Eleven (11) soil samples were received on 08/28/08 for Semi Volatile Organic analysis by Method 3550B/8270C in accordance with USEPA SW846, 3rd edition and DOD QSM, v.3.

1. **Holding Time**

   Analytical holding time was met.

2. **Tuning and Calibration**

   Tuning and calibration were carried out at 12-hour interval. All QC requirements were met.

3. **Method Blank**

   Method blank was free of contamination at half of reporting limit.

4. **Surrogate Recovery**

   Recoveries were within QC limit except two surrogates were biased low in sample H299-06 due to matrix interference.

5. **Lab Control Sample**

   Recoveries were within QC limit.

6. **Matrix Spike/Matrix Spike Duplicate**

   Sample H299-04 was spiked. All recoveries were within QC limit. %RPD of one analyte was above the limit.

7. **Sample Analysis**

   Samples were analyzed according to the prescribed QC procedures. All criteria were met with the aforementioned exception.

   Sample H299-03 and -05 were required GPC clean up due to matrix problem.

LAB CHRONICLE
SEMI VOLATILE ORGANICS BY GC/MS

Client : SHAW E&I
Project : NPS WAA MATHER

SDG NO. : 08H299
Instrument ID : T-052

SOIL

Client Sample ID	Laboratory Sample ID	Dilution Factor	% Moist	Analysis DateTime	Extraction DateTime	Sample Data FN	Calibration Data FN	Prep. Batch	Notes
MBLK1S	SVI006SB	1	NA	09/08/0815:27	09/04/0814:30	RIK028	RHK031	SVI006S	Method Blank
LCS1S	SVI006SL	1	NA	09/08/0815:46	09/04/0814:30	RIK029	RHK031	SVI006S	Lab Control Sample (LCS)
YWM02A-2268	H299-01	1	4.1	09/08/0816:04	09/04/0814:30	RIK030	RHK031	SVI006S	Field Sample
YWM06-2276MS	H299-04M	1	3.4	09/08/0816:23	09/04/0814:30	RIK031	RHK031	SVI006S	Matrix Spike Sample (MS)
YWM06-2276MSD	H299-04S	1	3.4	09/08/0816:42	09/04/0814:30	RIK032	RHK031	SVI006S	MS Duplicate (MSD)
YWM06-2274	H299-03	2	0.7	09/08/0817:01	09/04/0814:30	RIK033	RHK031	SVI006S	Field Sample
YWM06-2276	H299-04	1	3.4	09/08/0817:20	09/04/0814:30	RIK034	RHK031	SVI006S	Field Sample
YWM07-2277	H299-05	2	4.5	09/08/0817:38	09/04/0814:30	RIK035	RHK031	SVI006S	Field Sample
YWM07-2279	H299-06	1	3.2	09/08/0817:57	09/04/0814:30	RIK036	RHK031	SVI006S	Field Sample
YWM08-2280	H299-07	1	1.7	09/08/0818:16	09/04/0814:30	RIK037	RHK031	SVI006S	Field Sample
YWM08-2281	H299-08	1	0.6	09/08/0818:35	09/04/0814:30	RIK038	RHK031	SVI006S	Field Sample
YWM08-2282	H299-09	1	0.5	09/08/0818:55	09/04/0814:30	RIK039	RHK031	SVI006S	Field Sample
YWM09-2284	H299-10	1	4.2	09/08/0819:13	09/04/0814:30	RIK040	RHK031	SVI006S	Field Sample
YWM09-2285	H299-11	1	1.4	09/08/0819:32	09/04/0814:30	RIK041	RHK031	SVI006S	Field Sample
YWM09-2286	H299-12	1	2.6	09/08/0819:51	09/04/0814:30	RIK042	RHK031	SVI006S	Field Sample

FN - Filename
% Moist - Percent Moisture

SAMPLE RESULTS

METHOD 3550B/8270C
SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM02A-2268	Date Analyzed:	09/08/08 16:04
Lab Samp ID:	H299-01	Dilution Factor:	1
Lab File ID:	RIK030	Matrix :	SOIL
Ext Btch ID:	SVI006S	% Moisture :	4.1
Calib. Ref.:	RHK031	Instrument ID :	T-052

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,2,4-TRICHLOROBENZENE	ND	340	170
1,2-DICHLOROBENZENE	ND	340	170
1,3-DICHLOROBENZENE	ND	340	170
1,4-DICHLOROBENZENE	ND	340	170
2,4,5-TRICHLOROPHENOL	ND	340	170
2,4,6-TRICHLOROPHENOL	ND	340	190
2,4-DICHLOROPHENOL	ND	340	170
2,4-DIMETHYLPHENOL	ND	340	170
2,4-DINITROPHENOL	ND	690	170
2,4-DINITROTOLUENE	ND	340	170
2,6-DINITROTOLUENE	ND	340	170
2-CHLORONAPHTHALENE	ND	340	170
2-CHLOROPHENOL	ND	340	170
2-METHYLNAPHTHALENE	ND	340	170
2-METHYLPHENOL	ND	340	170
2-NITROANILINE	ND	340	170
2-NITROPHENOL	ND	340	170
3,3'-DICHLOROBENZIDINE	ND	340	170
3-NITROANILINE	ND	340	170
4,6-DINITRO-2-METHYLPHENOL	ND	690	170
4-BROMOPHENYL-PHENYL ETHER	ND	340	170
4-CHLORO-3-METHYLPHENOL	ND	340	170
4-CHLOROANILINE	ND	340	170
4-CHLOROPHENYL-PHENYL ETHER	ND	340	180
4-METHYLPHENOL (1)	ND	340	170
4-NITROANILINE	ND	340	170
4-NITROPHENOL	ND	690	170
ACENAPHTHENE	ND	340	170
ACENAPHTHYLENE	ND	340	170
ANTHRACENE	ND	340	170
BENZO(A)ANTHRACENE	ND	340	170
BENZO(A)PYRENE	ND	340	170
BENZO(B)FLUORANTHENE	ND	340	170
BENZO(K)FLUORANTHENE	ND	340	170
BENZO(G,H,I)PERYLENE	ND	340	170
BIS(2-CHLOROETHOXY)METHANE	ND	340	170
BIS(2-CHLOROETHYL)ETHER	ND	340	170
BIS(2-CHLOROISOPROPYL)ETHER	ND	340	170
BIS(2-ETHYLHEXYL)PHTHALATE	ND	340	170
BUTYLBENZYLPHTHALATE	ND	340	170
CHRYSENE	ND	340	170
DI-N-BUTYLPHTHALATE	ND	340	170
DI-N-OCTYLPHTHALATE	ND	340	170
DIBENZO(A,H)ANTHRACENE	ND	340	170
DIBENZOFURAN	ND	340	170
DIETHYLPHTHALATE	ND	340	170
DIMETHYLPHTHALATE	ND	340	170
FLUORANTHENE	ND	340	170
FLUORENE	ND	340	170
HEXACHLOROBENZENE	ND	340	170
HEXACHLOROBUTADIENE	ND	340	200
HEXACHLOROCYCLOPENTADIENE	ND	340	170
HEXACHLOROETHANE	ND	340	170
INDENO(1,2,3-CD)PYRENE	ND	340	170
ISOPHORONE	ND	340	170
N-NITROSO-DI-N-PROPYLAMINE	ND	340	170
N-NITROSODIPHENYLAMINE (2)	ND	340	170
NAPHTHALENE	ND	340	170
NITROBENZENE	ND	340	170
PENTACHLOROPHENOL	190J	690	180
PHENANTHRENE	ND	340	170
PHENOL	ND	340	170
PYRENE	ND	340	170

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
2,4,6-TRIBROMOPHENOL	81	35-125
2-FLUOROBIPHENYL	63	45-105
2-FLUOROPHENOL	56	35-105
NITROBENZENE-D5	57	35-100
PHENOL-D5	53	40-100
TERPHENYL-D14	85	30-125

(1): Cannot be separated from 3-Methylphenol
(2): Cannot be separated from Diphenylamine

METHOD 3550B/8270C
SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM06-2274	Date Analyzed:	09/08/08 17:01
Lab Samp ID:	H299-03	Dilution Factor:	2
Lab File ID:	RIK033	Matrix :	SOIL
Ext Btch ID:	SVI006S	% Moisture :	0.7
Calib. Ref.:	RHK031	Instrument ID :	T-052

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,2,4-TRICHLOROBENZENE	ND	660	340
1,2-DICHLOROBENZENE	ND	660	340
1,3-DICHLOROBENZENE	ND	660	340
1,4-DICHLOROBENZENE	ND	660	340
2,4,5-TRICHLOROPHENOL	ND	660	340
2,4,6-TRICHLOROPHENOL	ND	660	370
2,4-DICHLOROPHENOL	ND	660	340
2,4-DIMETHYLPHENOL	ND	660	340
2,4-DINITROPHENOL	ND	1300	340
2,4-DINITROTOLUENE	ND	660	340
2,6-DINITROTOLUENE	ND	660	340
2-CHLORONAPHTHALENE	ND	660	340
2-CHLOROPHENOL	ND	660	340
2-METHYLNAPHTHALENE	ND	660	340
2-METHYLPHENOL	ND	660	340
2-NITROANILINE	ND	660	340
2-NITROPHENOL	ND	660	340
3,3'-DICHLOROBENZIDINE	ND	660	340
3-NITROANILINE	ND	660	340
4,6-DINITRO-2-METHYLPHENOL	ND	1300	340
4-BROMOPHENYL-PHENYL ETHER	ND	660	340
4-CHLORO-3-METHYLPHENOL	ND	660	340
4-CHLOROANILINE	ND	660	340
4-CHLOROPHENYL-PHENYL ETHER	ND	660	340
4-METHYLPHENOL (1)	ND	660	340
4-NITROANILINE	ND	660	340
4-NITROPHENOL	ND	1300	340
ACENAPHTHENE	ND	660	340
ACENAPHTHYLENE	ND	660	340
ANTHRACENE	ND	660	340
BENZO(A)ANTHRACENE	ND	660	340
BENZO(A)PYRENE	ND	660	340
BENZO(B)FLUORANTHENE	ND	660	340
BENZO(K)FLUORANTHENE	ND	660	340
BENZO(G,H,I)PERYLENE	ND	660	340
BIS(2-CHLOROETHOXY)METHANE	ND	660	340
BIS(2-CHLOROETHYL)ETHER	ND	660	340
BIS(2-CHLOROISOPROPYL)ETHER	ND	660	340
BIS(2-ETHYLHEXYL)PHTHALATE	ND	660	340
BUTYLBENZYLPHTHALATE	ND	660	340
CHRYSENE	ND	660	340
DI-N-BUTYLPHTHALATE	ND	660	340
DI-N-OCTYLPHTHALATE	ND	660	340
DIBENZO(A,H)ANTHRACENE	ND	660	340
DIBENZOFURAN	ND	660	340
DIETHYLPHTHALATE	ND	660	340
DIMETHYLPHTHALATE	ND	660	340
FLUORANTHENE	ND	660	340
FLUORENE	ND	660	340
HEXACHLOROBENZENE	ND	660	340
HEXACHLOROBUTADIENE	ND	660	380
HEXACHLOROCYCLOPENTADIENE	ND	660	340
HEXACHLOROETHANE	ND	660	340
INDENO(1,2,3-CD)PYRENE	ND	660	340
ISOPHORONE	ND	660	340
N-NITROSO-DI-N-PROPYLAMINE	ND	660	340
N-NITROSODIPHENYLAMINE (2)	ND	660	340
NAPHTHALENE	ND	660	340
NITROBENZENE	ND	660	340
PENTACHLOROPHENOL	ND	1300	350
PHENANTHRENE	ND	660	340
PHENOL	ND	660	340
PYRENE	ND	660	340

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
2,4,6-TRIBROMOPHENOL	79	35-125
2-FLUOROBIPHENYL	70	45-105
2-FLUOROPHENOL	50	35-105
NITROBENZENE-D5	52	35-100
PHENOL-D5	54	40-100
TERPHENYL-D14	86	30-125

(1): Cannot be separated from 3-Methylphenol
(2): Cannot be separated from Diphenylamine

METHOD 3550B/8270C
SEMI VOLATILE ORGANICS BY GC/MS

Client : SHAW E&I
Project : NPS WAA MATHER
Batch No. : 08H299
Sample ID: YWM06-2276
Lab Samp ID: H299-04
Lab File ID: RIK034
Ext Btch ID: SVI006S
Calib. Ref.: RHK031

Date Collected: 08/26/08
Date Received: 08/28/08
Date Extracted: 09/04/08 14:30
Date Analyzed: 09/08/08 17:20
Dilution Factor: 1
Matrix : SOIL
% Moisture : 3.4
Instrument ID : T-052

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,2,4-TRICHLOROBENZENE	ND	340	170
1,2-DICHLOROBENZENE	ND	340	170
1,3-DICHLOROBENZENE	ND	340	170
1,4-DICHLOROBENZENE	ND	340	170
2,4,5-TRICHLOROPHENOL	ND	340	170
2,4,6-TRICHLOROPHENOL	ND	340	190
2,4-DICHLOROPHENOL	ND	340	170
2,4-DIMETHYLPHENOL	ND	340	170
2,4-DINITROPHENOL	ND	680	170
2,4-DINITROTOLUENE	ND	340	170
2,6-DINITROTOLUENE	ND	340	170
2-CHLORONAPHTHALENE	ND	340	170
2-CHLOROPHENOL	ND	340	170
2-METHYLNAPHTHALENE	ND	340	170
2-METHYLPHENOL	ND	340	170
2-NITROANILINE	ND	340	170
2-NITROPHENOL	ND	340	170
3,3'-DICHLOROBENZIDINE	ND	340	170
3-NITROANILINE	ND	340	170
4,6-DINITRO-2-METHYLPHENOL	ND	680	170
4-BROMOPHENYL-PHENYL ETHER	ND	340	170
4-CHLORO-3-METHYLPHENOL	ND	340	170
4-CHLOROANILINE	ND	340	170
4-CHLOROPHENYL-PHENYL ETHER	ND	340	180
4-METHYLPHENOL (1)	ND	340	170
4-NITROANILINE	ND	340	170
4-NITROPHENOL	ND	680	170
ACENAPHTHENE	ND	340	170
ACENAPHTHYLENE	ND	340	170
ANTHRACENE	ND	340	170
BENZO(A)ANTHRACENE	ND	340	170
BENZO(A)PYRENE	ND	340	170
BENZO(B)FLUORANTHENE	ND	340	170
BENZO(K)FLUORANTHENE	ND	340	170
BENZO(G,H,I)PERYLENE	ND	340	170
BIS(2-CHLOROETHOXY)METHANE	ND	340	170
BIS(2-CHLOROETHYL)ETHER	ND	340	170
BIS(2-CHLOROISOPROPYL)ETHER	ND	340	170
BIS(2-ETHYLHEXYL)PHTHALATE	ND	340	170
BUTYLBENZYLPHTHALATE	ND	340	170
CHRYSENE	ND	340	170
DI-N-BUTYLPHTHALATE	ND	340	170
DI-N-OCTYLPHTHALATE	ND	340	170
DIBENZO(A,H)ANTHRACENE	ND	340	170
DIBENZOFURAN	ND	340	170
DIETHYLPHTHALATE	ND	340	170
DIMETHYLPHTHALATE	ND	340	170
FLUORANTHENE	ND	340	170
FLUORENE	ND	340	170
HEXACHLOROBENZENE	ND	340	170
HEXACHLOROBUTADIENE	ND	340	200
HEXACHLOROCYCLOPENTADIENE	ND	340	170
HEXACHLOROETHANE	ND	340	170
INDENO(1,2,3-CD)PYRENE	ND	340	170
ISOPHORONE	ND	340	170
N-NITROSO-DI-N-PROPYLAMINE	ND	340	170
N-NITROSODIPHENYLAMINE (2)	ND	340	170
NAPHTHALENE	ND	340	170
NITROBENZENE	ND	340	170
PENTACHLOROPHENOL	ND	680	180
PHENANTHRENE	ND	340	170
PHENOL	ND	340	170
PYRENE	ND	340	170

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
2,4,6-TRIBROMOPHENOL	80	35-125
2-FLUOROBIPHENYL	69	45-105
2-FLUOROPHENOL	55	35-105
NITROBENZENE-D5	61	35-100
PHENOL-D5	55	40-100
TERPHENYL-D14	85	30-125

(1): Cannot be separated from 3-Methylphenol
(2): Cannot be separated from Diphenylamine

METHOD 3550B/8270C
SEMI VOLATILE ORGANICS BY GC/MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/04/08 14:30
Sample ID: YWM07-2277	Date Analyzed: 09/08/08 17:38
Lab Samp ID: H299-05	Dilution Factor: 2
Lab File ID: RIK035	Matrix : SOIL
Ext Btch ID: SVI006S	% Moisture : 4.5
Calib. Ref.: RHK031	Instrument ID : T-052

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,2,4-TRICHLOROBENZENE	ND	690	350
1,2-DICHLOROBENZENE	ND	690	350
1,3-DICHLOROBENZENE	ND	690	350
1,4-DICHLOROBENZENE	ND	690	350
2,4,5-TRICHLOROPHENOL	ND	690	350
2,4,6-TRICHLOROPHENOL	ND	690	390
2,4-DICHLOROPHENOL	ND	690	350
2,4-DIMETHYLPHENOL	ND	690	350
2,4-DINITROPHENOL	ND	1400	350
2,4-DINITROTOLUENE	ND	690	350
2,6-DINITROTOLUENE	ND	690	350
2-CHLORONAPHTHALENE	ND	690	350
2-CHLOROPHENOL	ND	690	350
2-METHYLNAPHTHALENE	ND	690	350
2-METHYLPHENOL	ND	690	350
2-NITROANILINE	ND	690	350
2-NITROPHENOL	ND	690	350
3,3'-DICHLOROBENZIDINE	ND	690	350
3-NITROANILINE	ND	690	350
4,6-DINITRO-2-METHYLPHENOL	ND	1400	350
4-BROMOPHENYL-PHENYL ETHER	ND	690	350
4-CHLORO-3-METHYLPHENOL	ND	690	350
4-CHLOROANILINE	ND	690	350
4-CHLOROPHENYL-PHENYL ETHER	ND	690	360
4-METHYLPHENOL (1)	ND	690	350
4-NITROANILINE	ND	690	350
4-NITROPHENOL	ND	1400	350
ACENAPHTHENE	ND	690	350
ACENAPHTHYLENE	ND	690	350
ANTHRACENE	ND	690	350
BENZO(A)ANTHRACENE	ND	690	350
BENZO(A)PYRENE	ND	690	350
BENZO(B)FLUORANTHENE	ND	690	350
BENZO(K)FLUORANTHENE	ND	690	350
BENZO(G,H,I)PERYLENE	ND	690	350
BIS(2-CHLOROETHOXY)METHANE	ND	690	350
BIS(2-CHLOROETHYL)ETHER	ND	690	350
BIS(2-CHLOROISOPROPYL)ETHER	ND	690	350
BIS(2-ETHYLHEXYL)PHTHALATE	ND	690	350
BUTYLBENZYLPHTHALATE	ND	690	350
CHRYSENE	ND	690	350
DI-N-BUTYLPHTHALATE	ND	690	350
DI-N-OCTYLPHTHALATE	ND	690	350
DIBENZO(A,H)ANTHRACENE	ND	690	350
DIBENZOFURAN	ND	690	350
DIETHYLPHTHALATE	ND	690	350
DIMETHYLPHTHALATE	ND	690	350
FLUORANTHENE	ND	690	350
FLUORENE	ND	690	350
HEXACHLOROBENZENE	ND	690	350
HEXACHLOROBUTADIENE	ND	690	400
HEXACHLOROCYCLOPENTADIENE	ND	690	350
HEXACHLOROETHANE	ND	690	350
INDENO(1,2,3-CD)PYRENE	ND	690	350
ISOPHORONE	ND	690	350
N-NITROSO-DI-N-PROPYLAMINE	ND	690	350
N-NITROSODIPHENYLAMINE (2)	ND	690	350
NAPHTHALENE	ND	690	350
NITROBENZENE	ND	690	350
PENTACHLOROPHENOL	ND	1400	370
PHENANTHRENE	ND	690	350
PHENOL	ND	690	350
PYRENE	ND	690	350

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
2,4,6-TRIBROMOPHENOL	74	35-125
2-FLUOROBIPHENYL	67	45-105
2-FLUOROPHENOL	40	35-105
NITROBENZENE-D5	53	35-100
PHENOL-D5	48	40-100
TERPHENYL-D14	85	30-125

(1): Cannot be separated from 3-Methylphenol
(2): Cannot be separated from Diphenylamine

METHOD 3550B/8270C
SEMI VOLATILE ORGANICS BY GC/MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/04/08 14:30
Sample ID: YWM07-2279	Date Analyzed: 09/08/08 17:57
Lab Samp ID: H299-06	Dilution Factor: 1
Lab File ID: RIK036	Matrix : SOIL
Ext Btch ID: SVI006S	% Moisture : 3.2
Calib. Ref.: RHK031	Instrument ID : T-052

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,2,4-TRICHLOROBENZENE	ND	340	170
1,2-DICHLOROBENZENE	ND	340	170
1,3-DICHLOROBENZENE	ND	340	170
1,4-DICHLOROBENZENE	ND	340	170
2,4,5-TRICHLOROPHENOL	ND	340	170
2,4,6-TRICHLOROPHENOL	ND	340	190
2,4-DICHLOROPHENOL	ND	340	170
2,4-DIMETHYLPHENOL	ND	340	170
2,4-DINITROPHENOL	ND	680	170
2,4-DINITROTOLUENE	ND	340	170
2,6-DINITROTOLUENE	ND	340	170
2-CHLORONAPHTHALENE	ND	340	170
2-CHLOROPHENOL	ND	340	170
2-METHYLNAPHTHALENE	ND	340	170
2-METHYLPHENOL	ND	340	170
2-NITROANILINE	ND	340	170
2-NITROPHENOL	ND	340	170
3,3'-DICHLOROBENZIDINE	ND	340	170
3-NITROANILINE	ND	340	170
4,6-DINITRO-2-METHYLPHENOL	ND	680	170
4-BROMOPHENYL-PHENYL ETHER	ND	340	170
4-CHLORO-3-METHYLPHENOL	ND	340	170
4-CHLOROANILINE	ND	340	170
4-CHLOROPHENYL-PHENYL ETHER	ND	340	180
4-METHYLPHENOL (1)	ND	340	170
4-NITROANILINE	ND	340	170
4-NITROPHENOL	ND	680	170
ACENAPHTHENE	ND	340	170
ACENAPHTHYLENE	ND	340	170
ANTHRACENE	ND	340	170
BENZO(A)ANTHRACENE	ND	340	170
BENZO(A)PYRENE	ND	340	170
BENZO(B)FLUORANTHENE	ND	340	170
BENZO(K)FLUORANTHENE	ND	340	170
BENZO(G,H,I)PERYLENE	ND	340	170
BIS(2-CHLOROETHOXY)METHANE	ND	340	170
BIS(2-CHLOROETHYL)ETHER	ND	340	170
BIS(2-CHLOROISOPROPYL)ETHER	ND	340	170
BIS(2-ETHYLHEXYL)PHTHALATE	ND	340	170
BUTYLBENZYLPHTHALATE	ND	340	170
CHRYSENE	ND	340	170
DI-N-BUTYLPHTHALATE	ND	340	170
DI-N-OCTYLPHTHALATE	ND	340	170
DIBENZO(A,H)ANTHRACENE	ND	340	170
DIBENZOFURAN	ND	340	170
DIETHYLPHTHALATE	ND	340	170
DIMETHYLPHTHALATE	ND	340	170
FLUORANTHENE	ND	340	170
FLUORENE	ND	340	170
HEXACHLOROBENZENE	ND	340	170
HEXACHLOROBUTADIENE	ND	340	200
HEXACHLOROCYCLOPENTADIENE	ND	340	170
HEXACHLOROETHANE	ND	340	170
INDENO(1,2,3-CD)PYRENE	ND	340	170
ISOPHORONE	ND	340	170
N-NITROSO-DI-N-PROPYLAMINE	ND	340	170
N-NITROSODIPHENYLAMINE (2)	ND	340	170
NAPHTHALENE	ND	340	170
NITROBENZENE	ND	340	170
PENTACHLOROPHENOL	ND	680	180
PHENANTHRENE	ND	340	170
PHENOL	ND	340	170
PYRENE	ND	340	170

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
2,4,6-TRIBROMOPHENOL	54	35-125
2-FLUOROBIPHENYL	39*	45-105
2-FLUOROPHENOL	35	35-105
NITROBENZENE-D5	41	35-100
PHENOL-D5	38*	40-100
TERPHENYL-D14	82	30-125

(1): Cannot be separated from 3-Methylphenol
(2): Cannot be separated from Diphenylamine

METHOD 3550B/8270C
SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM08-2280	Date Analyzed:	09/08/08 18:16
Lab Samp ID:	H299-07	Dilution Factor:	1
Lab File ID:	RIK037	Matrix	: SOIL
Ext Btch ID:	SVI006S	% Moisture	: 1.7
Calib. Ref.:	RHK031	Instrument ID	: T-052

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,2,4-TRICHLOROBENZENE	ND	340	170
1,2-DICHLOROBENZENE	ND	340	170
1,3-DICHLOROBENZENE	ND	340	170
1,4-DICHLOROBENZENE	ND	340	170
2,4,5-TRICHLOROPHENOL	ND	340	170
2,4,6-TRICHLOROPHENOL	ND	340	190
2,4-DICHLOROPHENOL	ND	340	170
2,4-DIMETHYLPHENOL	ND	340	170
2,4-DINITROPHENOL	ND	670	170
2,4-DINITROTOLUENE	ND	340	170
2,6-DINITROTOLUENE	ND	340	170
2-CHLORONAPHTHALENE	ND	340	170
2-CHLOROPHENOL	ND	340	170
2-METHYLNAPHTHALENE	ND	340	170
2-METHYLPHENOL	ND	340	170
2-NITROANILINE	ND	340	170
2-NITROPHENOL	ND	340	170
3,3'-DICHLOROBENZIDINE	ND	340	170
3-NITROANILINE	ND	340	170
4,6-DINITRO-2-METHYLPHENOL	ND	670	170
4-BROMOPHENYL-PHENYL ETHER	ND	340	170
4-CHLORO-3-METHYLPHENOL	ND	340	170
4-CHLOROANILINE	ND	340	170
4-CHLOROPHENYL-PHENYL ETHER	ND	340	170
4-METHYLPHENOL (1)	ND	340	170
4-NITROANILINE	ND	340	170
4-NITROPHENOL	ND	670	170
ACENAPHTHENE	ND	340	170
ACENAPHTHYLENE	ND	340	170
ANTHRACENE	ND	340	170
BENZO(A)ANTHRACENE	ND	340	170
BENZO(A)PYRENE	ND	340	170
BENZO(B)FLUORANTHENE	ND	340	170
BENZO(K)FLUORANTHENE	ND	340	170
BENZO(G,H,I)PERYLENE	ND	340	170
BIS(2-CHLOROETHOXY)METHANE	ND	340	170
BIS(2-CHLOROETHYL)ETHER	ND	340	170
BIS(2-CHLOROISOPROPYL)ETHER	ND	340	170
BIS(2-ETHYLHEXYL)PHTHALATE	240J	340	170
BUTYLBENZYLPHTHALATE	ND	340	170
CHRYSENE	ND	340	170
DI-N-BUTYLPHTHALATE	ND	340	170
DI-N-OCTYLPHTHALATE	ND	340	170
DIBENZO(A,H)ANTHRACENE	ND	340	170
DIBENZOFURAN	ND	340	170
DIETHYLPHTHALATE	ND	340	170
DIMETHYLPHTHALATE	ND	340	170
FLUORANTHENE	ND	340	170
FLUORENE	ND	340	170
HEXACHLOROBENZENE	ND	340	170
HEXACHLOROBUTADIENE	ND	340	190
HEXACHLOROCYCLOPENTADIENE	ND	340	170
HEXACHLOROETHANE	ND	340	170
INDENO(1,2,3-CD)PYRENE	ND	340	170
ISOPHORONE	ND	340	170
N-NITROSO-DI-N-PROPYLAMINE	ND	340	170
N-NITROSODIPHENYLAMINE (2)	ND	340	170
NAPHTHALENE	ND	340	170
NITROBENZENE	ND	340	170
PENTACHLOROPHENOL	ND	670	180
PHENANTHRENE	ND	340	170
PHENOL	ND	340	170
PYRENE	ND	340	170

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
2,4,6-TRIBROMOPHENOL	72	35-125
2-FLUOROBIPHENYL	69	45-105
2-FLUOROPHENOL	54	35-105
NITROBENZENE-D5	61	35-100
PHENOL-D5	60	40-100
TERPHENYL-D14	86	30-125

(1): Cannot be separated from 3-Methylphenol
(2): Cannot be separated from Diphenylamine

METHOD 3550B/8270C
SEMI VOLATILE ORGANICS BY GC/MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/04/08 14:30
Sample ID: YWM08-2281	Date Analyzed: 09/08/08 18:35
Lab Samp ID: H299-08	Dilution Factor: 1
Lab File ID: RIK038	Matrix : SOIL
Ext Btch ID: SVI006S	% Moisture : 0.6
Calib. Ref.: RHK031	Instrument ID : T-052

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,2,4-TRICHLOROBENZENE	ND	330	170
1,2-DICHLOROBENZENE	ND	330	170
1,3-DICHLOROBENZENE	ND	330	170
1,4-DICHLOROBENZENE	ND	330	170
2,4,5-TRICHLOROPHENOL	ND	330	170
2,4,6-TRICHLOROPHENOL	ND	330	190
2,4-DICHLOROPHENOL	ND	330	170
2,4-DIMETHYLPHENOL	ND	330	170
2,4-DINITROPHENOL	ND	660	170
2,4-DINITROTOLUENE	ND	330	170
2,6-DINITROTOLUENE	ND	330	170
2-CHLORONAPHTHALENE	ND	330	170
2-CHLOROPHENOL	ND	330	170
2-METHYLNAPHTHALENE	ND	330	170
2-METHYLPHENOL	ND	330	170
2-NITROANILINE	ND	330	170
2-NITROPHENOL	ND	330	170
3,3'-DICHLOROBENZIDINE	ND	330	170
3-NITROANILINE	ND	330	170
4,6-DINITRO-2-METHYLPHENOL	ND	660	170
4-BROMOPHENYL-PHENYL ETHER	ND	330	170
4-CHLORO-3-METHYLPHENOL	ND	330	170
4-CHLOROANILINE	ND	330	170
4-CHLOROPHENYL-PHENYL ETHER	ND	330	170
4-METHYLPHENOL (1)	ND	330	170
4-NITROANILINE	ND	330	170
4-NITROPHENOL	ND	660	170
ACENAPHTHENE	ND	330	170
ACENAPHTHYLENE	ND	330	170
ANTHRACENE	ND	330	170
BENZO(A)ANTHRACENE	ND	330	170
BENZO(A)PYRENE	ND	330	170
BENZO(B)FLUORANTHENE	ND	330	170
BENZO(K)FLUORANTHENE	ND	330	170
BENZO(G,H,I)PERYLENE	ND	330	170
BIS(2-CHLOROETHOXY)METHANE	ND	330	170
BIS(2-CHLOROETHYL)ETHER	ND	330	170
BIS(2-CHLOROISOPROPYL)ETHER	ND	330	170
BIS(2-ETHYLHEXYL)PHTHALATE	ND	330	170
BUTYLBENZYLPHTHALATE	ND	330	170
CHRYSENE	ND	330	170
DI-N-BUTYLPHTHALATE	ND	330	170
DI-N-OCTYLPHTHALATE	ND	330	170
DIBENZO(A,H)ANTHRACENE	ND	330	170
DIBENZOFURAN	ND	330	170
DIETHYLPHTHALATE	ND	330	170
DIMETHYLPHTHALATE	ND	330	170
FLUORANTHENE	ND	330	170
FLUORENE	ND	330	170
HEXACHLOROBENZENE	ND	330	170
HEXACHLOROBUTADIENE	ND	330	190
HEXACHLOROCYCLOPENTADIENE	ND	330	170
HEXACHLOROETHANE	ND	330	170
INDENO(1,2,3-CD)PYRENE	ND	330	170
ISOPHORONE	ND	330	170
N-NITROSO-DI-N-PROPYLAMINE	ND	330	170
N-NITROSODIPHENYLAMINE (2)	ND	330	170
NAPHTHALENE	ND	330	170
NITROBENZENE	ND	330	170
PENTACHLOROPHENOL	ND	660	180
PHENANTHRENE	ND	330	170
PHENOL	ND	330	170
PYRENE	ND	330	170

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
2,4,6-TRIBROMOPHENOL	70	35-125
2-FLUOROBIPHENYL	63	45-105
2-FLUOROPHENOL	56	35-105
NITROBENZENE-D5	60	35-100
PHENOL-D5	59	40-100
TERPHENYL-D14	83	30-125

(1): Cannot be separated from 3-Methylphenol
(2): Cannot be separated from Diphenylamine

METHOD 3550B/8270C
SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM08-2282	Date Analyzed:	09/08/08 18:55
Lab Samp ID:	H299-09	Dilution Factor:	1
Lab File ID:	RIK039	Matrix :	SOIL
Ext Btch ID:	SVI006S	% Moisture :	0.5
Calib. Ref.:	RHK031	Instrument ID :	T-052

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,2,4-TRICHLOROBENZENE	ND	330	170
1,2-DICHLOROBENZENE	ND	330	170
1,3-DICHLOROBENZENE	ND	330	170
1,4-DICHLOROBENZENE	ND	330	170
2,4,5-TRICHLOROPHENOL	ND	330	170
2,4,6-TRICHLOROPHENOL	ND	330	180
2,4-DICHLOROPHENOL	ND	330	170
2,4-DIMETHYLPHENOL	ND	330	170
2,4-DINITROPHENOL	ND	660	170
2,4-DINITROTOLUENE	ND	330	170
2,6-DINITROTOLUENE	ND	330	170
2-CHLORONAPHTHALENE	ND	330	170
2-CHLOROPHENOL	ND	330	170
2-METHYLNAPHTHALENE	ND	330	170
2-METHYLPHENOL	ND	330	170
2-NITROANILINE	ND	330	170
2-NITROPHENOL	ND	330	170
3,3'-DICHLOROBENZIDINE	ND	330	170
3-NITROANILINE	ND	330	170
4,6-DINITRO-2-METHYLPHENOL	ND	660	170
4-BROMOPHENYL-PHENYL ETHER	ND	330	170
4-CHLORO-3-METHYLPHENOL	ND	330	170
4-CHLOROANILINE	ND	330	170
4-CHLOROPHENYL-PHENYL ETHER	ND	330	170
4-METHYLPHENOL (1)	ND	330	170
4-NITROANILINE	ND	330	170
4-NITROPHENOL	ND	660	170
ACENAPHTHENE	ND	330	170
ACENAPHTHYLENE	ND	330	170
ANTHRACENE	ND	330	170
BENZO(A)ANTHRACENE	ND	330	170
BENZO(A)PYRENE	ND	330	170
BENZO(B)FLUORANTHENE	ND	330	170
BENZO(K)FLUORANTHENE	ND	330	170
BENZO(G,H,I)PERYLENE	ND	330	170
BIS(2-CHLOROETHOXY)METHANE	ND	330	170
BIS(2-CHLOROETHYL)ETHER	ND	330	170
BIS(2-CHLOROISOPROPYL)ETHER	ND	330	170
BIS(2-ETHYLHEXYL)PHTHALATE	ND	330	170
BUTYLBENZYLPHTHALATE	ND	330	170
CHRYSENE	ND	330	170
DI-N-BUTYLPHTHALATE	ND	330	170
DI-N-OCTYLPHTHALATE	ND	330	170
DIBENZO(A,H)ANTHRACENE	ND	330	170
DIBENZOFURAN	ND	330	170
DIETHYLPHTHALATE	ND	330	170
DIMETHYLPHTHALATE	ND	330	170
FLUORANTHENE	ND	330	170
FLUORENE	ND	330	170
HEXACHLOROBENZENE	ND	330	170
HEXACHLOROBUTADIENE	ND	330	190
HEXACHLOROCYCLOPENTADIENE	ND	330	170
HEXACHLOROETHANE	ND	330	170
INDENO(1,2,3-CD)PYRENE	ND	330	170
ISOPHORONE	ND	330	170
N-NITROSO-DI-N-PROPYLAMINE	ND	330	170
N-NITROSODIPHENYLAMINE (2)	ND	330	170
NAPHTHALENE	ND	330	170
NITROBENZENE	ND	330	170
PENTACHLOROPHENOL	ND	660	180
PHENANTHRENE	ND	330	170
PHENOL	ND	330	170
PYRENE	ND	330	170

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
2,4,6-TRIBROMOPHENOL	75	35-125
2-FLUOROBIPHENYL	64	45-105
2-FLUOROPHENOL	59	35-105
NITROBENZENE-D5	61	35-100
PHENOL-D5	66	40-100
TERPHENYL-D14	76	30-125

(1): Cannot be separated from 3-Methylphenol
(2): Cannot be separated from Diphenylamine

METHOD 3550B/8270C
SEMI VOLATILE ORGANICS BY GC/MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/04/08 14:30
Sample ID: YWM09-2284	Date Analyzed: 09/08/08 19:13
Lab Samp ID: H299-10	Dilution Factor: 1
Lab File ID: RIK040	Matrix : SOIL
Ext Btch ID: SVI006S	% Moisture : 4.2
Calib. Ref.: RHK031	Instrument ID : T-052

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,2,4-TRICHLOROBENZENE	ND	340	170
1,2-DICHLOROBENZENE	ND	340	170
1,3-DICHLOROBENZENE	ND	340	170
1,4-DICHLOROBENZENE	ND	340	170
2,4,5-TRICHLOROPHENOL	ND	340	170
2,4,6-TRICHLOROPHENOL	ND	340	190
2,4-DICHLOROPHENOL	ND	340	170
2,4-DIMETHYLPHENOL	ND	340	170
2,4-DINITROPHENOL	ND	690	170
2,4-DINITROTOLUENE	ND	340	170
2,6-DINITROTOLUENE	ND	340	170
2-CHLORONAPHTHALENE	ND	340	170
2-CHLOROPHENOL	ND	340	170
2-METHYLNAPHTHALENE	ND	340	170
2-METHYLPHENOL	ND	340	170
2-NITROANILINE	ND	340	170
2-NITROPHENOL	ND	340	170
3,3'-DICHLOROBENZIDINE	ND	340	170
3-NITROANILINE	ND	340	170
4,6-DINITRO-2-METHYLPHENOL	ND	690	170
4-BROMOPHENYL-PHENYL ETHER	ND	340	170
4-CHLORO-3-METHYLPHENOL	ND	340	170
4-CHLOROANILINE	ND	340	170
4-CHLOROPHENYL-PHENYL ETHER	ND	340	180
4-METHYLPHENOL (1)	ND	340	170
4-NITROANILINE	ND	340	170
4-NITROPHENOL	ND	690	170
ACENAPHTHENE	ND	340	170
ACENAPHTHYLENE	ND	340	170
ANTHRACENE	ND	340	170
BENZO(A)ANTHRACENE	ND	340	170
BENZO(A)PYRENE	ND	340	170
BENZO(B)FLUORANTHENE	ND	340	170
BENZO(K)FLUORANTHENE	ND	340	170
BENZO(G,H,I)PERYLENE	ND	340	170
BIS(2-CHLOROETHOXY)METHANE	ND	340	170
BIS(2-CHLOROETHYL)ETHER	ND	340	170
BIS(2-CHLOROISOPROPYL)ETHER	ND	340	170
BIS(2-ETHYLHEXYL)PHTHALATE	720	340	170
BUTYLBENZYLPHTHALATE	ND	340	170
CHRYSENE	ND	340	170
DI-N-BUTYLPHTHALATE	ND	340	170
DI-N-OCTYLPHTHALATE	ND	340	170
DIBENZO(A,H)ANTHRACENE	ND	340	170
DIBENZOFURAN	ND	340	170
DIETHYLPHTHALATE	ND	340	170
DIMETHYLPHTHALATE	ND	340	170
FLUORANTHENE	ND	340	170
FLUORENE	ND	340	170
HEXACHLOROBENZENE	ND	340	170
HEXACHLOROBUTADIENE	ND	340	200
HEXACHLOROCYCLOPENTADIENE	ND	340	170
HEXACHLOROETHANE	ND	340	170
INDENO(1,2,3-CD)PYRENE	ND	340	170
ISOPHORONE	ND	340	170
N-NITROSO-DI-N-PROPYLAMINE	ND	340	170
N-NITROSODIPHENYLAMINE (2)	ND	340	170
NAPHTHALENE	ND	340	170
NITROBENZENE	ND	340	170
PENTACHLOROPHENOL	ND	690	180
PHENANTHRENE	ND	340	170
PHENOL	ND	340	170
PYRENE	ND	340	170

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
2,4,6-TRIBROMOPHENOL	69	35-125
2-FLUOROBIPHENYL	47	45-105
2-FLUOROPHENOL	46	35-105
NITROBENZENE-D5	47	35-100
PHENOL-D5	51	40-100
TERPHENYL-D14	73	30-125

(1): Cannot be separated from 3-Methylphenol
(2): Cannot be separated from Diphenylamine

METHOD 3550B/8270C
SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM09-2285	Date Analyzed:	09/08/08 19:32
Lab Samp ID:	H299-11	Dilution Factor:	1
Lab File ID:	RIK041	Matrix :	SOIL
Ext Btch ID:	SVI006S	% Moisture :	1.4
Calib. Ref.:	RHK031	Instrument ID :	T-052

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,2,4-TRICHLOROBENZENE	ND	330	170
1,2-DICHLOROBENZENE	ND	330	170
1,3-DICHLOROBENZENE	ND	330	170
1,4-DICHLOROBENZENE	ND	330	170
2,4,5-TRICHLOROPHENOL	ND	330	170
2,4,6-TRICHLOROPHENOL	ND	330	190
2,4-DICHLOROPHENOL	ND	330	170
2,4-DIMETHYLPHENOL	ND	330	170
2,4-DINITROPHENOL	ND	670	170
2,4-DINITROTOLUENE	ND	330	170
2,6-DINITROTOLUENE	ND	330	170
2-CHLORONAPHTHALENE	ND	330	170
2-CHLOROPHENOL	ND	330	170
2-METHYLNAPHTHALENE	ND	330	170
2-METHYLPHENOL	ND	330	170
2-NITROANILINE	ND	330	170
2-NITROPHENOL	ND	330	170
3,3'-DICHLOROBENZIDINE	ND	330	170
3-NITROANILINE	ND	330	170
4,6-DINITRO-2-METHYLPHENOL	ND	670	170
4-BROMOPHENYL-PHENYL ETHER	ND	330	170
4-CHLORO-3-METHYLPHENOL	ND	330	170
4-CHLOROANILINE	ND	330	170
4-CHLOROPHENYL-PHENYL ETHER	ND	330	170
4-METHYLPHENOL (1)	ND	330	170
4-NITROANILINE	ND	330	170
4-NITROPHENOL	ND	670	170
ACENAPHTHENE	ND	330	170
ACENAPHTHYLENE	ND	330	170
ANTHRACENE	ND	330	170
BENZO(A)ANTHRACENE	ND	330	170
BENZO(A)PYRENE	ND	330	170
BENZO(B)FLUORANTHENE	ND	330	170
BENZO(K)FLUORANTHENE	ND	330	170
BENZO(G,H,I)PERYLENE	ND	330	170
BIS(2-CHLOROETHOXY)METHANE	ND	330	170
BIS(2-CHLOROETHYL)ETHER	ND	330	170
BIS(2-CHLOROISOPROPYL)ETHER	ND	330	170
BIS(2-ETHYLHEXYL)PHTHALATE	290J	330	170
BUTYLBENZYLPHTHALATE	ND	330	170
CHRYSENE	ND	330	170
DI-N-BUTYLPHTHALATE	ND	330	170
DI-N-OCTYLPHTHALATE	ND	330	170
DIBENZO(A,H)ANTHRACENE	ND	330	170
DIBENZOFURAN	ND	330	170
DIETHYLPHTHALATE	ND	330	170
DIMETHYLPHTHALATE	ND	330	170
FLUORANTHENE	ND	330	170
FLUORENE	ND	330	170
HEXACHLOROBENZENE	ND	330	170
HEXACHLOROBUTADIENE	ND	330	190
HEXACHLOROCYCLOPENTADIENE	ND	330	170
HEXACHLOROETHANE	ND	330	170
INDENO(1,2,3-CD)PYRENE	ND	330	170
ISOPHORONE	ND	330	170
N-NITROSO-DI-N-PROPYLAMINE	ND	330	170
N-NITROSODIPHENYLAMINE (2)	ND	330	170
NAPHTHALENE	ND	330	170
NITROBENZENE	ND	330	170
PENTACHLOROPHENOL	ND	670	180
PHENANTHRENE	ND	330	170
PHENOL	ND	330	170
PYRENE	ND	330	170

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
2,4,6-TRIBROMOPHENOL	62	35-125
2-FLUOROBIPHENYL	59	45-105
2-FLUOROPHENOL	51	35-105
NITROBENZENE-D5	55	35-100
PHENOL-D5	58	40-100
TERPHENYL-D14	68	30-125

(1): Cannot be separated from 3-Methylphenol
(2): Cannot be separated from Diphenylamine

METHOD 3550B/8270C
SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM09-2286	Date Analyzed:	09/08/08 19:51
Lab Samp ID:	H299-12	Dilution Factor:	1
Lab File ID:	RIK042	Matrix :	SOIL
Ext Btch ID:	SVI006S	% Moisture :	2.6
Calib. Ref.:	RHK031	Instrument ID :	T-052

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,2,4-TRICHLOROBENZENE	ND	340	170
1,2-DICHLOROBENZENE	ND	340	170
1,3-DICHLOROBENZENE	ND	340	170
1,4-DICHLOROBENZENE	ND	340	170
2,4,5-TRICHLOROPHENOL	ND	340	170
2,4,6-TRICHLOROPHENOL	ND	340	190
2,4-DICHLOROPHENOL	ND	340	170
2,4-DIMETHYLPHENOL	ND	340	170
2,4-DINITROPHENOL	ND	680	170
2,4-DINITROTOLUENE	ND	340	170
2,6-DINITROTOLUENE	ND	340	170
2-CHLORONAPHTHALENE	ND	340	170
2-CHLOROPHENOL	ND	340	170
2-METHYLNAPHTHALENE	ND	340	170
2-METHYLPHENOL	ND	340	170
2-NITROANILINE	ND	340	170
2-NITROPHENOL	ND	340	170
3,3'-DICHLOROBENZIDINE	ND	340	170
3-NITROANILINE	ND	340	170
4,6-DINITRO-2-METHYLPHENOL	ND	680	170
4-BROMOPHENYL-PHENYL ETHER	ND	340	170
4-CHLORO-3-METHYLPHENOL	ND	340	170
4-CHLOROANILINE	ND	340	170
4-CHLOROPHENYL-PHENYL ETHER	ND	340	170
4-METHYLPHENOL (1)	ND	340	170
4-NITROANILINE	ND	340	170
4-NITROPHENOL	ND	680	170
ACENAPHTHENE	ND	340	170
ACENAPHTHYLENE	ND	340	170
ANTHRACENE	ND	340	170
BENZO(A)ANTHRACENE	ND	340	170
BENZO(A)PYRENE	ND	340	170
BENZO(B)FLUORANTHENE	ND	340	170
BENZO(K)FLUORANTHENE	ND	340	170
BENZO(G,H,I)PERYLENE	ND	340	170
BIS(2-CHLOROETHOXY)METHANE	ND	340	170
BIS(2-CHLOROETHYL)ETHER	ND	340	170
BIS(2-CHLOROISOPROPYL)ETHER	ND	340	170
BIS(2-ETHYLHEXYL)PHTHALATE	ND	340	170
BUTYLBENZYLPHTHALATE	ND	340	170
CHRYSENE	ND	340	170
DI-N-BUTYLPHTHALATE	ND	340	170
DI-N-OCTYLPHTHALATE	ND	340	170
DIBENZO(A,H)ANTHRACENE	ND	340	170
DIBENZOFURAN	ND	340	170
DIETHYLPHTHALATE	ND	340	170
DIMETHYLPHTHALATE	ND	340	170
FLUORANTHENE	ND	340	170
FLUORENE	ND	340	170
HEXACHLOROBENZENE	ND	340	170
HEXACHLOROBUTADIENE	ND	340	200
HEXACHLOROCYCLOPENTADIENE	ND	340	170
HEXACHLOROETHANE	ND	340	170
INDENO(1,2,3-CD)PYRENE	ND	340	170
ISOPHORONE	ND	340	170
N-NITROSO-DI-N-PROPYLAMINE	ND	340	170
N-NITROSODIPHENYLAMINE (2)	ND	340	170
NAPHTHALENE	ND	340	170
NITROBENZENE	ND	340	170
PENTACHLOROPHENOL	ND	680	180
PHENANTHRENE	ND	340	170
PHENOL	ND	340	170
PYRENE	ND	340	170

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
2,4,6-TRIBROMOPHENOL	73	35-125
2-FLUOROBIPHENYL	66	45-105
2-FLUOROPHENOL	51	35-105
NITROBENZENE-D5	55	35-100
PHENOL-D5	60	40-100
TERPHENYL-D14	76	30-125

(1): Cannot be separated from 3-Methylphenol
(2): Cannot be separated from Diphenylamine

LABORATORY REPORT FOR

SHAW E&I

NPS WAA MATHER

METHOD 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

SDG#: 08H299

CASE NARRATIVE

CLIENT: SHAW E&I

PROJECT: NPS WAA MATHER

SDG: 08H299

METHOD 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

Twenty One (21) soil samples were received on 08/28/08 for Semi Volatile Organic analysis by Method 3550B/8270C SIM in accordance with USEPA SW846, 3rd edition and DOD QSM, v.3.

1. **Holding Time**

   Analytical holding time was met.

2. **Tuning and Calibration**

   Tuning and calibration were carried out at 12-hour interval. All QC requirements were met.

3. **Method Blank**

   Method blanks were free of contamination at half of reporting limit.

4. **Surrogate Recovery**

   Recoveries were within QC limit.

5. **Lab Control Sample/Lab Control Sample Duplicate**

   Recoveries were within QC limit except one analyte in LCS2S was slightly biased high at 114% but was within the limit in LCD2S.

6. **Matrix Spike/Matrix Spike Duplicate**

   Sample H299-04 was spiked. All recoveries were within QC limit.

7. **Sample Analysis**

   Samples were analyzed according to the prescribed QC procedures. All criteria were met with the aforementioned exception.

   Sample H299-03 and -05 were required GPC clean up due to matrix problem.

   One analyte in sample H299-05 and two analyte in sample H299-11 were manually reintegrated to correct for improper integration. Chromatograms of before and after manual reintegration were kept on file for review.

LAB CHRONICLE
SEMI VOLATILE ORGANICS BY GC/MS

Client : SHAW E&I
Project : NPS WAA MATHER

SDG NO. : 08H299
Instrument ID : T-048

SOIL

Client Sample ID	Laboratory Sample ID	Dilution Factor	% Moist	Analysis DateTime	Extraction DateTime	Sample Data FN	Calibration Data FN	Prep. Batch	Notes
MBLK1S	SVI006SB	1	NA	09/11/0819:07	09/04/0814:30	RIZ094	RIZ035	SVI006S	Method Blank
LCS1S	SVI006SL	8	NA	09/11/0819:27	09/04/0814:30	RIZ095	RIZ035	SVI006S	Lab Control Sample (LCS)
YWM02A-2268	H299-01	1	4.1	09/11/0820:24	09/04/0814:30	RIZ098	RIZ035	SVI006S	Field Sample
YWM06-2274	H299-03	2	0.7	09/11/0820:44	09/04/0814:30	RIZ099	RIZ035	SVI006S	Field Sample
YWM06-2276	H299-04	1	3.4	09/11/0821:03	09/04/0814:30	RIZ100	RIZ035	SVI006S	Field Sample
YWM07-2277	H299-05	2	4.5	09/11/0821:22	09/04/0814:30	RIZ101	RIZ035	SVI006S	Field Sample
YWM07-2279	H299-06	1	3.2	09/11/0821:42	09/04/0814:30	RIZ102	RIZ035	SVI006S	Field Sample
YWM08-2280	H299-07	1	1.7	09/11/0822:01	09/04/0814:30	RIZ103	RIZ035	SVI006S	Field Sample
YWM08-2281	H299-08	1	0.6	09/11/0822:21	09/04/0814:30	RIZ104	RIZ035	SVI006S	Field Sample
YWM08-2282	H299-09	1	0.5	09/11/0822:40	09/04/0814:30	RIZ105	RIZ035	SVI006S	Field Sample
YWM09-2284	H299-10	1	4.2	09/11/0822:59	09/04/0814:30	RIZ106	RIZ035	SVI006S	Field Sample
YWM09-2286	H299-12	1	2.6	09/11/0823:38	09/04/0814:30	RIZ108	RIZ035	SVI006S	Field Sample
YWM102-2288	H299-14	1	5.1	09/12/0800:17	09/04/0814:30	RIZ110	RIZ035	SVI006S	Field Sample
YWM103-2289	H299-15	1	2.4	09/12/0800:36	09/04/0814:30	RIZ111	RIZ035	SVI006S	Field Sample
YWM104-2290	H299-16	1	2.4	09/12/0800:55	09/04/0814:30	RIZ112	RIZ035	SVI006S	Field Sample
YWM105-2291	H299-17	1	3.3	09/12/0801:14	09/04/0814:30	RIZ113	RIZ035	SVI006S	Field Sample
YWM108-2294	H299-20	1	2.9	09/12/0802:12	09/04/0814:30	RIZ116	RIZ035	SVI006S	Field Sample
MBLK2S	SVI008SB	1	NA	09/12/0802:50	09/04/0814:30	RIZ118	RIZ035	SVI008S	Method Blank
LCS2S	SVI008SL	8	NA	09/12/0803:09	09/04/0814:30	RIZ119	RIZ035	SVI008S	Lab Control Sample (LCS)
LCD2S	SVI008SC	8	NA	09/12/0803:28	09/04/0814:30	RIZ120	RIZ035	SVI008S	LCS Duplicate
YWM110-2296	H299-22	1	3.3	09/12/0803:47	09/04/0814:30	RIZ121	RIZ035	SVI008S	Field Sample
YWM06-2276MS	H299-04H	8	3.4	09/12/0812:41	09/04/0814:30	RIZ127	RIZ035	SVI006S	MS Duplicate (MSD)
YWM09-2285	H299-11W	1	1.4	09/12/0813:00	09/04/0814:30	RIZ128	RIZ035	SVI006S	Field Sample
YWM101-2287	H299-13W	1	3.9	09/12/0813:20	09/04/0814:30	RIZ129	RIZ035	SVI006S	Field Sample
YWM106-2292	H299-18W	1	2.5	09/12/0813:39	09/04/0814:30	RIZ130	RIZ035	SVI006S	Field Sample
YWM107-2293	H299-19W	1	3.1	09/12/0813:59	09/04/0814:30	RIZ131	RIZ035	SVI006S	Field Sample
YWM109-2295	H299-21W	1	2.5	09/12/0814:18	09/04/0814:30	RIZ132	RIZ035	SVI006S	Field Sample
YWM06-2276MSD	H299-04G	8	3.4	09/12/0814:37	09/04/0814:30	RIZ133	RIZ035	SVI006S	Matrix Spike Sample (MS)

FN - Filename
% Moist - Percent Moisture

SAMPLE RESULTS

SW 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM02A-2268	Date Analyzed:	09/11/08 20:24
Lab Samp ID:	H299-01	Dilution Factor:	1
Lab File ID:	RIZ098	Matrix	: SOIL
Ext Btch ID:	SVI006S	% Moisture	: 4.1
Calib. Ref.:	RIZ035	Instrument ID	: T-048

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	5.2	2.6
ACENAPHTHYLENE	ND	5.2	2.6
ANTHRACENE	ND	5.2	2.6
BENZO(A)ANTHRACENE	ND	5.2	2.6
BENZO(A)PYRENE	ND	5.2	2.6
BENZO(B)FLUORANTHENE	ND	5.2	2.6
BENZO(K)FLUORANTHENE	ND	5.2	2.6
BENZO(G,H,I)PERYLENE	7.0	5.2	2.6
CHRYSENE	ND	5.2	2.6
DIBENZO(A,H)ANTHRACENE	ND	5.2	2.6
FLUORANTHENE	5.2	5.2	2.6
FLUORENE	ND	5.2	2.6
INDENO(1,2,3-CD)PYRENE	5.2J	5.2	2.6
NAPHTHALENE	ND	5.2	2.6
PHENANTHRENE	ND	5.2	2.6
PYRENE	4.6J	5.2	2.6

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TERPHENYL-D14	81	40-130

RL: Reporting Limit

SW 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM06-2274	Date Analyzed:	09/11/08 20:44
Lab Samp ID:	H299-03	Dilution Factor:	2
Lab File ID:	RIZ099	Matrix	: SOIL
Ext Btch ID:	SVI006S	% Moisture	: 0.7
Calib. Ref.:	RIZ035	Instrument ID	: T-048

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	10	5.0
ACENAPHTHYLENE	ND	10	5.0
ANTHRACENE	ND	10	5.0
BENZO(A)ANTHRACENE	ND	10	5.0
BENZO(A)PYRENE	ND	10	5.0
BENZO(B)FLUORANTHENE	ND	10	5.0
BENZO(K)FLUORANTHENE	ND	10	5.0
BENZO(G,H,I)PERYLENE	ND	10	5.0
CHRYSENE	ND	10	5.0
DIBENZO(A,H)ANTHRACENE	ND	10	5.0
FLUORANTHENE	ND	10	5.0
FLUORENE	ND	10	5.0
INDENO(1,2,3-CD)PYRENE	ND	10	5.0
NAPHTHALENE	ND	10	5.0
PHENANTHRENE	ND	10	5.0
PYRENE	ND	10	5.0

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TERPHENYL-D14	70	40-130

RL: Reporting Limit

SW 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM06-2276	Date Analyzed:	09/11/08 21:03
Lab Samp ID:	H299-04	Dilution Factor:	1
Lab File ID:	RIZ100	Matrix	: SOIL
Ext Btch ID:	SVI006S	% Moisture	: 3.4
Calib. Ref.:	RIZ035	Instrument ID	: T-048

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	5.2	2.6
ACENAPHTHYLENE	ND	5.2	2.6
ANTHRACENE	ND	5.2	2.6
BENZO(A)ANTHRACENE	ND	5.2	2.6
BENZO(A)PYRENE	ND	5.2	2.6
BENZO(B)FLUORANTHENE	ND	5.2	2.6
BENZO(K)FLUORANTHENE	ND	5.2	2.6
BENZO(G,H,I)PERYLENE	ND	5.2	2.6
CHRYSENE	ND	5.2	2.6
DIBENZO(A,H)ANTHRACENE	ND	5.2	2.6
FLUORANTHENE	ND	5.2	2.6
FLUORENE	ND	5.2	2.6
INDENO(1,2,3-CD)PYRENE	ND	5.2	2.6
NAPHTHALENE	ND	5.2	2.6
PHENANTHRENE	ND	5.2	2.6
PYRENE	ND	5.2	2.6

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TERPHENYL-D14	77	40-130

RL: Reporting Limit

SW 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/04/08 14:30
Sample ID: YWM07-2277	Date Analyzed: 09/11/08 21:22
Lab Samp ID: H299-05	Dilution Factor: 2
Lab File ID: RIZ101	Matrix : SOIL
Ext Btch ID: SVI006S	% Moisture : 4.5
Calib. Ref.: RIZ035	Instrument ID : T-048

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	10	5.2
ACENAPHTHYLENE	ND	10	5.2
ANTHRACENE	ND	10	5.2
BENZO(A)ANTHRACENE	ND	10	5.2
BENZO(A)PYRENE	62	10	5.2
BENZO(B)FLUORANTHENE	ND	10	5.2
BENZO(K)FLUORANTHENE	ND	10	5.2
BENZO(G,H,I)PERYLENE	78	10	5.2
CHRYSENE	51	10	5.2
DIBENZO(A,H)ANTHRACENE	49	10	5.2
FLUORANTHENE	ND	10	5.2
FLUORENE	ND	10	5.2
INDENO(1,2,3-CD)PYRENE	ND	10	5.2
NAPHTHALENE	ND	10	5.2
PHENANTHRENE	ND	10	5.2
PYRENE	19	10	5.2

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TERPHENYL-D14	75	40-130

RL: Reporting Limit

SW 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/04/08 14:30
Sample ID: YWM07-2279	Date Analyzed: 09/11/08 21:42
Lab Samp ID: H299-06	Dilution Factor: 1
Lab File ID: RIZ102	Matrix : SOIL
Ext Btch ID: SVI006S	% Moisture : 3.2
Calib. Ref.: RIZ035	Instrument ID : T-048

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	5.2	2.6
ACENAPHTHYLENE	ND	5.2	2.6
ANTHRACENE	ND	5.2	2.6
BENZO(A)ANTHRACENE	ND	5.2	2.6
BENZO(A)PYRENE	ND	5.2	2.6
BENZO(B)FLUORANTHENE	ND	5.2	2.6
BENZO(K)FLUORANTHENE	ND	5.2	2.6
BENZO(G,H,I)PERYLENE	ND	5.2	2.6
CHRYSENE	ND	5.2	2.6
DIBENZO(A,H)ANTHRACENE	ND	5.2	2.6
FLUORANTHENE	ND	5.2	2.6
FLUORENE	ND	5.2	2.6
INDENO(1,2,3-CD)PYRENE	ND	5.2	2.6
NAPHTHALENE	ND	5.2	2.6
PHENANTHRENE	ND	5.2	2.6
PYRENE	ND	5.2	2.6

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TERPHENYL-D14	83	40-130

RL: Reporting Limit

SW 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM08-2280	Date Analyzed:	09/11/08 22:01
Lab Samp ID:	H299-07	Dilution Factor:	1
Lab File ID:	RIZ103	Matrix	: SOIL
Ext Btch ID:	SVI006S	% Moisture	: 1.7
Calib. Ref.:	RIZ035	Instrument ID	: T-048

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	5.1	2.5
ACENAPHTHYLENE	ND	5.1	2.5
ANTHRACENE	ND	5.1	2.5
BENZO(A)ANTHRACENE	ND	5.1	2.5
BENZO(A)PYRENE	ND	5.1	2.5
BENZO(B)FLUORANTHENE	ND	5.1	2.5
BENZO(K)FLUORANTHENE	ND	5.1	2.5
BENZO(G,H,I)PERYLENE	ND	5.1	2.5
CHRYSENE	ND	5.1	2.5
DIBENZO(A,H)ANTHRACENE	ND	5.1	2.5
FLUORANTHENE	ND	5.1	2.5
FLUORENE	ND	5.1	2.5
INDENO(1,2,3-CD)PYRENE	ND	5.1	2.5
NAPHTHALENE	ND	5.1	2.5
PHENANTHRENE	ND	5.1	2.5
PYRENE	ND	5.1	2.5

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TERPHENYL-D14	84	40-130

RL: Reporting Limit

SW 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM08-2281	Date Analyzed:	09/11/08 22:21
Lab Samp ID:	H299-08	Dilution Factor:	1
Lab File ID:	RIZ104	Matrix	: SOIL
Ext Btch ID:	SVI006S	% Moisture	: 0.6
Calib. Ref.:	RIZ035	Instrument ID	: T-048

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	5.0	2.5
ACENAPHTHYLENE	ND	5.0	2.5
ANTHRACENE	ND	5.0	2.5
BENZO(A)ANTHRACENE	ND	5.0	2.5
BENZO(A)PYRENE	ND	5.0	2.5
BENZO(B)FLUORANTHENE	ND	5.0	2.5
BENZO(K)FLUORANTHENE	ND	5.0	2.5
BENZO(G,H,I)PERYLENE	ND	5.0	2.5
CHRYSENE	ND	5.0	2.5
DIBENZO(A,H)ANTHRACENE	ND	5.0	2.5
FLUORANTHENE	ND	5.0	2.5
FLUORENE	ND	5.0	2.5
INDENO(1,2,3-CD)PYRENE	ND	5.0	2.5
NAPHTHALENE	ND	5.0	2.5
PHENANTHRENE	ND	5.0	2.5
PYRENE	ND	5.0	2.5

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TERPHENYL-D14	94	40-130

RL: Reporting Limit

SW 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM08-2282	Date Analyzed:	09/11/08 22:40
Lab Samp ID:	H299-09	Dilution Factor:	1
Lab File ID:	RIZ105	Matrix	: SOIL
Ext Btch ID:	SVI006S	% Moisture	: 0.5
Calib. Ref.:	RIZ035	Instrument ID	: T-048

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	5.0	2.5
ACENAPHTHYLENE	ND	5.0	2.5
ANTHRACENE	ND	5.0	2.5
BENZO(A)ANTHRACENE	ND	5.0	2.5
BENZO(A)PYRENE	ND	5.0	2.5
BENZO(B)FLUORANTHENE	ND	5.0	2.5
BENZO(K)FLUORANTHENE	ND	5.0	2.5
BENZO(G,H,I)PERYLENE	ND	5.0	2.5
CHRYSENE	ND	5.0	2.5
DIBENZO(A,H)ANTHRACENE	ND	5.0	2.5
FLUORANTHENE	ND	5.0	2.5
FLUORENE	ND	5.0	2.5
INDENO(1,2,3-CD)PYRENE	ND	5.0	2.5
NAPHTHALENE	ND	5.0	2.5
PHENANTHRENE	ND	5.0	2.5
PYRENE	ND	5.0	2.5

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TERPHENYL-D14	81	40-130

RL: Reporting Limit

SW 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM09-2284	Date Analyzed:	09/11/08 22:59
Lab Samp ID:	H299-10	Dilution Factor:	1
Lab File ID:	RIZ106	Matrix	: SOIL
Ext Btch ID:	SVI006S	% Moisture	: 4.2
Calib. Ref.:	RIZ035	Instrument ID	: T-048

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	5.2	2.6
ACENAPHTHYLENE	ND	5.2	2.6
ANTHRACENE	ND	5.2	2.6
BENZO(A)ANTHRACENE	ND	5.2	2.6
BENZO(A)PYRENE	ND	5.2	2.6
BENZO(B)FLUORANTHENE	ND	5.2	2.6
BENZO(K)FLUORANTHENE	ND	5.2	2.6
BENZO(G,H,I)PERYLENE	ND	5.2	2.6
CHRYSENE	ND	5.2	2.6
DIBENZO(A,H)ANTHRACENE	ND	5.2	2.6
FLUORANTHENE	ND	5.2	2.6
FLUORENE	ND	5.2	2.6
INDENO(1,2,3-CD)PYRENE	ND	5.2	2.6
NAPHTHALENE	ND	5.2	2.6
PHENANTHRENE	ND	5.2	2.6
PYRENE	ND	5.2	2.6

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TERPHENYL-D14	82	40-130

RL: Reporting Limit

SW 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/04/08 14:30
Sample ID: YWM09-2285	Date Analyzed: 09/12/08 13:00
Lab Samp ID: H299-11W	Dilution Factor: 1
Lab File ID: RIZ128	Matrix : SOIL
Ext Btch ID: SVI006S	% Moisture : 1.4
Calib. Ref.: RIZ035	Instrument ID : T-048

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	5.1	2.5
ACENAPHTHYLENE	ND	5.1	2.5
ANTHRACENE	6.0	5.1	2.5
BENZO(A)ANTHRACENE	19	5.1	2.5
BENZO(A)PYRENE	16	5.1	2.5
BENZO(B)FLUORANTHENE	24	5.1	2.5
BENZO(K)FLUORANTHENE	7.1	5.1	2.5
BENZO(G,H,I)PERYLENE	11	5.1	2.5
CHRYSENE	17	5.1	2.5
DIBENZO(A,H)ANTHRACENE	ND	5.1	2.5
FLUORANTHENE	50	5.1	2.5
FLUORENE	ND	5.1	2.5
INDENO(1,2,3-CD)PYRENE	10	5.1	2.5
NAPHTHALENE	ND	5.1	2.5
PHENANTHRENE	38	5.1	2.5
PYRENE	40	5.1	2.5

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TERPHENYL-D14	62	40-130

RL: Reporting Limit

SW 3550B/8270C SIM

SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM09-2286	Date Analyzed:	09/11/08 23:38
Lab Samp ID:	H299-12	Dilution Factor:	1
Lab File ID:	RIZ108	Matrix	: SOIL
Ext Btch ID:	SVI006S	% Moisture	: 2.6
Calib. Ref.:	RIZ035	Instrument ID	: T-048

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	5.1	2.6
ACENAPHTHYLENE	ND	5.1	2.6
ANTHRACENE	ND	5.1	2.6
BENZO(A)ANTHRACENE	ND	5.1	2.6
BENZO(A)PYRENE	ND	5.1	2.6
BENZO(B)FLUORANTHENE	ND	5.1	2.6
BENZO(K)FLUORANTHENE	ND	5.1	2.6
BENZO(G,H,I)PERYLENE	ND	5.1	2.6
CHRYSENE	ND	5.1	2.6
DIBENZO(A,H)ANTHRACENE	ND	5.1	2.6
FLUORANTHENE	ND	5.1	2.6
FLUORENE	ND	5.1	2.6
INDENO(1,2,3-CD)PYRENE	ND	5.1	2.6
NAPHTHALENE	ND	5.1	2.6
PHENANTHRENE	ND	5.1	2.6
PYRENE	ND	5.1	2.6

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TERPHENYL-D14	88	40-130

RL: Reporting Limit

SW 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM101-2287	Date Analyzed:	09/12/08 13:20
Lab Samp ID:	H299-13W	Dilution Factor:	1
Lab File ID:	RIZ129	Matrix	: SOIL
Ext Btch ID:	SVI006S	% Moisture	: 3.9
Calib. Ref.:	RIZ035	Instrument ID	: T-048

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	5.2	2.6
ACENAPHTHYLENE	ND	5.2	2.6
ANTHRACENE	ND	5.2	2.6
BENZO(A)ANTHRACENE	ND	5.2	2.6
BENZO(A)PYRENE	ND	5.2	2.6
BENZO(B)FLUORANTHENE	ND	5.2	2.6
BENZO(K)FLUORANTHENE	ND	5.2	2.6
BENZO(G,H,I)PERYLENE	ND	5.2	2.6
CHRYSENE	ND	5.2	2.6
DIBENZO(A,H)ANTHRACENE	ND	5.2	2.6
FLUORANTHENE	ND	5.2	2.6
FLUORENE	ND	5.2	2.6
INDENO(1,2,3-CD)PYRENE	ND	5.2	2.6
NAPHTHALENE	ND	5.2	2.6
PHENANTHRENE	ND	5.2	2.6
PYRENE	ND	5.2	2.6

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TERPHENYL-D14	70	40-130

RL: Reporting Limit

SW 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM102-2288	Date Analyzed:	09/12/08 00:17
Lab Samp ID:	H299-14	Dilution Factor:	1
Lab File ID:	RIZ110	Matrix	: SOIL
Ext Btch ID:	SVI006S	% Moisture	: 5.1
Calib. Ref.:	RIZ035	Instrument ID	: T-048

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	5.3	2.6
ACENAPHTHYLENE	ND	5.3	2.6
ANTHRACENE	ND	5.3	2.6
BENZO(A)ANTHRACENE	ND	5.3	2.6
BENZO(A)PYRENE	ND	5.3	2.6
BENZO(B)FLUORANTHENE	ND	5.3	2.6
BENZO(K)FLUORANTHENE	ND	5.3	2.6
BENZO(G,H,I)PERYLENE	ND	5.3	2.6
CHRYSENE	ND	5.3	2.6
DIBENZO(A,H)ANTHRACENE	ND	5.3	2.6
FLUORANTHENE	ND	5.3	2.6
FLUORENE	ND	5.3	2.6
INDENO(1,2,3-CD)PYRENE	ND	5.3	2.6
NAPHTHALENE	ND	5.3	2.6
PHENANTHRENE	ND	5.3	2.6
PYRENE	ND	5.3	2.6

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TERPHENYL-D14	62	40-130

RL: Reporting Limit

SW 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM103-2289	Date Analyzed:	09/12/08 00:36
Lab Samp ID:	H299-15	Dilution Factor:	1
Lab File ID:	RIZ111	Matrix	: SOIL
Ext Btch ID:	SVI006S	% Moisture	: 2.4
Calib. Ref.:	RIZ035	Instrument ID	: T-048

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	5.1	2.6
ACENAPHTHYLENE	ND	5.1	2.6
ANTHRACENE	ND	5.1	2.6
BENZO(A)ANTHRACENE	ND	5.1	2.6
BENZO(A)PYRENE	ND	5.1	2.6
BENZO(B)FLUORANTHENE	ND	5.1	2.6
BENZO(K)FLUORANTHENE	ND	5.1	2.6
BENZO(G,H,I)PERYLENE	ND	5.1	2.6
CHRYSENE	ND	5.1	2.6
DIBENZO(A,H)ANTHRACENE	ND	5.1	2.6
FLUORANTHENE	ND	5.1	2.6
FLUORENE	ND	5.1	2.6
INDENO(1,2,3-CD)PYRENE	ND	5.1	2.6
NAPHTHALENE	ND	5.1	2.6
PHENANTHRENE	ND	5.1	2.6
PYRENE	ND	5.1	2.6

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TERPHENYL-D14	96	40-130

RL: Reporting Limit

SW 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM104-2290	Date Analyzed:	09/12/08 00:55
Lab Samp ID:	H299-16	Dilution Factor:	1
Lab File ID:	RIZ112	Matrix	: SOIL
Ext Btch ID:	SVI006S	% Moisture	: 2.4
Calib. Ref.:	RIZ035	Instrument ID	: T-048

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	5.1	2.6
ACENAPHTHYLENE	ND	5.1	2.6
ANTHRACENE	ND	5.1	2.6
BENZO(A)ANTHRACENE	ND	5.1	2.6
BENZO(A)PYRENE	ND	5.1	2.6
BENZO(B)FLUORANTHENE	ND	5.1	2.6
BENZO(K)FLUORANTHENE	ND	5.1	2.6
BENZO(G,H,I)PERYLENE	ND	5.1	2.6
CHRYSENE	ND	5.1	2.6
DIBENZO(A,H)ANTHRACENE	ND	5.1	2.6
FLUORANTHENE	ND	5.1	2.6
FLUORENE	ND	5.1	2.6
INDENO(1,2,3-CD)PYRENE	ND	5.1	2.6
NAPHTHALENE	ND	5.1	2.6
PHENANTHRENE	ND	5.1	2.6
PYRENE	ND	5.1	2.6

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TERPHENYL-D14	85	40-130

RL: Reporting Limit

SW 3550B/8270C SIM

SEMI VOLATILE ORGANICS BY GC/MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/04/08 14:30
Sample ID: YWM105-2291	Date Analyzed: 09/12/08 01:14
Lab Samp ID: H299-17	Dilution Factor: 1
Lab File ID: RIZ113	Matrix : SOIL
Ext Btch ID: SVI006S	% Moisture : 3.3
Calib. Ref.: RIZ035	Instrument ID : T-048

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	5.2	2.6
ACENAPHTHYLENE	ND	5.2	2.6
ANTHRACENE	ND	5.2	2.6
BENZO(A)ANTHRACENE	ND	5.2	2.6
BENZO(A)PYRENE	ND	5.2	2.6
BENZO(B)FLUORANTHENE	ND	5.2	2.6
BENZO(K)FLUORANTHENE	ND	5.2	2.6
BENZO(G,H,I)PERYLENE	ND	5.2	2.6
CHRYSENE	ND	5.2	2.6
DIBENZO(A,H)ANTHRACENE	ND	5.2	2.6
FLUORANTHENE	ND	5.2	2.6
FLUORENE	ND	5.2	2.6
INDENO(1,2,3-CD)PYRENE	ND	5.2	2.6
NAPHTHALENE	ND	5.2	2.6
PHENANTHRENE	ND	5.2	2.6
PYRENE	ND	5.2	2.6

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TERPHENYL-D14	91	40-130

RL: Reporting Limit

SW 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM106-2292	Date Analyzed:	09/12/08 13:39
Lab Samp ID:	H299-18W	Dilution Factor:	1
Lab File ID:	RIZ130	Matrix	: SOIL
Ext Btch ID:	SVI006S	% Moisture	: 2.5
Calib. Ref.:	RIZ035	Instrument ID	: T-048

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	5.1	2.6
ACENAPHTHYLENE	ND	5.1	2.6
ANTHRACENE	ND	5.1	2.6
BENZO(A)ANTHRACENE	ND	5.1	2.6
BENZO(A)PYRENE	ND	5.1	2.6
BENZO(B)FLUORANTHENE	ND	5.1	2.6
BENZO(K)FLUORANTHENE	ND	5.1	2.6
BENZO(G,H,I)PERYLENE	ND	5.1	2.6
CHRYSENE	ND	5.1	2.6
DIBENZO(A,H)ANTHRACENE	ND	5.1	2.6
FLUORANTHENE	ND	5.1	2.6
FLUORENE	ND	5.1	2.6
INDENO(1,2,3-CD)PYRENE	ND	5.1	2.6
NAPHTHALENE	ND	5.1	2.6
PHENANTHRENE	ND	5.1	2.6
PYRENE	ND	5.1	2.6

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TERPHENYL-D14	77	40-130

RL: Reporting Limit

SW 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM107-2293	Date Analyzed:	09/12/08 13:59
Lab Samp ID:	H299-19W	Dilution Factor:	1
Lab File ID:	RIZ131	Matrix	: SOIL
Ext Btch ID:	SVI006S	% Moisture	: 3.1
Calib. Ref.:	RIZ035	Instrument ID	: T-048

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	5.2	2.6
ACENAPHTHYLENE	ND	5.2	2.6
ANTHRACENE	ND	5.2	2.6
BENZO(A)ANTHRACENE	ND	5.2	2.6
BENZO(A)PYRENE	ND	5.2	2.6
BENZO(B)FLUORANTHENE	ND	5.2	2.6
BENZO(K)FLUORANTHENE	ND	5.2	2.6
BENZO(G,H,I)PERYLENE	ND	5.2	2.6
CHRYSENE	ND	5.2	2.6
DIBENZO(A,H)ANTHRACENE	ND	5.2	2.6
FLUORANTHENE	ND	5.2	2.6
FLUORENE	ND	5.2	2.6
INDENO(1,2,3-CD)PYRENE	ND	5.2	2.6
NAPHTHALENE	ND	5.2	2.6
PHENANTHRENE	ND	5.2	2.6
PYRENE	ND	5.2	2.6

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TERPHENYL-D14	71	40-130

RL: Reporting Limit

SW 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/04/08 14:30
Sample ID: YWM108-2294	Date Analyzed: 09/12/08 02:12
Lab Samp ID: H299-20	Dilution Factor: 1
Lab File ID: RIZ116	Matrix : SOIL
Ext Btch ID: SVI006S	% Moisture : 2.9
Calib. Ref.: RIZ035	Instrument ID : T-048

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	5.1	2.6
ACENAPHTHYLENE	ND	5.1	2.6
ANTHRACENE	ND	5.1	2.6
BENZO(A)ANTHRACENE	ND	5.1	2.6
BENZO(A)PYRENE	ND	5.1	2.6
BENZO(B)FLUORANTHENE	ND	5.1	2.6
BENZO(K)FLUORANTHENE	ND	5.1	2.6
BENZO(G,H,I)PERYLENE	ND	5.1	2.6
CHRYSENE	ND	5.1	2.6
DIBENZO(A,H)ANTHRACENE	ND	5.1	2.6
FLUORANTHENE	ND	5.1	2.6
FLUORENE	ND	5.1	2.6
INDENO(1,2,3-CD)PYRENE	ND	5.1	2.6
NAPHTHALENE	ND	5.1	2.6
PHENANTHRENE	ND	5.1	2.6
PYRENE	ND	5.1	2.6

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TERPHENYL-D14	80	40-130

RL: Reporting Limit

SW 3550B/8270C SIM

SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM109-2295	Date Analyzed:	09/12/08 14:18
Lab Samp ID:	H299-21W	Dilution Factor:	1
Lab File ID:	RIZ132	Matrix	: SOIL
Ext Btch ID:	SVI006S	% Moisture	: 2.5
Calib. Ref.:	RIZ035	Instrument ID	: T-048

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	5.1	2.6
ACENAPHTHYLENE	ND	5.1	2.6
ANTHRACENE	ND	5.1	2.6
BENZO(A)ANTHRACENE	ND	5.1	2.6
BENZO(A)PYRENE	ND	5.1	2.6
BENZO(B)FLUORANTHENE	ND	5.1	2.6
BENZO(K)FLUORANTHENE	ND	5.1	2.6
BENZO(G,H,I)PERYLENE	ND	5.1	2.6
CHRYSENE	ND	5.1	2.6
DIBENZO(A,H)ANTHRACENE	ND	5.1	2.6
FLUORANTHENE	ND	5.1	2.6
FLUORENE	ND	5.1	2.6
INDENO(1,2,3-CD)PYRENE	ND	5.1	2.6
NAPHTHALENE	ND	5.1	2.6
PHENANTHRENE	ND	5.1	2.6
PYRENE	ND	5.1	2.6

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TERPHENYL-D14	71	40-130

RL: Reporting Limit

SW 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08 14:30
Sample ID:	YWM110-2296	Date Analyzed:	09/12/08 03:47
Lab Samp ID:	H299-22	Dilution Factor:	1
Lab File ID:	RIZ121	Matrix	: SOIL
Ext Btch ID:	SVI008S	% Moisture	: 3.3
Calib. Ref.:	RIZ035	Instrument ID	: T-048

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	5.2	2.6
ACENAPHTHYLENE	ND	5.2	2.6
ANTHRACENE	ND	5.2	2.6
BENZO(A)ANTHRACENE	ND	5.2	2.6
BENZO(A)PYRENE	ND	5.2	2.6
BENZO(B)FLUORANTHENE	ND	5.2	2.6
BENZO(K)FLUORANTHENE	ND	5.2	2.6
BENZO(G,H,I)PERYLENE	ND	5.2	2.6
CHRYSENE	ND	5.2	2.6
DIBENZO(A,H)ANTHRACENE	ND	5.2	2.6
FLUORANTHENE	ND	5.2	2.6
FLUORENE	ND	5.2	2.6
INDENO(1,2,3-CD)PYRENE	ND	5.2	2.6
NAPHTHALENE	ND	5.2	2.6
PHENANTHRENE	ND	5.2	2.6
PYRENE	ND	5.2	2.6

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TERPHENYL-D14	80	40-130

RL: Reporting Limit

LABORATORY REPORT FOR

SHAW E&I

NPS WAA MATHER

METHOD 5035/M8015
TOTAL PETROLEUM HYDROCARBONS BY PURGE AND TRAP

SDG#: 08H299

CASE NARRATIVE

CLIENT: SHAW E&I

PROJECT: NPS WAA MATHER

SDG: 08H299

METHOD 5035/M8015
TOTAL PETROLEUM HYDROCARBONS BY PURGE AND TRAP

Eleven (11) soil samples were received on 08/28/08 for Total Petroleum Hydrocarbons by Purge and Trap analysis by Method 5035/M8015 in accordance with USEPA SW846, 3rd edition and DOD QSM, v.3.

1. **Holding Time**

   Samples were analyzed within holding time as prescribed by the method. Samples #03 to #12 were received in encores and were frozen upon arrival and sample #1 was received in jars. All samples were preserved with methanol on 08/29/08.

2. **Calibration**

   Multi-calibration points were analyzed to establish ICAL and was verified using a secondary source. Refer to Initial calibration summary ICAL/ICV form. Continuing calibrations were performed at a frequency specified by the project. All criteria were met.

3. **Method Blank**

   Method blank was free of contamination at half of reporting limit.

4. **Surrogate Recovery**

   Surrogate was added to MB, LCS/LCSD, MS/MSD and the samples. Results are included in the report forms. All percent recoveries met the project QC limits.

5. **Lab Control Sample/Lab Control Sample Duplicate**

   LCS/LCSD were analyzed at a frequency specified by the project. All percent recoveries met the project QC limits.

6. **Matrix Spike/Matrix Spike Duplicate**

   Sample H298-04 was designated for MS/MSD. Recoveries were within project QC limits.

7. **Sample Analysis**

   Samples were analyzed according to the prescribed QC procedures. All criteria were met. Results were quantified from C6 to C10 using GRO (C6-C10) calibration factor.

LAB CHRONICLE
TOTAL PETROLEUM HYDROCARBONS BY PURGE AND TRAP

Client : SHAW E&I
Project : NPS WAA MATHER

SDG NO. : 08H299
Instrument ID : GCT039

SOIL

Client Sample ID	Laboratory Sample ID	Dilution Factor	% Moist	Analysis DateTime	Extraction DateTime	Sample Data FN	Calibration Data FN	Prep. Batch	Notes
MBLK1S	VMH016SB	1	NA	08/29/0822:24	08/29/0822:24	EH29014A	EH29012A	VMH016S	Method Blank
LCS1S	VMH016SL	1	NA	08/29/0823:03	08/29/0823:03	EH29015A	EH29012A	VMH016S	Lab Control Sample (LCS)
LCD1S	VMH016SC	1	NA	08/29/0823:42	08/29/0823:42	EH29016A	EH29012A	VMH016S	LCS Duplicate
YWM02A-2268	H299-01	1	4.1	08/30/0803:34	08/30/0803:34	EH29022A	EH29012A	VMH016S	Field Sample
YWM06-2274	H299-03	1.16	0.7	08/30/0804:13	08/30/0804:13	EH29023A	EH29012A	VMH016S	Field Sample
YWM06-2276	H299-04	1.09	3.4	08/30/0806:09	08/30/0806:09	EH29026A	EH29024A	VMH016S	Field Sample
YWM07-2277	H299-05	1.56	4.5	08/30/0808:06	08/30/0808:06	EH29029A	EH29024A	VMH016S	Field Sample
YWM07-2279	H299-06	1.22	3.2	08/30/0808:45	08/30/0808:45	EH29030A	EH29024A	VMH016S	Field Sample
YWM08-2280	H299-07	1.47	1.7	08/30/0809:24	08/30/0809:24	EH29031A	EH29024A	VMH016S	Field Sample
YWM08-2281	H299-08	1.06	0.6	08/30/0810:02	08/30/0810:02	EH29032A	EH29024A	VMH016S	Field Sample
YWM08-2282	H299-09	1.09	0.5	08/30/0810:41	08/30/0810:41	EH29033A	EH29024A	VMH016S	Field Sample
YWM09-2284	H299-10	1.28	4.2	08/30/0811:20	08/30/0811:20	EH29034A	EH29024A	VMH016S	Field Sample
YWM09-2285	H299-11	1.06	1.4	08/30/0811:59	08/30/0811:59	EH29035A	EH29024A	VMH016S	Field Sample
YWM09-2286	H299-12	1.19	2.6	08/30/0813:56	08/30/0813:56	EH29038A	EH29036A	VMH016S	Field Sample
YWM06-2276MS	H299-04M	1.11	3.4	08/30/0806:48	08/30/0806:48	EH29027A	EH29024A	VMH016S	Matrix Spike Sample (MS)
YWM06-2276MSD	H299-04S	1.11	3.4	08/30/0807:27	08/30/0807:27	EH29028A	EH29024A	VMH016S	MS Duplicate (MSD)

FN - Filename
% Moist - Percent Moisture

SAMPLE RESULTS

METHOD 5035/M8015
TOTAL PETROLEUM HYDROCARBONS BY PURGE AND TRAP

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	08/30/08 03:34
Sample ID:	YWM02A-2268	Date Analyzed:	08/30/08 03:34
Lab Samp ID:	H299-01	Dilution Factor:	1
Lab File ID:	EH29022A	Matrix	: SOIL
Ext Btch ID:	VMH016S	% Moisture	: 4.1
Calib. Ref.:	EH29012A	Instrument ID	: GCT039

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
GASOLINE	ND	1.0	0.52

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOFLUOROBENZENE	96	70-140

Parameter	H-C Range
Gasoline	C6-C10

SAMPLE RECEIVED IN JAR

METHOD 5035/M8015
TOTAL PETROLEUM HYDROCARBONS BY PURGE AND TRAP

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	08/30/08 04:13
Sample ID:	YWM06-2274	Date Analyzed:	08/30/08 04:13
Lab Samp ID:	H299-03	Dilution Factor:	1.16
Lab File ID:	EH29023A	Matrix :	SOIL
Ext Btch ID:	VMH016S	% Moisture :	0.7
Calib. Ref.:	EH29012A	Instrument ID :	GCT039

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
GASOLINE	ND	1.2	0.58

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOFLUOROBENZENE	91	70-140

Parameter	H-C Range
Gasoline	C6-C10

METHANOL EXTRACTION: 08/29/08 16:00

METHOD 5035/M8015
TOTAL PETROLEUM HYDROCARBONS BY PURGE AND TRAP

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	08/30/08 06:09
Sample ID:	YWM06-2276	Date Analyzed:	08/30/08 06:09
Lab Samp ID:	H299-04	Dilution Factor:	1.09
Lab File ID:	EH29026A	Matrix :	SOIL
Ext Btch ID:	VMH016S	% Moisture :	3.4
Calib. Ref.:	EH29024A	Instrument ID :	GCT039

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
GASOLINE	1.3	1.1	0.56

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOFLUOROBENZENE	94	70-140

Parameter	H-C Range
Gasoline	C6-C10

METHANOL EXTRACTION: 08/29/08 16:00

METHOD 5035/M8015
TOTAL PETROLEUM HYDROCARBONS BY PURGE AND TRAP

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 08/30/08 08:06
Sample ID: YWM07-2277	Date Analyzed: 08/30/08 08:06
Lab Samp ID: H299-05	Dilution Factor: 1.56
Lab File ID: EH29029A	Matrix : SOIL
Ext Btch ID: VMH016S	% Moisture : 4.5
Calib. Ref.: EH29024A	Instrument ID : GCT039

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
GASOLINE	2.5	1.6	0.82

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOFLUOROBENZENE	90	70-140

Parameter	H-C Range
Gasoline	C6-C10

METHANOL EXTRACTION: 08/29/08 16:00

METHOD 5035/M8015
TOTAL PETROLEUM HYDROCARBONS BY PURGE AND TRAP

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 08/30/08 08:45
Sample ID: YWM07-2279	Date Analyzed: 08/30/08 08:45
Lab Samp ID: H299-06	Dilution Factor: 1.22
Lab File ID: EH29030A	Matrix : SOIL
Ext Btch ID: VMH016S	% Moisture : 3.2
Calib. Ref.: EH29024A	Instrument ID : GCT039

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
GASOLINE	ND	1.3	0.63

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOFLUOROBENZENE	97	70-140

Parameter	H-C Range
Gasoline	C6-C10

METHANOL EXTRACTION: 08/29/08 16:00

METHOD 5035/M8015
TOTAL PETROLEUM HYDROCARBONS BY PURGE AND TRAP

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	08/30/08 09:24
Sample ID:	YWM08-2280	Date Analyzed:	08/30/08 09:24
Lab Samp ID:	H299-07	Dilution Factor:	1.47
Lab File ID:	EH29031A	Matrix :	SOIL
Ext Btch ID:	VMH016S	% Moisture :	1.7
Calib. Ref.:	EH29024A	Instrument ID :	GCT039

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
GASOLINE	ND	1.5	0.75

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOFLUOROBENZENE	88	70-140

Parameter	H-C Range
Gasoline	C6-C10

METHANOL EXTRACTION: 08/29/08 16:00

METHOD 5035/M8015
TOTAL PETROLEUM HYDROCARBONS BY PURGE AND TRAP

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	08/30/08 10:02
Sample ID:	YWM08-2281	Date Analyzed:	08/30/08 10:02
Lab Samp ID:	H299-08	Dilution Factor:	1.06
Lab File ID:	EH29032A	Matrix	: SOIL
Ext Btch ID:	VMH016S	% Moisture	: 0.6
Calib. Ref.:	EH29024A	Instrument ID	: GCT039

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
GASOLINE	ND	1.1	0.53

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOFLUOROBENZENE	99	70-140

Parameter	H-C Range
Gasoline	C6-C10

METHANOL EXTRACTION: 08/29/08 16:00

METHOD 5035/M8015
TOTAL PETROLEUM HYDROCARBONS BY PURGE AND TRAP

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	08/30/08 10:41
Sample ID:	YWM08-2282	Date Analyzed:	08/30/08 10:41
Lab Samp ID:	H299-09	Dilution Factor:	1.09
Lab File ID:	EH29033A	Matrix :	SOIL
Ext Btch ID:	VMH016S	% Moisture :	0.5
Calib. Ref.:	EH29024A	Instrument ID :	GCT039

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
GASOLINE	ND	1.1	0.55

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOFLUOROBENZENE	97	70-140

Parameter	H-C Range
Gasoline	C6-C10

METHANOL EXTRACTION: 08/29/08 16:00

METHOD 5035/M8015
TOTAL PETROLEUM HYDROCARBONS BY PURGE AND TRAP

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	08/30/08 11:20
Sample ID:	YWM09-2284	Date Analyzed:	08/30/08 11:20
Lab Samp ID:	H299-10	Dilution Factor:	1.28
Lab File ID:	EH29034A	Matrix	: SOIL
Ext Btch ID:	VMH016S	% Moisture	: 4.2
Calib. Ref.:	EH29024A	Instrument ID	: GCT039

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
GASOLINE	ND	1.3	0.67

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOFLUOROBENZENE	98	70-140

Parameter	H-C Range
Gasoline	C6-C10

METHANOL EXTRACTION: 08/29/08 16:00

METHOD 5035/M8015
TOTAL PETROLEUM HYDROCARBONS BY PURGE AND TRAP

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	08/30/08 11:59
Sample ID:	YWM09-2285	Date Analyzed:	08/30/08 11:59
Lab Samp ID:	H299-11	Dilution Factor:	1.06
Lab File ID:	EH29035A	Matrix	: SOIL
Ext Btch ID:	VMH016S	% Moisture	: 1.4
Calib. Ref.:	EH29024A	Instrument ID	: GCT039

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
GASOLINE	ND	1.1	0.54

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOFLUOROBENZENE	100	70-140

Parameter	H-C Range
Gasoline	C6-C10

METHANOL EXTRACTION: 08/29/08 16:00

METHOD 5035/M8015
TOTAL PETROLEUM HYDROCARBONS BY PURGE AND TRAP

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 08/30/08 13:56
Sample ID: YWM09-2286	Date Analyzed: 08/30/08 13:56
Lab Samp ID: H299-12	Dilution Factor: 1.19
Lab File ID: EH29038A	Matrix : SOIL
Ext Btch ID: VMH016S	% Moisture : 2.6
Calib. Ref.: EH29036A	Instrument ID : GCT039

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
GASOLINE	ND	1.2	0.61

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOFLUOROBENZENE	98	70-140

Parameter	H-C Range
Gasoline	C6-C10

METHANOL EXTRACTION: 08/29/08 16:00

LABORATORY REPORT FOR

SHAW E&I

NPS WAA MATHER

METHOD 3550B/8015 MOD
PETROLEUM HYDROCARBONS BY EXTRACTION

SDG#: 08H299

CASE NARRATIVE

CLIENT: SHAW E&I

PROJECT: NPS WAA Mather

SDG: 08H299

METHOD 3550B/8015 Mod
PETROLEUM HYDROCARBONS BY EXTRACTION

Twelve (12) soil sample was received on 08/28/08 for Petroleum Hydrocarbons by Extraction by Method 3550B/8015 Mod in accordance with SW846, 3rd edition and DOD QSM, v.3.

1. **Holding Time**

   Analytical holding time was met. Extraction was performed and completed on 09/03/08.

2. **Calibration**

   Initial calibration was seven points for Diesel and Motor Oil. %RSDs were within 20%. Continuing calibration verifications were carried out every 12 hours at the end of analysis sequence. All recoveries were within 85-115%.

3. **Method Blank**

   Method blank was free of contamination at the reporting limit.

4. **Surrogate Recovery**

   For sample H299-02, surrogate recoveries were not evaluated due to dilution. All other recoveries were within QC limits.

5. **Lab Control Sample**

   Recovery was within QC limits.

6. **Matrix Spike/Matrix Spike Duplicate**

   Sample H299-04 was designated as MS/MSD. All recoveries were within QC limits.

7. **Sample Analysis**

   Samples were analyzed according to the prescribed QC procedures. All criteria were met with the aforementioned exception. Sample results were quantified from C10 to C24 using Diesel (C10-C24) calibration factor and from C24 to C36 using Motor Oil calibration factor.

   Sample H299-02, -03, -04 and -05 displayed heavier fuel pattern.

   Silica Gel clean-up was performed prior to analysis.

LAB CHRONICLE
PETROLEUM HYDROCARBONS BY EXTRACTION

Client : SHAW E&I
Project : NPS WAA MATHER

SDG NO. : 08H299
Instrument ID : GCT105

SOIL

Client Sample ID	Laboratory Sample ID	Dilution Factor	% Moist	Analysis DateTime	Extraction DateTime	Sample Data FN	Calibration Data FN	Prep. Batch	Notes
MBLK1S	DSI004SB	1	NA	09/04/0814:44	09/03/0816:00	LI04017A	LI04012A	DSI004S	Method Blank
LCS1S	DSI004SL	1	NA	09/04/0815:01	09/03/0816:00	LI04018A	LI04012A	DSI004S	Lab Control Sample (LCS)
YWM02A-2268	H299-01	1	4.1	09/04/0818:04	09/03/0816:00	LI04029A	LI04025A	DSI004S	Field Sample
YWM05A-2271	H299-02T	50	6.2	09/08/0820:14	09/03/0816:00	LI08031A	LI08023A	DSI004S	Diluted Sample
YWM06-2274	H299-03	1	0.7	09/08/0820:30	09/03/0816:00	LI08032A	LI08023A	DSI004S	Field Sample
YWM06-2276	H299-04	1	3.4	09/04/0818:20	09/03/0816:00	LI04030A	LI04025A	DSI004S	Field Sample
YWM07-2277	H299-05	1	4.5	09/04/0819:10	09/03/0816:00	LI04033A	LI04025A	DSI004S	Field Sample
YWM07-2279	H299-06	1	3.2	09/04/0815:17	09/03/0816:00	LI04019A	LI04012A	DSI004S	Field Sample
YWM08-2280	H299-07	1	1.7	09/04/0815:34	09/03/0816:00	LI04020A	LI04012A	DSI004S	Field Sample
YWM08-2281	H299-08	1	0.6	09/04/0815:51	09/03/0816:00	LI04021A	LI04012A	DSI004S	Field Sample
YWM08-2282	H299-09	1	0.5	09/04/0816:07	09/03/0816:00	LI04022A	LI04012A	DSI004S	Field Sample
YWM09-2284	H299-10	1	4.2	09/04/0816:24	09/03/0816:00	LI04023A	LI04012A	DSI004S	Field Sample
YWM09-2285	H299-11	1	1.4	09/04/0817:30	09/03/0816:00	LI04027A	LI04025A	DSI004S	Field Sample
YWM09-2286	H299-12	1	2.6	09/04/0817:47	09/03/0816:00	LI04028A	LI04025A	DSI004S	Field Sample
YWM06-2276MS	H299-04M	1	3.4	09/04/0818:37	09/03/0816:00	LI04031A	LI04025A	DSI004S	Matrix Spike Sample (MS)
YWM06-2276MSD	H299-04S	1	3.4	09/04/0818:53	09/03/0816:00	LI04032A	LI04025A	DSI004S	MS Duplicate (MSD)

FN - Filename
% Moist - Percent Moisture

SAMPLE RESULTS

METHOD 3550B/8015 Mod
PETROLEUM HYDROCARBONS BY EXTRACTION

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/03/08 16:00
Sample ID:	YWM02A-2268	Date Analyzed:	09/04/08 18:04
Lab Samp ID:	H299-01	Dilution Factor:	1
Lab File ID:	LI04029A	Matrix :	SOIL
Ext Btch ID:	DSI004S	% Moisture :	4.1
Calib. Ref.:	LI04025A	Instrument ID :	GCT105

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
DIESEL	ND	10	5.2
MOTOR OIL	ND	10	5.2

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOBENZENE	77	50-150
HEXACOSANE	77	50-150

RL : Reporting Limit

Parameter	H-C Range
Diesel	C10-C24
Motor Oil	C24-C36

METHOD 3550B/8015 Mod
PETROLEUM HYDROCARBONS BY EXTRACTION

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/03/08 16:00
Sample ID: YWM05A-2271	Date Analyzed: 09/08/08 20:14
Lab Samp ID: H299-02T	Dilution Factor: 50
Lab File ID: LI08031A	Matrix : SOIL
Ext Btch ID: DSI004S	% Moisture : 6.2
Calib. Ref.: LI08023A	Instrument ID : GCT105

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
DIESEL	4800	530	270
MOTOR OIL	88000	530	270

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOBENZENE	DO	50-150
HEXACOSANE	DO	50-150

RL : Reporting Limit

Parameter	H-C Range
Diesel	C10-C24
Motor Oil	C24-C36

DO: Dilution Out

METHOD 3550B/8015 Mod
PETROLEUM HYDROCARBONS BY EXTRACTION

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/03/08 16:00
Sample ID:	YWM06-2274	Date Analyzed:	09/08/08 20:30
Lab Samp ID:	H299-03	Dilution Factor:	1
Lab File ID:	LI08032A	Matrix	: SOIL
Ext Btch ID:	DSI004S	% Moisture	: 0.7
Calib. Ref.:	LI08023A	Instrument ID	: GCT105

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
DIESEL	89	10	5.0
MOTOR OIL	2000	10	5.0

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOBENZENE	86	50-150
HEXACOSANE	132	50-150

RL : Reporting Limit

Parameter	H-C Range
Diesel	C10-C24
Motor Oil	C24-C36

METHOD 3550B/8015 Mod
PETROLEUM HYDROCARBONS BY EXTRACTION

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/03/08 16:00
Sample ID: YWM06-2276	Date Analyzed: 09/04/08 18:20
Lab Samp ID: H299-04	Dilution Factor: 1
Lab File ID: LI04030A	Matrix : SOIL
Ext Btch ID: DSI004S	% Moisture : 3.4
Calib. Ref.: LI04025A	Instrument ID : GCT105

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
DIESEL	9.9J	10	5.2
MOTOR OIL	170	10	5.2

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOBENZENE	78	50-150
HEXACOSANE	89	50-150

RL : Reporting Limit

Parameter	H-C Range
Diesel	C10-C24
Motor Oil	C24-C36

METHOD 3550B/8015 Mod
PETROLEUM HYDROCARBONS BY EXTRACTION

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/03/08 16:00
Sample ID: YWM07-2277	Date Analyzed: 09/04/08 19:10
Lab Samp ID: H299-05	Dilution Factor: 1
Lab File ID: LI04033A	Matrix : SOIL
Ext Btch ID: DSI004S	% Moisture : 4.5
Calib. Ref.: LI04025A	Instrument ID : GCT105

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
DIESEL	31	10	5.2
MOTOR OIL	740	10	5.2

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOBENZENE	78	50-150
HEXACOSANE	123	50-150

RL : Reporting Limit

Parameter	H-C Range
Diesel	C10-C24
Motor Oil	C24-C36

METHOD 3550B/8015 Mod
PETROLEUM HYDROCARBONS BY EXTRACTION

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/03/08 16:00
Sample ID:	YWM07-2279	Date Analyzed:	09/04/08 15:17
Lab Samp ID:	H299-06	Dilution Factor:	1
Lab File ID:	LI04019A	Matrix	: SOIL
Ext Btch ID:	DSI004S	% Moisture	: 3.2
Calib. Ref.:	LI04012A	Instrument ID	: GCT105

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
DIESEL	ND	10	5.2
MOTOR OIL	ND	10	5.2

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOBENZENE	81	50-150
HEXACOSANE	78	50-150

RL : Reporting Limit

Parameter	H-C Range
Diesel	C10-C24
Motor Oil	C24-C36

METHOD 3550B/8015 Mod
PETROLEUM HYDROCARBONS BY EXTRACTION

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/03/08 16:00
Sample ID:	YWM08-2280	Date Analyzed:	09/04/08 15:34
Lab Samp ID:	H299-07	Dilution Factor:	1
Lab File ID:	LI04020A	Matrix	: SOIL
Ext Btch ID:	DSI004S	% Moisture	: 1.7
Calib. Ref.:	LI04012A	Instrument ID	: GCT105

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
DIESEL	ND	10	5.1
MOTOR OIL	ND	10	5.1

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOBENZENE	82	50-150
HEXACOSANE	82	50-150

RL : Reporting Limit

Parameter	H-C Range
Diesel	C10-C24
Motor Oil	C24-C36

METHOD 3550B/8015 Mod
PETROLEUM HYDROCARBONS BY EXTRACTION

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/03/08 16:00
Sample ID:	YWM08-2281	Date Analyzed:	09/04/08 15:51
Lab Samp ID:	H299-08	Dilution Factor:	1
Lab File ID:	LI04021A	Matrix	: SOIL
Ext Btch ID:	DSI004S	% Moisture	: 0.6
Calib. Ref.:	LI04012A	Instrument ID	: GCT105

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
DIESEL	ND	10	5.0
MOTOR OIL	ND	10	5.0

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOBENZENE	82	50-150
HEXACOSANE	82	50-150

RL : Reporting Limit

Parameter	H-C Range
Diesel	C10-C24
Motor Oil	C24-C36

METHOD 3550B/8015 Mod
PETROLEUM HYDROCARBONS BY EXTRACTION

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/03/08 16:00
Sample ID: YWM08-2282	Date Analyzed: 09/04/08 16:07
Lab Samp ID: H299-09	Dilution Factor: 1
Lab File ID: LI04022A	Matrix : SOIL
Ext Btch ID: DSI004S	% Moisture : 0.5
Calib. Ref.: LI04012A	Instrument ID : GCT105

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
DIESEL	ND	10	5.0
MOTOR OIL	ND	10	5.0

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOBENZENE	80	50-150
HEXACOSANE	76	50-150

RL : Reporting Limit

Parameter	H-C Range
Diesel	C10-C24
Motor Oil	C24-C36

METHOD 3550B/8015 Mod
PETROLEUM HYDROCARBONS BY EXTRACTION

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/03/08 16:00
Sample ID: YWM09-2284	Date Analyzed: 09/04/08 16:24
Lab Samp ID: H299-10	Dilution Factor: 1
Lab File ID: LI04023A	Matrix : SOIL
Ext Btch ID: DSI004S	% Moisture : 4.2
Calib. Ref.: LI04012A	Instrument ID : GCT105

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
DIESEL	ND	10	5.2
MOTOR OIL	ND	10	5.2

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOBENZENE	85	50-150
HEXACOSANE	87	50-150

RL : Reporting Limit

Parameter	H-C Range
Diesel	C10-C24
Motor Oil	C24-C36

METHOD 3550B/8015 Mod
PETROLEUM HYDROCARBONS BY EXTRACTION

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/03/08 16:00
Sample ID:	YWM09-2285	Date Analyzed:	09/04/08 17:30
Lab Samp ID:	H299-11	Dilution Factor:	1
Lab File ID:	LI04027A	Matrix	: SOIL
Ext Btch ID:	DSI004S	% Moisture	: 1.4
Calib. Ref.:	LI04025A	Instrument ID	: GCT105

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
DIESEL	ND	10	5.1
MOTOR OIL	ND	10	5.1

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOBENZENE	80	50-150
HEXACOSANE	80	50-150

RL : Reporting Limit

Parameter	H-C Range
Diesel	C10-C24
Motor Oil	C24-C36

METHOD 3550B/8015 Mod
PETROLEUM HYDROCARBONS BY EXTRACTION

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/03/08 16:00
Sample ID: YWM09-2286	Date Analyzed: 09/04/08 17:47
Lab Samp ID: H299-12	Dilution Factor: 1
Lab File ID: LI04028A	Matrix : SOIL
Ext Btch ID: DSI004S	% Moisture : 2.6
Calib. Ref.: LI04025A	Instrument ID : GCT105

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
DIESEL	ND	10	5.1
MOTOR OIL	ND	10	5.1

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOBENZENE	78	50-150
HEXACOSANE	81	50-150

RL : Reporting Limit

Parameter	H-C Range
Diesel	C10-C24
Motor Oil	C24-C36

LABORATORY REPORT FOR

SHAW E&I

NPS WAA MATHER

METHOD 3550B/8082
PCBs

SDG#: 08H299

CASE NARRATIVE

CLIENT: SHAW E&I

PROJECT: NPS WAA MATHER

SDG: 08H299

METHOD 3550B/8082
PCBs

Twelve (12) soil samples were received on 08/28/08 for PCBs analysis by Method 3550B/8082 in accordance with "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW846, 3rd edition and DOD QSM, v.3.

1. **Holding Time**

   Analytical holding time was met.

2. **Instrument Performance and Calibration**

   Initial calibration was calibrated for PCB-1016, PCB-1248, PCB-1254 and PCB-1260, all RSDs were within 20%. All continue calibrations were analyzed at 10 samples interval and all recoveries were within 80-120%.

3. **Method Blank**

   Method blank was free of contamination at half of reporting limit.

4. **Surrogate Recovery**

   Recoveries were within QC limit except one surrogate in samples H299-01 and -02 was out of QC limit due to matrix interference.

5. **Lab Control Sample**

   All recoveries were within QC limits.

6. **Matrix Spike/Matrix Spike Duplicate**

   Sample H299-01 was spiked. All recoveries were within QC limit.

7. **Sample Analysis**

   Samples were analyzed according to the prescribed QC procedures. All criteria were met with the aforementioned exception.

LAB CHRONICLE
PCBs

Client : SHAW E&I
Project : NPS WAA MATHER

SDG NO. : 08H299
Instrument ID : GCT071

SOIL

Client Sample ID	Laboratory Sample ID	Dilution Factor	% Moist	Analysis DateTime	Extraction DateTime	Sample Data FN	Calibration Data FN	Prep. Batch	Notes
MBLK1S	60I004SB	1	NA	09/04/0819:02	09/04/0811:30	KI04010A	KI04002A	60I004S	Method Blank
LCS1S	60I004SL	1	NA	09/04/0819:23	09/04/0811:30	KI04011A	KI04002A	60I004S	Lab Control Sample (LCS)
YWM02A-2268	H299-01	1	4.1	09/04/0819:44	09/04/0811:30	KI04012A	KI04002A	60I004S	Field Sample
YWM05A-2271	H299-02	1	6.2	09/05/0803:06	09/04/0811:30	KI04033A	KI04030A	60I004S	Field Sample
YWM06-2274	H299-03	1	0.7	09/04/0820:05	09/04/0811:30	KI04013A	KI04002A	60I004S	Field Sample
YWM06-2276	H299-04	1	3.4	09/04/0820:26	09/04/0811:30	KI04014A	KI04002A	60I004S	Field Sample
YWM07-2277	H299-05	1	4.5	09/04/0822:53	09/04/0811:30	KI04021A	KI04016A	60I004S	Field Sample
YWM07-2279	H299-06	1	3.2	09/04/0823:14	09/04/0811:30	KI04022A	KI04016A	60I004S	Field Sample
YWM08-2280	H299-07	1	1.7	09/04/0823:35	09/04/0811:30	KI04023A	KI04016A	60I004S	Field Sample
YWM08-2281	H299-08	1	0.6	09/04/0823:56	09/04/0811:30	KI04024A	KI04016A	60I004S	Field Sample
YWM08-2282	H299-09	1	0.5	09/05/0800:18	09/04/0811:30	KI04025A	KI04016A	60I004S	Field Sample
YWM09-2284	H299-10	1	4.2	09/05/0800:39	09/04/0811:30	KI04026A	KI04016A	60I004S	Field Sample
YWM09-2285	H299-11	1	1.4	09/05/0801:00	09/04/0811:30	KI04027A	KI04016A	60I004S	Field Sample
YWM09-2286	H299-12	1	2.6	09/05/0801:21	09/04/0811:30	KI04028A	KI04016A	60I004S	Field Sample
YWM06-2276MS	H299-04M	1	3.4	09/04/0822:11	09/04/0811:30	KI04019A	KI04016A	60I004S	Matrix Spike Sample (MS)
YWM06-2276MSD	H299-04S	1	3.4	09/04/0822:32	09/04/0811:30	KI04020A	KI04016A	60I004S	MS Duplicate (MSD)

FN - Filename
% Moist - Percent Moisture

SAMPLE RESULTS

METHOD 3550B/8082
PCBs

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/04/08/ 11:30
Sample ID: YWM02A-2268	Date Analyzed: 09/04/08 19:44
Lab Samp ID: H299-01	Dilution Factor: 1
Lab File ID: KI04012A	Matrix : SOIL
Ext Btch ID: 60I004S	% Moisture : 4.1
Calib. Ref.: KI04002A	Instrument ID : GCT071

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
PCB-1016	(ND)|ND	52	21|21
PCB-1221	(ND)|ND	52	21|21
PCB-1232	(ND)|ND	52	21|21
PCB-1242	(ND)|ND	52	21|21
PCB-1248	(ND)|ND	52	21|21
PCB-1254	(ND)|ND	52	21|21
PCB-1260	(ND)|ND	52	21|21

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TETRACHLORO-M-XYLENE	104|(109)	25-140
DECACHLOROBIPHENYL	151*|(166*)	60-125

Left of | is related to first column ; Right of | related to second column
Final result indicated by ( )
* Out side of QC Limit

METHOD 3550B/8082
PCBs

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/04/08/ 11:30
Sample ID: YWM05A-2271	Date Analyzed: 09/05/08 03:06
Lab Samp ID: H299-02	Dilution Factor: 1
Lab File ID: KI04033A	Matrix : SOIL
Ext Btch ID: 60I004S	% Moisture : 6.2
Calib. Ref.: KI04030A	Instrument ID : GCT071

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
PCB-1016	(ND)|ND	53	21|21
PCB-1221	(ND)|ND	53	21|21
PCB-1232	(ND)|ND	53	21|21
PCB-1242	(ND)|ND	53	21|21
PCB-1248	(ND)|ND	53	21|21
PCB-1254	(ND)|ND	53	21|21
PCB-1260	(ND)|ND	53	21|21

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TETRACHLORO-M-XYLENE	(99)|88	25-140
DECACHLOROBIPHENYL	26*|(27*)	60-125

Left of | is related to first column ; Right of | related to second column
Final result indicated by ( )
* Out side of QC Limit

METHOD 3550B/8082
PCBs

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08/ 11:30
Sample ID:	YWM06-2274	Date Analyzed:	09/04/08 20:05
Lab Samp ID:	H299-03	Dilution Factor:	1
Lab File ID:	KI04013A	Matrix :	SOIL
Ext Btch ID:	60I004S	% Moisture :	0.7
Calib. Ref.:	KI04002A	Instrument ID :	GCT071

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
PCB-1016	(ND)|ND	50	20|20
PCB-1221	(ND)|ND	50	20|20
PCB-1232	(ND)|ND	50	20|20
PCB-1242	(ND)|ND	50	20|20
PCB-1248	(ND)|ND	50	20|20
PCB-1254	(ND)|ND	50	20|20
PCB-1260	(ND)|ND	50	20|20

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TETRACHLORO-M-XYLENE	(103)|99	25-140
DECACHLOROBIPHENYL	80|(82)	60-125

Left of | is related to first column ; Right of | related to second column
Final result indicated by ( )
* Out side of QC Limit

METHOD 3550B/8082
PCBs

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/04/08/ 11:30
Sample ID: YWM06-2276	Date Analyzed: 09/04/08 20:26
Lab Samp ID: H299-04	Dilution Factor: 1
Lab File ID: KI04014A	Matrix : SOIL
Ext Btch ID: 60I004S	% Moisture : 3.4
Calib. Ref.: KI04002A	Instrument ID : GCT071

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
PCB-1016	(ND)|ND	52	21|21
PCB-1221	(ND)|ND	52	21|21
PCB-1232	(ND)|ND	52	21|21
PCB-1242	(ND)|ND	52	21|21
PCB-1248	(ND)|ND	52	21|21
PCB-1254	(ND)|ND	52	21|21
PCB-1260	(ND)|ND	52	21|21

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TETRACHLORO-M-XYLENE	(87)|72	25-140
DECACHLOROBIPHENYL	83|(87)	60-125

Left of | is related to first column ; Right of | related to second column
Final result indicated by ( )
* Out side of QC Limit

METHOD 3550B/8082
PCBs

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/04/08/ 11:30
Sample ID: YWM07-2277	Date Analyzed: 09/04/08 22:53
Lab Samp ID: H299-05	Dilution Factor: 1
Lab File ID: KI04021A	Matrix : SOIL
Ext Btch ID: 60I004S	% Moisture : 4.5
Calib. Ref.: KI04016A	Instrument ID : GCT071

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
PCB-1016	(ND)|ND	52	21|21
PCB-1221	(ND)|ND	52	21|21
PCB-1232	(ND)|ND	52	21|21
PCB-1242	(ND)|ND	52	21|21
PCB-1248	(ND)|ND	52	21|21
PCB-1254	(ND)|ND	52	21|21
PCB-1260	(ND)|ND	52	21|21

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TETRACHLORO-M-XYLENE	(100)|86	25-140
DECACHLOROBIPHENYL	89|(96)	60-125

Left of | is related to first column ; Right of | related to second column
Final result indicated by ( )
* Out side of QC Limit

METHOD 3550B/8082
PCBs

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/04/08/ 11:30
Sample ID: YWM07-2279	Date Analyzed: 09/04/08 23:14
Lab Samp ID: H299-06	Dilution Factor: 1
Lab File ID: KI04022A	Matrix : SOIL
Ext Btch ID: 60I004S	% Moisture : 3.2
Calib. Ref.: KI04016A	Instrument ID : GCT071

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
PCB-1016	(ND)|ND	52	21|21
PCB-1221	(ND)|ND	52	21|21
PCB-1232	(ND)|ND	52	21|21
PCB-1242	(ND)|ND	52	21|21
PCB-1248	(ND)|ND	52	21|21
PCB-1254	(ND)|ND	52	21|21
PCB-1260	(ND)|ND	52	21|21

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TETRACHLORO-M-XYLENE	(86)|72	25-140
DECACHLOROBIPHENYL	85|(96)	60-125

Left of | is related to first column ; Right of | related to second column
Final result indicated by ( )
 * Out side of QC Limit

METHOD 3550B/8082
PCBs

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08/ 11:30
Sample ID:	YWM08-2280	Date Analyzed:	09/04/08 23:35
Lab Samp ID:	H299-07	Dilution Factor:	1
Lab File ID:	KI04023A	Matrix	: SOIL
Ext Btch ID:	60I004S	% Moisture	: 1.7
Calib. Ref.:	KI04016A	Instrument ID	: GCT071

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
PCB-1016	(ND) | ND	51	20 | 20
PCB-1221	(ND) | ND	51	20 | 20
PCB-1232	(ND) | ND	51	20 | 20
PCB-1242	(ND) | ND	51	20 | 20
PCB-1248	(ND) | ND	51	20 | 20
PCB-1254	(ND) | ND	51	20 | 20
PCB-1260	(ND) | ND	51	20 | 20

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TETRACHLORO-M-XYLENE	(95) | 90	25-140
DECACHLOROBIPHENYL	92 | (94)	60-125

Left of | is related to first column ; Right of | related to second column
Final result indicated by ( )
* Out side of QC Limit

METHOD 3550B/8082
PCBs

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/04/08/ 11:30
Sample ID: YWM08-2281	Date Analyzed: 09/04/08 23:56
Lab Samp ID: H299-08	Dilution Factor: 1
Lab File ID: KI04024A	Matrix : SOIL
Ext Btch ID: 60I004S	% Moisture : 0.6
Calib. Ref.: KI04016A	Instrument ID : GCT071

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
PCB-1016	(ND)|ND	50	20|20
PCB-1221	(ND)|ND	50	20|20
PCB-1232	(ND)|ND	50	20|20
PCB-1242	(ND)|ND	50	20|20
PCB-1248	(ND)|ND	50	20|20
PCB-1254	(ND)|ND	50	20|20
PCB-1260	(ND)|ND	50	20|20

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TETRACHLORO-M-XYLENE	98|(103)	25-140
DECACHLOROBIPHENYL	95|(100)	60-125

Left of | is related to first column ; Right of | related to second column
Final result indicated by ( )
* Out side of QC Limit

METHOD 3550B/8082
PCBs

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/04/08/ 11:30
Sample ID: YWM08-2282	Date Analyzed: 09/05/08 00:18
Lab Samp ID: H299-09	Dilution Factor: 1
Lab File ID: KI04025A	Matrix : SOIL
Ext Btch ID: 60I004S	% Moisture : 0.5
Calib. Ref.: KI04016A	Instrument ID : GCT071

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
PCB-1016	(ND)|ND	50	20|20
PCB-1221	(ND)|ND	50	20|20
PCB-1232	(ND)|ND	50	20|20
PCB-1242	(ND)|ND	50	20|20
PCB-1248	(ND)|ND	50	20|20
PCB-1254	(ND)|ND	50	20|20
PCB-1260	(ND)|ND	50	20|20

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TETRACHLORO-M-XYLENE	98|(106)	25-140
DECACHLOROBIPHENYL	97|(104)	60-125

Left of | is related to first column ; Right of | related to second column
Final result indicated by ( )
* Out side of QC Limit

METHOD 3550B/8082
PCBs

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Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
Batch No.	: 08H299	Date Extracted:	09/04/08/ 11:30
Sample ID:	YWM09-2284	Date Analyzed:	09/05/08 00:39
Lab Samp ID:	H299-10	Dilution Factor:	1
Lab File ID:	KI04026A	Matrix	: SOIL
Ext Btch ID:	60I004S	% Moisture	: 4.2
Calib. Ref.:	KI04016A	Instrument ID	: GCT071

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PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
PCB-1016	(ND)|ND	52	21|21
PCB-1221	(ND)|ND	52	21|21
PCB-1232	(ND)|ND	52	21|21
PCB-1242	(ND)|ND	52	21|21
PCB-1248	(ND)|ND	52	21|21
PCB-1254	(ND)|ND	52	21|21
PCB-1260	(ND)|ND	52	21|21

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TETRACHLORO-M-XYLENE	98|(106)	25-140
DECACHLOROBIPHENYL	103|(107)	60-125

Left of | is related to first column ; Right of | related to second column
Final result indicated by ( )
* Out side of QC Limit

METHOD 3550B/8082
PCBs

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/04/08/ 11:30
Sample ID: YWM09-2285	Date Analyzed: 09/05/08 01:00
Lab Samp ID: H299-11	Dilution Factor: 1
Lab File ID: KI04027A	Matrix : SOIL
Ext Btch ID: 60I004S	% Moisture : 1.4
Calib. Ref.: KI04016A	Instrument ID : GCT071

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
PCB-1016	(ND)|ND	51	20|20
PCB-1221	(ND)|ND	51	20|20
PCB-1232	(ND)|ND	51	20|20
PCB-1242	(ND)|ND	51	20|20
PCB-1248	(ND)|ND	51	20|20
PCB-1254	(ND)|ND	51	20|20
PCB-1260	(ND)|ND	51	20|20

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TETRACHLORO-M-XYLENE	104|(105)	25-140
DECACHLOROBIPHENYL	108|(114)	60-125

Left of | is related to first column ; Right of | related to second column
Final result indicated by ( )
* Out side of QC Limit

METHOD 3550B/8082

PCBs

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Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
Batch No. : 08H299	Date Extracted: 09/04/08/ 11:30
Sample ID: YWM09-2286	Date Analyzed: 09/05/08 01:21
Lab Samp ID: H299-12	Dilution Factor: 1
Lab File ID: KI04028A	Matrix : SOIL
Ext Btch ID: 60I004S	% Moisture : 2.6
Calib. Ref.: KI04016A	Instrument ID : GCT071

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<table>
<tr><th>PARAMETERS</th><th>RESULTS (ug/kg)</th><th>RL (ug/kg)</th><th>MDL (ug/kg)</th></tr>
<tr><td>PCB-1016</td><td>(ND)|ND</td><td>51</td><td>21|21</td></tr>
<tr><td>PCB-1221</td><td>(ND)|ND</td><td>51</td><td>21|21</td></tr>
<tr><td>PCB-1232</td><td>(ND)|ND</td><td>51</td><td>21|21</td></tr>
<tr><td>PCB-1242</td><td>(ND)|ND</td><td>51</td><td>21|21</td></tr>
<tr><td>PCB-1248</td><td>(ND)|ND</td><td>51</td><td>21|21</td></tr>
<tr><td>PCB-1254</td><td>(ND)|ND</td><td>51</td><td>21|21</td></tr>
<tr><td>PCB-1260</td><td>(ND)|ND</td><td>51</td><td>21|21</td></tr>
</table>

<table>
<tr><th>SURROGATE PARAMETERS</th><th>% RECOVERY</th><th>QC LIMIT</th></tr>
<tr><td>TETRACHLORO-M-XYLENE</td><td>93|(98)</td><td>25-140</td></tr>
<tr><td>DECACHLOROBIPHENYL</td><td>105|(110)</td><td>60-125</td></tr>
</table>

Left of | is related to first column ; Right of | related to second column

Final result indicated by ( )

* Out side of QC Limit

LABORATORY REPORT FOR

SHAW E&I

NPS WAA MATHER

METALS / MERCURY

SDG#: 08H299

CASE NARRATIVE

CLIENT: SHAW E&I

PROJECT: NPS WAA BASELINE

SDG: 08H299

METHOD 6020A
METALS BY ICP-MS

Twenty-one (21) soil samples were received on 08/28/08 for Metals analysis by Method 6020A in accordance with "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW846, 3rd edition and DOD QSM, v.3.

1. **Holding Time**

   Analysis met holding time criteria.

2. **Continuing Calibrations (CCV's) and ICSA/ICSAB**

   CCV's and ICSA/ICSAB were analyzed at a frequency specified by the project. All project requirements were met.

3. **Method Blank**

   Method blanks were free of contamination at half of reporting limit.

4. **Lab Control Sample/Lab Control Sample Duplicate**

   Lab control results were within QC limit.

5. **Serial Dilution/Post-Analytical Spike**

   Sample H298-01 from another SDG was analyzed for serial dilution and post-analytical spike. All QC requirements were met.

6. **Matrix Spike/Matrix Spike Duplicate**

   Sample H299-04 was spiked. All recoveries were within QC limit except four elements were out of the limit in both MS/MSD.

7. **Sample Analysis**

   Samples were analyzed according to the prescribed QC procedures. All criteria were met with the aforementioned exception.

   MRLs were analyzed at the beginning of each sequence run. Recoveries were within QC limit of 80-120%.

LAB CHRONICLE
METALS BY ICP-MS

Client : SHAW E&I
Project : NPS WAA MATHER

SDG NO. : 08H299
Instrument ID : T-I98

SOIL

Client Sample ID	Laboratory Sample ID	Dilution Factor	% Moist	Analysis DateTime	Extraction DateTime	Sample Data FN	Calibration Data FN	Prep. Batch	Notes
MBLK1S	IMI002SB	1	NA	09/03/0820:18	09/02/0815:00	98I02051	98I02048	IMI002S	Method Blank
LCS1S	IMI002SL	1	NA	09/03/0820:23	09/02/0815:00	98I02052	98I02048	IMI002S	Lab Control Sample (LCS)
LCD1S	IMI002SC	1	NA	09/03/0820:29	09/02/0815:00	98I02053	98I02048	IMI002S	LCS Duplicate
YWM110-2296	H299-22	1	3.3	09/03/0823:58	09/02/0815:00	98I02091	98I02084	IMI002S	Field Sample
YWB05-2241AS	H298-01A	1	3.4	09/03/0820:45	09/02/0815:00	98I02056	98I02048	IMI002S	Analytical Spike Sample
YWB05-2241	H298-01	1	3.4	09/03/0820:51	09/02/0815:00	98I02057	98I02048	IMI002S	Field Sample
YWB05-2241DL	H298-01J	5	3.4	09/03/0820:56	09/02/0815:00	98I02058	98I02048	IMI002S	Diluted Sample
MBLK2S	IMI003SB	1	NA	09/03/0823:30	09/02/0815:15	98I02086	98I02084	IMI003S	Method Blank
LCS2S	IMI003SL	1	NA	09/03/0823:36	09/02/0815:15	98I02087	98I02084	IMI003S	Lab Control Sample (LCS)
LCD2S	IMI003SC	1	NA	09/03/0823:41	09/02/0815:15	98I02088	98I02084	IMI003S	LCS Duplicate
YWM02A-2268	H299-01	1	4.1	09/03/0823:47	09/02/0815:15	98I02089	98I02084	IMI003S	Field Sample
YWM06-2274	H299-03	1	0.7	09/03/0823:52	09/02/0815:15	98I02090	98I02084	IMI003S	Field Sample
YWM06-2276AS	H299-04A	1	3.4	09/04/0800:03	09/02/0815:15	98I02092	98I02084	IMI003S	Analytical Spike Sample
YWM06-2276	H299-04	1	3.4	09/04/0800:09	09/02/0815:15	98I02093	98I02084	IMI003S	Field Sample
YWM06-2276DL	H299-04J	5	3.4	09/04/0800:14	09/02/0815:15	98I02094	98I02084	IMI003S	Diluted Sample
YWM06-2276MS	H299-04M	1	3.4	09/04/0800:36	09/02/0815:15	98I02098	98I02096	IMI003S	Matrix Spike Sample (MS)
YWM06-2276MSD	H299-04S	1	3.4	09/04/0800:42	09/02/0815:15	98I02099	98I02096	IMI003S	MS Duplicate (MSD)
YWM07-2277	H299-05	1	4.5	09/04/0800:47	09/02/0815:15	98I02100	98I02096	IMI003S	Field Sample
YWM07-2279	H299-06	1	3.2	09/04/0800:52	09/02/0815:15	98I02101	98I02096	IMI003S	Field Sample
YWM08-2280	H299-07	1	1.7	09/04/0800:58	09/02/0815:15	98I02102	98I02096	IMI003S	Field Sample
YWM08-2281	H299-08	1	0.6	09/04/0801:03	09/02/0815:15	98I02103	98I02096	IMI003S	Field Sample
YWM08-2282	H299-09	1	0.5	09/04/0801:09	09/02/0815:15	98I02104	98I02096	IMI003S	Field Sample
YWM09-2284	H299-10	1	4.2	09/04/0801:15	09/02/0815:15	98I02105	98I02096	IMI003S	Field Sample
YWM09-2285	H299-11	1	1.4	09/04/0801:20	09/02/0815:15	98I02106	98I02096	IMI003S	Field Sample
YWM09-2286	H299-12	1	2.6	09/04/0801:42	09/02/0815:15	98I02110	98I02108	IMI003S	Field Sample
YWM101-2287	H299-13	1	3.9	09/04/0801:47	09/02/0815:15	98I02111	98I02108	IMI003S	Field Sample
YWM102-2288	H299-14	1	5.1	09/04/0801:53	09/02/0815:15	98I02112	98I02108	IMI003S	Field Sample
YWM103-2289	H299-15	1	2.4	09/04/0801:58	09/02/0815:15	98I02113	98I02108	IMI003S	Field Sample
YWM104-2290	H299-16	1	2.4	09/04/0802:04	09/02/0815:15	98I02114	98I02108	IMI003S	Field Sample
YWM105-2291	H299-17	1	3.3	09/04/0802:09	09/02/0815:15	98I02115	98I02108	IMI003S	Field Sample
YWM106-2292	H299-18	1	2.5	09/04/0802:15	09/02/0815:15	98I02116	98I02108	IMI003S	Field Sample
YWM107-2293	H299-19	1	3.1	09/04/0802:20	09/02/0815:15	98I02117	98I02108	IMI003S	Field Sample
YWM108-2294	H299-20	1	2.9	09/04/0815:26	09/02/0815:15	98I03035	98I03029	IMI003S	Field Sample
YWM109-2295	H299-21	1	2.5	09/04/0815:32	09/02/0815:15	98I03036	98I03029	IMI003S	Field Sample

FN - Filename
% Moist - Percent Moisture

METHOD 6020A
METALS BY ICP-MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
SDG NO. : 08H299	Date Extracted: 09/02/08 15:15
Sample ID: YWM02A-2268	Date Analyzed: 09/03/08 23:47
Lab Samp ID: H299-01	Dilution Factor: 1
Lab File ID: 98I02089	Matrix : SOIL
Ext Btch ID: IMI003S	% Moisture : 4.1
Calib. Ref.: 98I02084	Instrument ID : EMAXTI98

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Aluminum	7590	104	20.9
Antimony	4.63	0.521	0.104
Arsenic	6.42	0.521	0.104
Barium	509	0.521	0.104
Beryllium	0.147J	0.521	0.104
Cadmium	6.78	0.313	0.104
Calcium	25600	104	20.9
Chromium	23.0	0.521	0.104
Cobalt	5.20	0.521	0.104
Copper	97.3	0.521	0.209
Iron	30500	104	20.9
Lead	689	0.521	0.104
Magnesium	2630	104	20.9
Manganese	1900	0.521	0.104
Molybdenum	2.22	0.521	0.104
Nickel	12.3	0.521	0.104
Potassium	1710	104	20.9
Selenium	0.155J	0.521	0.104
Silver	0.915	0.521	0.104
Sodium	215	104	20.9
Thallium	0.406J	0.521	0.104
Vanadium	16.3	0.521	0.104
Zinc	2380	1.04	0.521

METHOD 6020A
METALS BY ICP-MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
SDG NO. : 08H299	Date Extracted: 09/02/08 15:15
Sample ID: YWM06-2274	Date Analyzed: 09/03/08 23:52
Lab Samp ID: H299-03	Dilution Factor: 1
Lab File ID: 98I02090	Matrix : SOIL
Ext Btch ID: IMI003S	% Moisture : 0.7
Calib. Ref.: 98I02084	Instrument ID : EMAXTI98

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Aluminum	12000	101	20.1
Antimony	0.802	0.504	0.101
Arsenic	3.04	0.504	0.101
Barium	149	0.504	0.101
Beryllium	0.165J	0.504	0.101
Cadmium	0.815	0.302	0.101
Calcium	2820	101	20.1
Chromium	11.0	0.504	0.101
Cobalt	8.36	0.504	0.101
Copper	88.4	0.504	0.201
Iron	28400	101	20.1
Lead	126	0.504	0.101
Magnesium	5290	101	20.1
Manganese	516	0.504	0.101
Molybdenum	1.38	0.504	0.101
Nickel	10.1	0.504	0.101
Potassium	5660	101	20.1
Selenium	0.119J	0.504	0.101
Silver	1.07	0.504	0.101
Sodium	187	101	20.1
Thallium	0.392J	0.504	0.101
Vanadium	37.4	0.504	0.101
Zinc	316	1.01	0.504

METHOD 6020A
METALS BY ICP-MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
SDG NO. : 08H299	Date Extracted: 09/02/08 15:15
Sample ID: YWM06-2276	Date Analyzed: 09/04/08 00:09
Lab Samp ID: H299-04	Dilution Factor: 1
Lab File ID: 98I02093	Matrix : SOIL
Ext Btch ID: IMI003S	% Moisture : 3.4
Calib. Ref.: 98I02084	Instrument ID : EMAXTI98

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Aluminum	9470	104	20.7
Antimony	0.331J	0.518	0.104
Arsenic	1.13	0.518	0.104
Barium	36.4	0.518	0.104
Beryllium	0.234J	0.518	0.104
Cadmium	0.211J	0.311	0.104
Calcium	1010	104	20.7
Chromium	3.39	0.518	0.104
Cobalt	2.22	0.518	0.104
Copper	7.53	0.518	0.207
Iron	8530	104	20.7
Lead	27.1	0.518	0.104
Magnesium	1810	104	20.7
Manganese	156	0.518	0.104
Molybdenum	0.752	0.518	0.104
Nickel	2.76	0.518	0.104
Potassium	1370	104	20.7
Selenium	0.204J	0.518	0.104
Silver	0.113J	0.518	0.104
Sodium	81.2J	104	20.7
Thallium	0.249J	0.518	0.104
Vanadium	17.0	0.518	0.104
Zinc	48.1	1.04	0.518

METHOD 6020A
METALS BY ICP-MS

Client	: SHAW E&I	Date Collected	: 08/26/08
Project	: NPS WAA MATHER	Date Received	: 08/28/08
SDG NO.	: 08H299	Date Extracted	: 09/02/08 15:15
Sample ID	: YWM07-2277	Date Analyzed	: 09/04/08 00:47
Lab Samp ID	: H299-05	Dilution Factor	: 1
Lab File ID	: 98I02100	Matrix	: SOIL
Ext Btch ID	: IMI003S	% Moisture	: 4.5
Calib. Ref.	: 98I02096	Instrument ID	: EMAXTI98

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Aluminum	11200	105	20.9
Antimony	2.30	0.524	0.105
Arsenic	4.41	0.524	0.105
Barium	346	0.524	0.105
Beryllium	0.176J	0.524	0.105
Cadmium	3.04	0.314	0.105
Calcium	11000	105	20.9
Chromium	17.9	0.524	0.105
Cobalt	9.24	0.524	0.105
Copper	108	0.524	0.209
Iron	40200	105	20.9
Lead	332	0.524	0.105
Magnesium	3670	105	20.9
Manganese	1240	0.524	0.105
Molybdenum	2.17	0.524	0.105
Nickel	19.7	0.524	0.105
Potassium	3310	105	20.9
Selenium	0.155J	0.524	0.105
Silver	0.776	0.524	0.105
Sodium	192	105	20.9
Thallium	0.567	0.524	0.105
Vanadium	27.0	0.524	0.105
Zinc	2420	1.05	0.524

METHOD 6020A
METALS BY ICP-MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
SDG NO.	: 08H299	Date Extracted:	09/02/08 15:15
Sample ID:	YWM07-2279	Date Analyzed:	09/04/08 00:52
Lab Samp ID:	H299-06	Dilution Factor:	1
Lab File ID:	98I02101	Matrix	: SOIL
Ext Btch ID:	IMI003S	% Moisture	: 3.2
Calib. Ref.:	98I02096	Instrument ID	: EMAXTI98

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Aluminum	12000	103	20.7
Antimony	ND	0.517	0.103
Arsenic	1.39	0.517	0.103
Barium	21.1	0.517	0.103
Beryllium	0.251J	0.517	0.103
Cadmium	ND	0.310	0.103
Calcium	375	103	20.7
Chromium	3.75	0.517	0.103
Cobalt	1.78	0.517	0.103
Copper	2.20	0.517	0.207
Iron	10300	103	20.7
Lead	3.82	0.517	0.103
Magnesium	1500	103	20.7
Manganese	86.6	0.517	0.103
Molybdenum	0.782	0.517	0.103
Nickel	2.13	0.517	0.103
Potassium	813	103	20.7
Selenium	0.156J	0.517	0.103
Silver	ND	0.517	0.103
Sodium	47.9J	103	20.7
Thallium	0.281J	0.517	0.103
Vanadium	22.4	0.517	0.103
Zinc	19.4	1.03	0.517

METHOD 6020A
METALS BY ICP-MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
SDG NO. : 08H299	Date Extracted: 09/02/08 15:15
Sample ID: YWM08-2280	Date Analyzed: 09/04/08 00:58
Lab Samp ID: H299-07	Dilution Factor: 1
Lab File ID: 98I02102	Matrix : SOIL
Ext Btch ID: IMI003S	% Moisture : 1.7
Calib. Ref.: 98I02096	Instrument ID : EMAXTI98

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Aluminum	10200	102	20.3
Antimony	0.107J	0.509	0.102
Arsenic	1.47	0.509	0.102
Barium	64.5	0.509	0.102
Beryllium	0.220J	0.509	0.102
Cadmium	0.186J	0.305	0.102
Calcium	1020	102	20.3
Chromium	4.30	0.509	0.102
Cobalt	3.70	0.509	0.102
Copper	53.8	0.509	0.203
Iron	13200	102	20.3
Lead	59.9	0.509	0.102
Magnesium	3270	102	20.3
Manganese	341	0.509	0.102
Molybdenum	0.505J	0.509	0.102
Nickel	4.15	0.509	0.102
Potassium	3190	102	20.3
Selenium	0.149J	0.509	0.102
Silver	ND	0.509	0.102
Sodium	78.9J	102	20.3
Thallium	0.361J	0.509	0.102
Vanadium	21.0	0.509	0.102
Zinc	80.1	1.02	0.509

METHOD 6020A
METALS BY ICP-MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
SDG NO. : 08H299	Date Extracted: 09/02/08 15:15
Sample ID: YWM08-2281	Date Analyzed: 09/04/08 01:03
Lab Samp ID: H299-08	Dilution Factor: 1
Lab File ID: 98I02103	Matrix : SOIL
Ext Btch ID: IMI003S	% Moisture : 0.6
Calib. Ref.: 98I02096	Instrument ID : EMAXTI98

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Aluminum	8940	101	20.1
Antimony	ND	0.503	0.101
Arsenic	1.10	0.503	0.101
Barium	66.3	0.503	0.101
Beryllium	0.171J	0.503	0.101
Cadmium	0.153J	0.302	0.101
Calcium	1550	101	20.1
Chromium	2.66	0.503	0.101
Cobalt	4.08	0.503	0.101
Copper	28.9	0.503	0.201
Iron	14600	101	20.1
Lead	30.0	0.503	0.101
Magnesium	4200	101	20.1
Manganese	387	0.503	0.101
Molybdenum	0.384J	0.503	0.101
Nickel	2.12	0.503	0.101
Potassium	5050	101	20.1
Selenium	0.127J	0.503	0.101
Silver	ND	0.503	0.101
Sodium	90.2J	101	20.1
Thallium	0.381J	0.503	0.101
Vanadium	23.6	0.503	0.101
Zinc	66.2	1.01	0.503

METHOD 6020A
METALS BY ICP-MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
SDG NO. : 08H299	Date Extracted: 09/02/08 15:15
Sample ID: YWM08-2282	Date Analyzed: 09/04/08 01:09
Lab Samp ID: H299-09	Dilution Factor: 1
Lab File ID: 98I02104	Matrix : SOIL
Ext Btch ID: IMI003S	% Moisture : 0.5
Calib. Ref.: 98I02096	Instrument ID : EMAXTI98

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Aluminum	7360	101	20.1
Antimony	ND	0.503	0.101
Arsenic	0.877	0.503	0.101
Barium	50.7	0.503	0.101
Beryllium	0.148J	0.503	0.101
Cadmium	0.123J	0.302	0.101
Calcium	1390	101	20.1
Chromium	1.98	0.503	0.101
Cobalt	3.71	0.503	0.101
Copper	18.4	0.503	0.201
Iron	13200	101	20.1
Lead	11.5	0.503	0.101
Magnesium	3810	101	20.1
Manganese	384	0.503	0.101
Molybdenum	0.333J	0.503	0.101
Nickel	1.74	0.503	0.101
Potassium	4760	101	20.1
Selenium	0.112J	0.503	0.101
Silver	ND	0.503	0.101
Sodium	93.8J	101	20.1
Thallium	0.339J	0.503	0.101
Vanadium	21.3	0.503	0.101
Zinc	49.3	1.01	0.503

METHOD 6020A
METALS BY ICP-MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
SDG NO.	: 08H299	Date Extracted:	09/02/08 15:15
Sample ID:	YWM09-2284	Date Analyzed:	09/04/08 01:15
Lab Samp ID:	H299-10	Dilution Factor:	1
Lab File ID:	98I02105	Matrix	: SOIL
Ext Btch ID:	IMI003S	% Moisture	: 4.2
Calib. Ref.:	98I02096	Instrument ID	: EMAXTI98

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Aluminum	8900	104	20.9
Antimony	1.61	0.522	0.104
Arsenic	7.37	0.522	0.104
Barium	918	0.522	0.104
Beryllium	0.155J	0.522	0.104
Cadmium	1.50	0.313	0.104
Calcium	26900	104	20.9
Chromium	23.6	0.522	0.104
Cobalt	6.45	0.522	0.104
Copper	198	0.522	0.209
Iron	25300	104	20.9
Lead	617	0.522	0.104
Magnesium	3650	104	20.9
Manganese	1300	0.522	0.104
Molybdenum	0.969	0.522	0.104
Nickel	27.9	0.522	0.104
Potassium	3050	104	20.9
Selenium	0.197J	0.522	0.104
Silver	0.719	0.522	0.104
Sodium	190	104	20.9
Thallium	0.232J	0.522	0.104
Vanadium	20.1	0.522	0.104
Zinc	1140	1.04	0.522

METHOD 6020A
METALS BY ICP-MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
SDG NO. : 08H299	Date Extracted: 09/02/08 15:15
Sample ID: YWM09-2285	Date Analyzed: 09/04/08 01:20
Lab Samp ID: H299-11	Dilution Factor: 1
Lab File ID: 98I02106	Matrix : SOIL
Ext Btch ID: IMI003S	% Moisture : 1.4
Calib. Ref.: 98I02096	Instrument ID : EMAXTI98

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Aluminum	9960	101	20.3
Antimony	2.27	0.507	0.101
Arsenic	5.23	0.507	0.101
Barium	977	0.507	0.101
Beryllium	0.192J	0.507	0.101
Cadmium	3.58	0.304	0.101
Calcium	31800	101	20.3
Chromium	28.4	0.507	0.101
Cobalt	5.69	0.507	0.101
Copper	260	0.507	0.203
Iron	29700	101	20.3
Lead	994	0.507	0.101
Magnesium	4490	101	20.3
Manganese	1790	0.507	0.101
Molybdenum	1.18	0.507	0.101
Nickel	9.93	0.507	0.101
Potassium	3780	101	20.3
Selenium	0.184J	0.507	0.101
Silver	1.23	0.507	0.101
Sodium	293	101	20.3
Thallium	0.275J	0.507	0.101
Vanadium	22.7	0.507	0.101
Zinc	1930	1.01	0.507

METHOD 6020A
METALS BY ICP-MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
SDG NO.	: 08H299	Date Extracted:	09/02/08 15:15
Sample ID:	YWM09-2286	Date Analyzed:	09/04/08 01:42
Lab Samp ID:	H299-12	Dilution Factor:	1
Lab File ID:	98I02110	Matrix :	SOIL
Ext Btch ID:	IMI003S	% Moisture :	2.6
Calib. Ref.:	98I02108	Instrument ID :	EMAXTI98

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Aluminum	10300	103	20.5
Antimony	2.40	0.513	0.103
Arsenic	4.08	0.513	0.103
Barium	352	0.513	0.103
Beryllium	0.232J	0.513	0.103
Cadmium	3.06	0.308	0.103
Calcium	6220	103	20.5
Chromium	14.3	0.513	0.103
Cobalt	4.26	0.513	0.103
Copper	88.0	0.513	0.205
Iron	21000	103	20.5
Lead^	9930	5.13	1.03
Magnesium	2800	103	20.5
Manganese	938	0.513	0.103
Molybdenum	0.848	0.513	0.103
Nickel	7.48	0.513	0.103
Potassium	1920	103	20.5
Selenium	0.159J	0.513	0.103
Silver	0.854	0.513	0.103
Sodium	123	103	20.5
Thallium	0.219J	0.513	0.103
Vanadium	20.6	0.513	0.103
Zinc	807	1.03	0.513

^ : Analyzed @ DF 10 on 09/04/08 14:29 | File ID 98I03025

METHOD 6020A
METALS BY ICP-MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
SDG NO. : 08H299	Date Extracted: 09/02/08 15:15
Sample ID: YWM101-2287	Date Analyzed: 09/04/08 01:47
Lab Samp ID: H299-13	Dilution Factor: 1
Lab File ID: 98I02111	Matrix : SOIL
Ext Btch ID: IMI003S	% Moisture : 3.9
Calib. Ref.: 98I02108	Instrument ID : EMAXTI98

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Aluminum	15000	104	20.8
Antimony	ND	0.520	0.104
Arsenic	2.06	0.520	0.104
Barium	46.4	0.520	0.104
Beryllium	0.328J	0.520	0.104
Cadmium	ND	0.312	0.104
Calcium	617	104	20.8
Chromium	5.06	0.520	0.104
Cobalt	3.45	0.520	0.104
Copper	5.39	0.520	0.208
Iron	12200	104	20.8
Lead	8.78	0.520	0.104
Magnesium	2790	104	20.8
Manganese	210	0.520	0.104
Molybdenum	0.650	0.520	0.104
Nickel	4.38	0.520	0.104
Potassium	1790	104	20.8
Selenium	0.340J	0.520	0.104
Silver	ND	0.520	0.104
Sodium	57.1J	104	20.8
Thallium	0.230J	0.520	0.104
Vanadium	24.5	0.520	0.104
Zinc	34.0	1.04	0.520

METHOD 6020A
METALS BY ICP-MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
SDG NO. : 08H299	Date Extracted: 09/02/08 15:15
Sample ID: YWM102-2288	Date Analyzed: 09/04/08 01:53
Lab Samp ID: H299-14	Dilution Factor: 1
Lab File ID: 98I02112	Matrix : SOIL
Ext Btch ID: IMI003S	% Moisture : 5.1
Calib. Ref.: 98I02108	Instrument ID : EMAXTI98

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Aluminum	13200	105	21.1
Antimony	ND	0.527	0.105
Arsenic	1.79	0.527	0.105
Barium	37.1	0.527	0.105
Beryllium	0.287J	0.527	0.105
Cadmium	ND	0.316	0.105
Calcium	558	105	21.1
Chromium	3.94	0.527	0.105
Cobalt	2.75	0.527	0.105
Copper	4.60	0.527	0.211
Iron	10500	105	21.1
Lead	4.94	0.527	0.105
Magnesium	2220	105	21.1
Manganese	171	0.527	0.105
Molybdenum	0.652	0.527	0.105
Nickel	3.94	0.527	0.105
Potassium	1460	105	21.1
Selenium	0.340J	0.527	0.105
Silver	ND	0.527	0.105
Sodium	57.8J	105	21.1
Thallium	0.198J	0.527	0.105
Vanadium	21.3	0.527	0.105
Zinc	29.3	1.05	0.527

METHOD 6020A
METALS BY ICP-MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
SDG NO.	: 08H299	Date Extracted:	09/02/08 15:15
Sample ID:	YWM103-2289	Date Analyzed:	09/04/08 01:58
Lab Samp ID:	H299-15	Dilution Factor:	1
Lab File ID:	98I02113	Matrix :	SOIL
Ext Btch ID:	IMI003S	% Moisture :	2.4
Calib. Ref.:	98I02108	Instrument ID :	EMAXTI98

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Aluminum	12500	102	20.5
Antimony	ND	0.512	0.102
Arsenic	1.61	0.512	0.102
Barium	55.2	0.512	0.102
Beryllium	0.278J	0.512	0.102
Cadmium	ND	0.307	0.102
Calcium	632	102	20.5
Chromium	4.66	0.512	0.102
Cobalt	3.61	0.512	0.102
Copper	5.62	0.512	0.205
Iron	11300	102	20.5
Lead	4.41	0.512	0.102
Magnesium	2990	102	20.5
Manganese	267	0.512	0.102
Molybdenum	0.758	0.512	0.102
Nickel	4.49	0.512	0.102
Potassium	1840	102	20.5
Selenium	0.205J	0.512	0.102
Silver	ND	0.512	0.102
Sodium	71.2J	102	20.5
Thallium	0.215J	0.512	0.102
Vanadium	21.9	0.512	0.102
Zinc	37.1	1.02	0.512

METHOD 6020A
METALS BY ICP-MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
SDG NO. : 08H299	Date Extracted: 09/02/08 15:15
Sample ID: YWM104-2290	Date Analyzed: 09/04/08 02:04
Lab Samp ID: H299-16	Dilution Factor: 1
Lab File ID: 98I02114	Matrix : SOIL
Ext Btch ID: IMI003S	% Moisture : 2.4
Calib. Ref.: 98I02108	Instrument ID : EMAXTI98

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Aluminum	10000	102	20.5
Antimony	ND	0.512	0.102
Arsenic	1.33	0.512	0.102
Barium	46.2	0.512	0.102
Beryllium	0.233J	0.512	0.102
Cadmium	ND	0.307	0.102
Calcium	618	102	20.5
Chromium	3.72	0.512	0.102
Cobalt	3.10	0.512	0.102
Copper	4.86	0.512	0.205
Iron	9200	102	20.5
Lead	3.29	0.512	0.102
Magnesium	2560	102	20.5
Manganese	203	0.512	0.102
Molybdenum	0.509J	0.512	0.102
Nickel	3.73	0.512	0.102
Potassium	1520	102	20.5
Selenium	0.163J	0.512	0.102
Silver	ND	0.512	0.102
Sodium	71.5J	102	20.5
Thallium	0.169J	0.512	0.102
Vanadium	19.0	0.512	0.102
Zinc	31.8	1.02	0.512

METHOD 6020A
METALS BY ICP-MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
SDG NO. : 08H299	Date Extracted: 09/02/08 15:15
Sample ID: YWM105-2291	Date Analyzed: 09/04/08 02:09
Lab Samp ID: H299-17	Dilution Factor: 1
Lab File ID: 98I02115	Matrix : SOIL
Ext Btch ID: IMI003S	% Moisture : 3.3
Calib. Ref.: 98I02108	Instrument ID : EMAXTI98

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Aluminum	12300	103	20.7
Antimony	ND	0.517	0.103
Arsenic	5.99	0.517	0.103
Barium	45.8	0.517	0.103
Beryllium	0.376J	0.517	0.103
Cadmium	0.144J	0.310	0.103
Calcium	526	103	20.7
Chromium	4.53	0.517	0.103
Cobalt	2.65	0.517	0.103
Copper	4.46	0.517	0.207
Iron	12100	103	20.7
Lead	4.80	0.517	0.103
Magnesium	2010	103	20.7
Manganese	167	0.517	0.103
Molybdenum	0.793	0.517	0.103
Nickel	3.49	0.517	0.103
Potassium	1260	103	20.7
Selenium	0.279J	0.517	0.103
Silver	ND	0.517	0.103
Sodium	73.4J	103	20.7
Thallium	0.169J	0.517	0.103
Vanadium	23.7	0.517	0.103
Zinc	25.5	1.03	0.517

METHOD 6020A
METALS BY ICP-MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
SDG NO. : 08H299	Date Extracted: 09/02/08 15:15
Sample ID: YWM106-2292	Date Analyzed: 09/04/08 02:15
Lab Samp ID: H299-18	Dilution Factor: 1
Lab File ID: 98I02116	Matrix : SOIL
Ext Btch ID: IMI003S	% Moisture : 2.5
Calib. Ref.: 98I02108	Instrument ID : EMAXTI98

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Aluminum	12400	103	20.5
Antimony	ND	0.513	0.103
Arsenic	1.76	0.513	0.103
Barium	41.3	0.513	0.103
Beryllium	0.332J	0.513	0.103
Cadmium	0.118J	0.308	0.103
Calcium	507	103	20.5
Chromium	4.26	0.513	0.103
Cobalt	2.99	0.513	0.103
Copper	4.37	0.513	0.205
Iron	10400	103	20.5
Lead	3.99	0.513	0.103
Magnesium	2140	103	20.5
Manganese	213	0.513	0.103
Molybdenum	0.712	0.513	0.103
Nickel	3.57	0.513	0.103
Potassium	1250	103	20.5
Selenium	0.226J	0.513	0.103
Silver	ND	0.513	0.103
Sodium	55.1J	103	20.5
Thallium	0.183J	0.513	0.103
Vanadium	21.3	0.513	0.103
Zinc	26.3	1.03	0.513

METHOD 6020A
METALS BY ICP-MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
SDG NO. : 08H299	Date Extracted: 09/02/08 15:15
Sample ID: YWM107-2293	Date Analyzed: 09/04/08 02:20
Lab Samp ID: H299-19	Dilution Factor: 1
Lab File ID: 98I02117	Matrix : SOIL
Ext Btch ID: IMI003S	% Moisture : 3.1
Calib. Ref.: 98I02108	Instrument ID : EMAXTI98

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Aluminum	13600	103	20.6
Antimony	ND	0.516	0.103
Arsenic	1.52	0.516	0.103
Barium	49.7	0.516	0.103
Beryllium	0.610	0.516	0.103
Cadmium	ND	0.310	0.103
Calcium	479	103	20.6
Chromium	5.15	0.516	0.103
Cobalt	3.13	0.516	0.103
Copper	4.47	0.516	0.206
Iron	12700	103	20.6
Lead	4.54	0.516	0.103
Magnesium	2150	103	20.6
Manganese	123	0.516	0.103
Molybdenum	0.863	0.516	0.103
Nickel	4.20	0.516	0.103
Potassium	1150	103	20.6
Selenium	0.215J	0.516	0.103
Silver	ND	0.516	0.103
Sodium	59.5J	103	20.6
Thallium	0.202J	0.516	0.103
Vanadium	25.5	0.516	0.103
Zinc	26.6	1.03	0.516

METHOD 6020A
METALS BY ICP-MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
SDG NO. : 08H299	Date Extracted: 09/02/08 15:15
Sample ID: YWM108-2294	Date Analyzed: 09/04/08 15:26
Lab Samp ID: H299-20	Dilution Factor: 1
Lab File ID: 98I03035	Matrix : SOIL
Ext Btch ID: IMI003S	% Moisture : 2.9
Calib. Ref.: 98I03029	Instrument ID : EMAXTI98

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Aluminum	15100	103	20.6
Antimony	0.144J	0.515	0.103
Arsenic	1.94	0.515	0.103
Barium	52.9	0.515	0.103
Beryllium	0.624	0.515	0.103
Cadmium	0.144J	0.309	0.103
Calcium	767	103	20.6
Chromium	5.65	0.515	0.103
Cobalt	3.14	0.515	0.103
Copper	4.87	0.515	0.206
Iron	12500	103	20.6
Lead	4.84	0.515	0.103
Magnesium	2180	103	20.6
Manganese	123	0.515	0.103
Molybdenum	1.09	0.515	0.103
Nickel	4.45	0.515	0.103
Potassium	1090	103	20.6
Selenium	0.227J	0.515	0.103
Silver	ND	0.515	0.103
Sodium	72.6J	103	20.6
Thallium	0.267J	0.515	0.103
Vanadium	25.9	0.515	0.103
Zinc	26.5	1.03	0.515

METHOD 6020A
METALS BY ICP-MS

Client : SHAW E&I	Date Collected: 08/26/08
Project : NPS WAA MATHER	Date Received: 08/28/08
SDG NO. : 08H299	Date Extracted: 09/02/08 15:15
Sample ID: YWM109-2295	Date Analyzed: 09/04/08 15:32
Lab Samp ID: H299-21	Dilution Factor: 1
Lab File ID: 98I03036	Matrix : SOIL
Ext Btch ID: IMI003S	% Moisture : 2.5
Calib. Ref.: 98I03029	Instrument ID : EMAXTI98

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Aluminum	12900	103	20.5
Antimony	0.111J	0.513	0.103
Arsenic	2.84	0.513	0.103
Barium	41.7	0.513	0.103
Beryllium	0.261J	0.513	0.103
Cadmium	ND	0.308	0.103
Calcium	804	103	20.5
Chromium	5.68	0.513	0.103
Cobalt	2.92	0.513	0.103
Copper	6.92	0.513	0.205
Iron	13300	103	20.5
Lead	4.88	0.513	0.103
Magnesium	2840	103	20.5
Manganese	189	0.513	0.103
Molybdenum	1.47	0.513	0.103
Nickel	4.09	0.513	0.103
Potassium	2110	103	20.5
Selenium	0.402J	0.513	0.103
Silver	ND	0.513	0.103
Sodium	78.8J	103	20.5
Thallium	0.259J	0.513	0.103
Vanadium	21.6	0.513	0.103
Zinc	33.9	1.03	0.513

METHOD 6020A
METALS BY ICP-MS

Client	: SHAW E&I	Date Collected:	08/26/08
Project	: NPS WAA MATHER	Date Received:	08/28/08
SDG NO.	: 08H299	Date Extracted:	09/02/08 15:00
Sample ID:	YWM110-2296	Date Analyzed:	09/03/08 23:58
Lab Samp ID:	H299-22	Dilution Factor:	1
Lab File ID:	98I02091	Matrix	: SOIL
Ext Btch ID:	IMI002S	% Moisture	: 3.3
Calib. Ref.:	98I02084	Instrument ID	: EMAXTI98

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Aluminum	14300	103	20.7
Antimony	0.191J	0.517	0.103
Arsenic	3.59	0.517	0.103
Barium	25.6	0.517	0.103
Beryllium	0.119J	0.517	0.103
Cadmium	ND	0.310	0.103
Calcium	444	103	20.7
Chromium	3.38	0.517	0.103
Cobalt	2.23	0.517	0.103
Copper	8.81	0.517	0.207
Iron	7120	103	20.7
Lead	4.31	0.517	0.103
Magnesium	1720	103	20.7
Manganese	104	0.517	0.103
Molybdenum	1.02	0.517	0.103
Nickel	2.76	0.517	0.103
Potassium	1200	103	20.7
Selenium	0.464J	0.517	0.103
Silver	ND	0.517	0.103
Sodium	51.7J	103	20.7
Thallium	0.161J	0.517	0.103
Vanadium	16.1	0.517	0.103
Zinc	20.3	1.03	0.517

CASE NARRATIVE

CLIENT: SHAW E&I

PROJECT: NPS WAA MATHER

SDG: 08H299

METHOD 9081
CATION EXCHANGE CAPACITY BY TRACE ICP

Two (2) soil samples were received on 08/28/08 for Cation Exchange Capacity analysis in accordance with Method 9081.

1. **Holding Time**

   Analysis met holding time criteria.

2. **Continuing Calibrations (CCV's) and ICSA/ICSAB**

   CCV's and ICSA/ICSAB were analyzed at a frequency specified by the project. All project requirements were met.

3. **Duplicate**

   Sample H299-04 was spiked. %RPD was within QC limit.

4. **Sample Analysis**

   Samples were analyzed according to the prescribed QC procedures. All criteria were met.

LAB CHRONICLE
CATIONS EXCHANGE CAPACITY BY TRACE ICP

Client : SHAW E&I
Project : NPS WAA MATHER

SDG NO. : 08H299
Instrument ID : T-ID8

SOIL

Client Sample ID	Laboratory Sample ID	Dilution Factor	% Moist	Analysis DateTime	Extraction DateTime	Sample Data FN	Calibration Data FN	Prep. Batch	Notes
YWM06-2276	H299-04	1	3.4	09/05/0803:16	09/04/0811:00	ID8I005141	ID8I005135	CEI001S	Field Sample
YWM06-2276DUP	H299-04D	1	3.4	09/05/0803:21	09/04/0811:00	ID8I005142	ID8I005135	CEI001S	Duplicate Sample
YWM08-2282	H299-09	1	0.5	09/05/0803:26	09/04/0811:00	ID8I005143	ID8I005135	CEI001S	Field Sample

FN - Filename
% Moist - Percent Moisture

METHOD 9081
CATION EXCHANGE CAPACITY BY TRACE ICP

Client : SHAW E&I	Date Collected: 08/26/08 15:45
Project : NPS WAA MATHER	Date Received: 08/28/08
SDG NO. : 08H299	Date Extracted: 09/04/08 11:00
Sample ID: YWM06-2276	Date Analyzed: 09/05/08 03:16
Lab Samp ID: H299-04	Dilution Factor: 1
Lab File ID: ID8I005141	Matrix : SOIL
Ext Btch ID: CEI001S	% Moisture : 3.4
Calib. Ref.: ID8I005135	Instrument ID : EMAXTID8

PARAMETERS	RESULTS (meq/100gm)	RL (meq/100gm)	MDL (meq/100gm)
Cation Exchange Capacity	16.2	NA	NA

METHOD 9081
CATION EXCHANGE CAPACITY BY TRACE ICP

Client	: SHAW E&I	Date Collected:	08/26/08 14:40
Project	: NPS WAA MATHER	Date Received:	08/28/08
SDG NO.	: 08H299	Date Extracted:	09/04/08 11:00
Sample ID:	YWM08-2282	Date Analyzed:	09/05/08 03:26
Lab Samp ID:	H299-09	Dilution Factor:	1
Lab File ID:	ID8I005143	Matrix	: SOIL
Ext Btch ID:	CEI001S	% Moisture	: 0.5
Calib. Ref.:	ID8I005135	Instrument ID	: EMAXTID8

PARAMETERS	RESULTS (meq/100gm)	RL (meq/100gm)	MDL (meq/100gm)
Cation Exchange Capacity	7.11	NA	NA

CASE NARRATIVE

CLIENT: SHAW E&I

PROJECT: NPS WAA MATHER

SDG: 08H299

METHOD 7471A
MERCURY BY COLD VAPOR

Twenty-one (21) soil samples were received on 08/28/08 for Mercury analysis by Method 7471A in accordance with "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW846, 3rd edition and DOD QSM, v.3.

1. **Holding Time**

   Analysis met holding time criteria.

2. **Continuing Calibrations (CCV's)**

   CCV's were analyzed at a frequency specified by the project. All project requirements were met.

3. **Method Blank**

   Method blanks were free of contamination at half of reporting limit.

4. **Lab Control Sample/Lab Control Sample Duplicate**

   Lab control results were within QC limit.

5. **Serial Dilution/Post-Analytical Spike**

   Sample H299-04 and sample H298-01 from another SDG were analyzed for serial dilution and post-analytical spike. All QC requirements were met.

6. **Matrix Spike/Matrix Spike Duplicate**

   Sample H299-04 was spiked. All recoveries were within QC limit.

7. **Sample Analysis**

   Samples were analyzed according to the prescribed QC procedures. All criteria were met.

LAB CHRONICLE
MERCURY BY COLD VAPOR

Client : SHAW E&I
Project : NPS WAA MATHER

SDG NO. : 08H299
Instrument ID : TI047

SOIL

Client Sample ID	Laboratory Sample ID	Dilution Factor	% Moist	Analysis DateTime	Extraction DateTime	Sample Data FN	Calibration Data FN	Prep. Batch	Notes
MBLK1S	HGI008SB	1	NA	09/05/0818:24	09/05/0811:00	M47I005045	M47I005035	HGI008S	Method Blank
LCS1S	HGI008SL	1	NA	09/05/0818:26	09/05/0811:00	M47I005046	M47I005035	HGI008S	Lab Control Sample (LCS)
LCD1S	HGI008SC	1	NA	09/05/0818:32	09/05/0811:00	M47I005049	M47I005047	HGI008S	LCS Duplicate
YWB05-2241	H298-01	1	3.4	09/05/0818:36	09/05/0811:00	M47I005051	M47I005047	HGI008S	Field Sample
YWB05-2241DL	H298-01J	5	3.4	09/05/0818:38	09/05/0811:00	M47I005052	M47I005047	HGI008S	Diluted Sample
YWM110-2296	H299-22	1	3.3	09/05/0819:30	09/05/0811:00	M47I005077	M47I005071	HGI008S	Field Sample
MBLK2S	HGI009SB	1	NA	09/05/0819:32	09/05/0811:30	M47I005078	M47I005071	HGI009S	Method Blank
LCS2S	HGI009SL	1	NA	09/05/0819:34	09/05/0811:30	M47I005079	M47I005071	HGI009S	Lab Control Sample (LCS)
LCD2S	HGI009SC	1	NA	09/05/0819:36	09/05/0811:30	M47I005080	M47I005071	HGI009S	LCS Duplicate
YWM06-2276	H299-04	1	3.4	09/05/0819:40	09/05/0811:30	M47I005082	M47I005071	HGI009S	Field Sample
YWM06-2276DL	H299-04J	5	3.4	09/05/0819:47	09/05/0811:30	M47I005085	M47I005083	HGI009S	Diluted Sample
YWM06-2276MS	H299-04M	1	3.4	09/05/0819:49	09/05/0811:30	M47I005086	M47I005083	HGI009S	Matrix Spike Sample (MS)
YWM06-2276MSD	H299-04S	1	3.4	09/05/0819:51	09/05/0811:30	M47I005087	M47I005083	HGI009S	MS Duplicate (MSD)
YWM02A-2268	H299-01	1	4.1	09/05/0819:53	09/05/0811:30	M47I005088	M47I005083	HGI009S	Field Sample
YWM06-2274	H299-03	1	0.7	09/05/0819:55	09/05/0811:30	M47I005089	M47I005083	HGI009S	Field Sample
YWM07-2277	H299-05	1	4.5	09/05/0819:57	09/05/0811:30	M47I005090	M47I005083	HGI009S	Field Sample
YWM07-2279	H299-06	1	3.2	09/05/0819:59	09/05/0811:30	M47I005091	M47I005083	HGI009S	Field Sample
YWM08-2280	H299-07	1	1.7	09/05/0820:01	09/05/0811:30	M47I005092	M47I005083	HGI009S	Field Sample
YWM08-2281	H299-08	1	0.6	09/05/0820:03	09/05/0811:30	M47I005093	M47I005083	HGI009S	Field Sample
YWM08-2282	H299-09	1	0.5	09/05/0820:05	09/05/0811:30	M47I005094	M47I005083	HGI009S	Field Sample
YWM09-2284	H299-10	1	4.2	09/05/0820:11	09/05/0811:30	M47I005097	M47I005095	HGI009S	Field Sample
YWM09-2285	H299-11	1	1.4	09/05/0820:13	09/05/0811:30	M47I005098	M47I005095	HGI009S	Field Sample
YWM09-2286	H299-12	1	2.6	09/05/0820:15	09/05/0811:30	M47I005099	M47I005095	HGI009S	Field Sample
YWM101-2287	H299-13	1	3.9	09/05/0820:17	09/05/0811:30	M47I005100	M47I005095	HGI009S	Field Sample
YWM102-2288	H299-14	1	5.1	09/05/0820:19	09/05/0811:30	M47I005101	M47I005095	HGI009S	Field Sample
YWM103-2289	H299-15	1	2.4	09/05/0820:21	09/05/0811:30	M47I005102	M47I005095	HGI009S	Field Sample
YWM104-2290	H299-16	1	2.4	09/05/0820:23	09/05/0811:30	M47I005103	M47I005095	HGI009S	Field Sample
YWM105-2291	H299-17	1	3.3	09/05/0820:25	09/05/0811:30	M47I005104	M47I005095	HGI009S	Field Sample
YWM106-2292	H299-18	1	2.5	09/05/0820:27	09/05/0811:30	M47I005105	M47I005095	HGI009S	Field Sample
YWM107-2293	H299-19	1	3.1	09/05/0820:29	09/05/0811:30	M47I005106	M47I005095	HGI009S	Field Sample
YWM108-2294	H299-20	1	2.9	09/05/0820:35	09/05/0811:30	M47I005109	M47I005107	HGI009S	Field Sample
YWM109-2295	H299-21	1	2.5	09/05/0820:37	09/05/0811:30	M47I005110	M47I005107	HGI009S	Field Sample

FN - Filename
% Moist - Percent Moisture

METHOD 7471A
MERCURY BY COLD VAPOR

Client : SHAW E&I
Project : NPS WAA MATHER
Batch No. : 08H299

Matrix : SOIL
Instrument ID : TI047

SAMPLE ID	EMAX SAMPLE ID	RESULTS (mg/kg)	DLF	MOIST	RL (mg/kg)	MDL (mg/kg)	Analysis DATETIME	Extraction DATETIME	LFID	CAL REF	PREP BATCH	Collection DATETIME	Received DATETIME
MBLK1S	HGI008SB	ND	1	NA	0.100	0.0330	09/05/0818:24	09/05/0811:00	M47I005045	M47I005035	HGI008S	NA	09/05/08
LCS1S	HGI008SL	0.810	1	NA	0.100	0.0330	09/05/0818:26	09/05/0811:00	M47I005046	M47I005035	HGI008S	NA	09/05/08
LCD1S	HGI008SC	0.818	1	NA	0.100	0.0330	09/05/0818:32	09/05/0811:00	M47I005049	M47I005047	HGI008S	NA	09/05/08
YWM110-2296	H299-22	0.0808J	1	3.3	0.103	0.0341	09/05/0819:30	09/05/0811:00	M47I005077	M47I005071	HGI008S	08/26/08	08/28/08
MBLK2S	HGI009SB	ND	1	NA	0.100	0.0330	09/05/0819:32	09/05/0811:30	M47I005078	M47I005071	HGI009S	NA	09/05/08
LCS2S	HGI009SL	0.787	1	NA	0.100	0.0330	09/05/0819:34	09/05/0811:30	M47I005079	M47I005071	HGI009S	NA	09/05/08
LCD2S	HGI009SC	0.782	1	NA	0.100	0.0330	09/05/0819:36	09/05/0811:30	M47I005080	M47I005071	HGI009S	NA	09/05/08
YWM06-2276	H299-04	ND	1	3.4	0.104	0.0342	09/05/0819:40	09/05/0811:30	M47I005082	M47I005071	HGI009S	08/26/08	08/28/08
YWM06-2276DL	H299-04J	ND	5	3.4	0.518	0.171	09/05/0819:47	09/05/0811:30	M47I005085	M47I005083	HGI009S	08/26/08	08/28/08
YWM06-2276MS	H299-04M	0.832	1	3.4	0.104	0.0342	09/05/0819:49	09/05/0811:30	M47I005086	M47I005083	HGI009S	08/26/08	08/28/08
YWM06-2276MSD	H299-04S	0.823	1	3.4	0.104	0.0342	09/05/0819:51	09/05/0811:30	M47I005087	M47I005083	HGI009S	08/26/08	08/28/08
YWM02A-2268	H299-01	0.746	1	4.1	0.104	0.0344	09/05/0819:53	09/05/0811:30	M47I005088	M47I005083	HGI009S	08/26/08	08/28/08
YWM06-2274	H299-03	0.232	1	0.7	0.101	0.0332	09/05/0819:55	09/05/0811:30	M47I005089	M47I005083	HGI009S	08/26/08	08/28/08
YWM07-2277	H299-05	0.417	1	4.5	0.105	0.0346	09/05/0819:57	09/05/0811:30	M47I005090	M47I005083	HGI009S	08/26/08	08/28/08
YWM07-2279	H299-06	ND	1	3.2	0.103	0.0341	09/05/0819:59	09/05/0811:30	M47I005091	M47I005083	HGI009S	08/26/08	08/28/08
YWM08-2280	H299-07	0.485	1	1.7	0.102	0.0336	09/05/0820:01	09/05/0811:30	M47I005092	M47I005083	HGI009S	08/26/08	08/28/08
YWM08-2281	H299-08	0.758	1	0.6	0.101	0.0332	09/05/0820:03	09/05/0811:30	M47I005093	M47I005083	HGI009S	08/26/08	08/28/08
YWM08-2282	H299-09	1.14	1	0.5	0.101	0.0332	09/05/0820:05	09/05/0811:30	M47I005094	M47I005083	HGI009S	08/26/08	08/28/08
YWM09-2284	H299-10	0.358	1	4.2	0.104	0.0344	09/05/0820:11	09/05/0811:30	M47I005097	M47I005095	HGI009S	08/26/08	08/28/08
YWM09-2285	H299-11	1.37	1	1.4	0.101	0.0335	09/05/0820:13	09/05/0811:30	M47I005098	M47I005095	HGI009S	08/26/08	08/28/08
YWM09-2286	H299-12	0.329	1	2.6	0.103	0.0339	09/05/0820:15	09/05/0811:30	M47I005099	M47I005095	HGI009S	08/26/08	08/28/08
YWM101-2287	H299-13	ND	1	3.9	0.104	0.0343	09/05/0820:17	09/05/0811:30	M47I005100	M47I005095	HGI009S	08/26/08	08/28/08
YWM102-2288	H299-14	ND	1	5.1	0.105	0.0348	09/05/0820:19	09/05/0811:30	M47I005101	M47I005095	HGI009S	08/26/08	08/28/08
YWM103-2289	H299-15	ND	1	2.4	0.102	0.0338	09/05/0820:21	09/05/0811:30	M47I005102	M47I005095	HGI009S	08/26/08	08/28/08
YWM104-2290	H299-16	ND	1	2.4	0.102	0.0338	09/05/0820:23	09/05/0811:30	M47I005103	M47I005095	HGI009S	08/26/08	08/28/08
YWM105-2291	H299-17	ND	1	3.3	0.103	0.0341	09/05/0820:25	09/05/0811:30	M47I005104	M47I005095	HGI009S	08/26/08	08/28/08
YWM106-2292	H299-18	ND	1	2.5	0.103	0.0338	09/05/0820:27	09/05/0811:30	M47I005105	M47I005095	HGI009S	08/26/08	08/28/08
YWM107-2293	H299-19	ND	1	3.1	0.103	0.0341	09/05/0820:29	09/05/0811:30	M47I005106	M47I005095	HGI009S	08/26/08	08/28/08
YWM108-2294	H299-20	ND	1	2.9	0.103	0.0340	09/05/0820:35	09/05/0811:30	M47I005109	M47I005107	HGI009S	08/26/08	08/28/08
YWM109-2295	H299-21	0.0487J	1	2.5	0.103	0.0338	09/05/0820:37	09/05/0811:30	M47I005110	M47I005107	HGI009S	08/26/08	08/28/08

LABORATORY REPORT FOR

SHAW E&I

NPS WAA MATHER

WET CHEMICAL ANALYSES

SDG#: 08H299

CASE NARRATIVE

CLIENT: SHAW E&I

PROJECT: NPS WAA MATHER

SDG: 08H299

METHOD 9045C
pH

Two (2) soil samples were received on 08/28/08 for pH analysis by Method 9045C in accordance with "Test Methods for Evaluating Solid Waste, Physical/Chemical Method", SW846, 3rd edition.

1. **Holding Time**

   Extract of soil samples were analyzed on the same day as extraction.

2. **Duplicate**

   Sample H299-04 was analyzed for duplicate. %RPD was within QC limit.

3. **Sample Analysis**

   Samples were analyzed according to the prescribed QC procedures. All criteria were met.

METHOD 9045C
PH

Client : SHAW E&I
Project : NPS WAA MATHER
Batch No. : 08H299

Matrix : SOIL
Instrument ID : I53

SAMPLE ID	EMAX SAMPLE ID	RESULTS (pH Unit)	DLF	MOIST	RL (pH Unit)	MDL (pH Unit)	Analysis DATETIME	Extraction DATETIME	LFID	CAL REF	PREP BATCH	Collection DATETIME	Received DATETIME
YWM06-2276	H299-04	6.02	1	NA	NA	NA	08/29/0818:02	08/29/0816:30	PHH02705	PHH02701	PHH027S	08/26/0815:45	08/28/08
YWM06-2276DUP	H299-04D	6.01	1	NA	NA	NA	08/29/0818:04	08/29/0816:30	PHH02706	PHH02701	PHH027S	08/26/0815:45	08/28/08
YWM08-2282	H299-09	5.72	1	NA	NA	NA	08/29/0818:05	08/29/0816:30	PHH02707	PHH02701	PHH027S	08/26/0814:40	08/28/08

CASE NARRATIVE

CLIENT: SHAW E&I

PROJECT: NPS WAA MATHER

SDG: 08H299

TOC BY WALKLEY BLACK METHOD

Two (2) soil samples were received on 08/28/08 for TOC analysis by Walkley Black Method in accordance with "Methods of Soil Analysis, ASA, SSSA", 1992.

1. **Holding Time**

   Analysis met holding time criteria.

2. **Method Blank**

   Method blank was free of contamination at the reporting limit.

3. **Lab Control Sample/Lab Control Sample Duplicate**

   Lab control results were within QC limit.

4. **Duplicate**

   Sample H299-04 was analyzed for duplicate. %RPD was within QC limit.

5. **Sample Analysis**

   Samples were analyzed according to the prescribed QC procedures. All criteria were met.

TOC BY WALKLEY-BLACK METHOD

Client : SHAW E&I
Project : NPS WAA MATHER
Batch No. : 08H299

Matrix : SOIL
Instrument ID : NA

SAMPLE ID	EMAX SAMPLE ID	RESULTS (mg/kg)	DLF	MOIST	RL (mg/kg)	MDL (mg/kg)	Analysis DATETIME	Extraction DATETIME	LFID	CAL REF	PREP BATCH	Collection DATETIME	Received DATETIME
MBLK1S	BCI001SB	ND	1	NA	1000	500	09/05/0813:55	NA	BCI00101	NA	BCI001S	NA	NA
LCS1S	BCI001SL	2000	1	NA	1000	500	09/05/0813:55	NA	BCI00102	NA	BCI001S	NA	NA
LCD1S	BCI001SC	1900	1	NA	1000	500	09/05/0813:56	NA	BCI00103	NA	BCI001S	NA	NA
YWM06-2276	H299-04	9510	1	3.4	1040	518	09/05/0813:57	NA	BCI00108	NA	BCI001S	08/26/0815:45	08/28/08
YWM06-2276DUP	H299-04D	9180	1	3.4	1040	518	09/05/0813:57	NA	BCI00109	NA	BCI001S	08/26/0815:45	08/28/08
YWM08-2282	H299-09	2010	1	0.5	1010	503	09/05/0813:57	NA	BCI00110	NA	BCI001S	08/26/0814:40	08/28/08

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: SHAW E&I
PROJECT: NPS WAA MATHER
METHOD: TOC by Walkley-Black
MATRIX: SOIL
% MOISTURE: NA

BATCH NO.: 08H299
SAMPLE ID: LCS1S/LCD1S
CONTROL NO.: BCI001SL/C

DATE RECEIVED: NA
DATE EXTRACTED: NA
DATE ANALYZED: 09/05/08 13:55/13:56

ACCESSION:

PARAMETER	BLNK RSLT (mg/kg)	SPIKE AMT (mg/kg)	BS RSLT (mg/kg)	BS % REC	SPIKE AMT (mg/kg)	BSD RSLT (mg/kg)	BSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TOC	ND	1000	2000	200*	1000	1900	190*	5	80-120	20

EMAX QUALITY CONTROL DATA
DUPLICATE ANALYSIS

CLIENT: SHAW E&I
PROJECT: NPS WAA MATHER
METHOD: TOC by Walkley-Black
MATRIX: SOIL
% MOISTURE: NA

==

BATCH NO.: 08H299
SAMPLE ID: YWM06-2276DUP
CONTROL NO.: H299-04D

DATE RECEIVED: 08/28/08
DATE EXTRACTED: NA
DATE ANALYZED: 09/05/08 13:57

ACCESSION:

PARAMETER	SAMPLE (mg/kg)	DUP. SAMPLE (mg/kg)	RPD (%)	RPD LIMIT (%)
TOC	9510	9180	4	20

LABORATORY REPORT FOR

SHAW E&I

NPS WAA MATHER

MOISTURE CONTENT DETERMINATION

SDG#: 08H299

MOISTURE CONTENT DETERMINATION

Analytical Batch:	08MCI005	Start Date/Time:	09/08/08	12:07	Temp IN (°C): 103
Instrument ID:	10601202	End Date/Time:	09/09/08	11:55	Temp Out (°C): 105

Sample ID	Weight of Dish (g)	Wet Weight+ Dish (g)	Dry Weight+ Dish (g)	Percent Solids	Percent Moisture	NOTES
I032-01	1.252	6.494	5.706	85.0%	15.0%	0.8%
I032-01D	1.239	6.578	5.782	85.1%	14.9%	
I032-02	1.243	9.513	7.952	81.1%	18.9%	
H299-01	1.284	6.513	6.297	95.9%	4.1%	
H299-02	1.275	6.895	6.544	93.8%	6.2%	
H299-03	1.25	8.919	8.863	99.3%	0.7%	
H299-04	1.292	8.638	8.386	96.6%	3.4%	
H299-05	1.267	6.505	6.27	95.5%	4.5%	
H299-06	1.267	6.868	6.686	96.8%	3.2%	
H299-07	1.264	6.438	6.348	98.3%	1.7%	
H299-08	1.272	6.984	6.952	99.4%	0.6%	
H299-09	1.325	6.374	6.351	99.5%	0.5%	
H299-10	1.254	6.449	6.229	95.8%	4.2%	
H299-11	1.296	6.449	6.376	98.6%	1.4%	
H299-12	1.24	6.436	6.303	97.4%	2.6%	
H299-13	1.275	6.411	6.212	96.1%	3.9%	
H299-14	1.315	6.462	6.198	94.9%	5.1%	
H299-15	1.259	6.457	6.333	97.6%	2.4%	
H299-16	1.254	6.371	6.249	97.6%	2.4%	
H299-17	1.319	7.431	7.229	96.7%	3.3%	
H299-18	1.073	6.575	6.439	97.5%	2.5%	

COMMENT:

Initial Reading by: RK

Final Reading by: CD CD

Reviewed by: ML for JM

MOISTURE CONTENT DETERMINATION

Analytical Batch:	08MCI006	Start Date/Time:	09/08/08	12:39	Temp IN (°C):	103
Instrument ID:	10601202	End Date/Time:	09/09/08	11:57	Temp Out (°C):	105

Sample ID	Weight of Dish (g)	Wet Weight+ Dish (g)	Dry Weight+ Dish (g)	Percent Solids	Percent Moisture	NOTES
H299-19	1.264	6.59	6.425	96.9%	3.1%	
H299-20	1.272	6.747	6.589	97.1%	2.9%	
H299-21	1.277	6.795	6.659	97.5%	2.5%	
H299-22	1.265	6.96	6.774	96.7%	3.3%	
I042-01	1.249	9.179	7.822	82.9%	17.1%	
I043-01	1.264	7.02	5.982	82.0%	18.0%	7.1%
I043-01D	1.269	7.575	6.354	80.6%	19.4%	

COMMENT:

Initial Reading by: RK

Final Reading by: CD CD

Reviewed by: ML for JM

PTS
Laboratories, Inc.

8100 Secura Way • Santa Fe Springs, CA 90670
Telephone (562) 347-2500 • Fax (562) 907-3610

September 19, 2008

Susan Huang
Shaw Environmental
4005 Port Chicago Hwy.
Concord CA 94520

Re: PTS File No: 38800
Physical Properties Data
National Park Service; 870508

Dear Ms. Huang:

Please find enclosed report for Physical Properties analyses conducted upon cores received from your National Park Service; 870508 project. All analyses were performed by applicable ASTM, EPA, or API methodologies. An electronic version of the report has previously been sent to your attention via the internet. The samples are currently in storage and will be retained for thirty days past completion of testing at no charge. Please note that the samples will be disposed of at that time. You may contact me regarding storage, disposal, or return of the samples.

PTS Laboratories appreciates the opportunity to be of service. If you have any questions or require additional information, please give me a call at (562) 347-2504.

Sincerely,
PTS Laboratories

Rachel Spitz
Project Manager

Encl.

PTS Laboratories

Project Name: National Park Service
Project Number: 870508

PTS File No: 38800
Client: Shaw Environmental & Infrastructure

TEST PROGRAM

CORE ID	Depth ft.	Core Recovery ft.	Dry Bulk Density ASTM D2937			Notes
		Plugs:	Ring			
Rcvd. 8/29/08						
YWM06-2276	N/A	0.5	X			
YWM08-2282	N/A	0.5	X			
YWB08-2251	N/A	0.5	X			
YWB05-2241	N/A	0.5	X			
TOTALS:	4 cores	2	4			

Laboratory Test Program Notes

PTS File No: 38800
Client: Shaw Environmental & Infrastructure

DRY BULK DENSITY OF IN-PLACE SOIL

(METHODOLOGY: ASTM D2937)

PROJECT NAME: National Park Service
PROJECT NO: 870508

SAMPLE ID.	DEPTH, ft.	TOTAL SAMPLE VOLUME, cc	MOISTURE CONTENT, % wt	VOLUMETRIC WATER CONTENT, fraction Vb	DRY BULK DENSITY, g/cc
YWM06-2276	N/A	134.83	3.3	0.053	1.61
YWM08-2282	N/A	132.47	0.5	0.011	2.02
YWB08-2251	N/A	143.14	2.6	0.044	1.71
YWB05-2241	N/A	141.21	2.7	0.041	1.51

* Vb = Bulk Volume

38800 **Chain Of Custody** COC # 461

PROJ NO.	PROJECT NAME	
870508	NATIONAL PARK SERVICE	YOSEMITE: WAA Baseline - NPS 36
SHAW Contact (Name and Phone Number)	Susan Huang - (925) 288-2099	
NAME OF SAMPLER:	J. Strack, B. Matz, N. Hauelt	

Cooler Temperature: 84°F
Cooler: 1 of 1
Ship Date: 8-28-08
PO: UPS 1Z6V6V5450198844260
FedEx/Airborne No: ___________
Cost Code: 870508-02103150

Lab Contact:
PST
8100 Secura Way
Santa Fe Springs, CA 90670
Tel 562 907-3607

Location ID	Sample DATE (mmddyy)	Sample ~~TIME~~	1 x 6" Brass Sleeve / ~~NA~~ / ASTM D2937 Bulk Density	MATRIX A=Aqueous or S=Solid	Please Mark 1 MS/MSD per MATRIX per shipment / COMMENTS
Temperature Blank					One 40 mL in each cooler
YWB08-2251	082508	1230	X	S	
YWB05-2241	082508	1300	X	S	
——— LAST LINE ———					

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Joe Strack	8-28-08/1000	(PTS) 8-29-08 1550			
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)

U:\National Park Service\database\Pre-Sampling\COCs Access.mdb\ rpt_WaaBaselineCOC-PST

38800

Chain Of Custody

COC # 481

PROJ NO.	PROJECT NAME	
870508	NATIONAL PARK SERVICE	YOSEMITE: WAA Mather - NPS 37
SHAW Contact (Name and Phone Number)	Susan Huang - (925) 288-2099	
NAME OF SAMPLER:	B.Matz, J.Strack, N.Hanelt	

Cooler Temperature: 8.4°F
Cooler: 1 of 1
Ship Date: 8-28-08
PO: VBS 1266 V8450198264260
FedEx/Airborne No: ________
Cost Code: 870508-02103150

Lab Contact:
PST
8100 Secura Way
Santa Fe Springs, CA 90670
Tel 562 907-3607

Location ID	Sample DATE (mmddyy)	Sample TIME	1 x 6" Brass Sleeve / ~~NA~~ / ASTM D2937 Bulk Density	MATRIX A=Aqueous or S=Solid	*Please Mark 1 MS/MSD per MATRIX per shipment* COMMENTS
Temperature Blank					One 40 mL in each cooler
YWM06-2276	082608	1545	X	S	
YWM08-2282	082608	1440	X	S	
——LAST LINE——					

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Joe Strack	8-28-08/1020	[signature] (PTS) 8/29/08 1556			

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APPENDIX C
LABORATORY DATA QUALITY ASSESSMENT

APPENDIX C

LABORATORY DATA QUALITY ASSESSMENT

Laboratory data quality assessments (DQAs) were performed to evaluate the analytical results obtained in each of the two site inspections at Mather WAA. The detailed results are presented in the following sections and on the associated DQA summary tables. Table C-1 summarizes the sample numbers, laboratory ID numbers, sampling dates, extraction dates, analysis dates and data review level for the 2001 and 2008 Mather WAA sampling events. Table C-2 presents the definitions of data qualifications and reason codes applied to the affected sample results in the 2001 and 2008 DQAs.

2001 Laboratory Data Quality Assessment

Fifteen soil samples were collected on August 27 and 28, 2001, from the Mather Waste Accumulation Area (WAA), Yosemite National Park, California. One field duplicate sample and one rinsate sample were also generated during the sampling period. The analyses described in Section 3.5 were conducted on the soil samples and the equipment blank, however not every analysis was requested for every sample. All samples were analyzed by Applied Physics & Chemistry Laboratory located in Chino, California.

A Level III data review was performed on all analytical results. The review was conducted in accordance with the guidelines and control criteria specified in the Plan, and in *National Functional Guidelines for Organic Data Review,* (USEPA, 1999) and *National Functional Guidelines for Inorganic Data Review*, (USEPA, 1994). The following Quality Control (QC) elements were included in the Level III data review:

- Sample holding times;
- Surrogate recoveries;
- Laboratory control sample/laboratory control sample duplicate recoveries (LCS/LCSD);
- Matrix spike/matrix spike duplicate recoveries (MS/MSD);
- Relative percent differences (RPD);
- Internal Standard Recoveries;
- Initial calibrations;
- Continuing calibrations;
- Laboratory Method Blanks; and
- Field Blanks.

The following sections provide a discussion of the review. The discussion focuses on the QC analytical results that were outside their respective control criteria and the potential impact of non-compliant issues on the data usability. The discussion does not include sample results associated with acceptable control limits. Qualified data and their associated sampling locations are identified in Table C-3.

- **Serial Dilution, Reason Code A.** Detected results for arsenic, barium, chromium, cobalt, lead, mercury, nickel, and zinc in all of the soil samples were qualified as estimated (J) because the percent difference in the serial dilution analysis did not meet the acceptance criterion for accuracy. Qualified data for the affected analytes are considered to be quantitatively uncertain due to matrix effects. Since the percent differences for most of the non-compliant analytes were marginally above the acceptance criterion, the serial dilution deviations have minimal effect on data quality and usability.

- **Method Blank Contamination, Reason Code B.** Detected results for molybdenum in two soil samples were qualified as non-detected (U) because molybdenum was also detected in the associated method blank. Sample results with concentrations less than five times the blank concentration for molybdenum were qualified as non-detected (U). Qualified sample results less than the reporting limit were raised to the laboratory reporting limit. Laboratory blank contamination did not significantly affect data quality and usability.
- **Laboratory Duplicate Sample, Reason Code D.** Detected results for barium in all of the soil samples and for cadmium in four soil samples were qualified as estimated (J) because the RPD in the sample duplicate analysis did not meet the acceptance criterion for precision. Qualified data for barium and cadmium have the potential for variability due to sample non-homogeneity and matrix effects. Overall, the non-compliant duplicate analyses have minimal impact on data quality and usability.
- **Hydrocarbon Pattern Matching, Reason Code F.** Detected results for Total Petroleum Hydrocarbons (TPH) as diesel and motor oils in the equipment blank sample were qualified as estimated (J) because the hydrocarbon pattern in the sample does not match the hydrocarbon pattern in the standard. The results reported in the equipment blank sample do not represent TPD asdiesel or TPH as motor oils as the chromatographic patterns indicate individual or series of peaks not consistent with fuel mixtures. Qualified data for TPH as diesel and TPH as motor oils in the equipment blank sample may be considered to be unknown hydrocarbons.
- **Holding Time, Reason Code H.** The quantitation limits for hexavalent chromium in all of the soil samples were qualified as estimated (UJ) because of holding time violations. Qualified data for hexavalent chromium have the potential to be biased low. Overall, the holding time deviations have minimal impact on data quality and usability.
- **Matrix Spike, Reason Code M.** Detected results and quantitation limits for cadmium, chromium, and thallium in all of the soil samples and for TPH as diesel, acenaphthene, acenaphthylene, dibenz(a,h) anthracene, fluorene, and naphthalene in the unspiked QC soil sample were qualified as estimated (J/UJ) because the percent recoveries for these analytes in the matrix spike sample did not meet the acceptance criteria for accuracy. Qualified data for the affected spiked analytes have the potential to be biased low. Since the percent recoveries for most of the non-compliant spiked analytes were marginally below the lower control limit, the matrix spike deviations have minimal impact on data quality and usability.

Field Quality Control Samples: Field aqueous QC samples included one equipment rinse sample; no trip blank was submitted because no samples were submitted for analysis of volatile organic compounds (VOCs). The field aqueous QC data are included in the laboratory reports in Appendix B.

Equipment Rinse Sample: The equipment rinse sample was analyzed for the same parameters as the field investigative samples. In the equipment rinse, chromium, lead, and nickel were reported at estimated values well below their respective PQLs. Chromium, lead, and nickel were also detected in the source blank, previously collected during the Vogelsang investigation (IT, 2001), at equivalent concentrations. Zinc was reported above the PQL at 132 micrograms per liter (µg/L), but zinc was also detected in the source blank at a lower concentration. In general, zinc may be considered to be a common laboratory contaminant. As a result, chromium, lead, nickel, and zinc in the equipment rinse sample are considered to be non-detected. No other parameters were detected in the equipment rinse, indicating acceptable equipment decontamination.

Field Duplicate Sample: One field duplicate soil sample was collected in test pit TP02 at six feet bgs in August 2001. The data from the duplicate pair were compared using relative percent difference (RPD) calculations. Results of the calculations are presented in Table C-4. The acceptance limit specified in the plan for precision between duplicate soil samples is 50 percent. Sixteen of 26 calculated RPDs exceeded the acceptance limit. Field duplicate imprecision can be caused by sample non-homogeneity and matrix effects. The data are not qualified based on these field duplicate RPD results.

2001 Laboratory Data Quality Assessment Summary: The laboratory data quality for the sampling event met the quality assurance objectives and project goals specified in the Plan.

2008 Laboratory Data Quality Assessment

Site investigation samples and background samples were collected from Mather WAA, Yosemite National Park, California on August 26, 2008. The samples were shipped to EMAX Laboratories, Inc., located in Torrance, California for analyses. EMAX holds a current National Environmental Laboratory Accreditation Program (NELAP) certification from the State of California Department of Health Services to perform the required analyses. Samples from selected locations were shipped to PST laboratories, Inc. located in Santa Fe Springs, California for bulk density analysis.

Because the site is located in a remote area, soil samples for VOCs and TPH as gasoline analyses were collected in EnCore sampling devices and kept on dry ice immediately after the sampling. The VOCs and TPH as gasoline samples were stored on dry ice during shipping to the off site laboratory and kept in a freezer at the laboratory until the analysis. Non-volatile organic samples were also properly preserved prior to the analysis.

The Data Validation Group, Inc. located in Rancho Santa Margarita, California manually performed a Level III data review for the majority of the analytical results obtained from the sampling event. A Shaw project chemist manually performed a Level III data review on the remaining soil characterization data, which consists of total organic carbons (TOC), pH, and cation exchange capacity. The review was performed in accordance with the guidelines and control criteria specified in the following documents:

- Department of Defense Quality Systems Manual for Environmental Laboratories (DoD QSM, Final Version 3, January 2006);
- USEPA Test Methods for Evaluating Solid Waste, SW-846 Physical/Chemical Methods (EPA, 1996);
- USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (EPA, 1999) and
- USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (EPA, 2004).

The following QC elements were included in the Level III data review:

- Laboratory method blanks;
- Initial and continuing calibration blanks (metals only);
- Sample extraction and analysis holding times;
- Surrogate recoveries;
- LCS/LCSD;
- MS/MSD;
- RPD;
- Internal standard recoveries;
- Inductively Coupled Plasma (ICP) serial dilution (metals only);
- Initial calibration;
- Continuing calibration;

- Field duplicates; and
- Field blanks.

The 2008 data were reviewed in terms of precision, accuracy, representativeness, comparability, and completeness (PARCC). The PARCC parameters were evaluated for the analytical data as follows:

- Accuracy is demonstrated by recovery of target analytes from fortified blank and sample matrices, LCS/LCSD and MS/MSD, respectively. The recovery of target analytes from fortified samples is compared to acceptance criteria. For organic methods, accuracy is also demonstrated through recovery of surrogates from each field and QC samples. When these criteria are not met, the data are flagged as appropriate.
- Precision is expressed as RPD between the results of replicate sample analyses: sample duplicates, LCSDs and MSDs. When analyte RPDs exceed the acceptance criteria, the data are flagged as appropriate.
- Representativeness of the samples submitted for analysis is ensured by adherence to standard sampling techniques and protocols.
- Comparability of sample results is ensured through the use of approved sampling and analysis methods.
- Completeness is expressed as a ratio of number of usable data to all analytical data.

The following presents a discussion of the third party data review findings. Table C-2 presents definitions of data qualifications and reason codes applied to the affected sample results. Table C-3 presents a summary of qualified and rejected data.

Laboratory Method Blank: The field sample results were evaluated with respect to the laboratory method blank prepared and analyzed for each analytical batch. One laboratory method blank was prepared for each laboratory QC batch and for each analytical method. No target analytes were detected in the laboratory method blanks.

Initial and Continuing Calibration Blank (Reason Code B2): For metal analysis, initial and continuing calibration blanks were prepared to verify that the instrument was free of target analytes prior to sample analysis. In a continuing calibration blank for metal analysis, mercury was observed at a trace level of 0.011 milligrams per kilogram (mg/kg), well below the practical quantitation limit (PQL) of 0.1 mg/kg. Since the detected level was below one half the PQL, the blank level was considered acceptable and no laboratory corrective actions were required. The concentration for mercury in one associated sample was less than five times the amount reported in the blank level, and was consequently qualified as non-detected (U) at the PQL. The data qualification has no effect on the data usability.

Mercury in all other samples was either not detected or the concentration in samples exceeded five times the blank level. Therefore no other mercury results were affected by the continuing calibration blank detection. With the exception of mercury, no other metal detections were reported in the calibration blanks.

Sample Holding Time: Sample holding times were evaluated by comparing the sample collection dates to the sample analysis dates. As stated before, because the site is located in a remote area, VOCs and TPH as gasoline samples were kept frozen immediately after the sampling until the analysis. When VOCs and TPH as gasoline samples were kept frozen, sample holding time was extended to 14 days from the sample collection date. Extraction and analysis holding times were reviewed for all samples to determine the validity of analytical results. For the Mather WAA sampling event, all samples were extracted and analyzed within their respective holding time requirements.

Surrogate Recovery (Reason Code S): Surrogate standards are organic compounds added to field and laboratory QC samples for organic analysis to evaluate matrix effect and method performance on an individual sample basis. Surrogate recoveries in all samples met the acceptance criteria with the exceptions shown on the following table:

Method	Sample Number	Surrogate	Surrogate Recovery	Acceptable Limit
USEPA 8260B	YWM06-2274	1,2-Dichloroethane	153%	70-140%
		4-Bromofluorobenzene	126%	85-120%
	YWM07-2277	1,2-Dichloroethane	225%	70-140%
		Toluene-d8	207%	85-115%
	YWM09-2285	Toluene-d8	117%	85-115%
	YWM07-2277 RE	1,2-Dichloroethane	160%	74-140%
		Toluene-d8	166%	85-115%
		4-Bromofluorobenzene	126%	85-120%
USEPA 8082	YWM05A-2271	Decachlorobiphenyl	26%	60-125%

Acetone was the only VOC detected in sample YWM06-2274; and methylene chloride was the only VOC detected in samples YWM07-2277 and YWM09-2285. As a result of the high surrogate recoveries, the detected results for acetone and methylene chloride in the mentioned samples were qualified as estimated (J+) with a potential high bias. The surrogate recovery outliers were likely attributed to a matrix effect in the samples. A second analysis was performed on sample YMW07-2277, which also yielded high recoveries.

In addition to the non-compliant surrogate recoveries for the VOC samples, a low surrogate recovery was observed for USEPA 8082 analysis. Surrogate decachlorobiphenyl in sample YWM05A-2271 was recovered below the lower control limit. Accordingly, the PQLs for polychlorinated biphenyls (PCBs) in the sample were qualified as estimated (UJ). It should be noted that the surrogate recovery for the second surrogate tetrachloro-m-xylene in the same sample met the accuracy requirement.

High surrogate recovery was noted for another PCB sample. Since PCBs were not detected in the sample, no data qualification was warranted. Low surrogate recoveries were reported for one acid and one base surrogates in a semivolatile organic compound (SVOC) sample. In accordance with USEPA national functional guidelines, SVOC results were not qualified when only one acid or one base surrogate recovery was outside the specification.

Although data qualification was applied to the above VOC and PCB results, the data usability is not affected. With the exception of the non-compliant surrogate recoveries discussed above, surrogate recoveries for all other analyses were within the acceptable control criteria.

Laboratory Control Sample/Laboratory Control Sample Duplicate: The LCS is an aliquot of analyte-free matrix spiked with target analytes and is prepared with each analytical batch. The recovery of target analytes from the LCS analysis is a measurement of method performance in an interference-free sample matrix. The review indicated that LCS analysis was performed for each laboratory QC batch and for each analytical method. LCS and LCSD recoveries, and RPDs between LCS and LCSD recoveries met the established accuracy and precision requirements for all analyses.

Matrix Spike/Matrix Spike Duplicate and Precision (Reason Code M): Matrix Spike and MSD samples are collected at a rate of one per 20 environmental samples. The MS and MSD samples are a portion of a field sample spiked with target analytes and are prepared with each analytical batch. The MS/MSD results are used to evaluate any bias introduced to the method due to matrix interference, and to measure accuracy and precision for each analytical batch.

One project sample from location YWM06 was collected and spiked for VOCs, TPH as gasoline, diesel and motor oil, SVOCs, polynuclear aromatic hydrocarbons (PAHs), PCBs, and metals analyses.

Non-compliant MS results were observed for USEPA Methods 8260B and 6020A as summarized below:

Method	Analyte	MS/MSD Recovery	Acceptable Limit
USEPA Method 8260B	1,1,2,2-Tetrachloroethane	133%/116%	55-130%
	Bromoform	136%/117%	55-135%
USEPA Method 6020A	Antimony	46%/46%	80-120%
	Lead	63%/62%	80-120%

Since MS recoveries for 1,1,2,2-tetrachloroethane and bromoform were within the marginal exceedance limits, no data qualification was applied to the VOC results. The MSD recoveries for the listed VOCs were within the acceptance criteria; and the RPDs between the MS and MSD recoveries met the precision goal.

As a result of the low MS/MSD recoveries, the detected results for antimony and lead were qualified as estimated (J-) with a potential low bias.

Because of inherent variability in soil matrix, only the spiked sample was qualified. The associated LCS results for these VOCs and metals met the accuracy requirements, indicating acceptable laboratory method performance for all samples in the batch. Except where noted, MS results for all other analyses met the acceptance criteria.

Internal Standard Recoveries (Reason Code I): Internal standard recoveries were checked to ensure that gas chromatography/mass spectrometry (GC/MS) sensitivity and response were stable. As indicated in the Level III data review, non-compliant internal standard recoveries were noted for USEPA Method 8260B as summarized below:

Method	Sample	Internal Standard	Internal Standard Recovery	Acceptable Limit
USEPA Method 8260B	YWM06-2274	1,2-Dichlorobenzene-d4	36%	-50 to + 100%
	YWM06-2274 RE	Chlorobenzene-d5	49%	-50 to + 100%
		1,2-Dichlorobenzene-d4	34%	-50 to + 100%
	YWM07-2277	1,4-Difluorobenzene-d4	20%	-50 to + 100%
		1,2-Dichlorobenzene-d4	4%	-50 to + 100%
		Chlorobenzene-d5	9%	-50 to + 100%
	YWM07-2277 RE	1,4-Difluorobenzene-d4	27%	-50 to + 100%
		Chlorobenzene-d5	16%	-50 to + 100%
		1,2-Dichlorobenzene-d4	8%	-50 to + 100%
	YWM08-2280	1,2-Dichlorobenzene-d4	37%	-50 to + 100%
	YWM09-2286	Chlorobenzene-d5	46%	-50 to + 100%
		1,2-Dichlorobenzene-d4	25%	-50 to + 100%

Method	Sample	Internal Standard	Internal Standard Recovery	Acceptable Limit
	YWM09-2286 RE	1,2-Dichlorobenzene-d4	48%	-50 to + 100%

When internal standard area counts are less than 50% of the standard area counts, the instrument does not have sufficient sensitivity to detect target analytes in the sample, and therefore the laboratory reported results may have been lower than their true values.

As a result of the low internal standard recoveries for samples YWM06-2274, YWM08-2280 and YWM09-2286RE, target analyte results that were quantitated using the internal standard 1,2-dichlorobenzene-d4 were qualified as estimated (UJ). Additionally, target analyte results for sample YWM07-2277RE that were quantitated using the internal standards 1,4-difluorobenzene-d4 and chlorobenzene-d5 were qualified as estimated (UJ).

Due to a severe instrument sensitivity loss in sample YWM07-2277RE, the PQLs were rejected for target analytes associated with the internal standard 1,2-dichlorobenzene-d4. As presented in Table C-3, the PQLs for 1,1,2,2-tetrachloroethane, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene and bromoform are considered not usable. A review of the detected organic results for the Mather WAA sampling event indicates that:

- Only PAHs, diesel and motor oil, and methylene chloride were detected in location YWM07, however the analytes 1,1,2,2-tetrachloroethane, 1,2-dichlorobenzene, 1,3-dihclorobenzene, 1,4-dichlorobenzene and bromoform are not degradation products of either PAHs, TPH as diesel or TH as motor oil compounds. Therefore, these listed VOCs are not expected to be present at location YWM07
- Except for acetone and methylene chloride detections in one or more locations, no other VOCs were detected at the site.

As shown above, it does not appear that false negatives have been reported for 1,1,2,2-tetrachloroethane, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene or bromoform in sample YWM07-2277RE. Thus, the rejected data has no adverse impact on the project objectives.

The laboratory took corrective actions and reanalyzed samples YWM06-2274, YWM07-2277 and YWM09-2286. The second analysis provided similar low internal standard recoveries and confirmed a matrix effect in the samples. In this case, when two runs were reported, results that have better data quality (less qualified data or less rejected data) have been selected and should be used for any project decisions. Except where noted, all other internal standard recoveries for samples analyzed for VOCs and SVOCs met the accuracy requirements.

ICP Serial Dilution (Reason Code A): When an analyte concentration is greater than 50 times the Instrument Detection Limit (IDL), a serial dilution is performed at a five fold dilution. Results of the ICP serial dilution are used to determine if interference is present due to sample matrix. The review indicated that a percent difference for zinc between the original analysis and diluted analysis was reported at 11% marginally exceeding the 10% control limit. The detected result for zinc in one associated sample was qualified as estimated (J-). The data usability is not affected because of the ICP serial dilution exceedance.

Initial Calibration: Instrument calibration is performed for each analysis according to the USEPA method requirements. The linear analytical range is established for each method by analysis of standards prepared at increasing concentrations that cover the expected sample concentrations. The acceptability of the initial calibration is determined by calculation of a percent relative standard deviation (RSD) or coefficient and relative response factors (RRF). Based on the review, RSDs and RRFs for all target analytes met the established control criteria for the Mather WAA sampling event.

Continuing Calibration (Reason Code C): Following initial calibrations and routinely during sample analysis, the stability of analytical systems is monitored by analysis of continuing calibration standards at concentrations near the mid-point of the linear range. The review indicated acceptable continuing calibration results for the majority of the analyses with the following exceptions. Percent differences between initial calibration RRFs and continuing calibration RRFs fell outside the acceptance criteria as presented below:

Methods	Calibration Date (Time)	Analyte	Percent Difference	Acceptable Limit
USEPA Method 8260B	8/30/08 (00:28)	Dichlorodifluoromethane	-28.8%	<20%
	9/2/08 (13:08)	Dichlorodifluoromethane	-36.4%	<20%
	9/3/08 (10:07)	Dichlorodifluoromethane	-31.3%	<20%

Dichlorofluoromethane was not detected in the project samples associated with the calibration outliers. Accordingly, the PQL for the analyte was qualified as estimated (UJ). Because the degree of calibration exceedance did not significantly deviate from the acceptance criteria, the data usability is not affected.

Elevated percent differences were observed for 11 SVOCs. Since these SVOCs were not detected in any project samples associated with the calibration outliers, the high percent differences did not affect the data quality and data usability. No data qualification was applied to any SVOC results. Except where noted, continuing calibration results for all analyses were acceptable.

Trip Blanks: Since no liquid VOC samples were collected for the Mather WAA sampling event, no trip blanks were required.

Equipment Rinse Blanks: Dedicated sampling equipment was used to collect soil samples, and therefore no equipment blanks were required.

Field Duplicate: Field duplicate samples are collected at a minimum rate of 10% of investigation samples. Field duplicate samples are evaluated by calculating the RPD between the sample and its duplicate. The RPD is calculated using the following equation.

$$RPD = \left|(S-D)/[(S+D)/2]\right| * 100$$

where:

S = sample result
D = duplicate result

The RPD is calculated between pairs of duplicate samples when both results are detected above the PQL. The field duplicate precision goal is established at equal to or less than 50% for soil samples. In cases where one of the results is below the PQL, pairs of field duplicate results are considered in agreement if the absolute value of the difference between the result and the PQL is less than the PQL.

One duplicate pair was collected from location YWM08 in August 2008 and analyzed for VOCs, TPH as gasoline, diesel and motor oil, SVOCs, PAHs, PCBs, and metals. The 10% field duplicate frequency goal was met for the Mather WAA sampling event.

Table C-4 presents a summary of the field duplicate results. As shown on the table, in general, metals were detected in both the primary and duplicate pair; while all other target analytes were below their respective PQLs in the duplicate pair.

With the exception of lead, the RPDs for all other detected metals ranged from 0.8 to 44% and met the field duplicate precision requirement. The RPD for lead was 89% exceeding the 50% precision limit. Over 94% of the calculable field duplicate results met the precision requirement, indicating acceptable overall sampling and analytical precision. In accordance with the USEPA national functional guidelines, no data qualification was applied to the lead result that was outside the field duplicate precision limit.

Completeness

The following sections present a discussion of analytical and technical completeness for August 2008 Mather WAA soil sample results. The 2008 completeness results are presented in Table C-5. For information purposes, completeness calculations are also performed for soil characterization results.

Analytical Completeness

Analytical completeness is a quantitative expression of how closely the results adhered to all QC requirements based on the number of data points qualified for any reason. The analytical completeness goal is 90%. Analytical completeness is calculated as follows:

$$\% \text{ Analytical Completeness} = \frac{\text{Number of unqualified results}}{\text{Total Number of results}} \times 100$$

Analytical completeness is based on samples qualified for any reason and includes all target analytes. As presented on Table C-5, the 90% analytical completeness goal was missed for USEPA Method 8260B (84.9%). The low analytical completeness was due to non-compliant surrogate and internal standard recoveries and calibration outliers. The 90% analytical completeness objective was achieved for all other methods.

Technical Completeness

Technical completeness is a quantitative expression of the data usability based on the number of rejected data. For this project, the technical completeness for each method is established at equal to or greater than 95%. The technical completeness calculation considers all data that is not rejected to be usable and technical completeness is calculated as follows:

$$\% \text{ Technical Completeness} = \frac{\text{Number of useable results}}{\text{Total Number of results}} \times 100$$

For the Mather WAA sampling event, the technical completeness was 98.9% for USPEA Method 8260B and 100% for all other analytical methods. Sufficient acceptable data was obtained to achieve project objectives.

Internal Data Review: In addition to the above third party data review discussed, a Shaw project chemist performed a Level III data review for TOC, pH and cation exchange capacity results. The review was performed in accordance with DoD QSM, USEPA Test Methods and National Functional Guidelines review requirements. The Level III data review findings were documented on Level III data review worksheets. Based on the internal data review, elevated LCS and LSCD recoveries were reported for TOC analysis, and consequently the detected TOC results were qualified as estimated (J+) in the affected samples. The data usability is not affected because of the LCS recovery outlier. No other data quality issues were noted for soil characterization results.

Based on the above third party and Shaw's internal data review, one significant data quality issue was identified with respect to the rejected PQLs for five VOC compounds. Calibration blank detection; and non-compliant surrogate, MS/MSD and internal standard recoveries, ICP serial dilution and calibrations were also observed and the affected sample results were qualified as non-detected or estimated. With the exception of the rejected PQLs, all other qualified data are usable. The 95% data usability goal was exceeded for the Mather WAA sampling event.

TABLE C-1: SAMPLE CROSS REFERENCE
AUGUST 2001 AND AUGUST 2008 SITE INSPECTIONS
MATHER WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK, CALIFORNIA

Date Collected	*Lab ID*	*Field ID*	*Lab*	*Sample Type*	*Date Prepared*	*Prep Method*	*Date Analyzed*	*Analytical Method*	*Review Level*
AUGUST 2001 INSPECTION									
Upgradient Samples									
08/27/2001	01-5540-12	YWM-UG01-SO-1043	APHC	NS	NA	NONE	08/30/01	D2216	III
08/27/2001	01-5540-12	YWM-UG01-SO-1043	APHC	NS	08/30/01	SW3550	08/31/01	M8015D	III
08/27/2001	01-5540-12	YWM-UG01-SO-1043	APHC	NS	09/04/01	SW3550	09/06/01	M8015D	III
08/27/2001	01-5540-12	YWM-UG01-SO-1043	APHC	NS	08/30/01	SW3050	08/30/01	SW6010B	III
08/27/2001	01-5540-12	YWM-UG01-SO-1043	APHC	NS	NA	NONE	09/05/01	SW7196A	III
08/27/2001	01-5540-12	YWM-UG01-SO-1043	APHC	NS	08/31/01	METHOD	08/31/01	SW7471A	III
08/27/2001	01-5540-12	YWM-UG01-SO-1043	APHC	NS	08/31/01	SW3550	09/04/01	SW8310	III
08/27/2001	01-5540-13	YWM-UG02-SO-1044	APHC	NS	NA	NONE	08/30/01	D2216	III
08/27/2001	01-5540-13	YWM-UG02-SO-1044	APHC	NS	08/30/01	SW3550	08/31/01	M8015D	III
08/27/2001	01-5540-13	YWM-UG02-SO-1044	APHC	NS	09/04/01	SW3550	09/06/01	M8015D	III
08/27/2001	01-5540-13	YWM-UG02-SO-1044	APHC	NS	08/30/01	SW3050	08/30/01	SW6010B	III
08/27/2001	01-5540-13	YWM-UG02-SO-1044	APHC	NS	NA	NONE	09/05/01	SW7196A	III
08/27/2001	01-5540-13	YWM-UG02-SO-1044	APHC	NS	08/31/01	METHOD	08/31/01	SW7471A	III
08/27/2001	01-5540-13	YWM-UG02-SO-1044	APHC	NS	08/31/01	SW3550	09/04/01	SW8310	III
08/27/2001	G1I19021700	YWM-UG02-SO-1044	SVLS	NS	09/21/01	METHOD	09/24/01	SW8290	III
08/27/2001	01-5540-14	YWM-UG03-SO-1045	APHC	NS	NA	NONE	08/30/01	D2216	III
08/27/2001	01-5540-14	YWM-UG03-SO-1045	APHC	NS	08/30/01	SW3550	08/31/01	M8015D	III
08/27/2001	01-5540-14	YWM-UG03-SO-1045	APHC	NS	09/04/01	SW3550	09/06/01	M8015D	III
08/27/2001	01-5540-14	YWM-UG03-SO-1045	APHC	NS	08/30/01	SW3050	08/30/01	SW6010B	III
08/27/2001	01-5540-14	YWM-UG03-SO-1045	APHC	NS	NA	NONE	09/05/01	SW7196A	III
08/27/2001	01-5540-14	YWM-UG03-SO-1045	APHC	NS	08/31/01	METHOD	08/31/01	SW7471A	III
08/27/2001	01-5540-14	YWM-UG03-SO-1045	APHC	NS	08/31/01	SW3550	09/04/01	SW8310	III
Investigative Test Pit Samples									
08/27/2001	01-5540-4	YWM-TP01-SO-1042	APHC	NS	NA	NONE	08/30/01	D2216	III
08/27/2001	01-5540-4	YWM-TP01-SO-1042	APHC	NS	08/30/01	SW3550	08/31/01	M8015D	III
08/27/2001	01-5540-4	YWM-TP01-SO-1042	APHC	NS	09/04/01	SW3550	09/06/01	M8015D	III
08/27/2001	01-5540-4	YWM-TP01-SO-1042	APHC	NS	08/30/01	SW3050	08/30/01	SW6010B	III
08/27/2001	01-5540-4	YWM-TP01-SO-1042	APHC	NS	NA	NONE	09/05/01	SW7196A	III
08/27/2001	01-5540-4	YWM-TP01-SO-1042	APHC	NS	08/31/01	METHOD	08/31/01	SW7471A	III
08/27/2001	01-5540-4	YWM-TP01-SO-1042	APHC	NS	08/31/01	SW3550	09/04/01	SW8310	III
08/27/2001	01-5540-5	YWM-TP02-SO-1046	APHC	NS	NA	NONE	08/30/01	D2216	III
08/27/2001	01-5540-5	YWM-TP02-SO-1046	APHC	NS	08/30/01	SW3550	08/31/01	M8015D	III
08/27/2001	01-5540-5	YWM-TP02-SO-1046	APHC	NS	09/04/01	SW3550	09/06/01	M8015D	III
08/27/2001	01-5540-5	YWM-TP02-SO-1046	APHC	NS	08/30/01	SW3050	08/30/01	SW6010B	III
08/27/2001	01-5540-5	YWM-TP02-SO-1046	APHC	NS	NA	NONE	09/05/01	SW7196A	III
08/27/2001	01-5540-5	YWM-TP02-SO-1046	APHC	NS	08/31/01	METHOD	08/31/01	SW7471A	III
08/27/2001	01-5540-5	YWM-TP02-SO-1046	APHC	NS	08/31/01	SW3550	09/04/01	SW8310	III
08/27/2001	01-5540-6	YWM-TP02-SO-1047	APHC	FD	NA	NONE	08/30/01	D2216	III
08/27/2001	01-5540-6	YWM-TP02-SO-1047	APHC	FD	08/30/01	SW3550	08/31/01	M8015D	III
08/27/2001	01-5540-6	YWM-TP02-SO-1047	APHC	FD	09/04/01	SW3550	09/06/01	M8015D	III
08/27/2001	01-5540-6	YWM-TP02-SO-1047	APHC	FD	08/30/01	SW3050	08/30/01	SW6010B	III
08/27/2001	01-5540-6	YWM-TP02-SO-1047	APHC	FD	NA	NONE	09/05/01	SW7196A	III

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Date Collected	*Lab ID*	*Field ID*	*Lab*	*Sample Type*	*Date Prepared*	*Prep Method*	*Date Analyzed*	*Analytical Method*	*Review Level*
08/27/2001	01-5540-6	YWM-TP02-SO-1047	APHC	FD	08/31/01	METHOD	08/31/01	SW7471A	III
08/27/2001	01-5540-6	YWM-TP02-SO-1047	APHC	FD	08/31/01	SW3550	09/04/01	SW8310	III
08/27/2001	01-5540-7	YWM-TP02-SO-1048	APHC	NS	NA	NONE	08/30/01	D2216	III
08/27/2001	01-5540-7	YWM-TP02-SO-1048	APHC	NS	08/30/01	SW3550	08/31/01	M8015D	III
08/27/2001	01-5540-7	YWM-TP02-SO-1048	APHC	NS	09/04/01	SW3550	09/06/01	M8015D	III
08/27/2001	01-5540-7	YWM-TP02-SO-1048	APHC	NS	08/30/01	SW3050	08/30/01	SW6010B	III
08/27/2001	01-5540-7	YWM-TP02-SO-1048	APHC	NS	NA	NONE	09/05/01	SW7196A	III
08/27/2001	01-5540-7	YWM-TP02-SO-1048	APHC	NS	08/31/01	METHOD	08/31/01	SW7471A	III
08/27/2001	01-5540-7	YWM-TP02-SO-1048	APHC	NS	08/31/01	SW3550	09/04/01	SW8310	III
08/27/2001	G1I07012300	YWM-TP02-SO-1049	SVLS	NS	09/11/01	METHOD	09/13/01	SW8290	III
08/27/2001	01-5540-8	YWM-TP04-SO-1037	APHC	NS	NA	NONE	08/30/01	D2216	III
08/27/2001	01-5540-8	YWM-TP04-SO-1037	APHC	NS	08/30/01	SW3550	08/31/01	M8015D	III
08/27/2001	01-5540-8	YWM-TP04-SO-1037	APHC	NS	09/04/01	SW3550	09/06/01	M8015D	III
08/27/2001	01-5540-8	YWM-TP04-SO-1037	APHC	NS	08/30/01	SW3050	08/30/01	SW6010B	III
08/27/2001	01-5540-8	YWM-TP04-SO-1037	APHC	NS	NA	NONE	09/05/01	SW7196A	III
08/27/2001	01-5540-8	YWM-TP04-SO-1037	APHC	NS	08/31/01	METHOD	08/31/01	SW7471A	III
08/27/2001	01-5540-8	YWM-TP04-SO-1037	APHC	NS	08/31/01	SW3550	09/04/01	SW8310	III
08/27/2001	01-5540-9	YWM-TP05-SO-1038	APHC	NS	NA	NONE	08/30/01	D2216	III
08/27/2001	01-5540-9	YWM-TP05-SO-1038	APHC	NS	08/30/01	SW3550	08/31/01	M8015D	III
08/27/2001	01-5540-9	YWM-TP05-SO-1038	APHC	NS	09/04/01	SW3550	09/06/01	M8015D	III
08/27/2001	01-5540-9	YWM-TP05-SO-1038	APHC	NS	08/30/01	SW3050	08/30/01	SW6010B	III
08/27/2001	01-5540-9	YWM-TP05-SO-1038	APHC	NS	NA	NONE	09/05/01	SW7196A	III
08/27/2001	01-5540-9	YWM-TP05-SO-1038	APHC	NS	08/31/01	METHOD	08/31/01	SW7471A	III
08/27/2001	01-5540-9	YWM-TP05-SO-1038	APHC	NS	08/31/01	SW3550	09/04/01	SW8310	III
08/27/2001	01-5540-10	YWM-TP05-SO-1039	APHC	NS	NA	NONE	08/30/01	D2216	III
08/27/2001	01-5540-10	YWM-TP05-SO-1039	APHC	NS	08/30/01	SW3550	08/31/01	M8015D	III
08/27/2001	01-5540-10	YWM-TP05-SO-1039	APHC	NS	09/04/01	SW3550	09/06/01	M8015D	III
08/27/2001	01-5540-10	YWM-TP05-SO-1039	APHC	NS	08/30/01	SW3050	08/30/01	SW6010B	III
08/27/2001	01-5540-10	YWM-TP05-SO-1039	APHC	NS	NA	NONE	09/05/01	SW7196A	III
08/27/2001	01-5540-10	YWM-TP05-SO-1039	APHC	NS	08/31/01	METHOD	08/31/01	SW7471A	III
08/27/2001	01-5540-10	YWM-TP05-SO-1039	APHC	NS	08/31/01	SW3550	09/04/01	SW8310	III
08/27/2001	01-5540-11	YWM-TP05-SO-1040	APHC	NS	NA	NONE	08/30/01	D2216	III
08/27/2001	01-5540-11	YWM-TP05-SO-1040	APHC	NS	08/30/01	SW3550	08/31/01	M8015D	III
08/27/2001	01-5540-11	YWM-TP05-SO-1040	APHC	NS	09/04/01	SW3550	09/06/01	M8015D	III
08/27/2001	G1I07012300	YWM-TP05-SO-1041	SVLS	NS	09/11/01	METHOD	09/13/01	SW8290	III
Downgradient Samples									
08/28/2001	01-5540-1	YWM-DG01-SO-1050	APHC	NS	NA	NONE	08/30/01	D2216	III
08/28/2001	01-5540-1	YWM-DG01-SO-1050	APHC	NS	08/30/01	SW3550	08/31/01	M8015D	III
08/28/2001	01-5540-1	YWM-DG01-SO-1050	APHC	NS	09/04/01	SW3550	09/06/01	M8015D	III
08/28/2001	01-5540-1	YWM-DG01-SO-1050	APHC	NS	08/30/01	SW3050	08/30/01	SW6010B	III
08/28/2001	01-5540-1	YWM-DG01-SO-1050	APHC	NS	NA	NONE	09/05/01	SW7196A	III
08/28/2001	01-5540-1	YWM-DG01-SO-1050	APHC	NS	08/31/01	METHOD	08/31/01	SW7471A	III
08/28/2001	01-5540-1	YWM-DG01-SO-1050	APHC	NS	08/31/01	SW3550	09/04/01	SW8310	III
08/28/2001	01-5540-2	YWM-DG02-SO-1051	APHC	NS	NA	NONE	08/30/01	D2216	III

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Date Collected	*Lab ID*	*Field ID*	*Lab*	*Sample Type*	*Date Prepared*	*Prep Method*	*Date Analyzed*	*Analytical Method*	*Review Level*
08/28/2001	01-5540-2	YWM-DG02-SO-1051	APHC	NS	08/30/01	SW3550	08/31/01	M8015D	III
08/28/2001	01-5540-2	YWM-DG02-SO-1051	APHC	NS	09/04/01	SW3550	09/06/01	M8015D	III
08/28/2001	01-5540-2	YWM-DG02-SO-1051	APHC	NS	08/30/01	SW3050	08/30/01	SW6010B	III
08/28/2001	01-5540-2	YWM-DG02-SO-1051	APHC	NS	NA	NONE	09/05/01	SW7196A	III
08/28/2001	01-5540-2	YWM-DG02-SO-1051	APHC	NS	08/31/01	METHOD	08/31/01	SW7471A	III
08/28/2001	01-5540-2	YWM-DG02-SO-1051	APHC	NS	08/31/01	SW3550	09/04/01	SW8310	III
08/28/2001	01-5540-3	YWM-DG03-SO-1052	APHC	NS	NA	NONE	08/30/01	D2216	III
08/28/2001	01-5540-3	YWM-DG03-SO-1052	APHC	NS	08/30/01	SW3550	08/31/01	M8015D	III
08/28/2001	01-5540-3	YWM-DG03-SO-1052	APHC	NS	09/04/01	SW3550	09/06/01	M8015D	III
08/28/2001	01-5540-3	YWM-DG03-SO-1052	APHC	NS	08/30/01	SW3050	08/30/01	SW6010B	III
08/28/2001	01-5540-3	YWM-DG03-SO-1052	APHC	NS	NA	NONE	09/05/01	SW7196A	III
08/28/2001	01-5540-3	YWM-DG03-SO-1052	APHC	NS	08/31/01	METHOD	08/31/01	SW7471A	III
08/28/2001	01-5540-3	YWM-DG03-SO-1052	APHC	NS	08/31/01	SW3550	09/04/01	SW8310	III
Equipment Blank Sample									
08/29/2001	01-5540-15	YWM-EB-WH-1065	APHC	EB	08/31/01	SW3510	08/31/01	SW8310	III
08/29/2001	01-5540-15	YWM-EB-WH-1065	APHC	EB	09/04/01	SW3510	09/04/01	M8015D	III
08/29/2001	01-5540-15	YWM-EB-WH-1065	APHC	EB	09/04/01	METHOD	09/04/01	SW7470A	III
08/29/2001	01-5540-15	YWM-EB-WH-1065	APHC	EB	08/31/01	SW3010	08/31/01	SW6010B	III
08/29/2001	01-5540-15	YWM-EB-WH-1065	APHC	EB	NA	NONE	08/30/01	SW7196A	III
AUGUST 2008 INSPECTION									
Investigative Test Pit Samples									
08/26/2008	08H299	YWM02A-2268	EMAX	NS	09/02/08	METHOD	09/03/08	SW6020A	III
08/26/2008	08H299	YWM02A-2268	EMAX	NS	09/05/08	METHOD	09/05/08	SW7471A	III
08/26/2008	08H299	YWM02A-2268	EMAX	NS	08/30/08	SW5035	08/30/08	SW8015B	III
08/26/2008	08H299	YWM02A-2268	EMAX	NS	09/03/08	SW3550B	09/04/08	SW8015B	III
08/26/2008	08H299	YWM02A-2268	EMAX	NS	09/04/08	SW3550B	09/04/08	SW8082	III
08/26/2008	08H299	YWM02A-2268	EMAX	NS	09/03/08	SW5030B	09/03/08	SW8260B	III
08/26/2008	08H299	YWM02A-2268	EMAX	NS	09/04/08	SW3550B	09/08/08	SW8270C	III
08/26/2008	08H299	YWM02A-2268	EMAX	NS	09/04/08	SW3550B	09/11/08	SW8270C SIM	III
08/26/2008	08H299	YWM05A-2271	EMAX	NS	09/03/08	SW3550B	09/08/08	SW8015B	III
08/26/2008	08H299	YWM05A-2271	EMAX	NS	09/04/08	SW3550B	09/05/08	SW8082	III
08/26/2008	08H299	YWM06-2274	EMAX	NS	09/02/08	METHOD	09/03/08	SW6020A	III
08/26/2008	08H299	YWM06-2274	EMAX	NS	09/05/08	METHOD	09/05/08	SW7471A	III
08/26/2008	08H299	YWM06-2274	EMAX	NS	08/30/08	SW5035	08/30/08	SW8015B	III
08/26/2008	08H299	YWM06-2274	EMAX	NS	09/03/08	SW3550B	09/08/08	SW8015B	III
08/26/2008	08H299	YWM06-2274	EMAX	NS	09/04/08	SW3550B	09/04/08	SW8082	III
08/26/2008	08H299	YWM06-2274	EMAX	NS	08/30/08	SW5035	08/30/08	SW8260B	III
08/26/2008	08H299	YWM06-2274	EMAX	NS	09/04/08	SW3550B	09/08/08	SW8270C	III
08/26/2008	08H299	YWM06-2274	EMAX	NS	09/04/08	SW3550B	09/11/08	SW8270C SIM	III
08/26/2008	08H299	YWM06-2276	EMAX	NS	09/02/08	METHOD	09/04/08	SW6020A	III
08/26/2008	08H299	YWM06-2276	EMAX	NS	09/05/08	METHOD	09/05/08	SW7471A	III
08/26/2008	08H299	YWM06-2276	EMAX	NS	08/30/08	SW5035	08/30/08	SW8015B	III
08/26/2008	08H299	YWM06-2276	EMAX	NS	09/03/08	SW3550B	09/04/08	SW8015B	III
08/26/2008	08H299	YWM06-2276	EMAX	NS	09/04/08	SW3550B	09/04/08	SW8082	III

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Date Collected	*Lab ID*	*Field ID*	*Lab*	*Sample Type*	*Date Prepared*	*Prep Method*	*Date Analyzed*	*Analytical Method*	*Review Level*
08/26/2008	08H299	YWM06-2276	EMAX	NS	09/02/08	SW5035	09/02/08	SW8260B	III
08/26/2008	08H299	YWM06-2276	EMAX	NS	09/04/08	SW3550B	09/08/08	SW8270C	III
08/26/2008	08H299	YWM06-2276	EMAX	NS	09/04/08	SW3550B	09/11/08	SW8270C SIM	III
08/26/2008	08H299	YWM07-2277	EMAX	NS	09/02/08	METHOD	09/04/08	SW6020A	III
08/26/2008	08H299	YWM07-2277	EMAX	NS	09/05/08	METHOD	09/05/08	SW7471A	III
08/26/2008	08H299	YWM07-2277	EMAX	NS	08/30/08	SW5035	08/30/08	SW8015B	III
08/26/2008	08H299	YWM07-2277	EMAX	NS	09/03/08	SW3550B	09/04/08	SW8015B	III
08/26/2008	08H299	YWM07-2277	EMAX	NS	09/04/08	SW3550B	09/04/08	SW8082	III
08/26/2008	08H299	YWM07-2277	EMAX	NS	09/03/08	SW5035	09/03/08	SW8260B	III
08/26/2008	08H299	YWM07-2277	EMAX	NS	09/04/08	SW3550B	09/08/08	SW8270C	III
08/26/2008	08H299	YWM07-2277	EMAX	NS	09/04/08	SW3550B	09/11/08	SW8270C SIM	III
08/26/2008	08H299	YWM07-2279	EMAX	NS	09/02/08	METHOD	09/04/08	SW6020A	III
08/26/2008	08H299	YWM07-2279	EMAX	NS	09/05/08	METHOD	09/05/08	SW7471A	III
08/26/2008	08H299	YWM07-2279	EMAX	NS	08/30/08	SW5035	08/30/08	SW8015B	III
08/26/2008	08H299	YWM07-2279	EMAX	NS	09/03/08	SW3550B	09/04/08	SW8015B	III
08/26/2008	08H299	YWM07-2279	EMAX	NS	09/04/08	SW3550B	09/04/08	SW8082	III
08/26/2008	08H299	YWM07-2279	EMAX	NS	08/30/08	SW5035	08/30/08	SW8260B	III
08/26/2008	08H299	YWM07-2279	EMAX	NS	09/04/08	SW3550B	09/08/08	SW8270C	III
08/26/2008	08H299	YWM07-2279	EMAX	NS	09/04/08	SW3550B	09/11/08	SW8270C SIM	III
08/26/2008	08H299	YWM08-2280	EMAX	NS	09/02/08	METHOD	09/04/08	SW6020A	III
08/26/2008	08H299	YWM08-2280	EMAX	NS	09/05/08	METHOD	09/05/08	SW7471A	III
08/26/2008	08H299	YWM08-2280	EMAX	NS	08/30/08	SW5035	08/30/08	SW8015B	III
08/26/2008	08H299	YWM08-2280	EMAX	NS	09/03/08	SW3550B	09/04/08	SW8015B	III
08/26/2008	08H299	YWM08-2280	EMAX	NS	09/04/08	SW3550B	09/04/08	SW8082	III
08/26/2008	08H299	YWM08-2280	EMAX	NS	08/30/08	SW5035	08/30/08	SW8260B	III
08/26/2008	08H299	YWM08-2280	EMAX	NS	09/04/08	SW3550B	09/08/08	SW8270C	III
08/26/2008	08H299	YWM08-2280	EMAX	NS	09/04/08	SW3550B	09/11/08	SW8270C SIM	III
08/26/2008	08H299	YWM08-2281	EMAX	NS	09/02/08	METHOD	09/04/08	SW6020A	III
08/26/2008	08H299	YWM08-2281	EMAX	NS	09/05/08	METHOD	09/05/08	SW7471A	III
08/26/2008	08H299	YWM08-2281	EMAX	NS	08/30/08	SW5035	08/30/08	SW8015B	III
08/26/2008	08H299	YWM08-2281	EMAX	NS	09/03/08	SW3550B	09/04/08	SW8015B	III
08/26/2008	08H299	YWM08-2281	EMAX	NS	09/04/08	SW3550B	09/04/08	SW8082	III
08/26/2008	08H299	YWM08-2281	EMAX	NS	08/30/08	SW5035	08/30/08	SW8260B	III
08/26/2008	08H299	YWM08-2281	EMAX	NS	09/04/08	SW3550B	09/08/08	SW8270C	III
08/26/2008	08H299	YWM08-2281	EMAX	NS	09/04/08	SW3550B	09/11/08	SW8270C SIM	III
08/26/2008	08H299	YWM08-2282	EMAX	FD	09/02/08	METHOD	09/04/08	SW6020A	III
08/26/2008	08H299	YWM08-2282	EMAX	FD	09/05/08	METHOD	09/05/08	SW7471A	III
08/26/2008	08H299	YWM08-2282	EMAX	FD	08/30/08	SW5035	08/30/08	SW8015B	III
08/26/2008	08H299	YWM08-2282	EMAX	FD	09/03/08	SW3550B	09/04/08	SW8015B	III
08/26/2008	08H299	YWM08-2282	EMAX	FD	09/04/08	SW3550B	09/05/08	SW8082	III
08/26/2008	08H299	YWM08-2282	EMAX	FD	08/30/08	SW5035	08/30/08	SW8260B	III
08/26/2008	08H299	YWM08-2282	EMAX	FD	09/04/08	SW3550B	09/08/08	SW8270C	III
08/26/2008	08H299	YWM08-2282	EMAX	FD	09/04/08	SW3550B	09/11/08	SW8270C SIM	III
08/26/2008	08H299	YWM09-2284	EMAX	NS	09/02/08	METHOD	09/04/08	SW6020A	III

Refer to footnotes on Page 6.

TABLE C-1: SAMPLE CROSS REFERENCE
AUGUST 2001 AND AUGUST 2008 SITE INSPECTIONS
MATHER WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK, CALIFORNIA

Date Collected	*Lab ID*	*Field ID*	*Lab*	*Sample Type*	*Date Prepared*	*Prep Method*	*Date Analyzed*	*Analytical Method*	*Review Level*
08/26/2008	08H299	YWM09-2284	EMAX	NS	09/05/08	METHOD	09/05/08	SW7471A	III
08/26/2008	08H299	YWM09-2284	EMAX	NS	08/30/08	SW5035	08/30/08	SW8015B	III
08/26/2008	08H299	YWM09-2284	EMAX	NS	09/03/08	SW3550B	09/04/08	SW8015B	III
08/26/2008	08H299	YWM09-2284	EMAX	NS	09/04/08	SW3550B	09/05/08	SW8082	III
08/26/2008	08H299	YWM09-2284	EMAX	NS	09/03/08	SW5035	09/03/08	SW8260B	III
08/26/2008	08H299	YWM09-2284	EMAX	NS	09/04/08	SW3550B	09/08/08	SW8270C	III
08/26/2008	08H299	YWM09-2284	EMAX	NS	09/04/08	SW3550B	09/11/08	SW8270C SIM	III
08/26/2008	08H299	YWM09-2285	EMAX	NS	09/02/08	METHOD	09/04/08	SW6020A	III
08/26/2008	08H299	YWM09-2285	EMAX	NS	09/05/08	METHOD	09/05/08	SW7471A	III
08/26/2008	08H299	YWM09-2285	EMAX	NS	08/30/08	SW5035	08/30/08	SW8015B	III
08/26/2008	08H299	YWM09-2285	EMAX	NS	09/03/08	SW3550B	09/04/08	SW8015B	III
08/26/2008	08H299	YWM09-2285	EMAX	NS	09/04/08	SW3550B	09/05/08	SW8082	III
08/26/2008	08H299	YWM09-2285	EMAX	NS	09/03/08	SW5035	09/03/08	SW8260B	III
08/26/2008	08H299	YWM09-2285	EMAX	NS	09/04/08	SW3550B	09/08/08	SW8270C	III
08/26/2008	08H299	YWM09-2285	EMAX	NS	09/04/08	SW3550B	09/12/08	SW8270C SIM	III
08/26/2008	08H299	YWM09-2286	EMAX	NS	09/02/08	METHOD	09/04/08	SW6020A	III
08/26/2008	08H299	YWM09-2286	EMAX	NS	09/05/08	METHOD	09/05/08	SW7471A	III
08/26/2008	08H299	YWM09-2286	EMAX	NS	08/30/08	SW5035	08/30/08	SW8015B	III
08/26/2008	08H299	YWM09-2286	EMAX	NS	09/03/08	SW3550B	09/04/08	SW8015B	III
08/26/2008	08H299	YWM09-2286	EMAX	NS	09/04/08	SW3550B	09/05/08	SW8082	III
08/26/2008	08H299	YWM09-2286	EMAX	NS	09/03/08	SW5035	09/03/08	SW8260B	III
08/26/2008	08H299	YWM09-2286	EMAX	NS	09/04/08	SW3550B	09/08/08	SW8270C	III
08/26/2008	08H299	YWM09-2286	EMAX	NS	09/04/08	SW3550B	09/11/08	SW8270C SIM	III
Background Samples									
08/26/2008	08H299	YWM101-2287	EMAX	NS	09/02/08	METHOD	09/04/08	SW6020A	III
08/26/2008	08H299	YWM101-2287	EMAX	NS	09/05/08	METHOD	09/05/08	SW7471A	III
08/26/2008	08H299	YWM101-2287	EMAX	NS	09/04/08	SW3550B	09/12/08	SW8270C	III
08/26/2008	08H299	YWM102-2288	EMAX	NS	09/02/08	METHOD	09/04/08	SW6020A	III
08/26/2008	08H299	YWM102-2288	EMAX	NS	09/05/08	METHOD	09/05/08	SW7471A	III
08/26/2008	08H299	YWM102-2288	EMAX	NS	09/04/08	SW3550B	09/12/08	SW8270C	III
08/26/2008	08H299	YWM103-2289	EMAX	NS	09/02/08	METHOD	09/04/08	SW6020A	III
08/26/2008	08H299	YWM103-2289	EMAX	NS	09/05/08	METHOD	09/05/08	SW7471A	III
08/26/2008	08H299	YWM103-2289	EMAX	NS	09/04/08	SW3550B	09/12/08	SW8270C	III
08/26/2008	08H299	YWM104-2290	EMAX	NS	09/02/08	METHOD	09/04/08	SW6020A	III
08/26/2008	08H299	YWM104-2290	EMAX	NS	09/05/08	METHOD	09/05/08	SW7471A	III
08/26/2008	08H299	YWM104-2290	EMAX	NS	09/04/08	SW3550B	09/12/08	SW8270C	III
08/26/2008	08H299	YWM105-2291	EMAX	NS	09/02/08	METHOD	09/04/08	SW6020A	III
08/26/2008	08H299	YWM105-2291	EMAX	NS	09/05/08	METHOD	09/05/08	SW7471A	III
08/26/2008	08H299	YWM105-2291	EMAX	NS	09/04/08	SW3550B	09/12/08	SW8270C	III
08/26/2008	08H299	YWM106-2292	EMAX	NS	09/02/08	METHOD	09/04/08	SW6020A	III
08/26/2008	08H299	YWM106-2292	EMAX	NS	09/05/08	METHOD	09/05/08	SW7471A	III
08/26/2008	08H299	YWM106-2292	EMAX	NS	09/04/08	SW3550B	09/12/08	SW8270C	III
08/26/2008	08H299	YWM107-2293	EMAX	NS	09/02/08	METHOD	09/04/08	SW6020A	III
08/26/2008	08H299	YWM107-2293	EMAX	NS	09/05/08	METHOD	09/05/08	SW7471A	III

Refer to footnotes on Page 6.

TABLE C-1: SAMPLE CROSS REFERENCE
AUGUST 2001 AND AUGUST 2008 SITE INSPECTIONS
MATHER WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK, CALIFORNIA

Date Collected	*Lab ID*	*Field ID*	*Lab*	*Sample Type*	*Date Prepared*	*Prep Method*	*Date Analyzed*	*Analytical Method*	*Review Level*
08/26/2008	08H299	YWM107-2293	EMAX	NS	09/04/08	SW3550B	09/12/08	SW8270C	III
08/26/2008	08H299	YWM108-2294	EMAX	NS	09/02/08	METHOD	09/04/08	SW6020A	III
08/26/2008	08H299	YWM108-2294	EMAX	NS	09/05/08	METHOD	09/05/08	SW7471A	III
08/26/2008	08H299	YWM108-2294	EMAX	NS	09/04/08	SW3550B	09/12/08	SW8270C	III
08/26/2008	08H299	YWM109-2295	EMAX	NS	09/02/08	METHOD	09/04/08	SW6020A	III
08/26/2008	08H299	YWM109-2295	EMAX	NS	09/05/08	METHOD	09/05/08	SW7471A	III
08/26/2008	08H299	YWM109-2295	EMAX	NS	09/04/08	SW3550B	09/12/08	SW8270C	III
08/26/2008	08H299	YWM110-2296	EMAX	NS	09/02/08	METHOD	09/03/08	SW6020A	III
08/26/2008	08H299	YWM110-2296	EMAX	NS	09/05/08	METHOD	09/05/08	SW7471A	III
08/26/2008	08H299	YWM110-2296	EMAX	NS	09/04/08	SW3550B	09/12/08	SW8270C	III
Soil Characterization Samples									
08/26/2008	08H299	YWM06-2276	PTS	NS	NA	NONE	Not specifie	D2937	III
08/26/2008	08H299	YWM06-2276	EMAX	NS	08/29/08	METHOD	08/29/08	SW9045	III
08/26/2008	08H299	YWM06-2276	EMAX	NS	09/04/08	METHOD	09/05/08	SW9081	III
08/26/2008	08H299	YWM06-2276	EMAX	NS	NA	NONE	09/05/08	WBLACK	III
08/26/2008	08H299	YWM08-2282	PTS	FD	NA	NONE	Not specifie	D2937	III
08/26/2008	08H299	YWM08-2282	EMAX	FD	08/29/08	METHOD	08/29/08	SW9045	III
08/26/2008	08H299	YWM08-2282	EMAX	FD	09/04/08	METHOD	09/05/08	SW9081	III
08/26/2008	08H299	YWM08-2282	EMAX	FD	NA	NONE	09/05/08	WBLACK	III

Notes:

APHC = Applied Physics and Chemistry Laboratory
EB = Equipment blank sample
EMAX = EMAX Laboratories, Inc.
NS = Normal field sample
FD = Field duplicate sample
SIM = Selected Ion Monitoring
WBLACK = Walkley-Black analytical method
III = Samples received Level III data review

TABLE C-2: DATA QUALIFICATION FLAGS AND REASON CODES

Data Qualifier Definitions For Organic Data Review

Qualifier	Definition
	No Qualifier indicates that the data are acceptable both qualitatively and quantitatively.
U	The analyte was analyzed for but was not detected above the reported sample quantitation limit.
J	The analyte was analyzed for and was positively identified, but the reported numerical value may not be consistent with the amount actually present in the environmental sample. Results are estimated although the data are considered usable and may be used as appropriate to meet project objectives. Results are qualitatively acceptable and quantitatively uncertain.
J-	The analyte was positively identified; associated numerical value is its approximate concentration with a low bias in the sample.
J+	The analyte was positively identified; associated numerical value is its approximate concentration with a high bias in the sample.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a “tentative identification.”
NJ	The analysis indicates the presence of an analyte that has been “tentatively identified” and the associated value represents its approximate concentration.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
R	The analyte was analyzed for, but the presence or absence of the analyte has not been verified. Resampling and reanalysis may be necessary to confirm or deny the presence of the analyte. Results are rejected and data are unusable for any purposes.

Data Qualifier Definitions For Inorganic Data Review

Qualifier	Definition
	No Qualifier indicates that the data are acceptable both qualitatively and quantitatively.
U	The analyte was analyzed for but was not detected above the level of the reported value. The reported value is the instrument detection limit for waters and the method detection limit for soils for all analytes except cyanide and mercury. For cyanide and mercury, the reported value is the contract required detection limit.
J	The analyte was analyzed for and was positively identified, but the reported numerical value may not be consistent with the amount actually present in the environmental sample. Results are estimated although the data are considered usable and may be used as appropriate to meet project objectives. Results are qualitatively acceptable and quantitatively uncertain.
J-	The analyte was positively identified; associated numerical value is its approximate concentration with a low bias in the sample.
J+	The analyte was positively identified; associated numerical value is its approximate concentration with a high bias in the sample.
UJ	The analyte was analyzed for but was not detected above the reported value. The reported value may not accurately or precisely represent the sample reporting limit.
R	The analyte was analyzed for, but the presence or absence of the analyte has not been verified. Resampling and reanalysis may be necessary to confirm or deny the presence of the analyte. Results are rejected and data are unusable for any purposes.

TABLE C-2: DATA QUALIFICATION FLAGS AND REASON CODES

Reason Codes for Data Review and Validation

REASON CODE	DESCRIPTION
A	Serial dilution outside criteria (Level IV).
B1	Method blank contaminants above reporting limit.
B2	Calibration blank contaminants above reporting limit.
B2, Bias Flag “-“	Calibration blank indicates negative interference, false negatives may be present.
C	Calibration outside control limits
D1	Sample duplicate RPD outside control limit
D2	Matrix duplicate RPD outside control limit
E	The sample results exceed the linear calibration range of the instrument.
F	Hydrocarbon pattern does not match hydrocarbon pattern in the standard.
G1	Initial calibration RSD outside control limit
G2	Initial continuing calibration RRF outside control limit.
G3	Continuing calibration RRF outside control limit.
H	Holding time exceeded.
I	Internal standard recovery outside control limit.
K1	Equipment rinsate contamination.
K2	Ambient blank contamination.
K3	Trip blank contamination.
L	LCS outside control limits.
M	MS outside control limits.
O	Interference check sample outside acceptance criteria.
P	Analyte qualified based on the professional judgment of the reviewer.
S	Surrogate recovery outside control limit.
T	Temperature outside acceptance criteria.
Tr	Value reported detected between the MDL and PQL
W	Pesticide breakdown outside criteria (Level IV)
X	Raised reporting limit due to matrix interference or high analyte concentration
Y	Analyte was not confirmed by a second column
Y1	Primary and Confirmation Sample duplicate RPD outside control limit.

TABLE C-3: QUALIFIED AND REJECTED DATA
MATHER WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK, CALIFORNIA

Field Sample ID	Lab ID	Parameter	Result	Units	RL[1]	Qual[2]	RC[3]
2001 SITE INSPECTION SAMPLES							
YWM-UG01-SO-1043	01-5540-12	Cadmium	<0.41	mg/kg	0.41	UJ	M
	01-5540-12	Chromium, hexavalent	<0.51	mg/kg	0.51	UJ	H
	01-5540-12	Thallium	<2	mg/kg	2	UJ	M
	01-5540-12	Molybdenum	<0.82	mg/kg	0.82	U	B
	01-5540-12	Arsenic	2.4	mg/kg	1.2	J	A
	01-5540-12	Barium	64.6	mg/kg	4.1	J	AD
	01-5540-12	Chromium	4.7	mg/kg	2	J-	AM
	01-5540-12	Cobalt	5	mg/kg	2	J	A
	01-5540-12	Lead	3.5	mg/kg	1.2	J	A
	01-5540-12	Nickel	3.8	mg/kg	1.2	J	A
	01-5540-12	Total Mercury	0.034	mg/kg	0.2	J	ATr
	01-5540-12	Zinc	27.1	mg/kg	4.1	J	A
YWM-UG02-SO-1044	01-5540-13	Cadmium	<0.41	mg/kg	0.41	UJ	M
	01-5540-13	Chromium, hexavalent	<0.51	mg/kg	0.51	UJ	H
	01-5540-13	Thallium	<2	mg/kg	2	UJ	M
	01-5540-13	Arsenic	3.4	mg/kg	1.2	J	A
	01-5540-13	Barium	46.7	mg/kg	4.1	J	AD
	01-5540-13	Chromium	7.9	mg/kg	2	J-	AM
	01-5540-13	Cobalt	6.4	mg/kg	2	J	A
	01-5540-13	Lead	5.1	mg/kg	1.2	J	A
	01-5540-13	Nickel	4.4	mg/kg	1.2	J	A
	01-5540-13	Total Mercury	0.081	mg/kg	0.2	J	ATr
	01-5540-13	Zinc	40.1	mg/kg	4.1	J	A
YWM-UG03-SO-1045	01-5540-14	Cadmium	<0.41	mg/kg	0.41	UJ	M
	01-5540-14	Chromium, hexavalent	<0.51	mg/kg	0.51	UJ	H
	01-5540-14	Thallium	<2.1	mg/kg	2.1	UJ	M
	01-5540-14	Arsenic	2.1	mg/kg	1.2	J	A
	01-5540-14	Barium	53.6	mg/kg	4.1	J	AD
	01-5540-14	Chromium	4.9	mg/kg	2.1	J-	AM
	01-5540-14	Cobalt	6	mg/kg	2.1	J	A
	01-5540-14	Lead	3.7	mg/kg	1.2	J	A
	01-5540-14	Nickel	4.4	mg/kg	1.2	J	A
	01-5540-14	Total Mercury	0.045	mg/kg	0.21	J	ATr
	01-5540-14	Zinc	52.8	mg/kg	4.1	J	A
YWM-TP01-SO-1042	01-5540-4	Cadmium	<0.41	mg/kg	0.41	UJ	M
	01-5540-4	Chromium, hexavalent	<0.51	mg/kg	0.51	UJ	H
	01-5540-4	Thallium	<2	mg/kg	2	UJ	M
	01-5540-4	Arsenic	1.9	mg/kg	1.2	J	A

TABLE C-3: QUALIFIED AND REJECTED DATA
MATHER WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK, CALIFORNIA

Field Sample ID	Lab ID	Parameter	Result	Units	RL[1]	Qual[2]	RC[3]
YWM-TP01-SO-1042	01-5540-4	Barium	44	mg/kg	4.1	J	AD
	01-5540-4	Chromium	2.1	mg/kg	2	J-	AM
	01-5540-4	Cobalt	5.3	mg/kg	2	J	A
	01-5540-4	Lead	10.7	mg/kg	1.2	J	A
	01-5540-4	Nickel	2.1	mg/kg	1.2	J	A
	01-5540-4	Total Mercury	0.88	mg/kg	0.2	J	A
	01-5540-4	Zinc	38.8	mg/kg	4.1	J	A
YWM-TP02-SO-1048	01-5540-7	Acenaphthene	<53	µg/kg	53	UJ	M
	01-5540-7	Acenaphthylene	<21	µg/kg	21	UJ	M
	01-5540-7	Chromium, hexavalent	<0.53	mg/kg	0.53	UJ	H
	01-5540-7	Fluorene	<2.1	µg/kg	2.1	UJ	M
	01-5540-7	Naphthalene	<53	µg/kg	53	UJ	M
	01-5540-7	Thallium	<0.53	mg/kg	0.53	UJ	M
	01-5540-7	Arsenic	5.7	mg/kg	0.32	J	A
	01-5540-7	Barium	1,420	mg/kg	1.1	J	AD
	01-5540-7	Cadmium	11.8	mg/kg	0.11	J-	DM
	01-5540-7	Chromium	36.4	mg/kg	0.53	J-	AM
	01-5540-7	Cobalt	5.7	mg/kg	0.53	J	A
	01-5540-7	Dibenz(a,h)anthracene	17	µg/kg	5.3	J-	M
	01-5540-7	Diesel Fuel with SGC	8	µg/kg	11	J-	MTr
	01-5540-7	Lead	1,040	mg/kg	0.32	J	A
	01-5540-7	Nickel	11.9	mg/kg	0.32	J	A
	01-5540-7	Total Mercury	0.88	mg/kg	0.21	J	A
	01-5540-7	Zinc	1,460	mg/kg	1.1	J	A
YWM-TP02-SO-1046	01-5540-5	Chromium, hexavalent	<0.52	mg/kg	0.52	UJ	H
	01-5540-5	Thallium	<2.1	mg/kg	2.1	UJ	M
	01-5540-5	Arsenic	5.2	mg/kg	1.2	J	A
	01-5540-5	Barium	1,040	mg/kg	4.1	J	AD
	01-5540-5	Cadmium	3.9	mg/kg	0.41	J-	DM
	01-5540-5	Chromium	29	mg/kg	2.1	J-	AM
	01-5540-5	Cobalt	6.3	mg/kg	2.1	J	A
	01-5540-5	Lead	600	mg/kg	1.2	J	A
	01-5540-4	Nickel	8.7	mg/kg	1.2	J	A
	01-5540-4	Total Mercury	0.67	mg/kg	0.21	J	A
	01-5540-4	Zinc	1,690	mg/kg	4.1	J	A
YWM-TP02-SO-1047	01-5540-5	Chromium, hexavalent	<0.51	mg/kg	0.51	UJ	H
	01-5540-5	Thallium	<2.1	mg/kg	2.1	UJ	M
	01-5540-5	Arsenic	8.4	mg/kg	1.2	J	A
	01-5540-5	Barium	452	mg/kg	4.1	J	AD

TABLE C-3: QUALIFIED AND REJECTED DATA
MATHER WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK, CALIFORNIA

Field Sample ID	Lab ID	Parameter	Result	Units	RL[1]	Qual[2]	RC[3]
YWM-TP02-SO-1047	01-5540-5	Cadmium	3.5	mg/kg	0.41	J-	DM
	01-5540-5	Chromium	21.3	mg/kg	2.1	J-	AM
	01-5540-5	Cobalt	6.8	mg/kg	2.1	J	A
	01-5540-5	Lead	447	mg/kg	1.2	J	A
	01-5540-5	Nickel	12.5	mg/kg	1.2	J	A
	01-5540-5	Total Mercury	1.6	mg/kg	0.21	J	A
	01-5540-5	Zinc	2,120	mg/kg	4.1	J	A
YWM-TP04-SO-1037	01-5540-8	Cadmium	<0.41	mg/kg	0.41	UJ	M
	01-5540-8	Chromium, hexavalent	<0.51	mg/kg	0.52	UJ	H
	01-5540-8	Thallium	<2.1	mg/kg	2.1	UJ	M
	01-5540-8	Arsenic	2	mg/kg	1.2	J	A
	01-5540-8	Barium	31.6	mg/kg	4.1	J	AD
	01-5540-8	Chromium	2.6	mg/kg	2.1	J-	AM
	01-5540-8	Cobalt	3.4	mg/kg	2.1	J	A
	01-5540-8	Lead	3	mg/kg	1.2	J	A
	01-5540-8	Nickel	2.2	mg/kg	1.2	J	A
	01-5540-8	Total Mercury	0.052	mg/kg	0.21	J	ATr
	01-5540-8	Zinc	25.7	mg/kg	4.1	J	A
YWM-TP05-SO-1039	01-5540-10	Cadmium	<0.41	mg/kg	0.41	UJ	M
	01-5540-10	Chromium, hexavalent	<0.52	mg/kg	0.51	UJ	H
	01-5540-10	Thallium	<2.1	mg/kg	2.1	UJ	M
	01-5540-10	Arsenic	2.5	mg/kg	1.2	J	A
	01-5540-10	Barium	46.5	mg/kg	4.1	J	AD
	01-5540-10	Chromium	3.7	mg/kg	2.1	J-	AM
	01-5540-10	Cobalt	3.8	mg/kg	2.1	J	A
	01-5540-10	Lead	22.4	mg/kg	1.2	J	A
	01-5540-10	Nickel	3.6	mg/kg	1.2	J	A
	01-5540-10	Total Mercury	0.049	mg/kg	0.21	J	ATr
	01-5540-10	Zinc	24.6	mg/kg	4.1	J	A
YWM-TP05-SO-1038	01-5540-9	Cadmium	<0.41	mg/kg	0.41	UJ	M
	01-5540-9	Chromium, hexavalent	<0.52	mg/kg	0.51	UJ	H
	01-5540-9	Thallium	<2.1	mg/kg	2.1	UJ	M
	01-5540-9	Arsenic	2	mg/kg	1.2	J	A
	01-5540-9	Barium	39	mg/kg	4.1	J	AD
	01-5540-9	Chromium	4.1	mg/kg	2.1	J-	AM
	01-5540-9	Cobalt	4.2	mg/kg	2.1	J	A
	01-5540-9	Lead	4.8	mg/kg	1.2	J	A
	01-5540-9	Nickel	3.2	mg/kg	1.2	J	A
	01-5540-9	Total Mercury	0.031	mg/kg	0.21	J	ATr

TABLE C-3: QUALIFIED AND REJECTED DATA
MATHER WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK, CALIFORNIA

Field Sample ID	Lab ID	Parameter	Result	Units	RL[1]	Qual[2]	RC[3]
YWM-DG01-SO-1050	01-5540-1	Cadmium	<0.42	mg/kg	0.42	UJ	M
	01-5540-1	Chromium, hexavalent	<0.52	mg/kg	0.52	UJ	H
	01-5540-1	Thallium	<2.1	mg/kg	2.1	UJ	M
	01-5540-1	Arsenic	1.9	mg/kg	1.2	J	A
	01-5540-1	Barium	59.1	mg/kg	4.2	J	AD
	01-5540-1	Chromium	4.3	mg/kg	2.1	J-	AM
	01-5540-1	Cobalt	4.5	mg/kg	2.1	J	A
	01-5540-1	Lead	7.9	mg/kg	1.2	J	A
	01-5540-1	Nickel	4.6	mg/kg	1.2	J	A
	01-5540-1	Total Mercury	0.049	mg/kg	0.21	J	ATr
	01-5540-1	Zinc	38.6	mg/kg	4.2	J	A
YWM-DG02-SO-1051	01-5540-1	Cadmium	<0.4	mg/kg	0.4	UJ	M
	01-5540-1	Chromium, hexavalent	<0.5	mg/kg	0.5	UJ	H
	01-5540-1	Thallium	<2	mg/kg	2	UJ	M
	01-5540-1	Molybdenum	<0.8	mg/kg	0.8	U	B
	01-5540-1	Arsenic	1.2	mg/kg	1.2	J	ATr
	01-5540-1	Barium	35.5	mg/kg	4	J	AD
	01-5540-1	Chromium	1.7	mg/kg	2	J-	AMTr
	01-5540-1	Cobalt	4	mg/kg	2	J	A
	01-5540-1	Lead	3.5	mg/kg	1.2	J	A
	01-5540-1	Nickel	1.7	mg/kg	1.2	J	A
	01-5540-1	Total Mercury	0.041	mg/kg	0.2	J	ATr
	01-5540-1	Zinc	22.5	mg/kg	4	J	A
YWM-DG01-SO-1050	01-5540-1	Cadmium	<0.41	mg/kg	0.41	UJ	M
	01-5540-1	Chromium, hexavalent	<0.51	mg/kg	0.51	UJ	H
	01-5540-1	Thallium	<2	mg/kg	2	UJ	M
	01-5540-1	Arsenic	1.8	mg/kg	1.2	J	A
	01-5540-1	Barium	63.5	mg/kg	4.1	J	AD
	01-5540-1	Chromium	3.9	mg/kg	2	J-	AM
	01-5540-1	Cobalt	6	mg/kg	2	J	A
	01-5540-1	Lead	8.5	mg/kg	1.2	J	A
	01-5540-1	Nickel	4	mg/kg	1.2	J	A
	01-5540-1	Total Mercury	0.084	mg/kg	0.2	J	ATr
	01-5540-1	Zinc	39.5	mg/kg	4.1	J	A
YWM-EB-WH-1065	01-5540-15	Diesel Fuel	0.09	mg/L	0.05	J	F
	01-5540-15	Motor Oils	0.2	mg/L	0.5	J	FTr

TABLE C-3: QUALIFIED AND REJECTED DATA
MATHER WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK, CALIFORNIA

Field Sample ID	Lab ID	Parameter	Result	Units	RL[1]	Qual[2]	RC[3]
2008 SITE INSPECTION SAMPLES							
YWM02A-2268	08H299	Dichlorodifluoromethane	ND	µg/kg	10	UJ	C
YWM05A-2271	08H299	PCB-1016	ND	µg/kg	53	UJ	S
	08H299	PCB-1221	ND	µg/kg	53	UJ	S
	08H299	PCB-1232	ND	µg/kg	53	UJ	S
	08H299	PCB-1242	ND	µg/kg	53	UJ	S
	08H299	PCB-1248	ND	µg/kg	53	UJ	S
	08H299	PCB-1254	ND	µg/kg	53	UJ	S
	08H299	PCB-1260	ND	µg/kg	53	UJ	S
YWM06-2274	08H299	Dichlorodifluoromethane	ND	µg/kg	10	UJ	C
	08H299	1,1,2,2-Tetrachloroethane	ND	µg/kg	5	UJ	I
	08H299	1,2-Dichlorobenzene	ND	µg/kg	5	UJ	I
	08H299	1,3-Dichlorobenzene	ND	µg/kg	5	UJ	I
	08H299	1,4-Dichlorobenzene	ND	µg/kg	5	UJ	I
	08H299	Bromoform	ND	µg/kg	5	UJ	I
	08H299	Acetone	5.6	µg/kg	10	J+	S
YWM06-2276	08H299	Dichlorodifluoromethane	ND	µg/kg	11	UJ	C
	08H299	Antimony	0.331	mg/kg	0.518	J-	M
	08H299	Lead	27.1	mg/kg	0.518	J-	M
	08H299	TOC	9510	mg/kg	1040	J+	L
YWM07-2277	08H299	Dichlorodifluoromethane	ND	µg/kg	18	UJ	CI
	08H299	1,1,2,2-Tetrachloroethane	ND	µg/kg	8.9	R	reject
	08H299	1,1,1-Trichloroethane	ND	µg/kg	8.9	UJ	I
	08H299	1,1,2-Trichloroethane	ND	µg/kg	8.9	UJ	I
	08H299	1,2-Dichlorobenzene	ND	µg/kg	8.9	R	reject
	08H299	1,3-Dichlorobenzene	ND	µg/kg	8.9	R	reject
	08H299	1,4-Dichlorobenzene	ND	µg/kg	8.9	R	reject
	08H299	1,1-Dichloroethane	ND	µg/kg	8.9	UJ	I
	08H299	1,1-Dichloroethene	ND	µg/kg	8.9	UJ	I
	08H299	1,2-Dichloroethane	ND	µg/kg	8.9	UJ	I
	08H299	1,2-Dichloropropane	ND	µg/kg	8.9	UJ	I
	08H299	2-butanone	ND	µg/kg	18	UJ	I
	08H299	2-Hexanone	ND	µg/kg	18	UJ	I
	08H299	Acetone	ND	µg/kg	18	UJ	I
	08H299	Benzene	ND	µg/kg	8.9	UJ	I
	08H299	Bromodichloromethane	ND	µg/kg	8.9	UJ	I
	08H299	Bromoform	ND	µg/kg	8.9	R	reject
	08H299	Bromomethane	ND	µg/kg	18	UJ	I
	08H299	Carbon Disulfide	ND	µg/kg	8.9	UJ	I

TABLE C-3: QUALIFIED AND REJECTED DATA
MATHER WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK, CALIFORNIA

Field Sample ID	Lab ID	Parameter	Result	Units	RL[1]	Qual[2]	RC[3]
YWM07-2277	08H299	Carbon tetrachloride	ND	µg/kg	8.9	UJ	I
	08H299	Chlorobenzene	ND	µg/kg	8.9	UJ	I
	08H299	Chloroethane	ND	µg/kg	8.9	UJ	I
	08H299	Chloroform	ND	µg/kg	8.9	UJ	I
	08H299	Chloromethane	ND	µg/kg	18	UJ	I
	08H299	cis-1,2-Dichloroethylene	ND	µg/kg	8.9	UJ	I
	08H299	cis-1,3-Dichloropropene	ND	µg/kg	8.9	UJ	I
	08H299	Dibromochloromethane	ND	µg/kg	8.9	UJ	I
	08H299	Ethylbenzene	ND	µg/kg	8.9	UJ	I
	08H299	m,p-xylene	ND	µg/kg	18	UJ	I
	08H299	Methyl isobutyl ketone	ND	µg/kg	18	UJ	I
	08H299	Methyl tert-butyl ether	ND	µg/kg	8.9	UJ	I
	08H299	O-xylene	ND	µg/kg	8.9	UJ	I
	08H299	Styrene	ND	µg/kg	8.9	UJ	I
	08H299	Tetrachloroethylene	ND	µg/kg	8.9	UJ	I
	08H299	Toluene	ND	µg/kg	8.9	UJ	I
	08H299	Trans-1,2-Dichloroethene	ND	µg/kg	8.9	UJ	I
	08H299	Trans-1,3-Dichloropropene	ND	µg/kg	8.9	UJ	I
	08H299	Trichloroethylene	ND	µg/kg	8.9	UJ	I
	08H299	Trichlorofluoromethane	ND	µg/kg	8.9	UJ	I
	08H299	Vinyl chloride	ND	µg/kg	8.9	UJ	I
	08H299	Methylene CHLORIDE	7.2	µg/kg	18	J+	SI
YWM07-2279	08H299	Dichlorodifluoromethane	ND	µg/kg	14	UJ	C
YWM08-2280	08H299	Dichlorodifluoromethane	ND	µg/kg	11	UJ	C
	08H299	1,1,2,2-Tetrachloroethane	ND	µg/kg	5.6	UJ	I
	08H299	1,2-Dichlorobenzene	ND	µg/kg	5.6	UJ	I
	08H299	1,3-Dichlorobenzene	ND	µg/kg	5.6	UJ	I
	08H299	1,4-Dichlorobenzene	ND	µg/kg	5.6	UJ	I
	08H299	Bromoform	ND	µg/kg	5.6	UJ	I
YWM08-2281	08H299	Dichlorodifluoromethane	ND	µg/kg	11	UJ	C
YWM08-2282	08H299	Dichlorodifluoromethane	ND	µg/kg	11	UJ	C
	08H299	TOC	2010	mg/kg	1010	J+	L
YWM09-2284	08H299	Dichlorodifluoromethane	ND	µg/kg	10	UJ	C
YWM09-2285	08H299	Dichlorodifluoromethane	ND	µg/kg	13	UJ	C
	08H299	Methylene chloride	2.7	µg/kg	13	J+	S
YWM09-2286	08H299	Dichlorodifluoromethane	ND	µg/kg	14	UJ	C
	08H299	1,1,2,2-Tetrachloroethane	ND	µg/kg	7.2	UJ	I
	08H299	1,2-Dichlorobenzene	ND	µg/kg	7.2	UJ	I

TABLE C-3: QUALIFIED AND REJECTED DATA
MATHER WASTE ACCUMULATION AREA
YOSEMITE NATIONAL PARK, CALIFORNIA

Field Sample ID	Lab ID	Parameter	Result	Units	RL[1]	Qual[2]	RC[3]
YWM09-2286	08H299	1,3-Dichlorobenzene	ND	µg/kg	7.2	UJ	I
	08H299	1,4-Dichlorobenzene	ND	µg/kg	7.2	UJ	I
	08H299	Bromoform	ND	µg/kg	7.2	UJ	I
YWM109-2295	08H299	Mercury	0.0487	mg/kg	0.103	U	B2
YWM110-2296	08H299	Zinc	20.3	mg/kg	1.03	J-	A

NOTES:
[1] RL = Reporting Limit
[2] Qual = Qualifier (see Table C-2)
[3] RC = Reason Code (see Table C-2)
ug/kg = microgram per kilogram
mg/kg = milligram per kilogram
J = The analyte was positively identified, associated numerical value is its approximate concentration in the sample.
+ = Bias high
- = Bias low
UJ = The analytie was not detected above the reporting limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
ND = Not detected

TABLE C-4: FIELD DUPLICATE SUMMARY
MATHER WASTE ACCUMULATION AREA,
YOSEMITE NATIONAL PARK, CALIFORNIA

	Analyte	Units	NS Result	FD Result	RPD, %	Goal Met?
YWM-TP02	**Metals (SW6020A)**					
8/2001	Arsenic	mg/kg	5.7	8.4	38	Yes
	Barium	mg/kg	1420	452	**103**	**No**
	Cadmium	mg/kg	11.8	3.5	**108**	**No**
	Chromium,	mg/kg	36.4	21.3	**52**	**No**
	Cobalt	mg/kg	6.3	6.8	8	Yes
	Copper	mg/kg	107	63.3	**51**	**No**
	Lead	mg/kg	1040	447	**80**	**No**
	Molybdenum	mg/kg	2.3	0.64	**113**	**No**
	Nickel	mg/kg	11.9	12.5	5	Yes
	Silver	mg/kg	2.6	0.75	**110**	**No**
	Vanadium	mg/kg	24.1	21.4	12	Yes
	Zinc	mg/kg	1690	2120	23	Yes
	Mercury (SW7471A)	mg/kg	0.88	1.6	**58**	**No**
	PAHs (SW8310)					
	Benzo(a)anthracene	ug/kg	7.2	10	33	Yes
	Benzo(a)pyrene	ug/kg	15	34	**78**	**No**
	Benzo(b)fluoranthene	ug/kg	15	28	**60**	**No**
	Chrysene	ug/kg	17	35	**69**	**No**
	Dibenz(a,h)anthracene	ug/kg	17	30	**55**	**No**
	Fluroanthene	ug/kg	31	39	23	Yes
	Indeno(1,2,3-cd)pyrene	ug/kg	11	20	**58**	**No**
	Phenanthrene	ug/kg	13	20	42	Yes
	Pyrene	ug/kg	44	39	12	Yes
	TPH (SW8015D)					
	Diesel Fuel	mg/kg	77	240	103	No
	Diesel Fuel +SGC	mg/kg	99	79	22	Yes
	Motor Oil	mg/kg	390	990	**87**	**No**
	Motor Oil + SGC	mg/kg	220	600	**93**	**No**

TABLE C-4: FIELD DUPLICATE SUMMARY
MATHER WASTE ACCUMULATION AREA,
YOSEMITE NATIONAL PARK, CALIFORNIA

	Analyte	Units	NS Result	FD Result	RPD, %	Goal Met?
YWM08	**Metals (SW6020A)**					
8/2008	Arsenic	mg/kg	1.1	0.877	23	Yes
	Barium	mg/kg	66.3	50.7	27	Yes
	Beryllium	mg/kg	0.171	0.148	*	Yes
	Cadmium	mg/kg	0.153	0.123	*	Yes
	Chromium,	mg/kg	2.66	1.98	29	Yes
	Cobalt	mg/kg	4.08	3.71	9	Yes
	Copper	mg/kg	28.9	18.4	44	Yes
	Lead	mg/kg	30	11.5	**89**	**No**
	Molybdenum	mg/kg	0.384	0.333	*	Yes
	Nickel	mg/kg	2.12	1.74	20	Yes
	Selenium	mg/kg	0.127	0.112	*	Yes
	Thallium	mg/kg	0.381	0.339	*	Yes
	Vanadium	mg/kg	23.6	21.3	10	Yes
	Zinc	mg/kg	66.2	49.3	29	Yes
	Mercury	mg/kg	0.758	1.14	40	Yes
	Aluminum	mg/kg	8,940	7,360	19	Yes
	Calcium	mg/kg	1,550	1,390	11	Yes
	Iron	mg/kg	14,600	13,200	10	Yes
	Magnesium	mg/kg	4,200	3,810	10	Yes
	Manganese	mg/kg	387	384	0.8	Yes
	Potassium	mg/kg	5,050	4,760	6	Yes
	Sodium	mg/kg	90.2	93.8	*	Yes

Notes:
NS = normal sample
FD = field duplicate sample
* One or both of the detected results were less than their respective PQL, and the primary and duplicate samples were evaluated based on the absolute value of the difference between the two samples and the PQLs, as follows:
|Primary Result - FD Result| < PQL = Agreement
|Primary Result - FD Result| > PQL = Disagreement

TABLE C-5: ANALYTICAL AND TECHNICAL COMPLETENESS, AUGUST 2008 SAMPLES
MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Analytical Method Group	*Analytical Method*	*Leachate Method*	*Number of Analytes*	*Number of Samples*	*Number of Results*	*Number of Unqualified Results*	*Number of Usable Results*	*Analytical Completeness (%)* [a]	*Technical Completeness (%)* [b]
Investigation samples									
VOCs	SW8260B	NA	41	11	451	383	446	**84.9**	98.9
SVOCs	SW8270C	NA	63	11	693	693	693	100	100
PAHs	SW8270C SIM	NA	16	11	176	176	176	100	100
PCBs	SW8082	NA	7	12	84	77	84	91.7	100
TPH-p	SW8015B	NA	1	11	11	11	11	100	100
TPH-e	SW8015B	NA	2	12	24	24	24	100	100
Metals	SW6020A	NA	23	11	253	251	253	99.2	100
Mercury	SW7471A	NA	1	11	11	11	11	100	100
Background samples									
PAHs	SW8270C SIM	NA	16	10	160	160	160	100	100
Metals	SW6020A	NA	23	10	230	229	230	99.6	100
Mercury	SW7471A	NA	1	10	10	9	10	90	100
Soil Characterization samples									
CEC	SW9081	NA	1	2	2	2	2	100	100
TOC	WBLACK	NA	1	2	2	0	2	**0**	100
Bulk Density	D2937	NA	1	2	2	2	2	100	100
pH	SW9045	NA	1	2	2	2	2	100	100

Notes:
[a] Goal for Analytical Completeness is 90%.
[b] Goal for Technical Completeness is 95%.
Values in bold indicate Completness Results that do not meet the Project Goal.

CEC = Cation Exchange Capacity
NA = Not Applicable (not performed)
PAHs = Polynuclear Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls
SIM = Selected ion monitoring
SVOCs = Semi-volatile Organic Compounds
TOC = Total Organic Carbons
TPH-e = Total Petroleum Hydrocarbons – Extractable
TPH-p = Total Petroleum Hydrocarbons – Purgeable
VOCs = Volatile Organic Compounds
WBLACK = Walkley-Black Method

APPENDIX D
CHARACTERIZATION OF BACKGROUND AND SITE-TO-BACKGROUND COMPARISON FOR METALS IN SOIL

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LIST OF ACRONYMS AND ABBREVIATIONS

ANOVA	analysis of variance
bgs	below ground surface
BSV	background screening value
CAM 17	California Assessment Manual 17
CalEPA	California Environmental Protection Agency
DTSC	[CalEPA] Department of Toxic Substances Control
MDC	maximum detected concentration
MDL	method detection limit
mg/kg	milligram per kilogram
TAL	target analyte list
USEPA	U.S. Environmental Protection Agency
UTL	upper tolerance limit
WAA	Waste Accumulation Area
WRS	Wilcoxon rank sum

1.0 CHARACTERIZATION OF BACKGROUND DISTRIBUTIONS

This appendix describes the methodology that was used to characterize the background distributions of selected elements in surface soil at the Mather Waste Accumulation Area (WAA), located within Yosemite National Park, California. Ten background surface soil samples (1 foot below ground surface [bgs]) were collected in August 2008 from locations close to the WAA and believed to be uninfluenced by site-related contamination. These samples were submitted to an off-site laboratory for analysis of the 23 target analyte list (TAL) metals, plus molybdenum. Three background soil samples (1 to 1.5 feet bgs) were collected in August 2001 and analyzed for the California Assessment Manual 17 (CAM 17) metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc). These 2001 data were evaluated and, where appropriate, combined with the 2008 data to increase the background sample size and therefore improve confidence in the resulting summary statistics.

U.S. Environmental Protection Agency (USEPA) guidance and California Environmental Protection Agency Department of Toxic Substances Control (DTSC) guidance were used to evaluate distributional assumptions and characterize the distributions. The completed background data set can be used in site-to-background comparisons to identify constituents of concern at Mather WAA and to determine the nature and extent of site-related contamination. In addition, the background data may be used to support human health and ecological risk assessments and proposals for no further action, develop realistic remediation goals, and evaluate the success of remediation efforts.

1.1 METHODOLOGY FOR CHARACTERIZATION OF BACKGROUND DISTRIBUTIONS

Background concentrations of naturally occurring metals form a distribution of values over a given spatial area. The characterization of background can be defined as the process of describing the statistical distributions of concentration values from samples obtained at representative locations. The statistical methodology used to characterize background distributions at Mather WAA is based on published USEPA guidance (USEPA, 1989, 1992, 1994, 1995, and 2006). Key issues in background characterization include:

- Handling of nondetects
- Evaluation of distributional assumptions
- Handling of outliers
- Percentile plots
- Calculation of summary statistics.

The following sections explain how these key issues were addressed.

1.1.1 Handling of Nondetects

A certain proportion of nondetect values are common in background data sets. A variety of methods to deal with nondetects have been proposed, each of which has advantages and disadvantages with respect to introducing unwanted bias into the description of background. In accordance with USEPA guidance, nondetects were replaced with a value equal to the method detection limit (MDL) for that analyte (USEPA, 1989).

1.1.2 Evaluation of Distributional Assumptions

The shape of the distribution, considered to be either normal, lognormal, or nonparametric, is reported as part of the characterization (the term "nonparametric" is not a specific shape, but is used to describe distributions that are neither normal nor lognormal, as per USEPA guidance). The selection of an appropriate type of statistical distribution is based on USEPA guidance (USEPA, 1989, 1992, and 2006).

The USEPA recommends the Shapiro-Wilk test for determining whether the distribution of concentration data is normal, lognormal, or neither (USEPA, 1992 and 2006). The test is performed on the untransformed data to test for normality. Lognormality is tested by taking the logarithm (log-transform) of the data and then testing for normality. The test returns a "*p*-level" value between zero and one, indicating the goodness of fit. A *p*-level of 0.05 or greater indicates an acceptable fit to a normal model at the 95 percent confidence level; in other words, there is only a one-in-twenty chance of falsely identifying the distribution as normal when it really is not. If the transformed and untransformed data both yield *p*-levels that are greater than 0.05, then the result with the highest *p*-level is used to determine if the distribution is normal or lognormal. If the Shapiro-Wilk test indicates that a data set is neither normal nor lognormal at this confidence level, then the data are assumed to have a nonparametric distribution. Data sets with greater than 15 percent nondetects are automatically treated as nonparametric distributions as per USEPA guidance (USEPA, 1989).

1.1.3 Handling of Outliers

Outliers are defined as data points whose values are anomalously high relative to the rest of the data set (USEPA, 1989). Possible reasons for outliers are improper sampling, analytical error, or laboratory contamination; errors in transcription of data values, decimal points, or units; the presence of actual contamination in the sample; or a natural background concentration that is unusually high. For each element, the concentration data were rank-ordered and the maximum value was flagged if it was greater than five times the second-highest value (USEPA, 1989). Samples flagged as outliers were further examined via geochemical evaluation to determine whether there is a natural source for the elevated concentrations. Statistical or geochemical outliers were only eliminated from consideration if there were reasons to suspect errors in the data or site-related contamination in the sample.

1.1.4 Percentile Plots

Percentile plots (presented in Attachment 1) were constructed for each element in the background data set To construct the plots, the data were first rank-ordered, and then concentrations were plotted on the y-axis and the corresponding percentiles were plotted on the x-axis. Percentile plots are similar to probability plots. Normally distributed data will appear as a straight line, and lognormally distributed data will appear as a straight line if a logarithmic concentration scale is used. In both cases, statistical outliers will appear above the linear trend. A break in the slope may be apparent if the distribution is bimodal, or if multiple samples have identical concentrations. These plots visualize the data, permit a qualitative assessment of the distribution shape, and permit the identification of potential outliers in the upper tail of the distribution.

Nondetects were set to the MDL for plotting purposes. Multiple nondetects may appear as a nearly horizontal line in the plots, if they represent similar MDLs. A break in slope may also be apparent between nondetect values and higher detected concentrations. Percentile plots were not constructed for analytes with greater than 75 percent nondetects, as the plots lose meaning when they contain such a high proportion of replacement values.

1.1.5 Calculation of Summary Statistics

A complete statistical description of each background distribution is provided in Section 1.2. These descriptions include the number of samples, percent nondetects, distribution type (normal, lognormal, or nonparametric), minimum, median, geometric mean, arithmetic mean, maximum, and a concentration that is representative of the upper range of the background distribution for use as a background screening value. The standard deviation and coefficient of variation (standard deviation divided by the mean) are also provided; they are both measures of the variance of the distributions. The skewness coefficient, which is a measure of the asymmetry of the distribution, is also provided for each element.

As noted previously, nondetects were replaced with a value equal to the MDL for purposes of characterizing distributions. The actual concentrations of nondetects are unknown, and thus for highly censored distributions, descriptive statistics have greater uncertainty. In this report, the standard deviation, coefficient of variation, and skewness are not calculated for elements with a high proportion of nondetects (75 percent or greater). Where appropriate, values representing less than the MDL are used for the minimum, maximum, and measures of central tendency.

It is important to select the background screening value carefully so that the probability of falsely identifying site samples as contaminated or uncontaminated is minimized. Ideally, a site sample with a concentration above the screening value would have a low probability of being a member of the background distribution, and may be an indicator of contamination. The 95^{th} upper tolerance limit (UTL) is recommended as a screening value for normally or lognormally distributed analytes, and the 95^{th} percentile is recommended as a screening value for nonparametrically distributed analytes (USEPA, 1989, 1992, and 1994).

The UTL establishes a concentration range that is constructed to contain a specified proportion of the population with a specified confidence. The proportion of the population included is referred to as the "coverage," and the probability with which the tolerance interval includes the proportion is referred to as the "tolerance coefficient." The USEPA-recommended coverage of 95 percent and tolerance coefficient of 95 percent (USEPA, 1989) were used to calculate the UTLs. A coverage of 95 percent means that random uncontaminated site samples will exceed the screening value less than 5 percent of the time. A tolerance coefficient of 95 percent means that one has a 95 percent confidence that the 95^{th} UTL will contain at least 95 percent of the background distribution. Site samples with concentrations above the background 95^{th} UTL (or 95^{th} percentile) are not necessarily contaminated, but they should be considered suspect. The background 95^{th} UTLs were calculated in accordance with USEPA, 1989 (UTL = mean + $K \cdot$ standard deviation), where K is a tolerance factor that is a function of n, the desired coverage (95 percent), and the desired confidence level (95 percent). For lognormal distributions, the equation is applied to the log-transformed data, and the antilog of the result is used as the UTL.

The complete descriptions of background distributions that are provided in Section 1.2 are sufficient to allow the calculation of most statistical parameters (such as the standard error of the mean, two standard deviations above the mean, etc.). The descriptions can also be used to support site-to-background data set comparisons. There are two general types of statistical site-to-background comparisons. Parametric comparisons, such as the analysis of variance (ANOVA) and the two-sample t test, require the means and standard deviations of the distributions that are being compared. Nonparametric comparison tests, such as the Wilcoxon rank sum test and the Gehan test, require the actual data rather than summary statistics. For these purposes, the actual analytical results are also provided in Appendix B.

1.2 BACKGROUND DISTRIBUTIONS OF METALS IN SURFACE SOIL

As noted above, the Mather WAA background surface soil data were subjected to an outlier test to identify potentially anomalous concentrations. No statistical outliers were identified among the 24 elements considered in the background study. Visual inspection of the percentile plots (Attachment 1) generally corroborates the quantitative test results.

In addition to the outlier test, the data were examined for the presence of high nondetect values. Three high nondetects each for antimony, selenium, silver, and thallium were deleted from the background data set. All of these high nondetects were observed in the 2001 samples. In the case of selenium, samples YWM-UG01, -02, and -03 have reporting limits of 2.0 to 2.1 milligrams per kilogram (mg/kg) and MDLs of 0.45 mg/kg. These nondetects comprise the top 23 percent of the distribution, whereas the remaining ten samples contain detectable selenium at estimated concentrations (denoted by the qualifier *J*) ranging from 0.163 J to 0.464 J mg/kg (median of 0.253 mg/kg). Likewise, for thallium, nondetect samples YWM-UG01, -02, and -03 have reporting limits of 2.0 to 2.1 mg/kg and MDLs of 0.31 to 0.32 mg/kg, versus detected concentrations of 0.161 J to 0.267 J mg/kg in the remaining ten samples. Exclusion of these high nondetects avoids introducing bias into the calculation of background summary statistics for selenium and thallium.

In the case of antimony and silver, the three 2001 samples have reporting limits that are one to two orders of magnitude higher than those of the ten 2008 samples, seven of which are nondetect for antimony and all of which are nondetect for silver. The antimony reporting limits are 20 to 21 mg/kg for the 2001 samples versus 0.512 to 0.527 mg/kg for the 2008 samples; the antimony MDLs are 0.28 mg/kg (2001) versus 0.102 to 0.105 mg/kg (2008). The three antimony detections range from 0.111 J to 0.191 J mg/kg, and these concentrations are below the 2001 samples' MDL. The silver reporting limits are 2.0 to 2.1 mg/kg for the 2001 samples versus 0.512 to 0.527 mg/kg for the 2008 samples; the silver MDLs are 0.061 to 0.062 mg/kg (2001) versus 0.102 to 0.105 mg/kg (2008). Exclusion of the high nondetects avoids introducing a high bias in the background screening values for antimony and silver, and is a conservative approach.

One hundred percent of the background surface soil samples are nondetect for silver (Table D-1). For this element, the maximum MDL is provided as an upper limit to the background distribution. The other 23 elements were detected in at least some of the background samples, with nondetect frequencies ranging from 0 to 77 percent. The distributions of antimony, beryllium, cadmium, and mercury were characterized as nonparametric due to their high percentage of nondetects (greater than 15 percent). Accordingly, the 95th percentile was calculated as the background screening value for these four elements. Lead and vanadium failed the normality/lognormality test and are also characterized as having nonparametric distributions; their background screening values also represent the 95th percentile. The distributions of the remaining elements were determined to be either normal or lognormal, and therefore parametric 95th UTLs were calculated as their background screening values.

It is important to note that the calculated background 95th UTLs (for the normally and lognormally distributed analytes) exceed their corresponding maximum detected concentrations (Table D-1). This is appropriate due to the small sample size (n = 10 or 13) and naturally large range of element concentrations. Under these conditions, it is not reasonable to assume that the limited number of samples have accurately characterized the upper tail of the actual population. As discussed in Section 1.1, the UTL is calculated from a fit to the data, and is thus able to extrapolate the upper tail of the population based on the existing data.

Of the 24 elements analyzed in the background samples, aluminum, iron, magnesium, and potassium have the highest median concentrations, in that order (Table D-1). Iron in the samples is most likely present as iron oxides, which are common soil-forming minerals that occur as discrete mineral grains or as coatings on silicate minerals (Cornell and Schwertmann, 2003). Aluminum is a primary component of common soil-forming minerals such as clays, feldspars, and micas. Aluminum also substitutes for ferric iron in iron oxide minerals, and it can adsorb on iron oxide surfaces (Cornell and Schwertmann, 2003). Magnesium and potassium are common components of soil-forming minerals such as clays.

Clays and iron oxides are fine-grained minerals that have strong affinities to adsorb specific trace elements. Finer-grained soil samples are therefore expected to contain naturally higher concentrations of aluminum, iron, and associated trace elements, relative to coarser-grained soil samples. If site samples are obtained from finer-grained soils relative to the background locations, then natural exceedances of the background screening values are expected.

2.0 SITE-TO-BACKGROUND COMPARISON

This section provides the methodology and results of the site-to-background comparison for inorganic constituents in soil samples from the Mather WAA. Site samples used in the comparison include ten soil samples (obtained at various depths ranging from 0.5 foot bgs to 5 feet bgs) collected in August 2008 and nine soil samples (various depths ranging from 1 to 5 feet bgs) collected in August 2001. The 2008 samples were analyzed for the full suite of 23 TAL metals, plus molybdenum. The TAL metals include major elements such as aluminum, calcium, iron, magnesium, and manganese, which are the important reference elements used during geochemical evaluation (Section 2.1.2). The 2001 samples were analyzed for only the CAM 17 metals, which exclude the major elements. Table D-2 lists the number of samples and percentage of nondetects for each analyte in the site data set.

Background distributions and background screening values were established above for 24 elements in soil at Mather WAA (Section 1.0), and they are used in the following comparison. The background data set consists of thirteen surface soil samples (depths of 1 foot bgs and 1.5 feet bgs) collected immediately adjacent to and upslope from the WAA.

Section 2.1 of this appendix describes the methodology for the statistical and geochemical evaluation techniques, and Section 2.2 presents the evaluations for Mather WAA soil. A summary of the site-to-background comparison is provided in Section 2.3, and references cited in the report are listed in Section 3.0. Box plots and geochemical correlation plots are included in Attachments 2 and 3, respectively.

2.1 COMPARISON METHODOLOGY

This section describes the statistical and geochemical evaluation techniques that were employed in the Mather WAA site-to-background comparison.

2.1.1 Statistical Procedures

Contamination can be caused by a variety of processes that yield different spatial distributions of elevated contaminant concentrations. Slight but pervasive contamination can occur from non-point-source releases and can result in slight increases in contaminant concentrations in a large percentage of samples. Localized, or “hot-spot,” contamination can result in elevated concentrations in a small percentage of the total number of site samples. No single, two-sample statistical comparison test is sensitive to both of these modes of contamination. For this reason, the use of several simultaneous tests is recommended for a valid and complete comparison of site versus background distributions (USEPA, 1989, 1992, and 1994; U.S. Navy, 2002).

The Wilcoxon rank sum (WRS) test is sensitive to slight but pervasive contamination but is not sensitive to localized or more extreme hot-spot situations. The background threshold comparison, or “hot measurement test,” is effective in identifying localized contamination but is not sensitive to slight but pervasive contamination. The WRS test and hot measurement test are thus complementary. Both tests are nonparametric, meaning that they do not require that assumptions be made regarding the type of distribution (normal, lognormal, etc.), and they are valid for a wide variety of distributional shapes. In addition to the quantitative WRS and hot measurement tests, box-and-whisker plots are used to visually compare the site and background distributions and to properly interpret the results of the WRS test.

Analytes that fail either of the quantitative comparison tests are subject to a geochemical evaluation to determine if the elevated concentrations are most likely due to natural processes or contamination. The hot measurement test, WRS test, box plots, and geochemical evaluation are described in greater detail in the following sections.

Hot Measurement Test. The hot measurement test consists of comparing each site measurement with a concentration value that is representative of the upper limit of the background distribution (USEPA, 1994). Ideally, a site sample with a concentration above the background screening value (BSV) would have a low probability of being a member of the background distribution, and may be an indicator of contamination. It is important to select such a BSV carefully so that the probability of falsely identifying site samples as contaminated or uncontaminated is minimized.

The 95th upper tolerance limit is recommended as a screening value for normally or lognormally distributed analytes, and the 95th percentile is recommended as a screening value for nonparametrically distributed analytes (USEPA, 1989, 1992, and 1994). On average, roughly five percent of uncontaminated site samples are expected to exceed the BSV. Site samples with concentrations above these values are not necessarily contaminated, but should be considered suspect.

The 95th upper tolerance limits or 95th percentiles of the background distributions for 24 elements in Mather WAA soil are provided in Table D-2. To perform the test, each analyte’s site maximum detected concentration (MDC) is compared to the corresponding BSV. If the site MDC exceeds the BSV, then that analyte will undergo a geochemical evaluation. If the MDC does not exceed the BSV, then hot-spot contamination is not indicated.

Wilcoxon Rank Sum Test. The WRS test has been recommended for use in site-to-background comparisons (USEPA, 2006; U.S. Navy, 2002). In this report, the WRS test is performed when the site and background data sets each contain less than 50 percent nondetects (i.e., measurements reported as not detected below the laboratory reporting limit). The WRS test is not performed on data sets containing 50 percent or more nondetects. The medians of such data sets are unknown, and hence the test lacks sufficient power to yield reliable results. In addition, the WRS test is not performed on data sets containing fewer than five samples.

The WRS test compares two data sets of size n and m ($n > m$), and tests the null hypothesis that the samples were drawn from populations with distributions having the same medians. To perform the test, the two sets of observations are pooled and arranged in order from smallest to largest. Each observation is assigned a rank; that is, the smallest is ranked 1, the next largest is ranked 2, and so on up to the largest observation, which is ranked ($n + m$). If ties occur between or within samples, each one is assigned the midrank. Next, the sum of the ranks of smaller data set m is calculated. Then the test statistic Z is determined,

$$Z = \frac{W - m(m+n+1)/2}{\sqrt{mn(m+n+1)/12}}$$

Where:

W	=	Sum of the ranks of the smaller data set
m	=	Number of data points in smaller group
n	=	Number of data points in larger group.

This test statistic Z is used to find the two-sided significance. For instance, if the test statistic yields a probability of a Type I error (p-level) less than 0.05, then there is a statistically significant difference between the medians at the 95 percent confidence level. A Type I error involves rejecting the null hypothesis when it is true. If the p-level is greater than 0.05, then there is no reasonable justification to reject the null hypothesis at the 95 percent confidence level. It can therefore be concluded that the medians of the two data sets are similar and can be assumed to be drawn from the same population.

If the *p*-level is less than 0.05, then the medians of the two distributions are significantly different at the 95 percent confidence level. This can occur if the site data are shifted higher or lower than the background data. If the site data are shifted higher relative to background, then contamination may be indicated, and the analyte in question will be carried on for geochemical evaluation. However, if the site data are shifted lower relative to background, then contamination is not indicated. If the *p*-level is greater than 0.05, then pervasive site contamination is not suspected.

Box Plots. A quick, robust graphical method recommended by the USEPA to visualize and compare two or more groups of data is the box plot comparison (USEPA, 1989 and 1992). These plots provide a summary view of the entire data set, including the overall location and degree of symmetry. The box encloses the central 50 percent of the data points so that the top of the box represents the 75th percentile and the bottom of the box represents the 25th percentile. The median of the data set is represented by a small box within the larger box. The upper whisker extends outward from the box to the maximum point, and the lower whisker extends to the minimum point. Nondetect results are set equal to one-half of the reporting limit for plotting purposes.

For each analyte subjected to the WRS test, box plots of site and background data are placed side by side to visually compare the distributions and qualitatively determine whether the data sets are similar or distinct (Attachment 2). Accordingly, the box plots are a necessary adjunct to the WRS test. As described previously, the WRS test may indicate that the medians of the site and background data sets are significantly different. Examination of the box plots will confirm whether that difference is caused by site data that are shifted higher or lower relative to background.

2.1.2 Geochemical Evaluation

Statistical site-to-background comparisons for trace elements in environmental media commonly have high false-positive error rates. A large number of background samples is required to adequately characterize the upper tails of most trace element distributions, which are typically right-skewed and span a wide range of concentrations, but such a large background data set is not always feasible. The presence of estimated concentrations and nondetects with differing reporting limits can also cause statistical comparison tests to fail.

Statistical tests consider only the absolute concentrations of individual elements, and they disregard the interdependence of element concentrations and the geochemical mechanisms controlling element behavior. However, it is well established that trace elements naturally associate with specific soil-forming minerals, and the preferential enrichment of a sample with these minerals will result in elevated trace element concentrations. It is thus important to be able to identify these naturally high concentrations and distinguish them from potential contamination. This is achieved by performing a geochemical evaluation.

Recent publications indicate that environmental investigations are increasingly considering these elemental associations (e.g., USEPA, 1995; Barclift et al., 2000; U.S. Navy, 2002 and 2003; Myers and Thorbjornsen, 2004; Thorbjornsen and Myers, 2007). A properly executed geochemical evaluation can distinguish between naturally high element concentrations versus contamination, and it can identify the specific samples that may contain some component of site-related contamination. If an analyte fails either of the statistical tests described above, then a geochemical evaluation is performed to determine if the elevated concentrations are caused by natural processes.

Geochemical Evaluation Methodology. Trace elements naturally associate with specific minerals in soil, and geochemical evaluations are predicated on these known associations. For example, in most uncontaminated oxic soils, arsenic exhibits an almost exclusive association with iron oxide minerals (Bowell, 1994; Schiff and Weisberg, 1997). Arsenic exists in oxic soil pore fluid as oxyanions such as $HAsO_4^{-2}$ and $H_2AsO_4^{-}$ (Brookins, 1988), and these negatively charged species have a strong affinity to adsorb on iron oxides, which tend to maintain a net positive surface charge (Electric Power Research Institute, 1986). (In this report, the term "iron oxide" encompasses oxides, hydroxides, oxyhydroxides, and hydrous oxides of iron.) This association is expressed as a positive correlation between arsenic concentrations and iron concentrations for uncontaminated samples: samples with a low percentage of iron oxides will contain proportionally lower arsenic concentrations, and samples that are enriched in iron oxides will contain proportionally higher arsenic concentrations. Although there is variability in the absolute concentrations of arsenic and iron in soil at a site, the As/Fe ratios of the samples will be relatively constant if no contamination is present (Daskalakis and O'Connor, 1995). Samples that contain excess arsenic from a contaminant source (e.g., arsenical pesticides) will exhibit anomalously high As/Fe ratios compared to the uncontaminated samples.

To perform the geochemical evaluation, correlation plots are constructed to explore the elemental associations and identify potentially contaminated samples. The detected concentrations of the trace element of interest (dependent variable) are plotted against the detected concentrations of the reference element (independent variable), which represents the mineral to which the trace element may be adsorbed. In the case of arsenic, the arsenic concentrations for a given set of samples would be plotted on the y-axis, and the corresponding iron concentrations would be plotted on the x-axis. If no contamination is present, then the samples will exhibit a common trend and consistent As/Fe ratios, and the samples with the highest arsenic concentrations will lie on this trend. This indicates that the elevated arsenic is due to the preferential enrichment of iron oxides in those samples and that the arsenic has a natural source. If, however, the samples with high arsenic concentrations have low or moderate iron concentrations (anomalously high As/Fe ratios), then they will lie above the trend established by the other samples. This would indicate that the anomalous samples contain excess arsenic beyond that which can be explained by the natural iron oxide content, and such samples may contain a component of contamination.

The reference elements against which trace elements are evaluated reflect the affinity that the trace elements have for specific minerals. The concentrations of iron, aluminum, and manganese serve as qualitative indicators of the amounts of iron oxide, clay, and manganese oxide minerals in the soil (or sediment) samples. Along with arsenic, selenium and vanadium are present in oxic soil pore fluid as anions and have an affinity to adsorb on iron oxides, which tend to maintain a net positive surface charge. Concentrations of arsenic, selenium, or vanadium in a set of samples can be evaluated through comparison to the corresponding iron concentrations. Barium, cadmium, lead, and zinc are typically present in soil as divalent cations and have an affinity to adsorb on clay minerals, which tend to maintain a net negative surface charge. Concentrations of barium, cadmium, lead, or zinc can be evaluated through comparison to the corresponding aluminum concentrations. Manganese oxides have a strong affinity to adsorb barium, cobalt, and lead (Kabata-Pendias, 2001), so concentrations of these elements can be compared to the corresponding manganese concentrations, as long as there is enough manganese present in the soil to form discrete manganese oxides.

It is important to note that some trace elements have very strong affinities for a particular type of mineral, whereas other elements will partition themselves between several minerals. For instance, vanadium has a particularly strong affinity for iron oxides, so correlation coefficients for vanadium versus iron in uncontaminated samples are usually very high, and this is expressed on a correlation plot as a consistent trend with little to no scatter. In contrast, chromium forms several coexisting aqueous species with different charges [$Cr(OH)_2^{+}$, $Cr(OH)_3^{0}$, and $Cr(OH)_4^{-}$] that will adsorb on several different types of minerals, including clays and iron oxides. This behavior will yield lower correlation coefficients for chromium versus iron or chromium versus aluminum relative to the coefficients observed for vanadium versus iron, and more scatter may be observed on the correlation plots. Some elements are more selective than others with respect to adsorption on specific mineral surfaces, and this selectivity is dependent on site-specific conditions, including soil pH, redox conditions, and concentrations of competing elements.

Site samples with a trace element present as a contaminant will exhibit anomalously high trace-versus-major element ratios compared to background trace-versus-major element ratios. These elevated ratios may not always be apparent in log-log correlation plots, especially at the upper range of concentrations. Therefore, ratio plots, which depict trace element concentrations on the y-axis and trace/major element ratios on the x-axis, are employed in conjunction with correlation plots in those cases where it is not immediately apparent which site samples have anomalously high elemental ratios on the correlation plots. The ratio plots permit easy identification of samples with anomalously high elemental ratios relative to background, and they have high resolution over the entire concentration range. The presence of an anomalously high elemental ratio is not definitive proof of site-related contamination; however, such samples are discussed in the text and, unless otherwise noted, are flagged as representing potential site-related contamination. This is a conservative approach.

It is important to note that there is natural variability, as well as analytical uncertainty, in the elemental ratios of uncontaminated soil samples. Trace/major element ratios are calculated from two uncertain analytical results, so the resulting uncertainties in the ratios can produce some scatter in the points on a ratio plot. This is especially true when estimated ("J"-qualified) analytical results are used. This can be seen on many of the plots that show more scatter of the points at the lower end of the concentration range, where analytical uncertainties are higher and analytical results are reported with fewer significant figures.

On ratio plots, vertical trends should be expected only in those cases where the trace element adsorption is a linear process, where the trace element concentrations are controlled exclusively by adsorption on a given mineral type, and where the variances of the reference and trace element concentrations are similar (Thorbjornsen and Myers, 2007). Nonvertical trends are more common in ratio plots, however, because adsorption processes often are not linear, trace elements often have affinities for more than one type of sorptive surface, and the reference and trace element concentrations usually possess different variances. Nonlinear adsorption of a trace element on mineral surfaces will manifest itself as a curve rather than a straight line on a correlation plot and as a nonvertical trend on a ratio plot. In addition, the presence of competing ions in soil (or sediment) and differences in pH and redox conditions among the sample locations can add to the natural variability of elemental ratios.

Ratio plots may also be prepared for the major elements (e.g., aluminum versus Al/Fe ratios). However, adsorption is not the dominant process controlling major element concentrations. For example, aluminum and iron concentrations covary largely because they are controlled by the abundance of fine-grained minerals in the samples. The plots thus reflect physical effects rather than chemical effects such as adsorption. Constant ratios are typically not observed for major versus major elements.

2.2 RESULTS OF THE SITE-TO-BACKGROUND COMPARISON

This section presents the results of the site-to-background comparison for metals in Mather WAA soil. Table D-4 lists the statistical test results for each element, along with the overall conclusions of the geochemical evaluations performed for elements that failed either or both quantitative statistical tests. Box plots are provided in Attachment 2, and geochemical correlation plots and ratio plots are included in Attachment 3.

Aluminum, beryllium, selenium, and vanadium in the site data set passed statistical comparison to background (Table D-4). The detected concentrations of these four elements are within their respective background ranges. The remaining 20 elements failed statistical comparison to background and required geochemical evaluation. Although statistically within the background range, aluminum is evaluated below, along with iron. Aluminum and iron are the primary reference elements used to evaluate the trace elements.

As previously noted, the ten 2008 soil samples were analyzed for 24 metals, including the major elements that serve as reference elements during geochemical evaluation. Accordingly, these are the only samples that can be examined during the geochemical evaluation. The nine 2001 soil samples lack major element analyses and thus cannot be included in the geochemical evaluation to determine if their elevated trace element concentrations have a natural source.

2.2.1 Aluminum and Iron – Geochemical Evaluation

Iron oxides are common soil-forming minerals, and they occur as discrete mineral grains or as coatings on silicate minerals (Cornell and Schwertmann, 2003). Aluminum is a primary component of common soil-forming minerals such as clays, feldspars, and micas. Aluminum also substitutes for ferric iron in iron oxide minerals, and it can adsorb on iron oxide surfaces (Cornell and Schwertmann, 2003). Iron oxides and clays tend to exist as very fine particles, so both iron and aluminum are enriched in samples with finer grain sizes. A plot of iron versus aluminum concentrations can be used to qualitatively assess the relative abundance of these minerals in site soil (Figure D-1). The Mather WAA site samples are represented by filled triangles and the Mather WAA background samples are represented by dark green circles. The ten background samples collected at the Baseline WAA (light green circles) are also included for comparative purposes.

Of note in Figure D-1 and subsequent correlation plots is that the Mather and Baseline background data sets exhibit different absolute concentrations for the various elements, with little to no overlap between their concentration ranges. The two background data sets also exhibit significant differences between their medians, for the majority of analyzed elements (this was confirmed using the WRS test). The two background data sets were therefore not combined for purposes of characterizing background distributions and performing statistical site-to-background comparison tests. However, their elemental ratios are similar for many of the element pairs considered in this appendix. This is a common phenomenon that has been observed for many background soils. Consistent elemental ratios have been documented for background soils representing a variety of soil types, parent materials, and climates (Hamon *et al*., 2004; Myers and Thorbjornsen, 2004).

The similar elemental ratios exhibited by the Mather WAA and Baseline WAA background samples indicate that it is appropriate to combine the two data sets for purposes of geochemical evaluation. This provides a larger total background data set to use for comparison to the site data, which in turn provides greater confidence in the determination of the presence or absence of inorganic contamination in the site samples. For those cases in which the Mather WAA and Baseline WAA background data sets exhibit distinctly different elemental ratios, however, the site ratios were compared to the Mather WAA background ratios, as a conservative approach.

The background samples and a few of the Mather WAA site samples form a common trend with a positive slope in Figure D-1. As noted previously, strong correlations are not expected for major versus major elements, because adsorption is not the dominant process controlling major element concentrations. Natural variability in major-versus-major element ratios is expected for uncontaminated soil samples. The three site samples with the lowest iron concentrations have Fe/Al ratios that are generally consistent with those of the background samples (Figure D-2), which suggests a natural source for their aluminum and iron concentrations. The seven site samples with iron concentrations ranging from 14,600 to 40,200 mg/kg have anomalously high Fe/Al ratios relative to background, and the elevated iron in these samples may reflect contamination. Table D-4 lists their sample identification numbers and corresponding location codes and sample depths. The iron concentrations in the other samples are most likely natural, as are the aluminum concentrations in all ten site samples.

As discussed in Section 2.1.2, clays and iron oxides have an affinity to adsorb specific trace elements. Samples that are enriched in these minerals (and which plot on the upper end of the background trend in Figure D-1) are expected to contain naturally high concentrations of trace elements.

2.2.2 Antimony – Geochemical Evaluation

Antimony has geochemical behavior similar to that of arsenic and, like arsenic, it has an affinity to adsorb on the surfaces of iron oxides. However, it can also adsorb on clays, so positive correlations between antimony and aluminum concentrations are often observed in uncontaminated soil samples. Iron contamination is suspected for seven site samples, so a plot of detected antimony versus aluminum concentrations is provided in this evaluation (Figure D-3). Seven of the Mather WAA background samples are nondetect for antimony (with reporting limits of 0.512 to 0.527 mg/kg) and all of the Baseline WAA background samples are nondetect for antimony (with reporting limits of 0.515 to 0.523 mg/kg), and thus only the three Mather WAA background samples with detectable antimony can be depicted for comparative purposes. The Baseline WAA site samples with detectable antimony are also depicted for context. It is important to note that the three Mather WAA background detections, two of the eight Mather WAA site detections, and seven of the eight Baseline WAA site detections are estimated (J-qualified) and below their reporting limits. Estimated concentrations have a high degree of analytical uncertainty, which can result in weak correlations, even in the absence of contamination. The combination of estimated concentrations and differences in reporting limits can also result in greater variability in elemental ratios for uncontaminated samples.

One of the Mather WAA site samples (YWM08-2280; 0.107 J mg/kg Sb) has an Sb/Al ratio that is similar to those of the Mather WAA background samples (Figure D-4), which suggests a natural source for its antimony concentration. Contamination is also not suspected for the other site sample with an estimated antimony detection (YWM06-2276; 0.331 J mg/kg); although this sample and five of the Baseline WAA site samples have higher Sb/Al ratios relative to background, these samples exhibit similar Sb/Al ratios that span a narrow range (2.6E-05 to 3.9E-05). If antimony were present as a site-related contaminant in these samples, consistent Sb/Al ratios would not be observed and higher concentrations above the reporting limit might be expected.

In contrast to the other samples, six Mather WAA site samples (YWM02A-2268; YWM06-2274; YWM07-2277; and YWM09-2284, -2285, and -2286) have the highest antimony concentrations of the Mather WAA site and background data sets (0.802 to 4.63 mg/kg) but relatively low aluminum. They lie above the trend established by most of the site samples in the correlation plot (Figure D-3) and to the right of the other samples in the ratio plot (Figure D-4). The anomalously high Sb/Al ratios of these six samples suggest the presence of antimony contamination (Table D-4).

The nine 2001 Mather WAA site samples were not analyzed for the major elements and therefore could not be included in the geochemical evaluation to determine if their antimony concentrations have a natural source. Two 2001 samples have detectable antimony (YWM-TP02-SO-1048 and YWM-TP02-SO-1046; 0.72 J mg/kg and 2.4 J mg/kg, respectively), and both concentrations exceed the BSV (0.170 mg/kg). The elevated antimony in these samples should also be considered suspect (Table D-5).

2.2.3 Arsenic – Geochemical Evaluation

Although arsenic preferentially adsorbs on iron oxide minerals, it can also adsorb on aluminum-bearing minerals such as clays (Kabata-Pendias, 2001), and thus covariance of arsenic and aluminum concentrations may be observed for uncontaminated soil samples. Iron contamination is suspected for seven site samples, so a plot of detected arsenic versus aluminum concentrations is provided in this evaluation (Figure D-5). Some scatter is observed for a few Mather WAA background samples, but the majority of background samples exhibit consistent As/Al ratios, and the four site samples with the lowest arsenic concentrations lie on the background trend in the plot. Arsenic concentrations in these site samples most likely has a natural source.

Figure D-6 is a ratio plot that depicts the arsenic concentrations of the site and background samples versus their corresponding As/Al ratios. Five site samples have As/Al ratios that exceed the background ratio range (excluding the maximum background ratio of 4.87E-04, which is anomalously high relative to the other background ratios), indicating that these five samples may contain excess arsenic from a contaminant source (Table D-4). Sample YWM06-2274 has a slightly higher As/Al ratio (2.53E-04) relative to most of the background samples, but there are two Mather WAA background samples with similar ratios and similar arsenic concentrations. Furthermore, the arsenic concentration of sample YWM06-2274 (3.04 mg/kg) is below the BSV (6.93 mg/kg), which suggests that any arsenic contamination in the sample, if present, would not be significant.

The nine 2001 site samples were not analyzed for the major elements and therefore could not be included in the geochemical evaluation to determine if their arsenic concentrations have a natural source. Arsenic concentrations in all of the 2001 samples are below the BSV (6.93 mg/kg). This suggests that any arsenic contamination in these samples, if present, would be insignificant.

2.2.4 Barium – Geochemical Evaluation

The divalent cation barium (Ba^{2+}) is commonly associated with magnesium (Mg^{2+}) in many geochemical environments (Kabata-Pendias, 2001). Covariance of barium versus magnesium concentrations may therefore be observed for uncontaminated soil samples. A plot of barium versus magnesium concentrations in the background samples and Mather WAA site samples is provided in Figure D-7. All of the background samples and five of the site samples form a common trend with a positive slope in this plot. This includes site sample YWM06-2274, which contains moderately high barium (149 mg/kg) but proportionally higher magnesium. The Ba/Mg ratios of these five site samples are consistent with those of the background samples, which suggests a natural source for their barium concentrations.

Another perspective on the data sets is provided in Figure D-8, which displays the barium concentrations of the site and background samples (y-axis) versus their corresponding Ba/Mg ratios (x-axis). If a site sample contains excess barium from a contaminant source, it will exhibit an anomalously high Ba/Mg ratio relative to background and will plot to the right of the background samples in Figure D-8. Five site samples have Ba/Mg ratios that exceed the background ratio range. These samples contain more barium than expected based on their magnesium content, and contamination is suspected (Table D-4).

The nine 2001 site samples were not analyzed for the major elements and therefore could not be included in the geochemical evaluation to determine if their barium concentrations have a natural source. Barium concentrations in two 2001 samples (YWM-TP02-SO-1048 and YWM-TP02-SO-1046; 1,420 J mg/kg and 1,040 J mg/kg, respectively) exceed the BSV (72.0 mg/kg). The elevated barium in these samples should also be considered suspect (Table D-5).

2.2.5 Cadmium – Geochemical Evaluation

Cadmium is commonly present in soil as a divalent cation (Cd^{2+}) and has an affinity to adsorb on clay minerals (Kabata-Pendias, 2001), which tend to maintain a net negative surface charge. Positive correlations between cadmium and aluminum concentrations are thus sometimes observed for uncontaminated samples. However, cadmium detections are often low, estimated values below the reporting limit, and the uncertainty associated with such values often results in weak correlations. A plot of detectable cadmium versus aluminum in the background samples and Mather WAA site samples is provided in Figure D-9. Three of the nine site cadmium detections and all eleven background cadmium detections are estimated (J-qualified) concentrations below the reporting limit, and the uncertainty associated with these concentrations contributes to the scatter observed for the samples at the low end of the concentration range (Figure D-9). The three 2008 site samples with the lowest cadmium concentrations have Cd/Al ratios that are similar to those of the background samples, which suggests that the cadmium detected in these samples is natural. The other six site samples have high cadmium (0.815 to 6.78 mg/kg) but low aluminum and lie well above the background samples in the plot. The anomalously high Cd/Al ratios of these samples suggest that they contain excess cadmium from a contaminant source (Table D-4).

The nine 2001 site samples were not analyzed for the major elements and therefore could not be included in the geochemical evaluation to determine if their cadmium concentrations have a natural source. Two of the 2001 samples have detectable cadmium (YWM-TP02-SO-1048 and YWM-TP02-SO-1046; 11.8 J mg/kg and 3.9 J mg/kg, respectively), and both concentrations exceed the BSV (0.144 mg/kg). The elevated cadmium in these samples should also be considered suspect (Table D-5).

2.2.6 Calcium – Geochemical Evaluation

Calcium and magnesium have similar chemical properties, and magnesium often substitutes for calcium in minerals. Covariance of their concentrations is sometimes observed in uncontaminated soil samples, although (as noted previously) strong correlations are not expected for the major elements, because adsorption is not the dominant process controlling their concentrations. A plot of calcium versus magnesium in the Mather WAA and background soil samples is provided in Figure D-10. The five site samples with lower calcium content (2,820 mg/kg and lower) fall close to the trend established by the background samples, suggesting a natural source for their calcium concentrations. In contrast, the five site samples with concentrations of 6,220 mg/kg and higher (YWM02A-2268; YWM07-2277; and YWM09-2284, -2285, and -2286) have higher Ca/Mg ratios relative to the other samples (Figure D-11), which suggests that their elevated calcium concentrations might not be explained entirely by natural processes. These samples also have relatively low potassium and aluminum, and they have anomalously high concentrations of many other elements. The elevated calcium in these five samples should be considered suspect (Table D-4).

2.2.7 Chromium – Geochemical Evaluation

As discussed previously, chromium can be present in soil as various species with different charges, and thus it can adsorb on several different types of minerals, including iron oxides and clays. Figure D-12 provides a plot of chromium versus aluminum for the site and background samples. The four site samples with the lowest chromium concentrations lie on the background trend, which suggests that the chromium in these samples is associated with clays at ratios consistent with those of the background samples and is natural. The other six site samples, however, have elevated chromium but low aluminum. Their Cr/Al ratios are anomalously high compared to background, as can also be seen in the ratio plot (Figure D-13). These samples contain more chromium than can be explained by their natural aluminum content and they may contain a component of contamination (Table D-4).

The nine 2001 site samples were not analyzed for the major elements and therefore could not be included in the geochemical evaluation to determine if their chromium concentrations have a natural source. Chromium concentrations in two 2001 samples (YWM-TP02-SO-1048 and YWM-TP02-SO-1046; 36.4 J mg/kg and 29 J mg/kg, respectively) exceed the BSV (8.49 mg/kg). The elevated chromium in these samples should also be considered suspect (Table D-5).

2.2.8 Cobalt – Geochemical Evaluation

Cobalt has an affinity to adsorb on the surfaces of clay minerals (Kabata-Pendias, 2001). As a result, covariance of cobalt and aluminum concentrations is commonly observed in uncontaminated soil samples. Samples containing excess cobalt from a contaminant source can be identified by their anomalously high Co/Al ratios. A plot of cobalt versus aluminum reveals a common trend with a positive slope for the background samples and some of the 2008 site samples (Figure D-14). The site samples moderately high cobalt concentrations also have moderately high aluminum content, and they lie on the background trend. Most of the 2008 site samples have Co/Al ratios that are similar to those of the background samples, as seen in Figure D-15. This suggests that cobalt in these site samples is associated with clays at ratios consistent with those of the background samples and that it is natural. The exceptions are the five samples with the highest cobalt concentrations of the site data set (5.2 to 9.24 mg/kg); they have low aluminum content and lie above the other samples in the correlation plot (Figure D-14) and to the right of the other samples in the ratio plot (Figure D-15). The anomalously high Co/Al ratios suggest that these samples may contain a component of contamination (Table D-4).

The nine 2001 site samples were not analyzed for the major elements and therefore could not be included in the geochemical evaluation to determine if their cobalt concentrations have a natural source. Cobalt concentrations in all of the 2001 samples are below the BSV (8.11 mg/kg). This suggests that any cobalt contamination in these samples, if present, would not be significant.

2.2.9 Copper – Geochemical Evaluation

In the Mather WAA background data set, copper exhibits the strongest association with magnesium (excluding one sample), so a plot of copper versus magnesium is provided for this evaluation (Figure D-16). The site sample with the lowest copper concentration lies on the trend established by the Mather WAA background samples; this suggests that copper in this sample may have a natural source. [The Baseline WAA background samples exhibit scatter and different Cu/Mg ratios than the Mather WAA background samples, which suggests that their copper concentrations are controlled by mechanism(s) other than association with magnesium-bearing minerals.] The other nine site samples have high copper (eight of them have higher copper concentrations than all of the background samples) but only moderately high magnesium content, and they lie above the Mather WAA background trend in the correlation plot (Figure D-16) and to the right of most of the Mather WAA background samples in the ratio plot (Figure D-17). The anomalously high Cu/Mg ratios of these nine samples suggest that they contain a component of copper contamination (Table D-4). The background sample with the highest Cu/Mg ratio is not used for comparative purposes here; it is elevated with respect to the other background samples, most likely because the copper in that sample is controlled by some mechanism other than association with magnesium-bearing minerals.

The nine 2001 site samples were not analyzed for the major elements and therefore could not be included in the geochemical evaluation to determine if their copper concentrations have a natural source. Three 2001 samples (YWM-TP02-SO-1048, YWM-TP02-SO-1046, and YWM-TP05-SO-1039) have copper concentrations (87 mg/kg, 107 mg/kg, and 18 mg/kg, respectively) that exceed the BSV (12.0 mg/kg). The elevated copper in these samples should also be considered suspect (Table D-5).

2.2.10 Lead – Geochemical Evaluation

As noted previously, divalent cations such as lead have an affinity to adsorb on clay minerals, which tend to maintain a net negative surface charge. Positive correlations between lead and aluminum concentrations are thus commonly observed for uncontaminated soil samples. A plot of lead versus aluminum in the Mather WAA and background soil samples is provided in Figure D-18. All but one of the site samples lie above the trend established by the background samples in the correlation plot. The remaining nine site samples have higher lead relative to background and only low to moderate aluminum content. The anomalously high Pb/Al ratios (Figure D-19) indicate that these nine samples may contain excess lead from a contaminant source (Table D-4).

The nine 2001 site samples were not analyzed for the major elements and therefore could not be included in the geochemical evaluation to determine if their lead concentrations have a natural source. Six 2001 samples have lead concentrations (7.9 J to 1,040 J mg/kg) that exceed the BSV of 6.57 mg/kg. The elevated lead in these samples should also be considered suspect (Table D-5).

2.2.11 Magnesium and Potassium – Geochemical Evaluation

Magnesium (Mg^{+2}) and potassium (K^{+}) and are common components of soil-forming minerals such as clays, often occurring as part of the mineral structure and as loosely adsorbed cations, and they participate in cation-exchange reactions. Positive correlations for magnesium versus potassium concentrations are thus often observed for uncontaminated soil samples. A plot of magnesium versus potassium for the Mather WAA site samples and background samples reveals a common trend with a positive slope (Figure D-20). The site samples with the highest magnesium also have the highest potassium and lie on the trend established by the other samples. The Mg/K ratios of the site samples are consistent with those of the background samples, which indicates a natural source for the site magnesium and potassium detections.

2.2.12 Manganese – Geochemical Evaluation

Manganese oxides are a class of naturally occurring minerals that are common in soils and sediments (Post, 1999). They exist either as discrete mineral grains or as coatings on other minerals. In addition to being present in the form of manganese oxides, manganese (as the divalent cation Mn^{2+}) can adsorb on the surfaces of iron oxides and can replace Fe^{2+} and Mg^{2+} in silicate and oxide minerals (Kabata-Pendias, 2001; Cornell and Schwertmann, 2003). Figure D-21 depicts manganese concentrations versus the corresponding magnesium concentrations in the site and background samples. As discussed previously, strong correlations are not expected between the major elements because adsorption is not the dominant process controlling major element concentrations. Five site samples have Mn/Mg ratios that are consistent with those of the background samples (Figure D-22), which indicates a natural source for their manganese detections. In contrast, the other five site samples have the highest manganese concentrations (938 to 1,900 mg/kg) of the site and background data sets but relatively low magnesium, and they have anomalously high Mn/Mg ratios relative to background. Elevated manganese in these samples should be considered suspect (Table D-4).

2.2.13 Mercury – Geochemical Evaluation

Mercury can adsorb on the surfaces of oxide and clay minerals, but its concentrations are commonly controlled through organic complex formation (Kabata-Pendias, 2001). In addition, mercury detections are often low, estimated (J-qualified) concentrations below the reporting limit, and such concentrations have a high degree of analytical uncertainty. As a result of these factors, poor correlations for mercury versus manganese, iron, or aluminum are often observed, even in uncontaminated soil samples. A plot is not provided for this evaluation because of the low detection frequency in the 2008 background data sets, lack of correlation observed for the site samples with detectable mercury, and absence of major element analyses for the 2001 background samples with detectable mercury. The ten 2008 Baseline WAA background samples are nondetect for mercury (with reporting limits of 0.103 to 0.105 mg/kg) and only one 2008 Mather WAA background sample has detectable mercury (0.0808 J mg/kg; the reporting limits for the other 2008 Mather WAA background samples range from 0.102 to 0.105 mg/kg). The three 2001 Mather WAA background samples have detectable mercury (0.034 J to 0.081 J mg/kg), as do the three 2001 Baseline WAA background samples (0.38 to 1.0 mg/kg); however, these 2001 background samples were not analyzed for the major elements required for geochemical evaluation.

Two of the 2008 Mather WAA site samples (YWM07-2279 and YWM06-2276) are nondetect for mercury, with reporting limits of 0.103 mg/kg and 0.104 mg/kg and method detection limits of 0.0341 mg/kg and 0.0342 mg/kg. The remaining eight site samples have detectable mercury (0.232 to 1.37 mg/kg) and all of these concentrations exceed the BSV of 0.0809 mg/kg. It is worth noting that these samples contain only low to moderate aluminum. These eight samples might reflect contamination (Table D-4).

The nine 2001 site samples were not analyzed for the major elements and therefore could not be included in the geochemical evaluation to determine if their mercury concentrations have a natural source. Four 2001 samples have mercury concentrations (0.084 J to 0.88 J mg/kg) that exceed the BSV of 0.0809 mg/kg. The elevated mercury in these samples should also be considered suspect (Table D-5).

2.2.14 Molybdenum – Geochemical Evaluation

Molybdenum has an affinity to adsorb on clay minerals (Kabata-Pendias, 2001), so positive correlations between molybdenum and aluminum concentrations may be observed for uncontaminated soil samples. However, no such correlation is observed for either the Mather WAA site data set or Mather WAA background data set. Eight of the 2008 samples have molybdenum concentrations (0.384 J to 1.38 mg/kg) that are within the background concentration range (0.39 J to 1.47 mg/kg) and below the BSV of 1.66 mg/kg. Contamination is not suspected for these samples. Two site samples (YWM02A-2268 and YWM07-2277; 2.22 mg/kg and 2.17 mg/kg) have molybdenum concentrations that exceed the BSV, and they also contain low to moderate aluminum. These samples might reflect contamination (Table D-4).

Of the nine 2001 samples, only one has a molybdenum concentration (YWM-TP02-SO-1046; 2.3 mg/kg) that exceeds the BSV (1.66 mg/kg). The elevated molybdenum in this sample should also be considered suspect (Table D-5).

2.2.15 Nickel – Geochemical Evaluation

Nickel has an affinity to adsorb on clay minerals (Kabata-Pendias, 2001), so a positive correlation between nickel and aluminum concentrations is often observed for uncontaminated soil samples. The background samples and four of the site samples form a common trend with a positive slope in a plot of nickel versus aluminum (Figure D-23). The site samples with the lowest nickel concentrations lie on the trend established by the background samples. These four samples have Ni/Al ratios that are consistent with those of the background samples (Figure D-24), which suggests that nickel in these site samples is associated with clays at ratios consistent with those of the background samples and is natural. The six site samples with the highest nickel of the site and background data sets (7.48 to 27.9 mg/kg) have low aluminum and anomalously high Ni/Al ratios. These samples might excess nickel from a contaminant source. It is worth noting that these samples also contain anomalously high concentrations of several other elements (Table D-4).

The nine 2001 site samples were not analyzed for the major elements and therefore could not be included in the geochemical evaluation to determine if their nickel concentrations have a natural source. Nickel concentrations in two 2001 samples (YWM-TP02-SO-1048 and YWM-TP02-SO-1046; 11.9 J mg/kg and 8.7 J mg/kg, respectively) exceed the BSV (5.32 mg/kg). The elevated nickel in these samples should also be considered suspect (Table D-5).

2.2.16 Silver – Geochemical Evaluation

A plot of detectable silver versus magnesium concentrations is provided in Figure D-25. Only the Mather WAA site samples are shown because silver was not detected in any of the background samples (at reporting limits of 0.512 to 2.1 mg/kg). Silver detections in the 2008 site samples range from 0.113 J to 1.23 mg/kg. The sample with the lowest silver concentration has the lowest magnesium concentration, and the samples with the highest silver concentrations have proportionally higher magnesium. This suggests that the silver detected in the site samples may have a natural source. If silver was elevated due to site-related contamination, then a higher degree of scatter would be observed in Figure D-25. However, the Ag/Mg ratios span a narrow range of 6.2E-05 to 3.5E-04 for all seven site samples with detectable silver, and an even narrower range of 2.0E-04 to 3.5E-04 for the six samples with unestimated concentrations (estimated concentrations have higher analytical uncertainty than unestimated concentrations, and the higher uncertainty translates to greater variability in elemental ratios). Such consistent ratios would not be expected for contaminated samples.

The nine 2001 site samples were not analyzed for the major elements and therefore could not be included in the geochemical evaluation to determine if their silver concentrations have a natural source. Two 2001 samples have detectable silver (YWM-TP02-SO-1048 and YWM-TP02-SO-1046; 2.6 mg/kg and 0.35 J mg/kg, respectively), and both concentrations exceed the BSV (0.105 mg/kg). The elevated silver in these samples should be considered suspect (Table D-5).

2.2.17 Sodium – Geochemical Evaluation

Sodium and magnesium are common components of soil-forming minerals such as clays, often occurring as part of the mineral structure and as loosely adsorbed cations. Clays are characterized by large surface-area-to-volume ratios and strong negative surface charges. As a result, the major cations, such as sodium and potassium, are attracted to these mineral surfaces and take part in cation-exchange reactions. Sodium and magnesium concentrations can covary in uncontaminated soil samples. As discussed previously, strong correlations are not expected between the major elements because adsorption is not the dominant process controlling major element concentrations. An additional consideration for this site is the potential presence of clasts of unweathered or partially weathered rock (e.g., sodium feldspar, which is a major component of granite), which can result in naturally variable major-versus-major element ratios and weaker correlations. A plot of sodium versus magnesium in the background and Mather WAA site samples is provided in Figure D-26. The Mather WAA background samples exhibit different Na/Mg ratios relative to the Mather WAA background samples, which may reflect natural differences as well as analytical uncertainty due to the estimated sodium concentrations (100 percent of the background sodium detections are J-qualified and below their reporting limits). However, the four Mather WAA site samples with the lowest sodium concentrations exhibit Na/Mg ratios that are consistent with those of the background samples, which indicates a natural source for their sodium detections. The six site samples with sodium concentrations of 123 to 293 mg/kg have anomalously high Na/Mg ratios and lie above the background trend in the correlation plot (these samples also have anomalously high Na/Al ratios). These six samples contain more sodium than expected based on their magnesium (and aluminum) content, and thus their elevated sodium concentrations should be considered suspect (Table D-4).

2.2.18 Thallium – Geochemical Evaluation

Thallium can adsorb on clay minerals (Kabata-Pendias, 2001), so positive correlations between thallium and aluminum concentrations are sometimes observed for uncontaminated soil samples. However, thallium concentrations are often low, estimated (J-qualified) detections near or below the reporting limit, as is the case for nine of the ten Mather WAA site detections, all ten of the Mather WAA background detections, and all ten of the Baseline WAA background detections. The analytical uncertainty associated with estimated concentrations contributes to the weak correlations that are sometimes observed, even for uncontaminated samples. The Mather WAA background samples and Baseline WAA background samples form a common trend with a positive slope in a plot of thallium versus aluminum (Figure D-27). Five of the Mather WAA site samples with low thallium concentrations (0.219 J to 0.281 J mg/kg) lie near the background trend on the correlation plot. The ratio plot (Figure D-28) confirms that the majority of site and background samples exhibit similar Tl/Al ratios, which suggests a natural source for these site thallium detections. The exceptions are the five site samples with the highest thallium detections of the Mather WAA data sets (0.361 J to 0.567 mg/kg); they have low aluminum and lie to the right of the other samples in the ratio plot. Their anomalously high Tl/Al ratios suggest that they may reflect contamination (Table D-4).

All nine 2001 site samples are nondetect for thallium.

2.2.19 Zinc – Geochemical Evaluation

Zinc has an affinity to adsorb on iron oxides (Kabata-Pendias, 2001), so positive correlations between zinc versus iron concentrations are often observed for uncontaminated soil samples. A plot of zinc versus iron in the site and background samples is provided in Figure D-29. The four samples with the lowest zinc concentrations lie on or near the background trend in the correlation plot; these samples have Zn/Fe ratios that are consistent with background (Figure D-30). The four site samples with lower concentrations most likely contain naturally occurring zinc. The six samples with the highest zinc concentrations of the site and background data sets (316 to 2,420 mg/kg) lie well above the background trend in the correlation plot (Figure D-29) and to the right of the other samples in the ratio plot (Figure D-30). Zinc contamination is suspected for these samples (Table D-4).

The nine 2001 site samples were not analyzed for the major elements and therefore could not be included in the geochemical evaluation to determine if their zinc concentrations have a natural source. Zinc concentrations in two 2001 samples (YWM-TP02-SO-1048 and YWM-TP02-SO-1046; 1,460 J mg/kg and 1,690 J mg/kg, respectively) exceed the BSV (58.9 mg/kg). The elevated zinc in these samples should also be considered suspect (Table D-5).

2.3 SUMMARY OF SITE-TO-BACKGROUND COMPARISON

The methodology used to compare the Mather WAA site and background data sets consists of a hot measurement test, nonparametric two-sample Wilcoxon rank sum test, and box-and-whisker plots. Analytes that failed either of the statistical tests were subjected to geochemical evaluation to determine if the elevated concentrations could be explained by natural processes.

Aluminum, beryllium, selenium, and vanadium in the site data set passed statistical comparison to background. The detected concentrations of these four elements are within their respective background ranges. Antimony, arsenic, barium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, potassium, silver, sodium, thallium, and zinc failed statistical comparison to background and were subjected to geochemical evaluation. Geochemical evaluation could only be performed on the 2008 samples, because the 2001 samples were not analyzed for the major elements. Geochemical evaluation indicates that the detected concentrations of magnesium, potassium, and silver in the 2008 site samples are most likely natural. Anomalously high concentrations of antimony, arsenic, barium, cadmium, calcium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, sodium, thallium, and zinc are present in two to nine samples each. Given the available data, these concentrations cannot be explained as the result of natural processes and they may contain a component of contamination (Table D-4).

The nine 2001 site samples could not be included in the geochemical evaluation to determine if their elevated trace element concentrations have a natural source. In the 2001 data set, antimony, barium, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, silver, and zinc concentrations exceed their respective BSVs in one to five samples each, and these concentrations should be considered suspect. The 2001 samples with element concentrations above BSVs are listed in Table D-5. The arsenic and cobalt concentrations are below their respective background screening values, so any arsenic or cobalt contamination, if present in these samples, would be insignificant. All of the 2001 site samples are nondetect for thallium.

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Tables

TABLE D-1: BACKGROUND SUMMARY STATISTICS FOR METALS IN SOIL, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Element	No. of Samples	Percent Nondetects	Distribution Type	Units	Minimum	Median	Geometric Mean	Arithmetic Mean	Maximum	Standard Deviation	Coefficient of Variation	Skewness	95th UTL/ 95th Percentile
Aluminum	10	0	Normal	mg/kg	10,000	13,050	13,050	13,100	15,100	1,500	0.11	-0.65	17,500
Antimony	10	70	Nonparametric	mg/kg	< 0.102	< 0.104	< 0.105	< 0.105	0.191	NA	NA	NA	0.170
Arsenic	13	0	Lognormal	mg/kg	1.33	2.06	2.27	2.49	5.99	1.26	0.51	2.00	6.93
Barium	13	0	Normal	mg/kg	25.6	46.4	45.7	46.7	64.6	9.49	0.20	-0.40	72.0
Beryllium	13	23	Nonparametric	mg/kg	< 0.02	0.278	0.166	0.270	0.624	0.198	0.73	0.44	0.616
Cadmium	13	77	Nonparametric	mg/kg	< 0.04	< 0.104	< 0.105	< 0.105	0.144	NA	NA	NA	0.144
Calcium	10	0	Lognormal	mg/kg	444	588	585	595	804	118	0.20	0.69	1,030
Chromium	13	0	Lognormal	mg/kg	3.38	4.7	4.78	4.89	7.9	1.14	0.23	1.48	8.49
Cobalt	13	0	Lognormal	mg/kg	2.23	3.13	3.46	3.64	6.4	1.31	0.36	1.36	8.11
Copper	13	0	Lognormal	mg/kg	3.5	4.86	5.27	5.52	10	1.93	0.35	1.51	12.0
Iron	10	0	Normal	mg/kg	7,120	11,700	10,970	11,100	13,300	1,880	0.17	-1.12	16,600
Lead	13	0	Nonparametric	mg/kg	3.29	4.54	4.56	4.70	8.78	1.36	0.29	2.44	6.57
Magnesium	10	0	Lognormal	mg/kg	1,720	2,200	2,330	2,360	2,990	412	0.17	0.23	3,880
Manganese	10	0	Normal	mg/kg	104	180	170	177	267	50.1	0.28	0.14	323
Mercury	13	69	Nonparametric	mg/kg	< 0.0338	0.0341	0.040	0.042	0.081	0.017	0.42	2.06	0.0809
Molybdenum	13	8	Normal	mg/kg	0.045	0.712	0.602	0.735	1.47	0.347	0.47	0.20	1.66
Nickel	13	0	Normal	mg/kg	2.76	4.09	3.94	3.98	4.49	0.50	0.13	-1.18	5.32
Potassium	10	0	Lognormal	mg/kg	1,090	1,360	1,430	1,470	2,110	344	0.23	0.78	2,760
Selenium	10	0	Lognormal	mg/kg	0.163	0.253	0.272	0.286	0.464	0.097	0.34	0.66	0.719
Silver	10	100	Nonparametric	mg/kg	< 0.102	< 0.103	< 0.105	< 0.105	< 0.105	NA	NA	NA	< 0.105
Sodium	10	0	Lognormal	mg/kg	51.7	65.35	64.2	64.9	78.8	9.5	0.15	0.02	98.9
Thallium	10	0	Lognormal	mg/kg	0.161	0.200	0.202	0.205	0.267	0.037	0.18	0.56	0.340
Vanadium	13	0	Nonparametric	mg/kg	16.1	23.7	24.3	25.2	51.2	8.5	0.34	2.59	37.7
Zinc	13	0	Lognormal	mg/kg	20.3	29.3	30.7	31.6	52.8	8.3	0.26	1.37	58.9

Note:

95th UTLs are provided for analytes with normal or lognormal distributions. 95th percentiles are provided for analytes with distributions that are neither normal nor lognormal, or that have greater than 15 percent nondetects (per EPA, 1989).

Acronuyms & Abbreviations:

mg/kg - Milligrams per kilogram.
NA - Not applicable.
UTL - Upper tolerance limit.

TABLE D-2: SAMPLE SIZE AND PERCENT NON-DETECTS FOR METALS IN SOIL, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Element	Number of Samples	Percent Nondetects
Aluminum	10	0
Antimony	19	47
Arsenic	19	0
Barium	19	0
Beryllium	19	47
Cadmium	19	42
Calcium	10	0
Chromium	19	0
Cobalt	19	0
Copper	19	0
Iron	10	0
Lead	19	0
Magnesium	10	0
Manganese	10	0
Mercury	19	11
Molybdenum	19	5
Nickel	19	0
Potassium	10	0
Selenium	19	47
Silver	19	53
Sodium	10	0
Thallium	19	47
Vanadium	19	0
Zinc	19	0

TABLE D-3: STATISTICAL TEST RESULTS AND GEOCHEMICAL EVALUATION CONCLUSIONS FOR METALS IN SOIL, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Element	Hm Test		WRS Test			Geochemical Evaluation
	Count > BSV	Test Result	*p* -level		Test Result	Conclusion
Aluminum	0	Pass	< 0.001	(Site < BG)	Pass	NA
Antimony	9	Fail	NA		NA	Anomalous concentrations (6)
Arsenic	1	Fail	0.687		Pass	Anomalous concentrations (5)
Barium	8	Fail	0.081		Pass	Anomalous concentrations (5)
Beryllium	0	Pass	0.008	(Site < BG)	Pass	NA
Cadmium	11	Fail	NA		NA	Anomalous concentrations (6)
Calcium	7	Fail	0.002	(Site > BG)	Fail	Anomalous concentrations (5)
Chromium	8	Fail	0.924		Pass	Anomalous concentrations (6)
Cobalt	2	Fail	0.019	(Site > BG)	Fail	Anomalous concentrations (5)
Copper	11	Fail	0.011	(Site > BG)	Fail	Anomalous concentrations (9)
Iron	6	Fail	0.016	(Site > BG)	Fail	Anomalous concentrations (7)
Lead	15	Fail	0.002	(Site > BG)	Fail	Anomalous concentrations (9)
Magnesium	3	Fail	0.049	(Site > BG)	Fail	Naturally occurring
Manganese	8	Fail	0.013	(Site > BG)	Fail	Anomalous concentrations (5)
Mercury	12	Fail	NA		NA	Anomalous concentrations (8)
Molybdenum	3	Fail	0.924		Pass	Anomalous concentrations (2)
Nickel	8	Fail	0.673		Pass	Anomalous concentrations (6)
Potassium	6	Fail	0.019	(Site > BG)	Fail	Naturally occurring
Selenium	0	Pass	0.359		Pass	NA
Silver	9	Fail	NA		NA	Naturally occurring
Sodium	6	Fail	0.002	(Site > BG)	Fail	Anomalous concentrations (6)
Thallium	5	Fail	< 0.001	(Site > BG)	Fail	Anomalous concentrations (5)
Vanadium	0	Pass	0.111		Pass	NA
Zinc	10	Fail	0.018	(Site > BG)	Fail	Anomalous concentrations (6)

NOTES:
BG = Background
BSV = Background screening value
Hm = Hot measurement
NA = Not applicable
WRS = Wilcoxon rank sum. Relative positions of site and BG medians provided in parentheses for p-levels <0.05.
See box plots (Attachment 1).

TABLE D-4: AUGUST 2008 SOIL SAMPLES WITH ANOMALOUSLY HIGH ELEMENT CONCENTRATIONS, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Location	Sample No.	Depth (ft bgs)	Elements
YWM02A	YWM02A-2268	0.5 - 0.5	Sb, As, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mn, Hg, Mo, Ni, Na, Tl, Zn
YWM06	YWM06-2274	0.5 - 0.5	Sb, Cd, Cr, Co, Cu, Fe, Pb, Hg, Ni, Na, Tl, Zn
YWM06	YWM06-2276	4 - 4	Cu, Pb
YWM07	YWM07-2277	0.5 - 0.5	Sb, As, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mn, Hg, Mo, Ni, Na, Tl, Zn
YWM08	YWM08-2280	0.5 - 0.5	Cu, Pb, Hg, Tl
YWM08	YWM08-2281	2 - 2	Cu, Fe, Pb, Hg, Tl
YWM09	YWM09-2284	0.5 - 0.5	Sb, As, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Na, Zn
YWM09	YWM09-2285	1.5 - 1.5	Sb, As, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Na, Zn
YWM09	YWM09-2286	2.5 - 2.5	Sb, As, Ba, Cd, Ca, Cr, Cu, Fe, Pb, Mn, Hg, Ni, Na, Zn

Note:
For the 2008 samples, all detected element concentrations not listed above are most likely naturally occurring.
ft bgs - feet below ground surface

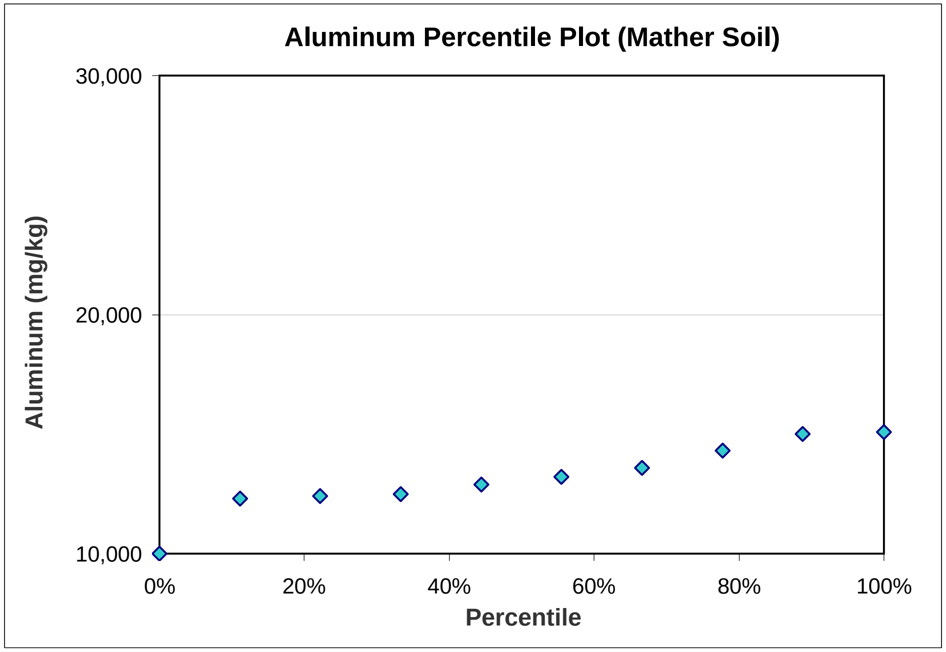
TABLE D-5: AUGUST 2001 SOIL SAMPLES WITH ELEMENT CONCENTRATIONS ABOVE BACKGROUND SCREENING VALUES, MATHER WASTE ACCUMULATION AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

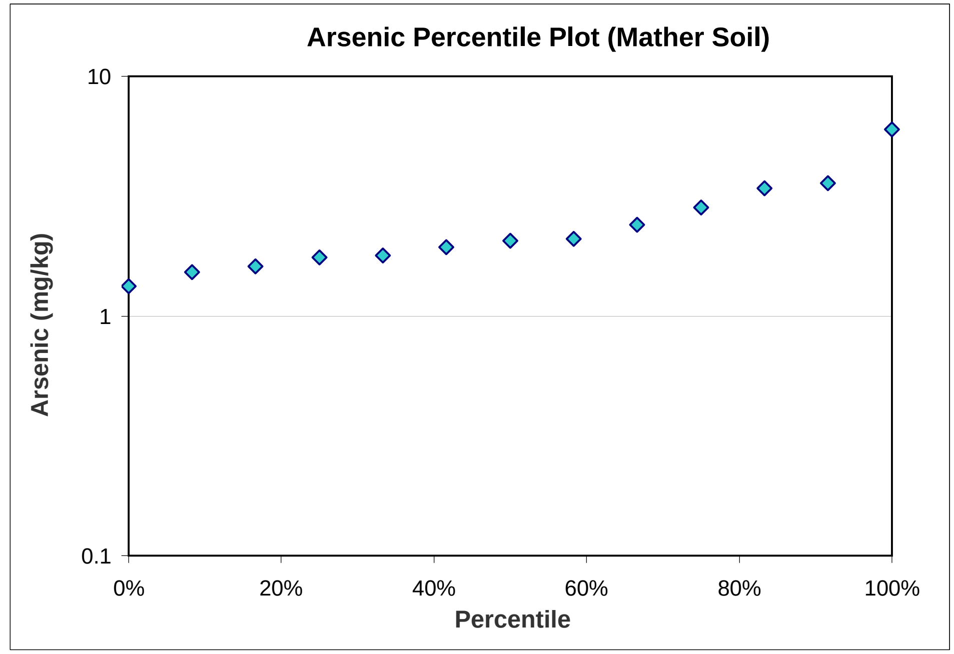
Location	Sample No.	Depth (ft bgs)	Element(s)
YWM-DG01	YWM-DG01-SO-1050	1 - 1.5	Pb
YWM-DG03	YWM-DG03-SO-1052	1 - 1.5	Pb, Hg
YWM-TP01	YWM-TP01-SO-1042	4 - 4.5	Pb, Hg
YWM-TP02	YWM-TP02-SO-1048	3 - 3.5	Sb, Ba, Cd, Cr, Cu, Pb, Hg, Ni, Ag, Zn
YWM-TP02	YWM-TP02-SO-1046	6 - 6.5	Sb, Ba, Cd, Cr, Cu, Pb, Hg, Mo, Ni, Ag, Zn
YWM-TP05	YWM-TP05-SO-1039	2.5 - 3	Cu, Pb

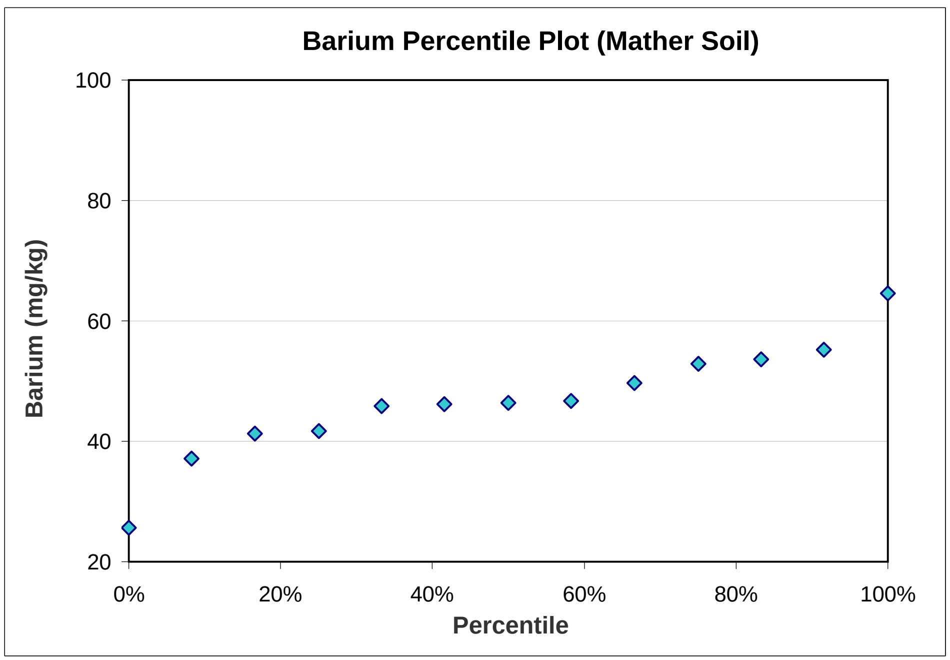
Note:

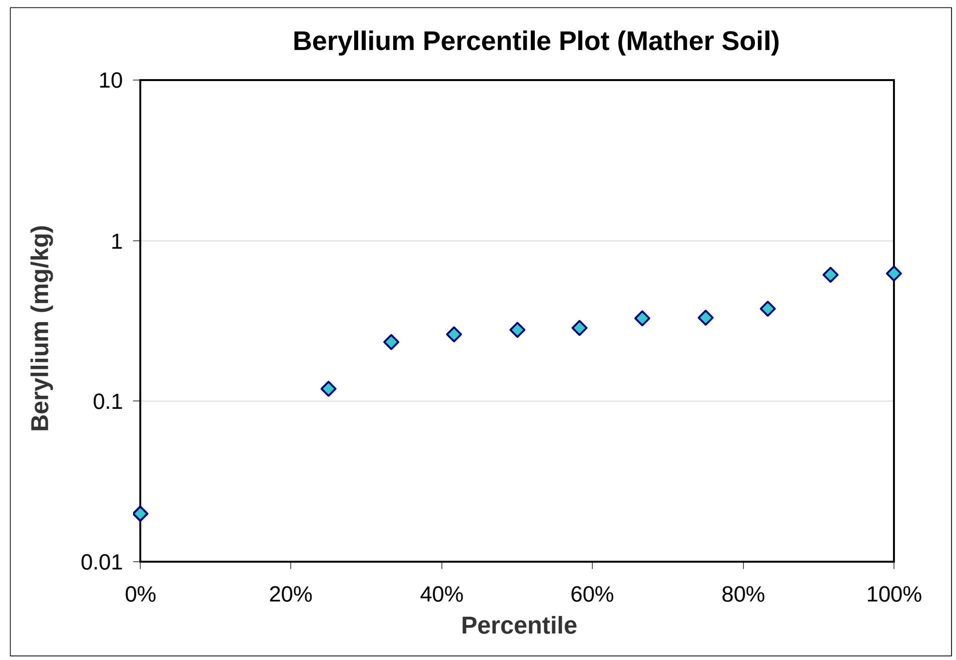
ft bgs - feet below ground surface

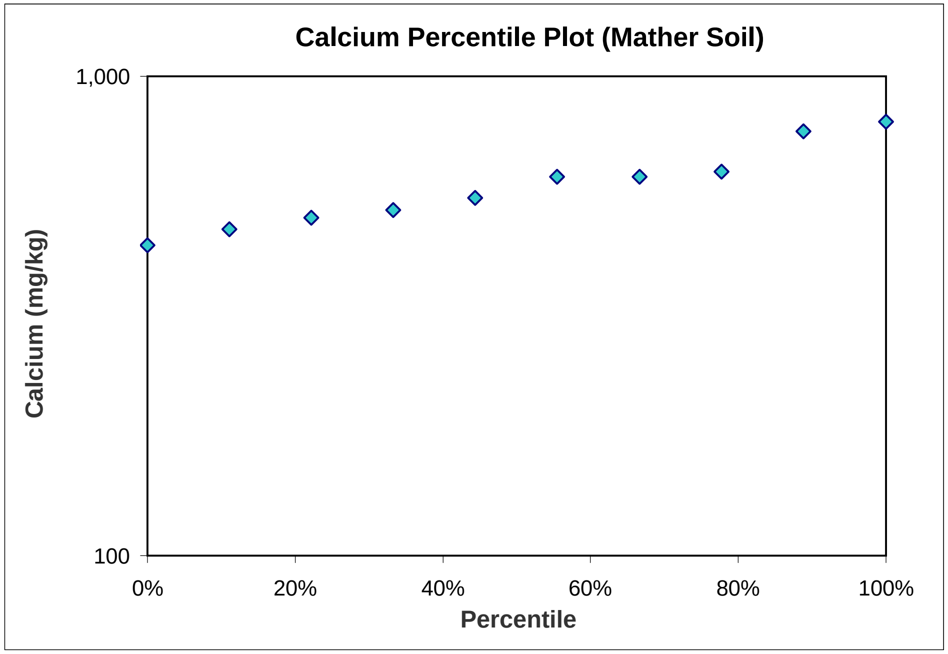
Attachment 1
Percentile Plots


Aluminum Percentile Plot (Mather Soil)
Aluminum (mg/kg)
30,000
20,000
10,000
0%
20%
40%
60%
80%
100%
Percentile

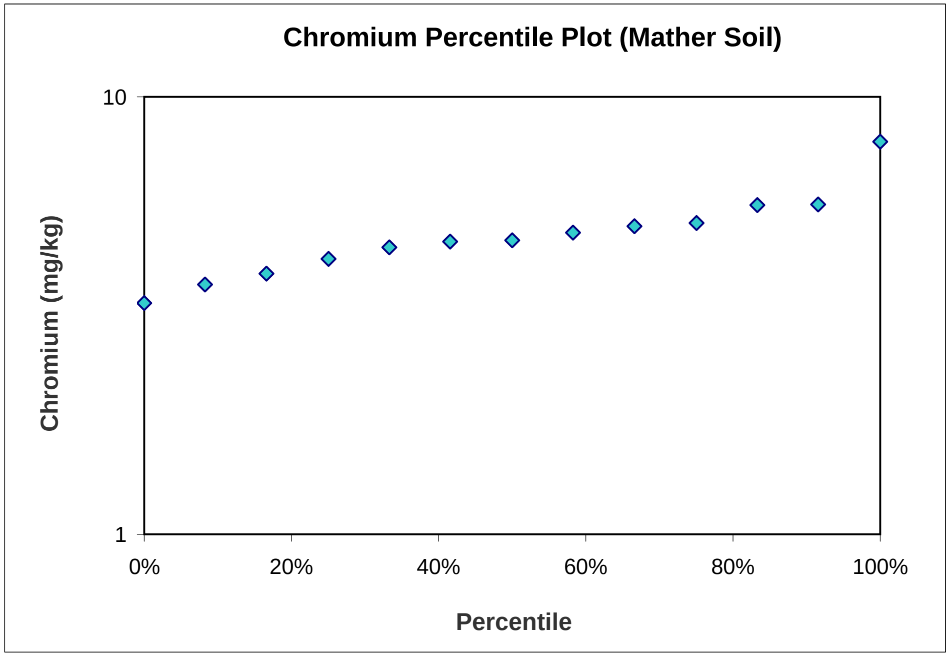

Arsenic Percentile Plot (Mather Soil)
Arsenic (mg/kg)
10
1
0.1
0%
20%
40%
60%
80%
100%
Percentile


Barium Percentile Plot (Mather Soil)
Barium (mg/kg)
100
80
60
40
20
0%
20%
40%
60%
80%
100%
Percentile

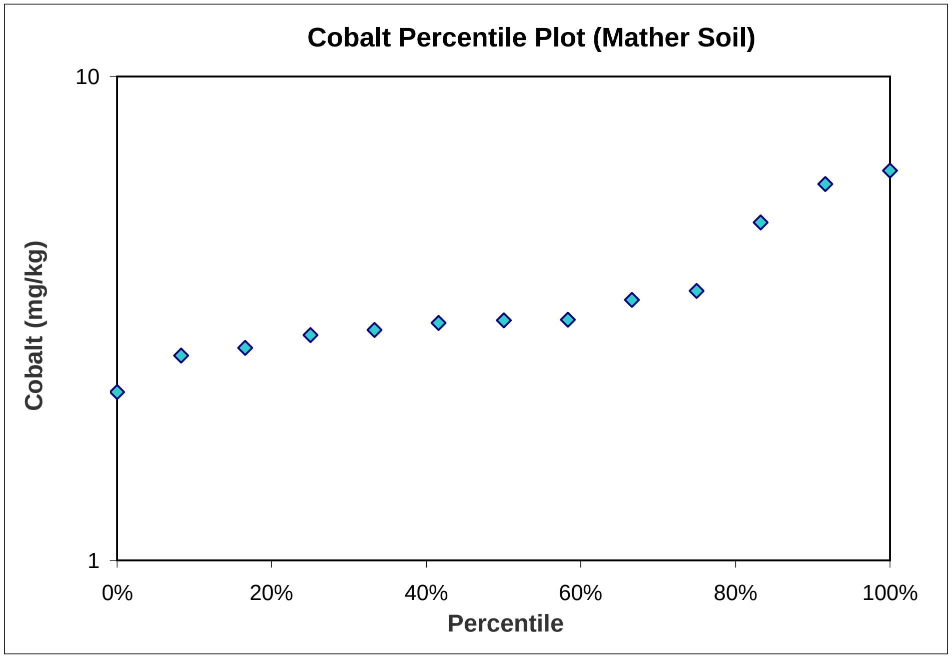

Beryllium Percentile Plot (Mather Soil)
Beryllium (mg/kg)
10
1
0.1
0.01
0%
20%
40%
60%
80%
100%
Percentile



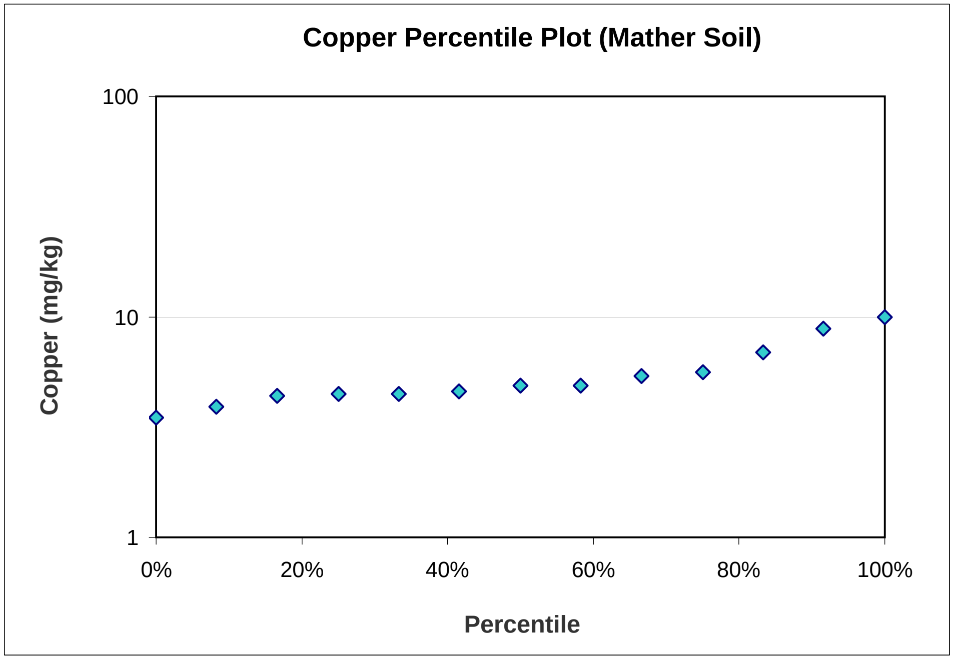
Calcium Percentile Plot (Mather Soil)
1,000
100
Calcium (mg/kg)
0%
20%
40%
60%
80%
100%
Percentile



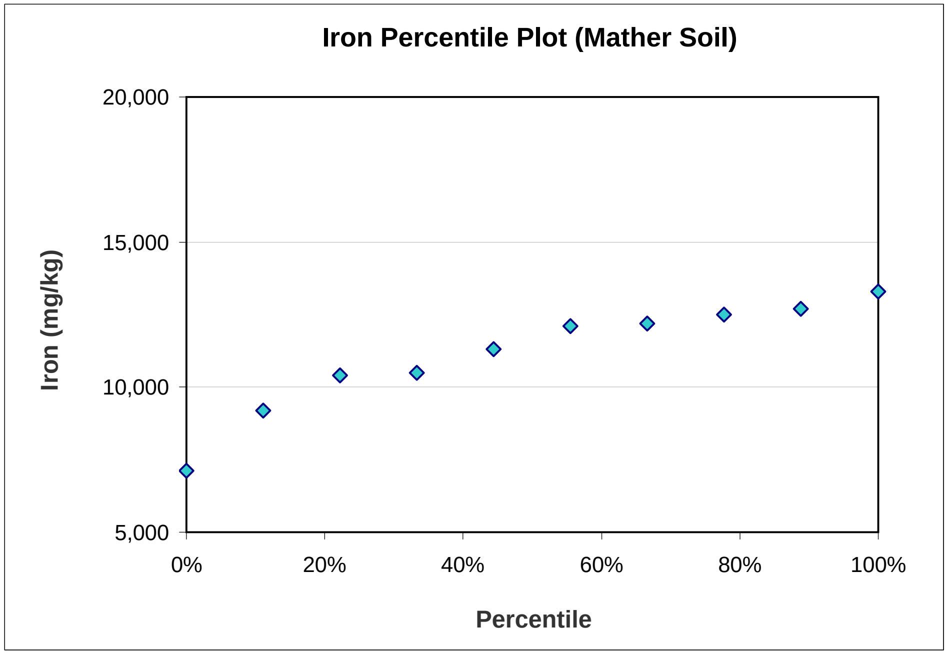
Chromium Percentile Plot (Mather Soil)
10
1
Chromium (mg/kg)
0%
20%
40%
60%
80%
100%
Percentile

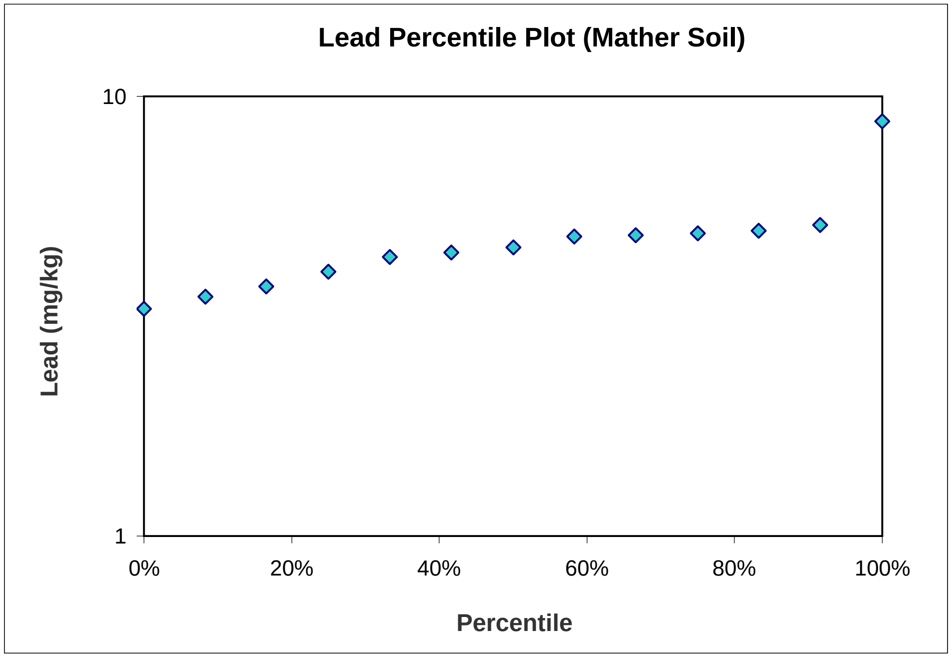


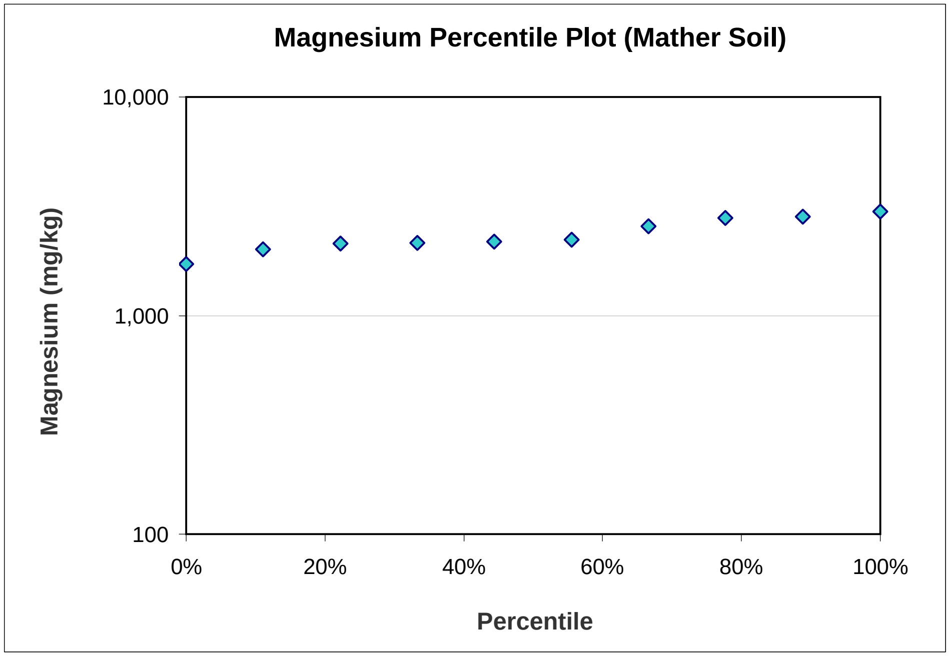
Cobalt Percentile Plot (Mather Soil)
10
1
Cobalt (mg/kg)
0%
20%
40%
60%
80%
100%
Percentile

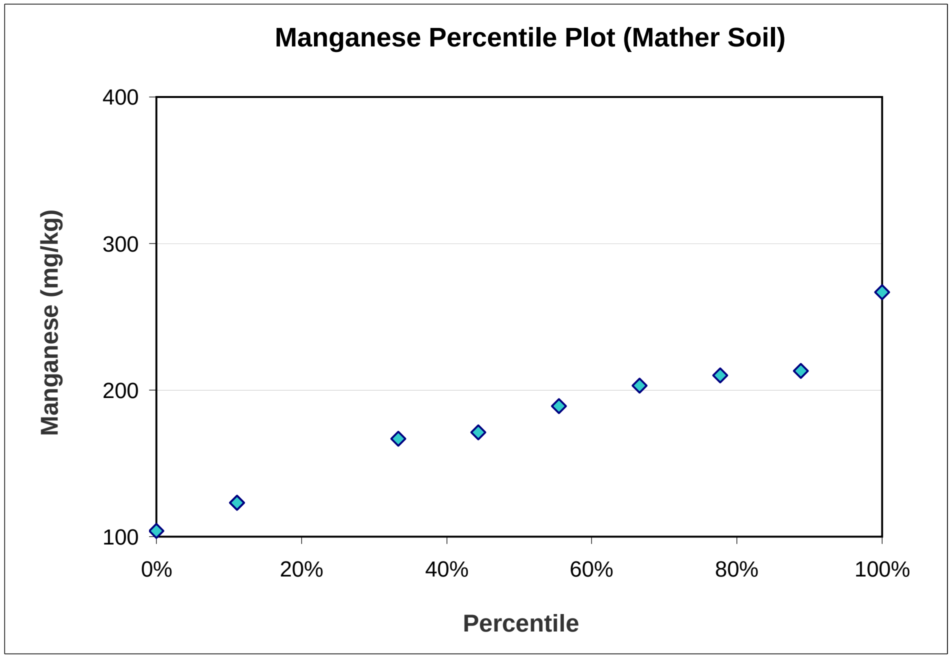


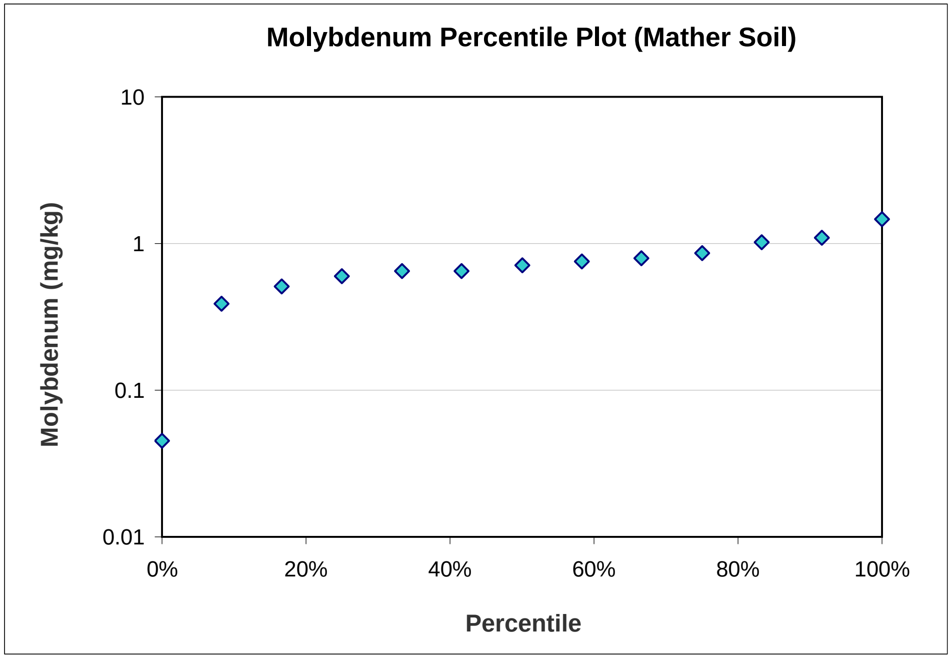
Copper Percentile Plot (Mather Soil)
100
10
1
Copper (mg/kg)
0%
20%
40%
60%
80%
100%
Percentile

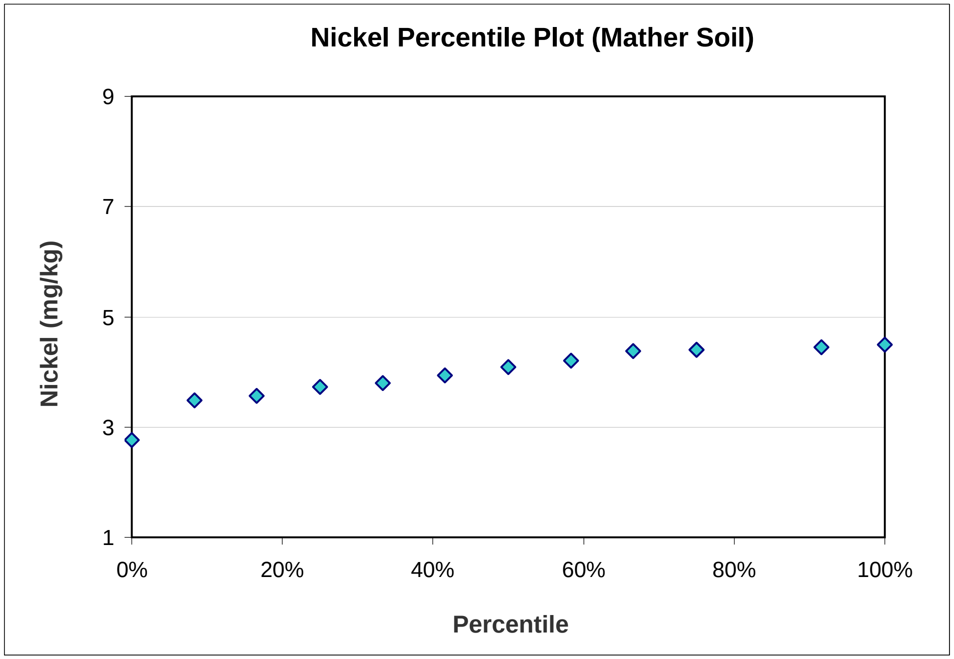

Iron Percentile Plot (Mather Soil)
20,000
15,000
10,000
5,000
Iron (mg/kg)
0%
20%
40%
60%
80%
100%
Percentile

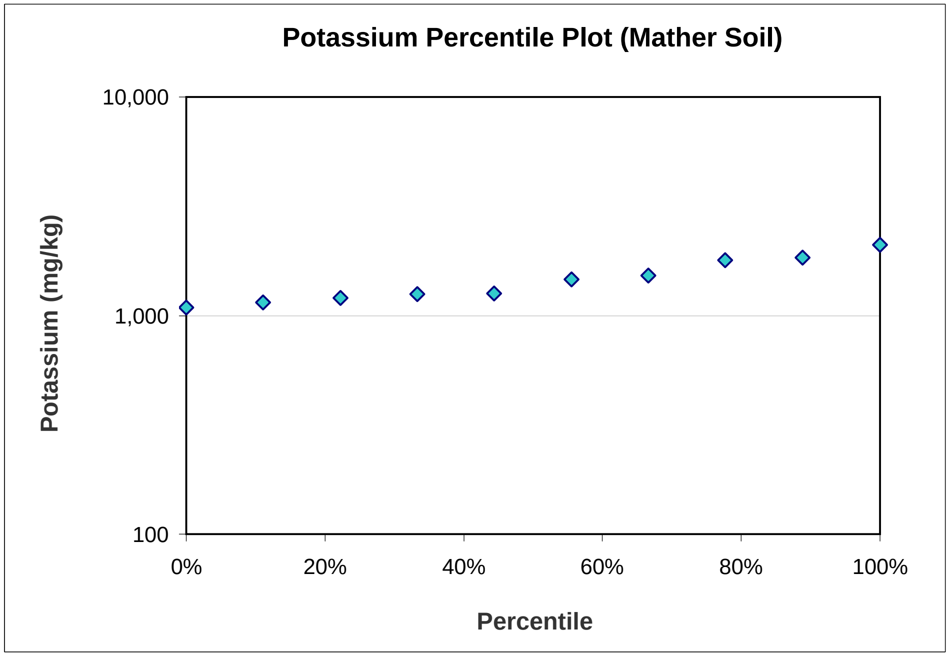

Lead Percentile Plot (Mather Soil)
10
1
Lead (mg/kg)
0%
20%
40%
60%
80%
100%
Percentile

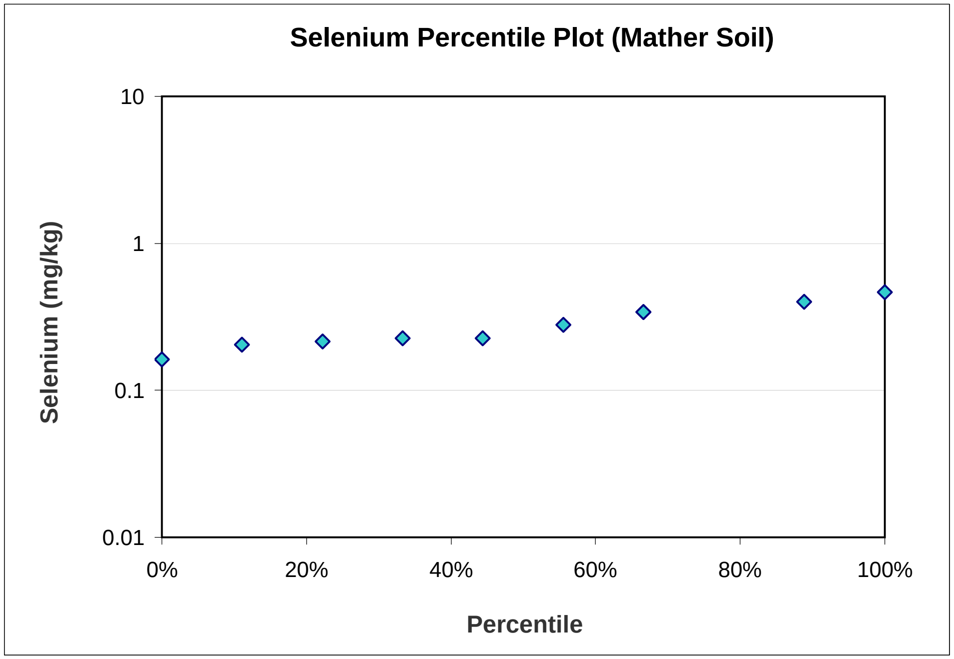

Magnesium Percentile Plot (Mather Soil)
10,000
1,000
100
Magnesium (mg/kg)
0%
20%
40%
60%
80%
100%
Percentile

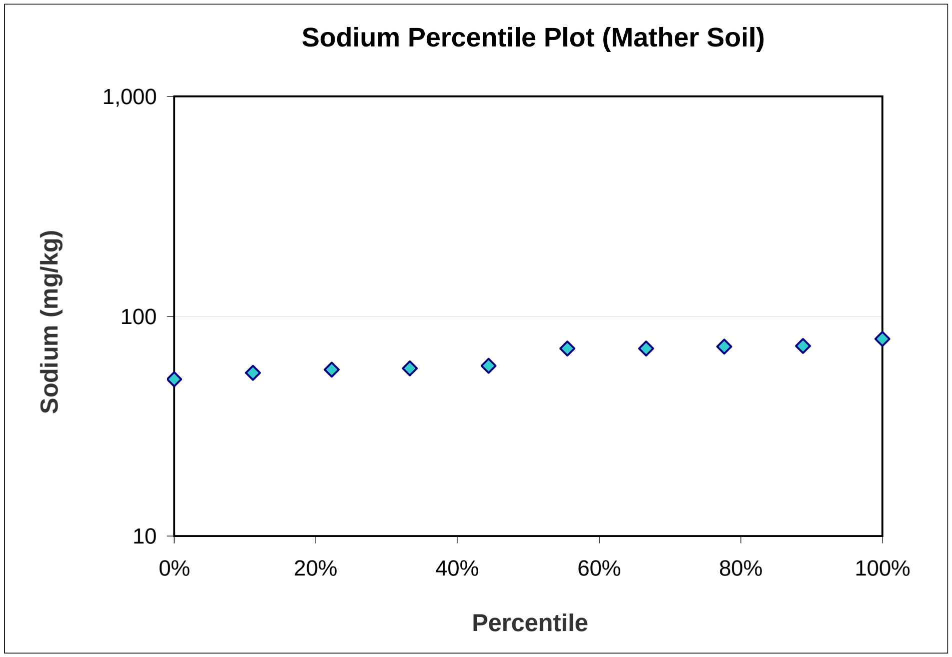

Manganese Percentile Plot (Mather Soil)
400
300
200
100
Manganese (mg/kg)
0%
20%
40%
60%
80%
100%
Percentile

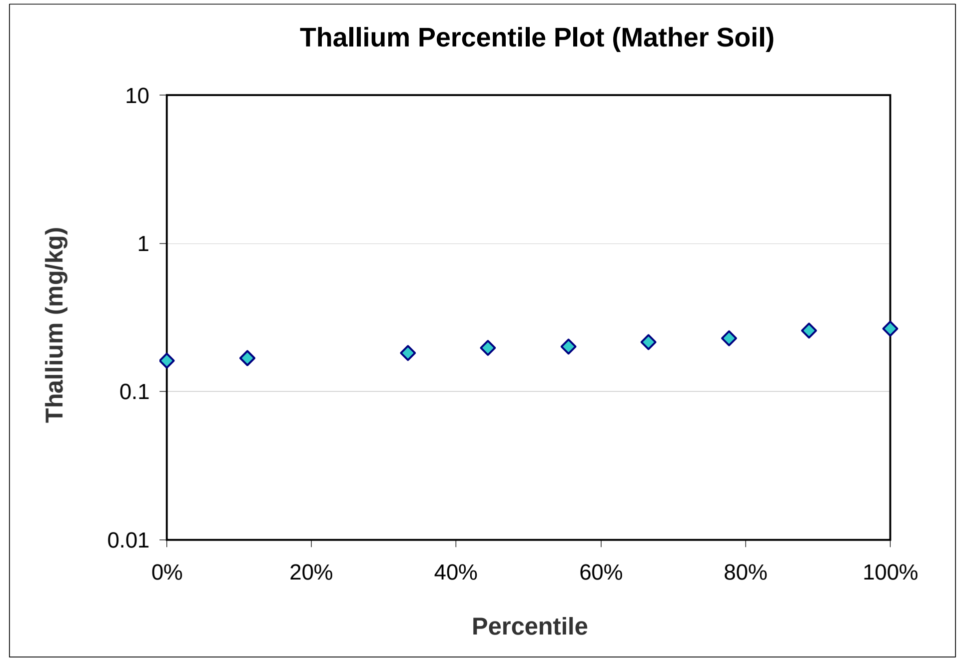

Molybdenum Percentile Plot (Mather Soil)
10
1
0.1
0.01
Molybdenum (mg/kg)
0%
20%
40%
60%
80%
100%
Percentile

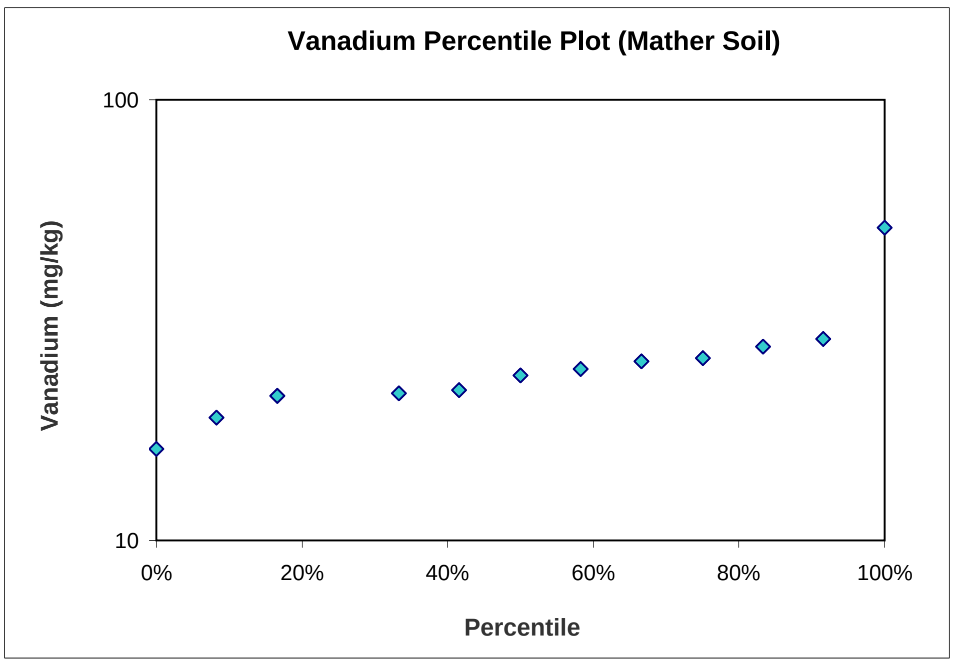

Nickel Percentile Plot (Mather Soil)
9
7
5
3
1
Nickel (mg/kg)
0%
20%
40%
60%
80%
100%
Percentile

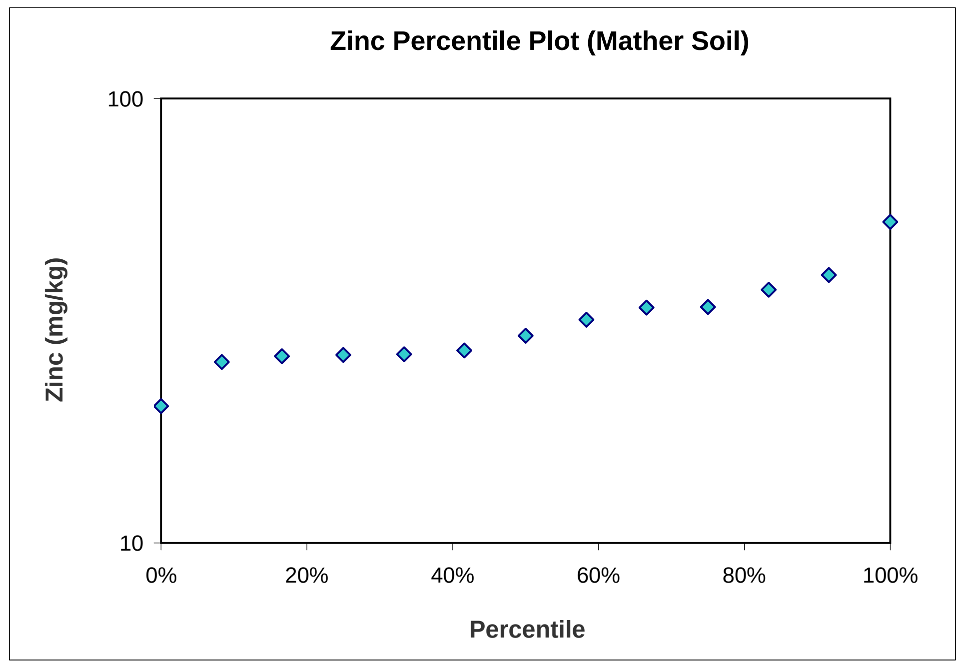

Potassium Percentile Plot (Mather Soil)
10,000
1,000
100
Potassium (mg/kg)
0%
20%
40%
60%
80%
100%
Percentile


Selenium Percentile Plot (Mather Soil)
10
1
0.1
0.01
Selenium (mg/kg)
0%
20%
40%
60%
80%
100%
Percentile


Sodium Percentile Plot (Mather Soil)
1,000
100
10
Sodium (mg/kg)
0%
20%
40%
60%
80%
100%
Percentile

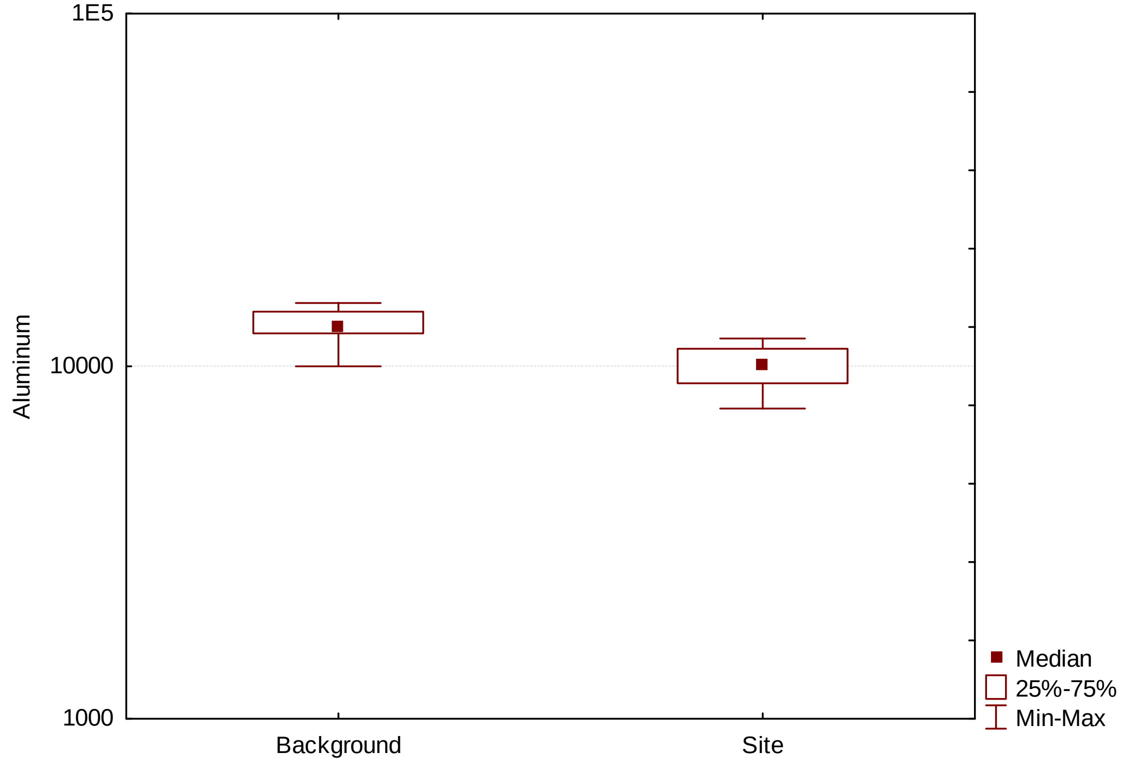

Thallium Percentile Plot (Mather Soil)
10
1
0.1
0.01
Thallium (mg/kg)
0%
20%
40%
60%
80%
100%
Percentile


Vanadium Percentile Plot (Mather Soil)
100
10
Vanadium (mg/kg)
0%
20%
40%
60%
80%
100%
Percentile

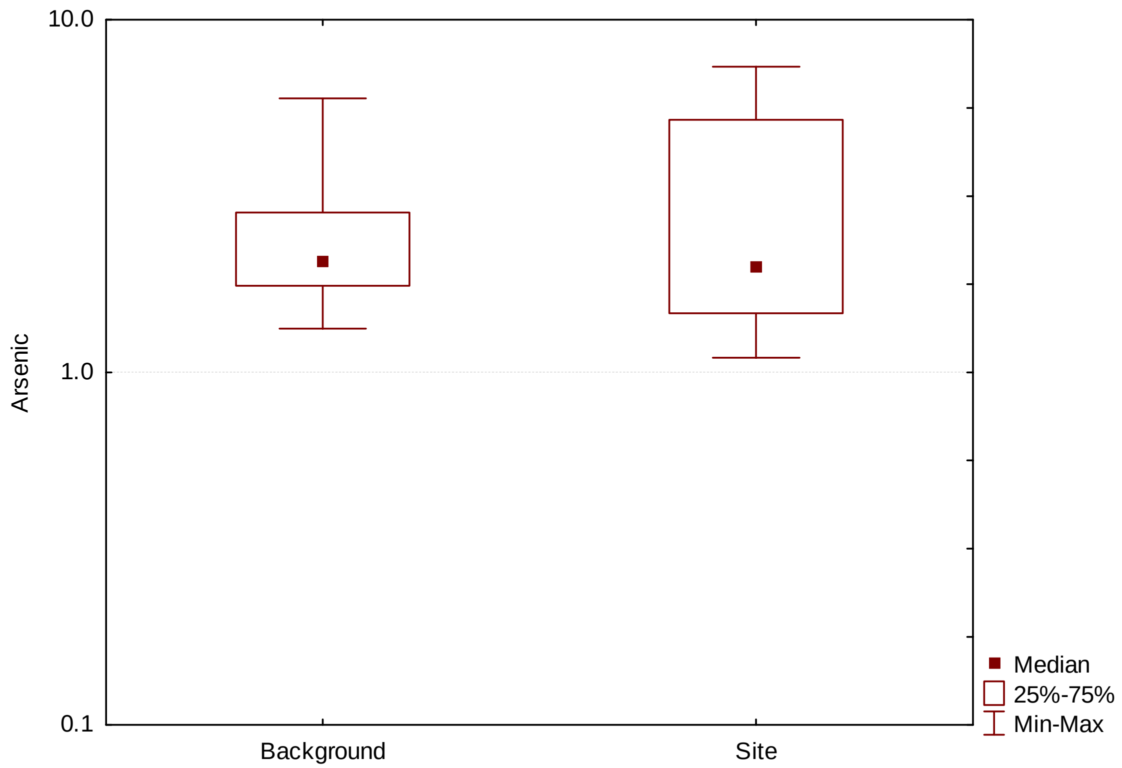

Zinc Percentile Plot (Mather Soil)
100
10
Zinc (mg/kg)
0%
20%
40%
60%
80%
100%
Percentile

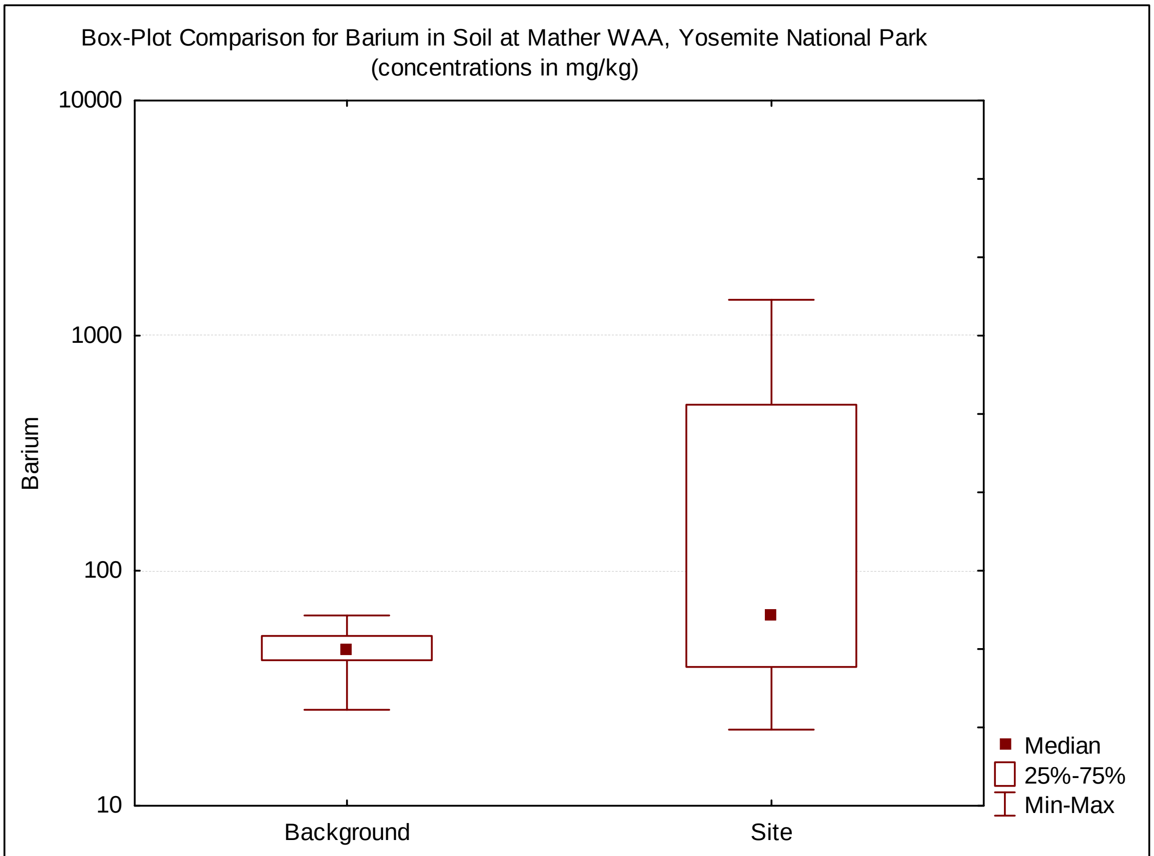
Attachment 2
Box Plots

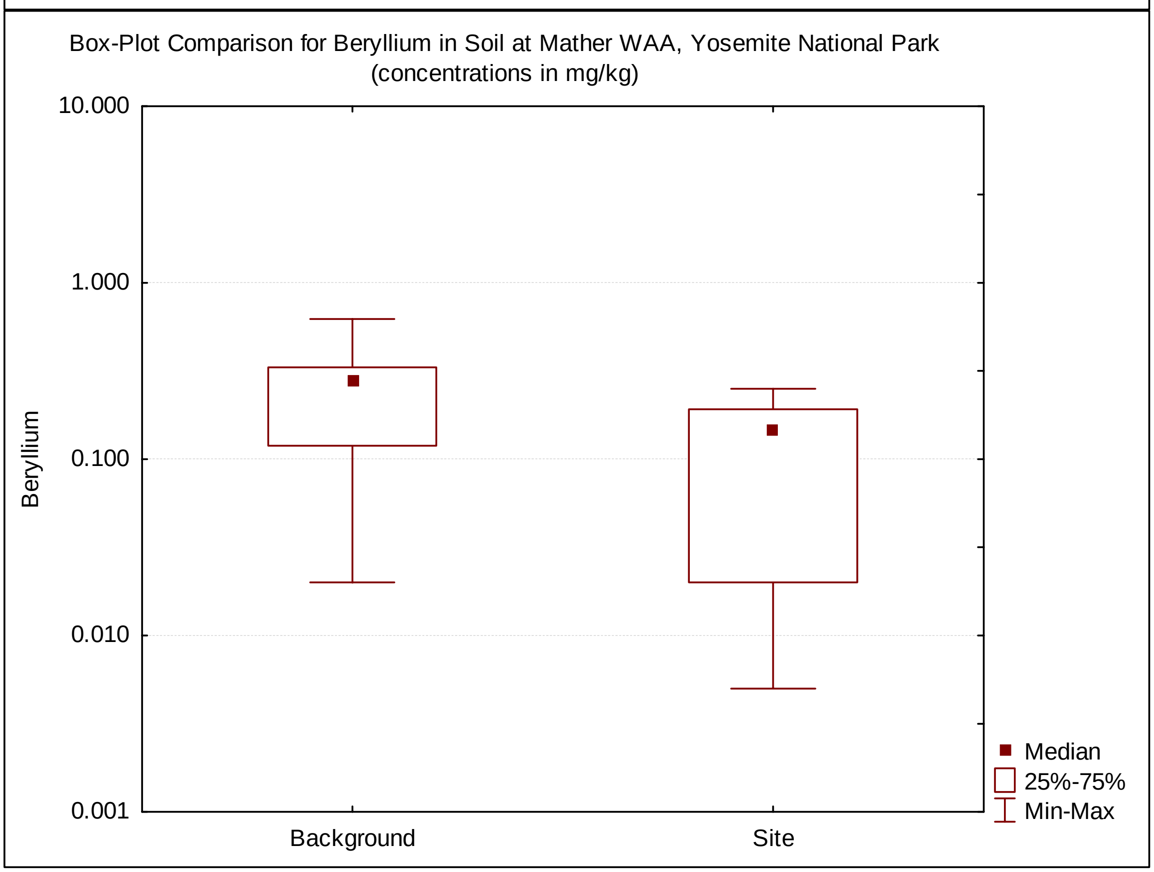
Box-Plot Comparison for Aluminum in Soil at Mather WAA, Yosemite National Park
(concentrations in mg/kg)

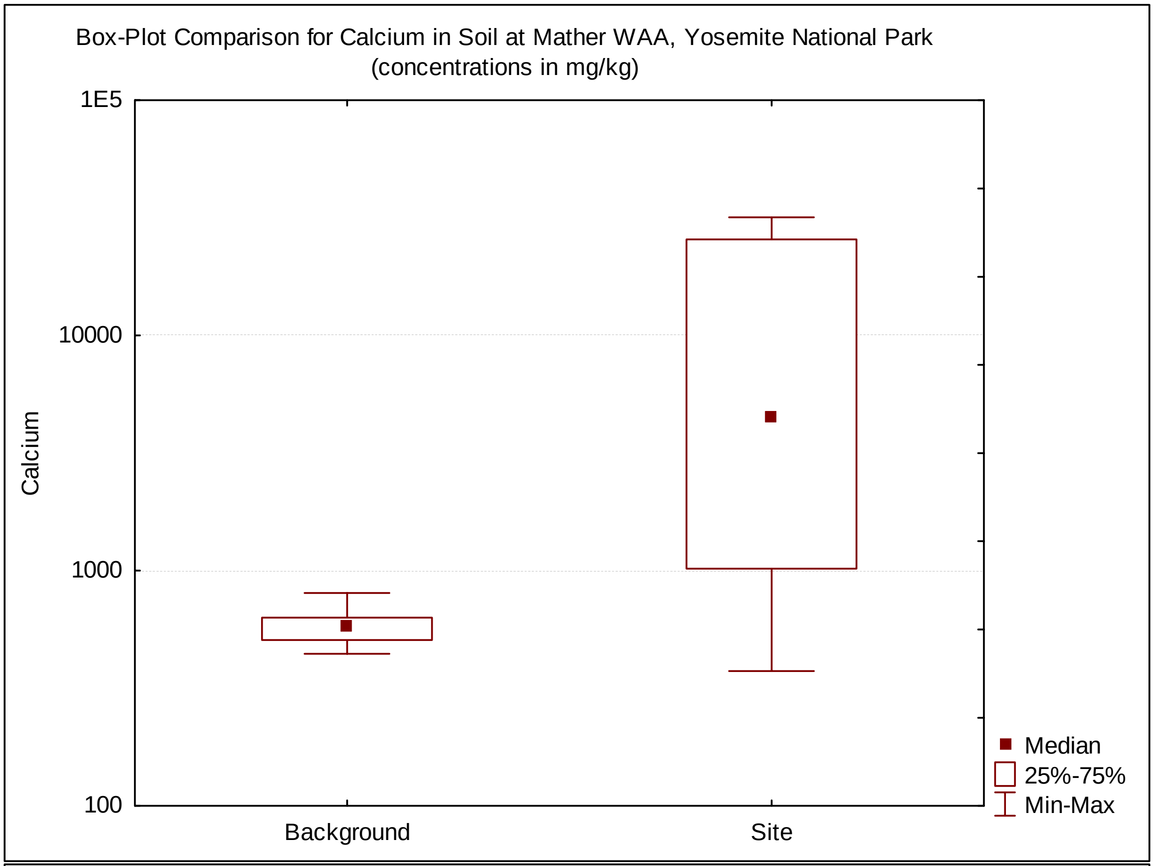


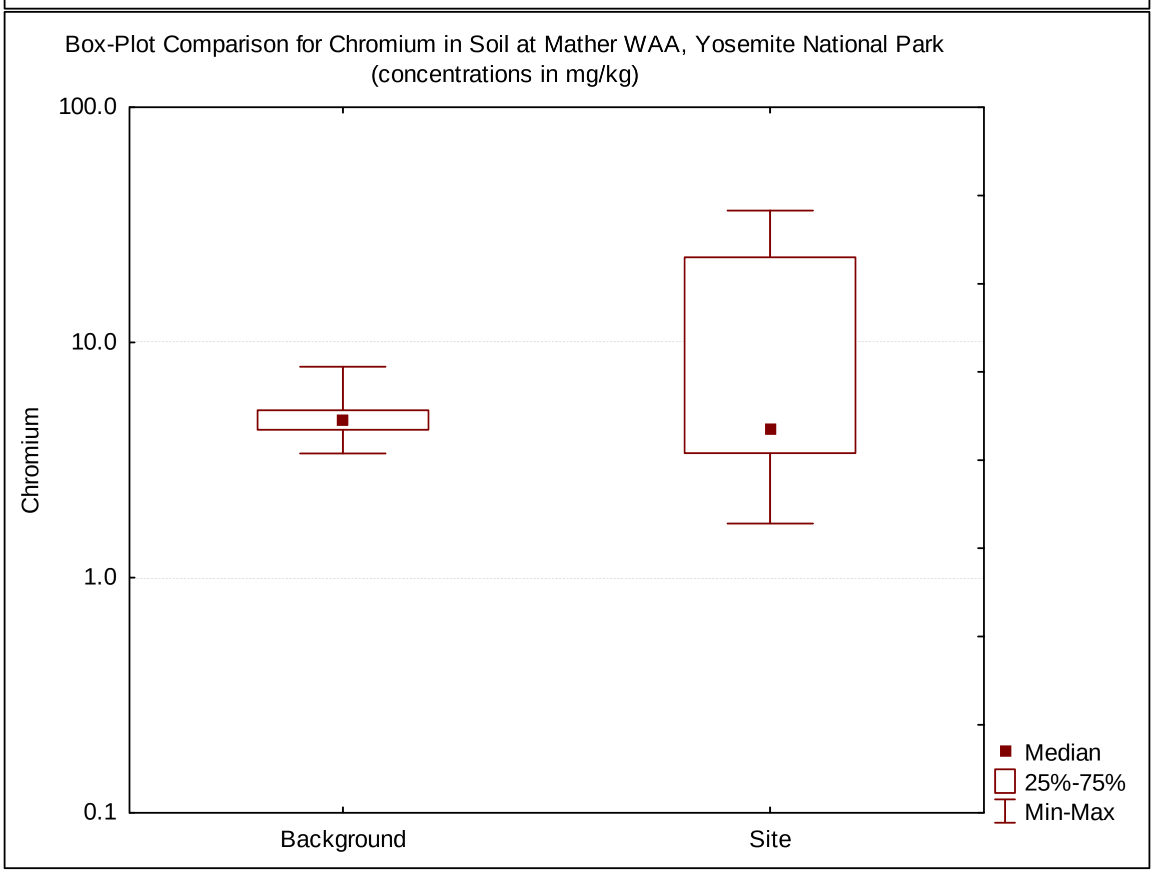
Box-Plot Comparison for Arsenic in Soil at Mather WAA, Yosemite National Park
(concentrations in mg/kg)

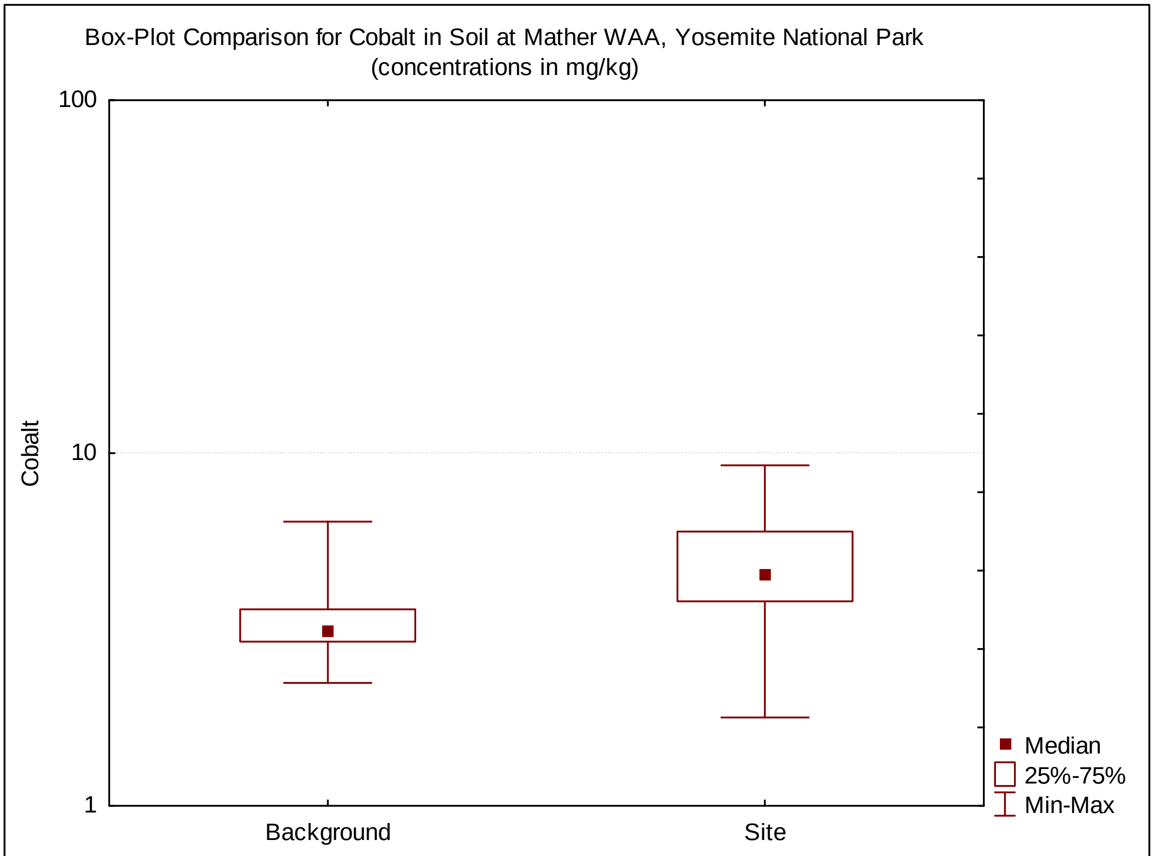


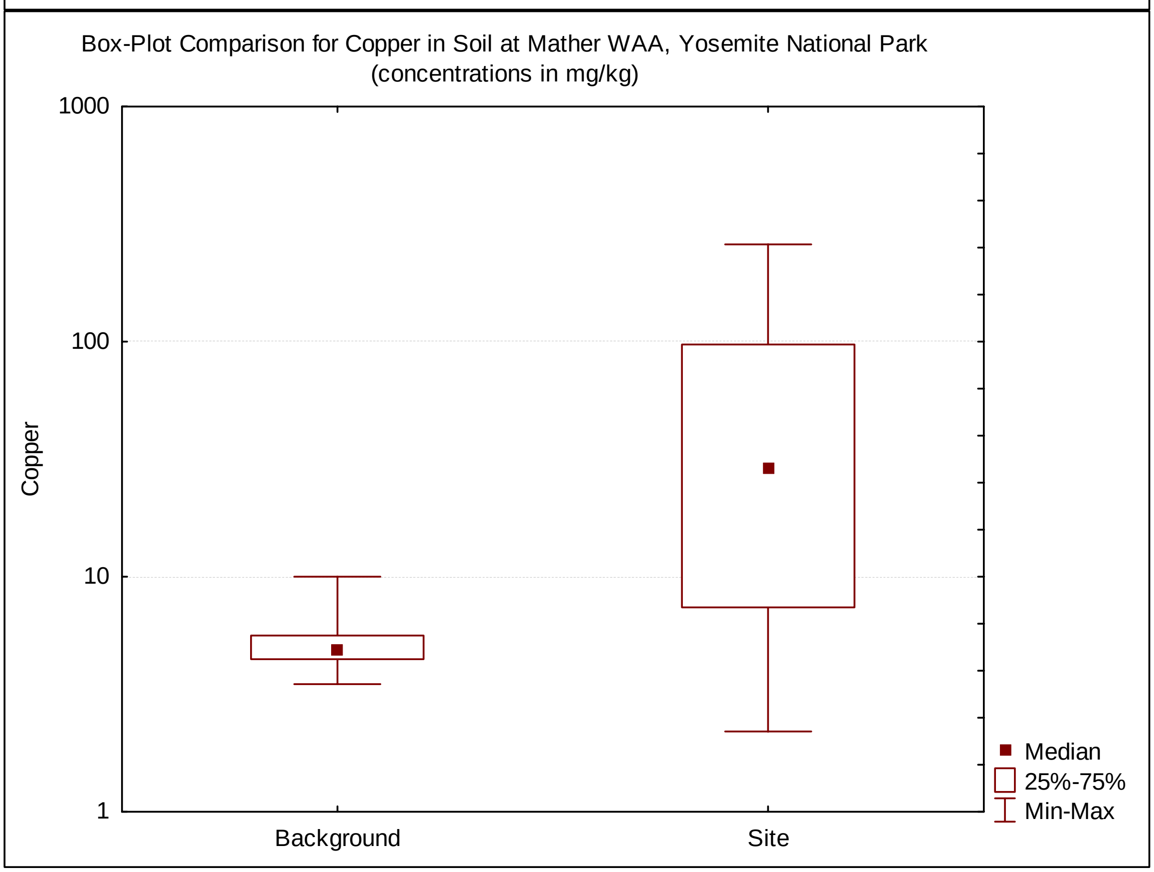

Box-Plot Comparison for Barium in Soil at Mather WAA, Yosemite National Park
(concentrations in mg/kg)
10000
1000
100
10
Barium
Background
Site
Median
25%-75%
Min-Max

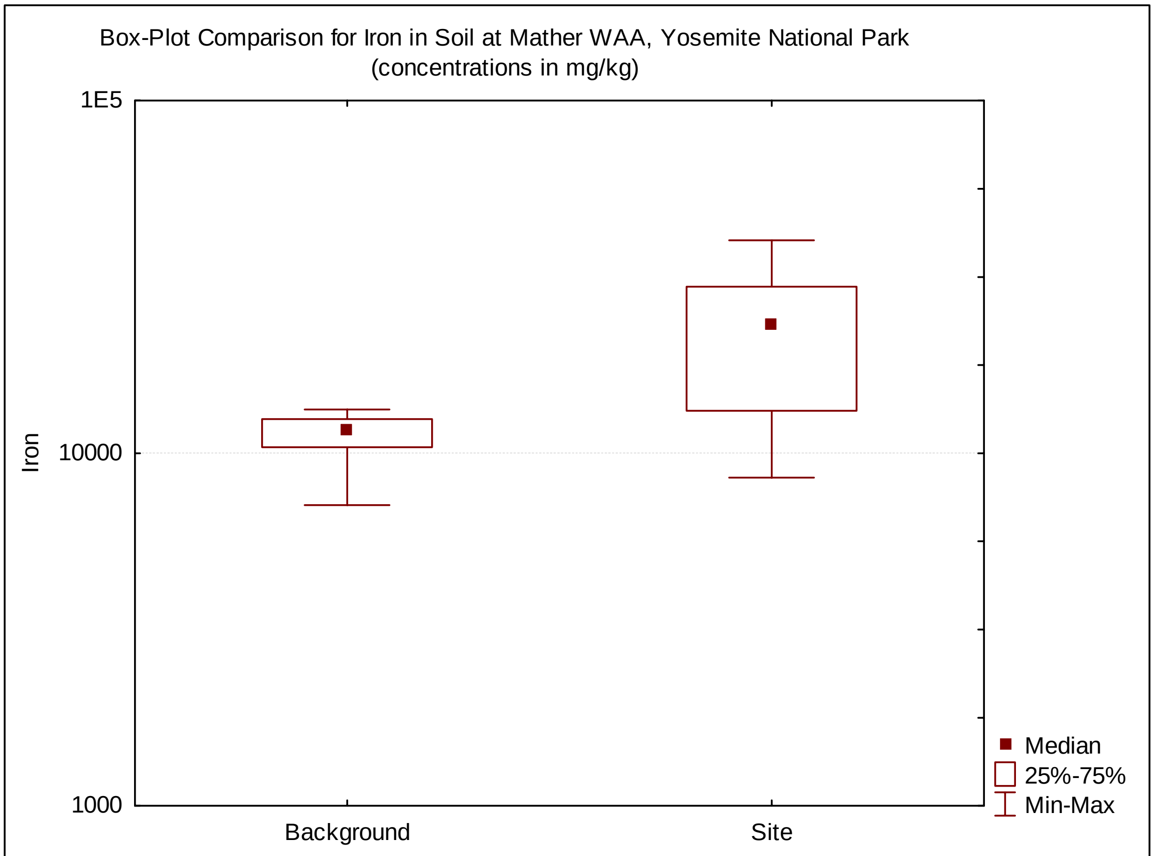

Box-Plot Comparison for Beryllium in Soil at Mather WAA, Yosemite National Park
(concentrations in mg/kg)
10.000
1.000
0.100
0.010
0.001
Beryllium
Background
Site
Median
25%-75%
Min-Max


Box-Plot Comparison for Calcium in Soil at Mather WAA, Yosemite National Park
(concentrations in mg/kg)
1E5
10000
1000
100
Calcium
Background
Site
Median
25%-75%
Min-Max

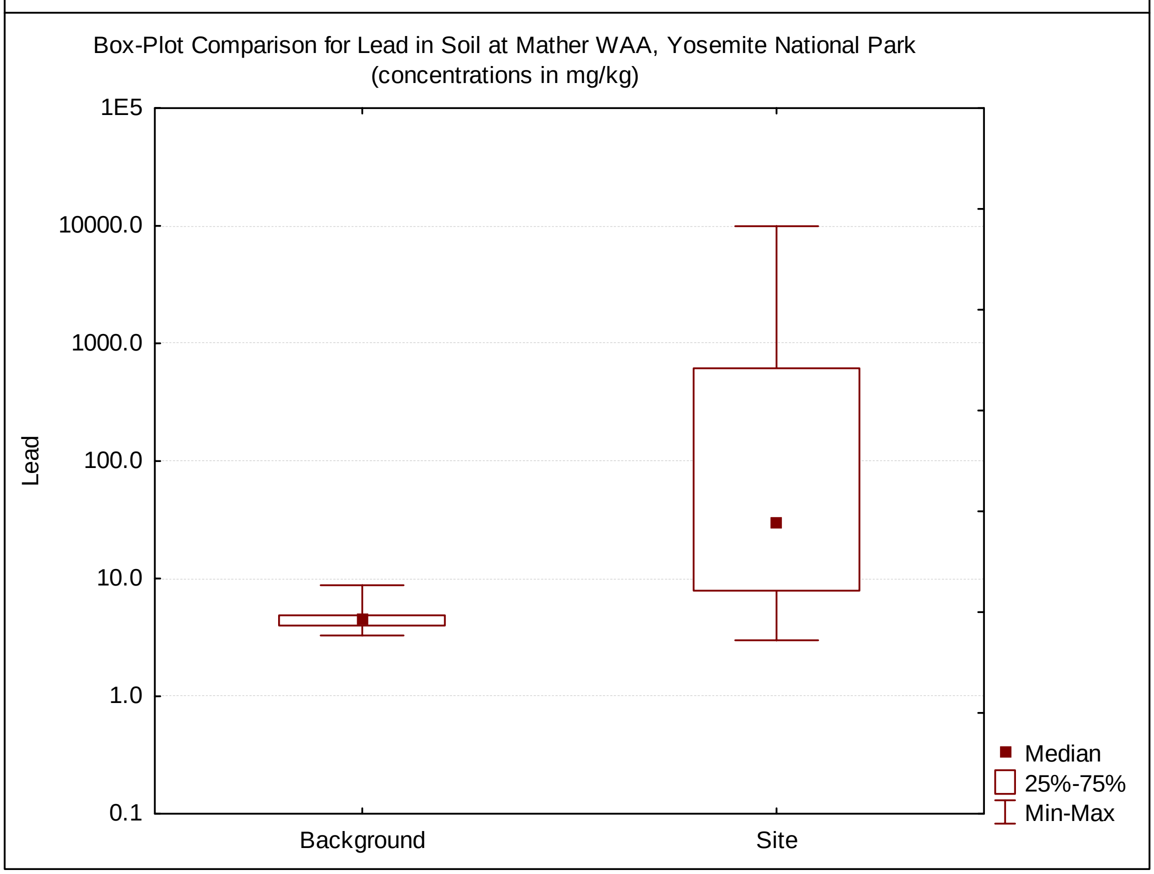

Box-Plot Comparison for Chromium in Soil at Mather WAA, Yosemite National Park
(concentrations in mg/kg)
100.0
10.0
1.0
0.1
Chromium
Background
Site
Median
25%-75%
Min-Max


Box-Plot Comparison for Cobalt in Soil at Mather WAA, Yosemite National Park
(concentrations in mg/kg)
100
10
1
Cobalt
Background
Site
Median
25%-75%
Min-Max

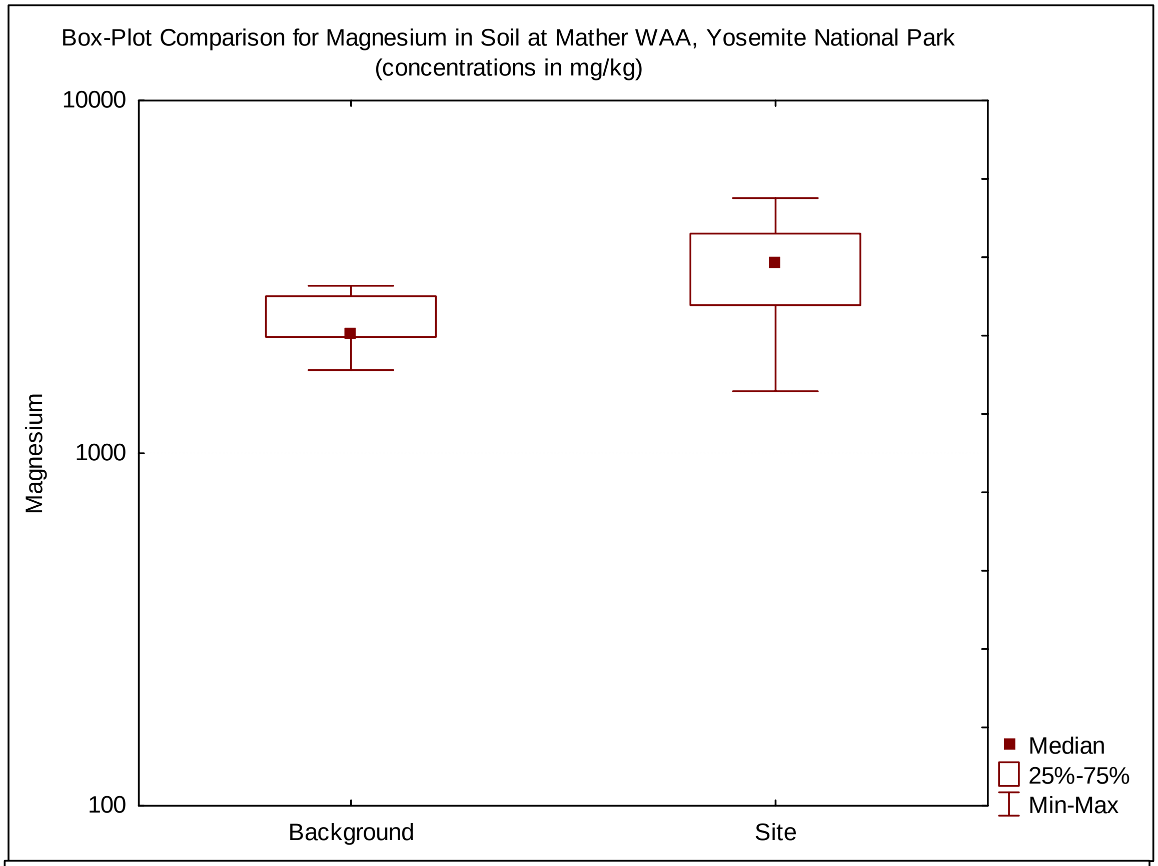

Box-Plot Comparison for Copper in Soil at Mather WAA, Yosemite National Park
(concentrations in mg/kg)
1000
100
10
1
Copper
Background
Site
Median
25%-75%
Min-Max

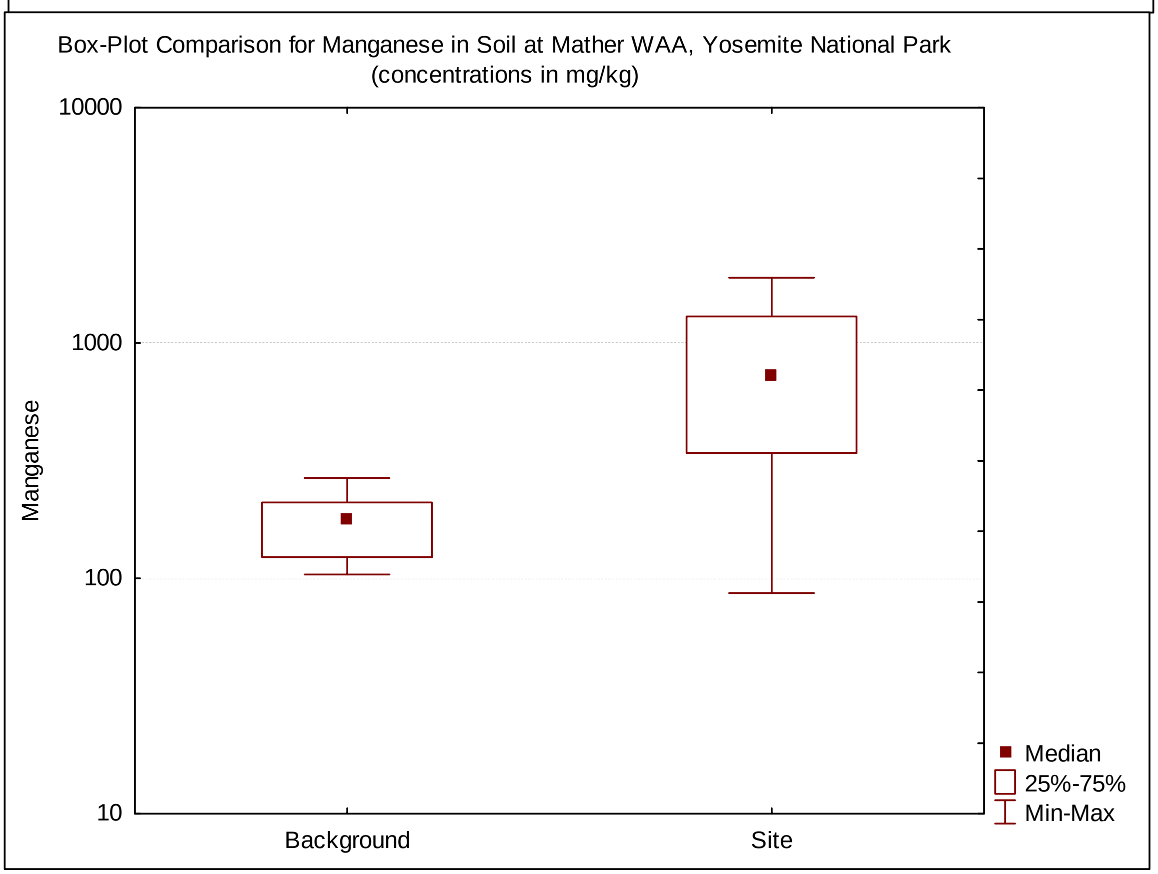


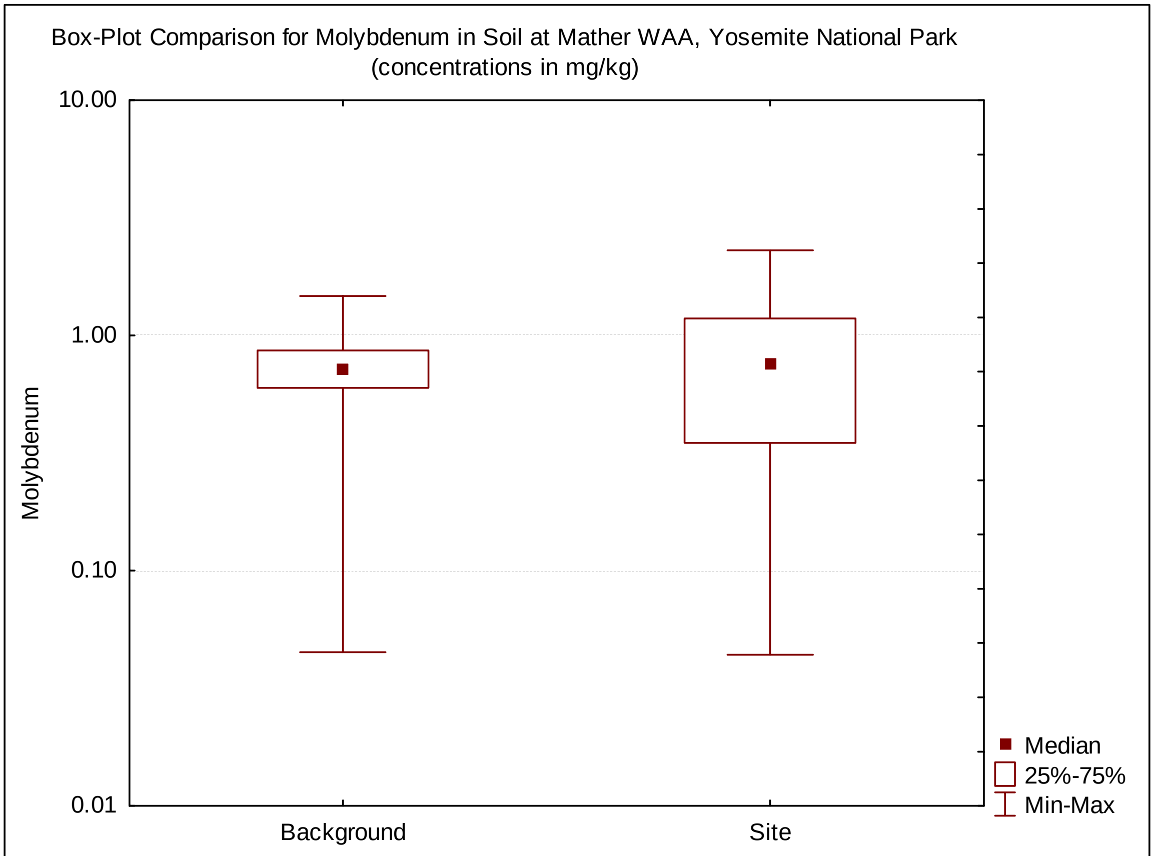
Box-Plot Comparison for Iron in Soil at Mather WAA, Yosemite National Park
(concentrations in mg/kg)
1E5
10000
1000
Iron
Background
Site
Median
25%-75%
Min-Max

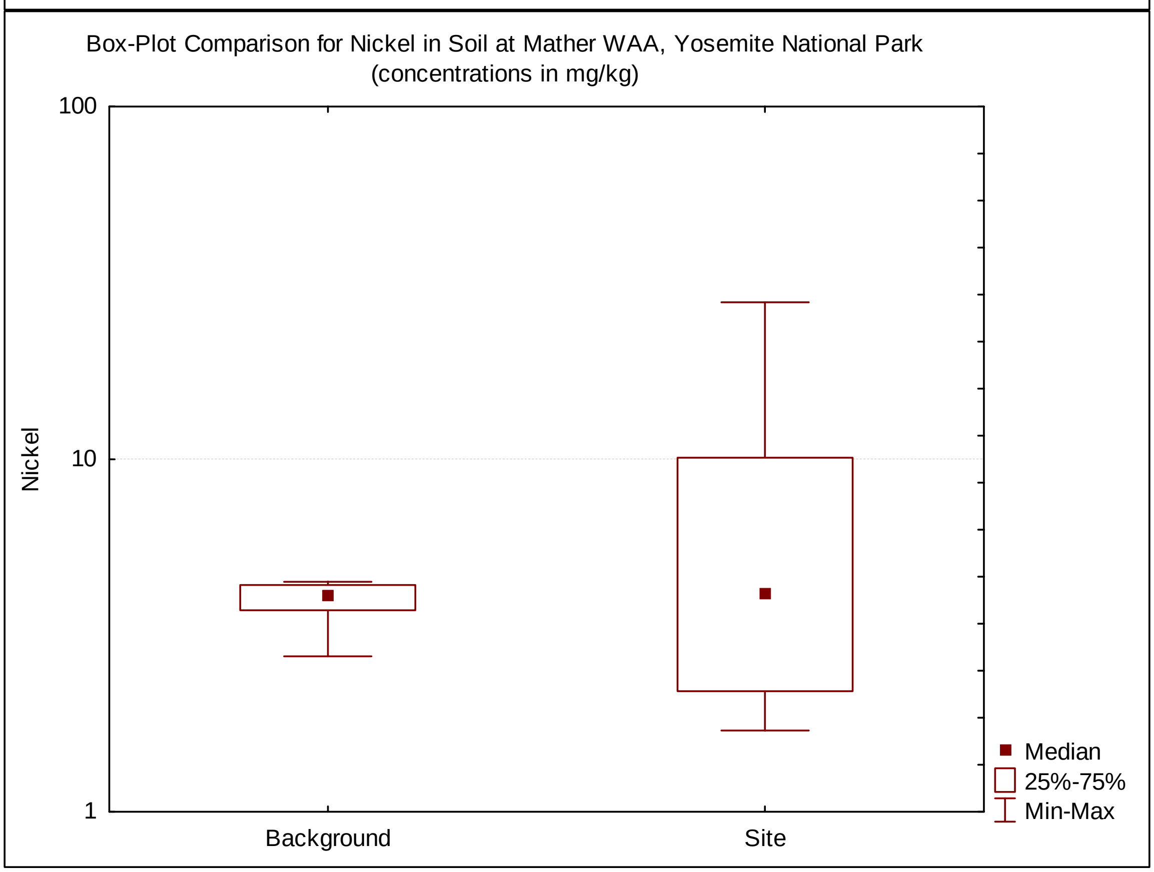


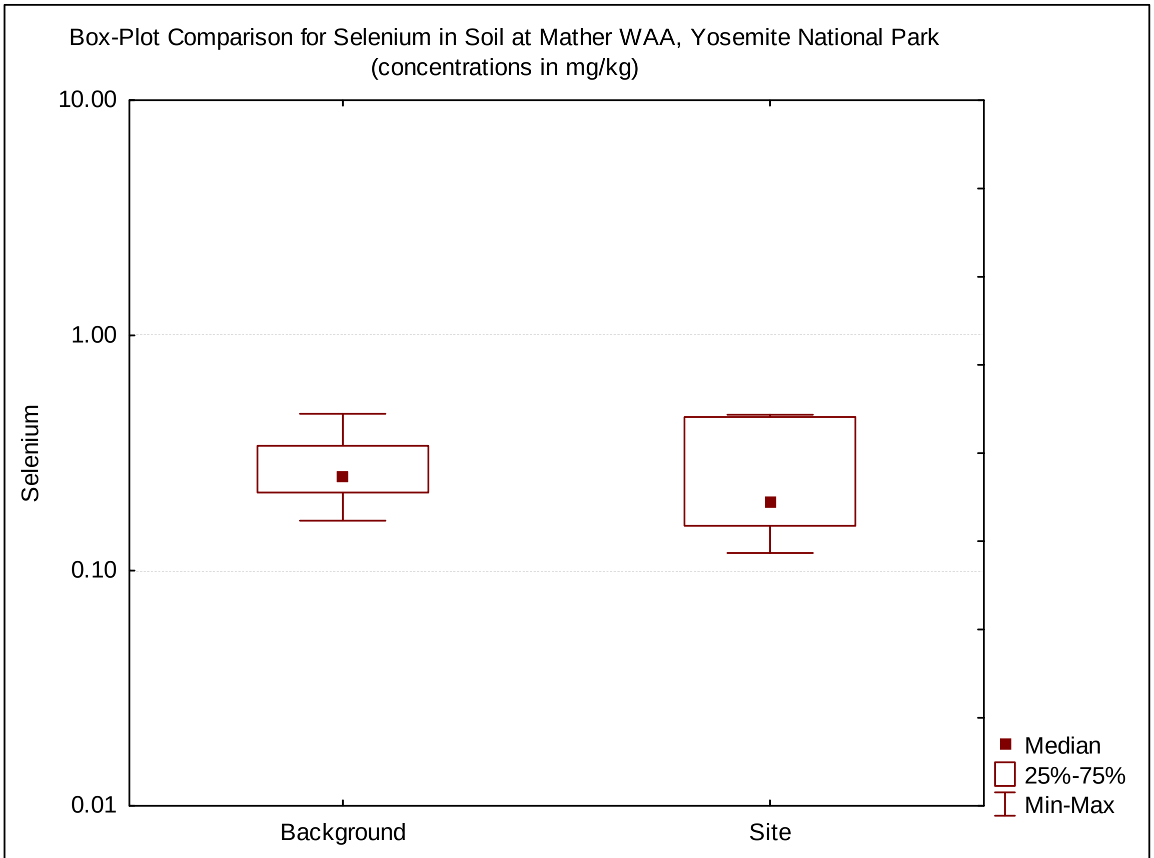
Box-Plot Comparison for Lead in Soil at Mather WAA, Yosemite National Park
(concentrations in mg/kg)
1E5
10000.0
1000.0
100.0
10.0
1.0
0.1
Lead
Background
Site
Median
25%-75%
Min-Max

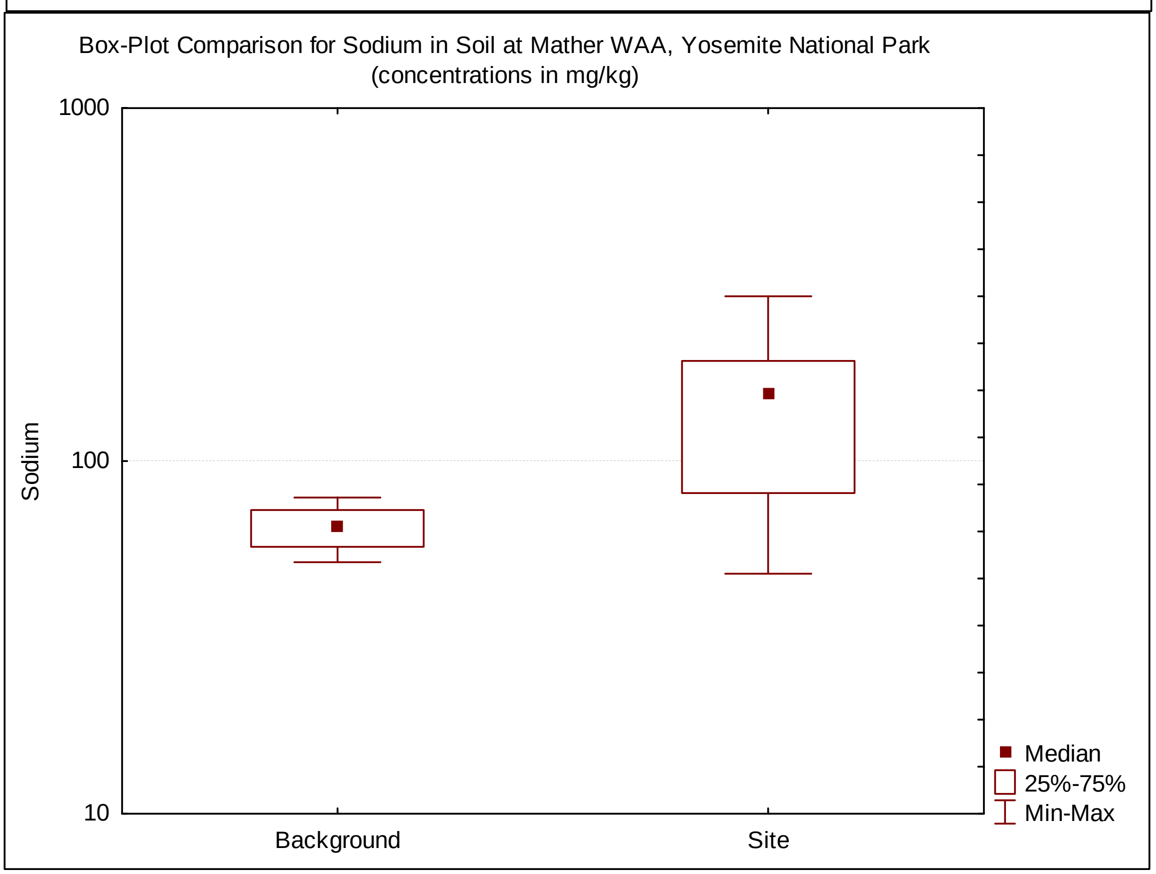

Box-Plot Comparison for Magnesium in Soil at Mather WAA, Yosemite National Park
(concentrations in mg/kg)
10000
1000
100
Magnesium
Background
Site
Median
25%-75%
Min-Max

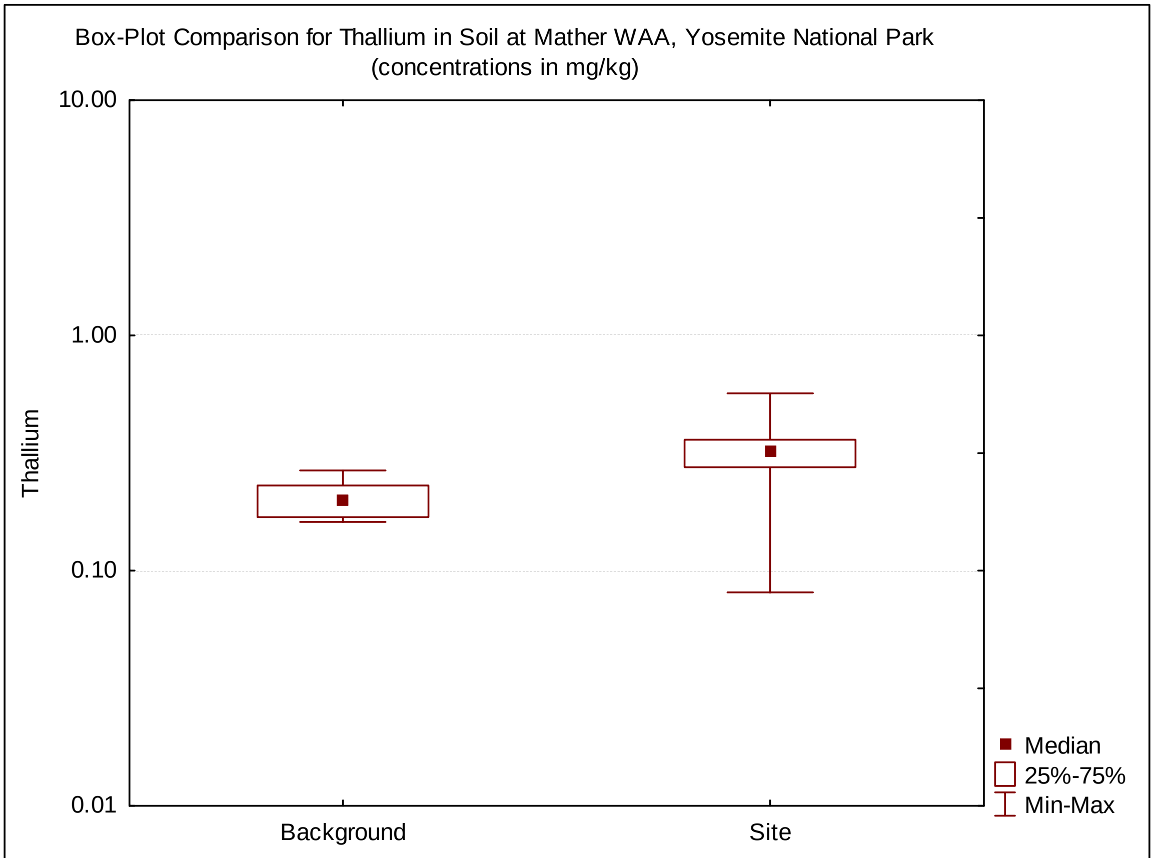

Box-Plot Comparison for Manganese in Soil at Mather WAA, Yosemite National Park
(concentrations in mg/kg)
10000
1000
100
10
Manganese
Background
Site
Median
25%-75%
Min-Max

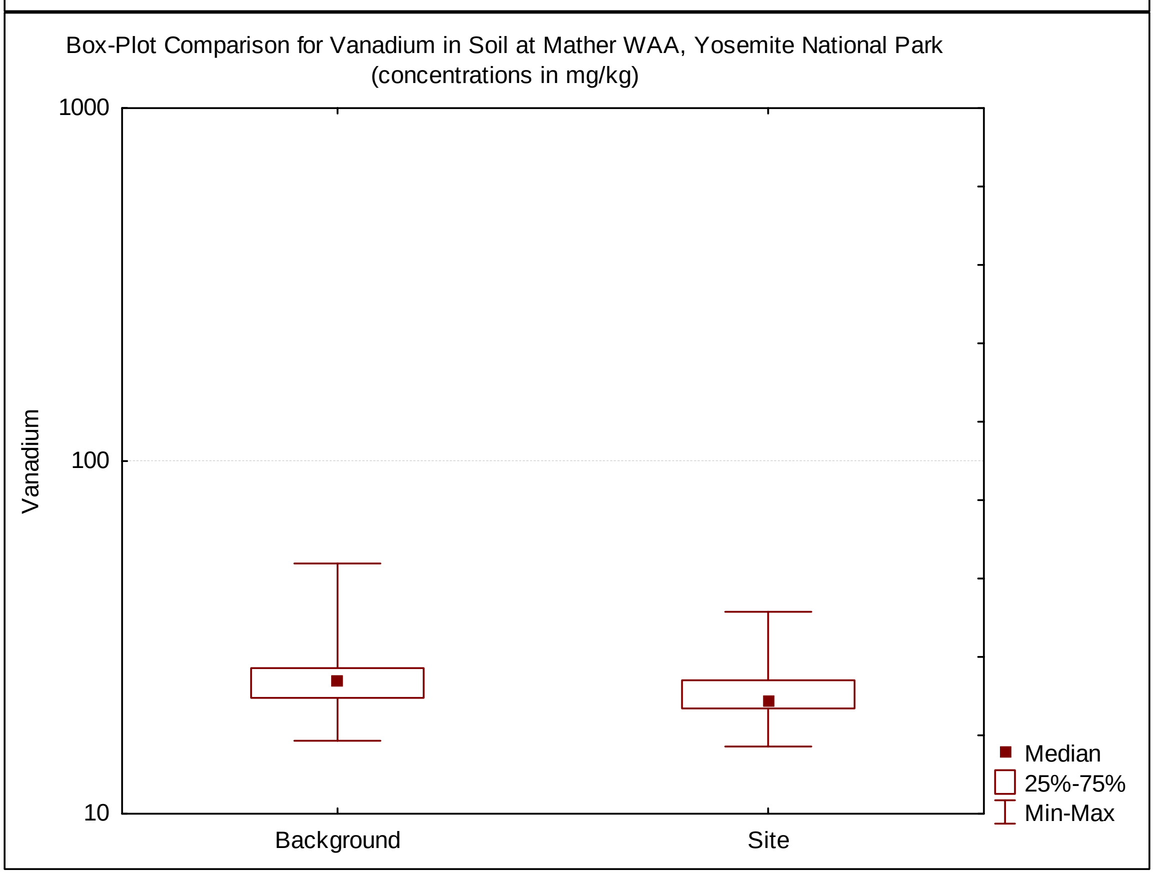

Box-Plot Comparison for Molybdenum in Soil at Mather WAA, Yosemite National Park
(concentrations in mg/kg)
10.00
1.00
0.10
0.01
Molybdenum
Background
Site
Median
25%-75%
Min-Max

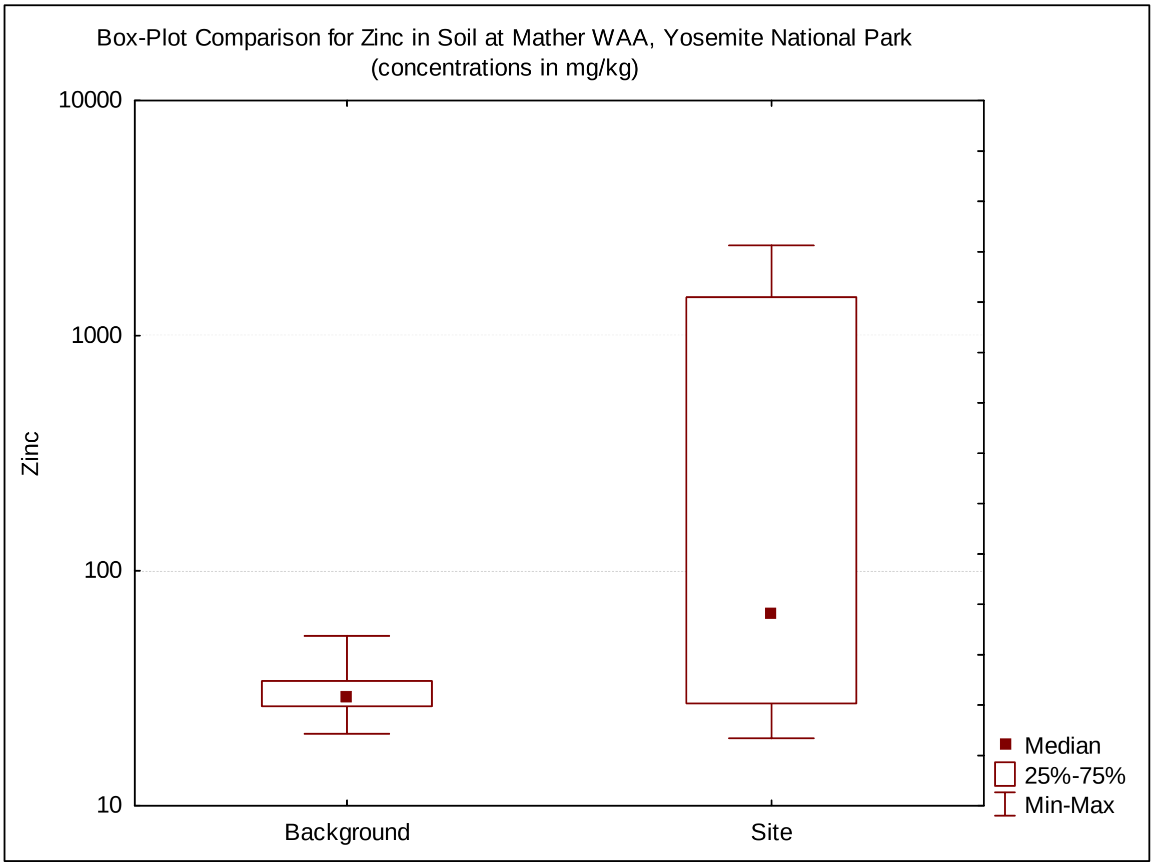

Box-Plot Comparison for Nickel in Soil at Mather WAA, Yosemite National Park
(concentrations in mg/kg)
100
10
1
Nickel
Background
Site
Median
25%-75%
Min-Max


Box-Plot Comparison for Selenium in Soil at Mather WAA, Yosemite National Park
(concentrations in mg/kg)
10.00
1.00
0.10
0.01
Selenium
Background
Site
Median
25%-75%
Min-Max


Box-Plot Comparison for Sodium in Soil at Mather WAA, Yosemite National Park
(concentrations in mg/kg)
1000
100
10
Sodium
Background
Site
Median
25%-75%
Min-Max


Box-Plot Comparison for Thallium in Soil at Mather WAA, Yosemite National Park
(concentrations in mg/kg)
10.00
1.00
0.10
0.01
Thallium
Background
Site
Median
25%-75%
Min-Max


Box-Plot Comparison for Vanadium in Soil at Mather WAA, Yosemite National Park
(concentrations in mg/kg)
1000
100
10
Vanadium
Background
Site
Median
25%-75%
Min-Max


Box-Plot Comparison for Zinc in Soil at Mather WAA, Yosemite National Park
(concentrations in mg/kg)
10000
1000
100
10
Zinc
Background
Site
Median
25%-75%
Min-Max

Attachment 3
Geochemical Correlation Plots and Ratio Plots
(Figures D-1 through D-30)

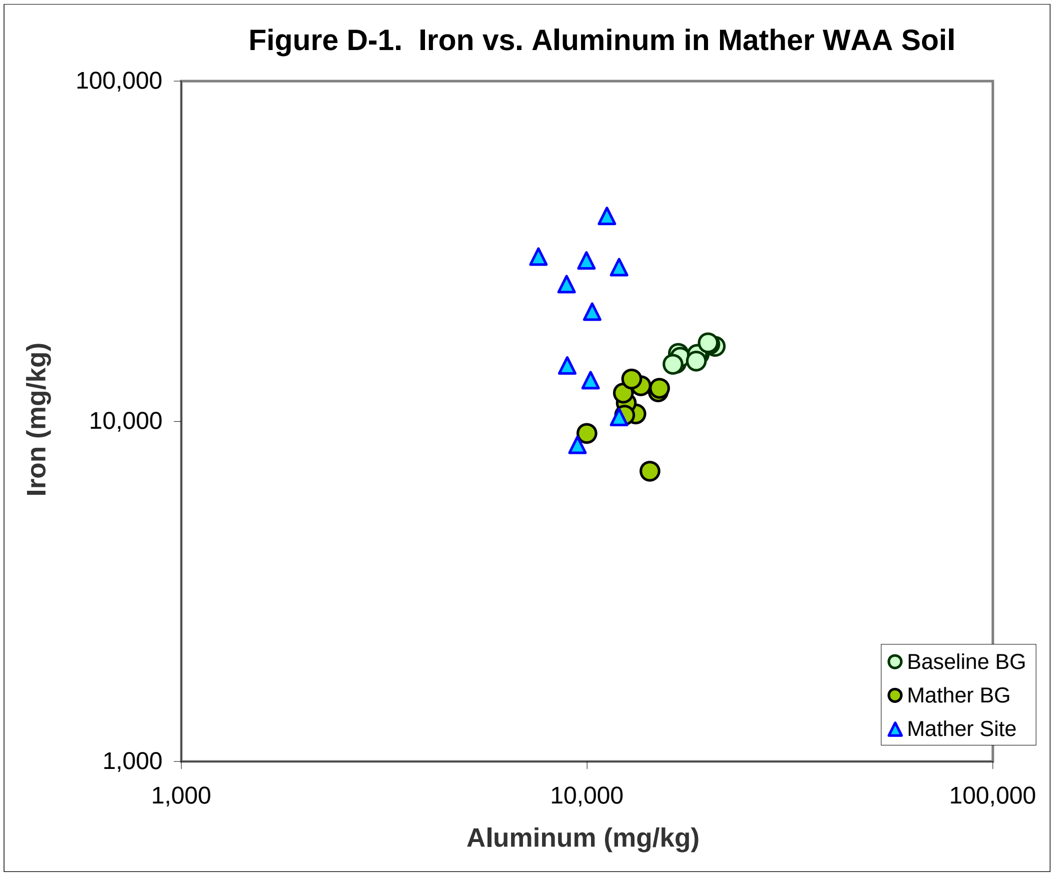


Figure D-1. Iron vs. Aluminum in Mather WAA Soil
100,000
10,000
1,000
Iron (mg/kg)
1,000
10,000
100,000
Aluminum (mg/kg)
Baseline BG
Mather BG
Mather Site

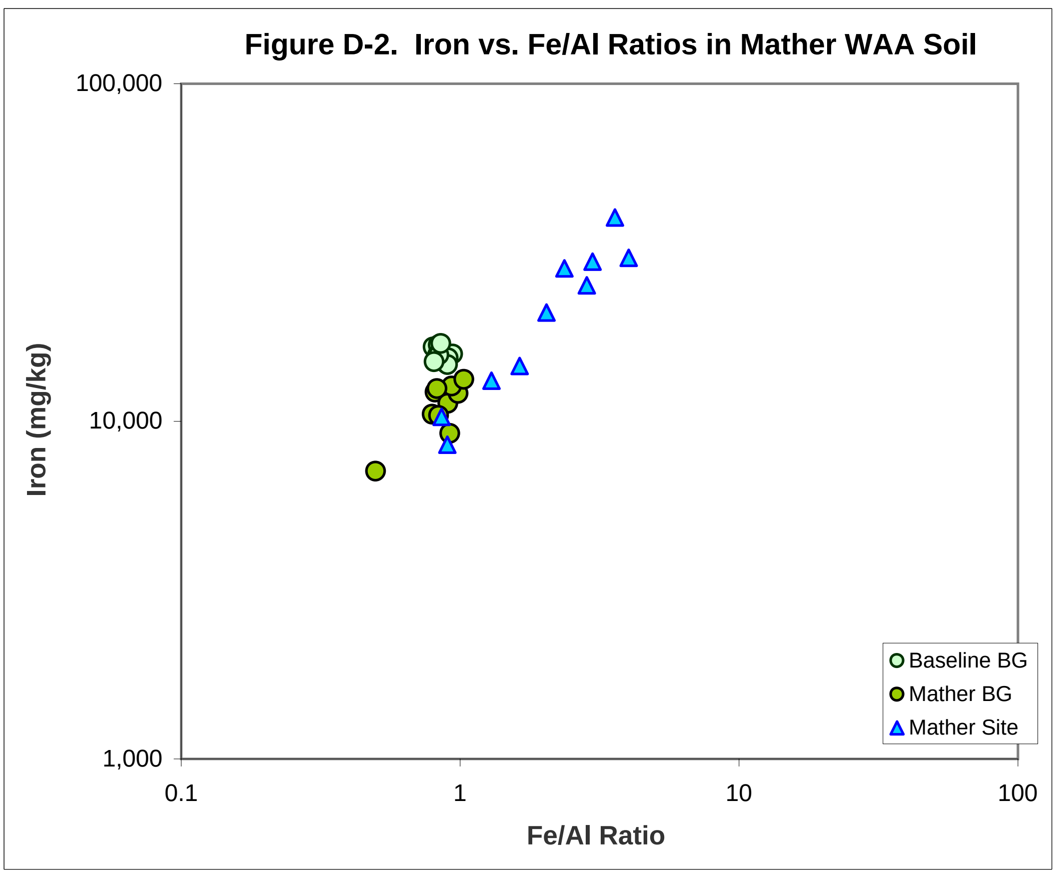


Figure D-2. Iron vs. Fe/Al Ratios in Mather WAA Soil
100,000
10,000
1,000
Iron (mg/kg)
0.1
1
10
100
Fe/Al Ratio
Baseline BG
Mather BG
Mather Site

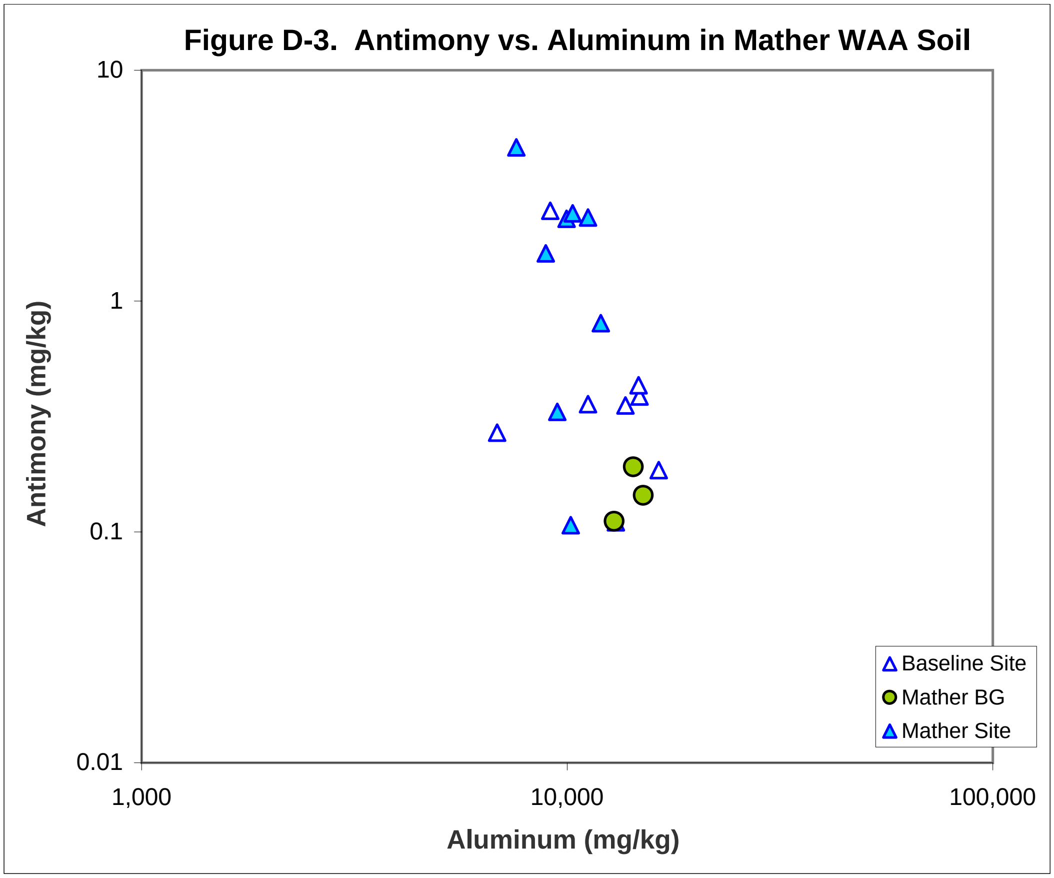


Figure D-3. Antimony vs. Aluminum in Mather WAA Soil
10
1
0.1
0.01
Antimony (mg/kg)
1,000
10,000
100,000
Aluminum (mg/kg)
Baseline Site
Mather BG
Mather Site

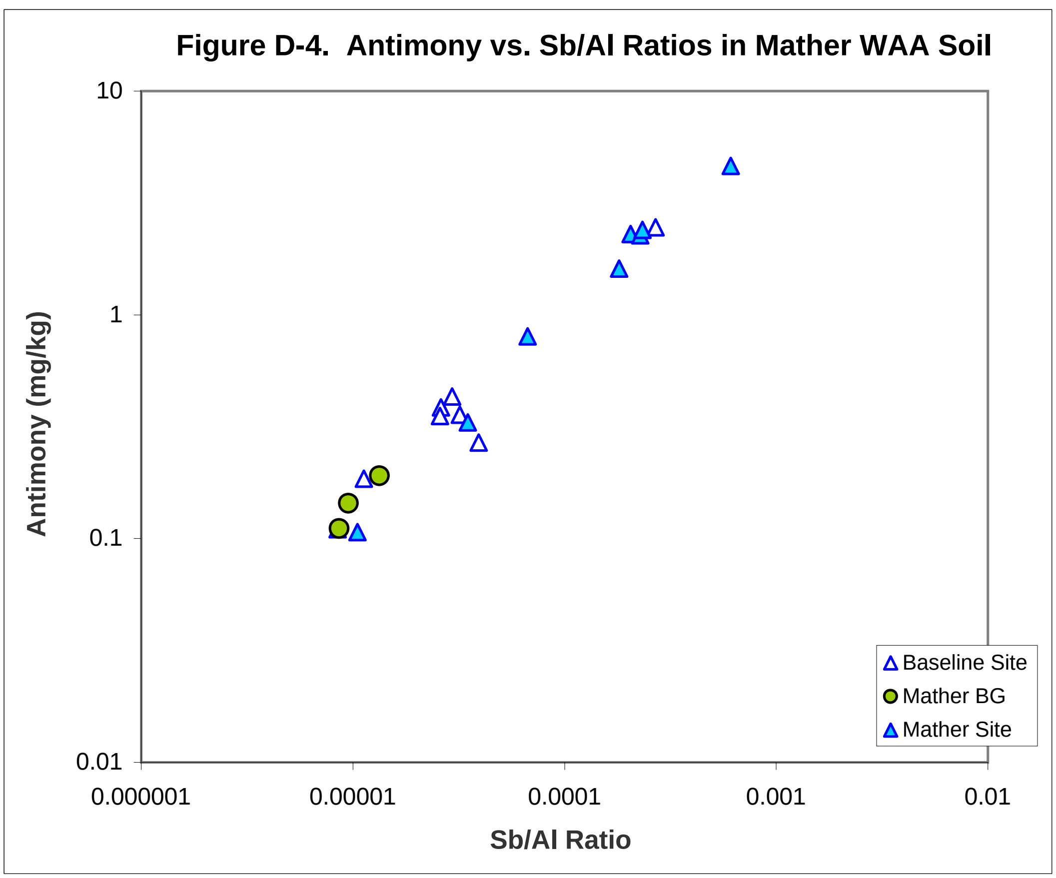


Figure D-4. Antimony vs. Sb/Al Ratios in Mather WAA Soil
10
1
0.1
0.01
Antimony (mg/kg)
0.000001
0.00001
0.0001
0.001
0.01
Sb/Al Ratio
Baseline Site
Mather BG
Mather Site

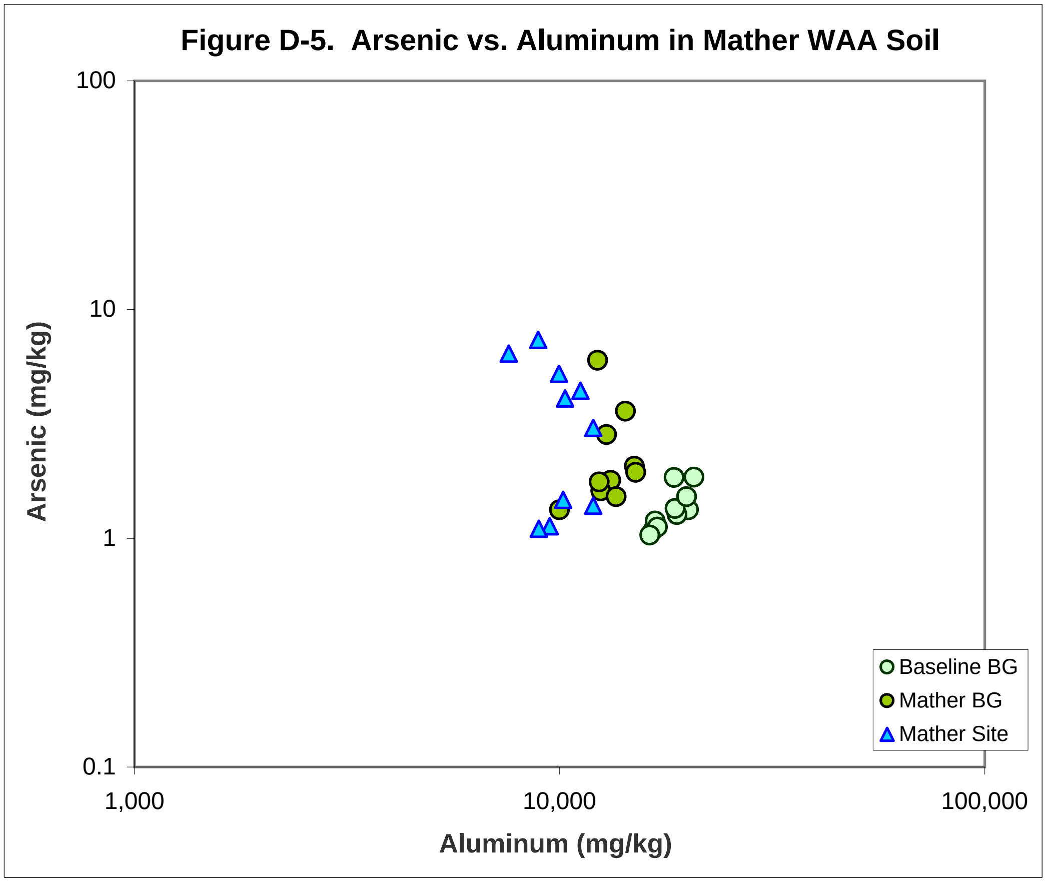


Figure D-5. Arsenic vs. Aluminum in Mather WAA Soil
100
10
1
0.1
Arsenic (mg/kg)
1,000
10,000
100,000
Aluminum (mg/kg)
Baseline BG
Mather BG
Mather Site

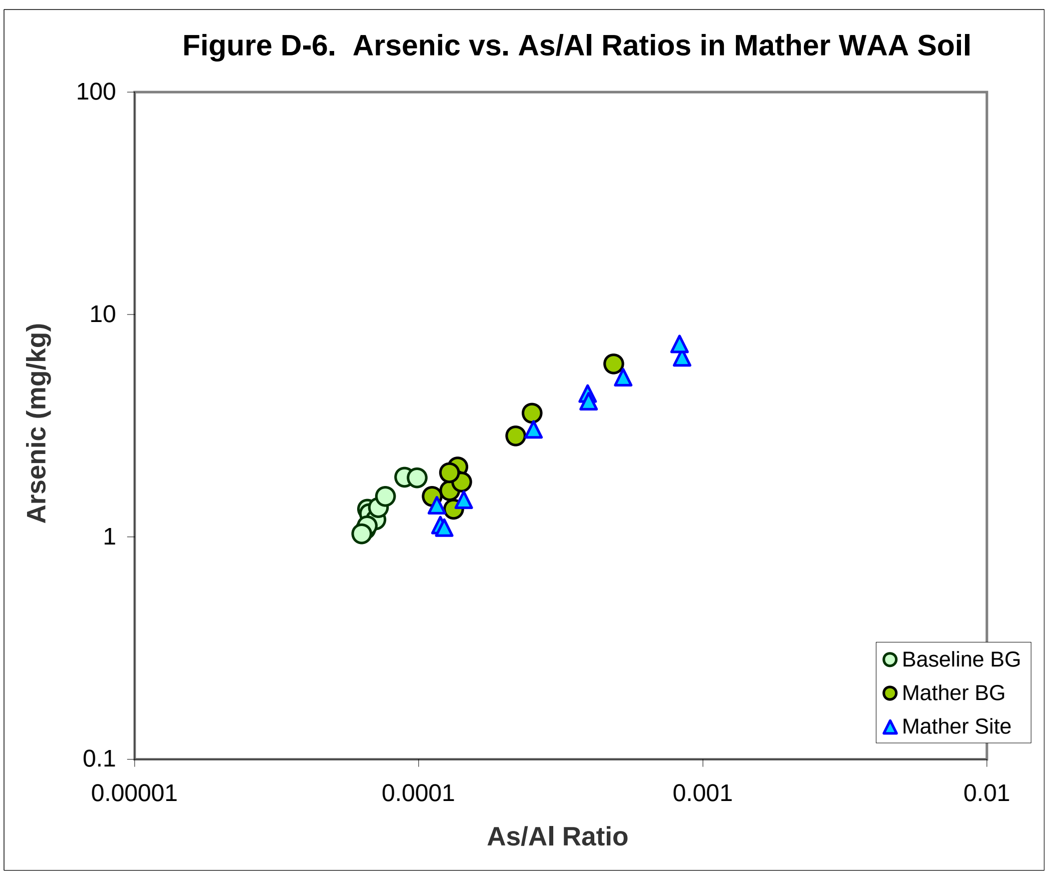


Figure D-6. Arsenic vs. As/Al Ratios in Mather WAA Soil
100
10
1
0.1
Arsenic (mg/kg)
0.00001
0.0001
0.001
0.01
As/Al Ratio
Baseline BG
Mather BG
Mather Site

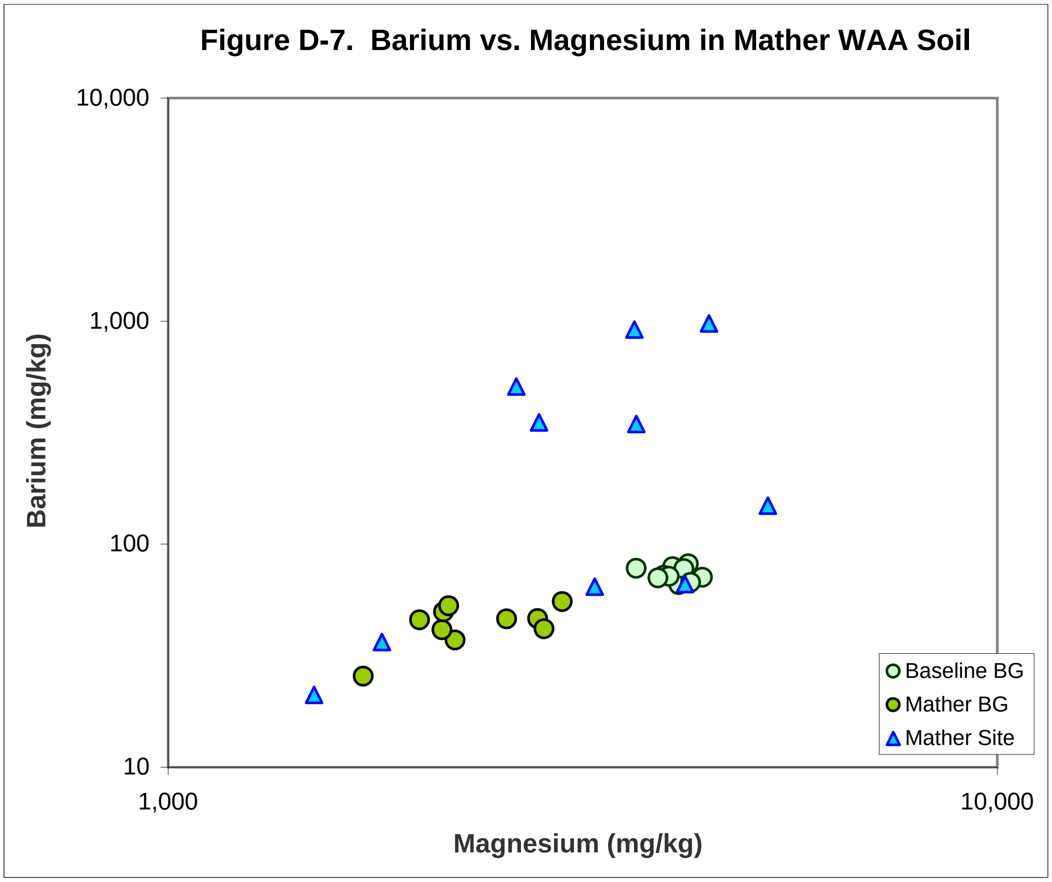


Figure D-7. Barium vs. Magnesium in Mather WAA Soil
10,000
1,000
100
10
Barium (mg/kg)
1,000
10,000
Magnesium (mg/kg)
Baseline BG
Mather BG
Mather Site

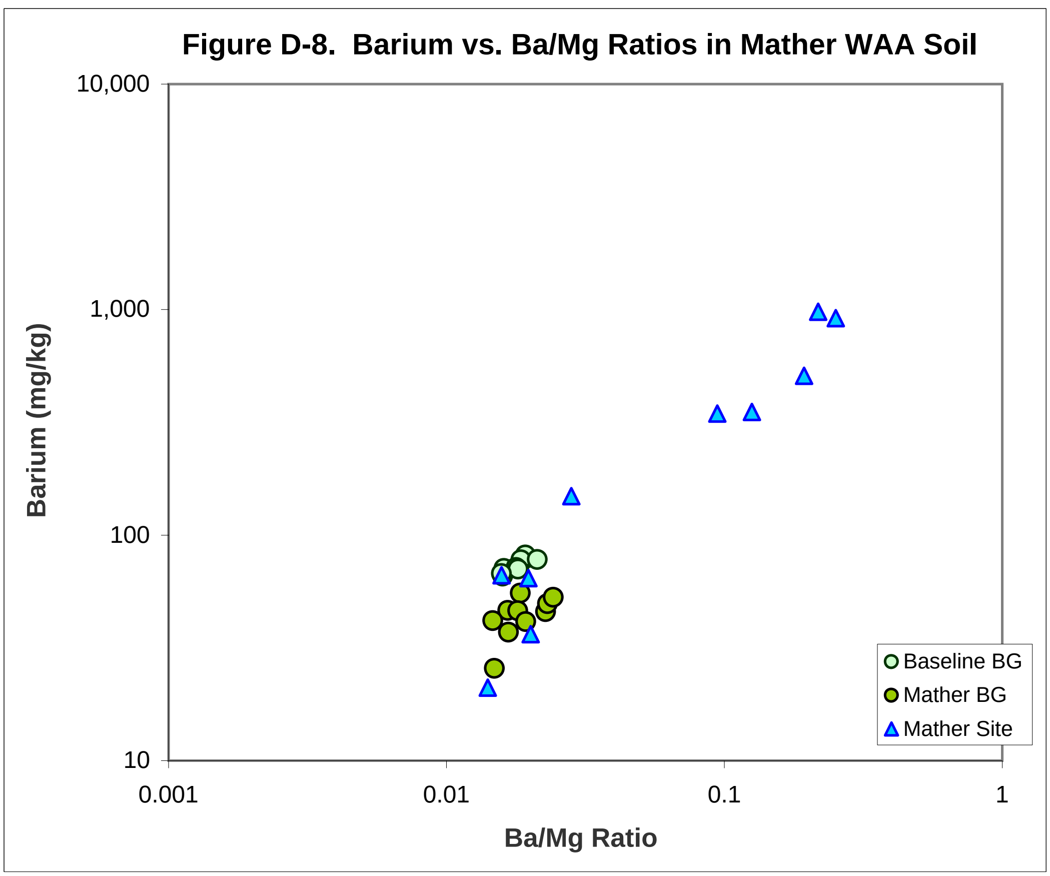


Figure D-8. Barium vs. Ba/Mg Ratios in Mather WAA Soil
10,000
1,000
100
10
Barium (mg/kg)
0.001
0.01
0.1
1
Ba/Mg Ratio
Baseline BG
Mather BG
Mather Site

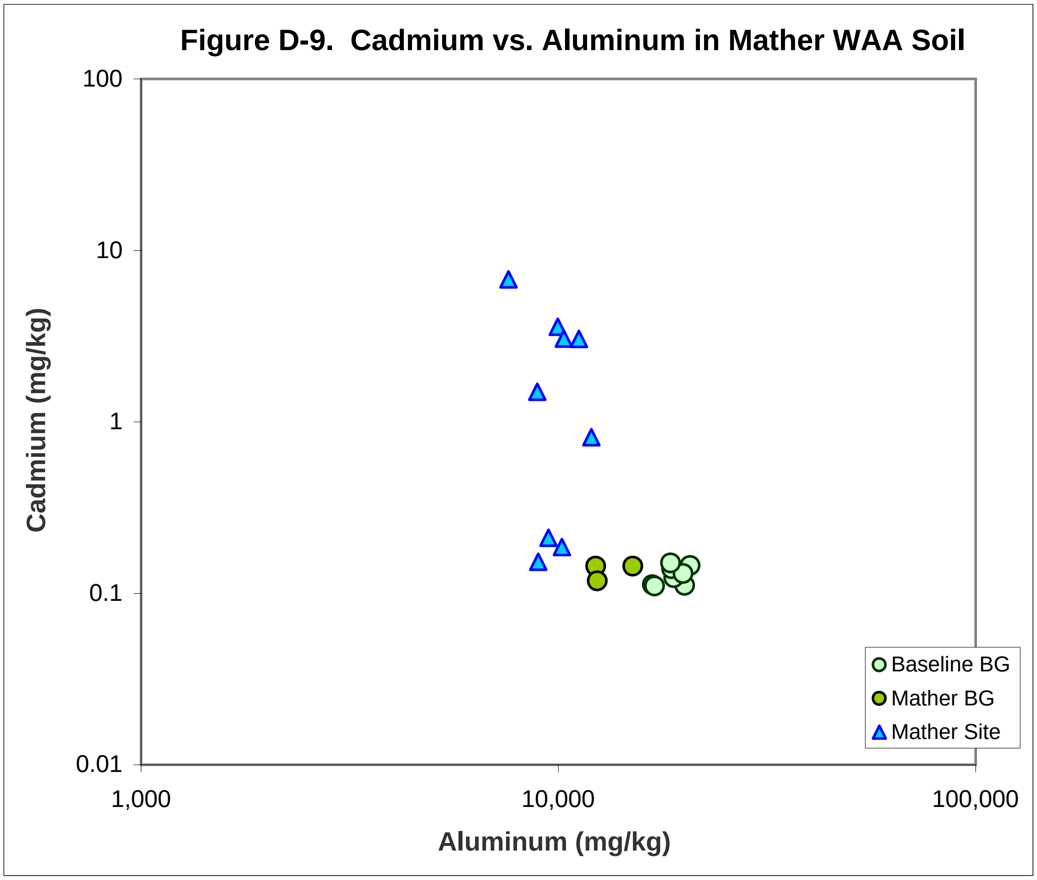


Figure D-9. Cadmium vs. Aluminum in Mather WAA Soil
Cadmium (mg/kg)
100
10
1
0.1
0.01
1,000
10,000
100,000
Aluminum (mg/kg)
Baseline BG
Mather BG
Mather Site

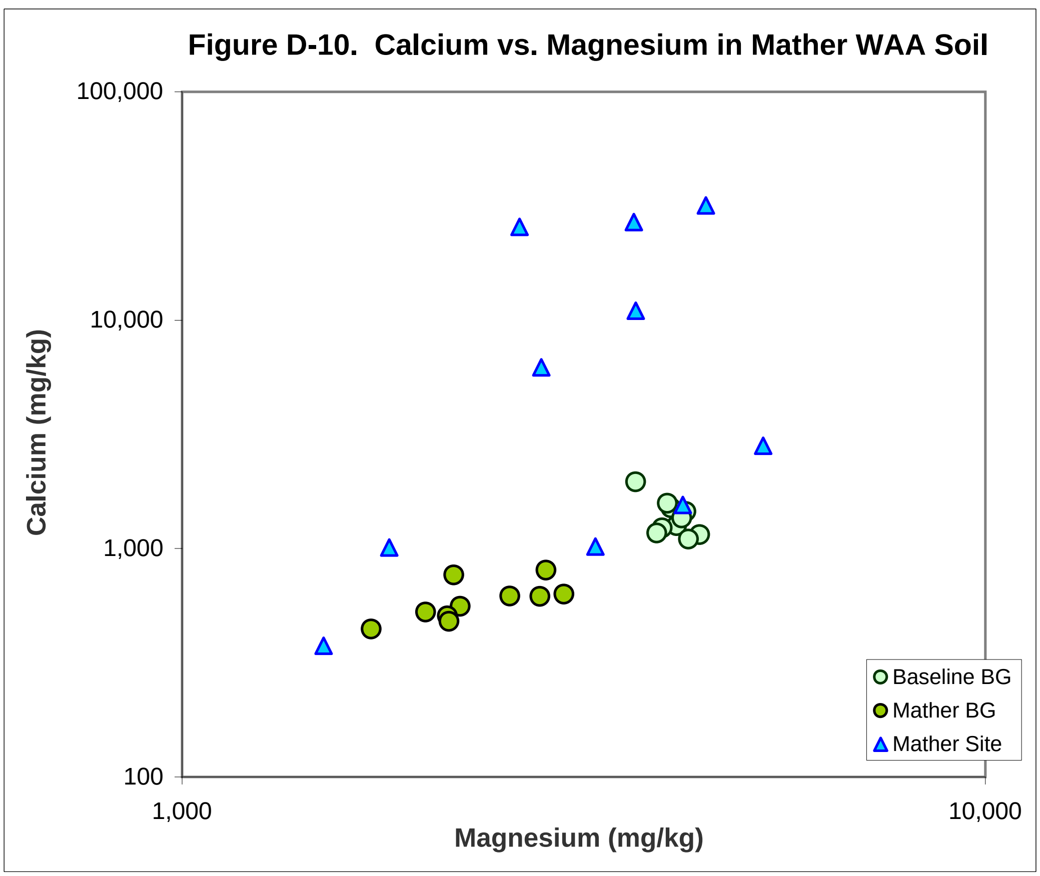


Figure D-10. Calcium vs. Magnesium in Mather WAA Soil
Calcium (mg/kg)
100,000
10,000
1,000
100
1,000
10,000
Magnesium (mg/kg)
Baseline BG
Mather BG
Mather Site

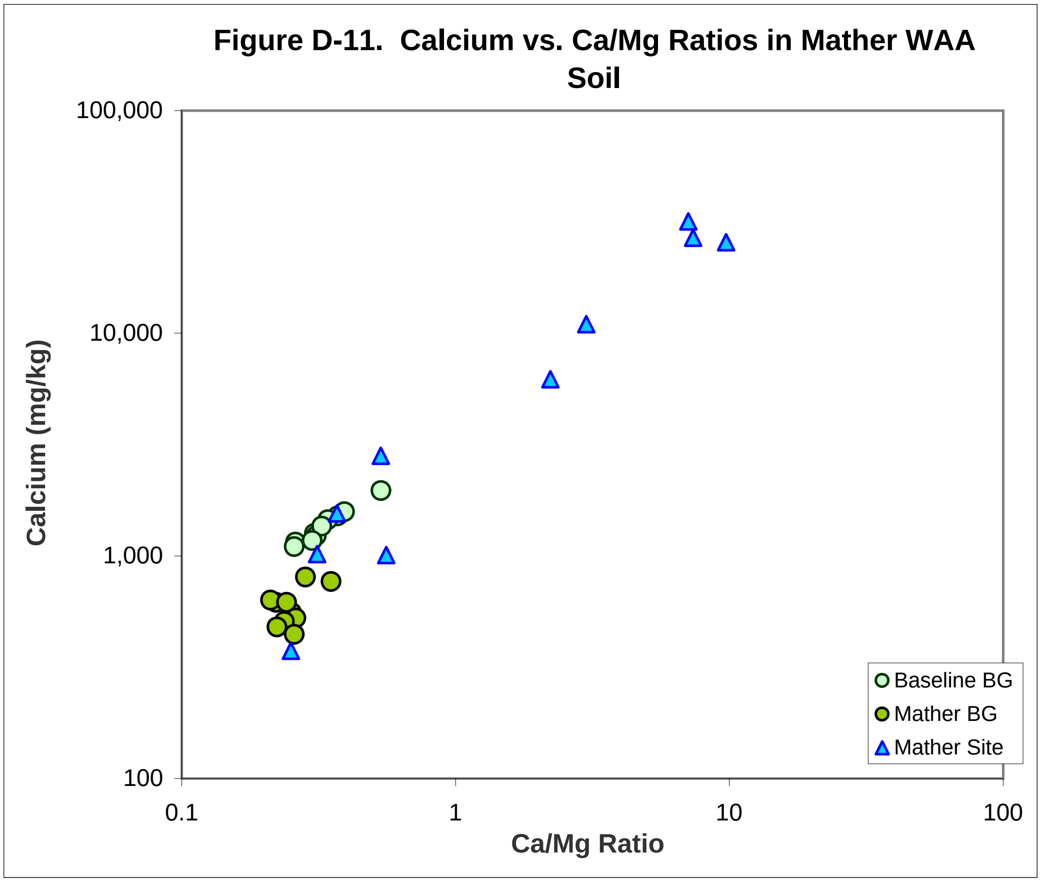


Figure D-11. Calcium vs. Ca/Mg Ratios in Mather WAA Soil
Calcium (mg/kg)
100,000
10,000
1,000
100
0.1
1
10
100
Ca/Mg Ratio
Baseline BG
Mather BG
Mather Site

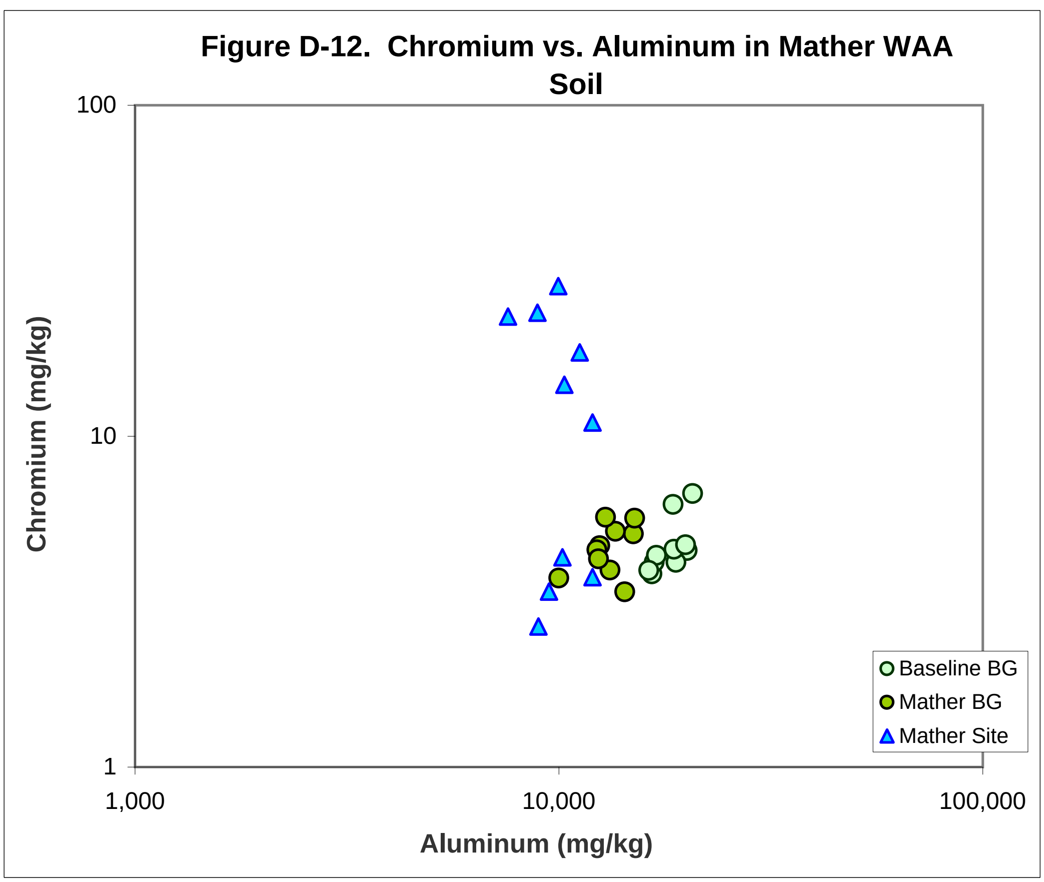


Figure D-12. Chromium vs. Aluminum in Mather WAA Soil
Chromium (mg/kg)
100
10
1
1,000
10,000
100,000
Aluminum (mg/kg)
Baseline BG
Mather BG
Mather Site

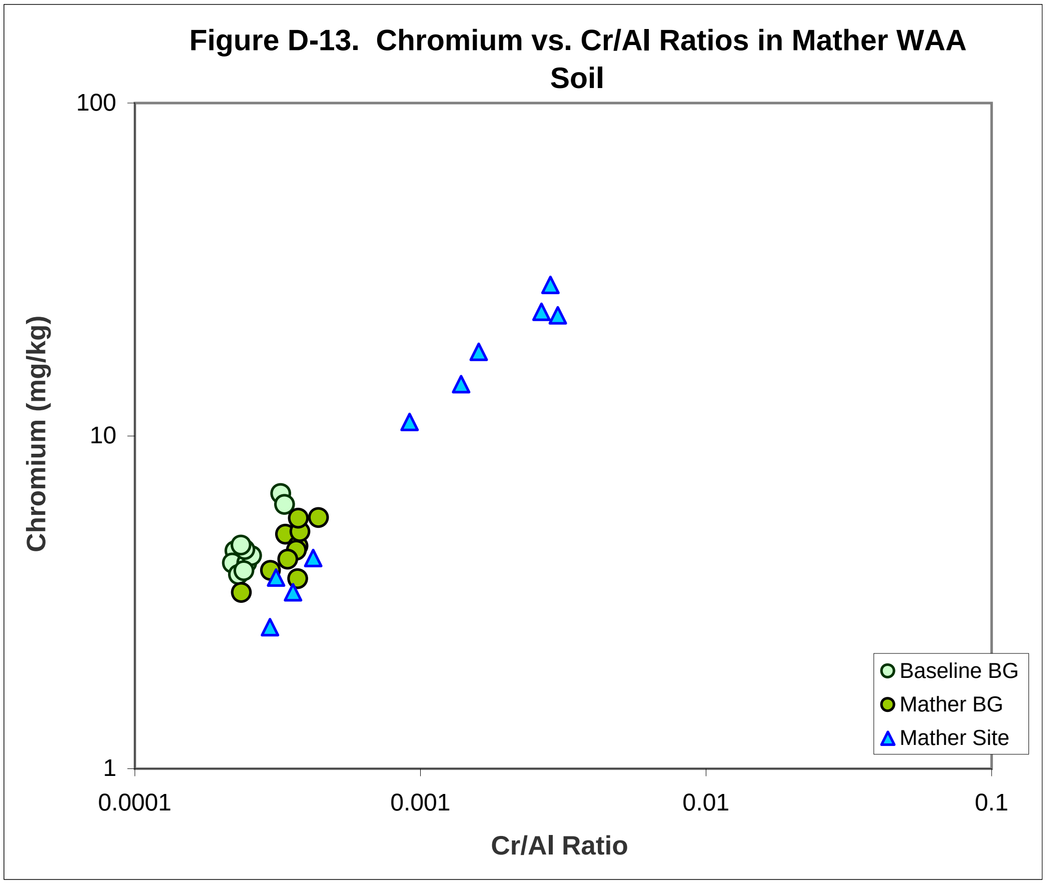


Figure D-13. Chromium vs. Cr/Al Ratios in Mather WAA Soil
Chromium (mg/kg)
100
10
1
0.0001
0.001
0.01
0.1
Cr/Al Ratio
Baseline BG
Mather BG
Mather Site

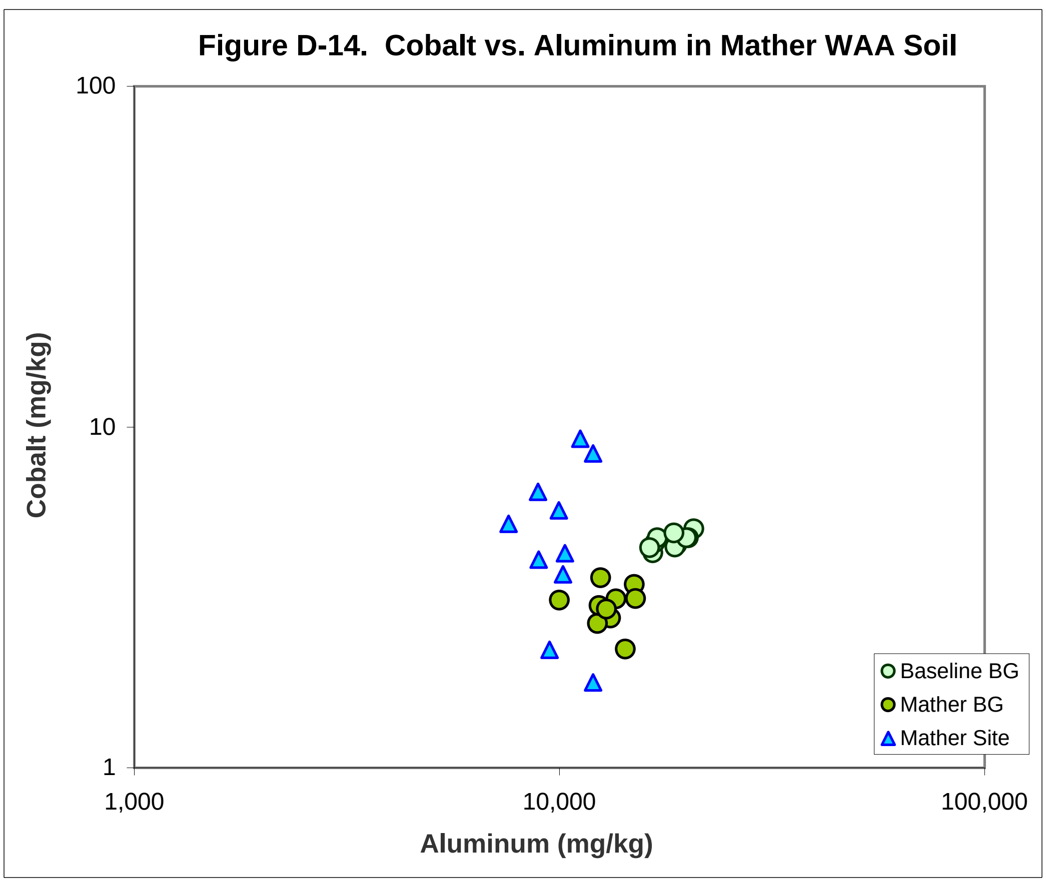


Figure D-14. Cobalt vs. Aluminum in Mather WAA Soil
Cobalt (mg/kg)
100
10
1
1,000
10,000
100,000
Aluminum (mg/kg)
Baseline BG
Mather BG
Mather Site

Figure D-15. Cobalt vs. Co/Al Ratios in Mather WAA Soil

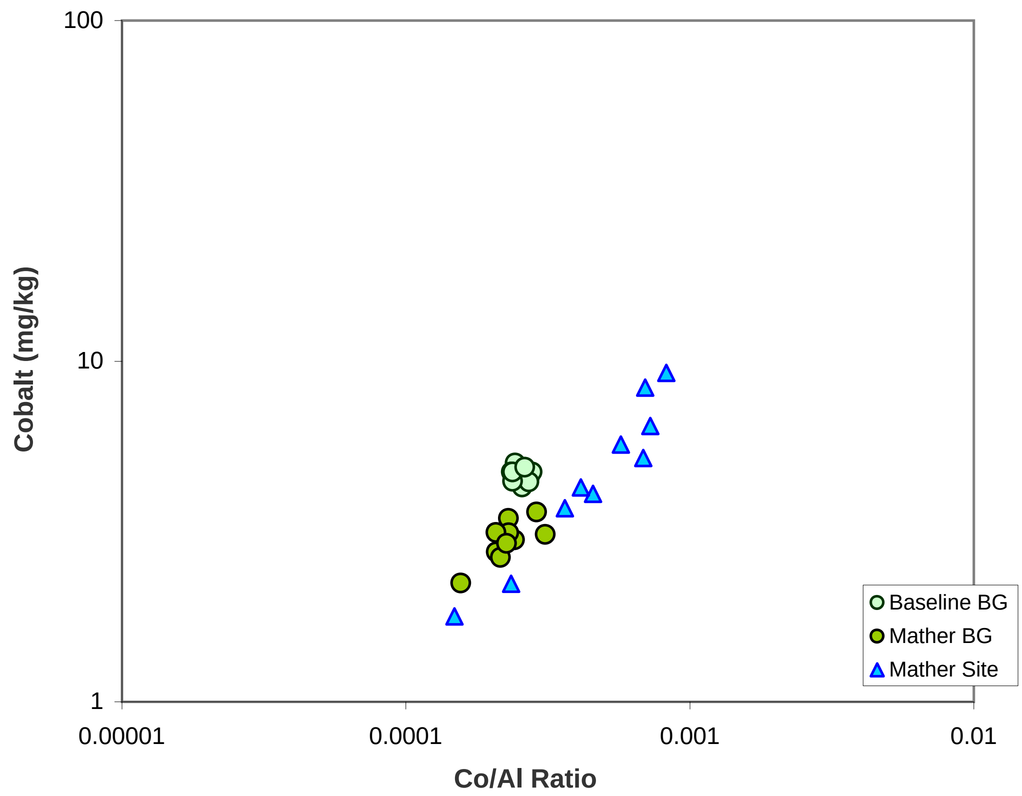
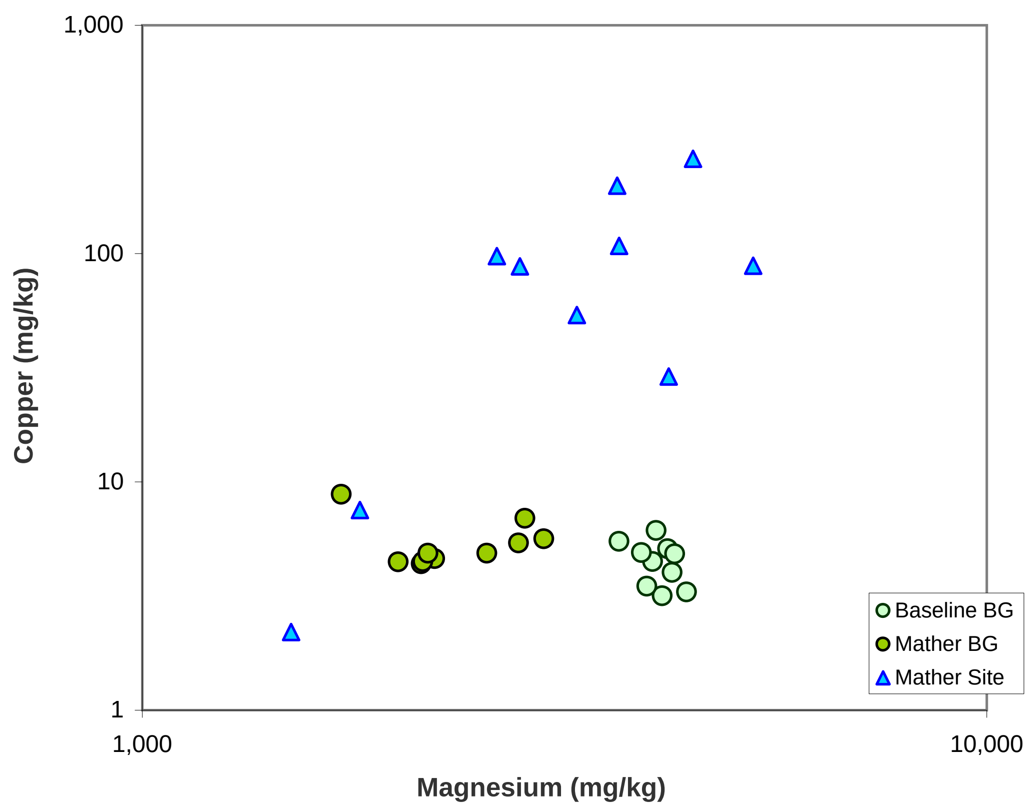


Figure D-16. Copper vs. Magnesium in Mather WAA Soil



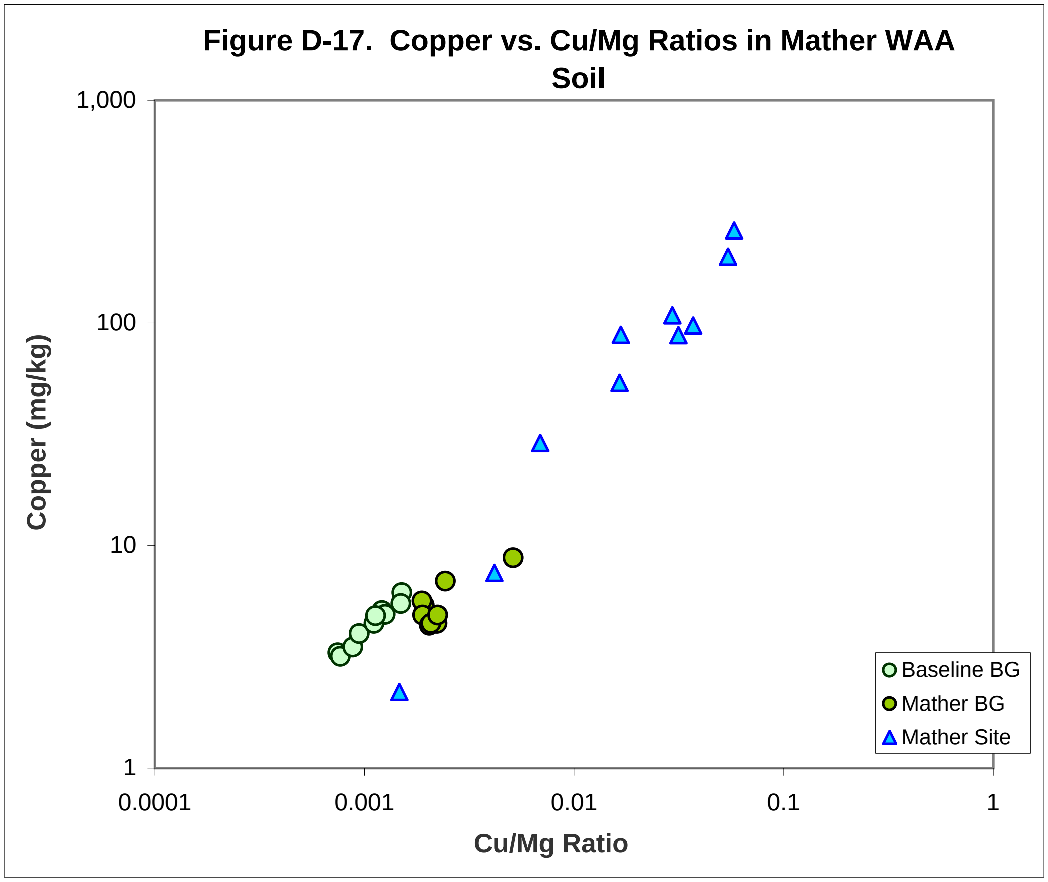


Figure D-17. Copper vs. Cu/Mg Ratios in Mather WAA Soil
1,000
100
10
1
Copper (mg/kg)
0.0001
0.001
0.01
0.1
1
Cu/Mg Ratio
Baseline BG
Mather BG
Mather Site

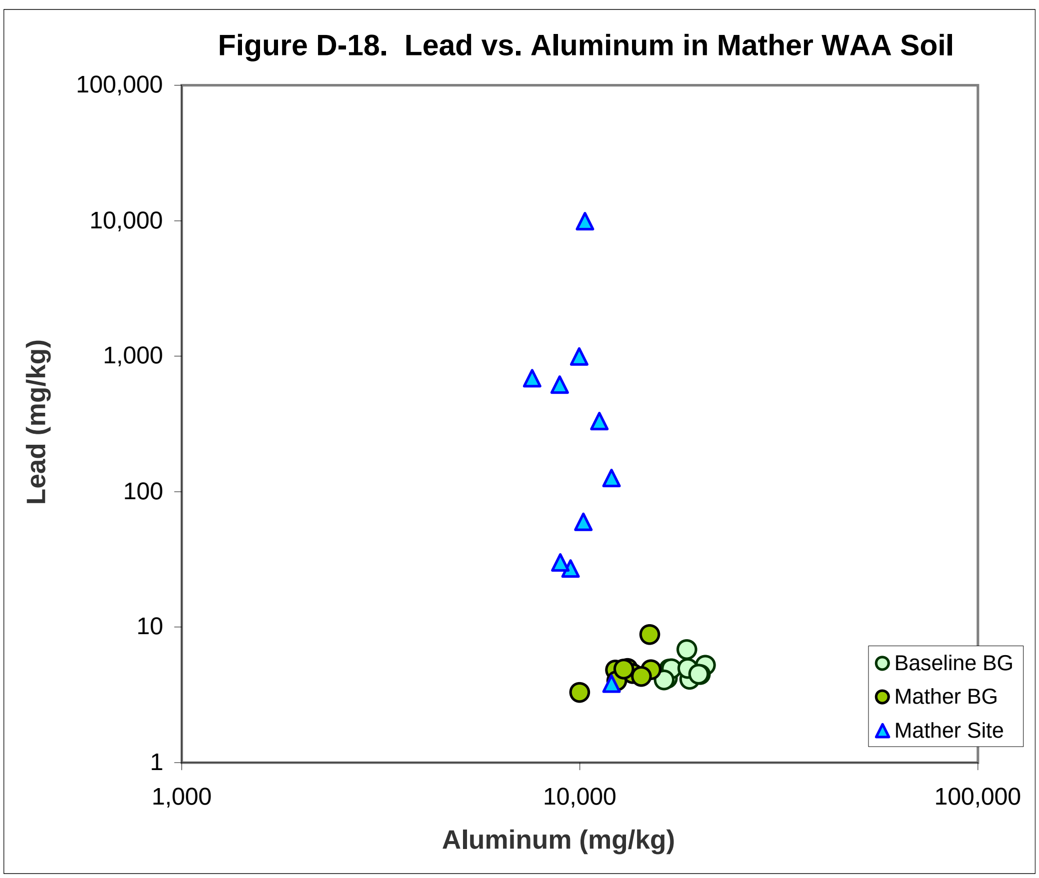


Figure D-18. Lead vs. Aluminum in Mather WAA Soil
100,000
10,000
1,000
100
10
1
Lead (mg/kg)
1,000
10,000
100,000
Aluminum (mg/kg)
Baseline BG
Mather BG
Mather Site

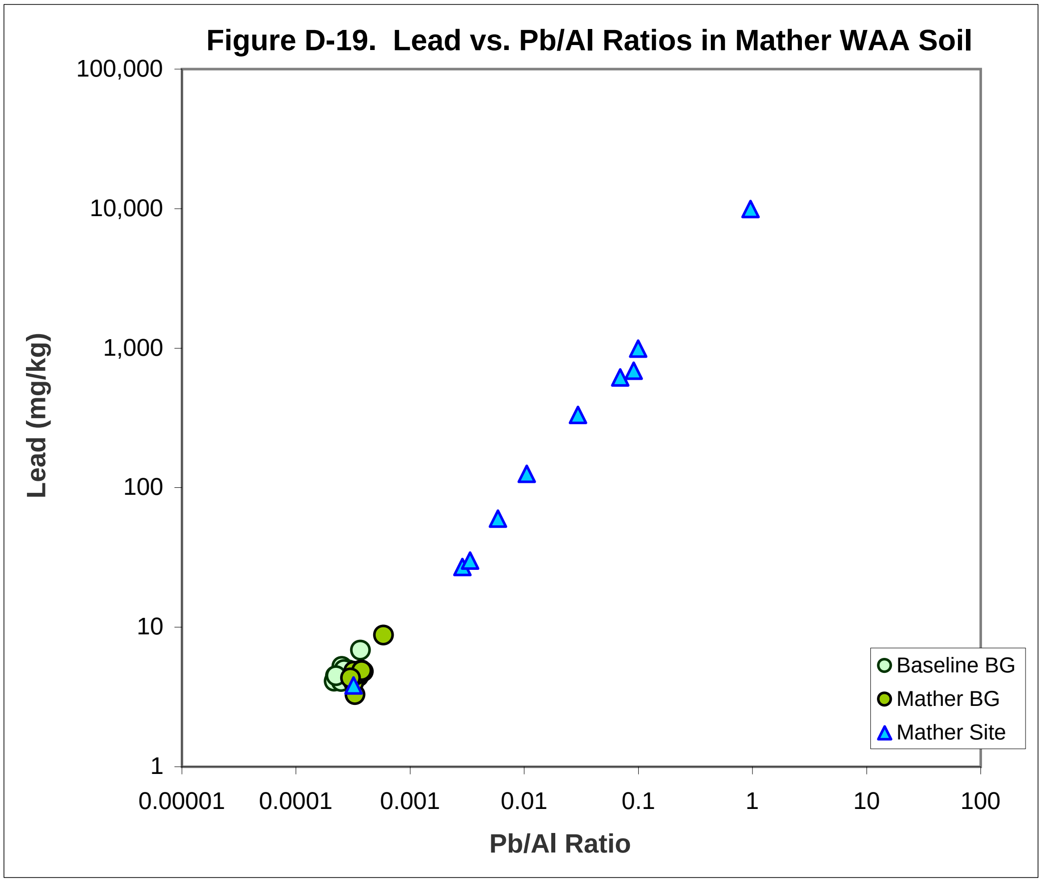


Figure D-19. Lead vs. Pb/Al Ratios in Mather WAA Soil
100,000
10,000
1,000
100
10
1
Lead (mg/kg)
0.00001
0.0001
0.001
0.01
0.1
1
10
100
Pb/Al Ratio
Baseline BG
Mather BG
Mather Site

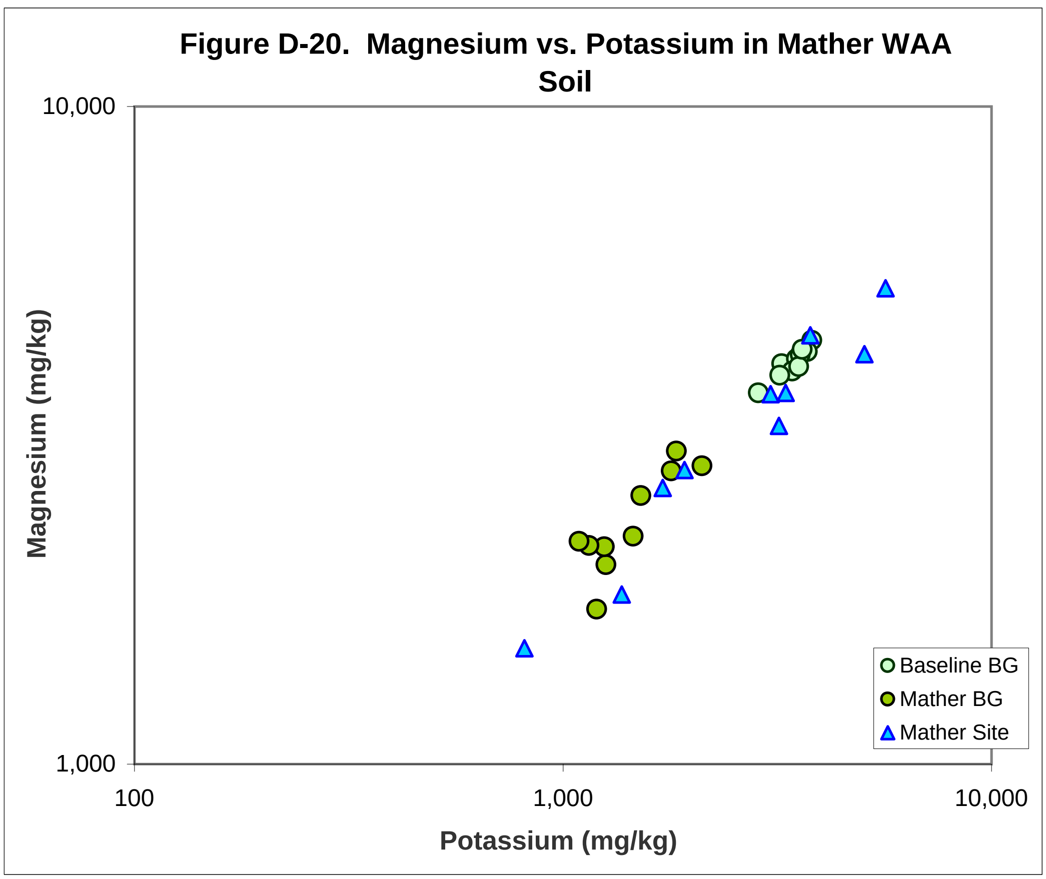


Figure D-20. Magnesium vs. Potassium in Mather WAA Soil
10,000
1,000
Magnesium (mg/kg)
100
1,000
10,000
Potassium (mg/kg)
Baseline BG
Mather BG
Mather Site

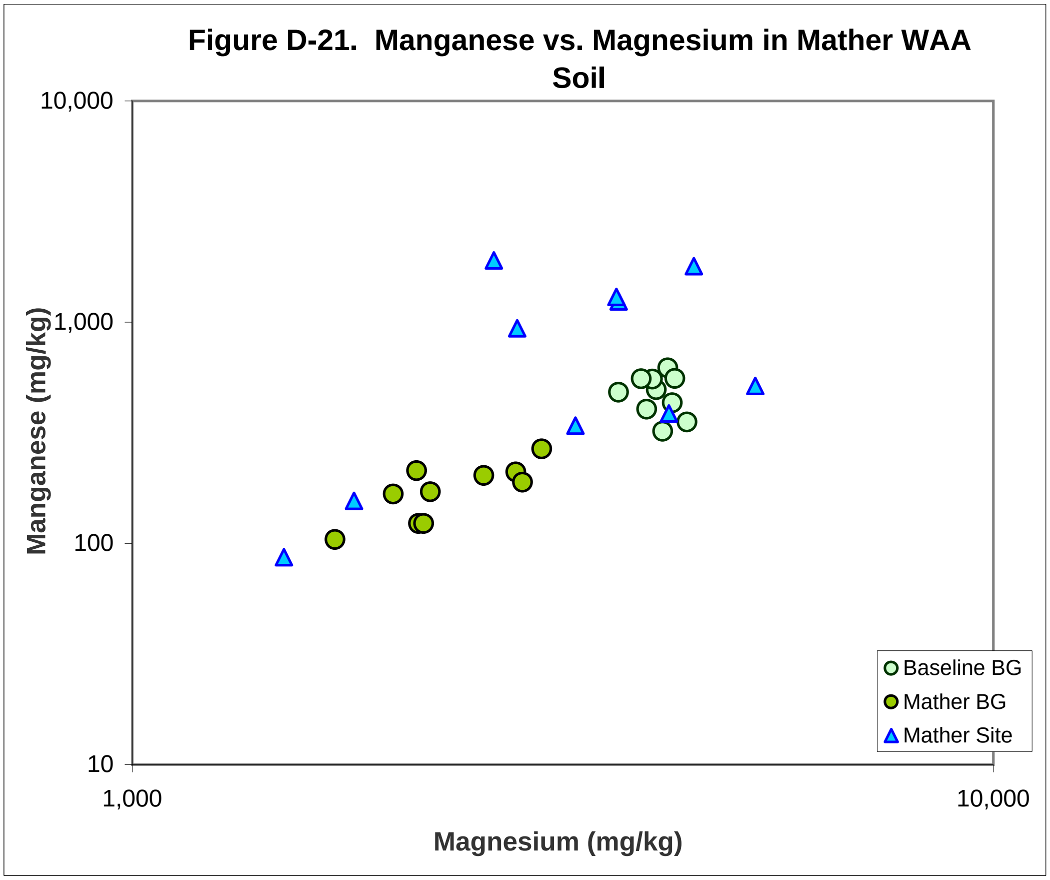


Figure D-21. Manganese vs. Magnesium in Mather WAA Soil
10,000
1,000
100
10
Manganese (mg/kg)
1,000
10,000
Magnesium (mg/kg)
Baseline BG
Mather BG
Mather Site

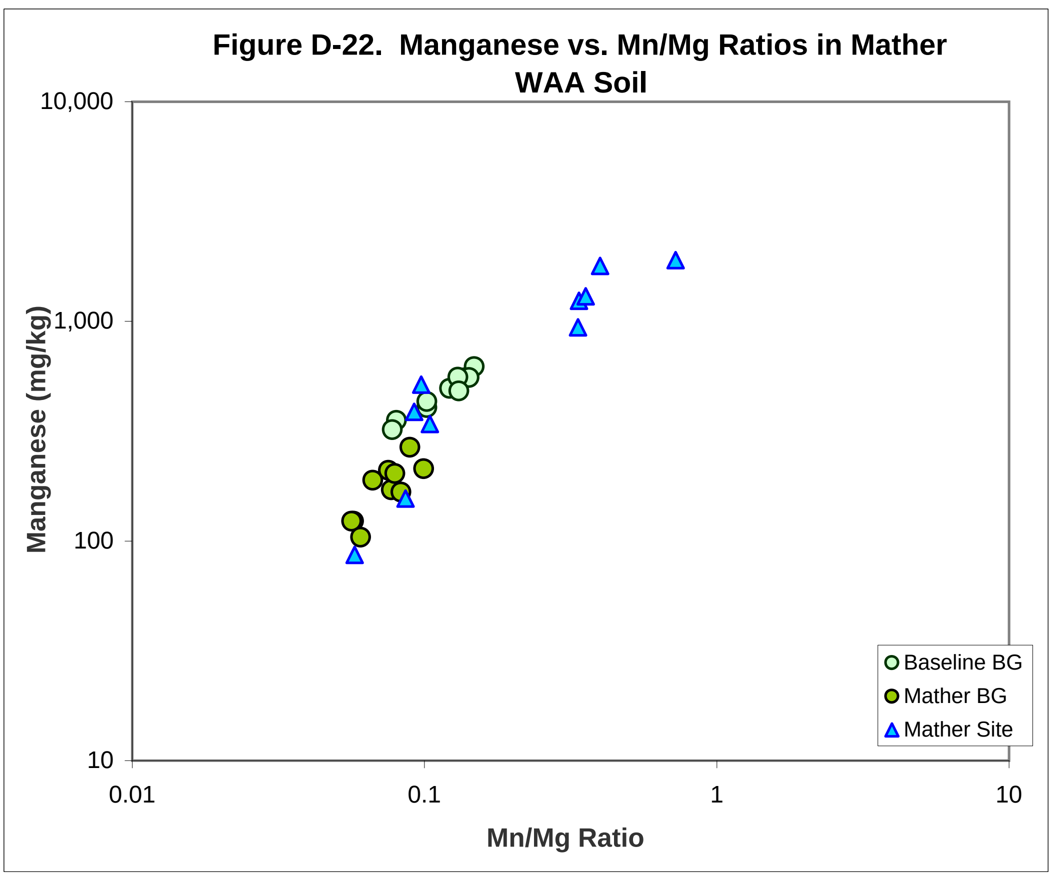


Figure D-22. Manganese vs. Mn/Mg Ratios in Mather WAA Soil
10,000
1,000
100
10
Manganese (mg/kg)
0.01
0.1
1
10
Mn/Mg Ratio
Baseline BG
Mather BG
Mather Site

Figure D-23. Nickel vs. Aluminum in Mather WAA Soil

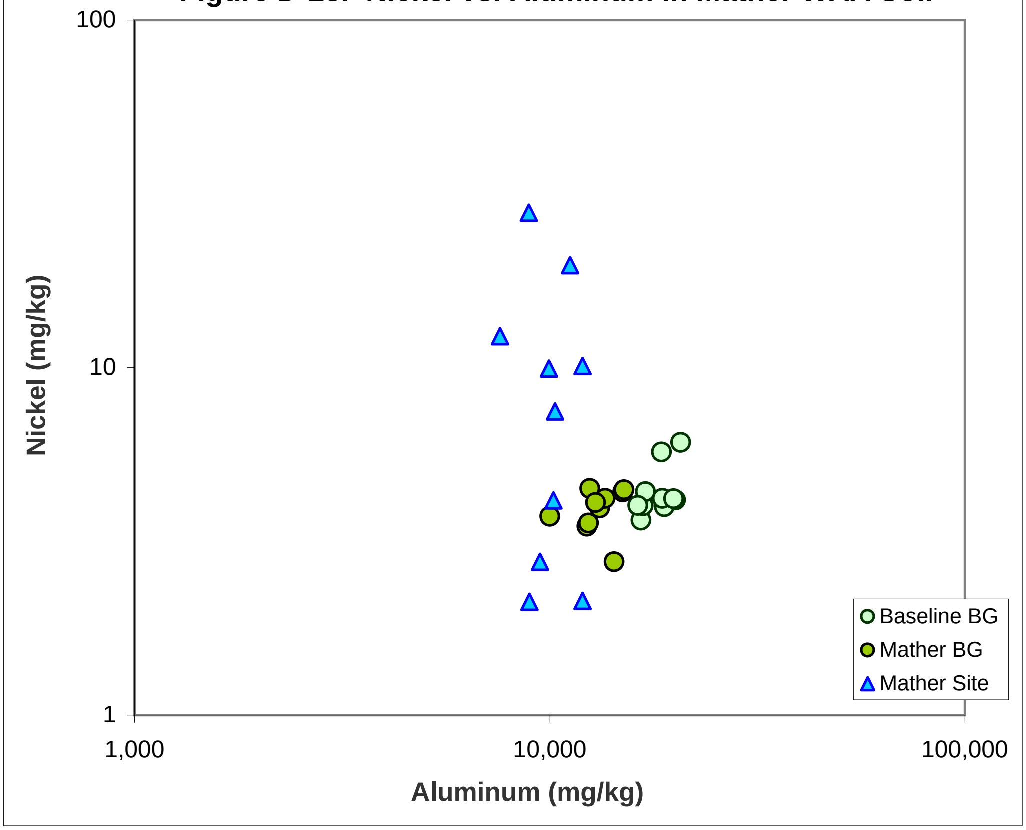
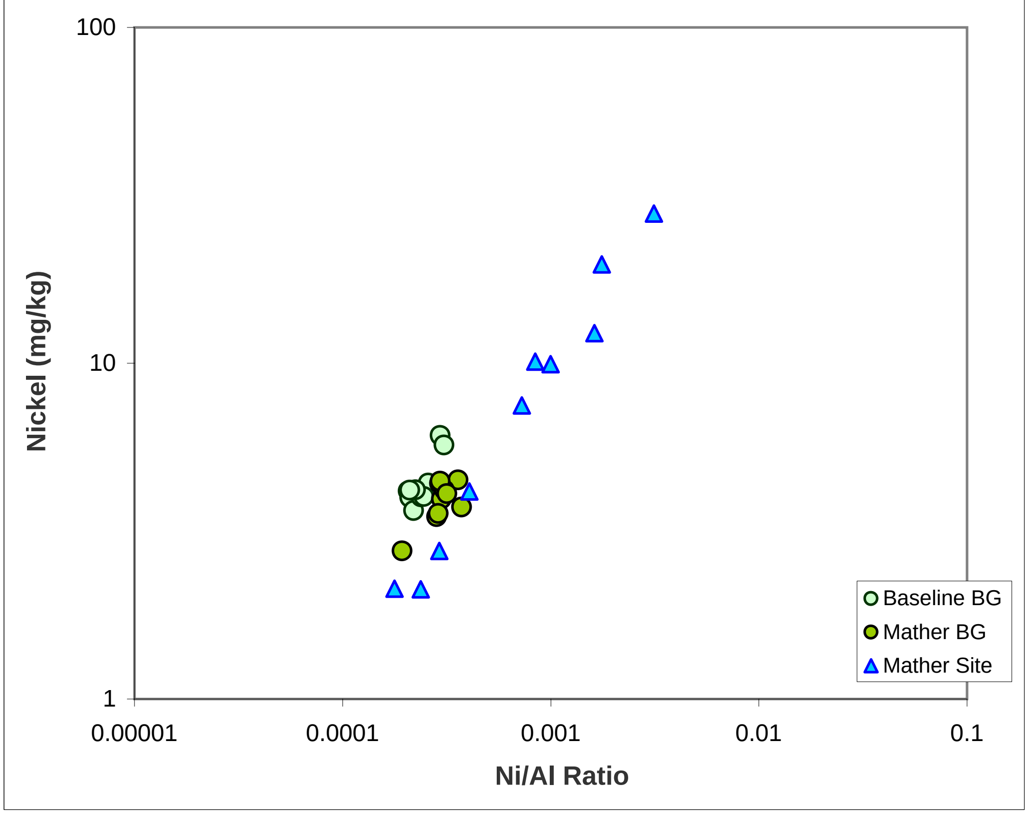


Figure D-24. Nickel vs. Ni/Al Ratios in Mather WAA Soil



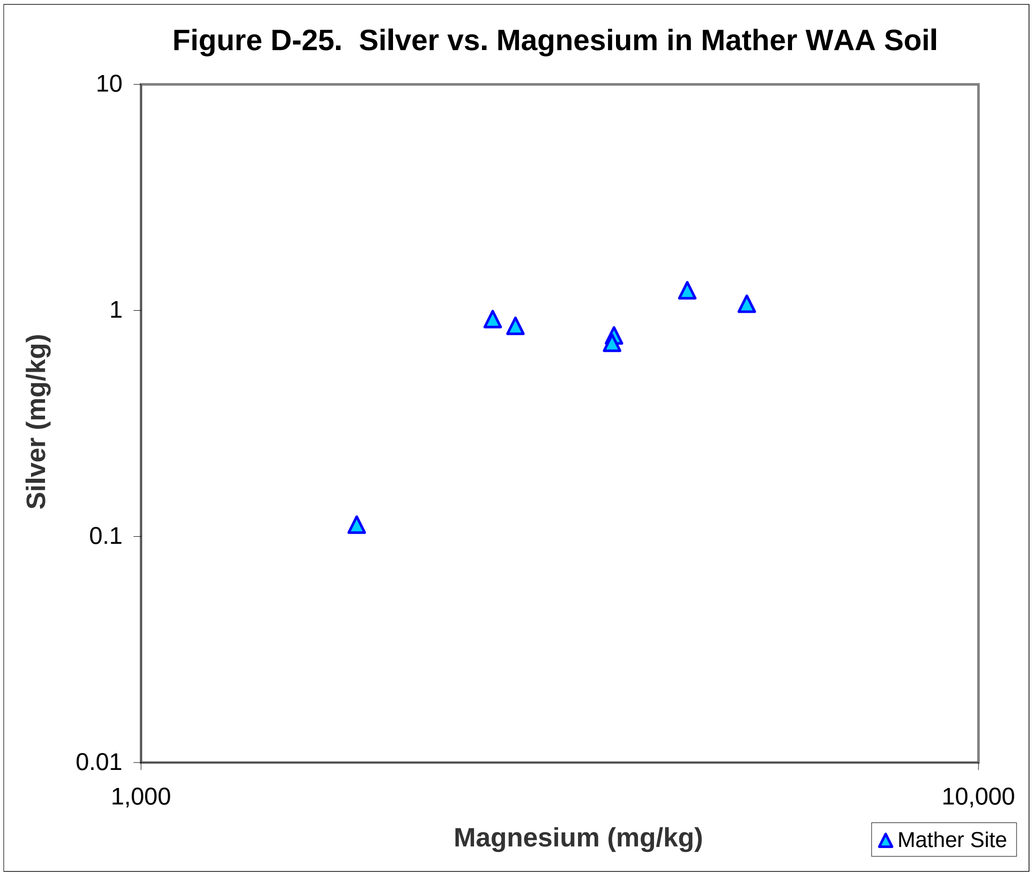


Figure D-25. Silver vs. Magnesium in Mather WAA Soil
10
1
0.1
0.01
Silver (mg/kg)
1,000
10,000
Magnesium (mg/kg)
Mather Site

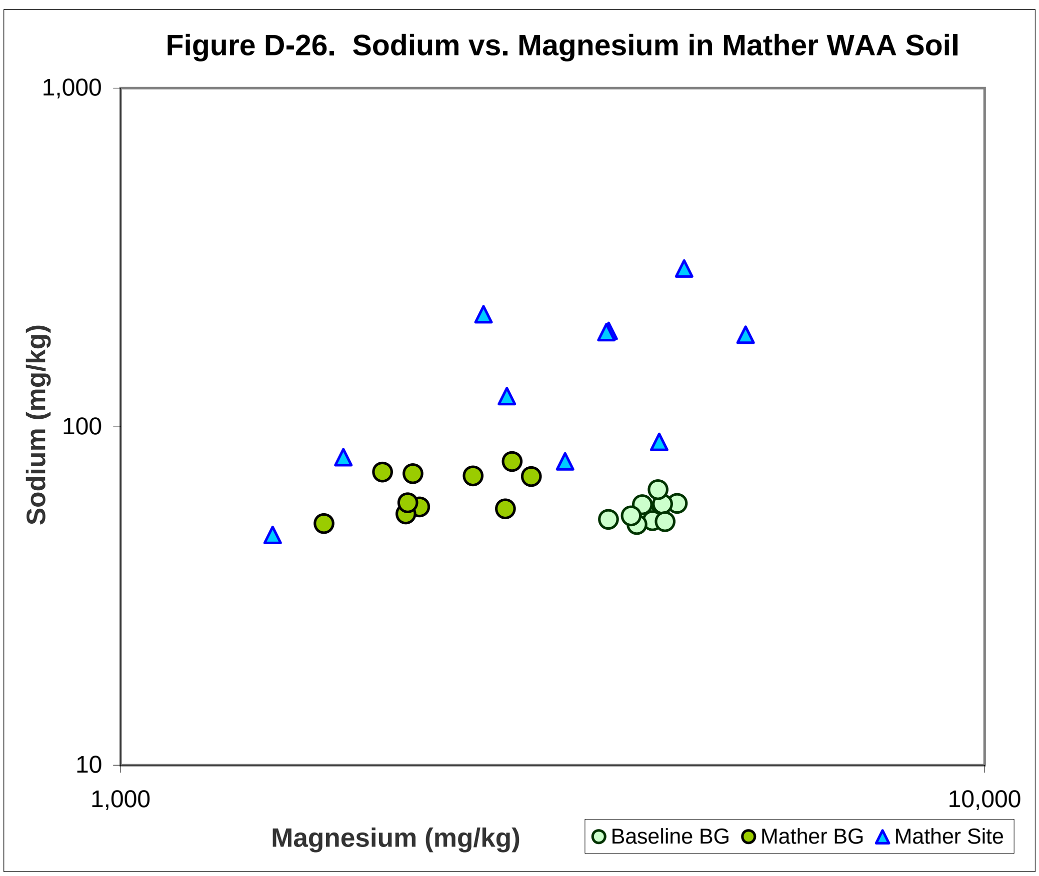


Figure D-26. Sodium vs. Magnesium in Mather WAA Soil
1,000
100
10
Sodium (mg/kg)
1,000
10,000
Magnesium (mg/kg)
Baseline BG
Mather BG
Mather Site

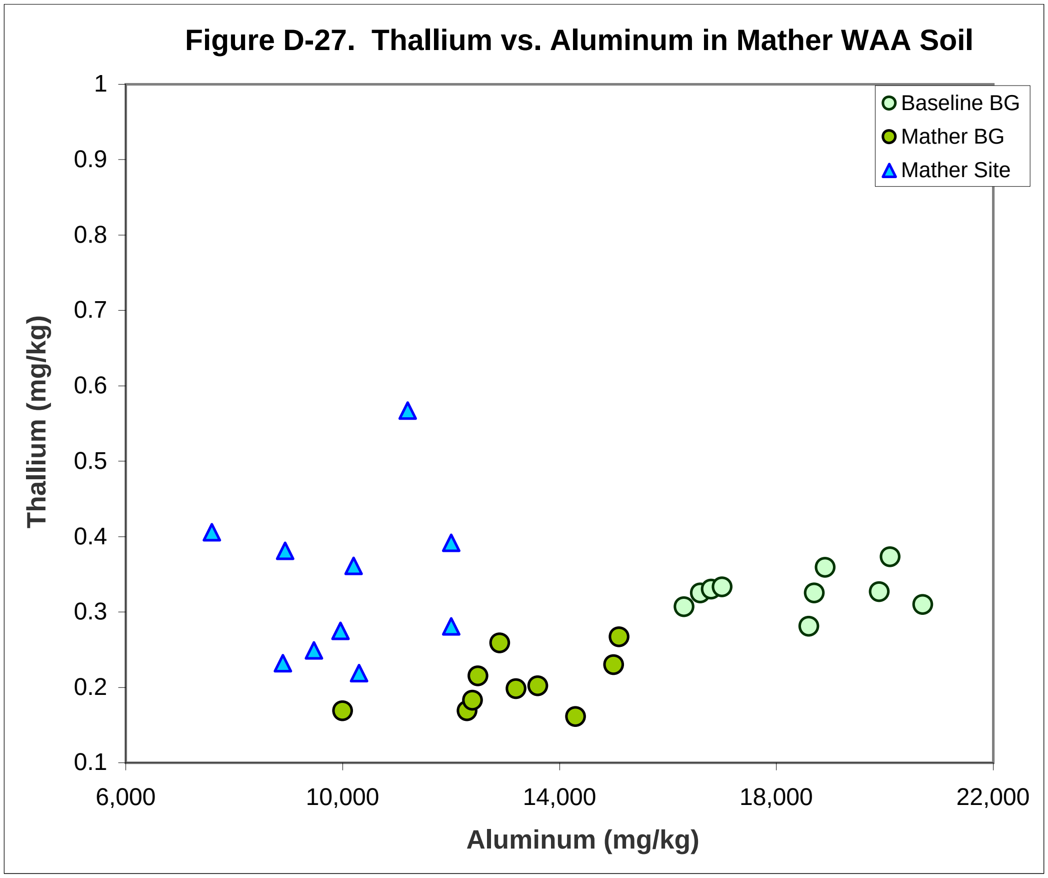


Figure D-27. Thallium vs. Aluminum in Mather WAA Soil
Thallium (mg/kg)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
6,000
10,000
14,000
18,000
22,000
Aluminum (mg/kg)
Baseline BG
Mather BG
Mather Site

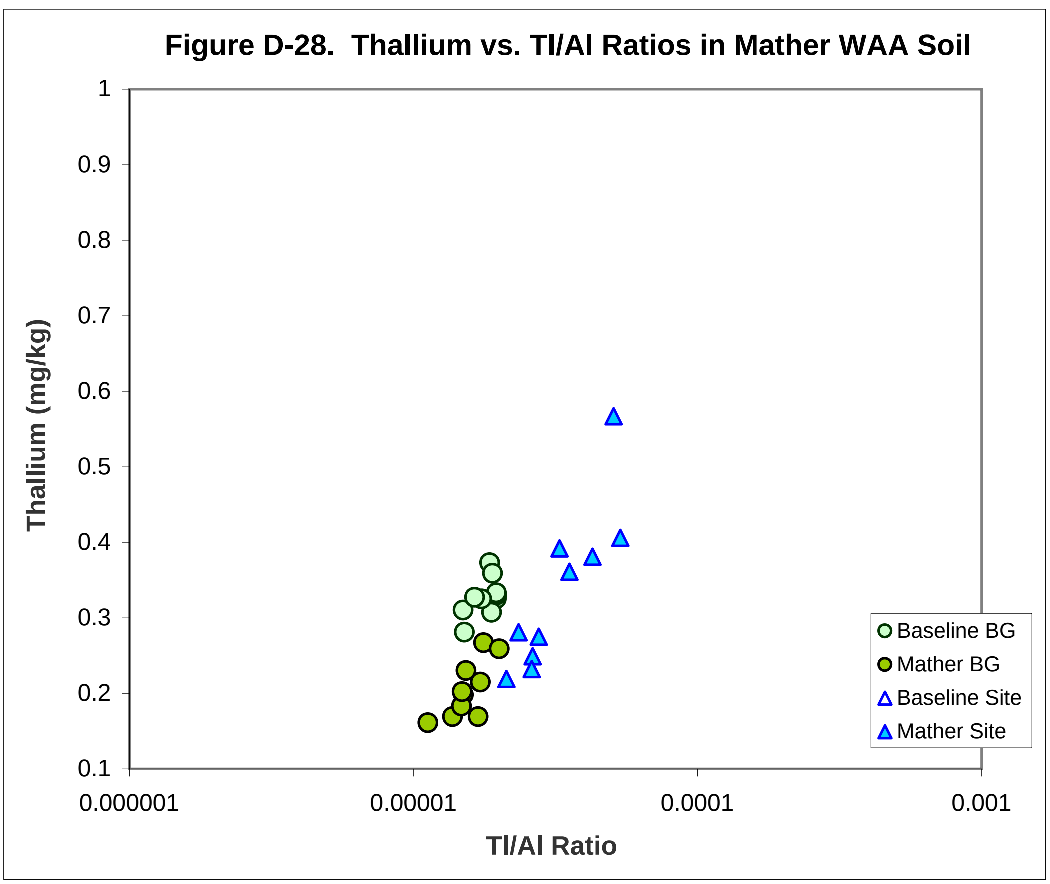


Figure D-28. Thallium vs. Tl/Al Ratios in Mather WAA Soil
Thallium (mg/kg)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.000001
0.00001
0.0001
0.001
Tl/Al Ratio
Baseline BG
Mather BG
Baseline Site
Mather Site

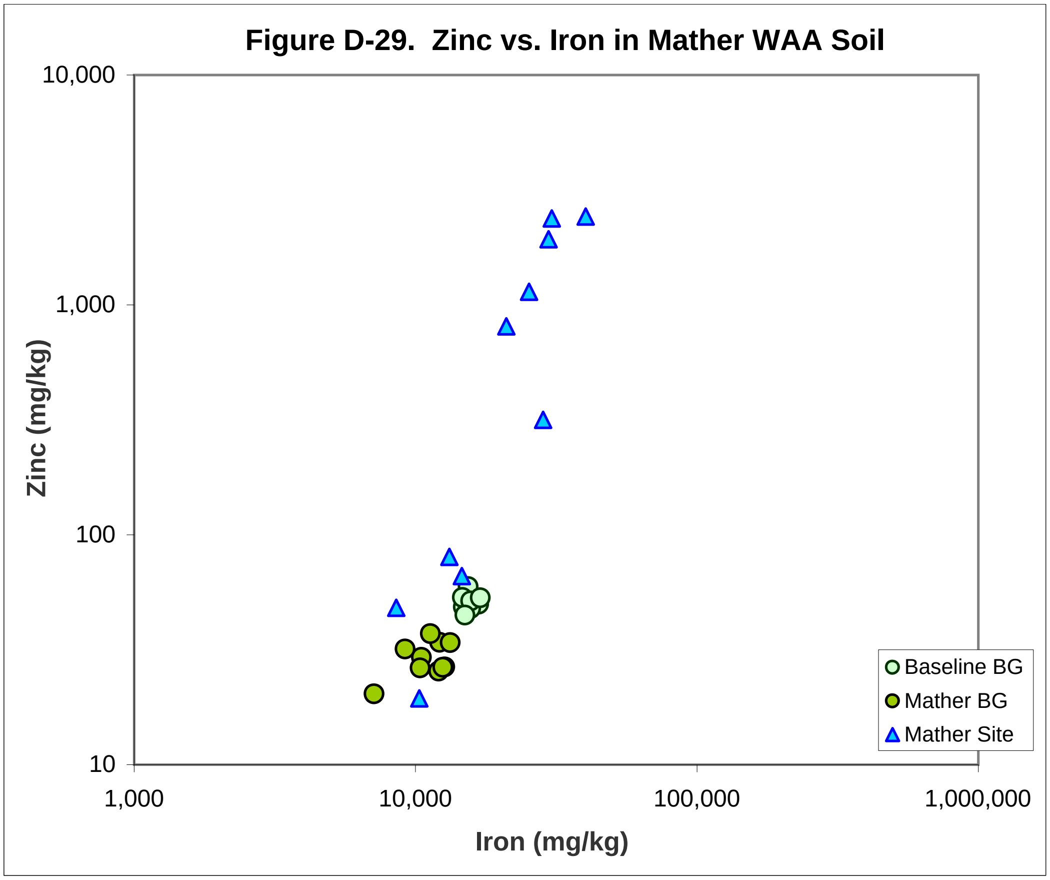


Figure D-29. Zinc vs. Iron in Mather WAA Soil
10,000
1,000
100
10
Zinc (mg/kg)
1,000
10,000
100,000
1,000,000
Iron (mg/kg)
Baseline BG
Mather BG
Mather Site

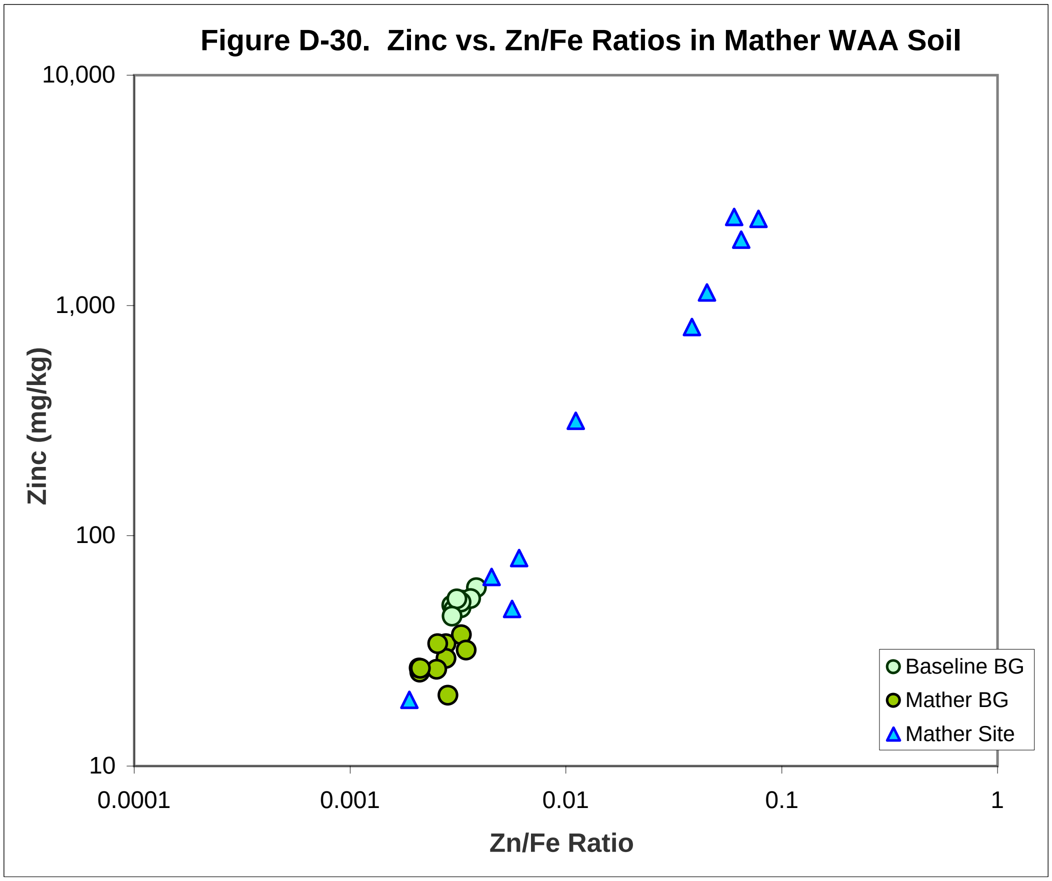


Figure D-30. Zinc vs. Zn/Fe Ratios in Mather WAA Soil
10,000
1,000
100
10
Zinc (mg/kg)
0.0001
0.001
0.01
0.1
1
Zn/Fe Ratio
Baseline BG
Mather BG
Mather Site

APPENDIX E
DESCRIPTION OF PEASPREAD FOR THE PARK HIKER AND THE PARK EMPLOYEE

PEAspread - Physical & Chemical Data

Table E-1. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): 2,3,7,8-Tetrachloro-p-dibenzodioxin TEQ **CASRN: 1746-01-6**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	1.11E-05	mg/kg	site-specific	$IR_{s,adult}$	100	mg/day	PEA, 1999	EF	7	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	$IR_{s,child}$	200	mg/day	PEA, 1999	$EF_{d,adult}$	7	days/yr	Shaw, 2009
SF_o	1.00E+05	$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,adults}$	20	m^3/day	PEA, 1999	$EF_{d,child}$	7	days/yr	Shaw, 2009
SF_i	1.00E+05	$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,child}$	10	m^3/day	PEA, 1999	ED_{adult}	24	yr	PEA, 1999
RfD_o		mg/kg-day	EPA, 2004a	$IR_{w,adult}$	2	L/day	DTSC, 2005	ED_{child}	6	yr	PEA, 1999
RfD_i		mg/kg-day	EPA, 2004a	$IR_{w,child}$	1	L/day	DTSC, 2005	BW_{adult}	70	kg	PEA, 1999
K_p	1.4E+00	cm/hr	EPA, 1992	$IR_{voc,adult}$	2	L/day	DTSC, 2005	BW_{child}	15	kg	PEA, 1999
ABS	0.03	unitless	PEA, 1999	$IR_{voc,child}$	1	L/day	DTSC, 2005	AT_c	70	yr	PEA, 1999
H_c	7.9E-05	atm-m^3/mole	EPA, 2004b	$IR_{w,voc}$	2	L/day	PEA, 1999	$AT_{nc\text{-}adult}$	24	yr	PEA, 1999
H'	3.2E-03	unitless	calc'd. from H_c	ET_{adult}	4	hr/day	DTSC, 2005	$AT_{nc\text{-}child}$	6	yr	PEA, 1999
K_d	2.93E+03	L/kg	calculated	ET_{child}	4	hr/day	DTSC, 2005	P_t	0.434	unitless	PEA, 1999
S	8.E-06	mg/L	EPA, 2004b	$SA_{adult\text{-}soil}$	5,800	cm^2/day	Shaw, 2009	P_w	0.150	unitless	PEA, 1999
D_i	4.04E-02	cm^2/s	EPA, 2009	$SA_{child\text{-}soil}$	2,900	cm^2/day	Shaw, 2009	P_a	0.284	unitless	PEA, 1999
K_{ow}	3.98E+06	L/kg	EPA, 2004	$SA_{adult\text{-}water}$		cm^2	NA	$C_{w\text{-}moisture}$	0.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	$SA_{child\text{-}water}$		cm^2	NA	θ_m	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}	1.463E+05	L/kg	EPA, 2008	AF	0.30	mg/cm^2	Shaw, 2009	σ	2.65	g/cm^3	PEA, 1999
VP	1.50E-09	mm Hg	EPA, 2004b	MW	322	atomic mass units	EPA, 2004	β	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <== ==> Henry's Law Constant is GREATER THAN 1E-5 atm-m3/mole

The COPC is a VOC

REFERENCES (All references must be checked and revised, as needed, for each use.)

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, Interim Report, EPA/600/8-91/011B, Office of Research and Development, Washington, DC 20460, January.

EPA, 2004a, Region 9 Preliminary Remediation Goals (PRGs) 2004, United States Environmental Protection Agency Region IX, San Francisco, CA, October 1.

EPA, 2004b, Superfund Chemical Data Matrix, *http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm*

EPA, 2008, Regional Screening Levels for Chemical Contaminants at Superfund Sites, Internet URL: h *ttp://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm* .

EPA, 2009, CHEMFATE data base, *http://srcinc.com/what-we-do/databaseforms.aspx?id=381*

OEHHA, 2009, http://www.oehha.ca.gov/risk/chemicalDB/index.asp?error=Unknown+Chemical&chemname=&casnum=

PEA, 1999, Preliminary Endangerment Assessment Guidance Manual, (Figures 1-8, Pages B-7 through B-14), State of California Environmental Protection Agency, Department of Toxic Substances Control, January, Second Printing, June, 1999.

Shaw, 2009, Supplemental Work Plan for Risk Assessment at Waste Accumulation Areas, Yosemite National Park, California, USACE Contract No. DACW05-96-D-0011, CTO No. 08 - WAD No. 02, Document Control Number: ACE08-367-H, Revision C, March.

PEAspread - Soil

Table E-1. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): 2,3,7,8-Tetrachloro-p-dibenzodioxin TEQ **CASRN: 1746-01-6**

$Cancer\ Risk_{soil}$ = $((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr)))$
$+ (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr)))$
$+ (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr)))$
$+ (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))))$

$Risk_{soil-adult,\ ingestion}$	=	1.E-08	**ILCR**	$Dose_{soil-adult,\ ingestion}$	=	1.E-13	mg/kg-day
$Risk_{soil-child,\ ingestion}$	=	2.E-08	**ILCR**	$Dose_{soil-child,\ ingestion}$	=	2.E-13	mg/kg-day
$Risk_{soil-adult,dermal}$	=	5.E-09	**ILCR**	$Dose_{soil-adult,dermal}$	=	5.E-14	mg/kg-day
$Risk_{soil-child,dermal}$	=	3.E-09	**ILCR**	$Dose_{soil-child,dermal}$	=	3.E-14	mg/kg-day
Cancer Risk$_{soil}$	**=**	**4.E-08**	**ILCR**	**Combined Dose$_{soil}$**	**=**	**4.E-13**	mg/kg-day

$Hazard\ Index_{soil}$ = $(((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc-adult}*365\ days/yr)))$
$+ ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc-child}*365\ days/yr)))$
$+ ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc-adult}*365\ days/yr)))$
$+ ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc-child}*365\ days/yr))))$

$Hazard\ Quotient_{soil-adult,\ ingestion}$	=	#DIV/0!	**HQ**	$Dose_{soil-adult,\ ingestion}$		3.E-13	mg/kg-day
$Hazard\ Quotient_{soil-child,\ ingestion}$	=	#DIV/0!	**HQ**	$Dose_{soil-child,\ ingestion}$		3.E-12	mg/kg-day
$Hazard\ Quotient_{soil-adult,dermal}$	=	#DIV/0!	**HQ**	$Dose_{soil-adult,dermal}$		2.E-13	mg/kg-day
$Hazard\ Quotient_{soil-child,dermal}$	=	#DIV/0!	**HQ**	$Dose_{soil-child,dermal}$		4.E-13	mg/kg-day
Hazard Index$_{soil}$	**=**	**#DIV/0!**	**HI**	**Combined Dose$_{soil}$**		**4.E-12**	mg/kg-day

PEAspread - Air

Table E-1. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): 2,3,7,8-Tetrachloro-p-dibenzodioxin TEQ **CASRN: 1746-01-6**

Cancer Risk$_{air}$	=	$(((SF_i*C_a)*((IR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_c*365\ day/yr)))$					
		$+((SF_i*Ca)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_c*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \le C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	2.34E-02	mg/kg	C_s	=	1.110E-05	mg/kg
E_i	=	8.30E-11	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**			
C_a	=	8.E-13	mg/m^3	**Screening Based on VOCs**			
Risk$_{air-adult}$	=	2.E-10	**ILCR**	Dose$_{air-adult,inhalation}$	=	2.E-15	mg/kg-day
Risk$_{air-child}$	=	9.E-11	**ILCR**	Dose$_{air-child, inhalation}$	=	9.E-16	mg/kg-day
Cancer Risk$_{air}$	**=**	**2.E-10**	**ILCR**	**Combined Dose$_{air}$**	**=**	**2.E-15**	mg/kg-day
Hazard$_{air}$	=	$(((C_a/RfD_i)*((IhR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_{nc-adult}*365\ day/yr)))$					
		$+((C_a/RfD_i)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_{nc-child}*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \le C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	2.34E-02	mg/kg	C_s	=	1.11E-05	mg/kg
E_i	=	8.30E-11	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**			
C_a	=	8.E-13	mg/m^3	**Screening Based on VOCs**			
Hazard Quotient$_{air-adult, vocs}$	=	#DIV/0!	**HQ**	Dose$_{air-vocs-adult,inhalation}$		5.E-15	mg/kg-day
Hazard Quotient$_{air-child, vocs}$	=	#DIV/0!	**HQ**	Dose$_{air-vocs-child, inhalation}$		1.E-14	mg/kg-day
Hazard Index$_{air, voc}$	**=**	**#DIV/0!**	**HI**	**Combined Dose$_{air-vocs}$**	**Total**	**2.E-14**	mg/kg-day

PEAspread - Physical & Chemical Data

Table E-2. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Antimony & compounds **CASRN: 7440-36-0**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	2.81	mg/kg (J)	site-specific	**$IR_{s,adult}$**	100	mg/day	PEA, 1999	**EF**	7	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	**$IR_{s,child}$**	200	mg/day	PEA, 1999	**$EF_{d,adult}$**	7	days/yr	Shaw, 2009
SF_o		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	**$IhR_{a,adults}$**	20	m^3/day	PEA, 1999	**$EF_{d,child}$**	7	days/yr	Shaw, 2009
SF_i		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	**$IhR_{a,child}$**	10	m^3/day	PEA, 1999	**ED_{adult}**	24	yr	PEA, 1999
RfD_o	4.0E-04	mg/kg-day	EPA, 2004a	**$IR_{w,adult}$**	2	L/day	DTSC, 2005	**ED_{child}**	6	yr	PEA, 1999
RfD_i		mg/kg-day	EPA, 2004a	**$IR_{w,child}$**	1	L/day	DTSC, 2005	**BW_{adult}**	70	kg	PEA, 1999
K_p		cm/hr	EPA, 1992	**$IR_{voc,adult}$**	2	L/day	DTSC, 2005	**BW_{child}**	15	kg	PEA, 1999
ABS	0.01	unitless	PEA, 1999	**$IR_{voc,child}$**	1	L/day	DTSC, 2005	**AT_c**	70	yr	PEA, 1999
H_c		atm-m^3/mole	EPA, 2008	**$IR_{w,voc}$**	2	L/day	PEA, 1999	**$AT_{nc\text{-}adult}$**	24	yr	PEA, 1999
H'	0.0E+00	unitless	calc'd. from H_c	**ET_{adult}**	4	hr/day	DTSC, 2005	**$AT_{nc\text{-}child}$**	6	yr	PEA, 1999
K_d	0.00E+00	L/kg	calc'd from K_{oc}	**ET_{child}**	4	hr/day	DTSC, 2005	**P_t**	0.434	unitless	PEA, 1999
S	3000	mg/L	EPA, 2004b	**$SA_{adult\text{-}soil}$**	5,800	cm^2/day	Shaw, 2009	**P_w**	0.150	unitless	PEA, 1999
D_i		cm^2/s	EPA, 2008	**$SA_{child\text{-}soil}$**	2,900	cm^2/day	Shaw, 2009	**P_a**	0.284	unitless	PEA, 1999
K_{ow}	5.37E+00	L/kg	EPA, 2004b	**$SA_{adult\text{-}water}$**		cm^2	NA	**$C_{w\text{-}moisture}$**	300.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	**$SA_{child\text{-}water}$**		cm^2	NA	**θ_m**	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}		L/kg	EPA, 2008	**AF**	0.30	mg/cm^2	Shaw, 2009	**σ**	2.65	g/cm^3	PEA, 1999
VP		mm Hg	EPA, 2004b	**MW**	122	atomic mass units	EPA, 2004	**β**	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, Interim Report, EPA/600/8-91/011B, Office of Research and Development, Washington, DC 20460, January.

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PEA, 1999, Preliminary Endangerment Assessment Guidance Manual, (Figures 1-8, Pages B-7 through B-14), State of California Environmental Protection Agency, Department of Toxic Substances Control, January, Second Printing, June, 1999.

Shaw, 2009, Supplemental Work Plan for Risk Assessment at Waste Accumulation Areas, Yosemite National Park, California, USACE Contract No. DACW05-96-D-0011, CTO No. 08 - WAD No. 02, Document Control Number: ACE08-367-H, Revision C, March.

PEAspread - Soil

Table E-2. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Antimony & compounds **CASRN: 7440-36-0**

$$\text{Cancer Risk}_{soil} = ((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_c*365\text{ days/yr}))) + (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_c*365\text{ days/yr}))) + (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_c*365\text{ days/yr}))) + (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_c*365\text{ days/yr})))$$

$Risk_{soil\text{-}adult, ingestion}$	=	0.E+00	ILCR	$Dose_{soil\text{-}adult, ingestion}$	=	3.E-08	mg/kg-day
$Risk_{soil\text{-}child, ingestion}$	=	0.E+00	ILCR	$Dose_{soil\text{-}child, ingestion}$	=	6.E-08	mg/kg-day
$Risk_{soil\text{-}adult,dermal}$	=	0.E+00	ILCR	$Dose_{soil\text{-}adult,dermal}$	=	5.E-09	mg/kg-day
$Risk_{soil\text{-}child,dermal}$	=	0.E+00	ILCR	$Dose_{soil\text{-}child,dermal}$	=	3.E-09	mg/kg-day
Cancer $Risk_{soil}$	**=**	**0.E+00**	**ILCR**	**Combined $Dose_{soil}$**	**=**	**1.E-07**	mg/kg-day

$$\text{Hazard Index}_{soil} = (((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_{nc\text{-}adult}*365\text{ days/yr}))) + ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_{nc\text{-}child}*365\text{ days/yr}))) + ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_{nc\text{-}adult}*365\text{ days/yr}))) + ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_{nc\text{-}child}*365\text{ days/yr}))))$$

Hazard $Quotient_{soil\text{-}adult, ingestion}$	=	2.E-04	HQ	$Dose_{soil\text{-}adult, ingestion}$	8.E-08	mg/kg-day
Hazard $Quotient_{soil\text{-}child, ingestion}$	=	2.E-03	HQ	$Dose_{soil\text{-}child, ingestion}$	7.E-07	mg/kg-day
Hazard $Quotient_{soil\text{-}adult,dermal}$	=	3.E-05	HQ	$Dose_{soil\text{-}adult,dermal}$	1.E-08	mg/kg-day
Hazard $Quotient_{soil\text{-}child,dermal}$	=	8.E-05	HQ	$Dose_{soil\text{-}child,dermal}$	3.E-08	mg/kg-day
Hazard $Index_{soil}$	**=**	**2.E-03**	**HI**	**Combined $Dose_{soil}$**	**8.E-07**	mg/kg-day

PEAspread - Air

Table E-2. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Antimony & compounds **CASRN: 7440-36-0**

Cancer $Risk_{air}$	=	$(((SF_i{*}C_a){*}((IR_{adult}{*}EF{*}ED_{adult})/(BW_{adult}{*}AT_c{*}365\ day/yr)))$					
		$+((SF_i{*}Ca){*}((IhR_{child}{*}EF{*}ED_{child})/(BW_{child}{*}AT_c{*}365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s{*}(0.05\ mg/m^3){*}(1{*}10^{-6}\ kg/mg)$		=	$C_s{*}(5{*}10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \le C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d{*}ß)+(P_w)+(H'{*}P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	3.00E+02	mg/kg	C_s	=	2.810E+00	mg/kg
E_i	=	#DIV/0!	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**			
C_a	=	1.E-07	mg/m^3	**But COPC is a Non-VOC**			
$Risk_{air\text{-}adult}$	=	0.E+00	**ILCR**	$Dose_{air\text{-}adult,inhalation}$	=	3.E-10	mg/kg-day
$Risk_{air\text{-}child}$	=	0.E+00	**ILCR**	$Dose_{air\text{-}child,\ inhalation}$	=	2.E-10	mg/kg-day
Cancer $Risk_{air}$	**=**	**0.E+00**	**ILCR**	**Combined $Dose_{air}$**	**=**	**4.E-10**	mg/kg-day

$Hazard_{air}$	=	$(((C_a/RfD_i){*}((IhR_{adult}{*}EF{*}ED_{adult})/(BW_{adult}{*}AT_{nc\text{-}adult}{*}365\ day/yr)))$					
		$+((C_a/RfD_i){*}((IhR_{child}{*}EF{*}ED_{child})/(BW_{child}{*}AT_{nc\text{-}child}{*}365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s{*}(0.05\ mg/m^3){*}(1{*}10^{-6}\ kg/mg)$		=	$C_s{*}(5{*}10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \le C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d{*}ß)+(P_w)+(H'{*}P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	3.00E+02	mg/kg	C_s	=	2.81E+00	mg/kg
E_i	=	#DIV/0!	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**			
C_a	=	1.E-07	mg/m^3	**But COPC is a Non-VOC**			
Hazard $Quotient_{air\text{-}adult,\ vocs}$	=	#DIV/0!	**HQ**	$Dose_{air\text{-}vocs\text{-}adult,inhalation}$		8.E-10	mg/kg-day
Hazard $Quotient_{air\text{-}child,\ vocs}$	=	#DIV/0!	**HQ**	$Dose_{air\text{-}vocs\text{-}child,\ inhalation}$		2.E-09	mg/kg-day
Hazard $Index_{air,\ voc}$	**=**	**#DIV/0!**	**HI**	**Combined $Dose_{air\text{-}vocs}$**	**Total**	**3.E-09**	mg/kg-day

PEAspread - Physical & Chemical Data

Table E-3. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Arsenic, inorganic **CASRN: 7440-38-2**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	4.73	mg/kg	site-specific	$IR_{s,adult}$	100	mg/day	PEA, 1999	EF	7	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	$IR_{s,child}$	200	mg/day	PEA, 1999	$EF_{d,adult}$	7	days/yr	Shaw, 2009
SF_o	9.50E+00	$(mg/kg\text{-}day)^{-1}$	OEHHA, 2009a	$IhR_{a,adults}$	20	m^3/day	PEA, 1999	$EF_{d,child}$	7	days/yr	Shaw, 2009
SF_i	1.20E+01	$(mg/kg\text{-}day)^{-1}$	OEHHA, 2009a	$IhR_{a,child}$	10	m^3/day	PEA, 1999	ED_{adult}	24	yr	PEA, 1999
RfD_o	3.0E-04	mg/kg-day	OEHHA, 2009a	$IR_{w,adult}$	2	L/day	DTSC, 2005	ED_{child}	6	yr	PEA, 1999
RfD_i	8.57E-06	mg/kg-day	OEHHA, 2009a	$IR_{w,child}$	1	L/day	DTSC, 2005	BW_{adult}	70	kg	PEA, 1999
K_p		cm/hr	PEA, 1999	$IR_{voc,adult}$	2	L/day	DTSC, 2005	BW_{child}	15	kg	PEA, 1999
ABS	0.03	unitless	PEA, 1999	$IR_{voc,child}$	1	L/day	DTSC, 2005	AT_c	70	yr	PEA, 1999
H_c		atm-m^3/mole	EPA, 2008	$IR_{w,voc}$	2	L/day	PEA, 1999	$AT_{nc\text{-}adult}$	24	yr	PEA, 1999
H'	0.0E+00	unitless	calc'd. from H_c	ET_{adult}	4	hr/day	DTSC, 2005	$AT_{nc\text{-}child}$	6	yr	PEA, 1999
K_d	2.90E+01	L/kg	calc'd	ET_{child}	4	hr/day	DTSC, 2005	P_t	0.434	unitless	PEA, 1999
S	0.0	mg/L	EPA, 2008	$SA_{adult\text{-}soil}$	5,800	cm^2/day	Shaw, 2009	P_w	0.150	unitless	PEA, 1999
D_i		cm^2/s	EPA, 2008	$SA_{child\text{-}soil}$	2,900	cm^2/day	Shaw, 2009	P_a	0.284	unitless	PEA, 1999
K_{ow}	4.79E+00	L/kg	EPA, 2004b	$SA_{adult\text{-}water}$		cm^2	NA	$C_{w\text{-}moisture}$	0.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	$SA_{child\text{-}water}$		cm^2	NA	θ_m	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}		L/kg	EPA, 2008	AF	0.30	mg/cm^2	Shaw, 2009	σ	2.65	g/cm^3	PEA, 1999
VP		mm Hg	EPA, 2004b	MW	74.92	atomic mass units	EPA, 2004	β	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

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PEAspread - Soil

Table E-3. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Arsenic, inorganic **CASRN: 7440-38-2**

$$\text{Cancer Risk}_{soil} = ((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_c*365\text{ days/yr})))$$
$$+ (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_c*365\text{ days/yr})))$$
$$+ (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_c*365\text{ days/yr})))$$
$$+ (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_c*365\text{ days/yr}))))$$

$Risk_{soil\text{-}adult,\ ingestion}$	=	4.E-07	**ILCR**	$Dose_{soil\text{-}adult,\ ingestion}$	=	4.E-08	mg/kg-day
$Risk_{soil\text{-}child,\ ingestion}$	=	1.E-06	**ILCR**	$Dose_{soil\text{-}child,\ ingestion}$	=	1.E-07	mg/kg-day
$Risk_{soil\text{-}adult,dermal}$	=	2.E-07	**ILCR**	$Dose_{soil\text{-}adult,dermal}$	=	2.E-08	mg/kg-day
$Risk_{soil\text{-}child,dermal}$	=	1.E-07	**ILCR**	$Dose_{soil\text{-}child,dermal}$	=	1.E-08	mg/kg-day
Cancer $Risk_{soil}$	**=**	**2.E-06**	**ILCR**	**Combined $Dose_{soil}$**	**=**	**2.E-07**	mg/kg-day

$$\text{Hazard Index}_{soil} = (((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_{nc\text{-}adult}*365\text{ days/yr})))$$
$$+ ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_{nc\text{-}child}*365\text{ days/yr})))$$
$$+ ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_{nc\text{-}adult}*365\text{ days/yr})))$$
$$+ ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_{nc\text{-}child}*365\text{ days/yr}))))$$

Hazard $Quotient_{soil\text{-}adult,\ ingestion}$	=	4.E-04	**HQ**	$Dose_{soil\text{-}adult,\ ingestion}$	1.E-07	mg/kg-day
Hazard $Quotient_{soil\text{-}child,\ ingestion}$	=	4.E-03	**HQ**	$Dose_{soil\text{-}child,\ ingestion}$	1.E-06	mg/kg-day
Hazard $Quotient_{soil\text{-}adult,dermal}$	=	2.E-04	**HQ**	$Dose_{soil\text{-}adult,dermal}$	7.E-08	mg/kg-day
Hazard $Quotient_{soil\text{-}child,dermal}$	=	5.E-04	**HQ**	$Dose_{soil\text{-}child,dermal}$	2.E-07	mg/kg-day
Hazard $Index_{soil}$	**=**	**5.E-03**	**HI**	**Combined $Dose_{soil}$**	**2.E-06**	mg/kg-day

PEAspread - Air

Table E-3. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Arsenic, inorganic — **CASRN: 7440-38-2**

Cancer $Risk_{air}$	=	$(((SF_i{*}C_a){*}((IR_{adult}{*}EF{*}ED_{adult})/(BW_{adult}{*}AT_c{*}365\ day/yr)))$ $+((SF_i{*}Ca){*}((IhR_{child}{*}EF{*}ED_{child})/(BW_{child}{*}AT_c{*}365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s{*}(0.05\ mg/m^3){*}(1{*}10^{-6}\ kg/mg)$		=	$C_s{*}(5{*}10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \le C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d{*}ß)+(P_w)+(H'{*}P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	0.00E+00	mg/kg	C_s	=	4.730E+00	mg/kg
E_i	=	#DIV/0!	mg/sec	**SCREENING METHOD NOT VALID FOR VOCs**			
C_a	=	2.E-07	mg/m^3	**But COPC is a Non-VOC**			
$Risk_{air-adult}$	=	5.E-09	**ILCR**	$Dose_{air-adult,inhalation}$	=	4.E-10	mg/kg-day
$Risk_{air-child}$	=	3.E-09	**ILCR**	$Dose_{air-child,\ inhalation}$	=	3.E-10	mg/kg-day
Cancer $Risk_{air}$	**=**	**8.E-09**	**ILCR**	**Combined $Dose_{air}$**	**=**	**7.E-10**	mg/kg-day
$Hazard_{air}$	=	$(((C_a/RfD_i){*}((IhR_{adult}{*}EF{*}ED_{adult})/(BW_{adult}{*}AT_{nc-adult}{*}365\ day/yr)))$ $+((C_a/RfD_i){*}((IhR_{child}{*}EF{*}ED_{child})/(BW_{child}{*}AT_{nc-child}{*}365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s{*}(0.05\ mg/m^3){*}(1{*}10^{-6}\ kg/mg)$		=	$C_s{*}(5{*}10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \le C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d{*}ß)+(P_w)+(H'{*}P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	0.00E+00	mg/kg	C_s	=	4.73E+00	mg/kg
E_i	=	#DIV/0!	mg/sec	**Screening Method Not Valid for VOCs**			
C_a	=	2.E-07	mg/m^3	**But COPC is a Non-VOC**			
Hazard $Quotient_{air-adult,\ vocs}$	=	2.E-04	**HQ**	$Dose_{air-vocs-adult,inhalation}$		1.E-09	mg/kg-day
Hazard $Quotient_{air-child,\ vocs}$	=	4.E-04	**HQ**	$Dose_{air-vocs-child,\ inhalation}$		3.E-09	mg/kg-day
Hazard $Index_{air,\ voc}$	**=**	**5.E-04**	**HI**	**Combined $Dose_{air-vocs}$**	**Total**	**4.E-09**	mg/kg-day

PEAspread - Physical & Chemical Data

Table E-4. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Barium **CASRN: 7440-39-3**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	691	mg/kg	site-specific	**$IR_{s,adult}$**	100	mg/day	PEA, 1999	**EF**	7	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	**$IR_{s,child}$**	200	mg/day	PEA, 1999	**$EF_{d,adult}$**	7	days/yr	Shaw, 2009
SF_o		$(mg/kg\text{-}day)^{-1}$	EPA, 2008	**$IhR_{a,adults}$**	20	m^3/day	PEA, 1999	**$EF_{d,child}$**	7	days/yr	Shaw, 2009
SF_i		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	**$IhR_{a,child}$**	10	m^3/day	PEA, 1999	**ED_{adult}**	24	yr	PEA, 1999
RfD_o	7.0E-02	mg/kg-day	EPA, 2004a	**$IR_{w,adult}$**	2	L/day	DTSC, 2005	**ED_{child}**	6	yr	PEA, 1999
RfD_i	1.4E-04	mg/kg-day	EPA, 2004a	**$IR_{w,child}$**	1	L/day	DTSC, 2005	**BW_{adult}**	70	kg	PEA, 1999
K_p		cm/hr	EPA, 1992	**$IR_{voc,adult}$**	2	L/day	DTSC, 2005	**BW_{child}**	15	kg	PEA, 1999
ABS	0.01	unitless	PEA, 1999	**$IR_{voc,child}$**	1	L/day	DTSC, 2005	**AT_c**	70	yr	PEA, 1999
H_c		atm-m^3/mole	EPA, 2008	**$IR_{w,voc}$**	2	L/day	PEA, 1999	**$AT_{nc\text{-}adult}$**	24	yr	PEA, 1999
H'	0.0E+00	unitless	calc'd. from H_c	**ET_{adult}**	4	hr/day	DTSC, 2005	**$AT_{nc\text{-}child}$**	6	yr	PEA, 1999
K_d	0.00E+00	L/kg	calc'd	**ET_{child}**	4	hr/day	DTSC, 2005	**P_t**	0.434	unitless	PEA, 1999
S		mg/L	EPA, 2008	**$SA_{adult\text{-}soil}$**	5,800	cm^2/day	Shaw, 2009	**P_w**	0.150	unitless	PEA, 1999
D_i		cm^2/s	EPA, 2008	**$SA_{child\text{-}soil}$**	2,900	cm^2/day	Shaw, 2009	**P_a**	0.284	unitless	PEA, 1999
K_{ow}	1.70E+00	L/kg	EPA, 2004b	**$SA_{adult\text{-}water}$**		cm^2	NA	**$C_{w\text{-}moisture}$**	0.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	**$SA_{child\text{-}water}$**		cm^2	NA	**θ_m**	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}		L/kg	EPA, 2008	**AF**	0.30	mg/cm^2	Shaw, 2009	**σ**	2.65	g/cm^3	PEA, 1999
VP		mm Hg	EPA, 2004b	**MW**	140	atomic mass units	EPA, 2004	**β**	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, Interim Report, EPA/600/8-91/011B, Office of Research and Development, Washington, DC 20460, January.

EPA, 2004a, Region 9 Preliminary Remediation Goals (PRGs) 2004, United States Environmental Protection Agency Region IX, San Francisco, CA, October 1.

EPA, 2004b, Superfund Chemical Data Matrix, *http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm*

EPA, 2008, Regional Screening Levels for Chemical Contaminants at Superfund Sites, Internet URL: h *ttp://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm* .

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OEHHA, 2009, http://www.oehha.ca.gov/risk/chemicalDB/index.asp?error=Unknown+Chemical&chemname=&casnum=

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Shaw, 2009, Supplemental Work Plan for Risk Assessment at Waste Accumulation Areas, Yosemite National Park, California, USACE Contract No. DACW05-96-D-0011, CTO No. 08 - WAD No. 02, Document Control Number: ACE08-367-H, Revision C, March.

PEAspread - Soil

Table E-4. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Barium **CASRN: 7440-39-3**

$$Cancer\ Risk_{soil} = ((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr))) + (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))) + (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr))) + (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))))$$

$Risk_{soil-adult, ingestion}$	=	0.E+00	**ILCR**	$Dose_{soil-adult, ingestion}$	=	6.E-06	mg/kg-day
$Risk_{soil-child, ingestion}$	=	0.E+00	**ILCR**	$Dose_{soil-child, ingestion}$	=	2.E-05	mg/kg-day
$Risk_{soil-adult,dermal}$	=	0.E+00	**ILCR**	$Dose_{soil-adult,dermal}$	=	1.E-06	mg/kg-day
$Risk_{soil-child,dermal}$	=	0.E+00	**ILCR**	$Dose_{soil-child,dermal}$	=	7.E-07	mg/kg-day
Cancer Risk$_{soil}$	**=**	**0.E+00**	**ILCR**	**Combined Dose$_{soil}$**	**=**	**2.E-05**	mg/kg-day

$$Hazard\ Index_{soil} = (((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc-adult}*365\ days/yr))) + ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc-child}*365\ days/yr))) + ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc-adult}*365\ days/yr))) + ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc-child}*365\ days/yr))))$$

$Hazard\ Quotient_{soil-adult, ingestion}$	=	3.E-04	**HQ**	$Dose_{soil-adult, ingestion}$	2.E-05	mg/kg-day
$Hazard\ Quotient_{soil-child, ingestion}$	=	3.E-03	**HQ**	$Dose_{soil-child, ingestion}$	2.E-04	mg/kg-day
$Hazard\ Quotient_{soil-adult,dermal}$	=	5.E-05	**HQ**	$Dose_{soil-adult,dermal}$	3.E-06	mg/kg-day
$Hazard\ Quotient_{soil-child,dermal}$	=	1.E-04	**HQ**	$Dose_{soil-child,dermal}$	8.E-06	mg/kg-day
Hazard Index$_{soil}$	**=**	**3.E-03**	**HI**	**Combined Dose$_{soil}$**	**2.E-04**	mg/kg-day

PEAspread - Air

Table E-4. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Barium **CASRN: 7440-39-3**

Cancer $Risk_{air}$	=	$(((SF_i*C_a)*((IR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_c*365\ day/yr)))$						
		$+((SF_i*Ca)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_c*365\ day/yr))))$						
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$			=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$				
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$						
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]						
C_{sat}	=	0.00E+00	mg/kg	C_s	=	6.910E+02	mg/kg	
E_i	=	#DIV/0!	mg/sec	**SCREENING METHOD NOT VALID FOR VOCs**				
C_a	=	3.E-05	mg/m^3	**But COPC is a Non-VOC**				
$Risk_{air-adult}$	=	0.E+00	**ILCR**	$Dose_{air-adult,inhalation}$	=	6.E-08	mg/kg-day	
$Risk_{air-child}$	=	0.E+00	**ILCR**	$Dose_{air-child,\ inhalation}$	=	4.E-08	mg/kg-day	
Cancer $Risk_{air}$	**=**	**0.E+00**	**ILCR**	**Combined $Dose_{air}$**	**=**	**1.E-07**	mg/kg-day	
$Hazard_{air}$	=	$(((C_a/RfD_i)*((IhR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_{nc-adult}*365\ day/yr)))$						
		$+((C_a/RfD_i)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_{nc-child}*365\ day/yr))))$						
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$			=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$				
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$						
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]						
C_{sat}	=	0.00E+00	mg/kg	C_s	=	6.91E+02	mg/kg	
E_i	=	#DIV/0!	mg/sec	**Screening Method Not Valid for VOCs**				
C_a	=	3.E-05	mg/m^3	**But COPC is a Non-VOC**				
Hazard $Quotient_{air-adult,\ vocs}$	=	1.E-03	**HQ**	$Dose_{air-vocs-adult,inhalation}$		2.E-07	mg/kg-day	
Hazard $Quotient_{air-child,\ vocs}$	=	3.E-03	**HQ**	$Dose_{air-vocs-child,\ inhalation}$		4.E-07	mg/kg-day	
Hazard $Index_{air,\ voc}$	**=**	**5.E-03**	**HI**	**Combined $Dose_{air-vocs}$**	**Total**	**6.E-07**	mg/kg-day	

PEAspread - Physical & Chemical Data

Table E-5. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Benzo(a)pyrene — **CASRN: 50-32-8**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	0.0159	mg/kg	site-specific	$IR_{s,adult}$	100	mg/day	PEA, 1999	EF	7	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	$IR_{s,child}$	200	mg/day	PEA, 1999	$EF_{d,adult}$	7	days/yr	Shaw, 2009
SF_o	1.20E+01	$(mg/kg\text{-}day)^{-1}$	EPA, 2008	$IhR_{a,adults}$	20	m^3/day	PEA, 1999	$EF_{d,child}$	7	days/yr	Shaw, 2009
SF_i	3.90E+00	$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,child}$	10	m^3/day	PEA, 1999	ED_{adult}	24	yr	PEA, 1999
RfD_o		mg/kg-day	EPA, 2004a	$IR_{w,adult}$	2	L/day	DTSC, 2005	ED_{child}	6	yr	PEA, 1999
RfD_i		mg/kg-day	EPA, 2004a	$IR_{w,child}$	1	L/day	DTSC, 2005	BW_{adult}	70	kg	PEA, 1999
K_p	1.2E+00	cm/hr	PEA, 1999	$IR_{voc,adult}$	2	L/day	DTSC, 2005	BW_{child}	15	kg	PEA, 1999
ABS	0.15	unitless	PEA, 1999	$IR_{voc,child}$	1	L/day	DTSC, 2005	AT_c	70	yr	PEA, 1999
H_c	1.1E-06	atm-m^3/mole	EPA, 2008	$IR_{w,voc}$	2	L/day	PEA, 1999	$AT_{nc\text{-}adult}$	24	yr	PEA, 1999
H'	4.5E-05	unitless	calc'd. from H_c	ET_{adult}	4	hr/day	DTSC, 2005	$AT_{nc\text{-}child}$	6	yr	PEA, 1999
K_d	1.57E+04	L/kg	calc'd	ET_{child}	4	hr/day	DTSC, 2005	P_t	0.434	unitless	PEA, 1999
S	0.00162	mg/L	EPA, 2008	$SA_{adult\text{-}soil}$	5,800	cm^2/day	Shaw, 2009	P_w	0.150	unitless	PEA, 1999
D_i		cm^2/s	EPA, 2008	$SA_{child\text{-}soil}$	2,900	cm^2/day	Shaw, 2009	P_a	0.284	unitless	PEA, 1999
K_{ow}	1.00E+06	L/kg	EPA, 2004b	$SA_{adult\text{-}water}$		cm^2	NA	$C_{w\text{-}moisture}$	0.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	$SA_{child\text{-}water}$		cm^2	NA	θ_m	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}	7.87E+05	L/kg	EPA, 2008	AF	0.30	mg/cm^2	Shaw, 2009	σ	2.65	g/cm^3	PEA, 1999
VP	5.50E-09	mm Hg	EPA, 2004b	MW	250	atomic mass units	EPA, 2004	β	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, Interim Report, EPA/600/8-91/011B, Office of Research and Development, Washington, DC 20460, January.

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PEA, 1999, Preliminary Endangerment Assessment Guidance Manual, (Figures 1-8, Pages B-7 through B-14), State of California Environmental Protection Agency, Department of Toxic Substances Control, January, Second Printing, June, 1999.

Shaw, 2009, Supplemental Work Plan for Risk Assessment at Waste Accumulation Areas, Yosemite National Park, California, USACE Contract No. DACW05-96-D-0011, CTO No. 08 - WAD No. 02, Document Control Number: ACE08-367-H, Revision C, March.

PEAspread - Soil

Table E-5. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Benzo(a)pyrene **CASRN: 50-32-8**

$Cancer\ Risk_{soil}$ = $((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr)))$
$+ (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr)))$
$+ (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr)))$
$+ (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))))$

$Risk_{soil\text{-}adult,\ ingestion}$	=	2.E-09	ILCR	$Dose_{soil\text{-}adult,\ ingestion}$	=	1.E-10	mg/kg-day
$Risk_{soil\text{-}child,\ ingestion}$	=	4.E-09	ILCR	$Dose_{soil\text{-}child,\ ingestion}$	=	3.E-10	mg/kg-day
$Risk_{soil\text{-}adult,dermal}$	=	5.E-09	ILCR	$Dose_{soil\text{-}adult,dermal}$	=	4.E-10	mg/kg-day
$Risk_{soil\text{-}child,dermal}$	=	3.E-09	ILCR	$Dose_{soil\text{-}child,dermal}$	=	2.E-10	mg/kg-day
$Cancer\ Risk_{soil}$	**=**	**1.E-08**	**ILCR**	**$Combined\ Dose_{soil}$**	**=**	**1.E-09**	mg/kg-day

$Hazard\ Index_{soil}$ = $(((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc\text{-}adult}*365\ days/yr)))$
$+ ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc\text{-}child}*365\ days/yr)))$
$+ ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc\text{-}adult}*365\ days/yr)))$
$+ ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc\text{-}child}*365\ days/yr))))$

$Hazard\ Quotient_{soil\text{-}adult,\ ingestion}$	=	#DIV/0!	HQ	$Dose_{soil\text{-}adult,\ ingestion}$	4.E-10	mg/kg-day
$Hazard\ Quotient_{soil\text{-}child,\ ingestion}$	=	#DIV/0!	HQ	$Dose_{soil\text{-}child,\ ingestion}$	4.E-09	mg/kg-day
$Hazard\ Quotient_{soil\text{-}adult,dermal}$	=	#DIV/0!	HQ	$Dose_{soil\text{-}adult,dermal}$	1.E-09	mg/kg-day
$Hazard\ Quotient_{soil\text{-}child,dermal}$	=	#DIV/0!	HQ	$Dose_{soil\text{-}child,dermal}$	3.E-09	mg/kg-day
$Hazard\ Index_{soil}$	**=**	**#DIV/0!**	**HI**	**$Combined\ Dose_{soil}$**	**8.E-09**	mg/kg-day

PEAspread - Air

Table E-5. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Benzo(a)pyrene **CASRN: 50-32-8**

Cancer $Risk_{air}$	=	$(((SF_i*C_a)*((IR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_c*365\ day/yr)))$					
		$+((SF_i*Ca)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_c*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	2.55E+01	mg/kg	C_s	=	1.590E-02	mg/kg
E_i	=	#DIV/0!	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**			
C_a	=	8.E-10	mg/m^3	**But COPC is a Non-VOC**			
$Risk_{air-adult}$	=	6.E-12	**ILCR**	$Dose_{air-adult,inhalation}$	=	1.E-12	mg/kg-day
$Risk_{air-child}$	=	3.E-12	**ILCR**	$Dose_{air-child,\ inhalation}$	=	9.E-13	mg/kg-day
Cancer $Risk_{air}$	**=**	**9.E-12**	**ILCR**	**Combined $Dose_{air}$**	**=**	**2.E-12**	mg/kg-day
$Hazard_{air}$	=	$(((C_a/RfD_i)*((IhR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_{nc-adult}*365\ day/yr)))$					
		$+((C_a/RfD_i)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_{nc-child}*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	2.55E+01	mg/kg	C_s	=	1.59E-02	mg/kg
E_i	=	#DIV/0!	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**			
C_a	=	8.E-10	mg/m^3	**But COPC is a Non-VOC**			
Hazard $Quotient_{air-adult,\ vocs}$	=	#DIV/0!	**HQ**	$Dose_{air-vocs-adult,inhalation}$		4.E-12	mg/kg-day
Hazard $Quotient_{air-child,\ vocs}$	=	#DIV/0!	**HQ**	$Dose_{air-vocs-child,\ inhalation}$		1.E-11	mg/kg-day
Hazard $Index_{air,\ voc}$	**=**	**#DIV/0!**	**HI**	**Combined $Dose_{air-vocs}$**	**Total**	**1.E-11**	mg/kg-day

PEAspread - Physical & Chemical Data

Table E-6. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Benzo(g,h,i)perylene (Pyrene surrogate) **CASRN: 191-24-2**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	0.078	mg/kg	site-specific	$IR_{s,adult}$	100	mg/day	PEA, 1999	EF	7	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	$IR_{s,child}$	200	mg/day	PEA, 1999	$EF_{d,adult}$	7	days/yr	Shaw, 2009
SF_o		$(mg/kg\text{-}day)^{-1}$	EPA, 2009	$IhR_{a,adults}$	20	m^3/day	PEA, 1999	$EF_{d,child}$	7	days/yr	Shaw, 2009
SF_i		$(mg/kg\text{-}day)^{-1}$	EPA, 2009	$IhR_{a,child}$	10	m^3/day	PEA, 1999	ED_{adult}	24	yr	PEA, 1999
RfD_o	3.0E-02	mg/kg-day	EPA, 2004a	$IR_{w,adult}$	2	L/day	DTSC, 2005	ED_{child}	6	yr	PEA, 1999
RfD_i	3.0E-02	mg/kg-day	EPA, 2004a	$IR_{w,child}$	1	L/day	DTSC, 2005	BW_{adult}	70	kg	PEA, 1999
K_p	2.7E-01	cm/hr	EPA, 1992	$IR_{voc,adult}$	2	L/day	DTSC, 2005	BW_{child}	15	kg	PEA, 1999
ABS	0.15	unitless	PEA, 1999	$IR_{voc,child}$	1	L/day	DTSC, 2005	AT_c	70	yr	PEA, 1999
H_c	1.4E-07	atm-m^3/mole	EPA, 2008	$IR_{w,voc}$	2	L/day	PEA, 1999	$AT_{nc\text{-}adult}$	24	yr	PEA, 1999
H'	5.7E-06	unitless	calc'd. from H_c	ET_{adult}	4	hr/day	DTSC, 2005	$AT_{nc\text{-}child}$	6	yr	PEA, 1999
K_d	1.39E+03	L/kg	calc'd from K_{ow}	ET_{child}	4	hr/day	DTSC, 2005	P_t	0.434	unitless	PEA, 1999
S	2.6E-04	mg/L	EPA, 2004b	$SA_{adult\text{-}soil}$	5,800	cm^2/day	Shaw, 2009	P_w	0.150	unitless	PEA, 1999
D_i	2.80E-02	cm^2/s	EPA, 2008	$SA_{child\text{-}soil}$	2,900	cm^2/day	Shaw, 2009	P_a	0.284	unitless	PEA, 1999
K_{ow}	3.16E+04	L/kg	EPA, 2004b	$SA_{adult\text{-}water}$		cm^2	NA	$C_{w\text{-}moisture}$	0.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	$SA_{child\text{-}water}$		cm^2	NA	θ_m	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}	6.94E+04	L/kg	EPA, 2008	AF	0.30	mg/cm^2	Shaw, 2009	σ	2.65	g/cm^3	PEA, 1999
VP	1.0E-10	mm Hg	EPA, 2008	MW	276.34	atomic mass units	EPA, 2004	β	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, Interim Report, EPA/600/8-91/011B, Office of Research and Development, Washington, DC 20460, January.

EPA, 2004a, Region 9 Preliminary Remediation Goals (PRGs) 2004, United States Environmental Protection Agency Region IX, San Francisco, CA, October 1.

EPA, 2004b, Superfund Chemical Data Matrix, *http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm*

EPA, 2008, Regional Screening Levels for Chemical Contaminants at Superfund Sites, Internet URL: h *ttp://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm* .

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PEAspread - Soil

Table E-6. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Benzo(g,h,i)perylene (Pyrene surrogate) **CASRN: 191-24-2**

$$\text{Cancer Risk}_{soil} = ((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr))) + (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))) + (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr))) + (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))))$$

$Risk_{soil\text{-}adult,\ ingestion}$	=	0.E+00	ILCR	$Dose_{soil\text{-}adult,\ ingestion}$	=	7.E-10	mg/kg-day
$Risk_{soil\text{-}child,\ ingestion}$	=	0.E+00	ILCR	$Dose_{soil\text{-}child,\ ingestion}$	=	2.E-09	mg/kg-day
$Risk_{soil\text{-}adult,dermal}$	=	0.E+00	ILCR	$Dose_{soil\text{-}adult,dermal}$	=	2.E-09	mg/kg-day
$Risk_{soil\text{-}child,dermal}$	=	0.E+00	ILCR	$Dose_{soil\text{-}child,dermal}$	=	1.E-09	mg/kg-day
Cancer Risk$_{soil}$	**=**	**0.E+00**	**ILCR**	**Combined Dose$_{soil}$**	**=**	**5.E-09**	mg/kg-day

$$\text{Hazard Index}_{soil} = (((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc\text{-}adult}*365\ days/yr))) + ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc\text{-}child}*365\ days/yr))) + ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc\text{-}adult}*365\ days/yr))) + ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc\text{-}child}*365\ days/yr))))$$

$\text{Hazard Quotient}_{soil\text{-}adult,\ ingestion}$	=	7.E-08	HQ	$Dose_{soil\text{-}adult,\ ingestion}$	2.E-09	mg/kg-day
$\text{Hazard Quotient}_{soil\text{-}child,\ ingestion}$	=	7.E-07	HQ	$Dose_{soil\text{-}child,\ ingestion}$	2.E-08	mg/kg-day
$\text{Hazard Quotient}_{soil\text{-}adult,dermal}$	=	2.E-07	HQ	$Dose_{soil\text{-}adult,dermal}$	6.E-09	mg/kg-day
$\text{Hazard Quotient}_{soil\text{-}child,dermal}$	=	4.E-07	HQ	$Dose_{soil\text{-}child,dermal}$	1.E-08	mg/kg-day
Hazard Index$_{soil}$	**=**	**1.E-06**	**HI**	**Combined Dose$_{soil}$**	**4.E-08**	mg/kg-day

PEAspread - Air

Table E-6. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Benzo(g,h,i)perylene (Pyrene surrogate) **CASRN: 191-24-2**

Cancer $Risk_{air}$	=	$(((SF_i*C_a)*((IR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_c*365\ day/yr)))$
		$+((SF_i*Ca)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_c*365\ day/yr))))$
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$ = $C_s*(5*10^{-8}\ kg/m^3)$
or for VOCs, where C_a	=	$E_i/99$ when $C_s \leq C_{sat}$
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]

C_{sat}	=	3.61E-01	mg/kg	C_s	=	7.800E-02	mg/kg
E_i	=	2.97E-08	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**			
C_a	=	4.E-09	mg/m^3	**But COPC is a Non-VOC**			
$Risk_{air-adult}$	=	0.E+00	**ILCR**	$Dose_{air-adult,inhalation}$	=	7.E-12	mg/kg-day
$Risk_{air-child}$	=	0.E+00	**ILCR**	$Dose_{air-child,\ inhalation}$	=	4.E-12	mg/kg-day
Cancer $Risk_{air}$	**=**	**0.E+00**	**ILCR**	**Combined $Dose_{air}$**	**=**	**1.E-11**	mg/kg-day

$Hazard_{air}$	=	$(((C_a/RfD_i)*((IhR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_{nc-adult}*365\ day/yr)))$
		$+((C_a/RfD_i)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_{nc-child}*365\ day/yr))))$
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$ = $C_s*(5*10^{-8}\ kg/m^3)$
or for VOCs, where C_a	=	$E_i/99$ when $C_s \leq C_{sat}$
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]

C_{sat}	=	3.61E-01	mg/kg	C_s	=	7.80E-02	mg/kg
E_i	=	2.97E-08	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**			
C_a	=	4.E-09	mg/m^3	**But COPC is a Non-VOC**			
Hazard $Quotient_{air-adult,\ vocs}$	=	7.E-10	**HQ**	$Dose_{air-vocs-adult,inhalation}$		2.E-11	mg/kg-day
Hazard $Quotient_{air-child,\ vocs}$	=	2.E-09	**HQ**	$Dose_{air-vocs-child,\ inhalation}$		5.E-11	mg/kg-day
Hazard $Index_{air,\ voc}$	**=**	**2.E-09**	**HI**	**Combined $Dose_{air-vocs}$**	**Total**	**7.E-11**	mg/kg-day

PEAspread - Physical & Chemical Data

Table E-7. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Cadmium and compounds **CASRN: 7440-43-9**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	2.96	mg/kg	site-specific	$IR_{s,adult}$	100	mg/day	PEA, 1999	EF	7	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	$IR_{s,child}$	200	mg/day	PEA, 1999	$EF_{d,adult}$	7	days/yr	Shaw, 2009
SF_o	3.80E-01	$(mg/kg\text{-}day)^{-1}$	OEHHA, 2009a	$IhR_{a,adults}$	20	m^3/day	PEA, 1999	$EF_{d,child}$	7	days/yr	Shaw, 2009
SF_i	1.50E+01	$(mg/kg\text{-}day)^{-1}$	OEHHA, 2009a	$IhR_{a,child}$	10	m^3/day	PEA, 1999	ED_{adult}	24	yr	PEA, 1999
RfD_o	5.0E-04	mg/kg-day	OEHHA, 2009a	$IR_{w,adult}$	2	L/day	DTSC, 2005	ED_{child}	6	yr	PEA, 1999
RfD_i	5.7E+06	mg/kg-day	OEHHA, 2009a	$IR_{w,child}$	1	L/day	DTSC, 2005	BW_{adult}	70	kg	PEA, 1999
K_p	1.0E-03	cm/hr	EPA, 1992	$IR_{voc,adult}$	2	L/day	DTSC, 2005	BW_{child}	15	kg	PEA, 1999
ABS	0.001	unitless	PEA, 1999	$IR_{voc,child}$	1	L/day	DTSC, 2005	AT_c	70	yr	PEA, 1999
H_c		atm-m^3/mole	EPA, 2004b	$IR_{w,voc}$	2	L/day	PEA, 1999	$AT_{nc\text{-}adult}$	24	yr	PEA, 1999
H'	0.0E+00	unitless	calc'd. from H_c	ET_{adult}	4	hr/day	DTSC, 2005	$AT_{nc\text{-}child}$	6	yr	PEA, 1999
K_d	0.00E+00	L/kg	calc'd	ET_{child}	4	hr/day	DTSC, 2005	P_t	0.434	unitless	PEA, 1999
S	0.0E+00	mg/L	EPA, 2008	$SA_{adult\text{-}soil}$	5,800	cm^2/day	Shaw, 2009	P_w	0.150	unitless	PEA, 1999
D_i		cm^2/s	EPA, 2008	$SA_{child\text{-}soil}$	2,900	cm^2/day	Shaw, 2009	P_a	0.284	unitless	PEA, 1999
K_{ow}	8.51E-01	L/kg	EPA, 2004b	$SA_{adult\text{-}water}$		cm^2	NA	$C_{w\text{-}moisture}$	0.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	$SA_{child\text{-}water}$		cm^2	NA	θ_m	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}		L/kg	EPA, 2008	AF	0.30	mg/cm^2	Shaw, 2009	σ	2.65	g/cm^3	PEA, 1999
VP		mm Hg	EPA, 2004b	MW	112.41	atomic mass units	EPA, 2004	β	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, Interim Report, EPA/600/8-91/011B, Office of Research and Development, Washington, DC 20460, January.

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EPA, 2009, IRIS Data Base, www.epa.gov/iris

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Shaw, 2009, Supplemental Work Plan for Risk Assessment at Waste Accumulation Areas, Yosemite National Park, California, USACE Contract No. DACW05-96-D-0011, CTO No. 08 - WAD No. 02, Document Control Number: ACE08-367-H, Revision C, March.

PEAspread - Soil

Table E-7. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Cadmium and compounds **CASRN: 7440-43-9**

$$Cancer\ Risk_{soil} = ((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr))) + (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))) + (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr))) + (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))))$$

$Risk_{soil\text{-}adult,\ ingestion}$	=	1.E-08	**ILCR**	$Dose_{soil\text{-}adult,\ ingestion}$	=	3.E-08	mg/kg-day
$Risk_{soil\text{-}child,\ ingestion}$	=	2.E-08	**ILCR**	$Dose_{soil\text{-}child,\ ingestion}$	=	6.E-08	mg/kg-day
$Risk_{soil\text{-}adult,dermal}$	=	2.E-10	**ILCR**	$Dose_{soil\text{-}adult,dermal}$	=	5.E-10	mg/kg-day
$Risk_{soil\text{-}child,dermal}$	=	1.E-10	**ILCR**	$Dose_{soil\text{-}child,dermal}$	=	3.E-10	mg/kg-day
Cancer $Risk_{soil}$	**=**	**4.E-08**	**ILCR**	**Combined $Dose_{soil}$**	**=**	**9.E-08**	mg/kg-day

$$Hazard\ Index_{soil} = (((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc\text{-}adult}*365\ days/yr))) + ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc\text{-}child}*365\ days/yr))) + ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc\text{-}adult}*365\ days/yr))) + ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc\text{-}child}*365\ days/yr))))$$

Hazard $Quotient_{soil\text{-}adult,\ ingestion}$	=	2.E-04	**HQ**	$Dose_{soil\text{-}adult,\ ingestion}$	8.E-08	mg/kg-day
Hazard $Quotient_{soil\text{-}child,\ ingestion}$	=	2.E-03	**HQ**	$Dose_{soil\text{-}child,\ ingestion}$	8.E-07	mg/kg-day
Hazard $Quotient_{soil\text{-}adult,dermal}$	=	3.E-06	**HQ**	$Dose_{soil\text{-}adult,dermal}$	1.E-09	mg/kg-day
Hazard $Quotient_{soil\text{-}child,dermal}$	=	7.E-06	**HQ**	$Dose_{soil\text{-}child,dermal}$	3.E-09	mg/kg-day
Hazard $Index_{soil}$	**=**	**2.E-03**	**HI**	**Combined $Dose_{soil}$**	**8.E-07**	mg/kg-day

PEAspread - Air

Table E-7. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Cadmium and compounds **CASRN: 7440-43-9**

Cancer $Risk_{air}$	=	$(((SF_i*C_a)*((IR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_c*365\ day/yr)))$					
		$+((SF_i*Ca)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_c*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	0.00E+00	mg/kg	C_s	=	2.960E+00 mg/kg	
E_i	=	#DIV/0!	mg/sec	**SCREENING METHOD NOT VALID FOR VOCs**			
C_a	=	1.E-07	mg/m^3	**But COPC is a Non-VOC**			
$Risk_{air-adult}$	=	4.E-09	**ILCR**	$Dose_{air-adult,inhalation}$	=	3.E-10	mg/kg-day
$Risk_{air-child}$	=	2.E-09	**ILCR**	$Dose_{air-child,\ inhalation}$	=	2.E-10	mg/kg-day
Cancer $Risk_{air}$	**=**	**7.E-09**	**ILCR**	**Combined $Dose_{air}$**	**=**	**4.E-10**	mg/kg-day

$Hazard_{air}$	=	$(((C_a/RfD_i)*((IhR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_{nc-adult}*365\ day/yr)))$					
		$+((C_a/RfD_i)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_{nc-child}*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	0.00E+00	mg/kg	C_s	=	2.96E+00 mg/kg	
E_i	=	#DIV/0!	mg/sec	**Screening Method Not Valid for VOCs**			
C_a	=	1.E-07	mg/m^3	**But COPC is a Non-VOC**			
Hazard $Quotient_{air-adult,\ vocs}$	=	1.E-16	**HQ**	$Dose_{air-vocs-adult,inhalation}$		8.E-10	mg/kg-day
Hazard $Quotient_{air-child,\ vocs}$	=	3.E-16	**HQ**	$Dose_{air-vocs-child,\ inhalation}$		2.E-09	mg/kg-day
Hazard $Index_{air,\ voc}$	**=**	**5.E-16**	**HI**	**Combined $Dose_{air-vocs}$**	**Total**	**3.E-09**	mg/kg-day

PEAspread - Physical & Chemical Data

Table E-8. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Iron compounds **CASRN: 7439-89-6**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	32,900	mg/kg	site-specific	$IR_{s,adult}$	100	mg/day	PEA, 1999	EF	7	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	$IR_{s,child}$	200	mg/day	PEA, 1999	$EF_{d,adult}$	7	days/yr	Shaw, 2009
SF_o		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,adults}$	20	m^3/day	PEA, 1999	$EF_{d,child}$	7	days/yr	Shaw, 2009
SF_i		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,child}$	10	m^3/day	PEA, 1999	ED_{adult}	24	yr	PEA, 1999
RfD_o	3.0E-01	mg/kg-day	EPA, 2004a	$IR_{w,adult}$	2	L/day	DTSC, 2005	ED_{child}	6	yr	PEA, 1999
RfD_i		mg/kg-day	EPA, 2004a	$IR_{w,child}$	1	L/day	DTSC, 2005	BW_{adult}	70	kg	PEA, 1999
K_p		cm/hr	EPA, 2008	$IR_{voc,adult}$	2	L/day	DTSC, 2005	BW_{child}	15	kg	PEA, 1999
ABS	0.01	unitless	PEA, 1999	$IR_{voc,child}$	1	L/day	DTSC, 2005	AT_c	70	yr	PEA, 1999
H_c		atm-m^3/mole	EPA, 2008	$IR_{w,voc}$	2	L/day	PEA, 1999	$AT_{nc\text{-}adult}$	24	yr	PEA, 1999
H'	0.0E+00	unitless	calc'd. from H_c	ET_{adult}	4	hr/day	DTSC, 2005	$AT_{nc\text{-}child}$	6	yr	PEA, 1999
K_d	0.00E+00	L/kg	calc'd	ET_{child}	4	hr/day	DTSC, 2005	P_t	0.434	unitless	PEA, 1999
S	0.0	mg/L	EPA, 2008	$SA_{adult\text{-}soil}$	5,800	cm^2/day	Shaw, 2009	P_w	0.150	unitless	PEA, 1999
D_i		cm^2/s	EPA, 2008	$SA_{child\text{-}soil}$	2,900	cm^2/day	Shaw, 2009	P_a	0.284	unitless	PEA, 1999
K_{ow}	1.00E+00	L/kg	EPA, 2004b	$SA_{adult\text{-}water}$		cm^2	NA	$C_{w\text{-}moisture}$	0.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	$SA_{child\text{-}water}$		cm^2	NA	θ_m	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}		L/kg	EPA, 2008	AF	0.30	mg/cm^2	Shaw, 2009	σ	2.65	g/cm^3	PEA, 1999
VP		mm Hg	EPA, 2004b	MW	55.85	atomic mass units	EPA, 2004	β	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <===> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, Interim Report, EPA/600/8-91/011B, Office of Research and Development, Washington, DC 20460, January.

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Shaw, 2009, Supplemental Work Plan for Risk Assessment at Waste Accumulation Areas, Yosemite National Park, California, USACE Contract No. DACW05-96-D-0011, CTO No. 08 - WAD No. 02, Document Control Number: ACE08-367-H, Revision C, March.

PEAspread - Soil

Table E-8. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Iron compounds **CASRN: 7439-89-6**

$Cancer\ Risk_{soil}$ = $((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr)))$
$+ (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr)))$
$+ (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr)))$
$+ (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))))$

$Risk_{soil-adult, ingestior}$	=	0.E+00	**ILCR**	$Dose_{soil-adult, ingestior}$	=	3.E-04	mg/kg-day
$Risk_{soil-child, ingestior}$	=	0.E+00	**ILCR**	$Dose_{soil-child, ingestior}$	=	7.E-04	mg/kg-day
$Risk_{soil-adult,derma}$	=	0.E+00	**ILCR**	$Dose_{soil-adult,derma}$	=	5.E-05	mg/kg-day
$Risk_{soil-child,derma}$	=	0.E+00	**ILCR**	$Dose_{soil-child,derma}$	=	3.E-05	mg/kg-day
$Cancer\ Risk_{soil}$	**=**	**0.E+00**	**ILCR**	**$Combined\ Dose_{soil}$**	**=**	**1.E-03**	mg/kg-day

$Hazard\ Index_{soil}$ = $(((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc-adult}*365\ days/yr)))$
$+ ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc-chilc}*365\ days/yr)))$
$+ ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc-adult}*365\ days/yr)))$
$+ ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc-chilc}*365\ days/yr))))$

$Hazard\ Quotient_{soil-adult, ingestior}$	=	3.E-03	**HQ**	$Dose_{soil-adult, ingestior}$	9.E-04	mg/kg-day
$Hazard\ Quotient_{soil-child, ingestior}$	=	3.E-02	**HQ**	$Dose_{soil-child, ingestior}$	8.E-03	mg/kg-day
$Hazard\ Quotient_{soil-adult,derma}$	=	5.E-04	**HQ**	$Dose_{soil-adult,derma}$	2.E-04	mg/kg-day
$Hazard\ Quotient_{soil-child,derma}$	=	1.E-03	**HQ**	$Dose_{soil-child,derma}$	4.E-04	mg/kg-day
$Hazard\ Index_{soil}$	**=**	**3.E-02**	**HI**	**$Combined\ Dose_{soil}$**	**1.E-02**	mg/kg-day

PEAspread - Air

Table E-8. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Iron compounds **CASRN: 7439-89-6**

Cancer $Risk_{air}$	=	$(((SF_i*C_a)*((IR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_c*365\ day/yr)))$					
		$+((SF_i*Ca)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_c*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	0.00E+00	mg/kg	C_s	=	3.290E+04 mg/kg	
E_i	=	#DIV/0!	mg/sec	SCREENING METHOD NOT VALID FOR VOCs			
C_a	=	2.E-03	mg/m^3	But COPC is a Non-VOC			
$Risk_{air-adult}$	=	0.E+00	ILCR	$Dose_{air-adult,inhalation}$	=	3.E-06	mg/kg-day
$Risk_{air-child}$	=	0.E+00	ILCR	$Dose_{air-child, inhalation}$	=	2.E-06	mg/kg-day
Cancer $Risk_{air}$	**=**	**0.E+00**	**ILCR**	**Combined $Dose_{air}$**	**=**	**5.E-06**	mg/kg-day
$Hazard_{air}$	=	$(((C_a/RfD_i)*((IhR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_{nc-adult}*365\ day/yr)))$					
		$+((C_a/RfD_i)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_{nc-child}*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	0.00E+00	mg/kg	C_s	=	3.29E+04 mg/kg	
E_i	=	#DIV/0!	mg/sec	Screening Method Not Valid for VOCs			
C_a	=	2.E-03	mg/m^3	But COPC is a Non-VOC			
Hazard $Quotient_{air-adult, vocs}$	=	#DIV/0!	HQ	$Dose_{air-vocs-adult,inhalation}$		9.E-06	mg/kg-day
Hazard $Quotient_{air-child, vocs}$	=	#DIV/0!	HQ	$Dose_{air-vocs-child, inhalation}$		2.E-05	mg/kg-day
Hazard $Index_{air, voc}$	**=**	**#DIV/0!**	**HI**	**Combined $Dose_{air-vocs}$**	**Total**	**3.E-05**	mg/kg-day

PEAspread - Physical & Chemical Data

Table E-9. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Manganese and compounds **CASRN: 7439-96-5**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	1,550	mg/kg	site-specific	$IR_{s,adult}$	100	mg/day	PEA, 1999	EF	7	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	$IR_{s,child}$	200	mg/day	PEA, 1999	$EF_{d,adult}$	7	days/yr	Shaw, 2009
SF_o		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,adults}$	20	m^3/day	PEA, 1999	$EF_{d,child}$	7	days/yr	Shaw, 2009
SF_i		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,child}$	10	m^3/day	PEA, 1999	ED_{adult}	24	yr	PEA, 1999
RfD_o	2.4E-02	mg/kg-day	EPA, 2004a	$IR_{w,adult}$	2	L/day	DTSC, 2005	ED_{child}	6	yr	PEA, 1999
RfD_i	1.4E-05	mg/kg-day	EPA, 2004a	$IR_{w,child}$	1	L/day	DTSC, 2005	BW_{adult}	70	kg	PEA, 1999
K_p		cm/hr	EPA, 1992	$IR_{voc,adult}$	2	L/day	DTSC, 2005	BW_{child}	15	kg	PEA, 1999
ABS	0.01	unitless	PEA, 1999	$IR_{voc,child}$	1	L/day	DTSC, 2005	AT_c	70	yr	PEA, 1999
H_c		atm-m^3/mole	EPA, 2008	$IR_{w,voc}$	2	L/day	PEA, 1999	$AT_{nc\text{-}adult}$	24	yr	PEA, 1999
H'	0.0E+00	unitless	calc'd. from H_c	ET_{adult}	4	hr/day	DTSC, 2005	$AT_{nc\text{-}child}$	6	yr	PEA, 1999
K_d	0.00E+00	L/kg	calc'd	ET_{child}	4	hr/day	DTSC, 2005	P_t	0.434	unitless	PEA, 1999
S	0.0	mg/L	EPA, 2008	$SA_{adult\text{-}soil}$	5,800	cm^2/day	Shaw, 2009	P_w	0.150	unitless	PEA, 1999
D_i		cm^2/s	EPA, 2008	$SA_{child\text{-}soil}$	2,900	cm^2/day	Shaw, 2009	P_a	0.284	unitless	PEA, 1999
K_{ow}	1.70E+00	L/kg	EPA, 2004b	$SA_{adult\text{-}water}$		cm^2	NA	$C_{w\text{-}moisture}$	0.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	$SA_{child\text{-}water}$		cm^2	NA	θ_m	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}		L/kg	EPA, 2004b	AF	0.30	mg/cm^2	Shaw, 2009	σ	2.65	g/cm^3	PEA, 1999
VP		mm Hg	EPA, 2004b	MW	55	atomic mass units	EPA, 2004	β	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, Interim Report, EPA/600/8-91/011B, Office of Research and Development, Washington, DC 20460, January.

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PEA, 1999, Preliminary Endangerment Assessment Guidance Manual, (Figures 1-8, Pages B-7 through B-14), State of California Environmental Protection Agency, Department of Toxic Substances Control, January, Second Printing, June, 1999.

Shaw, 2009, Supplemental Work Plan for Risk Assessment at Waste Accumulation Areas, Yosemite National Park, California, USACE Contract No. DACW05-96-D-0011, CTO No. 08 - WAD No. 02, Document Control Number: ACE08-367-H, Revision C, March.

PEAspread - Soil

Table E-9. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Manganese and compounds **CASRN: 7439-96-5**

$$\text{Cancer Risk}_{soil} = ((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_c*365\text{ days/yr})))$$
$$+ (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_c*365\text{ days/yr})))$$
$$+ (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_c*365\text{ days/yr})))$$
$$+ (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_c*365\text{ days/yr}))))$$

$\text{Risk}_{soil\text{-}adult,\ ingestion}$	=	0.E+00	**ILCR**	$\text{Dose}_{soil\text{-}adult,\ ingestion}$	=	1.E-05	mg/kg-day
$\text{Risk}_{soil\text{-}child,\ ingestion}$	=	0.E+00	**ILCR**	$\text{Dose}_{soil\text{-}child,\ ingestion}$	=	3.E-05	mg/kg-day
$\text{Risk}_{soil\text{-}adult,dermal}$	=	0.E+00	**ILCR**	$\text{Dose}_{soil\text{-}adult,dermal}$	=	3.E-06	mg/kg-day
$\text{Risk}_{soil\text{-}child,dermal}$	=	0.E+00	**ILCR**	$\text{Dose}_{soil\text{-}child,dermal}$	=	1.E-06	mg/kg-day
Cancer Risk$_{soil}$	**=**	**0.E+00**	**ILCR**	**Combined Dose$_{soil}$**	**=**	**5.E-05**	mg/kg-day

$$\text{Hazard Index}_{soil} = (((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_{nc\text{-}adult}*365\text{ days/yr})))$$
$$+ ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_{nc\text{-}child}*365\text{ days/yr})))$$
$$+ ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_{nc\text{-}adult}*365\text{ days/yr})))$$
$$+ ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_{nc\text{-}child}*365\text{ days/yr}))))$$

$\text{Hazard Quotient}_{soil\text{-}adult,\ ingestion}$	=	2.E-03	**HQ**	$\text{Dose}_{soil\text{-}adult,\ ingestion}$	4.E-05	mg/kg-day
$\text{Hazard Quotient}_{soil\text{-}child,\ ingestion}$	=	2.E-02	**HQ**	$\text{Dose}_{soil\text{-}child,\ ingestion}$	4.E-04	mg/kg-day
$\text{Hazard Quotient}_{soil\text{-}adult,dermal}$	=	3.E-04	**HQ**	$\text{Dose}_{soil\text{-}adult,dermal}$	7.E-06	mg/kg-day
$\text{Hazard Quotient}_{soil\text{-}child,dermal}$	=	7.E-04	**HQ**	$\text{Dose}_{soil\text{-}child,dermal}$	2.E-05	mg/kg-day
Hazard Index$_{soil}$	**=**	**2.E-02**	**HI**	**Combined Dose$_{soil}$**	**5.E-04**	mg/kg-day

PEAspread - Air

Table E-9. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Manganese and compounds **CASRN: 7439-96-5**

Cancer $Risk_{air}$	=	$(((SF_i*C_a)*((IR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_c*365\ day/yr)))$					
		$+((SF_i*Ca)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_c*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \le C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	0.00E+00	mg/kg	C_s	=	1.550E+03 mg/kg	
E_i	=	#DIV/0!	mg/sec	**SCREENING METHOD NOT VALID FOR VOCs**			
C_a	=	8.E-05	mg/m^3	**But COPC is a Non-VOC**			
$Risk_{air-adult}$	=	0.E+00	**ILCR**	$Dose_{air-adult,inhalation}$	=	1.E-07	mg/kg-day
$Risk_{air-child}$	=	0.E+00	**ILCR**	$Dose_{air-child,\ inhalation}$	=	8.E-08	mg/kg-day
Cancer $Risk_{air}$	**=**	**0.E+00**	**ILCR**	**Combined $Dose_{air}$**	**=**	**2.E-07**	mg/kg-day
$Hazard_{air}$	=	$(((C_a/RfD_i)*((IhR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_{nc-adult}*365\ day/yr)))$					
		$+((C_a/RfD_i)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_{nc-child}*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \le C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	0.00E+00	mg/kg	C_s	=	1.55E+03 mg/kg	
E_i	=	#DIV/0!	mg/sec	**Screening Method Not Valid for VOCs**			
C_a	=	8.E-05	mg/m^3	**But COPC is a Non-VOC**			
Hazard $Quotient_{air-adult,\ vocs}$	=	3.E-02	**HQ**	$Dose_{air-vocs-adult,inhalation}$		4.E-07	mg/kg-day
Hazard $Quotient_{air-child,\ vocs}$	=	7.E-02	**HQ**	$Dose_{air-vocs-child,\ inhalation}$		1.E-06	mg/kg-day
Hazard $Index_{air,\ voc}$	**=**	**1.E-01**	**HI**	**Combined $Dose_{air-vocs}$**	**Total**	**1.E-06**	mg/kg-day

PEAspread - Physical & Chemical Data

Table E-10. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Phenanthrene (Pyrene surrogate) **CASRN: 85-1-08**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	0.00994	mg/kg	site-specific	$IR_{s,adult}$	100	mg/day	PEA, 1999	EF	7	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	$IR_{s,child}$	200	mg/day	PEA, 1999	$EF_{d,adult}$	7	days/yr	Shaw, 2009
SF_o		$(mg/kg\text{-}day)^{-1}$	EPA, 2008	$IhR_{a,adults}$	20	m^3/day	PEA, 1999	$EF_{d,child}$	7	days/yr	Shaw, 2009
SF_i		$(mg/kg\text{-}day)^{-1}$	EPA, 2008	$IhR_{a,child}$	10	m^3/day	PEA, 1999	ED_{adult}	24	yr	PEA, 1999
RfD_o	3.0E-02	mg/kg-day	EPA, 2008	$IR_{w,adult}$	2	L/day	DTSC, 2005	ED_{child}	6	yr	PEA, 1999
RfD_i	3.0E-02	mg/kg-day	EPA, 2008	$IR_{w,child}$	1	L/day	DTSC, 2005	BW_{adult}	70	kg	PEA, 1999
K_p	2.7E-01	cm/hr	EPA, 1992	$IR_{voc,adult}$	2	L/day	DTSC, 2005	BW_{child}	15	kg	PEA, 1999
ABS	0.15	unitless	PEA, 1999	$IR_{voc,child}$	1	L/day	DTSC, 2005	AT_c	70	yr	PEA, 1999
H_c	1.4E-07	atm-m^3/mole	EPA, 2008	$IR_{w,voc}$	2	L/day	PEA, 1999	$AT_{nc\text{-}adult}$	24	yr	PEA, 1999
H'	5.7E-06	unitless	calc'd. from H_c	ET_{adult}	4	hr/day	DTSC, 2005	$AT_{nc\text{-}child}$	6	yr	PEA, 1999
K_d	9.50E+03	L/kg	calc'd	ET_{child}	4	hr/day	DTSC, 2005	P_t	0.434	unitless	PEA, 1999
S	1.1	mg/L	EPA, 2004b	$SA_{adult\text{-}soil}$	5,800	cm^2/day	Shaw, 2009	P_w	0.150	unitless	PEA, 1999
D_i	2.80E-02	cm^2/s	EPA, 2008	$SA_{child\text{-}soil}$	2,900	cm^2/day	Shaw, 2009	P_a	0.284	unitless	PEA, 1999
K_{ow}	3.16E+04	L/kg	EPA, 2004b	$SA_{adult\text{-}water}$		cm^2	NA	$C_{w\text{-}moisture}$	0.11	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	$SA_{child\text{-}water}$		cm^2	NA	θ_m	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}	6.94E+04	L/kg	EPA, 2008	AF	0.30	mg/cm^2	Shaw, 2009	σ	2.65	g/cm^3	PEA, 1999
VP	4.60E-06	mm Hg	EPA, 2004b	MW	178.2	atomic mass units	EPA, 2004	β	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, Interim Report, EPA/600/8-91/011B, Office of Research and Development, Washington, DC 20460, January.

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PEAspread - Soil

Table E-10. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Phenanthrene (Pyrene surrogate) **CASRN: 85-1-08**

$$\text{Cancer Risk}_{soil} = ((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_c*365\text{ days/yr})))$$
$$+ (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_c*365\text{ days/yr})))$$
$$+ (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_c*365\text{ days/yr})))$$
$$+ (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_c*365\text{ days/yr}))))$$

$\text{Risk}_{soil\text{-}adult,\ ingestion}$	=	0.E+00	**ILCR**	$\text{Dose}_{soil\text{-}adult,\ ingestion}$	=	9.E-11	mg/kg-day
$\text{Risk}_{soil\text{-}child,\ ingestion}$	=	0.E+00	**ILCR**	$\text{Dose}_{soil\text{-}child,\ ingestion}$	=	2.E-10	mg/kg-day
$\text{Risk}_{soil\text{-}adult,dermal}$	=	0.E+00	**ILCR**	$\text{Dose}_{soil\text{-}adult,dermal}$	=	2.E-10	mg/kg-day
$\text{Risk}_{soil\text{-}child,dermal}$	=	0.E+00	**ILCR**	$\text{Dose}_{soil\text{-}child,dermal}$	=	1.E-10	mg/kg-day
$\text{Cancer Risk}_{soil}$	**=**	**0.E+00**	**ILCR**	**$\text{Combined Dose}_{soil}$**	**=**	**7.E-10**	mg/kg-day

$$\text{Hazard Index}_{soil} = (((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_{nc\text{-}adult}*365\text{ days/yr})))$$
$$+ ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_{nc\text{-}child}*365\text{ days/yr})))$$
$$+ ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_{nc\text{-}adult}*365\text{ days/yr})))$$
$$+ ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_{nc\text{-}child}*365\text{ days/yr}))))$$

$\text{Hazard Quotient}_{soil\text{-}adult,\ ingestion}$	=	9.E-09	**HQ**	$\text{Dose}_{soil\text{-}adult,\ ingestion}$	3.E-10	mg/kg-day
$\text{Hazard Quotient}_{soil\text{-}child,\ ingestion}$	=	8.E-08	**HQ**	$\text{Dose}_{soil\text{-}child,\ ingestion}$	3.E-09	mg/kg-day
$\text{Hazard Quotient}_{soil\text{-}adult,dermal}$	=	2.E-08	**HQ**	$\text{Dose}_{soil\text{-}adult,dermal}$	7.E-10	mg/kg-day
$\text{Hazard Quotient}_{soil\text{-}child,dermal}$	=	6.E-08	**HQ**	$\text{Dose}_{soil\text{-}child,dermal}$	2.E-09	mg/kg-day
$\text{Hazard Index}_{soil}$	**=**	**2.E-07**	**HI**	**$\text{Combined Dose}_{soil}$**	**5.E-09**	mg/kg-day

PEAspread - Air

Table E-10. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Phenanthrene (Pyrene surrogate) **CASRN: 85-1-08**

Cancer $Risk_{air}$	=	$(((SF_i*C_a)*((IR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_c*365\ day/yr)))$						
		$+((SF_i*Ca)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_c*365\ day/yr))))$						
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$			=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$				
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$						
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]						
C_{sat}	=	1.05E+04	mg/kg	C_s	=	9.940E-03	mg/kg	
E_i	=	1.44E-09	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**				
C_a	=	5.E-10	mg/m^3	**But COPC is a Non-VOC**				
$Risk_{air-adult}$	=	0.E+00	**ILCR**	$Dose_{air-adult,inhalation}$	=	9.E-13	mg/kg-day	
$Risk_{air-child}$	=	0.E+00	**ILCR**	$Dose_{air-child,\ inhalation}$	=	5.E-13	mg/kg-day	
Cancer $Risk_{air}$	**=**	**0.E+00**	**ILCR**	**Combined $Dose_{air}$**	**=**	**1.E-12**	mg/kg-day	
$Hazard_{air}$	=	$(((C_a/RfD_i)*((IhR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_{nc-adult}*365\ day/yr)))$						
		$+((C_a/RfD_i)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_{nc-child}*365\ day/yr))))$						
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$			=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$				
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$						
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]						
C_{sat}	=	1.05E+04	mg/kg	C_s	=	9.94E-03	mg/kg	
E_i	=	1.44E-09	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**				
C_a	=	5.E-10	mg/m^3	**But COPC is a Non-VOC**				
Hazard $Quotient_{air-adult,\ vocs}$	=	9.E-11	**HQ**	$Dose_{air-vocs-adult,inhalation}$		3.E-12	mg/kg-day	
Hazard $Quotient_{air-child,\ vocs}$	=	2.E-10	**HQ**	$Dose_{air-vocs-child,\ inhalation}$		6.E-12	mg/kg-day	
Hazard $Index_{air,\ voc}$	**=**	**3.E-10**	**HI**	**Combined $Dose_{air-vocs}$**	**Total**	**9.E-12**	mg/kg-day	

PEAspread - Physical & Chemical Data

Table E-11. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Thallium — **CASRN: 7440-28-0**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	0.445	mg/kg	site-specific	$IR_{s,adult}$	100	mg/day	PEA, 1999	EF	7	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	$IR_{s,child}$	200	mg/day	PEA, 1999	$EF_{d,adult}$	7	days/yr	Shaw, 2009
SF_o		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,adults}$	20	m^3/day	PEA, 1999	$EF_{d,child}$	7	days/yr	Shaw, 2009
SF_i		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,child}$	10	m^3/day	PEA, 1999	ED_{adult}	24	yr	PEA, 1999
RfD_o	6.6E-05	mg/kg-day	EPA, 2009	$IR_{w,adult}$	2	L/day	DTSC, 2005	ED_{child}	6	yr	PEA, 1999
RfD_i		mg/kg-day	EPA, 2009	$IR_{w,child}$	1	L/day	DTSC, 2005	BW_{adult}	70	kg	PEA, 1999
K_p		cm/hr	EPA, 1992	$IR_{voc,adult}$	2	L/day	DTSC, 2005	BW_{child}	15	kg	PEA, 1999
ABS	0.01	unitless	PEA, 1999	$IR_{voc,child}$	1	L/day	DTSC, 2005	AT_c	70	yr	PEA, 1999
H_c		atm-m^3/mole	EPA, 2008	$IR_{w,voc}$	2	L/day	PEA, 1999	$AT_{nc\text{-}adult}$	24	yr	PEA, 1999
H'	0.0E+00	unitless	calc'd. from H_c	ET_{adult}	4	hr/day	DTSC, 2005	$AT_{nc\text{-}child}$	6	yr	PEA, 1999
K_d	0.00E+00	L/kg	calc'd.	ET_{child}	4	hr/day	DTSC, 2005	P_t	0.434	unitless	PEA, 1999
S	8.6E+03	mg/L	EPA, 2004b	$SA_{adult\text{-}soil}$	5,800	cm^2/day	Shaw, 2009	P_w	0.150	unitless	PEA, 1999
D_i		cm^2/s	EPA, 2008	$SA_{child\text{-}soil}$	2,900	cm^2/day	Shaw, 2009	P_a	0.284	unitless	PEA, 1999
K_{ow}	1.70E+00	L/kg	EPA, 2004b	$SA_{adult\text{-}water}$		cm^2	NA	$C_{w\text{-}moisture}$	860.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	$SA_{child\text{-}water}$		cm^2	NA	θ_m	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}		L/kg	EPA, 2008	AF	0.30	mg/cm^2	Shaw, 2009	σ	2.65	g/cm^3	PEA, 1999
VP		mm Hg	EPA, 2004b	MW	200	atomic mass units	EPA, 2004	β	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, Interim Report, EPA/600/8-91/011B, Office of Research and Development, Washington, DC 20460, January.

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PEA, 1999, Preliminary Endangerment Assessment Guidance Manual, (Figures 1-8, Pages B-7 through B-14), State of California Environmental Protection Agency, Department of Toxic Substances Control, January, Second Printing, June, 1999.

Shaw, 2009, Supplemental Work Plan for Risk Assessment at Waste Accumulation Areas, Yosemite National Park, California, USACE Contract No. DACW05-96-D-0011, CTO No. 08 - WAD No. 02, Document Control Number: ACE08-367-H, Revision C, March.

PEAspread - Soil

Table E-11. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Thallium **CASRN: 7440-28-0**

$$\text{Cancer Risk}_{soil} = ((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr))) + (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))) + (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr))) + (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))))$$

$Risk_{soil\text{-}adult,\ ingestion}$	=	0.E+00	**ILCR**	$Dose_{soil\text{-}adult,\ ingestion}$	=	4.E-09	mg/kg-day
$Risk_{soil\text{-}child,\ ingestion}$	=	0.E+00	**ILCR**	$Dose_{soil\text{-}child,\ ingestion}$	=	1.E-08	mg/kg-day
$Risk_{soil\text{-}adult,dermal}$	=	0.E+00	**ILCR**	$Dose_{soil\text{-}adult,dermal}$	=	7.E-10	mg/kg-day
$Risk_{soil\text{-}child,dermal}$	=	0.E+00	**ILCR**	$Dose_{soil\text{-}child,dermal}$	=	4.E-10	mg/kg-day
$\text{Cancer Risk}_{soil}$	**=**	**0.E+00**	**ILCR**	**$\text{Combined Dose}_{soil}$**	**=**	**2.E-08**	mg/kg-day

$$\text{Hazard Index}_{soil} = (((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc\text{-}adult}*365\ days/yr))) + ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc\text{-}child}*365\ days/yr))) + ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc\text{-}adult}*365\ days/yr))) + ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc\text{-}child}*365\ days/yr))))$$

$\text{Hazard Quotient}_{soil\text{-}adult,\ ingestion}$	=	2.E-04	**HQ**	$Dose_{soil\text{-}adult,\ ingestion}$	1.E-08	mg/kg-day
$\text{Hazard Quotient}_{soil\text{-}child,\ ingestion}$	=	2.E-03	**HQ**	$Dose_{soil\text{-}child,\ ingestion}$	1.E-07	mg/kg-day
$\text{Hazard Quotient}_{soil\text{-}adult,dermal}$	=	3.E-05	**HQ**	$Dose_{soil\text{-}adult,dermal}$	2.E-09	mg/kg-day
$\text{Hazard Quotient}_{soil\text{-}child,dermal}$	=	7.E-05	**HQ**	$Dose_{soil\text{-}child,dermal}$	5.E-09	mg/kg-day
$\text{Hazard Index}_{soil}$	**=**	**2.E-03**	**HI**	**$\text{Combined Dose}_{soil}$**	**1.E-07**	mg/kg-day

PEAspread - Air

Table E-11. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Thallium **CASRN: 7440-28-0**

Cancer $Risk_{air}$	=	$(((SF_i*C_a)*((IR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_c*365\ day/yr)))$					
		$+((SF_i*Ca)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_c*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	8.60E+02	mg/kg	C_s =	4.450E-01 mg/kg		
E_i	=	#DIV/0!	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**			
C_a	=	2.E-08	mg/m^3	**But COPC is a Non-VOC**			
$Risk_{air-adult}$	=	0.E+00	**ILCR**	$Dose_{air-adult,inhalation}$	=	4.E-11	mg/kg-day
$Risk_{air-child}$	=	0.E+00	**ILCR**	$Dose_{air-child,\ inhalation}$	=	2.E-11	mg/kg-day
Cancer $Risk_{air}$	**=**	**0.E+00**	**ILCR**	**Combined $Dose_{air}$**	**=**	**7.E-11**	mg/kg-day
$Hazard_{air}$	=	$(((C_a/RfD_i)*((IhR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_{nc-adult}*365\ day/yr)))$					
		$+((C_a/RfD_i)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_{nc-child}*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	8.60E+02	mg/kg	C_s =	4.45E-01 mg/kg		
E_i	=	#DIV/0!	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**			
C_a	=	2.E-08	mg/m^3	**But COPC is a Non-VOC**			
Hazard $Quotient_{air-adult,\ vocs}$	=	#DIV/0!	**HQ**	$Dose_{air-vocs-adult,inhalation}$		1.E-10	mg/kg-day
Hazard $Quotient_{air-child,\ vocs}$	=	#DIV/0!	**HQ**	$Dose_{air-vocs-child,\ inhalation}$		3.E-10	mg/kg-day
Hazard $Index_{air,\ voc}$	**=**	**#DIV/0!**	**HI**	**Combined $Dose_{air-vocs}$**	**Total**	**4.E-10**	mg/kg-day

PEAspread - Physical & Chemical Data

Table E-12. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Zinc compounds **CASRN: 7440-66-6**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	2,380	mg/kg (J)	site-specific	$IR_{s,adult}$	100	mg/day	PEA, 1999	EF	7	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	$IR_{s,child}$	200	mg/day	PEA, 1999	$EF_{d,adult}$	7	days/yr	Shaw, 2009
SF_o		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,adults}$	20	m^3/day	PEA, 1999	$EF_{d,child}$	7	days/yr	Shaw, 2009
SF_i		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,child}$	10	m^3/day	PEA, 1999	ED_{adult}	24	yr	PEA, 1999
RfD_o	3.0E-01	mg/kg-day	EPA, 2004a	$IR_{w,adult}$	2	L/day	DTSC, 2005	ED_{child}	6	yr	PEA, 1999
RfD_i		mg/kg-day	EPA, 2004a	$IR_{w,child}$	1	L/day	DTSC, 2005	BW_{adult}	70	kg	PEA, 1999
K_p	6.0E-04	cm/hr	EPA, 1992	$IR_{voc,adult}$	2	L/day	DTSC, 2005	BW_{child}	15	kg	PEA, 1999
ABS	0.01	unitless	PEA, 1999	$IR_{voc,child}$	1	L/day	DTSC, 2005	AT_c	70	yr	PEA, 1999
H_c		atm-m^3/mole	EPA, 2004b	$IR_{w,voc}$	2	L/day	PEA, 1999	$AT_{nc\text{-}adult}$	24	yr	PEA, 1999
H'	0.0E+00	unitless	calc'd. from H_c	ET_{adult}	4	hr/day	DTSC, 2005	$AT_{nc\text{-}child}$	6	yr	PEA, 1999
K_d	0.00E+00	L/kg	calc'd.	ET_{child}	4	hr/day	DTSC, 2005	P_t	0.434	unitless	PEA, 1999
S	1.4E+03	mg/L	EPA, 2004b	$SA_{adult\text{-}soil}$	5,800	cm^2/day	Shaw, 2009	P_w	0.150	unitless	PEA, 1999
D_i		cm^2/s	EPA, 2008	$SA_{child\text{-}soil}$	2,900	cm^2/day	Shaw, 2009	P_a	0.284	unitless	PEA, 1999
K_{ow}		L/kg	PEA, 1999	$SA_{adult\text{-}water}$		cm^2	NA	$C_{w\text{-}moisture}$	140.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	$SA_{child\text{-}water}$		cm^2	NA	θ_m	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}		L/kg	EPA, 2008	AF	0.30	mg/cm^2	Shaw, 2009	σ	2.65	g/cm^3	PEA, 1999
VP		mm Hg	EPA, 2004b	MW	65	atomic mass units	EPA, 2004	β	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, Interim Report, EPA/600/8-91/011B, Office of Research and Development, Washington, DC 20460, January.

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Shaw, 2009, Supplemental Work Plan for Risk Assessment at Waste Accumulation Areas, Yosemite National Park, California, USACE Contract No. DACW05-96-D-0011, CTO No. 08 - WAD No. 02, Document Control Number: ACE08-367-H, Revision C, March.

PEAspread - Soil

Table E-12. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Zinc compounds **CASRN: 7440-66-6**

$$Cancer\ Risk_{soil} = ((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr))) + (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))) + (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr))) + (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))))$$

$Risk_{soil-adult, ingestion}$	=	0.E+00	**ILCR**	$Dose_{soil-adult, ingestion}$	=	2.E-05	mg/kg-day
$Risk_{soil-child, ingestion}$	=	0.E+00	**ILCR**	$Dose_{soil-child, ingestion}$	=	5.E-05	mg/kg-day
$Risk_{soil-adult,dermal}$	=	0.E+00	**ILCR**	$Dose_{soil-adult,dermal}$	=	4.E-06	mg/kg-day
$Risk_{soil-child,dermal}$	=	0.E+00	**ILCR**	$Dose_{soil-child,dermal}$	=	2.E-06	mg/kg-day
Cancer $Risk_{soil}$	**=**	**0.E+00**	**ILCR**	**Combined $Dose_{soil}$**	**=**	**8.E-05**	mg/kg-day

$$Hazard\ Index_{soil} = (((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc-adult}*365\ days/yr))) + ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc-child}*365\ days/yr))) + ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc-adult}*365\ days/yr))) + ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc-child}*365\ days/yr))))$$

Hazard $Quotient_{soil-adult, ingestion}$	=	2.E-04	**HQ**	$Dose_{soil-adult, ingestion}$		7.E-05	mg/kg-day
Hazard $Quotient_{soil-child, ingestion}$	=	2.E-03	**HQ**	$Dose_{soil-child, ingestion}$		6.E-04	mg/kg-day
Hazard $Quotient_{soil-adult,dermal}$	=	4.E-05	**HQ**	$Dose_{soil-adult,dermal}$		1.E-05	mg/kg-day
Hazard $Quotient_{soil-child,dermal}$	=	9.E-05	**HQ**	$Dose_{soil-child,dermal}$		3.E-05	mg/kg-day
Hazard $Index_{soil}$	**=**	**2.E-03**	**HI**	**Combined $Dose_{soil}$**		**7.E-04**	mg/kg-day

PEAspread - Water

Table E-12. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Zinc compounds **CASRN: 7440-66-6**

$$\text{Cancer Risk}_{water} = ((SF_o{*}C_w{*}((IR_{w,adult}{*}EF{*}ED_{adult})/(BW_{adult}{*}AT_c{*}365\text{ days/yr})))$$
$$+ (SF_o{*}C_w{*}((IR_{w,child}{*}EF{*}ED_{child})/(BW_{child}{*}AT_c{*}365\text{ days/yr})))$$
$$+ (SF_o{*}C_w{*}((SA_{adult}{*}K_p{*}EF{*}ED_{d,adult}{*}ET_{adult}{*}10^{-3}\text{ L/cm}^3)/(BW_{adult}{*}AT_c{*}365\text{ days/yr})))$$
$$+ (SF_o{*}C_w{*}((SA_{child}{*}K_p{*}EF{*}ED_{d,child}{*}ET_{child}{*}10^{-3}\text{ L/cm}^3)/(BW_{child}{*}AT_c{*}365\text{ days/yr})))$$
$$+ ((SF_i{*}C_w{*}((IR_{voc,adult}{*}EF{*}ED_{adult})/(BW_{adult}{*}AT_c{*}365\text{ days/yr}))) \text{ [IF VOCs PRESENT]}$$
$$+ (SF_i{*}C_w{*}((IR_{voc,child}{*}EF{*}ED_{child})/(BW_{child}{*}AT_c{*}365\text{ days/yr})))) \text{ [IF VOCs PRESENT]}$$

The COPC is NOT a VOC for PEA Screening

$Risk_{water\text{-}adult,\ ingestion}$	=	#VALUE!	**ILCR**	$Dose_{water\text{-}adult,\ ingestion}$	=	#VALUE!	mg/kg-day
$Risk_{water\text{-}child,\ ingestion}$	=	#VALUE!	**ILCR**	$Dose_{water\text{-}child,\ ingestion}$	=	#VALUE!	mg/kg-day
$Risk_{water\text{-}adult,dermal}$	=	#VALUE!	**ILCR**	$Dose_{water\text{-}adult,dermal}$	=	#VALUE!	mg/kg-day
$Risk_{water\text{-}child,dermal}$	=	#VALUE!	**ILCR**	$Dose_{water\text{-}child,dermal}$	=	#VALUE!	mg/kg-day
$Risk_{water\text{-}vocs\text{-}adult,\ inhalation}$	=	0.E+00	**ILCR**	$Dose_{water\text{-}vocs\text{-}adult,\ inhalation}$	=	#VALUE!	mg/kg-day
$Risk_{water\text{-}vocs\text{-}child,\ inhalation}$	=	0.E+00	**ILCR**	$Dose_{water\text{-}vocs\text{-}child,\ inhalation}$	=	#VALUE!	mg/kg-day
Cancer $Risk_{water}$	**=**	**#VALUE!**	**ILCR**	**Combined $Dose_{water}$**	**=**	**#VALUE!**	mg/kg-day

$$\text{Hazard Index}_{water\text{-}vocs} = (((C_w/RfD_o){*}((IR_{w,child}{*}EF{*}ED_{child})/(BW_{child}{*}AT_{nc\text{-}child}{*}365\text{ days/yr}))$$
$$+ ((C_w/RfD_i){*}((IR_{w,child}{*}EF{*}ED_{child})/(BW_{child}{*}AT_{nc\text{-}child}{*}365\text{ days/yr}))) \text{ [IF VOCs PRESENT]}$$
$$+ ((C_w/RfD_o){*}((SA_{child}{*}K_p{*}EF{*}ED_{d,child}{*}ET_{child}{*}10^{-3}\text{ L/cm}^3)/(BW_{child}{*}AT_{nc\text{-}child}{*}365\text{ days/yr}))))$$

The COPC is NOT a VOC for PEA Screening

Hazard $Quotient_{water\text{-}child\text{-}ingestion}$	=	#VALUE!	**HQ**	$Dose_{water\text{-}child\text{-}ingestion}$	=	#VALUE!	mg/kg-day
Hazard $Quotient_{water\text{-}vocs\text{-}child\text{-}inhalation}$	=	0.E+00	**HQ**	$Dose_{water\text{-}vocs\text{-}child\text{-}inhalation}$	=	#VALUE!	mg/kg-day
Hazard $Quotient_{water\text{-}child\text{-}dermal}$	=	#VALUE!	**HQ**	$Dose_{water\text{-}child\text{-}dermal}$	=	#VALUE!	mg/kg-day
Hazard $Index_{water}$	**=**	**#VALUE!**	**HI**	**Combined $Dose_{water}$**	**=**	**#VALUE!**	mg/kg-day

PEAspread - Air

Table E-12. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Surface Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult and Child Hiker Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Zinc compounds **CASRN: 7440-66-6**

Cancer $Risk_{air}$	=	$(((SF_i*C_a)*((IR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_c*365\ day/yr)))$ $+((SF_i*Ca)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_c*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \le C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	1.40E+02	mg/kg	C_s	=	2.380E+03 mg/kg	
E_i	=	#DIV/0!	mg/sec	SCREENING METHOD NOT VALID FOR VOCs			
C_a	=	1.E-04	mg/m^3	But COPC is a Non-VOC			
$Risk_{air-adult}$	=	0.E+00	ILCR	$Dose_{air-adult,inhalation}$	=	2.E-07	mg/kg-day
$Risk_{air-child}$	=	0.E+00	ILCR	$Dose_{air-child,\ inhalation}$	=	1.E-07	mg/kg-day
Cancer $Risk_{air}$	**=**	**0.E+00**	**ILCR**	**Combined $Dose_{air}$**	**=**	**4.E-07**	mg/kg-day
$Hazard_{air}$	=	$(((C_a/RfD_i)*((IhR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_{nc-adult}*365\ day/yr)))$ $+((C_a/RfD_i)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_{nc-child}*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \le C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	1.40E+02	mg/kg	C_s	=	2.38E+03 mg/kg	
E_i	=	#DIV/0!	mg/sec	Screening Method Not Valid for VOCs			
C_a	=	1.E-04	mg/m^3	But COPC is a Non-VOC			
Hazard $Quotient_{air-adult,\ vocs}$	=	#DIV/0!	HQ	$Dose_{air-vocs-adult,inhalation}$		7.E-07	mg/kg-day
Hazard $Quotient_{air-child,\ vocs}$	=	#DIV/0!	HQ	$Dose_{air-vocs-child,\ inhalation}$		2.E-06	mg/kg-day
Hazard $Index_{air,\ voc}$	**=**	**#DIV/0!**	**HI**	**Combined $Dose_{air-vocs}$**	**Total**	**2.E-06**	mg/kg-day

PEAspread - Physical & Chemical Data

Table E-13. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): 2,3,7,8-Tetrachloro-p-dibenzodioxin **CASRN: 1746-01-6**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	1.11E-05	mg/kg	site-specific	$IR_{s,adult}$	50	mg/day	PEA, 1999	EF	120	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	$IR_{s,child}$		mg/day	PEA, 1999	$EF_{d,adult}$	120	days/yr	Shaw, 2009
SF_o	1.00E+05	$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,adults}$	20	m^3/day	PEA, 1999	$EF_{d,child}$		days/yr	Shaw, 2009
SF_i	1.00E+05	$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,child}$		m^3/day	PEA, 1999	ED_{adult}	25	yr	PEA, 1999
RfD_o		mg/kg-day	EPA, 2004a	$IR_{w,adult}$	2	L/day	DTSC, 2005	ED_{child}		yr	PEA, 1999
RfD_i		mg/kg-day	EPA, 2004a	$IR_{w,child}$	1	L/day	DTSC, 2005	BW_{adult}	70	kg	PEA, 1999
K_p	1.4E+00	cm/hr	EPA, 1992	$IR_{voc,adult}$	2	L/day	DTSC, 2005	BW_{child}		kg	PEA, 1999
ABS	0.03	unitless	PEA, 1999	$IR_{voc,child}$	1	L/day	DTSC, 2005	AT_c	70	yr	PEA, 1999
H_c	7.9E-05	atm-m^3/mole	EPA, 2004b	$IR_{w,voc}$	2	L/day	PEA, 1999	$AT_{nc\text{-}adult}$	25	yr	PEA, 1999
H'	3.2E-03	unitless	calc'd. from H_c	ET_{adult}	8	hr/day	DTSC, 2005	$AT_{nc\text{-}child}$		yr	PEA, 1999
K_d	2.93E+03	L/kg	calculated	ET_{child}		hr/day	DTSC, 2005	P_t	0.434	unitless	PEA, 1999
S	8.E-06	mg/L	EPA, 2004b	$SA_{adult\text{-}soil}$	3,400	cm^2/day	Shaw, 2009	P_w	0.150	unitless	PEA, 1999
D_i	4.04E-02	cm^2/s	EPA, 2009	$SA_{child\text{-}soil}$		cm^2/day	Shaw, 2009	P_a	0.284	unitless	PEA, 1999
K_{ow}	3.98E+06	L/kg	EPA, 2004	$SA_{adult\text{-}water}$		cm^2	NA	$C_{w\text{-}moisture}$	0.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	$SA_{child\text{-}water}$		cm^2	NA	θ_m	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}	1.463E+05	L/kg	EPA, 2008	AF	0.80	mg/cm^2	Shaw, 2009	σ	2.65	g/cm^3	PEA, 1999
VP	1.50E-09	mm Hg	EPA, 2004b	MW	322	atomic mass units	EPA, 2004	β	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is GREATER THAN 1E-5 atm-m3/mole

The COPC is a VOC

REFERENCES (All references must be checked and revised, as needed, for each use.)

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, Interim Report, EPA/600/8-91/011B, Office of Research and Development, Washington, DC 20460, January.

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PEAspread - Soil

Table E-13. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): 2,3,7,8-Tetrachloro-p-dibenzodioxin **CASRN: 1746-01-6**

$$Cancer\ Risk_{soil} = ((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr))) + (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))) + (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr))) + (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))))$$

$Risk_{soil\text{-}adult,\ ingestion}$	=	9.E-08	ILCR	$Dose_{soil\text{-}adult,\ ingestion}$	=	9.E-13	mg/kg-day
$Risk_{soil\text{-}child,\ ingestion}$	=		ILCR	$Dose_{soil\text{-}child,\ ingestion}$	=		mg/kg-day
$Risk_{soil\text{-}adult,dermal}$	=	2.E-07	ILCR	$Dose_{soil\text{-}adult,dermal}$	=	2.E-12	mg/kg-day
$Risk_{soil\text{-}child,dermal}$	=		ILCR	$Dose_{soil\text{-}child,dermal}$	=		mg/kg-day
Cancer $Risk_{soil}$	**=**	**2.E-07**	**ILCR**	**Combined $Dose_{soil}$**	**=**	**2.E-12**	mg/kg-day

$$Hazard\ Index_{soil} = (((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc\text{-}adult}*365\ days/yr))) + ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc\text{-}child}*365\ days/yr))) + ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc\text{-}adult}*365\ days/yr))) + ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc\text{-}child}*365\ days/yr))))$$

Hazard $Quotient_{soil\text{-}adult,\ ingestion}$	=	#DIV/0!	HQ	$Dose_{soil\text{-}adult,\ ingestion}$	3.E-12	mg/kg-day
Hazard $Quotient_{soil\text{-}child,\ ingestion}$	=		HQ	$Dose_{soil\text{-}child,\ ingestion}$		mg/kg-day
Hazard $Quotient_{soil\text{-}adult,dermal}$	=	#DIV/0!	HQ	$Dose_{soil\text{-}adult,dermal}$	4.E-12	mg/kg-day
Hazard $Quotient_{soil\text{-}child,dermal}$	=		HQ	$Dose_{soil\text{-}child,dermal}$		mg/kg-day
Hazard $Index_{soil}$	**=**	**#DIV/0!**	**HI**	**Combined $Dose_{soil}$**	**7.E-12**	mg/kg-day

PEAspread - Air

Table E-13. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): 2,3,7,8-Tetrachloro-p-dibenzodioxin **CASRN: 1746-01-6**

Cancer $Risk_{air}$	=	$(((SF_i*C_a)*((IR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_c*365\ day/yr)))$					
		$+((SF_i*Ca)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_c*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	2.34E-02	mg/kg	C_s	=	1.110E-05	mg/kg
E_i	=	8.30E-11	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**			
C_a	=	8.E-13	mg/m^3	**Screening Based on VOCs**			
$Risk_{air-adult}$	=	3.E-09	**ILCR**	$Dose_{air-adult,inhalation}$	=	3.E-14	mg/kg-day
$Risk_{air-child}$	=		**ILCR**	$Dose_{air-child, inhalation}$	=		mg/kg-day
Cancer $Risk_{air}$	**=**	**3.E-09**	**ILCR**	**Combined $Dose_{air}$**	**=**	**3.E-14**	mg/kg-day
$Hazard_{air}$	=	$(((C_a/RfD_i)*((IhR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_{nc-adult}*365\ day/yr)))$					
		$+((C_a/RfD_i)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_{nc-child}*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	2.34E-02	mg/kg	C_s	=	1.11E-05	mg/kg
E_i	=	8.30E-11	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**			
C_a	=	8.E-13	mg/m^3	**Screening Based on VOCs**			
Hazard $Quotient_{air-adult, vocs}$	=	#DIV/0!	**HQ**	$Dose_{air-vocs-adult,inhalation}$		8.E-14	mg/kg-day
Hazard $Quotient_{air-child, vocs}$	=		**HQ**	$Dose_{air-vocs-child, inhalation}$			mg/kg-day
Hazard $Index_{air, voc}$	**=**	**#DIV/0!**	**HI**	**Combined $Dose_{air-vocs}$**	**Total**	**8.E-14**	mg/kg-day

PEAspread - Physical & Chemical Data

Table E-14. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Antimony & compounds **CASRN: 7440-36-0**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	2.81	mg/kg (J)	site-specific	$IR_{s,adult}$	50	mg/day	PEA, 1999	EF	120	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	$IR_{s,child}$		mg/day	PEA, 1999	$EF_{d,adult}$	120	days/yr	Shaw, 2009
SF_o		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,adults}$	20	m^3/day	PEA, 1999	$EF_{d,child}$		days/yr	Shaw, 2009
SF_i		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,child}$		m^3/day	PEA, 1999	ED_{adult}	25	yr	PEA, 1999
RfD_o	4.0E-04	mg/kg-day	EPA, 2004a	$IR_{w,adult}$	2	L/day	DTSC, 2005	ED_{child}		yr	PEA, 1999
RfD_i		mg/kg-day	EPA, 2004a	$IR_{w,child}$	1	L/day	DTSC, 2005	BW_{adult}	70	kg	PEA, 1999
K_p		cm/hr	EPA, 1992	$IR_{voc,adult}$	2	L/day	DTSC, 2005	BW_{child}		kg	PEA, 1999
ABS	0.01	unitless	PEA, 1999	$IR_{voc,child}$	1	L/day	DTSC, 2005	AT_c	70	yr	PEA, 1999
H_c		atm-m^3/mole	EPA, 2008	$IR_{w,voc}$	2	L/day	PEA, 1999	$AT_{nc\text{-}adult}$	25	yr	PEA, 1999
H'	0.0E+00	unitless	calc'd. from H_c	ET_{adult}	8	hr/day	DTSC, 2005	$AT_{nc\text{-}child}$		yr	PEA, 1999
K_d	0.00E+00	L/kg	calc'd from K_{oc}	ET_{child}		hr/day	DTSC, 2005	P_t	0.434	unitless	PEA, 1999
S	3000	mg/L	EPA, 2004b	$SA_{adult\text{-}soil}$	3,400	cm^2/day	Shaw, 2009	P_w	0.150	unitless	PEA, 1999
D_i		cm^2/s	EPA, 2008	$SA_{child\text{-}soil}$		cm^2/day	Shaw, 2009	P_a	0.284	unitless	PEA, 1999
K_{ow}	5.37E+00	L/kg	EPA, 2004b	$SA_{adult\text{-}water}$		cm^2	NA	$C_{w\text{-}moisture}$	300.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	$SA_{child\text{-}water}$		cm^2	NA	θ_m	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}		L/kg	EPA, 2008	AF	0.80	mg/cm^2	Shaw, 2009	σ	2.65	g/cm^3	PEA, 1999
VP		mm Hg	EPA, 2004b	MW	122	atomic mass units	EPA, 2004	β	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

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PEAspread - Soil

Table E-14. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Antimony & compounds **CASRN: 7440-36-0**

$$Cancer\ Risk_{soil} = ((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr))) + (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))) + (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr))) + (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))))$$

$Risk_{soil-adult, ingestion}$	=	0.E+00	**ILCR**	$Dose_{soil-adult, ingestion}$	=	2.E-07	mg/kg-day
$Risk_{soil-child, ingestion}$	=		**ILCR**	$Dose_{soil-child, ingestion}$	=		mg/kg-day
$Risk_{soil-adult,dermal}$	=	0.E+00	**ILCR**	$Dose_{soil-adult,dermal}$	=	1.E-07	mg/kg-day
$Risk_{soil-child,dermal}$	=		**ILCR**	$Dose_{soil-child,dermal}$	=		mg/kg-day
Cancer Risk$_{soil}$	**=**	**0.E+00**	**ILCR**	**Combined Dose$_{soil}$**	**=**	**4.E-07**	mg/kg-day

$$Hazard\ Index_{soil} = (((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc-adult}*365\ days/yr))) + ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc-child}*365\ days/yr))) + ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc-adult}*365\ days/yr))) + ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc-child}*365\ days/yr))))$$

Hazard Quotient$_{soil-adult, ingestion}$	=	2.E-03	**HQ**	$Dose_{soil-adult, ingestion}$	7.E-07	mg/kg-day
Hazard Quotient$_{soil-child, ingestion}$	=		**HQ**	$Dose_{soil-child, ingestion}$		mg/kg-day
Hazard Quotient$_{soil-adult,dermal}$	=	9.E-04	**HQ**	$Dose_{soil-adult,dermal}$	4.E-07	mg/kg-day
Hazard Quotient$_{soil-child,dermal}$	=		**HQ**	$Dose_{soil-child,dermal}$		mg/kg-day
Hazard Index$_{soil}$	**=**	**3.E-03**	**HI**	**Combined Dose$_{soil}$**	**1.E-06**	mg/kg-day

PEAspread - Air

Table E-14. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Antimony & compounds **CASRN: 7440-36-0**

Cancer Risk$_{air}$	=	$(((SF_i*C_a)*((IR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_c*365\ day/yr)))$					
		$+((SF_i*Ca)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_c*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \le C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	3.00E+02	mg/kg	C_s	=	2.810E+00	mg/kg
E_i	=	#DIV/0!	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**			
C_a	=	1.E-07	mg/m^3	**But COPC is a Non-VOC**			
Risk$_{air-adult}$	=	0.E+00	**ILCR**	Dose$_{air-adult,inhalation}$	=	5.E-09	mg/kg-day
Risk$_{air-child}$	=		**ILCR**	Dose$_{air-child,\ inhalation}$	=		mg/kg-day
Cancer Risk$_{air}$	**=**	**0.E+00**	**ILCR**	**Combined Dose$_{air}$**	**=**	**5.E-09**	mg/kg-day
Hazard$_{air}$	=	$(((C_a/RfD_i)*((IhR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_{nc-adult}*365\ day/yr)))$					
		$+((C_a/RfD_i)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_{nc-child}*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \le C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	3.00E+02	mg/kg	C_s	=	2.81E+00	mg/kg
E_i	=	#DIV/0!	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**			
C_a	=	1.E-07	mg/m^3	**But COPC is a Non-VOC**			
Hazard Quotient$_{air-adult,\ vocs}$	=	#DIV/0!	**HQ**	Dose$_{air-vocs-adult,inhalation}$		1.E-08	mg/kg-day
Hazard Quotient$_{air-child,\ vocs}$	=		**HQ**	Dose$_{air-vocs-child,\ inhalation}$			mg/kg-day
Hazard Index$_{air,\ voc}$	**=**	**#DIV/0!**	**HI**	**Combined Dose$_{air-vocs}$**	**Total**	**1.E-08**	mg/kg-day

PEAspread - Physical & Chemical Data

Table E-15. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Arsenic, inorganic **CASRN: 7440-38-2**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	4.7	mg/kg	site-specific	**$IR_{s,adult}$**	50	mg/day	PEA, 1999	**EF**	120	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	**$IR_{s,child}$**		mg/day	PEA, 1999	**$EF_{d,adult}$**	120	days/yr	Shaw, 2009
SF_o	9.50E+00	$(mg/kg\text{-}day)^{-1}$	EPA, 2009a	**$IhR_{a,adults}$**	20	m^3/day	PEA, 1999	**$EF_{d,child}$**		days/yr	Shaw, 2009
SF_i	1.20E+01	$(mg/kg\text{-}day)^{-1}$	EPA, 2009a	**$IhR_{a,child}$**		m^3/day	PEA, 1999	**ED_{adult}**	25	yr	PEA, 1999
RfD_o	3.0E-04	mg/kg-day	EPA, 2009a	**$IR_{w,adult}$**	2	L/day	DTSC, 2005	**ED_{child}**		yr	PEA, 1999
RfD_i	8.57E-06	mg/kg-day	EPA, 2009a	**$IR_{w,child}$**	1	L/day	DTSC, 2005	**BW_{adult}**	70	kg	PEA, 1999
K_p		cm/hr	PEA, 1999	**$IR_{voc,adult}$**	2	L/day	DTSC, 2005	**BW_{child}**		kg	PEA, 1999
ABS	0.03	unitless	PEA, 1999	**$IR_{voc,child}$**	1	L/day	DTSC, 2005	**AT_c**	70	yr	PEA, 1999
H_c		atm-m^3/mole	EPA, 2008	**$IR_{w,voc}$**	2	L/day	PEA, 1999	**$AT_{nc\text{-}adult}$**	25	yr	PEA, 1999
H'	0.0E+00	unitless	calc'd. from H_c	**ET_{adult}**	8	hr/day	DTSC, 2005	**$AT_{nc\text{-}child}$**		yr	PEA, 1999
K_d	2.90E+01	L/kg	calc'd	**ET_{child}**		hr/day	DTSC, 2005	**P_t**	0.434	unitless	PEA, 1999
S		mg/L	EPA, 2008	**$SA_{adult\text{-}soil}$**	3,400	cm^2/day	Shaw, 2009	**P_w**	0.150	unitless	PEA, 1999
D_i		cm^2/s	EPA, 2008	**$SA_{child\text{-}soil}$**		cm^2/day	Shaw, 2009	**P_a**	0.284	unitless	PEA, 1999
K_{ow}	4.79E+00	L/kg	EPA, 2004b	**$SA_{adult\text{-}water}$**		cm^2	NA	**$C_{w\text{-}moisture}$**	0.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	**$SA_{child\text{-}water}$**		cm^2	NA	θ_m	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}		L/kg	EPA, 2008	**AF**	0.80	mg/cm^2	Shaw, 2009	σ	2.65	g/cm^3	PEA, 1999
VP		mm Hg	EPA, 2004b	**MW**	74.92	atomic mass units	EPA, 2004	β	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, Interim Report, EPA/600/8-91/011B, Office of Research and Development, Washington, DC 20460, January.

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Shaw, 2009, Supplemental Work Plan for Risk Assessment at Waste Accumulation Areas, Yosemite National Park, California, USACE Contract No. DACW05-96-D-0011, CTO No. 08 - WAD No. 02, Document Control Number: ACE08-367-H, Revision C, March.

PEAspread - Soil

Table E-15. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Arsenic, inorganic **CASRN: 7440-38-2**

$$\text{Cancer Risk}_{soil} = ((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr))) + (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))) + (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr))) + (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))))$$

$\text{Risk}_{soil\text{-}adult,\ ingestior}$	=	4.E-06	**ILCR**	$\text{Dose}_{soil\text{-}adult,\ ingestior}$	=	4.E-07	mg/kg-day
$\text{Risk}_{soil\text{-}child,\ ingestior}$	=		**ILCR**	$\text{Dose}_{soil\text{-}child,\ ingestior}$	=		mg/kg-day
$\text{Risk}_{soil\text{-}adult,derma}$	=	6.E-06	**ILCR**	$\text{Dose}_{soil\text{-}adult,derma}$	=	6.E-07	mg/kg-day
$\text{Risk}_{soil\text{-}child,derma}$	=		**ILCR**	$\text{Dose}_{soil\text{-}child,derma}$	=		mg/kg-day
Cancer Risk$_{soil}$	**=**	**1.E-05**	**ILCR**	**Combined Dose$_{soil}$**	**=**	**1.E-06**	mg/kg-day

$$\text{Hazard Index}_{soil} = (((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc\text{-}adult}*365\ days/yr))) + ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc\text{-}child}*365\ days/yr))) + ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc\text{-}adult}*365\ days/yr))) + ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc\text{-}child}*365\ days/yr))))$$

$\text{Hazard Quotient}_{soil\text{-}adult,\ ingestior}$	=	4.E-03	**HQ**	$\text{Dose}_{soil\text{-}adult,\ ingestior}$	1.E-06	mg/kg-day
$\text{Hazard Quotient}_{soil\text{-}child,\ ingestior}$	=		**HQ**	$\text{Dose}_{soil\text{-}child,\ ingestior}$		mg/kg-day
$\text{Hazard Quotient}_{soil\text{-}adult,derma}$	=	6.E-03	**HQ**	$\text{Dose}_{soil\text{-}adult,derma}$	2.E-06	mg/kg-day
$\text{Hazard Quotient}_{soil\text{-}child,derma}$	=		**HQ**	$\text{Dose}_{soil\text{-}child,derma}$		mg/kg-day
Hazard Index$_{soil}$	**=**	**1.E-02**	**HI**	**Combined Dose$_{soil}$**	**3.E-06**	mg/kg-day

PEAspread - Air

Table E-15. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Arsenic, inorganic | **CASRN: 7440-38-2**

Cancer $Risk_{air}$	=	$(((SF_i*C_a)*((IR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_c*365\ day/yr)))$					
		$+((SF_i*Ca)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_c*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	0.00E+00	mg/kg	C_s	=	4.730E+00	mg/kg
E_i	=	#DIV/0!	mg/sec	**SCREENING METHOD NOT VALID FOR VOCs**			
C_a	=	2.E-07	mg/m^3	**But COPC is a Non-VOC**			
$Risk_{air-adult}$	=	1.E-07	**ILCR**	$Dose_{air-adult,inhalation}$	=	8.E-09	mg/kg-day
$Risk_{air-child}$	=		**ILCR**	$Dose_{air-child, inhalation}$	=		mg/kg-day
Cancer $Risk_{air}$	**=**	**1.E-07**	**ILCR**	**Combined $Dose_{air}$**	**=**	**8.E-09**	mg/kg-day
$Hazard_{air}$	=	$(((C_a/RfD_i)*((IhR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_{nc-adult}*365\ day/yr)))$					
		$+((C_a/RfD_i)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_{nc-child}*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	0.00E+00	mg/kg	C_s	=	4.73E+00	mg/kg
E_i	=	#DIV/0!	mg/sec	**Screening Method Not Valid for VOCs**			
C_a	=	2.E-07	mg/m^3	**But COPC is a Non-VOC**			
Hazard $Quotient_{air-adult, vocs}$	=	3.E-03	**HQ**	$Dose_{air-vocs-adult,inhalation}$		2.E-08	mg/kg-day
Hazard $Quotient_{air-child, vocs}$	=		**HQ**	$Dose_{air-vocs-child, inhalation}$			mg/kg-day
Hazard $Index_{air, voc}$	**=**	**3.E-03**	**HI**	**Combined $Dose_{air-vocs}$**	**Total**	**2.E-08**	mg/kg-day

PEAspread - Physical & Chemical Data

Table E-16. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Barium **CASRN: 7440-39-3**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	691	mg/kg	site-specific	$IR_{s,adult}$	50	mg/day	PEA, 1999	EF	120	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	$IR_{s,child}$		mg/day	PEA, 1999	$EF_{d,adult}$	120	days/yr	Shaw, 2009
SF_o		$(mg/kg\text{-}day)^{-1}$	EPA, 2008	$IhR_{a,adults}$	20	m^3/day	PEA, 1999	$EF_{d,child}$		days/yr	Shaw, 2009
SF_i		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,child}$		m^3/day	PEA, 1999	ED_{adult}	25	yr	PEA, 1999
RfD_o	7.0E-02	mg/kg-day	EPA, 2004a	$IR_{w,adult}$	2	L/day	DTSC, 2005	ED_{child}		yr	PEA, 1999
RfD_i	1.4E-04	mg/kg-day	EPA, 2004a	$IR_{w,child}$	1	L/day	DTSC, 2005	BW_{adult}	70	kg	PEA, 1999
K_p		cm/hr	EPA, 1992	$IR_{voc,adult}$	2	L/day	DTSC, 2005	BW_{child}		kg	PEA, 1999
ABS	0.01	unitless	PEA, 1999	$IR_{voc,child}$	1	L/day	DTSC, 2005	AT_c	70	yr	PEA, 1999
H_c		atm-m^3/mole	EPA, 2008	$IR_{w,voc}$	2	L/day	PEA, 1999	$AT_{nc\text{-}adult}$	25	yr	PEA, 1999
H'	0.0E+00	unitless	calc'd. from H_c	ET_{adult}	8	hr/day	DTSC, 2005	$AT_{nc\text{-}child}$		yr	PEA, 1999
K_d	0.00E+00	L/kg	calc'd	ET_{child}		hr/day	DTSC, 2005	P_t	0.434	unitless	PEA, 1999
S		mg/L	EPA, 2008	$SA_{adult\text{-}soil}$	3,400	cm^2/day	Shaw, 2009	P_w	0.150	unitless	PEA, 1999
D_i		cm^2/s	EPA, 2008	$SA_{child\text{-}soil}$		cm^2/day	Shaw, 2009	P_a	0.284	unitless	PEA, 1999
K_{ow}	1.70E+00	L/kg	EPA, 2004b	$SA_{adult\text{-}water}$		cm^2	NA	$C_{w\text{-}moisture}$	0.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	$SA_{child\text{-}water}$		cm^2	NA	θ_m	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}		L/kg	EPA, 2008	AF	0.80	mg/cm^2	Shaw, 2009	σ	2.65	g/cm^3	PEA, 1999
VP		mm Hg	EPA, 2004b	MW	140	atomic mass units	EPA, 2004	β	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, Interim Report, EPA/600/8-91/011B, Office of Research and Development, Washington, DC 20460, January.

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PEAspread - Soil

**Table E-16. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525**

Chemical of Potential Concern (COPC): Barium **CASRN: 7440-39-3**

Cancer Risk$_{soil}$	=	$((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}$ kg/mg)/($BW_{adult}*AT_c$*365 days/yr))) + $(SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}$ kg/mg)/($BW_{child}*AT_c$*365 days/yr))) + $(SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}$ kg/mg)/($BW_{adult}*AT_c$*365 days/yr))) + $(SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}$ kg/mg)/($BW_{child}*AT_c$*365 days/yr))))					
Risk$_{soil\text{-}adult,\ ingestion}$	=	0.E+00	ILCR	Dose$_{soil\text{-}adult,\ ingestion}$	=	6.E-05	mg/kg-day
Risk$_{soil\text{-}child,\ ingestion}$	=		ILCR	Dose$_{soil\text{-}child,\ ingestion}$	=		mg/kg-day
Risk$_{soil\text{-}adult,dermal}$	=	0.E+00	ILCR	Dose$_{soil\text{-}adult,dermal}$	=	3.E-05	mg/kg-day
Risk$_{soil\text{-}child,dermal}$	=		ILCR	Dose$_{soil\text{-}child,dermal}$	=		mg/kg-day
Cancer Risk$_{soil}$	**=**	**0.E+00**	**ILCR**	**Combined Dose$_{soil}$**	**=**	**9.E-05**	mg/kg-day
Hazard Index$_{soil}$	=	$(((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}$ kg/mg)/($BW_{adult}*AT_{nc\text{-}adult}$*365 days/yr))) + $((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}$ kg/mg)/($BW_{child}*AT_{nc\text{-}child}$*365 days/yr))) + $((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}$ kg/mg)/($BW_{adult}*AT_{nc\text{-}adult}$*365 days/yr))) + $((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}$ kg/mg)/($BW_{child}*AT_{nc\text{-}child}$*365 days/yr))))					
Hazard Quotient$_{soil\text{-}adult,\ ingestion}$	=	2.E-03	HQ	Dose$_{soil\text{-}adult,\ ingestion}$		2.E-04	mg/kg-day
Hazard Quotient$_{soil\text{-}child,\ ingestion}$	=		HQ	Dose$_{soil\text{-}child,\ ingestion}$			mg/kg-day
Hazard Quotient$_{soil\text{-}adult,dermal}$	=	1.E-03	HQ	Dose$_{soil\text{-}adult,dermal}$		9.E-05	mg/kg-day
Hazard Quotient$_{soil\text{-}child,dermal}$	=		HQ	Dose$_{soil\text{-}child,dermal}$			mg/kg-day
Hazard Index$_{soil}$	**=**	**4.E-03**	**HI**	**Combined Dose$_{soil}$**		**3.E-04**	mg/kg-day

PEAspread - Air

Table E-16. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Barium **CASRN: 7440-39-3**

Cancer $Risk_{air}$	=	$(((SF_i{*}C_a){*}((IR_{adult}{*}EF{*}ED_{adult})/(BW_{adult}{*}AT_c{*}365\ day/yr)))$ $+((SF_i{*}Ca){*}((IhR_{child}{*}EF{*}ED_{child})/(BW_{child}{*}AT_c{*}365\ day/yr))))$						
for non-VOCs, where C_a	=	$C_s{*}(0.05\ mg/m^3){*}(1{*}10^{-6}\ kg/mg)$			=	$C_s{*}(5{*}10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$				
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$						
and, C_{sat}	=	$((S/ß)((K_d{*}ß)+(P_w)+(H'{*}P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]						
C_{sat}	=	0.00E+00	mg/kg	C_s	=	6.910E+02	mg/kg	
E_i	=	#DIV/0!	mg/sec	**SCREENING METHOD NOT VALID FOR VOCs**				
C_a	=	3.E-05	mg/m^3	**But COPC is a Non-VOC**				
$Risk_{air-adult}$	=	0.E+00	**ILCR**	$Dose_{air-adult,inhalation}$	=	1.E-06	mg/kg-day	
$Risk_{air-child}$	=		**ILCR**	$Dose_{air-child,\ inhalation}$	=		mg/kg-day	
Cancer $Risk_{air}$	**=**	**0.E+00**	**ILCR**	**Combined $Dose_{air}$**	**=**	**1.E-06**	mg/kg-day	
$Hazard_{air}$	=	$(((C_a/RfD_i){*}((IhR_{adult}{*}EF{*}ED_{adult})/(BW_{adult}{*}AT_{nc-adult}{*}365\ day/yr)))$ $+((C_a/RfD_i){*}((IhR_{child}{*}EF{*}ED_{child})/(BW_{child}{*}AT_{nc-child}{*}365\ day/yr))))$						
for non-VOCs, where C_a	=	$C_s{*}(0.05\ mg/m^3){*}(1{*}10^{-6}\ kg/mg)$			=	$C_s{*}(5{*}10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$				
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$						
and, C_{sat}	=	$((S/ß)((K_d{*}ß)+(P_w)+(H'{*}P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]						
C_{sat}	=	0.00E+00	mg/kg	C_s	=	6.91E+02	mg/kg	
E_i	=	#DIV/0!	mg/sec	**Screening Method Not Valid for VOCs**				
C_a	=	3.E-05	mg/m^3	**But COPC is a Non-VOC**				
Hazard $Quotient_{air-adult,\ vocs}$	=	2.E-02	**HQ**	$Dose_{air-vocs-adult,inhalation}$		3.E-06	mg/kg-day	
Hazard $Quotient_{air-child,\ vocs}$	=		**HQ**	$Dose_{air-vocs-child,\ inhalation}$			mg/kg-day	
Hazard $Index_{air,\ voc}$	**=**	**2.E-02**	**HI**	**Combined $Dose_{air-vocs}$**	**Total**	**3.E-06**	mg/kg-day	

PEAspread - Physical & Chemical Data

Table E-17. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Benzo(a)pyrene **CASRN: 50-32-8**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	0.0159	mg/kg	site-specific	$IR_{s,adult}$	50	mg/day	PEA, 1999	EF	120	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	$IR_{s,child}$		mg/day	PEA, 1999	$EF_{d,adult}$	120	days/yr	Shaw, 2009
SF_o	1.20E+01	$(mg/kg\text{-}day)^{-1}$	OEHHA, 2009	$IhR_{a,adults}$	20	m^3/day	PEA, 1999	$EF_{d,child}$		days/yr	Shaw, 2009
SF_i	3.90E+00	$(mg/kg\text{-}day)^{-1}$	OEHHA, 2009	$IhR_{a,child}$		m^3/day	PEA, 1999	ED_{adult}	25	yr	PEA, 1999
RfD_o		mg/kg-day	EPA, 2004a	$IR_{w,adult}$	2	L/day	DTSC, 2005	ED_{child}		yr	PEA, 1999
RfD_i		mg/kg-day	EPA, 2004a	$IR_{w,child}$	1	L/day	DTSC, 2005	BW_{adult}	70	kg	PEA, 1999
K_p	1.2E+00	cm/hr	EPA, 1992	$IR_{voc,adult}$	2	L/day	DTSC, 2005	BW_{child}		kg	PEA, 1999
ABS	0.15	unitless	PEA, 1999	$IR_{voc,child}$	1	L/day	DTSC, 2005	AT_c	70	yr	PEA, 1999
H_c	1.1E-06	atm-m^3/mole	EPA, 2008	$IR_{w,voc}$	2	L/day	PEA, 1999	$AT_{nc\text{-}adult}$	25	yr	PEA, 1999
H'	4.5E-05	unitless	calc'd. from H_c	ET_{adult}	8	hr/day	DTSC, 2005	$AT_{nc\text{-}child}$		yr	PEA, 1999
K_d	1.57E+04	L/kg	calc'd	ET_{child}		hr/day	DTSC, 2005	P_t	0.434	unitless	PEA, 1999
S	0.00162	mg/L	EPA, 2008	$SA_{adult\text{-}soil}$	3,400	cm^2/day	Shaw, 2009	P_w	0.150	unitless	PEA, 1999
D_i		cm^2/s	EPA, 2008	$SA_{child\text{-}soil}$		cm^2/day	Shaw, 2009	P_a	0.284	unitless	PEA, 1999
K_{ow}	1.00E+06	L/kg	EPA, 2004b	$SA_{adult\text{-}water}$		cm^2	NA	$C_{w\text{-}moisture}$	0.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	$SA_{child\text{-}water}$		cm^2	NA	θ_m	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}	7.87E+05	L/kg	EPA, 2008	AF	0.80	mg/cm^2	Shaw, 2009	σ	2.65	g/cm^3	PEA, 1999
VP	5.50E-09	mm Hg	EPA, 2004b	MW	250	atomic mass units	EPA, 2004	β	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, Interim Report, EPA/600/8-91/011B, Office of Research and Development, Washington, DC 20460, January.

EPA, 2004a, Region 9 Preliminary Remediation Goals (PRGs) 2004, United States Environmental Protection Agency Region IX, San Francisco, CA, October 1.

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EPA, 2008, Regional Screening Levels for Chemical Contaminants at Superfund Sites, Internet URL: h *ttp://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm* .

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PEA, 1999, Preliminary Endangerment Assessment Guidance Manual, (Figures 1-8, Pages B-7 through B-14), State of California Environmental Protection Agency, Department of Toxic Substances Control, January, Second Printing, June, 1999.

Shaw, 2009, Supplemental Work Plan for Risk Assessment at Waste Accumulation Areas, Yosemite National Park, California, USACE Contract No. DACW05-96-D-0011, CTO No. 08 - WAD No. 02, Document Control Number: ACE08-367-H, Revision C, March.

PEAspread - Soil

Table E-17. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Benzo(a)pyrene **CASRN: 50-32-8**

$$Cancer\ Risk_{soil} = ((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr))) + (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))) + (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr))) + (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))))$$

$Risk_{soil-adult, ingestion}$	=	2.E-08	ILCR	$Dose_{soil-adult, ingestion}$	=	1.E-09	mg/kg-day
$Risk_{soil-child, ingestion}$	=		ILCR	$Dose_{soil-child, ingestion}$	=		mg/kg-day
$Risk_{soil-adult,dermal}$	=	1.E-07	ILCR	$Dose_{soil-adult,dermal}$	=	1.E-08	mg/kg-day
$Risk_{soil-child,dermal}$	=		ILCR	$Dose_{soil-child,dermal}$	=		mg/kg-day
$Cancer\ Risk_{soil}$	**=**	**1.E-07**	**ILCR**	**$Combined\ Dose_{soil}$**	**=**	**1.E-08**	mg/kg-day

$$Hazard\ Index_{soil} = (((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc-adult}*365\ days/yr))) + ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc-child}*365\ days/yr))) + ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc-adult}*365\ days/yr))) + ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc-child}*365\ days/yr))))$$

$Hazard\ Quotient_{soil-adult, ingestion}$	=	#DIV/0!	HQ	$Dose_{soil-adult, ingestion}$	4.E-09	mg/kg-day
$Hazard\ Quotient_{soil-child, ingestion}$	=		HQ	$Dose_{soil-child, ingestion}$		mg/kg-day
$Hazard\ Quotient_{soil-adult,dermal}$	=	#DIV/0!	HQ	$Dose_{soil-adult,dermal}$	3.E-08	mg/kg-day
$Hazard\ Quotient_{soil-child,dermal}$	=		HQ	$Dose_{soil-child,dermal}$		mg/kg-day
$Hazard\ Index_{soil}$	**=**	**#DIV/0!**	**HI**	**$Combined\ Dose_{soil}$**	**3.E-08**	mg/kg-day

PEAspread - Air

Table E-17. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Benzo(a)pyrene **CASRN: 50-32-8**

Cancer $Risk_{air}$	=	$(((SF_i{*}C_a){*}((IR_{adult}{*}EF{*}ED_{adult})/(BW_{adult}{*}AT_c{*}365\ day/yr)))$					
		$+((SF_i{*}Ca){*}((IhR_{child}{*}EF{*}ED_{child})/(BW_{child}{*}AT_c{*}365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s{*}(0.05\ mg/m^3){*}(1{*}10^{-6}\ kg/mg)$		=	$C_s{*}(5{*}10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \le C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d{*}ß)+(P_w)+(H'{*}P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	2.55E+01	mg/kg	C_s	=	1.590E-02	mg/kg
E_i	=	#DIV/0!	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**			
C_a	=	8.E-10	mg/m^3	**But COPC is a Non-VOC**			
$Risk_{air-adult}$	=	1.E-10	**ILCR**	$Dose_{air-adult,inhalation}$	=	3.E-11	mg/kg-day
$Risk_{air-child}$	=		**ILCR**	$Dose_{air-child,\ inhalation}$	=		mg/kg-day
Cancer $Risk_{air}$	**=**	**1.E-10**	**ILCR**	**Combined $Dose_{air}$**	**=**	**3.E-11**	mg/kg-day

$Hazard_{air}$	=	$(((C_a/RfD_i){*}((IhR_{adult}{*}EF{*}ED_{adult})/(BW_{adult}{*}AT_{nc-adult}{*}365\ day/yr)))$					
		$+((C_a/RfD_i){*}((IhR_{child}{*}EF{*}ED_{child})/(BW_{child}{*}AT_{nc-child}{*}365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s{*}(0.05\ mg/m^3){*}(1{*}10^{-6}\ kg/mg)$		=	$C_s{*}(5{*}10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \le C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d{*}ß)+(P_w)+(H'{*}P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	2.55E+01	mg/kg	C_s	=	1.59E-02	mg/kg
E_i	=	#DIV/0!	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**			
C_a	=	8.E-10	mg/m^3	**But COPC is a Non-VOC**			
Hazard $Quotient_{air-adult,\ vocs}$	=	#DIV/0!	**HQ**	$Dose_{air-vocs-adult,inhalation}$		7.E-11	mg/kg-day
Hazard $Quotient_{air-child,\ vocs}$	=		**HQ**	$Dose_{air-vocs-child,\ inhalation}$			mg/kg-day
Hazard $Index_{air,\ voc}$	**=**	**#DIV/0!**	**HI**	**Combined $Dose_{air-vocs}$**	**Total**	**7.E-11**	mg/kg-day

PEAspread - Physical & Chemical Data

Table E-18. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Benzo(g,h,i)perylene (Pyrene surrogate) **CASRN: 191-24-2**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	0.078	mg/kg	site-specific	$IR_{s,adult}$	50	mg/day	PEA, 1999	EF	120	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	$IR_{s,child}$		mg/day	PEA, 1999	$EF_{d,adult}$	120	days/yr	Shaw, 2009
SF_o		$(mg/kg\text{-}day)^{-1}$	EPA, 2009	$IhR_{a,adults}$	20	m^3/day	PEA, 1999	$EF_{d,child}$		days/yr	Shaw, 2009
SF_i		$(mg/kg\text{-}day)^{-1}$	EPA, 2009	$IhR_{a,child}$		m^3/day	PEA, 1999	ED_{adult}	25	yr	PEA, 1999
RfD_o	3.0E-02	mg/kg-day	EPA, 2004a	$IR_{w,adult}$	2	L/day	DTSC, 2005	ED_{child}		yr	PEA, 1999
RfD_i	3.0E-02	mg/kg-day	EPA, 2004a	$IR_{w,child}$	1	L/day	DTSC, 2005	BW_{adult}	70	kg	PEA, 1999
K_p	2.7E-01	cm/hr	EPA, 1992	$IR_{voc,adult}$	2	L/day	DTSC, 2005	BW_{child}		kg	PEA, 1999
ABS	0.15	unitless	PEA, 1999	$IR_{voc,child}$	1	L/day	DTSC, 2005	AT_c	70	yr	PEA, 1999
H_c	1.4E-07	atm-m^3/mole	EPA, 2008	$IR_{w,voc}$	2	L/day	PEA, 1999	$AT_{nc\text{-}adult}$	25	yr	PEA, 1999
H'	5.7E-06	unitless	calc'd. from H_c	ET_{adult}	8	hr/day	DTSC, 2005	$AT_{nc\text{-}child}$		yr	PEA, 1999
K_d	1.39E+03	L/kg	calc'd from K_{ow}	ET_{child}		hr/day	DTSC, 2005	P_t	0.434	unitless	PEA, 1999
S	2.6E-04	mg/L	EPA, 2004b	$SA_{adult\text{-}soil}$	3,400	cm^2/day	Shaw, 2009	P_w	0.150	unitless	PEA, 1999
D_i	2.80E-02	cm^2/s	EPA, 2008	$SA_{child\text{-}soil}$		cm^2/day	Shaw, 2009	P_a	0.284	unitless	PEA, 1999
K_{ow}	3.16E+04	L/kg	EPA, 2004b	$SA_{adult\text{-}water}$		cm^2	NA	$C_{w\text{-}moisture}$	0.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	$SA_{child\text{-}water}$		cm^2	NA	θ_m	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}	6.94E+04	L/kg	EPA, 2008	AF	0.80	mg/cm^2	Shaw, 2009	σ	2.65	g/cm^3	PEA, 1999
VP	1.0E-10	mm Hg	EPA, 2008	MW	276.34	atomic mass units	EPA, 2004	β	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, Interim Report, EPA/600/8-91/011B, Office of Research and Development, Washington, DC 20460, January.

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PEAspread - Soil

Table E-18. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Benzo(g,h,i)perylene (Pyrene surrogate) **CASRN: 191-24-2**

Cancer $Risk_{soil}$	=	$((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr)))$ $+ (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr)))$ $+ (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr)))$ $+ (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))))$					
$Risk_{soil\text{-}adult,\ ingestion}$	=	0.E+00	ILCR	$Dose_{soil\text{-}adult,\ ingestion}$	=	7.E-09	mg/kg-day
$Risk_{soil\text{-}child,\ ingestion}$	=		ILCR	$Dose_{soil\text{-}child,\ ingestion}$	=		mg/kg-day
$Risk_{soil\text{-}adult,dermal}$	=	0.E+00	ILCR	$Dose_{soil\text{-}adult,dermal}$	=	5.E-08	mg/kg-day
$Risk_{soil\text{-}child,dermal}$	=		ILCR	$Dose_{soil\text{-}child,dermal}$	=		mg/kg-day
Cancer $Risk_{soil}$	**=**	**0.E+00**	**ILCR**	**Combined $Dose_{soil}$**	**=**	**6.E-08**	mg/kg-day
Hazard $Index_{soil}$	=	$(((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc\text{-}adult}*365\ days/yr)))$ $+ ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc\text{-}child}*365\ days/yr)))$ $+ ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc\text{-}adult}*365\ days/yr)))$ $+ ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc\text{-}child}*365\ days/yr))))$					
Hazard $Quotient_{soil\text{-}adult,\ ingestion}$	=	6.E-07	HQ	$Dose_{soil\text{-}adult,\ ingestion}$		2.E-08	mg/kg-day
Hazard $Quotient_{soil\text{-}child,\ ingestion}$	=		HQ	$Dose_{soil\text{-}child,\ ingestion}$			mg/kg-day
Hazard $Quotient_{soil\text{-}adult,dermal}$	=	5.E-06	HQ	$Dose_{soil\text{-}adult,dermal}$		1.E-07	mg/kg-day
Hazard $Quotient_{soil\text{-}child,dermal}$	=		HQ	$Dose_{soil\text{-}child,dermal}$			mg/kg-day
Hazard $Index_{soil}$	**=**	**6.E-06**	**HI**	**Combined $Dose_{soil}$**		**2.E-07**	mg/kg-day

PEAspread - Air

Table E-18. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Benzo(g,h,i)perylene (Pyrene surrogate) **CASRN: 191-24-2**

$Cancer\ Risk_{air}$	=	$(((SF_i*C_a)*((IR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_c*365\ day/yr)))$					
		$+((SF_i*Ca)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_c*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	3.61E-01	mg/kg	C_s	=	7.800E-02	mg/kg
E_i	=	2.97E-08	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**			
C_a	=	4.E-09	mg/m^3	**But COPC is a Non-VOC**			
$Risk_{air-adult}$	=	0.E+00	**ILCR**	$Dose_{air-adult,inhalation}$	=	1.E-10	mg/kg-day
$Risk_{air-child}$	=		**ILCR**	$Dose_{air-child,\ inhalation}$	=		mg/kg-day
$Cancer\ Risk_{air}$	**=**	**0.E+00**	**ILCR**	**$Combined\ Dose_{air}$**	**=**	**1.E-10**	mg/kg-day

$Hazard_{air}$	=	$(((C_a/RfD_i)*((IhR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_{nc-adult}*365\ day/yr)))$					
		$+((C_a/RfD_i)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_{nc-child}*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	3.61E-01	mg/kg	C_s	=	7.80E-02	mg/kg
E_i	=	2.97E-08	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**			
C_a	=	4.E-09	mg/m^3	**But COPC is a Non-VOC**			
$Hazard\ Quotient_{air-adult,\ vocs}$	=	1.E-08	**HQ**	$Dose_{air-vocs-adult,inhalation}$		4.E-10	mg/kg-day
$Hazard\ Quotient_{air-child,\ vocs}$	=		**HQ**	$Dose_{air-vocs-child,\ inhalation}$			mg/kg-day
$Hazard\ Index_{air,\ voc}$	**=**	**1.E-08**	**HI**	**$Combined\ Dose_{air-vocs}$**	**Total**	**4.E-10**	mg/kg-day

PEAspread - Physical & Chemical Data

Table E-19. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Cadmium and compounds **CASRN: 7440-43-9**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	2.96	mg/kg	site-specific	**$IR_{s,adult}$**	50	mg/day	PEA, 1999	**EF**	120	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	**$IR_{s,child}$**		mg/day	PEA, 1999	**$EF_{d,adult}$**	120	days/yr	Shaw, 2009
SF_o	3.80E-01	$(mg/kg\text{-}day)^{-1}$	OEHHA, 2009a	**$IhR_{a,adults}$**	20	m^3/day	PEA, 1999	**$EF_{d,child}$**		days/yr	Shaw, 2009
SF_i	1.50E+01	$(mg/kg\text{-}day)^{-1}$	OEHHA, 2009a	**$IhR_{a,child}$**		m^3/day	PEA, 1999	**ED_{adult}**	25	yr	PEA, 1999
RfD_o	5.0E-04	mg/kg-day	OEHHA, 2009a	**$IR_{w,adult}$**	2	L/day	DTSC, 2005	**ED_{child}**		yr	PEA, 1999
RfD_i	5.7E+06	mg/kg-day	OEHHA, 2009a	**$IR_{w,child}$**	1	L/day	DTSC, 2005	**BW_{adult}**	70	kg	PEA, 1999
K_p	1.0E-03	cm/hr	EPA, 1992	**$IR_{voc,adult}$**	2	L/day	DTSC, 2005	**BW_{child}**		kg	PEA, 1999
ABS	0.001	unitless	PEA, 1999	**$IR_{voc,child}$**	1	L/day	DTSC, 2005	**AT_c**	70	yr	PEA, 1999
H_c		$atm\text{-}m^3/mole$	EPA, 2004b	**$IR_{w,voc}$**	2	L/day	PEA, 1999	**$AT_{nc\text{-}adult}$**	25	yr	PEA, 1999
H'	0.0E+00	unitless	calc'd. from H_c	**ET_{adult}**	8	hr/day	DTSC, 2005	**$AT_{nc\text{-}child}$**		yr	PEA, 1999
K_d	0.00E+00	L/kg	calc'd	**ET_{child}**		hr/day	DTSC, 2005	**P_t**	0.434	unitless	PEA, 1999
S	0.0E+00	mg/L	EPA, 2008	**$SA_{adult\text{-}soil}$**	3,400	cm^2/day	Shaw, 2009	**P_w**	0.150	unitless	PEA, 1999
D_i		cm^2/s	EPA, 2008	**$SA_{child\text{-}soil}$**		cm^2/day	Shaw, 2009	**P_a**	0.284	unitless	PEA, 1999
K_{ow}	8.51E-01	L/kg	EPA, 2004b	**$SA_{adult\text{-}water}$**		cm^2	NA	**$C_{w\text{-}moisture}$**	0.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	**$SA_{child\text{-}water}$**		cm^2	NA	**θ_m**	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}		L/kg	EPA, 2008	**AF**	0.80	mg/cm^2	Shaw, 2009	**σ**	2.65	g/cm^3	PEA, 1999
VP		mm Hg	EPA, 2004b	**MW**	112.41	atomic mass units	EPA, 2004	**β**	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

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Shaw, 2009, Supplemental Work Plan for Risk Assessment at Waste Accumulation Areas, Yosemite National Park, California, USACE Contract No. DACW05-96-D-0011, CTO No. 08 - WAD No. 02, Document Control Number: ACE08-367-H, Revision C, March.

PEAspread - Soil

Table E-19. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Cadmium and compounds **CASRN: 7440-43-9**

$$Cancer\ Risk_{soil} = ((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr))) + (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))) + (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr))) + (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))))$$

$Risk_{soil-adult, ingestion}$	=	9.E-08	**ILCR**	$Dose_{soil-adult, ingestion}$	=	2.E-07	mg/kg-day
$Risk_{soil-child, ingestion}$	=		**ILCR**	$Dose_{soil-child, ingestion}$	=		mg/kg-day
$Risk_{soil-adult,dermal}$	=	5.E-09	**ILCR**	$Dose_{soil-adult,dermal}$	=	1.E-08	mg/kg-day
$Risk_{soil-child,dermal}$	=		**ILCR**	$Dose_{soil-child,dermal}$	=		mg/kg-day
Cancer Risk$_{soil}$	**=**	**1.E-07**	**ILCR**	**Combined Dose$_{soil}$**	**=**	**3.E-07**	mg/kg-day

$$Hazard\ Index_{soil} = (((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc-adult}*365\ days/yr))) + ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc-child}*365\ days/yr))) + ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc-adult}*365\ days/yr))) + ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc-child}*365\ days/yr))))$$

$Hazard\ Quotient_{soil-adult, ingestion}$	=	1.E-03	**HQ**	$Dose_{soil-adult, ingestion}$	7.E-07	mg/kg-day
$Hazard\ Quotient_{soil-child, ingestion}$	=		**HQ**	$Dose_{soil-child, ingestion}$		mg/kg-day
$Hazard\ Quotient_{soil-adult,dermal}$	=	8.E-05	**HQ**	$Dose_{soil-adult,dermal}$	4.E-08	mg/kg-day
$Hazard\ Quotient_{soil-child,dermal}$	=		**HQ**	$Dose_{soil-child,dermal}$		mg/kg-day
Hazard Index$_{soil}$	**=**	**1.E-03**	**HI**	**Combined Dose$_{soil}$**	**7.E-07**	mg/kg-day

PEAspread - Air

Table E-19. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Cadmium and compounds — **CASRN: 7440-43-9**

Cancer $Risk_{air}$	=	$(((SF_i{*}C_a){*}((IR_{adult}{*}EF{*}ED_{adult})/(BW_{adult}{*}AT_c{*}365\ day/yr)))$					
		$+((SF_i{*}Ca){*}((IhR_{child}{*}EF{*}ED_{child})/(BW_{child}{*}AT_c{*}365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s{*}(0.05\ mg/m^3){*}(1{*}10^{-6}\ kg/mg)$		=	$C_s{*}(5{*}10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d{*}ß)+(P_w)+(H'{*}P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	0.00E+00	mg/kg	C_s	=	2.960E+00	mg/kg
E_i	=	#DIV/0!	mg/sec	**SCREENING METHOD NOT VALID FOR VOCs**			
C_a	=	1.E-07	mg/m^3	**But COPC is a Non-VOC**			
$Risk_{air-adult}$	=	7.E-08	**ILCR**	$Dose_{air-adult,inhalation}$	=	5.E-09	mg/kg-day
$Risk_{air-child}$	=		**ILCR**	$Dose_{air-child,\ inhalation}$	=		mg/kg-day
Cancer $Risk_{air}$	**=**	**7.E-08**	**ILCR**	**Combined $Dose_{air}$**	**=**	**5.E-09**	mg/kg-day
$Hazard_{air}$	=	$(((C_a/RfD_i){*}((IhR_{adult}{*}EF{*}ED_{adult})/(BW_{adult}{*}AT_{nc-adult}{*}365\ day/yr)))$					
		$+((C_a/RfD_i){*}((IhR_{child}{*}EF{*}ED_{child})/(BW_{child}{*}AT_{nc-child}{*}365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s{*}(0.05\ mg/m^3){*}(1{*}10^{-6}\ kg/mg)$		=	$C_s{*}(5{*}10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d{*}ß)+(P_w)+(H'{*}P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	0.00E+00	mg/kg	C_s	=	2.96E+00	mg/kg
E_i	=	#DIV/0!	mg/sec	**Screening Method Not Valid for VOCs**			
C_a	=	1.E-07	mg/m^3	**But COPC is a Non-VOC**			
Hazard $Quotient_{air-adult,\ vocs}$	=	2.E-15	**HQ**	$Dose_{air-vocs-adult,inhalation}$		1.E-08	mg/kg-day
Hazard $Quotient_{air-child,\ vocs}$	=		**HQ**	$Dose_{air-vocs-child,\ inhalation}$			mg/kg-day
Hazard $Index_{air,\ voc}$	**=**	**2.E-15**	**HI**	**Combined $Dose_{air-vocs}$**	**Total**	**1.E-08**	mg/kg-day

PEAspread - Physical & Chemical Data

Table E-20. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Iron (Fe) **CASRN: 7439-89-6**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	32,900	mg/kg	site-specific	$IR_{s,adult}$	50	mg/day	PEA, 1999	EF	120	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	$IR_{s,child}$		mg/day	PEA, 1999	$EF_{d,adult}$	120	days/yr	Shaw, 2009
SF_o		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,adults}$	20	m^3/day	PEA, 1999	$EF_{d,child}$		days/yr	Shaw, 2009
SF_i		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,child}$		m^3/day	PEA, 1999	ED_{adult}	25	yr	PEA, 1999
RfD_o	3.0E-01	mg/kg-day	EPA, 2004a	$IR_{w,adult}$	2	L/day	DTSC, 2005	ED_{child}		yr	PEA, 1999
RfD_i		mg/kg-day	EPA, 2004a	$IR_{w,child}$	1	L/day	DTSC, 2005	BW_{adult}	70	kg	PEA, 1999
K_p		cm/hr	EPA, 2008	$IR_{voc,adult}$	2	L/day	DTSC, 2005	BW_{child}		kg	PEA, 1999
ABS	0.01	unitless	PEA, 1999	$IR_{voc,child}$	1	L/day	DTSC, 2005	AT_c	70	yr	PEA, 1999
H_c		atm-m^3/mole	EPA, 2008	$IR_{w,voc}$	2	L/day	PEA, 1999	$AT_{nc\text{-}adult}$	25	yr	PEA, 1999
H'	0.0E+00	unitless	calc'd. from H_c	ET_{adult}	8	hr/day	DTSC, 2005	$AT_{nc\text{-}child}$		yr	PEA, 1999
K_d	0.00E+00	L/kg	calc'd	ET_{child}		hr/day	DTSC, 2005	P_t	0.434	unitless	PEA, 1999
S		mg/L	EPA, 2008	$SA_{adult\text{-}soil}$	3,400	cm^2/day	Shaw, 2009	P_w	0.150	unitless	PEA, 1999
D_i		cm^2/s	EPA, 2008	$SA_{child\text{-}soil}$		cm^2/day	Shaw, 2009	P_a	0.284	unitless	PEA, 1999
K_{ow}	1.00E+00	L/kg	EPA, 2004b	$SA_{adult\text{-}water}$		cm^2	NA	$C_{w\text{-}moisture}$	0.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	$SA_{child\text{-}water}$		cm^2	NA	θ_m	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}		L/kg	EPA, 2008	AF	0.80	mg/cm^2	Shaw, 2009	σ	2.65	g/cm^3	PEA, 1999
VP		mm Hg	EPA, 2004b	MW	55.85	atomic mass units	EPA, 2004	β	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, Interim Report, EPA/600/8-91/011B, Office of Research and Development, Washington, DC 20460, January.

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PEAspread - Soil

Table E-20. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Iron (Fe) **CASRN: 7439-89-6**

$$\text{Cancer Risk}_{soil} = ((SF_o{*}C_s{*}((IR_{s,adult}{*}EF{*}ED_{adult}{*}10^{-6}\text{ kg/mg})/(BW_{adult}{*}AT_c{*}365\text{ days/yr})))$$
$$+ (SF_o{*}C_s{*}((IR_{s,child}{*}EF{*}ED_{child}{*}10^{-6}\text{ kg/mg})/(BW_{child}{*}AT_c{*}365\text{ days/yr})))$$
$$+ (SF_o{*}C_s{*}((SA_{adult}{*}AF{*}ABS{*}EF_{d,adult}{*}ED_{adult}{*}10^{-6}\text{ kg/mg})/(BW_{adult}{*}AT_c{*}365\text{ days/yr})))$$
$$+ (SF_o{*}C_s{*}((SA_{child}{*}AF{*}ABS{*}EF_{d,child}{*}ED_{child}{*}10^{-6}\text{ kg/mg})/(BW_{child}{*}AT_c{*}365\text{ days/yr}))))$$

$\text{Risk}_{soil\text{-}adult,\ ingestior}$	=	0.E+00	ILCR	$\text{Dose}_{soil\text{-}adult,\ ingestior}$	=	3.E-03	mg/kg-day
$\text{Risk}_{soil\text{-}child,\ ingestior}$	=		ILCR	$\text{Dose}_{soil\text{-}child,\ ingestior}$	=		mg/kg-day
$\text{Risk}_{soil\text{-}adult,derma}$	=	0.E+00	ILCR	$\text{Dose}_{soil\text{-}adult,derma}$	=	2.E-03	mg/kg-day
$\text{Risk}_{soil\text{-}child,derma}$	=		ILCR	$\text{Dose}_{soil\text{-}child,derma}$	=		mg/kg-day
Cancer Risk$_{soil}$	**=**	**0.E+00**	**ILCR**	**Combined Dose$_{soil}$**	**=**	**4.E-03**	mg/kg-day

$$\text{Hazard Index}_{soil} = (((C_s/RfD_o){*}((IR_{s,adult}{*}EF{*}ED_{adult}{*}10^{-6}\text{ kg/mg})/(BW_{adult}{*}AT_{nc\text{-}adult}{*}365\text{ days/yr})))$$
$$+ ((C_s/RfD_o){*}((IR_{s,child}{*}EF{*}ED_{child}{*}10^{-6}\text{ kg/mg})/(BW_{child}{*}AT_{nc\text{-}chilc}{*}365\text{ days/yr})))$$
$$+ ((C_s/RfD_o){*}((SA_{adult}{*}AF{*}ABS{*}EF_{d,adult}{*}ED_{adult}{*}10^{-6}\text{ kg/mg})/(BW_{adult}{*}AT_{nc\text{-}adult}{*}365\text{ days/yr})))$$
$$+ ((C_s/RfD_o){*}((SA_{child}{*}AF{*}ABS{*}EF_{d,child}{*}ED_{child}{*}10^{-6}\text{ kg/mg})/(BW_{child}{*}AT_{nc\text{-}chilc}{*}365\text{ days/yr}))))$$

$\text{Hazard Quotient}_{soil\text{-}adult,\ ingestior}$	=	3.E-02	HQ	$\text{Dose}_{soil\text{-}adult,\ ingestior}$	8.E-03	mg/kg-day
$\text{Hazard Quotient}_{soil\text{-}child,\ ingestior}$	=		HQ	$\text{Dose}_{soil\text{-}child,\ ingestior}$		mg/kg-day
$\text{Hazard Quotient}_{soil\text{-}adult,derma}$	=	1.E-02	HQ	$\text{Dose}_{soil\text{-}adult,derma}$	4.E-03	mg/kg-day
$\text{Hazard Quotient}_{soil\text{-}child,derma}$	=		HQ	$\text{Dose}_{soil\text{-}child,derma}$		mg/kg-day
Hazard Index$_{soil}$	**=**	**4.E-02**	**HI**	**Combined Dose$_{soil}$**	**1.E-02**	mg/kg-day

PEAspread - Air

Table E-20. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Iron (Fe) **CASRN: 7439-89-6**

$Cancer\ Risk_{air}$	=	$(((SF_i*C_a)*((IR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_c*365\ day/yr)))$					
		$+((SF_i*Ca)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_c*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	0.00E+00	mg/kg	C_s	=	3.290E+04 mg/kg	
E_i	=	#DIV/0!	mg/sec	**SCREENING METHOD NOT VALID FOR VOCs**			
C_a	=	2.E-03	mg/m^3	**But COPC is a Non-VOC**			
$Risk_{air-adult}$	=	0.E+00	**ILCR**	$Dose_{air-adult,inhalation}$	=	6.E-05	mg/kg-day
$Risk_{air-child}$	=		**ILCR**	$Dose_{air-child,\ inhalation}$	=		mg/kg-day
$Cancer\ Risk_{air}$	**=**	**0.E+00**	**ILCR**	**$Combined\ Dose_{air}$**	**=**	**6.E-05**	mg/kg-day
$Hazard_{air}$	=	$(((C_a/RfD_i)*((IhR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_{nc-adult}*365\ day/yr)))$					
		$+((C_a/RfD_i)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_{nc-child}*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	0.00E+00	mg/kg	C_s	=	3.29E+04 mg/kg	
E_i	=	#DIV/0!	mg/sec	**Screening Method Not Valid for VOCs**			
C_a	=	2.E-03	mg/m^3	**But COPC is a Non-VOC**			
$Hazard\ Quotient_{air-adult,\ vocs}$	=	#DIV/0!	**HQ**	$Dose_{air-vocs-adult,inhalation}$		2.E-04	mg/kg-day
$Hazard\ Quotient_{air-child,\ vocs}$	=		**HQ**	$Dose_{air-vocs-child,\ inhalation}$			mg/kg-day
$Hazard\ Index_{air,\ voc}$	**=**	**#DIV/0!**	**HI**	**$Combined\ Dose_{air-vocs}$**	**Total**	**2.E-04**	mg/kg-day

PEAspread - Physical & Chemical Data

Table E-21. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Manganese and compounds **CASRN: 7439-96-5**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	1,550	mg/kg	site-specific	$IR_{s,adult}$	50	mg/day	PEA, 1999	EF	120	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	$IR_{s,child}$		mg/day	PEA, 1999	$EF_{d,adult}$	120	days/yr	Shaw, 2009
SF_o		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,adults}$	20	m^3/day	PEA, 1999	$EF_{d,child}$		days/yr	Shaw, 2009
SF_i		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,child}$		m^3/day	PEA, 1999	ED_{adult}	25	yr	PEA, 1999
RfD_o	2.4E-02	mg/kg-day	EPA, 2004a	$IR_{w,adult}$	2	L/day	DTSC, 2005	ED_{child}		yr	PEA, 1999
RfD_i	1.4E-05	mg/kg-day	EPA, 2004a	$IR_{w,child}$	1	L/day	DTSC, 2005	BW_{adult}	70	kg	PEA, 1999
K_p		cm/hr	EPA, 1992	$IR_{voc,adult}$	2	L/day	DTSC, 2005	BW_{child}		kg	PEA, 1999
ABS	0.01	unitless	PEA, 1999	$IR_{voc,child}$	1	L/day	DTSC, 2005	AT_c	70	yr	PEA, 1999
H_c		atm-m^3/mole	EPA, 2008	$IR_{w,voc}$	2	L/day	PEA, 1999	$AT_{nc\text{-}adult}$	25	yr	PEA, 1999
H'	0.0E+00	unitless	calc'd. from H_c	ET_{adult}	8	hr/day	DTSC, 2005	$AT_{nc\text{-}child}$		yr	PEA, 1999
K_d	0.00E+00	L/kg	calc'd	ET_{child}		hr/day	DTSC, 2005	P_t	0.434	unitless	PEA, 1999
S		mg/L	EPA, 2008	$SA_{adult\text{-}soil}$	3,400	cm^2/day	Shaw, 2009	P_w	0.150	unitless	PEA, 1999
D_i		cm^2/s	EPA, 2008	$SA_{child\text{-}soil}$		cm^2/day	Shaw, 2009	P_a	0.284	unitless	PEA, 1999
K_{ow}	1.70E+00	L/kg	EPA, 2004b	$SA_{adult\text{-}water}$		cm^2	NA	$C_{w\text{-}moisture}$	0.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	$SA_{child\text{-}water}$		cm^2	NA	θ_m	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}		L/kg	EPA, 2004b	AF	0.80	mg/cm^2	Shaw, 2009	σ	2.65	g/cm^3	PEA, 1999
VP		mm Hg	EPA, 2004b	MW	55	atomic mass units	EPA, 2004	β	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, Interim Report, EPA/600/8-91/011B, Office of Research and Development, Washington, DC 20460, January.

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EPA, 2008, Regional Screening Levels for Chemical Contaminants at Superfund Sites, Internet URL: h *ttp://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm* .

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OEHHA, 2009a, http://www.oehha.ca.gov/risk/chemicalDB/index.asp?error=Unknown+Chemical&chemname=&casnum=

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PEAspread - Soil

Table E-21. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Manganese and compounds **CASRN: 7439-96-5**

$$\text{Cancer Risk}_{soil} = ((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_c*365\text{ days/yr}))) + (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_c*365\text{ days/yr}))) + (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_c*365\text{ days/yr}))) + (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_c*365\text{ days/yr}))))$$

$Risk_{soil\text{-}adult,\ ingestion}$	=	0.E+00	ILCR	$Dose_{soil\text{-}adult,\ ingestion}$	=	1.E-04	mg/kg-day
$Risk_{soil\text{-}child,\ ingestion}$	=		ILCR	$Dose_{soil\text{-}child,\ ingestion}$	=		mg/kg-day
$Risk_{soil\text{-}adult,dermal}$	=	0.E+00	ILCR	$Dose_{soil\text{-}adult,dermal}$	=	7.E-05	mg/kg-day
$Risk_{soil\text{-}child,dermal}$	=		ILCR	$Dose_{soil\text{-}child,dermal}$	=		mg/kg-day
Cancer Risk$_{soil}$	**=**	**0.E+00**	**ILCR**	**Combined Dose$_{soil}$**	**=**	**2.E-04**	mg/kg-day

$$\text{Hazard Index}_{soil} = (((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_{nc\text{-}adult}*365\text{ days/yr}))) + ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_{nc\text{-}child}*365\text{ days/yr}))) + ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_{nc\text{-}adult}*365\text{ days/yr}))) + ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_{nc\text{-}child}*365\text{ days/yr}))))$$

Hazard Quotient$_{soil\text{-}adult,\ ingestion}$	=	2.E-02	HQ	$Dose_{soil\text{-}adult,\ ingestion}$	4.E-04	mg/kg-day
Hazard Quotient$_{soil\text{-}child,\ ingestion}$	=		HQ	$Dose_{soil\text{-}child,\ ingestion}$		mg/kg-day
Hazard Quotient$_{soil\text{-}adult,dermal}$	=	8.E-03	HQ	$Dose_{soil\text{-}adult,dermal}$	2.E-04	mg/kg-day
Hazard Quotient$_{soil\text{-}child,dermal}$	=		HQ	$Dose_{soil\text{-}child,dermal}$		mg/kg-day
Hazard Index$_{soil}$	**=**	**2.E-02**	**HI**	**Combined Dose$_{soil}$**	**6.E-04**	mg/kg-day

PEAspread - Air

Table E-21. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Manganese and compounds **CASRN: 7439-96-5**

Cancer $Risk_{air}$	=	$(((SF_i{*}C_a){*}((IR_{adult}{*}EF{*}ED_{adult})/(BW_{adult}{*}AT_c{*}365\ day/yr)))$ $+((SF_i{*}Ca){*}((IhR_{child}{*}EF{*}ED_{child})/(BW_{child}{*}AT_c{*}365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s{*}(0.05\ mg/m^3){*}(1{*}10^{-6}\ kg/mg)$		=	$C_s{*}(5{*}10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d{*}ß)+(P_w)+(H'{*}P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	0.00E+00	mg/kg	C_s	=	1.550E+03	mg/kg
E_i	=	#DIV/0!	mg/sec	**SCREENING METHOD NOT VALID FOR VOCs**			
C_a	=	8.E-05	mg/m^3	**But COPC is a Non-VOC**			
$Risk_{air-adult}$	=	0.E+00	**ILCR**	$Dose_{air-adult,inhalation}$	=	3.E-06	mg/kg-day
$Risk_{air-child}$	=		**ILCR**	$Dose_{air-child,\ inhalation}$	=		mg/kg-day
Cancer $Risk_{air}$	**=**	**0.E+00**	**ILCR**	**Combined $Dose_{air}$**	**=**	**3.E-06**	mg/kg-day
$Hazard_{air}$	=	$(((C_a/RfD_i){*}((IhR_{adult}{*}EF{*}ED_{adult})/(BW_{adult}{*}AT_{nc-adult}{*}365\ day/yr)))$ $+((C_a/RfD_i){*}((IhR_{child}{*}EF{*}ED_{child})/(BW_{child}{*}AT_{nc-child}{*}365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s{*}(0.05\ mg/m^3){*}(1{*}10^{-6}\ kg/mg)$		=	$C_s{*}(5{*}10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d{*}ß)+(P_w)+(H'{*}P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	0.00E+00	mg/kg	C_s	=	1.55E+03	mg/kg
E_i	=	#DIV/0!	mg/sec	**Screening Method Not Valid for VOCs**			
C_a	=	8.E-05	mg/m^3	**But COPC is a Non-VOC**			
Hazard $Quotient_{air-adult,\ vocs}$	=	5.E-01	**HQ**	$Dose_{air-vocs-adult,inhalation}$		7.E-06	mg/kg-day
Hazard $Quotient_{air-child,\ vocs}$	=		**HQ**	$Dose_{air-vocs-child,\ inhalation}$			mg/kg-day
Hazard $Index_{air,\ voc}$	**=**	**5.E-01**	**HI**	**Combined $Dose_{air-vocs}$**	**Total**	**7.E-06**	mg/kg-day

PEAspread - Physical & Chemical Data

Table E-22. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Phenanthrene (Pyrene surrogate) **CASRN: 85-1-08**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	0.00994	mg/kg	site-specific	$IR_{s,adult}$	50	mg/day	PEA, 1999	EF	120	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	$IR_{s,child}$		mg/day	PEA, 1999	$EF_{d,adult}$	120	days/yr	Shaw, 2009
SF_o		$(mg/kg\text{-}day)^{-1}$	EPA, 2008	$IhR_{a,adults}$	20	m^3/day	PEA, 1999	$EF_{d,child}$		days/yr	Shaw, 2009
SF_i		$(mg/kg\text{-}day)^{-1}$	EPA, 2008	$IhR_{a,child}$		m^3/day	PEA, 1999	ED_{adult}	25	yr	PEA, 1999
RfD_o	3.0E-02	mg/kg-day	EPA, 2008	$IR_{w,adult}$	2	L/day	DTSC, 2005	ED_{child}		yr	PEA, 1999
RfD_i	3.0E-02	mg/kg-day	EPA, 2004	$IR_{w,child}$	1	L/day	DTSC, 2005	BW_{adult}	70	kg	PEA, 1999
K_p	2.7E-01	cm/hr	EPA, 1992	$IR_{voc,adult}$	2	L/day	DTSC, 2005	BW_{child}		kg	PEA, 1999
ABS	0.15	unitless	PEA, 1999	$IR_{voc,child}$	1	L/day	DTSC, 2005	AT_c	70	yr	PEA, 1999
H_c	1.4E-07	atm-m^3/mole	EPA, 2008	$IR_{w,voc}$	2	L/day	PEA, 1999	$AT_{nc\text{-}adult}$	25	yr	PEA, 1999
H'	5.7E-06	unitless	calc'd. from H_c	ET_{adult}	8	hr/day	DTSC, 2005	$AT_{nc\text{-}child}$		yr	PEA, 1999
K_d	9.50E+03	L/kg	calc'd	ET_{child}		hr/day	DTSC, 2005	P_t	0.434	unitless	PEA, 1999
S	1.1	mg/L	EPA, 2004b	$SA_{adult\text{-}soil}$	3,400	cm^2/day	Shaw, 2009	P_w	0.150	unitless	PEA, 1999
D_i	2.80E-02	cm^2/s	EPA, 2008	$SA_{child\text{-}soil}$		cm^2/day	Shaw, 2009	P_a	0.284	unitless	PEA, 1999
K_{ow}	3.16E+04	L/kg	EPA, 2004b	$SA_{adult\text{-}water}$		cm^2	NA	$C_{w\text{-}moisture}$	0.11	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	$SA_{child\text{-}water}$		cm^2	NA	θ_m	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}	6.94E+04	L/kg	EPA, 2008	AF	0.80	mg/cm^2	Shaw, 2009	σ	2.65	g/cm^3	PEA, 1999
VP	4.60E-06	mm Hg	EPA, 2004b	MW	178.2	atomic mass units	EPA, 2004	β	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, Interim Report, EPA/600/8-91/011B, Office of Research and Development, Washington, DC 20460, January.

EPA, 2004a, Region 9 Preliminary Remediation Goals (PRGs) 2004, United States Environmental Protection Agency Region IX, San Francisco, CA, October 1.

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PEAspread - Soil

Table E-22. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Phenanthrene (Pyrene surrogate) **CASRN: 85-1-08**

$$\text{Cancer Risk}_{soil} = ((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr)))$$
$$+ (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr)))$$
$$+ (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr)))$$
$$+ (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))))$$

$Risk_{soil-adult, ingestion}$	=	0.E+00	ILCR	$Dose_{soil-adult, ingestion}$	=	8.E-10	mg/kg-day
$Risk_{soil-child, ingestion}$	=		ILCR	$Dose_{soil-child, ingestion}$	=		mg/kg-day
$Risk_{soil-adult,dermal}$	=	0.E+00	ILCR	$Dose_{soil-adult,dermal}$	=	7.E-09	mg/kg-day
$Risk_{soil-child,dermal}$	=		ILCR	$Dose_{soil-child,dermal}$	=		mg/kg-day
Cancer Risk$_{soil}$	**=**	**0.E+00**	**ILCR**	**Combined Dose$_{soil}$**	**=**	**8.E-09**	mg/kg-day

$$\text{Hazard Index}_{soil} = (((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc-adult}*365\ days/yr)))$$
$$+ ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc-child}*365\ days/yr)))$$
$$+ ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc-adult}*365\ days/yr)))$$
$$+ ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc-child}*365\ days/yr))))$$

$\text{Hazard Quotient}_{soil-adult, ingestion}$	=	8.E-08	HQ	$Dose_{soil-adult, ingestion}$	2.E-09	mg/kg-day
$\text{Hazard Quotient}_{soil-child, ingestion}$	=		HQ	$Dose_{soil-child, ingestion}$		mg/kg-day
$\text{Hazard Quotient}_{soil-adult,dermal}$	=	6.E-07	HQ	$Dose_{soil-adult,dermal}$	2.E-08	mg/kg-day
$\text{Hazard Quotient}_{soil-child,dermal}$	=		HQ	$Dose_{soil-child,dermal}$		mg/kg-day
Hazard Index$_{soil}$	**=**	**7.E-07**	**HI**	**Combined Dose$_{soil}$**	**2.E-08**	mg/kg-day

PEAspread - Air

Table E-22. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Phenanthrene (Pyrene surrogate) **CASRN: 85-1-08**

Cancer $Risk_{air}$	=	$(((SF_i*C_a)*((IR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_c*365\ day/yr)))$						
		$+((SF_i*Ca)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_c*365\ day/yr))))$						
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$			
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$				
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$						
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]						
C_{sat}	=	1.05E+04	mg/kg	C_s	=	9.940E-03	mg/kg	
E_i	=	1.44E-09	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**				
C_a	=	5.E-10	mg/m^3	**But COPC is a Non-VOC**				
$Risk_{air-adult}$	=	0.E+00	**ILCR**	$Dose_{air-adult,inhalation}$	=	2.E-11	mg/kg-day	
$Risk_{air-child}$	=		**ILCR**	$Dose_{air-child,\ inhalation}$	=		mg/kg-day	
Cancer $Risk_{air}$	**=**	**0.E+00**	**ILCR**	**Combined $Dose_{air}$**	**=**	**2.E-11**	mg/kg-day	

$Hazard_{air}$	=	$(((C_a/RfD_i)*((IhR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_{nc-adult}*365\ day/yr)))$						
		$+((C_a/RfD_i)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_{nc-child}*365\ day/yr))))$						
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$			
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$				
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$						
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]						
C_{sat}	=	1.05E+04	mg/kg	C_s	=	9.94E-03	mg/kg	
E_i	=	1.44E-09	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**				
C_a	=	5.E-10	mg/m^3	**But COPC is a Non-VOC**				
Hazard $Quotient_{air-adult,\ vocs}$	=	2.E-09	**HQ**	$Dose_{air-vocs-adult,inhalation}$		5.E-11	mg/kg-day	
Hazard $Quotient_{air-child,\ vocs}$	=		**HQ**	$Dose_{air-vocs-child,\ inhalation}$			mg/kg-day	
Hazard $Index_{air,\ voc}$	**=**	**2.E-09**	**HI**	**Combined $Dose_{air-vocs}$**	**Total**	**5.E-11**	mg/kg-day	

PEAspread - Physical & Chemical Data

Table E-23. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Thallium **CASRN: 7440-28-0**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	0.445	mg/kg	site-specific	$IR_{s,adult}$	50	mg/day	PEA, 1999	EF	120	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	$IR_{s,child}$		mg/day	PEA, 1999	$EF_{d,adult}$	120	days/yr	Shaw, 2009
SF_o		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,adults}$	20	m^3/day	PEA, 1999	$EF_{d,child}$		days/yr	Shaw, 2009
SF_i		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,child}$		m^3/day	PEA, 1999	ED_{adult}	25	yr	PEA, 1999
RfD_o	6.6E-05	mg/kg-day	EPA, 2008	$IR_{w,adult}$	2	L/day	DTSC, 2005	ED_{child}		yr	PEA, 1999
RfD_i		mg/kg-day	EPA, 2008	$IR_{w,child}$	1	L/day	DTSC, 2005	BW_{adult}	70	kg	PEA, 1999
K_p		cm/hr	EPA, 1992	$IR_{voc,adult}$	2	L/day	DTSC, 2005	BW_{child}		kg	PEA, 1999
ABS	0.01	unitless	PEA, 1999	$IR_{voc,child}$	1	L/day	DTSC, 2005	AT_c	70	yr	PEA, 1999
H_c		atm-m^3/mole	EPA, 2008	$IR_{w,voc}$	2	L/day	PEA, 1999	$AT_{nc\text{-}adult}$	25	yr	PEA, 1999
H'	0.0E+00	unitless	calc'd. from H_c	ET_{adult}	8	hr/day	DTSC, 2005	$AT_{nc\text{-}child}$		yr	PEA, 1999
K_d	0.00E+00	L/kg	calc'd.	ET_{child}		hr/day	DTSC, 2005	P_t	0.434	unitless	PEA, 1999
S	8.6E+03	mg/L	EPA, 2004b	$SA_{adult\text{-}soil}$	3,400	cm^2/day	Shaw, 2009	P_w	0.150	unitless	PEA, 1999
D_i		cm^2/s	EPA, 2008	$SA_{child\text{-}soil}$		cm^2/day	Shaw, 2009	P_a	0.284	unitless	PEA, 1999
K_{ow}	1.70E+00	L/kg	PEA, 1999	$SA_{adult\text{-}water}$		cm^2	NA	$C_{w\text{-}moisture}$	860.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	$SA_{child\text{-}water}$		cm^2	NA	θ_m	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}		L/kg	EPA, 2008	AF	0.80	mg/cm^2	Shaw, 2009	σ	2.65	g/cm^3	PEA, 1999
VP		mm Hg	EPA, 2004b	MW	200	atomic mass units	EPA, 2004	β	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, Interim Report, EPA/600/8-91/011B, Office of Research and Development, Washington, DC 20460, January.

EPA, 2004a, Region 9 Preliminary Remediation Goals (PRGs) 2004, United States Environmental Protection Agency Region IX, San Francisco, CA, October 1.

EPA, 2004b, Superfund Chemical Data Matrix, *http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm*

EPA, 2008, Regional Screening Levels for Chemical Contaminants at Superfund Sites, Internet URL: h *ttp://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm* .

EPA, 2009, IRIS Data Base, www.epa.gov/iris

OEHHA, 2009a, http://www.oehha.ca.gov/risk/chemicalDB/index.asp?error=Unknown+Chemical&chemname=&casnum=

PEA, 1999, Preliminary Endangerment Assessment Guidance Manual, (Figures 1-8, Pages B-7 through B-14), State of California Environmental Protection Agency, Department of Toxic Substances Control, January, Second Printing, June, 1999.

Shaw, 2009, Supplemental Work Plan for Risk Assessment at Waste Accumulation Areas, Yosemite National Park, California, USACE Contract No. DACW05-96-D-0011, CTO No. 08 - WAD No. 02, Document Control Number: ACE08-367-H, Revision C, March.

PEAspread - Soil

Table E-23. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Thallium **CASRN: 7440-28-0**

$$\text{Cancer Risk}_{soil} = ((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_c*365\text{ days/yr}))) + (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_c*365\text{ days/yr}))) + (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_c*365\text{ days/yr}))) + (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_c*365\text{ days/yr}))))$$

$Risk_{soil-adult, ingestior}$	=	0.E+00	**ILCR**	$Dose_{soil-adult, ingestior}$	=	4.E-08	mg/kg-day
$Risk_{soil-child, ingestior}$	=		**ILCR**	$Dose_{soil-child, ingestior}$	=		mg/kg-day
$Risk_{soil-adult,derma}$	=	0.E+00	**ILCR**	$Dose_{soil-adult,derma}$	=	2.E-08	mg/kg-day
$Risk_{soil-child,derma}$	=		**ILCR**	$Dose_{soil-child,derma}$	=		mg/kg-day
Cancer Risk$_{soil}$	**=**	**0.E+00**	**ILCR**	**Combined Dose$_{soil}$**	**=**	**6.E-08**	mg/kg-day

$$\text{Hazard Index}_{soil} = (((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_{nc-adult}*365\text{ days/yr}))) + ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_{nc-child}*365\text{ days/yr}))) + ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\text{ kg/mg})/(BW_{adult}*AT_{nc-adult}*365\text{ days/yr}))) + ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\text{ kg/mg})/(BW_{child}*AT_{nc-child}*365\text{ days/yr}))))$$

Hazard Quotient$_{soil-adult, ingestior}$	=	2.E-03	**HQ**	$Dose_{soil-adult, ingestior}$	1.E-07	mg/kg-day
Hazard Quotient$_{soil-child, ingestior}$	=		**HQ**	$Dose_{soil-child, ingestior}$		mg/kg-day
Hazard Quotient$_{soil-adult,derma}$	=	9.E-04	**HQ**	$Dose_{soil-adult,derma}$	6.E-08	mg/kg-day
Hazard Quotient$_{soil-child,derma}$	=		**HQ**	$Dose_{soil-child,derma}$		mg/kg-day
Hazard Index$_{soil}$	**=**	**2.E-03**	**HI**	**Combined Dose$_{soil}$**	**2.E-07**	mg/kg-day

PEAspread - Air

Table E-23. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Thallium **CASRN: 7440-28-0**

Cancer $Risk_{air}$	=	$(((SF_i*C_a)*((IR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_c*365\ day/yr)))$					
		$+((SF_i*Ca)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_c*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	8.60E+02	mg/kg	C_s	=	4.450E-01	mg/kg
E_i	=	#DIV/0!	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**			
C_a	=	2.E-08	mg/m^3	**But COPC is a Non-VOC**			
$Risk_{air-adult}$	=	0.E+00	**ILCR**	$Dose_{air-adult,inhalation}$	=	7.E-10	mg/kg-day
$Risk_{air-child}$	=		**ILCR**	$Dose_{air-child,\ inhalation}$	=		mg/kg-day
Cancer $Risk_{air}$	**=**	**0.E+00**	**ILCR**	**Combined $Dose_{air}$**	**=**	**7.E-10**	mg/kg-day
$Hazard_{air}$	=	$(((C_a/RfD_i)*((IhR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_{nc-adult}*365\ day/yr)))$					
		$+((C_a/RfD_i)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_{nc-child}*365\ day/yr))))$					
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$		=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$			
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$					
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]					
C_{sat}	=	8.60E+02	mg/kg	C_s	=	4.45E-01	mg/kg
E_i	=	#DIV/0!	mg/sec	**Cs < Csat--SCREENING METHOD IS OK FOR VOCs**			
C_a	=	2.E-08	mg/m^3	**But COPC is a Non-VOC**			
Hazard $Quotient_{air-adult,\ vocs}$	=	#DIV/0!	**HQ**	$Dose_{air-vocs-adult,inhalation}$		2.E-09	mg/kg-day
Hazard $Quotient_{air-child,\ vocs}$	=		**HQ**	$Dose_{air-vocs-child,\ inhalation}$			mg/kg-day
Hazard $Index_{air,\ voc}$	**=**	**#DIV/0!**	**HI**	**Combined $Dose_{air-vocs}$**	**Total**	**2.E-09**	mg/kg-day

PEAspread - Physical & Chemical Data

Table E-24. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Zinc compounds | **CASRN: 7440-66-6**

Factor	Value	Units	Ref.	Factor	Value	Units	Ref.	Factor	Value	Units	Ref.
C_s (max)	2,380	mg/kg (J)	site-specific	$IR_{s,adult}$	50	mg/day	PEA, 1999	EF	120	days/yr	Shaw, 2009
C_w (max)	NA	mg/L	NA	$IR_{s,child}$		mg/day	PEA, 1999	$EF_{d,adult}$	120	days/yr	Shaw, 2009
SF_o		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,adults}$	20	m^3/day	PEA, 1999	$EF_{d,child}$		days/yr	Shaw, 2009
SF_i		$(mg/kg\text{-}day)^{-1}$	EPA, 2004a	$IhR_{a,child}$		m^3/day	PEA, 1999	ED_{adult}	25	yr	PEA, 1999
RfD_o	3.0E-01	mg/kg-day	EPA, 2004a	$IR_{w,adult}$	2	L/day	DTSC, 2005	ED_{child}		yr	PEA, 1999
RfD_i		mg/kg-day	EPA, 2004a	$IR_{w,child}$	1	L/day	DTSC, 2005	BW_{adult}	70	kg	PEA, 1999
K_p	6.0E-04	cm/hr	PEA, 1999	$IR_{voc,adult}$	2	L/day	DTSC, 2005	BW_{child}		kg	PEA, 1999
ABS	0.01	unitless	PEA, 1999	$IR_{voc,child}$	1	L/day	DTSC, 2005	AT_c	70	yr	PEA, 1999
H_c		atm-m^3/mole	EPA, 2004b	$IR_{w,voc}$	2	L/day	PEA, 1999	$AT_{nc\text{-}adult}$	25	yr	PEA, 1999
H'	0.0E+00	unitless	calc'd. from H_c	ET_{adult}	8	hr/day	DTSC, 2005	$AT_{nc\text{-}child}$		yr	PEA, 1999
K_d	0.00E+00	L/kg	calc'd.	ET_{child}		hr/day	DTSC, 2005	P_t	0.434	unitless	PEA, 1999
S	1.4E+03	mg/L	EPA, 2004b	$SA_{adult\text{-}soil}$	3,400	cm^2/day	Shaw, 2009	P_w	0.150	unitless	PEA, 1999
D_i		cm^2/s	EPA, 2008	$SA_{child\text{-}soil}$		cm^2/day	Shaw, 2009	P_a	0.284	unitless	PEA, 1999
K_{ow}		L/kg	PEA, 1999	$SA_{adult\text{-}water}$		cm^2	NA	$C_{w\text{-}moisture}$	140.00	mg/L-water	PEA, 1999
f_{oc}	0.02	g-C/g-soil	PEA, 1999	$SA_{child\text{-}water}$		cm^2	NA	θ_m	0.1	kg-water/kg-soil	PEA, 1999
K_{oc}		L/kg	EPA, 2008	AF	0.80	mg/cm^2	Shaw, 2009	σ	2.65	g/cm^3	PEA, 1999
VP		mm Hg	EPA, 2004b	MW	65	atomic mass units	EPA, 2004	β	1.5	kg/L (g/cm^3)	PEA, 1999

If either of the following is "GREATER THAN", the COPC is a Volatile Organic Chemical (VOC) for the risk/hazard calculations.

Vapor Pressure is LESS THAN 1E-3 mm Hg <====> Henry's Law Constant is LESS THAN 1E-5 atm-m3/mole

The COPC is NOT a VOC for PEA Screening

REFERENCES (All references must be checked and revised, as needed, for each use.)

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, Interim Report, EPA/600/8-91/011B, Office of Research and Development, Washington, DC 20460, January.

EPA, 2004a, Region 9 Preliminary Remediation Goals (PRGs) 2004, United States Environmental Protection Agency Region IX, San Francisco, CA, October 1.

EPA, 2004b, Superfund Chemical Data Matrix, *http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm*

EPA, 2008, Regional Screening Levels for Chemical Contaminants at Superfund Sites, Internet URL: h *ttp://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm* .

EPA, 2009, IRIS Data Base, www.epa.gov/iris

OEHHA, 2009a, http://www.oehha.ca.gov/risk/chemicalDB/index.asp?error=Unknown+Chemical&chemname=&casnum=

PEA, 1999, Preliminary Endangerment Assessment Guidance Manual, (Figures 1-8, Pages B-7 through B-14), State of California Environmental Protection Agency, Department of Toxic Substances Control, January, Second Printing, June, 1999.

Shaw, 2009, Supplemental Work Plan for Risk Assessment at Waste Accumulation Areas, Yosemite National Park, California, USACE Contract No. DACW05-96-D-0011, CTO No. 08 - WAD No. 02, Document Control Number: ACE08-367-H, Revision C, March.

PEAspread - Soil

Table E-24. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations
For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2)
For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening
Mather Waste Accumulation Area, Yosemite National Park, California
Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Zinc compounds **CASRN: 7440-66-6**

$Cancer\ Risk_{soil}$ = $((SF_o*C_s*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr)))$
$+ (SF_o*C_s*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr)))$
$+ (SF_o*C_s*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_c*365\ days/yr)))$
$+ (SF_o*C_s*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_c*365\ days/yr))))$

$Risk_{soil-adult, ingestion}$	=	0.E+00	**ILCR**	$Dose_{soil-adult, ingestion}$	=	2.E-04	mg/kg-day
$Risk_{soil-child, ingestion}$	=		**ILCR**	$Dose_{soil-child, ingestion}$	=		mg/kg-day
$Risk_{soil-adult,dermal}$	=	0.E+00	**ILCR**	$Dose_{soil-adult,dermal}$	=	1.E-04	mg/kg-day
$Risk_{soil-child,dermal}$	=		**ILCR**	$Dose_{soil-child,dermal}$	=		mg/kg-day
$Cancer\ Risk_{soil}$	**=**	**0.E+00**	**ILCR**	**$Combined\ Dose_{soil}$**	**=**	**3.E-04**	mg/kg-day

$Hazard\ Index_{soil}$ = $(((C_s/RfD_o)*((IR_{s,adult}*EF*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc-adult}*365\ days/yr)))$
$+ ((C_s/RfD_o)*((IR_{s,child}*EF*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc-child}*365\ days/yr)))$
$+ ((C_s/RfD_o)*((SA_{adult}*AF*ABS*EF_{d,adult}*ED_{adult}*10^{-6}\ kg/mg)/(BW_{adult}*AT_{nc-adult}*365\ days/yr)))$
$+ ((C_s/RfD_o)*((SA_{child}*AF*ABS*EF_{d,child}*ED_{child}*10^{-6}\ kg/mg)/(BW_{child}*AT_{nc-child}*365\ days/yr))))$

$Hazard\ Quotient_{soil-adult, ingestion}$	=	2.E-03	**HQ**	$Dose_{soil-adult, ingestion}$	6.E-04	mg/kg-day
$Hazard\ Quotient_{soil-child, ingestion}$	=		**HQ**	$Dose_{soil-child, ingestion}$		mg/kg-day
$Hazard\ Quotient_{soil-adult,dermal}$	=	1.E-03	**HQ**	$Dose_{soil-adult,dermal}$	3.E-04	mg/kg-day
$Hazard\ Quotient_{soil-child,dermal}$	=		**HQ**	$Dose_{soil-child,dermal}$		mg/kg-day
$Hazard\ Index_{soil}$	**=**	**3.E-03**	**HI**	**$Combined\ Dose_{soil}$**	**9.E-04**	mg/kg-day

PEAspread - Air

Table E-24. Preliminary Endangerment Assessment Risk/Hazard Spreadsheet (PEAspread) Calculations For Hypothetical Exposure to Chemical in Soil (0-2 feet bgs, Exposure Point Concentration from Table 5-2) For Adult Park Employee Occasional On-Site Exposure Scenario For Site Screening Mather Waste Accumulation Area, Yosemite National Park, California Shaw Project No. 870508.02122140.525

Chemical of Potential Concern (COPC): Zinc compounds **CASRN: 7440-66-6**

Cancer $Risk_{air}$	=	$(((SF_i*C_a)*((IR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_c*365\ day/yr)))$						
		$+((SF_i*Ca)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_c*365\ day/yr))))$						
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$			=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$				
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$						
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]						
C_{sat}	=	1.40E+02	mg/kg	C_s	=	2.380E+03 mg/kg		
E_i	=	#DIV/0!	mg/sec	**SCREENING METHOD NOT VALID FOR VOCs**				
C_a	=	1.E-04	mg/m^3	**But COPC is a Non-VOC**				
$Risk_{air-adult}$	=	0.E+00	**ILCR**	$Dose_{air-adult,inhalation}$	=		4.E-06	mg/kg-day
$Risk_{air-child}$	=		**ILCR**	$Dose_{air-child,\ inhalation}$	=			mg/kg-day
Cancer $Risk_{air}$	**=**	**0.E+00**	**ILCR**	**Combined $Dose_{air}$**	**=**		**4.E-06**	mg/kg-day
$Hazard_{air}$	=	$(((C_a/RfD_i)*((IhR_{adult}*EF*ED_{adult})/(BW_{adult}*AT_{nc-adult}*365\ day/yr)))$						
		$+((C_a/RfD_i)*((IhR_{child}*EF*ED_{child})/(BW_{child}*AT_{nc-child}*365\ day/yr))))$						
for non-VOCs, where C_a	=	$C_s*(0.05\ mg/m^3)*(1*10^{-6}\ kg/mg)$			=	$C_s*(5*10^{-8}\ kg/m^3)$		
or for VOCs, where C_a	=	$E_i/99$		when $C_s \leq C_{sat}$				
and, E_i	=	$((1.6 \times 10^5 \times D_i \times (H_c/K_d) \times C_s \times 10^{-6}\ kg/mg) / (D_i \times (0.023/(0.284 + (0.046 \times (K_d/H_c)))))^{0.5})$						
and, C_{sat}	=	$((S/ß)((K_d*ß)+(P_w)+(H'*P_a)))$ [see PEA Guidance Manual, Errata Sheet, pp. 2-34 & 2-35.]						
C_{sat}	=	1.40E+02	mg/kg	C_s	=	2.38E+03 mg/kg		
E_i	=	#DIV/0!	mg/sec	**Screening Method Not Valid for VOCs**				
C_a	=	1.E-04	mg/m^3	**But COPC is a Non-VOC**				
Hazard $Quotient_{air-adult,\ vocs}$	=	#DIV/0!	**HQ**	$Dose_{air-vocs-adult,inhalation}$			1.E-05	mg/kg-day
Hazard $Quotient_{air-child,\ vocs}$	=		**HQ**	$Dose_{air-vocs-child,\ inhalation}$				mg/kg-day
Hazard $Index_{air,\ voc}$	**=**	**#DIV/0!**	**HI**	**Combined $Dose_{air-vocs}$**		**Total**	**1.E-05**	mg/kg-day

APPENDIX F
APPLICATION OF THE DTSC LEAD MODEL, LEADSPREAD 7

TABLE OF CONTENTS

Page No.

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

CalEPA	California Environmental Protection Agency
CARB	California Air Resources Board
CSEM	Conceptual Site Exposure Model
DTSC	[CalEPA] Department of Toxic Substances Control
HERD	[DTSC] Health and Ecological Risk Division
LeadSpread7	CalEPA/DTSC spreadsheet for Lead Risk Assessment
LOC	Level of Concern
µg/dl	micrograms per deciliter
µg/g	micrograms per gram (equivalent to mg/kg)
µg/kg	micrograms per kilogram
µg/L	microgram per liter
µg/m^3	micrograms per cubic meter
mg/kg	milligram per kilogram (equivalent to µg/g)
percentile	value at specified percentage point in list of values, e.g, 50th, 95th, etc.
Pica	craving for unnatural materials as food stuffs
PRG	Preliminary Remediation Goal
PRG-95	Preliminary Remediation Goal - 95th percentile
PRG-99	Preliminary Remediation Goal - 99th percentile
RME	Reasonable Maximum Exposure
USEPA	U.S. Environmental Protection Agency
WAA	Waste Accumulation Area

1.0 APPLYING LEADSPREAD7 CUSTOM SPREADSHEET FOR LEAD RISK ASSESSMENT

Risk assessment for lead is conducted by comparison to site-specific lead concentrations and is not included in a typical cumulative risk/hazard assessment. California Human Health Screening Levels (CHHSLs) for lead have been calculated by means of a spreadsheet called LeadSpread (DTSC, 2007) that relates the lead concentration in environmental media to blood lead concentrations. The current version, LeadSpread7, was developed by the California Environmental Protection Agency (CalEPA) Department of Toxic Substances Control (DTSC) as a total exposure model. It considers exposure to lead from up to a total of five different environmental media: air, soil, water, home-grown produce, and respirable dust. The model was developed as a total exposure model because large national surveys[1] in the early 1970s (United States Environmental Protection Agency [USEPA], 1986, 1989, 2008) allowed compilation of blood lead concentrations for children and adults[2] potentially exposed to lead from all five of the possible sources.

Originally, allowable concentrations in soil were determined using LeadSpread7 with a level of concern (LOC) of 10 µg/dL for the 99th percentile of the child population. The lead CHHSLs for child and adult obtained by this approach have been 150 and 3,500 mg/kg, respectively.

1.1 REVISION OF THE CHILD CHHSL FOR LEAD

The Office of Environmental Health Hazard Assessment (OEHHA) has recognized more recently (OEHHA, 2007) that 10 µg/dL in not protective of children in the sense that even with child blood lead levels below 10 µg/dL an increase in blood lead concentration of 1 µg/dL can cause a decrement of intelligence quotient (IQ) by a third of an IQ point. More recently, OEHHA (2009) used LeadSpread7 with parameters corresponding to the level of lead in soil but with no background exposure that would produce a 1 µg/dL increase in blood lead. The input values from Table 1 of OEHHA, 2009 are reproduced as follows:

---

[1] These surveys addressed separately the special condition of what is called *Pica* behavior, in which there is a craving, notably among selected children, for unnatural food stuffs that might contain lead. Therefore, while Pica behavior can be addressed by the model, it is typically not addressed in assessments such as this one for protection of the general population, including sensitive subpopulations such as the infirm, the aged, and the very young.

[2] Currently, the calculation of blood lead occurrence for adults is lined out of LeadSpread7 while the spreadsheet is undergoing revision (reconfirmed 2/10/10). Calculation of blood lead estimates for the child population is still available and has been incorporated herein. The adult receptor is addressed in the federal models by the Adult Lead Model (ALM; USEPA, 2003).

LeadSpread Input Values
(from Table 1 of OEHHA, 2009)

FACTOR	LEVEL	UNITS
Lead in Soil/Dust	77	µg/g
Soil ingestion	100	mg/day
Ingestion constant	0.16	(µg/dL)/(µg/day)
Oral bioavailability	0.44	unitless
Skin area	2900	cm^2
Soil adherence	200	$\mu g/cm^2$
Dermal uptake constant	0.0001	(µg/dL)/(µg/day)
Respirable dust	1.5	$\mu g/m^3$
Breathing rate	6.8	m^3/day
Inhalation constant	0.192	(µg/dL)/(µg/day)
Exposure days per week	7	days/wk
Geometric Standard Deviation[1]	1.6	µg/dL
Background lead in air[2]	0	$\mu g/m^3$
Lead in water[2]	0	µg/L
Home-grown produce[3]	0	percent
Resulting 90th percentile increase in blood lead	1	µg/dL

[1]Based on blood lead levels in geographically limited populations of children (USEPA, 200

[2]Because this soil screening level is based on a change in blood lead due to the exposure under evaluation, no background exposures are included.

[3]As explained in (OEHHA, 2005), the food pathway is not used in calculating soil screening levels. These screening levels may not be appropriate for sites to be used for gardening or farming.

The resulting level of lead in soil/dust (lead/CHHSL) is 77 µg/g (mg/kg)[3], rounded to 80 mg/kg for the child CHHSL (OEHHA, 2009). The LeadSpread7 table yielding this result has been recreated to confirm the result and is presented as Table F-1. Of note in Table F-1 is that the default exposure parameter for *days per week* is *7 days/week*. For the Yosemite WAAs, a child hiker has been identified as potentially present on the site during a portion of the time that the park is accessible. A site-specific modification of the CHHSL to incorporate site-specific conditions is appropriate[4].

[3] The determination of the lead-in-soil/dust concentration is conducted using What-If Analysis—goal seek in Excel where the 90th percentile estimate of Blood Pb Change is set to 1.0 µg/dL and the lead-in-soil concentration is varied automatically to fit the child blood Pb criterion. The result in Table F-1 is 77 µg/g. For the spreadsheet, the confirmed input parameters are highlighted in yellow. The cells used for What-If Analysis are highlighted in green.

[4] The appropriateness of using a non-standard exposure scenario was confirmed with Michael J. Wade, Ph.D., D.A.B.T., Senior Toxicologist, Human and Ecological Risk Division, Brownfields and Environmental Restoration Program, Dept. of Toxic Substances Control, 8800 Cal Center Drive, Sacramento, California 95826 by email and telephone on October 26, 2009. Dr. Wade is the contact (mwade@dtsc.ca.gov) for LeadSpread designated on the webpage http://www.dtsc.ca.gov/AssessingRisk/leadspread.cfm. He also urged the review of this approach with the DTSC project toxicologist which is accomplished via the review cycle for this report.

1.2 CHHSL MODIFICATION FOR SITE-SPECIFIC EXPOSURE FREQUENCY

Table F-2 is modified from Table F-1 to account for an exposure frequency of 7 days/year[5] for an occasional child hiker with the "year" actually being the number of days between May 1 and November 1 (about 26 weeks), as the nominal time between significant snow events that limits or curtails access to the park. Days per week is modified from Table F-1 as follows:

$$7\ \frac{days}{week}\ x\ \left(\frac{30\,\frac{days}{year}}{184\,\frac{days}{year}}\right) = 1.141\ \frac{days}{week}$$

$$\frac{7\ \left(\frac{days}{year}\right)}{26\ \left(\frac{weeks}{year}\right)} = 0.27\left(\frac{days}{week}\right)$$

Application of 0.27 days/week in the Table F-1 format immediately changes the 90th percentile estimate of blood lead change in µg/dL to other than 1.0. Application of What-If Analysis—goal seek for 1.0 µg/dL blood lead change with automatic modification of Lead in Soil/Dust concentration results in a modified CHHSL for the site-specific child hiker of 2,000 µg/g (mg/kg) as shown in the version of LeadSpread7 presented in Table F-2. It is the modified child hiker lead CHHSL that is used for comparison to the site-specific representative lead-in-soil concentration for Mather WAA.

1.3 SUMMARY

The representative **average** surface soil lead concentration at the Mather WAA is 286 mg/kg (Table 5-2 in the main text) which is less than the Child Hiker CHHSL of 473 mg/kg. The maximum concentration for lead in surface soil at the Mather WAA is 994 mg/kg, and the statistical 95% UCL is 1,030 mg/kg. All of these are less than the modified CHHSL for a child and is also protective for the Adult Hiker and Adult Park Employee because a child will have a greater lead intake per kg body weight compared to an adult.

Lead in soil at the Mather WAA should not be a concern for adult and child hikers and park employees

[5] The exposure frequency for adult & child hikers is estimated conservatively as response to DTSC comments on the draft report. The revised estimate is that adult and child hikers visit the WAA, at most, an hour each day that they visit the park. That is 26 hours/year (1.1 day/year) for the 26 weeks/year that the park is accessible. Exposure frequency (EF) is to be an upper-bound estimate, such as a 90th percentile value. As a conservative estimate for EF, 7 days/year is chosen as an upper-bound estimate based on the visitation rationale for a remote WAA.

2.0 REFERENCES

California Environmental Protection Agency Department of Toxic Substances Control (DTSC), 2007, DTSC Lead Risk Assessment Spreadsheet; available at http://dtsc.ca.gov/AssessingRisk/leadspread.cfm

California Environmental Protection Agency Integrated Risk Assessment Branch Office of Environmental Health Hazard Assessment (OEHHA), 2007, *Development of Health Criteria for Schools Site Risk Assessment Pursuant to Health and Safety Code Section 901(g): Proposed Child-Specific Benchmark Change in Blood Lead Concentration for School Site Risk Assessment.* http://www.oehha.ca.gov/public/kids/index.html.

DTSC, see California Environmental Protection Agency Department of Toxic Substances Control.

OEHHA, 2009, *Revised California Human Health Screening Levels for Lead*, September, http://oehha.ca.gov/risk/pdf/LeadCHHSL091709.pdf

OEHHA, see California Environmental Protection Agency Integrated Risk Assessment Branch Office of Environmental Hazard Assessment.

U.S. Environmental Protection Agency (USEPA), 1986, *Air Quality Criteria for Lead*, EPA 600/8-83-028AF, BF, CF, DF, Office of Research and Development, Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Research Triangle Park, NC, June, with Addendum, September.

U.S. Environmental Protection Agency (USEPA), 1989, *Review of the National Ambient Air Quality Standards for Lead*, EPA 450/2-89-011, Office of Air Quality Planning and Standard, June. U.S. Environmental Protection Agency (USEPA), 2003, Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil, EPA-540-R-03-001, OSWER Dir #9285.7-54, December 1996 (January 2003)—The Adult Lead Methodology (ALM).

U.S. Environmental Protection Agency (USEPA), 2008, *Review of the National Ambient Air Quality Standards for Lead*, EPA 450/2-89-011, Office of Air Quality Planning and Standards, June, 1989; revised October 15, 2008.

Tables F-1 & F-2
Lead Risk Assessment Spreadsheets

TABLE F-1.

Blood Lead Change
Lead Risk Assessment Spreadsheet
(California Department of Toxic Substances Control)
Mather Waste Accumulation Area, Yosemite National Park

USER'S GUIDE to version 7

INPUT	
MEDIUM	LEVEL
Lead in Air (ug/m^3)	0
Lead in Soil/Dust (ug/g)	77
Lead in Water (ug/l)	0
% Home-grown Produce	0%
Respirable Dust (ug/m^3)	1.5

OUTPUT							
	Percentile Estimate of Blood Pb Change (ug/dl)					PRG-99	PRG-95
	50th	90th	95th	98th	99th	(ug/g)	(ug/g)
~~BLOOD Pb, ADULT~~	~~0.3~~	~~0.6~~	~~0.7~~	~~0.8~~	~~0.9~~	~~3379~~	~~4771~~
BLOOD Pb, CHILD	0.5	1.0	1.2	1.4	1.6	471	652
BLOOD Pb, PICA CHILD	1.1	2.0	2.4	2.9	3.3	237	327
~~BLOOD Pb, OCCUPATIONAL~~	~~0.3~~	~~0.5~~	~~0.6~~	~~0.7~~	~~0.8~~	~~4830~~	~~6819~~

key parameters confirmed and highlighted herein based on http://www.oehha.ca.gov/public_info/public/kids/index.html

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	2900
Skin area occupational	cm^2	2900	
Soil adherence	ug/cm^2	70	200
Dermal uptake constant	(ug/dl)/(ug/day	0.0001	
Soil ingestion	mg/day	50	100
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	6.8
Inhalation constant	(ug/dl)/(ug/day	0.082	0.192
Water ingestion	l/day	1.4	0.4
Food ingestion	kg/day	1.9	1.1
Lead in market basket	ug/kg	3.1	
Lead in home-grown produce	ug/kg	34.7	

PATHWAYS						
~~ADULTS~~	~~Residential~~			~~Occupational~~		
	~~Pathway contribution~~			~~Pathway contribution~~		
~~Pathway~~	~~PEF~~	~~ug/dl~~	~~percent~~	~~PEF~~	~~ug/dl~~	~~percent~~
~~Soil Contact~~	~~3.8E-5~~	~~0.00~~	~~1%~~	~~1.4E-5~~	~~0.00~~	~~0%~~
~~Soil Ingestion~~	~~8.8E-4~~	~~0.07~~	~~22%~~	~~6.3E-4~~	~~0.05~~	~~17%~~
~~Inhalation, bkgrnd~~		~~0.00~~	~~0%~~		~~0.00~~	~~0%~~
~~Inhalation~~	~~2.5E-6~~	~~0.00~~	~~0%~~	~~1.8E-6~~	~~0.00~~	~~0%~~
~~Water Ingestion~~		~~0.00~~	~~0%~~		~~0.00~~	~~0%~~
~~Food Ingestion, bkgrnd~~		~~0.23~~	~~77%~~		~~0.23~~	~~82%~~
~~Food Ingestion~~	~~0.0E+0~~	~~0.00~~	~~0%~~			~~0%~~

CHILDREN	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	5.6E-5	0.00	1%		0.00	0%
Soil Ingestion	7.0E-3	0.54	99%	1.4E-2	1.09	100%
Inhalation	2.0E-6	0.00	0%		0.00	0%
Inhalation, bkgrnd		0.00	0%		0.00	0%
Water Ingestion		0.00	0%		0.00	0%
Food Ingestion, bkgrnd		0.00	0%		0.00	0%
Food Ingestion	0.0E+0	0.00	0%		0.00	0%

Click here for REFERENCES

(yellow)	confirmed OEHHA parameters for calculation of 1 µg/dL benchmark for child
(green)	key parameters for calculation of soil CHHSL for 1 µg/dL blood lead change in child--77 µg/g (mg/kg, ppm)

TABLE F-1.

Blood Lead Change
Lead Risk Assessment Spreadsheet
(California Department of Toxic Substances Control)
Mather Waste Accumulation Area, Yosemite National Park

FOOTNOTES:

Human and Ecological Risk Divison, January, 2009:

* DTSC's LeadSpread is currently under revision to ensure that the model is adequately protective of women of child-bearing age. In the interim, HERD recommends using the 2004 U.S. EPA industrial PRG (800 mg/kg) to evaluate the industrial/commercial scenario and adult exposures to lead.

* This version of the DTSC LEAD RISK ASSESSMENT SPREADSHEET (version 7, 1999) is written in Excel 97. This version was modified in January 2009. It is designed to be self-contained. Site-related data are entered in cells B9 through B13. Default values may be used when site-specific data are not available.

* Cells C18 through D35 contain exposure parameters which are generally not site-specific. Departure from default values in cells C18 through D35 must be justified. Numerical values in other cells are generally formulas, and although they may be changed for various purposes, any results obtained from the modified spreadsheet should not be represented as having come from the DTSC LEAD RISK ASSESSMENT SPREADSHEET.

* Many cells contain notes which explain the cell contents when the cursor is moved over the cell. References are in a note attached to cell A37.

* Many default input values have been revised in this version of the DTSC LEAD RISK ASSESSMENT SPREADSHEET. but the basic equations are similar to version 6 with one exception: The equations describing the plant uptake pathway now permit any value between 0 and 100% (inclusive) to be entered in cell B12. However, this cell will usually contain a value of 0% or 7%, depending on the plausibility of gardening occurring at the site.

* Validation: Using default levels in air, water and food, and 20 ppm in soil, the DTSC LEAD RISK ASSESSMENT SPREADSHEET predicts a median blood lead concentration in children of 1.8 ug/dl. In comparison, an analysis of NHANES data (CDC, 1999) shows that children aged 1-6 years living in the Western United States in housing built since 1974 had a geometric mean blood lead concentration of 1.74 ug/dl (the corresponding value for 1-2 year-old children was 1.9 ug/dl).

* The worksheet is protected with the exception of the input cells (B9-B13) to avoid inadvertent changes in formulas. If you wish to alter exposure perameters or formulas you may use the unprotect feature of Excel to unprotect the sheet. There is no password. If the results will be submitted to DTSC, you will be required to identify and justify any changes other than to the input cells.

TABLE F-1.

Blood Lead Change
Lead Risk Assessment Spreadsheet
(California Department of Toxic Substances Control)
Mather Waste Accumulation Area, Yosemite National Park

REFERENCES:

1. ATSDR. 1990. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service; Toxicological Profile for Lead.

2. California Air Resources Board, 1999; statewide air monitoring data for 1997. Data are available on the CARB worldwide web site at http://www.arb.ca.gov/aqd/aqd.htm

3. CDC. 1991. Centers for Disease Control, U.S. Public Health Service, Preventing Lead Poisoning in Young Children.

4. CDC, 1997, National Health and Nutrition Examination Survey, III 1988-94 (PB97-502959, National Center for Health Statistics, U.S. Department of Health and Human Services).

5. Chaney, R. L, S. B. Sterrett, and H. W. Mielke. 1982. The Potential for Heavy Metal Exposure from Urban Gardens and Soils; In: Proceedings of a Symposium on Heavy Metals in Urban Gardens, Agricultural Experiment Station, University of the District of Columbia, James N. Preer, ed.

6. Chaney, R.L, H. W. Mielke, and S. B. Sterrett. 1988. Speciation, Mobility, and Bioavailability of Soil Lead; in B.E. Davies and B.G. Wixson (eds), Lead in Soil: Issues and Guidelines (Science Reviews Limited, Norwood, England) pp 105-129.

7. U. S. Environmental Protection Agency, May 1996, Soil Screening Guidance: Technical Background Document, EPA/540/R-95/128, Office of Solid Waste and Emergency Response, Appendix D, Table 3

8. FDA, 1990, Contaminants Team, Division of Toxicological Review and Evaluation, Food and Drug Administration, Public Health Service, U.S. Department of Health and Human services; Memorandum to Elizabeth Campbell, Division of Regulatory Guidance.

9. FDA. 1999, Total Diet Study. Data available on the FDA website at http://vm.cfsan.FDA.gov/~acrobat/TDS1byel.pdf

10. Moore, M. R., P. A Meridith, W.S. Watson, D. J. Summer, M. K Taylor, and A Goldberg. 1980. The percutaneous absorption of lead-203 in humans from cosmetic preparations containing lead acetate as assessed by whole-body, counting and other techniques. Food Cosmet. Toxicol. 18: 636.

11. Ryu, J.E., E.E. Ziegler. S.E. Nelson, and S.J. Fomon, 1983, Dietary Intake of Lead and Blood Lead Concentration in Early Infancy. Am. J. Dis. Early Child.

12. U. S. Environmental Protection Agency, 1986, Air Quality Criteria for Lead, EPA 600/8-83-028, June 1986, Environmental Criteria and Assessment Office

13. EPA, 1998 Risk Asssessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E Supplemental Guidance for Dermal Risk Assessment) Interim Guidance

14. U. S. Environmental Protection Agency, 1997, Exposure Factors Handbook EPA/600/P-95/002Fa, August, 1997, Office of Research and Development

15. White, P.D., P. VanLeeuwen, B.D. Davis, M. Maddaloni, K.A. Hogan, A.H. Marcus, and R.W. Elias, 1998; Environ. Health Perspect 106, Suppl. 6: 1513

TABLE F-2.

Child Hiker Scenario
Lead Risk Assessment Spreadsheet
(California Department of Toxic Substances Control)
Mather Waste Accumulation Area, Yosemite National Park

USER'S GUIDE to version 7

INPUT	
MEDIUM	LEVEL
Lead in Air (ug/m^3)	0
Lead in Soil/Dust (ug/g)	2,000
Lead in Water (ug/l)	0
% Home-grown Produce	0%
Respirable Dust (ug/m^3)	1.5

OUTPUT							
	Percentile Estimate of Blood Pb Change (ug/dl)					PRG-99	PRG-95
	50th	90th	95th	98th	99th	(ug/g)	(ug/g)
~~BLOOD Pb, ADULT~~	~~0.3~~	~~0.6~~	~~0.7~~	~~0.8~~	~~0.9~~	~~87616~~	~~123696~~
BLOOD Pb, CHILD	0.5	1.0	1.2	1.4	1.6	12219	16899
BLOOD Pb, PICA CHILD	1.1	2.0	2.4	2.9	3.3	6134	8484
~~BLOOD Pb, OCCUPATIONAL~~	~~1.5~~	~~2.8~~	~~3.3~~	~~4.0~~	~~4.5~~	~~4830~~	~~6819~~

key parameters confirmed and highlighted herein based on http://www.oehha.ca.gov/public_info/public/kids/index.html

EXPOSURE PARAMETERS			
	units	adults	children
Days per week	days/wk	0.270	
Days per week, occupational		5	
Geometric Standard Deviation		1.6	
Blood lead level of concern (ug/dl)		10	
Skin area, residential	cm^2	5700	2900
Skin area occupational	cm^2	2900	
Soil adherence	ug/cm^2	70	200
Dermal uptake constant	(ug/dl)/(ug/day	0.0001	
Soil ingestion	mg/day	50	100
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	6.8
Inhalation constant	(ug/dl)/(ug/day	0.082	0.192
Water ingestion	l/day	1.4	0.4
Food ingestion	kg/day	1.9	1.1
Lead in market basket	ug/kg	3.1	
Lead in home-grown produce	ug/kg	899.8	

PATHWAYS						
~~ADULTS~~	~~Residential~~			~~Occupational~~		
	~~Pathway contribution~~			~~Pathway contribution~~		
~~Pathway~~	~~PEF~~	~~ug/dl~~	~~percent~~	~~PEF~~	~~ug/dl~~	~~percent~~
~~Soil Contact~~	~~1.5E-6~~	~~0.00~~	~~1%~~	~~1.4E-5~~	~~0.03~~	~~2%~~
~~Soil Ingestion~~	~~3.4E-5~~	~~0.07~~	~~22%~~	~~6.3E-4~~	~~1.26~~	~~83%~~
~~Inhalation, bkgrnd~~		~~0.00~~	~~0%~~		~~0.00~~	~~0%~~
~~Inhalation~~	~~9.5E-8~~	~~0.00~~	~~0%~~	~~1.8E-6~~	~~0.00~~	~~0%~~
~~Water Ingestion~~		~~0.00~~	~~0%~~		~~0.00~~	~~0%~~
~~Food Ingestion, bkgrnd~~		~~0.23~~	~~77%~~		~~0.23~~	~~15%~~
~~Food Ingestion~~	~~0.0E+0~~	~~0.00~~	~~0%~~			~~0%~~

CHILDREN	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	2.1E-6	0.00	1%		0.00	0%
Soil Ingestion	2.7E-4	0.54	99%	5.4E-4	1.09	100%
Inhalation	7.6E-8	0.00	0%		0.00	0%
Inhalation, bkgrnd		0.00	0%		0.00	0%
Water Ingestion		0.00	0%		0.00	0%
Food Ingestion, bkgrnd		0.00	0%		0.00	0%
Food Ingestion	0.0E+0	0.00	0%		0.00	0%

Click here for REFERENCES

(light blue)	7 days/year, occasional hiker, is (7 da/yr/26 weeks/year that park is accessbile to public) = 0.27 days/week
(yellow)	confirmed OEHHA parameters for calculation of 1 µg/dL change benchmark for child
(green)	key parameters--re-calculation: soil CHHSL for 1 µg/dL blood lead change in child -- 2,000 µg/g (mg/kg, ppm)

TABLE F-2.
Child Hiker Scenario
Lead Risk Assessment Spreadsheet
(California Department of Toxic Substances Control)
Mather Waste Accumulation Area, Yosemite National Park

FOOTNOTES:

Human and Ecological Risk Divison, January, 2009:

* DTSC's LeadSpread is currently under revision to ensure that the model is adequately protective of women of child-bearing age. In the interim, HERD recommends using the 2004 U.S. EPA industrial PRG (800 mg/kg) to evaluate the industrial/commercial scenario and adult exposures to lead.

* This version of the DTSC LEAD RISK ASSESSMENT SPREADSHEET (version 7, 1999) is written in Excel 97. This version was modified in January 2009. It is designed to be self-contained. Site-related data are entered in cells B9 through B13. Default values may be used when site-specific data are not available.

* Cells C18 through D35 contain exposure parameters which are generally not site-specific. Departure from default values in cells C18 through D35 must be justified. Numerical values in other cells are generally formulas, and although they may be changed for various purposes, any results obtained from the modified spreadsheet should not be represented as having come from the DTSC LEAD RISK ASSESSMENT SPREADSHEET.

* Many cells contain notes which explain the cell contents when the cursor is moved over the cell. References are in a note attached to cell A37

* Many default input values have been revised in this version of the DTSC LEAD RISK ASSESSMENT SPREADSHEET. but the basic equations are similar to version 6 with one exception: The equations describing the plant uptake pathway now permit any value between 0 and 100% (inclusive) to be entered in cell B12. However, this cell will usually contain a value of 0% or 7%, depending on the plausibility of gardening occurring at the site.

* Validation: Using default levels in air, water and food, and 20 ppm in soil, the DTSC LEAD RISK ASSESSMENT SPREADSHEET predicts a median blood lead concentration in children of 1.8 ug/dl. In comparison, an analysis of NHANES data (CDC, 1999) shows that children aged 1-6 years living in the Western United States in housing built since 1974 had a geometric mean blood lead concentration of 1.74 ug/dl (the corresponding value for 1-2 year-old children was 1.9 ug/dl).

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TABLE F-2.

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2. California Air Resources Board, 1999; statewide air monitoring data for 1997. Data are available on the CARB worldwide web site at http://www.arb.ca.gov/aqd/aqd.htm

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4. CDC, 1997, National Health and Nutrition Examination Survey, III 1988-94 (PB97-502959, National Center for Health Statistics, U.S. Department of Health and Human Services).

5. Chaney, R. L, S. B. Sterrett, and H. W. Mielke. 1982. The Potential for Heavy Metal Exposure from Urban Gardens and Soils; In: Proceedings of a Symposium on Heavy Metals in Urban Gardens, Agricultural Experiment Station, University of the District of Columbia, James N. Preer, ed.

6. Chaney, R.L, H. W. Mielke, and S. B. Sterrett. 1988. Speciation, Mobility, and Bioavailability of Soil Lead; in B.E. Davies and B.G. Wixson (eds), Lead in Soil: Issues and Guidelines (Science Reviews Limited, Norwood, England) pp 105-129.

7. U. S. Environmental Protection Agency, May 1996, Soil Screening Guidance: Technical Background Document, EPA/540/R-95/128, Office of Solid Waste and Emergency Response, Appendix D, Table 3

8. FDA, 1990, Contaminants Team, Division of Toxicological Review and Evaluation, Food and Drug Administration, Public Health Service, U.S. Department of Health and Human services; Memorandum to Elizabeth Campbell, Division of Regulatory Guidance.

9. FDA. 1999, Total Diet Study. Data available on the FDA website at http://vm.cfsan.FDA.gov/~acrobat/TDS1byel.pdf

10. Moore, M. R., P. A Meridith, W.S. Watson, D. J. Summer, M. K Taylor, and A Goldberg. 1980. The percutaneous absorption of lead-203 in humans from cosmetic preparations containing lead acetate as assessed by whole-body, counting and other techniques. Food Cosmet. Toxicol. 18: 636.

11. Ryu, J.E., E.E. Ziegler. S.E. Nelson, and S.J. Fomon, 1983, Dietary Intake of Lead and Blood Lead Concentration in Early Infancy. Am. J. Dis. Early Child.

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APPENDIX G
ECOLOGICAL RISK CHARACTERIZATION SPREADSHEETS

TABLE G-1
TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR CALIFORNIA VOLES AT MATHER WAA, YOSEMITE

Hazard Estimate - Tier 1
California Vole

Chemical	Surface Water Exposure Point Concentration	Units	Sediment Exposure Point Concentration	Units	Soil Exposure Point Concentration	Units	Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF
							---- unitless ----					
2,3,7,8-TCDD-TEQ	0.00E+00	mg/L	0.00E+00	mg/kg	1.11E-05	mg/kg	NA	NA	4.38E+00	9.41E-02	2.20E+00	2.20E+00
Acetone	0.00E+00	mg/L	0.00E+00	mg/kg	1.04E-02	mg/kg	NA	NA	1.50E+00	7.56E+01	5.00E-01	5.00E-01
Anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	4.16E-03	mg/kg	NA	NA	2.42E+00	1.25E+00	6.40E-01	6.40E-01
Benzo(a)anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	6.06E-03	mg/kg	NA	NA	1.60E+00	5.29E-01	3.50E-01	3.50E-01
Benzo(a)pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	1.59E-02	mg/kg	NA	NA	1.30E+00	1.41E-01	2.80E-01	2.80E-01
Benzo(b)fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	7.07E-03	mg/kg	NA	NA	2.60E+00	3.10E-01	2.80E-01	2.80E-01
Benzo(g,h,i)perylene	0.00E+00	mg/L	0.00E+00	mg/kg	7.80E-02	mg/kg	NA	NA	2.90E+00	2.47E-01	2.40E-01	2.40E-01
Benzo(k)fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	4.40E-03	mg/kg	NA	NA	2.60E+00	2.48E-01	2.90E-01	2.90E-01
Bis(2-ethylhexyl)phthalate	0.00E+00	mg/L	0.00E+00	mg/kg	4.78E-01	mg/kg	NA	NA	5.81E+02	2.38E-03	5.00E-01	5.00E-01
Chrysene	0.00E+00	mg/L	0.00E+00	mg/kg	2.02E-02	mg/kg	NA	NA	2.29E+00	3.25E-01	3.50E-01	3.50E-01
Dibenz(a,h)anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	1.22E-02	mg/kg	NA	NA	2.31E+00	1.30E-01	2.00E-01	2.00E-01
Diesel Fuel	0.00E+00	mg/L	0.00E+00	mg/kg	1.61E+03	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	1.25E-02	mg/kg	NA	NA	3.00E+00	5.00E-01	5.00E-01	5.00E-01
Gasoline	0.00E+00	mg/L	0.00E+00	mg/kg	1.20E+00	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	5.38E-03	mg/kg	NA	NA	2.86E+00	1.10E-01	2.30E-01	2.30E-01
Methylene chloride	0.00E+00	mg/L	0.00E+00	mg/kg	7.11E-03	mg/kg	NA	NA	3.00E+00	1.73E+01	5.00E-01	5.00E-01
Motor Oil	0.00E+00	mg/L	0.00E+00	mg/kg	4.04E+04	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pentachlorophenol	0.00E+00	mg/L	0.00E+00	mg/kg	5.92E-01	mg/kg	NA	NA	1.46E+01	5.93E+00	2.37E-01	2.37E-01
Phenanthrene	0.00E+00	mg/L	0.00E+00	mg/kg	9.94E-03	mg/kg	NA	NA	1.70E+00	4.88E+00	6.00E-01	6.00E-01
Pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	2.32E-02	mg/kg	NA	NA	1.80E+00	7.20E-01	5.20E-01	5.20E-01
Antimony	0.00E+00	mg/L	0.00E+00	mg/kg	2.81E+00	mg/kg	NA	NA	1.00E+00	3.70E-02	1.40E-01	1.40E-01
Arsenic	0.00E+00	mg/L	0.00E+00	mg/kg	4.73E+00	mg/kg	NA	NA	1.53E-01	3.75E-02	5.92E-03	5.92E-03
Barium	0.00E+00	mg/L	0.00E+00	mg/kg	6.91E+02	mg/kg	NA	NA	9.10E-02	1.56E-01	4.71E-01	4.71E-01
Cadmium	0.00E+00	mg/L	0.00E+00	mg/kg	2.96E+00	mg/kg	NA	NA	6.63E+00	3.80E-01	1.60E-01	1.60E-01
Chromium	0.00E+00	mg/L	0.00E+00	mg/kg	1.80E+01	mg/kg	NA	NA	3.06E-01	4.10E-02	1.08E-01	1.08E-01
Cobalt	0.00E+00	mg/L	0.00E+00	mg/kg	6.80E+00	mg/kg	NA	NA	1.22E-01	7.50E-03	2.07E-02	2.07E-02
Copper	0.00E+00	mg/L	0.00E+00	mg/kg	1.35E+02	mg/kg	NA	NA	5.15E-01	9.98E-02	1.16E-01	1.16E-01
Iron	0.00E+00	mg/L	0.00E+00	mg/kg	3.29E+04	mg/kg	NA	NA	3.60E-02	0.00E+00	1.71E-02	1.71E-02
Lead	0.00E+00	mg/L	0.00E+00	mg/kg	1.03E+03	mg/kg	NA	NA	2.11E-01	1.26E-02	2.26E-02	2.26E-02
Manganese	0.00E+00	mg/L	0.00E+00	mg/kg	1.55E+03	mg/kg	NA	NA	4.31E-02	7.90E-02	2.05E-02	2.05E-02
Mercury	0.00E+00	mg/L	0.00E+00	mg/kg	7.25E-01	mg/kg	NA	NA	1.34E+00	4.27E-01	1.92E-01	1.92E-01
Molybdenum	0.00E+00	mg/L	0.00E+00	mg/kg	1.46E+00	mg/kg	NA	NA	9.53E-01	0.00E+00	0.00E+00	0.00E+00
Nickel	0.00E+00	mg/L	0.00E+00	mg/kg	1.46E+01	mg/kg	NA	NA	1.26E+00	5.51E-02	1.87E-01	1.87E-01
Silver	0.00E+00	mg/L	0.00E+00	mg/kg	1.05E+00	mg/kg	NA	NA	2.05E+00	1.40E-02	4.00E-03	4.00E-03
Thallium	0.00E+00	mg/L	0.00E+00	mg/kg	4.45E-01	mg/kg	NA	NA	0.00E+00	0.00E+00	1.23E-01	1.23E-01
Zinc	0.00E+00	mg/L	0.00E+00	mg/kg	2.38E+03	mg/kg	NA	NA	4.60E-01	1.51E-01	5.70E-02	5.70E-02

Chemical	PDE Surface Water mg/kg-d	PDE Sediment mg/kg-d	PDE Soil mg/kg-d	PDE Fish mg/kg-d	PDE Aq. Invert. mg/kg-d	PDE Terr. Invert. mg/kg-d	PDE Plants mg/kg-d	PDE Mammals mg/kg-d	PDE Birds mg/kg-d	Total PDE mg/kg-d	Chemical-Specific Toxicity Value UF	NOAEL mg/kg-d	Adjusted NOAEL mg/kg-d	EEQ N	LOAEL mg/kg-d	Adjusted LOAEL mg/kg-d	EEQ L	Percent Contribution to EEQ N	Percent Contribution to EEQ L
2,3,7,8-TCDD-TEQ	0.00E+00	0.00E+00	5.78E-08	NA	NA	0.00E+00	2.22E-07	0.00E+00	0.00E+00	2.80E-07	1	1.00E-06	1.00E-06	2.80E-01	1.00E-05	1.00E-05	2.80E-02	0.93%	1.32%
Acetone	0.00E+00	0.00E+00	5.40E-05	NA	NA	0.00E+00	1.67E-01	0.00E+00	0.00E+00	1.67E-01	1	1.00E+01	1.00E+01	1.67E-02	5.00E+01	5.00E+01	3.34E-03	0.06%	0.16%
Anthracene	0.00E+00	0.00E+00	2.16E-05	NA	NA	0.00E+00	1.11E-03	0.00E+00	0.00E+00	1.13E-03	1	6.56E+01	6.56E+01	1.72E-05	1.10E+02	1.10E+02	1.03E-05	0.00%	0.00%
Benzo(a)anthracene	0.00E+00	0.00E+00	3.15E-05	NA	NA	0.00E+00	6.81E-04	0.00E+00	0.00E+00	7.12E-04	1	6.15E-01	6.15E-01	1.16E-03	3.07E+00	3.07E+00	2.32E-04	0.00%	0.01%
Benzo(a)pyrene	0.00E+00	0.00E+00	8.24E-05	NA	NA	0.00E+00	4.76E-04	0.00E+00	0.00E+00	5.58E-04	1	1.31E+00	1.31E+00	4.26E-04	3.28E+01	3.28E+01	1.70E-05	0.00%	0.00%
Benzo(b)fluoranthene	0.00E+00	0.00E+00	3.67E-05	NA	NA	0.00E+00	4.65E-04	0.00E+00	0.00E+00	5.02E-04	1	6.15E-01	6.15E-01	8.16E-04	3.07E+00	3.07E+00	1.63E-04	0.00%	0.01%
Benzo(g,h,i)perylene	0.00E+00	0.00E+00	4.05E-04	NA	NA	0.00E+00	4.09E-03	0.00E+00	0.00E+00	4.50E-03	1	6.15E-01	6.15E-01	7.31E-03	3.07E+00	3.07E+00	1.46E-03	0.02%	0.07%
Benzo(k)fluoranthene	0.00E+00	0.00E+00	2.28E-05	NA	NA	0.00E+00	2.31E-04	0.00E+00	0.00E+00	2.54E-04	1	6.15E-01	6.15E-01	4.13E-04	3.07E+00	3.07E+00	8.27E-05	0.00%	0.00%
Bis(2-ethylhexyl)phthalate	0.00E+00	0.00E+00	2.48E-03	NA	NA	0.00E+00	2.41E-04	0.00E+00	0.00E+00	2.72E-03	1	1.83E+01	1.83E+01	1.49E-04	1.83E+02	1.83E+02	1.49E-05	0.00%	0.00%
Chrysene	0.00E+00	0.00E+00	1.05E-04	NA	NA	0.00E+00	1.39E-03	0.00E+00	0.00E+00	1.50E-03	1	6.15E-01	6.15E-01	2.43E-03	3.07E+00	3.07E+00	4.88E-04	0.01%	0.02%
Dibenz(a,h)anthracene	0.00E+00	0.00E+00	6.35E-05	NA	NA	0.00E+00	3.38E-04	0.00E+00	0.00E+00	4.01E-04	1	6.15E-01	6.15E-01	6.52E-04	3.07E+00	3.07E+00	1.31E-04	0.00%	0.01%
Diesel Fuel	0.00E+00	0.00E+00	8.33E+00	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.33E+00		NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	0.00E+00	0.00E+00	6.48E-05	NA	NA	0.00E+00	1.33E-03	0.00E+00	0.00E+00	1.39E-03	1	6.56E+01	6.56E+01	2.12E-05	1.10E+02	1.10E+02	1.26E-05	0.00%	0.00%
Gasoline	0.00E+00	0.00E+00	6.20E-03	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.20E-03		NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.00E+00	0.00E+00	2.79E-05	NA	NA	0.00E+00	1.26E-04	0.00E+00	0.00E+00	1.54E-04	1	6.15E-01	6.15E-01	2.50E-04	3.07E+00	3.07E+00	5.00E-05	0.00%	0.00%
Methylene chloride	0.00E+00	0.00E+00	3.69E-05	NA	NA	0.00E+00	2.61E-02	0.00E+00	0.00E+00	2.61E-02	1	5.85E+00	5.85E+00	4.47E-03	5.00E+01	5.00E+01	5.23E-04	0.01%	0.02%
Motor Oil	0.00E+00	0.00E+00	2.10E+02	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.10E+02		NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	0.00E+00	0.00E+00	3.07E-03	NA	NA	0.00E+00	7.45E-01	0.00E+00	0.00E+00	7.48E-01	10	8.42E+00	8.42E-01	8.89E-01	9.45E+00	9.45E-01	7.92E-01	2.93%	37.18%
Phenanthrene	0.00E+00	0.00E+00	5.16E-05	NA	NA	0.00E+00	1.03E-02	0.00E+00	0.00E+00	1.03E-02	1	6.56E+01	6.56E+01	1.58E-04	1.10E+02	1.10E+02	9.40E-05	0.00%	0.00%
Pyrene	0.00E+00	0.00E+00	1.20E-04	NA	NA	0.00E+00	3.55E-03	0.00E+00	0.00E+00	3.67E-03	1	6.15E-01	6.15E-01	5.96E-03	3.07E+00	3.07E+00	1.19E-03	0.02%	0.06%
Antimony	0.00E+00	0.00E+00	1.46E-02	NA	NA	0.00E+00	2.20E-02	0.00E+00	0.00E+00	3.66E-02	1	1.25E-01	1.25E-01	2.93E-01	1.25E+00	1.25E+00	2.93E-02	0.97%	1.37%
Arsenic	0.00E+00	0.00E+00	2.45E-02	NA	NA	0.00E+00	3.77E-02	0.00E+00	0.00E+00	6.22E-02	1	3.20E-01	3.20E-01	1.94E-01	4.70E+00	4.70E+00	1.32E-02	0.64%	0.62%
Barium	0.00E+00	0.00E+00	3.58E+00	NA	NA	0.00E+00	2.29E+01	0.00E+00	0.00E+00	2.65E+01	1	5.18E+01	5.18E+01	5.11E-01	1.21E+02	1.21E+02	2.19E-01	1.69%	10.26%
Cadmium	0.00E+00	0.00E+00	1.54E-02	NA	NA	0.00E+00	2.39E-01	0.00E+00	0.00E+00	2.54E-01	1	6.00E-02	6.00E-02	4.24E+00	2.64E+00	2.64E+00	9.63E-02	13.98%	4.52%
Chromium	0.00E+00	0.00E+00	9.33E-02	NA	NA	0.00E+00	1.56E-01	0.00E+00	0.00E+00	2.50E-01	5	2.40E+00	4.80E-01	5.20E-01	2.82E+00	5.64E-01	4.43E-01	1.72%	20.79%
Cobalt	0.00E+00	0.00E+00	3.53E-02	NA	NA	0.00E+00	1.08E-02	0.00E+00	0.00E+00	4.61E-02	1	1.20E+00	1.20E+00	3.84E-02	2.00E+01	2.00E+01	2.30E-03	0.13%	0.11%
Copper	0.00E+00	0.00E+00	7.00E-01	NA	NA	0.00E+00	2.86E+00	0.00E+00	0.00E+00	3.56E+00	1	2.67E+00	2.67E+00	1.33E+00	6.32E+02	6.32E+02	5.63E-03	4.40%	0.26%
Iron	0.00E+00	0.00E+00	1.71E+02	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.71E+02		NA	NA	NA	NA	NA	NA	NA	NA
Lead	0.00E+00	0.00E+00	5.33E+00	NA	NA	0.00E+00	2.75E+00	0.00E+00	0.00E+00	8.08E+00	1	1.00E+00	1.00E+00	8.08E+00	2.41E+02	2.41E+02	3.35E-02	26.67%	1.57%
Manganese	0.00E+00	0.00E+00	8.05E+00	NA	NA	0.00E+00	2.60E+01	0.00E+00	0.00E+00	3.41E+01	1	1.37E+01	1.37E+01	2.49E+00	1.59E+02	1.59E+02	2.14E-01	8.20%	10.05%
Mercury	0.00E+00	0.00E+00	3.76E-03	NA	NA	0.00E+00	6.56E-02	0.00E+00	0.00E+00	6.94E-02	1	2.50E-01	2.50E-01	2.78E-01	4.00E+00	4.00E+00	1.74E-02	0.92%	0.81%
Molybdenum	0.00E+00	0.00E+00	7.55E-03	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.55E-03	1	2.60E-01	2.60E-01	2.90E-02	2.60E+00	2.60E+00	2.90E-03	0.10%	0.14%
Nickel	0.00E+00	0.00E+00	7.55E-02	NA	NA	0.00E+00	1.70E-01	0.00E+00	0.00E+00	2.46E-01	1	1.33E-01	1.33E-01	1.85E+00	3.16E+01	3.16E+01	7.78E-03	6.10%	0.37%
Silver	0.00E+00	0.00E+00	5.42E-03	NA	NA	0.00E+00	3.11E-03	0.00E+00	0.00E+00	8.53E-03	10	6.02E+00	6.02E-01	1.42E-02	6.02E+01	6.02E+00	1.42E-03	0.05%	0.07%
Thallium	0.00E+00	0.00E+00	2.31E-03	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.31E-03	1	4.80E-01	4.80E-01	4.81E-03	1.43E+00	1.43E+00	1.61E-03	0.02%	0.08%
Zinc	0.00E+00	0.00E+00	1.24E+01	NA	NA	0.00E+00	7.62E+01	0.00E+00	0.00E+00	8.85E+01	1	9.60E+00	9.60E+00	9.22E+00	4.11E+02	4.11E+02	2.15E-01	30.44%	10.11%
Hazard Index (Total EEQ):														3.0E+01			2.1E+00	100.00%	100.00%

Intake Equation:

$$Ej = \left(\frac{A}{HR}\left[\sum_{i=1}^{m}\left(\frac{IRi\,x\,Cij}{BW}\right)\right]\right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I) (mg/kg or mg/L)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using FHR =1.
Tier 2 = EEQ using calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box): $\boxed{n}$ See appropriate text tables for equations.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	1	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.00022	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.009	kg/d
Body weight =	0.0424	kg
Home range =	0.37	acres
Water intake rate =	0.0058	L/d
Site Area =	0.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

TABLE G-2
TIER 2 CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN EEQs AND HAZARD INDICES FOR CALIFORNIA VOLES AT MATHER WAA, YOSEMITE

Hazard Estimate - Tier 2
California Vole

Chemical	Surface Water Exposure Point Concentration	Units	Sediment Exposure Point Concentration	Units	Soil Exposure Point Concentration	Units	Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	EEQ N	LOAEL	Adjusted LOAEL	EEQ L	Percent Contribution to EEQ N	Percent Contribution to EEQ L
							---------- unitless	----------	----------	----------	----------	----------	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d		mg/kg-d	mg/kg-d		mg/kg-d	mg/kg-d			
2,3,7,8-TCDD-TEQ	0.00E+00	mg/L	0.00E+00	mg/kg	1.11E-05	mg/kg	NA	NA	4.38E+00	9.41E-02	2.20E+00	2.20E+00	0.00E+00	0.00E+00	3.12E-08	NA	NA	0.00E+00	1.20E-07	0.00E+00	0.00E+00	1.52E-07	1	1.00E-06	1.00E-06	1.52E-01	1.00E-05	1.00E-05	1.52E-02	0.93%	1.32%
Acetone	0.00E+00	mg/L	0.00E+00	mg/kg	1.04E-02	mg/kg	NA	NA	1.50E+00	7.56E+01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	2.92E-05	NA	NA	0.00E+00	9.03E-02	0.00E+00	0.00E+00	9.04E-02	1	1.00E+01	1.00E+01	9.04E-03	5.00E+01	5.00E+01	1.81E-03	0.06%	0.16%
Anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	4.16E-03	mg/kg	NA	NA	2.42E+00	1.25E+00	6.40E-01	6.40E-01	0.00E+00	0.00E+00	1.17E-05	NA	NA	0.00E+00	5.99E-04	0.00E+00	0.00E+00	6.11E-04	1	6.56E+01	6.56E+01	9.31E-06	1.10E+02	1.10E+02	5.55E-06	0.00%	0.00%
Benzo(a)anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	6.06E-03	mg/kg	NA	NA	1.60E+00	5.29E-01	3.50E-01	3.50E-01	0.00E+00	0.00E+00	1.70E-05	NA	NA	0.00E+00	3.68E-04	0.00E+00	0.00E+00	3.85E-04	1	6.15E-01	6.15E-01	6.26E-04	3.07E+00	3.07E+00	1.25E-04	0.00%	0.01%
Benzo(a)pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	1.59E-02	mg/kg	NA	NA	1.30E+00	1.41E-01	2.80E-01	2.80E-01	0.00E+00	0.00E+00	4.45E-05	NA	NA	0.00E+00	2.57E-04	0.00E+00	0.00E+00	3.02E-04	1	1.31E+00	1.31E+00	2.30E-04	3.28E+01	3.28E+01	9.20E-06	0.00%	0.00%
Benzo(b)fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	7.07E-03	mg/kg	NA	NA	2.60E+00	3.10E-01	2.80E-01	2.80E-01	0.00E+00	0.00E+00	1.98E-05	NA	NA	0.00E+00	2.51E-04	0.00E+00	0.00E+00	2.71E-04	1	6.15E-01	6.15E-01	4.41E-04	3.07E+00	3.07E+00	8.83E-05	0.00%	0.01%
Benzo(g,h,i)perylene	0.00E+00	mg/L	0.00E+00	mg/kg	7.80E-02	mg/kg	NA	NA	2.90E+00	2.47E-01	2.40E-01	2.40E-01	0.00E+00	0.00E+00	2.19E-04	NA	NA	0.00E+00	2.21E-03	0.00E+00	0.00E+00	2.43E-03	1	6.15E-01	6.15E-01	3.95E-03	3.07E+00	3.07E+00	7.92E-04	0.02%	0.07%
Benzo(k)fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	4.40E-03	mg/kg	NA	NA	2.60E+00	2.48E-01	2.90E-01	2.90E-01	0.00E+00	0.00E+00	1.23E-05	NA	NA	0.00E+00	1.25E-04	0.00E+00	0.00E+00	1.37E-04	1	6.15E-01	6.15E-01	2.23E-04	3.07E+00	3.07E+00	4.47E-05	0.00%	0.00%
Bis(2-ethylhexyl)phthalate	0.00E+00	mg/L	0.00E+00	mg/kg	4.78E-01	mg/kg	NA	NA	5.81E+02	2.38E-03	5.00E-01	5.00E-01	0.00E+00	0.00E+00	1.34E-03	NA	NA	0.00E+00	1.31E-04	0.00E+00	0.00E+00	1.47E-03	1	1.83E+01	1.83E+01	8.04E-05	1.83E+02	1.83E+02	8.04E-06	0.00%	0.00%
Chrysene	0.00E+00	mg/L	0.00E+00	mg/kg	2.02E-02	mg/kg	NA	NA	2.29E+00	3.25E-01	3.50E-01	3.50E-01	0.00E+00	0.00E+00	5.67E-05	NA	NA	0.00E+00	7.52E-04	0.00E+00	0.00E+00	8.09E-04	1	6.15E-01	6.15E-01	1.32E-03	3.07E+00	3.07E+00	2.64E-04	0.01%	0.02%
Dibenz(a,h)anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	1.22E-02	mg/kg	NA	NA	2.31E+00	1.30E-01	2.00E-01	2.00E-01	0.00E+00	0.00E+00	3.43E-05	NA	NA	0.00E+00	1.83E-04	0.00E+00	0.00E+00	2.17E-04	1	6.15E-01	6.15E-01	3.53E-04	3.07E+00	3.07E+00	7.06E-05	0.00%	0.01%
Diesel Fuel	0.00E+00	mg/L	0.00E+00	mg/kg	1.61E+03	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.50E+00	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.50E+00		NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	1.25E-02	mg/kg	NA	NA	3.00E+00	5.00E-01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	3.50E-05	NA	NA	0.00E+00	7.16E-04	0.00E+00	0.00E+00	7.51E-04	1	6.56E+01	6.56E+01	1.15E-05	1.10E+02	1.10E+02	6.83E-06	0.00%	0.00%
Gasoline	0.00E+00	mg/L	0.00E+00	mg/kg	1.20E+00	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.35E-03	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.35E-03		NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	5.38E-03	mg/kg	NA	NA	2.86E+00	1.10E-01	2.30E-01	2.30E-01	0.00E+00	0.00E+00	1.51E-05	NA	NA	0.00E+00	6.79E-05	0.00E+00	0.00E+00	8.30E-05	1	6.15E-01	6.15E-01	1.35E-04	3.07E+00	3.07E+00	2.70E-05	0.00%	0.00%
Methylene chloride	0.00E+00	mg/L	0.00E+00	mg/kg	7.11E-03	mg/kg	NA	NA	3.00E+00	1.73E+01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	1.99E-05	NA	NA	0.00E+00	1.41E-02	0.00E+00	0.00E+00	1.41E-02	1	5.85E+00	5.85E+00	2.42E-03	5.00E+01	5.00E+01	2.83E-04	0.01%	0.02%
Motor Oil	0.00E+00	mg/L	0.00E+00	mg/kg	4.04E+04	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E+02	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E+02		NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	0.00E+00	mg/L	0.00E+00	mg/kg	5.92E-01	mg/kg	NA	NA	1.46E+01	5.93E+00	2.37E-01	2.37E-01	0.00E+00	0.00E+00	1.66E-03	NA	NA	0.00E+00	4.03E-01	0.00E+00	0.00E+00	4.05E-01	10	8.42E+00	8.42E-01	4.80E-01	9.45E+00	9.45E-01	4.28E-01	2.93%	37.18%
Phenanthrene	0.00E+00	mg/L	0.00E+00	mg/kg	9.94E-03	mg/kg	NA	NA	1.70E+00	4.88E+00	6.00E-01	6.00E-01	0.00E+00	0.00E+00	2.79E-05	NA	NA	0.00E+00	5.56E-03	0.00E+00	0.00E+00	5.59E-03	1	6.56E+01	6.56E+01	8.52E-05	1.10E+02	1.10E+02	5.08E-05	0.00%	0.00%
Pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	2.32E-02	mg/kg	NA	NA	1.80E+00	7.20E-01	5.20E-01	5.20E-01	0.00E+00	0.00E+00	6.51E-05	NA	NA	0.00E+00	1.92E-03	0.00E+00	0.00E+00	1.98E-03	1	6.15E-01	6.15E-01	3.22E-03	3.07E+00	3.07E+00	6.45E-04	0.02%	0.06%
Antimony	0.00E+00	mg/L	0.00E+00	mg/kg	2.81E+00	mg/kg	NA	NA	1.00E+00	3.70E-02	1.40E-01	1.40E-01	0.00E+00	0.00E+00	7.87E-03	NA	NA	0.00E+00	1.19E-02	0.00E+00	0.00E+00	1.98E-02	1	1.25E-01	1.25E-01	1.58E-01	1.25E+00	1.25E+00	1.58E-02	0.97%	1.37%
Arsenic	0.00E+00	mg/L	0.00E+00	mg/kg	4.73E+00	mg/kg	NA	NA	1.53E-01	3.75E-02	5.92E-03	5.92E-03	0.00E+00	0.00E+00	1.33E-02	NA	NA	0.00E+00	2.04E-02	0.00E+00	0.00E+00	3.36E-02	1	3.20E-01	3.20E-01	1.05E-01	4.70E+00	4.70E+00	7.15E-03	0.64%	0.62%
Barium	0.00E+00	mg/L	0.00E+00	mg/kg	6.91E+02	mg/kg	NA	NA	9.10E-02	1.56E-01	4.71E-01	4.71E-01	0.00E+00	0.00E+00	1.94E+00	NA	NA	0.00E+00	1.24E+01	0.00E+00	0.00E+00	1.43E+01	1	5.18E+01	5.18E+01	2.76E-01	1.21E+02	1.21E+02	1.18E-01	1.69%	10.26%
Cadmium	0.00E+00	mg/L	0.00E+00	mg/kg	2.96E+00	mg/kg	NA	NA	6.63E+00	3.80E-01	1.60E-01	1.60E-01	0.00E+00	0.00E+00	8.31E-03	NA	NA	0.00E+00	1.29E-01	0.00E+00	0.00E+00	1.37E-01	1	6.00E-02	6.00E-02	2.29E+00	2.64E+00	2.64E+00	5.20E-02	13.98%	4.52%
Chromium	0.00E+00	mg/L	0.00E+00	mg/kg	1.80E+01	mg/kg	NA	NA	3.06E-01	4.10E-02	1.08E-01	1.08E-01	0.00E+00	0.00E+00	5.04E-02	NA	NA	0.00E+00	8.46E-02	0.00E+00	0.00E+00	1.35E-01	5	2.40E+00	4.80E-01	2.81E-01	2.82E+00	5.64E-01	2.39E-01	1.72%	20.79%
Cobalt	0.00E+00	mg/L	0.00E+00	mg/kg	6.80E+00	mg/kg	NA	NA	1.22E-01	7.50E-03	2.07E-02	2.07E-02	0.00E+00	0.00E+00	1.91E-02	NA	NA	0.00E+00	5.85E-03	0.00E+00	0.00E+00	2.49E-02	1	1.20E+00	1.20E+00	2.08E-02	2.00E+01	2.00E+01	1.25E-03	0.13%	0.11%
Copper	0.00E+00	mg/L	0.00E+00	mg/kg	1.35E+02	mg/kg	NA	NA	5.15E-01	9.98E-02	1.16E-01	1.16E-01	0.00E+00	0.00E+00	3.79E-01	NA	NA	0.00E+00	1.55E+00	0.00E+00	0.00E+00	1.92E+00	1	2.67E+00	2.67E+00	7.21E-01	6.32E+02	6.32E+02	3.05E-03	4.40%	0.26%
Iron	0.00E+00	mg/L	0.00E+00	mg/kg	3.29E+04	mg/kg	NA	NA	3.60E-02	0.00E+00	1.71E-02	1.71E-02	0.00E+00	0.00E+00	9.24E+01	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.24E+01		NA	NA	NA	NA	NA	NA	NA	NA
Lead	0.00E+00	mg/L	0.00E+00	mg/kg	1.03E+03	mg/kg	NA	NA	2.11E-01	1.26E-02	2.26E-02	2.26E-02	0.00E+00	0.00E+00	2.88E+00	NA	NA	0.00E+00	1.49E+00	0.00E+00	0.00E+00	4.37E+00	1	1.00E+00	1.00E+00	4.37E+00	2.41E+02	2.41E+02	1.81E-02	26.67%	1.57%
Manganese	0.00E+00	mg/L	0.00E+00	mg/kg	1.55E+03	mg/kg	NA	NA	4.31E-02	7.90E-02	2.05E-02	2.05E-02	0.00E+00	0.00E+00	4.35E+00	NA	NA	0.00E+00	1.41E+01	0.00E+00	0.00E+00	1.84E+01	1	1.37E+01	1.37E+01	1.34E+00	1.59E+02	1.59E+02	1.16E-01	8.20%	10.05%
Mercury	0.00E+00	mg/L	0.00E+00	mg/kg	7.25E-01	mg/kg	NA	NA	1.34E+00	4.27E-01	1.92E-01	1.92E-01	0.00E+00	0.00E+00	2.03E-03	NA	NA	0.00E+00	3.55E-02	0.00E+00	0.00E+00	3.75E-02	1	2.50E-01	2.50E-01	1.50E-01	4.00E+00	4.00E+00	9.38E-03	0.92%	0.81%
Molybdenum	0.00E+00	mg/L	0.00E+00	mg/kg	1.46E+00	mg/kg	NA	NA	9.53E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.08E-03	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.08E-03	1	2.60E-01	2.60E-01	1.57E-02	2.60E+00	2.60E+00	1.57E-03	0.10%	0.14%
Nickel	0.00E+00	mg/L	0.00E+00	mg/kg	1.46E+01	mg/kg	NA	NA	1.26E+00	5.51E-02	1.87E-01	1.87E-01	0.00E+00	0.00E+00	4.08E-02	NA	NA	0.00E+00	9.21E-02	0.00E+00	0.00E+00	1.33E-01	1	1.33E-01	1.33E-01	1.00E+00	3.16E+01	3.16E+01	4.21E-03	6.10%	0.37%
Silver	0.00E+00	mg/L	0.00E+00	mg/kg	1.05E+00	mg/kg	NA	NA	2.05E+00	1.40E-02	4.00E-03	4.00E-03	0.00E+00	0.00E+00	2.93E-03	NA	NA	0.00E+00	1.68E-03	0.00E+00	0.00E+00	4.61E-03	10	6.02E+00	6.02E-01	7.66E-03	6.02E+01	6.02E+00	7.66E-04	0.05%	0.07%
Thallium	0.00E+00	mg/L	0.00E+00	mg/kg	4.45E-01	mg/kg	NA	NA	0.00E+00	0.00E+00	1.23E-01	1.23E-01	0.00E+00	0.00E+00	1.25E-03	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.25E-03	1	4.80E-01	4.80E-01	2.60E-03	1.43E+00	1.43E+00	8.73E-04	0.02%	0.08%
Zinc	0.00E+00	mg/L	0.00E+00	mg/kg	2.38E+03	mg/kg	NA	NA	4.60E-01	1.51E-01	5.70E-02	5.70E-02	0.00E+00	0.00E+00	6.68E+00	NA	NA	0.00E+00	4.12E+01	0.00E+00	0.00E+00	4.79E+01	1	9.60E+00	9.60E+00	4.99E+00	4.11E+02	4.11E+02	1.16E-01	30.44%	10.11%
																								Hazard Index (Total EEQ):		1.6E+01			1.2E+00	100.00%	100.00%

Intake Equation:

$$Ej = \left(\frac{A}{HR}\left[\sum_{i=1}^{m}\left(\frac{IRi\,x\,Cij}{BW}\right)\right]\right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I) (mg/kg or mg/L)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using FHR =1.
Tier 2 = EEQ using calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box): $\boxed{n}$ See appropriate text tables for equations.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	1	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.00022	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.009	kg/d
Body weight =	0.0424	kg
Home range =	0.37	acres
Water intake rate =	0.0058	L/d
Site Area =	0.2	acres
Frac. home range (FHR) =	5.41E-01	unitless

TABLE G-3

TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR DUSKY SHREWS AT MATHER WAA, YOSEMITE

Hazard Estimate - Tier 1
Dusky Shrew

Chemical	Surface Water Exposure Point Concentration	Units	Sediment Exposure Point Concentration	Units	Soil Exposure Point Concentration	Units	Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF
							---- unitless ----					
2,3,7,8-TCDD-TEQ	0.00E+00	mg/L	0.00E+00	mg/kg	1.11E-05	mg/kg	NA	NA	4.38E+00	9.41E-02	2.20E+00	2.20E+00
Acetone	0.00E+00	mg/L	0.00E+00	mg/kg	1.04E-02	mg/kg	NA	NA	1.50E+00	7.56E+01	5.00E-01	5.00E-01
Anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	4.16E-03	mg/kg	NA	NA	2.42E+00	1.25E+00	6.40E-01	6.40E-01
Benzo(a)anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	6.06E-03	mg/kg	NA	NA	1.60E+00	5.29E-01	3.50E-01	3.50E-01
Benzo(a)pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	1.59E-02	mg/kg	NA	NA	1.30E+00	1.41E-01	2.80E-01	2.80E-01
Benzo(b)fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	7.07E-03	mg/kg	NA	NA	2.60E+00	3.10E-01	2.80E-01	2.80E-01
Benzo(g,h,i)perylene	0.00E+00	mg/L	0.00E+00	mg/kg	7.80E-02	mg/kg	NA	NA	2.90E+00	2.47E-01	2.40E-01	2.40E-01
Benzo(k)fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	4.40E-03	mg/kg	NA	NA	2.60E+00	2.48E-01	2.90E-01	2.90E-01
Bis(2-ethylhexyl)phthalate	0.00E+00	mg/L	0.00E+00	mg/kg	4.78E-01	mg/kg	NA	NA	5.81E+02	2.38E-03	5.00E-01	5.00E-01
Chrysene	0.00E+00	mg/L	0.00E+00	mg/kg	2.02E-02	mg/kg	NA	NA	2.29E+00	3.25E-01	3.50E-01	3.50E-01
Dibenz(a,h)anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	1.22E-02	mg/kg	NA	NA	2.31E+00	1.30E-01	2.00E-01	2.00E-01
Diesel Fuel	0.00E+00	mg/L	0.00E+00	mg/kg	1.61E+03	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	1.25E-02	mg/kg	NA	NA	3.00E+00	5.00E-01	5.00E-01	5.00E-01
Gasoline	0.00E+00	mg/L	0.00E+00	mg/kg	1.20E+00	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	5.38E-03	mg/kg	NA	NA	2.86E+00	1.10E-01	2.30E-01	2.30E-01
Methylene chloride	0.00E+00	mg/L	0.00E+00	mg/kg	7.11E-03	mg/kg	NA	NA	3.00E+00	1.73E+01	5.00E-01	5.00E-01
Motor Oil	0.00E+00	mg/L	0.00E+00	mg/kg	4.04E+04	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pentachlorophenol	0.00E+00	mg/L	0.00E+00	mg/kg	5.92E-01	mg/kg	NA	NA	1.46E+01	5.93E+00	2.37E-01	2.37E-01
Phenanthrene	0.00E+00	mg/L	0.00E+00	mg/kg	9.94E-03	mg/kg	NA	NA	1.70E+00	4.88E+00	6.00E-01	6.00E-01
Pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	2.32E-02	mg/kg	NA	NA	1.80E+00	7.20E-01	5.20E-01	5.20E-01
Antimony	0.00E+00	mg/L	0.00E+00	mg/kg	2.81E+00	mg/kg	NA	NA	1.00E+00	3.70E-02	1.40E-01	1.40E-01
Arsenic	0.00E+00	mg/L	0.00E+00	mg/kg	4.73E+00	mg/kg	NA	NA	1.53E-01	3.75E-02	5.92E-03	5.92E-03
Barium	0.00E+00	mg/L	0.00E+00	mg/kg	6.91E+02	mg/kg	NA	NA	9.10E-02	1.56E-01	4.71E-01	4.71E-01
Cadmium	0.00E+00	mg/L	0.00E+00	mg/kg	2.96E+00	mg/kg	NA	NA	6.63E+00	3.80E-01	1.60E-01	1.60E-01
Chromium	0.00E+00	mg/L	0.00E+00	mg/kg	1.80E+01	mg/kg	NA	NA	3.06E-01	4.10E-02	1.08E-01	1.08E-01
Cobalt	0.00E+00	mg/L	0.00E+00	mg/kg	6.80E+00	mg/kg	NA	NA	1.22E-01	7.50E-03	2.07E-02	2.07E-02
Copper	0.00E+00	mg/L	0.00E+00	mg/kg	1.35E+02	mg/kg	NA	NA	5.15E-01	9.98E-02	1.16E-01	1.16E-01
Iron	0.00E+00	mg/L	0.00E+00	mg/kg	3.29E+04	mg/kg	NA	NA	3.60E-02	0.00E+00	1.71E-02	1.71E-02
Lead	0.00E+00	mg/L	0.00E+00	mg/kg	1.03E+03	mg/kg	NA	NA	2.11E-01	1.26E-02	2.26E-02	2.26E-02
Manganese	0.00E+00	mg/L	0.00E+00	mg/kg	1.55E+03	mg/kg	NA	NA	4.31E-02	7.90E-02	2.05E-02	2.05E-02
Mercury	0.00E+00	mg/L	0.00E+00	mg/kg	7.25E-01	mg/kg	NA	NA	1.34E+00	4.27E-01	1.92E-01	1.92E-01
Molybdenum	0.00E+00	mg/L	0.00E+00	mg/kg	1.46E+00	mg/kg	NA	NA	9.53E-01	0.00E+00	0.00E+00	0.00E+00
Nickel	0.00E+00	mg/L	0.00E+00	mg/kg	1.46E+01	mg/kg	NA	NA	1.26E+00	5.51E-02	1.87E-01	1.87E-01
Silver	0.00E+00	mg/L	0.00E+00	mg/kg	1.05E+00	mg/kg	NA	NA	2.05E+00	1.40E-02	4.00E-03	4.00E-03
Thallium	0.00E+00	mg/L	0.00E+00	mg/kg	4.45E-01	mg/kg	NA	NA	0.00E+00	0.00E+00	1.23E-01	1.23E-01
Zinc	0.00E+00	mg/L	0.00E+00	mg/kg	2.38E+03	mg/kg	NA	NA	4.60E-01	1.51E-01	5.70E-02	5.70E-02

Chemical	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	EEQ N	LOAEL	Adjusted LOAEL	EEQ L	Percent Contribution to EEQ N	Percent Contribution to EEQ L
	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d		mg/kg-d	mg/kg-d		mg/kg-d	mg/kg-d			
2,3,7,8-TCDD-TEQ	0.00E+00	0.00E+00	2.16E-07	NA	NA	9.44E-06	0.00E+00	0.00E+00	0.00E+00	9.66E-06	10	1.00E-06	1.00E-07	9.66E+01	1.00E-05	1.00E-06	9.66E+00	4.54%	17.07%
Acetone	0.00E+00	0.00E+00	2.02E-04	NA	NA	3.02E-03	0.00E+00	0.00E+00	0.00E+00	3.23E-03	10	1.00E+01	1.00E+00	3.23E-03	5.00E+01	5.00E+00	6.45E-04	0.00%	0.00%
Anthracene	0.00E+00	0.00E+00	8.06E-05	NA	NA	1.95E-03	0.00E+00	0.00E+00	0.00E+00	2.03E-03	10	6.56E+01	6.56E+00	3.10E-04	1.10E+02	1.10E+01	1.85E-04	0.00%	0.00%
Benzo(a)anthracene	0.00E+00	0.00E+00	1.17E-04	NA	NA	1.88E-03	0.00E+00	0.00E+00	0.00E+00	1.99E-03	10	6.15E-01	6.15E-02	3.24E-02	3.07E+00	3.07E-01	6.50E-03	0.00%	0.01%
Benzo(a)pyrene	0.00E+00	0.00E+00	3.07E-04	NA	NA	4.00E-03	0.00E+00	0.00E+00	0.00E+00	4.30E-03	10	1.31E+00	1.31E-01	3.28E-02	3.28E+01	3.28E+00	1.31E-03	0.00%	0.00%
Benzo(b)fluoranthene	0.00E+00	0.00E+00	1.37E-04	NA	NA	3.56E-03	0.00E+00	0.00E+00	0.00E+00	3.69E-03	10	6.15E-01	6.15E-02	6.01E-02	3.07E+00	3.07E-01	1.20E-02	0.00%	0.02%
Benzo(g,h,i)perylene	0.00E+00	0.00E+00	1.51E-03	NA	NA	4.38E-02	0.00E+00	0.00E+00	0.00E+00	4.53E-02	10	6.15E-01	6.15E-02	7.36E-01	3.07E+00	3.07E-01	1.48E-01	0.03%	0.26%
Benzo(k)fluoranthene	0.00E+00	0.00E+00	8.51E-05	NA	NA	2.21E-03	0.00E+00	0.00E+00	0.00E+00	2.30E-03	10	6.15E-01	6.15E-02	3.73E-02	3.07E+00	3.07E-01	7.48E-03	0.00%	0.01%
Bis(2-ethylhexyl)phthalate	0.00E+00	0.00E+00	9.25E-03	NA	NA	5.38E+01	0.00E+00	0.00E+00	0.00E+00	5.38E+01	10	1.83E+01	1.83E+00	2.94E+01	1.83E+02	1.83E+01	2.94E+00	1.38%	5.19%
Chrysene	0.00E+00	0.00E+00	3.91E-04	NA	NA	8.95E-03	0.00E+00	0.00E+00	0.00E+00	9.34E-03	10	6.15E-01	6.15E-02	1.52E-01	3.07E+00	3.07E-01	3.04E-02	0.01%	0.05%
Dibenz(a,h)anthracene	0.00E+00	0.00E+00	2.37E-04	NA	NA	5.47E-03	0.00E+00	0.00E+00	0.00E+00	5.71E-03	10	6.15E-01	6.15E-02	9.28E-02	3.07E+00	3.07E-01	1.86E-02	0.00%	0.03%
Diesel Fuel	0.00E+00	0.00E+00	3.11E+01	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.11E+01		NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	0.00E+00	0.00E+00	2.42E-04	NA	NA	7.25E-03	0.00E+00	0.00E+00	0.00E+00	7.49E-03	10	6.56E+01	6.56E+00	1.14E-03	1.10E+02	1.10E+01	6.81E-04	0.00%	0.00%
Gasoline	0.00E+00	0.00E+00	2.31E-02	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.31E-02		NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.00E+00	0.00E+00	1.04E-04	NA	NA	2.98E-03	0.00E+00	0.00E+00	0.00E+00	3.08E-03	10	6.15E-01	6.15E-02	5.01E-02	3.07E+00	3.07E-01	1.00E-02	0.00%	0.02%
Methylene chloride	0.00E+00	0.00E+00	1.38E-04	NA	NA	4.13E-03	0.00E+00	0.00E+00	0.00E+00	4.27E-03	10	5.85E+00	5.85E-01	7.29E-03	5.00E+01	5.00E+00	8.53E-04	0.00%	0.00%
Motor Oil	0.00E+00	0.00E+00	7.82E+02	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.82E+02		NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	0.00E+00	0.00E+00	1.15E-02	NA	NA	1.68E+00	0.00E+00	0.00E+00	0.00E+00	1.69E+00	10	8.42E+00	8.42E-01	2.01E+00	9.45E+00	9.45E-01	1.79E+00	0.09%	3.16%
Phenanthrene	0.00E+00	0.00E+00	1.92E-04	NA	NA	3.27E-03	0.00E+00	0.00E+00	0.00E+00	3.46E-03	10	6.56E+01	6.56E+00	5.28E-04	1.10E+02	1.10E+01	3.15E-04	0.00%	0.00%
Pyrene	0.00E+00	0.00E+00	4.49E-04	NA	NA	8.08E-03	0.00E+00	0.00E+00	0.00E+00	8.53E-03	10	6.15E-01	6.15E-02	1.39E-01	3.07E+00	3.07E-01	2.78E-02	0.01%	0.05%
Antimony	0.00E+00	0.00E+00	5.43E-02	NA	NA	5.43E-01	0.00E+00	0.00E+00	0.00E+00	5.97E-01	10	1.25E-01	1.25E-02	4.78E+01	1.25E+00	1.25E-01	4.78E+00	2.25%	8.45%
Arsenic	0.00E+00	0.00E+00	9.15E-02	NA	NA	1.40E-01	0.00E+00	0.00E+00	0.00E+00	2.32E-01	10	3.20E-01	3.20E-02	7.23E+00	4.70E+00	4.70E-01	4.93E-01	0.34%	0.87%
Barium	0.00E+00	0.00E+00	1.34E+01	NA	NA	1.22E+01	0.00E+00	0.00E+00	0.00E+00	2.55E+01	10	5.18E+01	5.18E+00	4.93E+00	1.21E+02	1.21E+01	2.11E+00	0.23%	3.73%
Cadmium	0.00E+00	0.00E+00	5.73E-02	NA	NA	3.80E+00	0.00E+00	0.00E+00	0.00E+00	3.86E+00	10	6.00E-02	6.00E-03	6.43E+02	2.64E+00	2.64E-01	1.46E+01	30.23%	25.82%
Chromium	0.00E+00	0.00E+00	3.48E-01	NA	NA	1.06E+00	0.00E+00	0.00E+00	0.00E+00	1.41E+00	10	2.40E+00	2.40E-01	5.89E+00	2.82E+00	2.82E-01	5.01E+00	0.28%	8.85%
Cobalt	0.00E+00	0.00E+00	1.32E-01	NA	NA	1.61E-01	0.00E+00	0.00E+00	0.00E+00	2.92E-01	10	1.20E+00	1.20E-01	2.43E+00	2.00E+01	2.00E+00	1.46E-01	0.11%	0.26%
Copper	0.00E+00	0.00E+00	2.61E+00	NA	NA	1.35E+01	0.00E+00	0.00E+00	0.00E+00	1.61E+01	10	2.67E+00	2.67E-01	6.02E+01	6.32E+02	6.32E+01	2.54E-01	2.83%	0.45%
Iron	0.00E+00	0.00E+00	6.37E+02	NA	NA	2.29E+02	0.00E+00	0.00E+00	0.00E+00	8.67E+02		NA	NA	NA	NA	NA	NA	NA	NA
Lead	0.00E+00	0.00E+00	1.99E+01	NA	NA	4.19E+01	0.00E+00	0.00E+00	0.00E+00	6.18E+01	10	1.00E+00	1.00E-01	6.18E+02	2.41E+02	2.41E+01	2.56E+00	29.06%	4.53%
Manganese	0.00E+00	0.00E+00	3.00E+01	NA	NA	1.29E+01	0.00E+00	0.00E+00	0.00E+00	4.29E+01	10	1.37E+01	1.37E+00	3.13E+01	1.59E+02	1.59E+01	2.70E+00	1.47%	4.77%
Mercury	0.00E+00	0.00E+00	1.40E-02	NA	NA	1.88E-01	0.00E+00	0.00E+00	0.00E+00	2.02E-01	10	2.50E-01	2.50E-02	8.09E+00	4.00E+00	4.00E-01	5.06E-01	0.38%	0.89%
Molybdenum	0.00E+00	0.00E+00	2.82E-02	NA	NA	2.68E-01	0.00E+00	0.00E+00	0.00E+00	2.97E-01	10	2.60E-01	2.60E-02	1.14E+01	2.60E+00	2.60E-01	1.14E+00	0.54%	2.02%
Nickel	0.00E+00	0.00E+00	2.82E-01	NA	NA	3.54E+00	0.00E+00	0.00E+00	0.00E+00	3.82E+00	10	1.33E-01	1.33E-02	2.87E+02	3.16E+01	3.16E+00	1.21E+00	13.50%	2.14%
Silver	0.00E+00	0.00E+00	2.02E-02	NA	NA	4.14E-01	0.00E+00	0.00E+00	0.00E+00	4.34E-01	10	6.02E+00	6.02E-01	7.21E-01	6.02E+01	6.02E+00	7.21E-02	0.03%	0.13%
Thallium	0.00E+00	0.00E+00	8.61E-03	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.61E-03	10	4.80E-01	4.80E-02	1.79E-01	1.43E+00	1.43E-01	6.02E-02	0.01%	0.11%
Zinc	0.00E+00	0.00E+00	4.61E+01	NA	NA	2.12E+02	0.00E+00	0.00E+00	0.00E+00	2.58E+02	10	9.60E+00	9.60E-01	2.69E+02	4.11E+02	4.11E+01	6.28E+00	12.65%	11.11%
Hazard Index (Total EEQ):														2.1E+03			5.7E+01	100.00%	100.00%

Intake Equation:

$$Ej = \left(\frac{A}{HR} \left[\sum_{i=1}^{m} \left(\frac{IRi\,x\,Cij}{BW} \right) \right] \right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I) (mg/kg or mg/L)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using FHR =1.
Tier 2 = EEQ using calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box): n See appropriate text tables for equations.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	1	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.00012	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.0012	kg/d
Body weight =	0.0062	kg
Home range =	0.1	acres
Water intake rate =	0.001	L/d
Site Area =	0.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

TABLE G-4
TIER 2 CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN EEQs AND HAZARD INDICES FOR DUSKY SHREWS AT MATHER WAA, YOSEMITE

Hazard Estimate - Tier 2
Dusky Shrew

Chemical	Surface Water Exposure Point Concentration	Units	Sediment Exposure Point Concentration	Units	Soil Exposure Point Concentration	Units	Fish BAF (unitless)	Aq. Invert. BAF (unitless)	Terr. Invert. BAF (unitless)	Plant BAF (unitless)	Mammal BAF (unitless)	Bird BAF (unitless)	PDE Surface Water mg/kg-d	PDE Sediment mg/kg-d	PDE Soil mg/kg-d	PDE Fish mg/kg-d	PDE Aq. Invert. mg/kg-d	PDE Terr. Invert. mg/kg-d	PDE Plants mg/kg-d	PDE Mammals mg/kg-d	PDE Birds mg/kg-d	Total PDE mg/kg-d	Chemical-Specific Toxicity Value UF	NOAEL mg/kg-d	Adjusted NOAEL mg/kg-d	EEQ N	LOAEL mg/kg-d	Adjusted LOAEL mg/kg-d	EEQ L	Percent Contribution to EEQ N	Percent Contribution to EEQ L
2,3,7,8-TCDD-TEQ	0.00E+00	mg/L	0.00E+00	mg/kg	1.11E-05	mg/kg	NA	NA	4.38E+00	9.41E-02	2.20E+00	2.20E+00	0.00E+00	0.00E+00	2.16E-07	NA	NA	9.44E-06	0.00E+00	0.00E+00	0.00E+00	9.66E-06	10	1.00E-06	1.00E-07	9.66E+01	1.00E-05	1.00E-06	9.66E+00	4.54%	17.07%
Acetone	0.00E+00	mg/L	0.00E+00	mg/kg	1.04E-02	mg/kg	NA	NA	1.50E+00	7.56E+01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	2.02E-04	NA	NA	3.02E-03	0.00E+00	0.00E+00	0.00E+00	3.23E-03	10	1.00E+01	1.00E+00	3.23E-03	5.00E+01	5.00E+00	6.45E-04	0.00%	0.00%
Anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	4.16E-03	mg/kg	NA	NA	2.42E+00	1.25E+00	6.40E-01	6.40E-01	0.00E+00	0.00E+00	8.06E-05	NA	NA	1.95E-03	0.00E+00	0.00E+00	0.00E+00	2.03E-03	10	6.56E+01	6.56E+00	3.10E-04	1.10E+02	1.10E+01	1.85E-04	0.00%	0.00%
Benzo(a)anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	6.06E-03	mg/kg	NA	NA	1.60E+00	5.29E-01	3.50E-01	3.50E-01	0.00E+00	0.00E+00	1.17E-04	NA	NA	1.88E-03	0.00E+00	0.00E+00	0.00E+00	1.99E-03	10	6.15E-01	6.15E-02	3.24E-02	3.07E+00	3.07E-01	6.50E-03	0.00%	0.01%
Benzo(a)pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	1.59E-02	mg/kg	NA	NA	1.30E+00	1.41E-01	2.80E-01	2.80E-01	0.00E+00	0.00E+00	3.07E-04	NA	NA	4.00E-03	0.00E+00	0.00E+00	0.00E+00	4.30E-03	10	1.31E+00	1.31E-01	3.28E-02	3.28E+01	3.28E+00	1.31E-03	0.00%	0.00%
Benzo(b)fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	7.07E-03	mg/kg	NA	NA	2.60E+00	3.10E-01	2.80E-01	2.80E-01	0.00E+00	0.00E+00	1.37E-04	NA	NA	3.56E-03	0.00E+00	0.00E+00	0.00E+00	3.69E-03	10	6.15E-01	6.15E-02	6.01E-02	3.07E+00	3.07E-01	1.20E-02	0.00%	0.02%
Benzo(g,h,i)perylene	0.00E+00	mg/L	0.00E+00	mg/kg	7.80E-02	mg/kg	NA	NA	2.90E+00	2.47E-01	2.40E-01	2.40E-01	0.00E+00	0.00E+00	1.51E-03	NA	NA	4.38E-02	0.00E+00	0.00E+00	0.00E+00	4.53E-02	10	6.15E-01	6.15E-02	7.36E-01	3.07E+00	3.07E-01	1.48E-01	0.03%	0.26%
Benzo(k)fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	4.40E-03	mg/kg	NA	NA	2.60E+00	2.48E-01	2.90E-01	2.90E-01	0.00E+00	0.00E+00	8.51E-05	NA	NA	2.21E-03	0.00E+00	0.00E+00	0.00E+00	2.30E-03	10	6.15E-01	6.15E-02	3.73E-02	3.07E+00	3.07E-01	7.48E-03	0.00%	0.01%
Bis(2-ethylhexyl)phthalate	0.00E+00	mg/L	0.00E+00	mg/kg	4.78E-01	mg/kg	NA	NA	5.81E+02	2.38E-03	5.00E-01	5.00E-01	0.00E+00	0.00E+00	9.25E-03	NA	NA	5.38E+01	0.00E+00	0.00E+00	0.00E+00	5.38E+01	10	1.83E+01	1.83E+00	2.94E+01	1.83E+02	1.83E+01	2.94E+00	1.38%	5.19%
Chrysene	0.00E+00	mg/L	0.00E+00	mg/kg	2.02E-02	mg/kg	NA	NA	2.29E+00	3.25E-01	3.50E-01	3.50E-01	0.00E+00	0.00E+00	3.91E-04	NA	NA	8.95E-03	0.00E+00	0.00E+00	0.00E+00	9.34E-03	10	6.15E-01	6.15E-02	1.52E-01	3.07E+00	3.07E-01	3.04E-02	0.01%	0.05%
Dibenz(a,h)anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	1.22E-02	mg/kg	NA	NA	2.31E+00	1.30E-01	2.00E-01	2.00E-01	0.00E+00	0.00E+00	2.37E-04	NA	NA	5.47E-03	0.00E+00	0.00E+00	0.00E+00	5.71E-03	10	6.15E-01	6.15E-02	9.28E-02	3.07E+00	3.07E-01	1.86E-02	0.00%	0.03%
Diesel Fuel	0.00E+00	mg/L	0.00E+00	mg/kg	1.61E+03	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.11E+01	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.11E+01		NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	1.25E-02	mg/kg	NA	NA	3.00E+00	5.00E-01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	2.42E-04	NA	NA	7.25E-03	0.00E+00	0.00E+00	0.00E+00	7.49E-03	10	6.56E+01	6.56E+00	1.14E-03	1.10E+02	1.10E+01	6.81E-04	0.00%	0.00%
Gasoline	0.00E+00	mg/L	0.00E+00	mg/kg	1.20E+00	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.31E-02	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.31E-02		NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	5.38E-03	mg/kg	NA	NA	2.86E+00	1.10E-01	2.30E-01	2.30E-01	0.00E+00	0.00E+00	1.04E-04	NA	NA	2.98E-03	0.00E+00	0.00E+00	0.00E+00	3.08E-03	10	6.15E-01	6.15E-02	5.01E-02	3.07E+00	3.07E-01	1.00E-02	0.00%	0.02%
Methylene chloride	0.00E+00	mg/L	0.00E+00	mg/kg	7.11E-03	mg/kg	NA	NA	3.00E+00	1.73E+01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	1.38E-04	NA	NA	4.13E-03	0.00E+00	0.00E+00	0.00E+00	4.27E-03	10	5.85E+00	5.85E-01	7.29E-03	5.00E+01	5.00E+00	8.53E-04	0.00%	0.00%
Motor Oil	0.00E+00	mg/L	0.00E+00	mg/kg	4.04E+04	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.82E+02	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.82E+02		NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	0.00E+00	mg/L	0.00E+00	mg/kg	5.92E-01	mg/kg	NA	NA	1.46E+01	5.93E+00	2.37E-01	2.37E-01	0.00E+00	0.00E+00	1.15E-02	NA	NA	1.68E+00	0.00E+00	0.00E+00	0.00E+00	1.69E+00	10	8.42E+00	8.42E-01	2.01E+00	9.45E+00	9.45E-01	1.79E+00	0.09%	3.16%
Phenanthrene	0.00E+00	mg/L	0.00E+00	mg/kg	9.94E-03	mg/kg	NA	NA	1.70E+00	4.88E+00	6.00E-01	6.00E-01	0.00E+00	0.00E+00	1.92E-04	NA	NA	3.27E-03	0.00E+00	0.00E+00	0.00E+00	3.46E-03	10	6.56E+01	6.56E+00	5.28E-04	1.10E+02	1.10E+01	3.15E-04	0.00%	0.00%
Pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	2.32E-02	mg/kg	NA	NA	1.80E+00	7.20E-01	5.20E-01	5.20E-01	0.00E+00	0.00E+00	4.49E-04	NA	NA	8.08E-03	0.00E+00	0.00E+00	0.00E+00	8.53E-03	10	6.15E-01	6.15E-02	1.39E-01	3.07E+00	3.07E-01	2.78E-02	0.01%	0.05%
Antimony	0.00E+00	mg/L	0.00E+00	mg/kg	2.81E+00	mg/kg	NA	NA	1.00E+00	3.70E-02	1.40E-01	1.40E-01	0.00E+00	0.00E+00	5.43E-02	NA	NA	5.43E-01	0.00E+00	0.00E+00	0.00E+00	5.97E-01	10	1.25E-01	1.25E-02	4.78E+01	1.25E+00	1.25E-01	4.78E+00	2.25%	8.45%
Arsenic	0.00E+00	mg/L	0.00E+00	mg/kg	4.73E+00	mg/kg	NA	NA	1.53E-01	3.75E-02	5.92E-03	5.92E-03	0.00E+00	0.00E+00	9.15E-02	NA	NA	1.40E-01	0.00E+00	0.00E+00	0.00E+00	2.32E-01	10	3.20E-01	3.20E-02	7.23E+00	4.70E+00	4.70E-01	4.93E-01	0.34%	0.87%
Barium	0.00E+00	mg/L	0.00E+00	mg/kg	6.91E+02	mg/kg	NA	NA	9.10E-02	1.56E-01	4.71E-01	4.71E-01	0.00E+00	0.00E+00	1.34E+01	NA	NA	1.22E+01	0.00E+00	0.00E+00	0.00E+00	2.55E+01	10	5.18E+01	5.18E+00	4.93E+00	1.21E+02	1.21E+01	2.11E+00	0.23%	3.73%
Cadmium	0.00E+00	mg/L	0.00E+00	mg/kg	2.96E+00	mg/kg	NA	NA	6.63E+00	3.80E-01	1.60E-01	1.60E-01	0.00E+00	0.00E+00	5.73E-02	NA	NA	3.80E+00	0.00E+00	0.00E+00	0.00E+00	3.86E+00	10	6.00E-02	6.00E-03	6.43E+02	2.64E+00	2.64E-01	1.46E+01	30.23%	25.82%
Chromium	0.00E+00	mg/L	0.00E+00	mg/kg	1.80E+01	mg/kg	NA	NA	3.06E-01	4.10E-02	1.08E-01	1.08E-01	0.00E+00	0.00E+00	3.48E-01	NA	NA	1.06E+00	0.00E+00	0.00E+00	0.00E+00	1.41E+00	10	2.40E+00	2.40E-01	5.89E+00	2.82E+00	2.82E-01	5.01E+00	0.28%	8.85%
Cobalt	0.00E+00	mg/L	0.00E+00	mg/kg	6.80E+00	mg/kg	NA	NA	1.22E-01	7.50E-03	2.07E-02	2.07E-02	0.00E+00	0.00E+00	1.32E-01	NA	NA	1.61E-01	0.00E+00	0.00E+00	0.00E+00	2.92E-01	10	1.20E+00	1.20E-01	2.43E+00	2.00E+01	2.00E+00	1.46E-01	0.11%	0.26%
Copper	0.00E+00	mg/L	0.00E+00	mg/kg	1.35E+02	mg/kg	NA	NA	5.15E-01	9.98E-02	1.16E-01	1.16E-01	0.00E+00	0.00E+00	2.61E+00	NA	NA	1.35E+01	0.00E+00	0.00E+00	0.00E+00	1.61E+01	10	2.67E+00	2.67E-01	6.02E+01	6.32E+02	6.32E+01	2.54E-01	2.83%	0.45%
Iron	0.00E+00	mg/L	0.00E+00	mg/kg	3.29E+04	mg/kg	NA	NA	3.60E-02	0.00E+00	1.71E-02	1.71E-02	0.00E+00	0.00E+00	6.37E+02	NA	NA	2.29E+02	0.00E+00	0.00E+00	0.00E+00	8.67E+02		NA	NA	NA	NA	NA	NA	NA	NA
Lead	0.00E+00	mg/L	0.00E+00	mg/kg	1.03E+03	mg/kg	NA	NA	2.11E-01	1.26E-02	2.26E-02	2.26E-02	0.00E+00	0.00E+00	1.99E+01	NA	NA	4.19E+01	0.00E+00	0.00E+00	0.00E+00	6.18E+01	10	1.00E+00	1.00E-01	6.18E+02	2.41E+02	2.41E+01	2.56E+00	29.06%	4.53%
Manganese	0.00E+00	mg/L	0.00E+00	mg/kg	1.55E+03	mg/kg	NA	NA	4.31E-02	7.90E-02	2.05E-02	2.05E-02	0.00E+00	0.00E+00	3.00E+01	NA	NA	1.29E+01	0.00E+00	0.00E+00	0.00E+00	4.29E+01	10	1.37E+01	1.37E+00	3.13E+01	1.59E+02	1.59E+01	2.70E+00	1.47%	4.77%
Mercury	0.00E+00	mg/L	0.00E+00	mg/kg	7.25E-01	mg/kg	NA	NA	1.34E+00	4.27E-01	1.92E-01	1.92E-01	0.00E+00	0.00E+00	1.40E-02	NA	NA	1.88E-01	0.00E+00	0.00E+00	0.00E+00	2.02E-01	10	2.50E-01	2.50E-02	8.09E+00	4.00E+00	4.00E-01	5.06E-01	0.38%	0.89%
Molybdenum	0.00E+00	mg/L	0.00E+00	mg/kg	1.46E+00	mg/kg	NA	NA	9.53E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.82E-02	NA	NA	2.68E-01	0.00E+00	0.00E+00	0.00E+00	2.97E-01	10	2.60E-01	2.60E-02	1.14E+01	2.60E+00	2.60E-01	1.14E+00	0.54%	2.02%
Nickel	0.00E+00	mg/L	0.00E+00	mg/kg	1.46E+01	mg/kg	NA	NA	1.26E+00	5.51E-02	1.87E-01	1.87E-01	0.00E+00	0.00E+00	2.82E-01	NA	NA	3.54E+00	0.00E+00	0.00E+00	0.00E+00	3.82E+00	10	1.33E-01	1.33E-02	2.87E+02	3.16E+01	3.16E+00	1.21E+00	13.50%	2.14%
Silver	0.00E+00	mg/L	0.00E+00	mg/kg	1.05E+00	mg/kg	NA	NA	2.05E+00	1.40E-02	4.00E-03	4.00E-03	0.00E+00	0.00E+00	2.02E-02	NA	NA	4.14E-01	0.00E+00	0.00E+00	0.00E+00	4.34E-01	10	6.02E+00	6.02E-01	7.21E-01	6.02E+01	6.02E+00	7.21E-02	0.03%	0.13%
Thallium	0.00E+00	mg/L	0.00E+00	mg/kg	4.45E-01	mg/kg	NA	NA	0.00E+00	0.00E+00	1.23E-01	1.23E-01	0.00E+00	0.00E+00	8.61E-03	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.61E-03	10	4.80E-01	4.80E-02	1.79E-01	1.43E+00	1.43E-01	6.02E-02	0.01%	0.11%
Zinc	0.00E+00	mg/L	0.00E+00	mg/kg	2.38E+03	mg/kg	NA	NA	4.60E-01	1.51E-01	5.70E-02	5.70E-02	0.00E+00	0.00E+00	4.61E+01	NA	NA	2.12E+02	0.00E+00	0.00E+00	0.00E+00	2.58E+02	10	9.60E+00	9.60E-01	2.69E+02	4.11E+02	4.11E+01	6.28E+00	12.65%	11.11%
Hazard Index (Total EEQ):																										2.1E+03			5.7E+01	100.00%	100.00%

Intake Equation:

$$Ej = \left(\frac{A}{HR} \left[\sum_{i=1}^{m} \left(\frac{IRi \, x Cij}{BW} \right) \right] \right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I) (mg/kg or mg/L)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using FHR =1.
Tier 2 = EEQ using calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box): n See appropriate text tables for equations.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text tables.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	1	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.00012	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.0012	kg/d
Body weight =	0.0062	kg
Home range =	0.1	acres
Water intake rate =	0.001	L/d
Site Area =	0.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

TABLE G-5
TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR AMERICAN ROBINS AT MATHER WAA, YOSEMITE

Hazard Estimate - Tier 1
American Robin

Chemical	Surface Water Exposure Point Concentration	Units	Sediment Exposure Point Concentration	Units	Soil Exposure Point Concentration	Units	Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment
							---------- unitless					----------	mg/kg-d	mg/kg-d
2,3,7,8-TCDD-TEQ	0.00E+00	mg/L	0.00E+00	mg/kg	1.11E-05	mg/kg	NA	NA	4.38E+00	9.41E-02	2.20E+00	2.20E+00	0.00E+00	0.00E+00
Acetone	0.00E+00	mg/L	0.00E+00	mg/kg	1.04E-02	mg/kg	NA	NA	1.50E+00	7.56E+01	5.00E-01	5.00E-01	0.00E+00	0.00E+00
Anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	4.16E-03	mg/kg	NA	NA	2.42E+00	1.25E+00	6.40E-01	6.40E-01	0.00E+00	0.00E+00
Benzo(a)anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	6.06E-03	mg/kg	NA	NA	1.60E+00	5.29E-01	3.50E-01	3.50E-01	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	1.59E-02	mg/kg	NA	NA	1.30E+00	1.41E-01	2.80E-01	2.80E-01	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	7.07E-03	mg/kg	NA	NA	2.60E+00	3.10E-01	2.80E-01	2.80E-01	0.00E+00	0.00E+00
Benzo(g,h,i)perylene	0.00E+00	mg/L	0.00E+00	mg/kg	7.80E-02	mg/kg	NA	NA	2.90E+00	2.47E-01	2.40E-01	2.40E-01	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	4.40E-03	mg/kg	NA	NA	2.60E+00	2.48E-01	2.90E-01	2.90E-01	0.00E+00	0.00E+00
Bis(2-ethylhexyl)phthalate	0.00E+00	mg/L	0.00E+00	mg/kg	4.78E-01	mg/kg	NA	NA	5.81E+02	2.38E-03	5.00E-01	5.00E-01	0.00E+00	0.00E+00
Chrysene	0.00E+00	mg/L	0.00E+00	mg/kg	2.02E-02	mg/kg	NA	NA	2.29E+00	3.25E-01	3.50E-01	3.50E-01	0.00E+00	0.00E+00
Dibenz(a,h)anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	1.22E-02	mg/kg	NA	NA	2.31E+00	1.30E-01	2.00E-01	2.00E-01	0.00E+00	0.00E+00
Diesel Fuel	0.00E+00	mg/L	0.00E+00	mg/kg	1.61E+03	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	1.25E-02	mg/kg	NA	NA	3.00E+00	5.00E-01	5.00E-01	5.00E-01	0.00E+00	0.00E+00
Gasoline	0.00E+00	mg/L	0.00E+00	mg/kg	1.20E+00	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	5.38E-03	mg/kg	NA	NA	2.86E+00	1.10E-01	2.30E-01	2.30E-01	0.00E+00	0.00E+00
Methylene chloride	0.00E+00	mg/L	0.00E+00	mg/kg	7.11E-03	mg/kg	NA	NA	3.00E+00	1.73E+01	5.00E-01	5.00E-01	0.00E+00	0.00E+00
Motor Oil	0.00E+00	mg/L	0.00E+00	mg/kg	4.04E+04	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pentachlorophenol	0.00E+00	mg/L	0.00E+00	mg/kg	5.92E-01	mg/kg	NA	NA	1.46E+01	5.93E+00	2.37E-01	2.37E-01	0.00E+00	0.00E+00
Phenanthrene	0.00E+00	mg/L	0.00E+00	mg/kg	9.94E-03	mg/kg	NA	NA	1.70E+00	4.88E+00	6.00E-01	6.00E-01	0.00E+00	0.00E+00
Pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	2.32E-02	mg/kg	NA	NA	1.80E+00	7.20E-01	5.20E-01	5.20E-01	0.00E+00	0.00E+00
Antimony	0.00E+00	mg/L	0.00E+00	mg/kg	2.81E+00	mg/kg	NA	NA	1.00E+00	3.70E-02	1.40E-01	1.40E-01	0.00E+00	0.00E+00
Arsenic	0.00E+00	mg/L	0.00E+00	mg/kg	4.73E+00	mg/kg	NA	NA	1.53E-01	3.75E-02	5.92E-03	5.92E-03	0.00E+00	0.00E+00
Barium	0.00E+00	mg/L	0.00E+00	mg/kg	6.91E+02	mg/kg	NA	NA	9.10E-02	1.56E-01	4.71E-01	4.71E-01	0.00E+00	0.00E+00
Cadmium	0.00E+00	mg/L	0.00E+00	mg/kg	2.96E+00	mg/kg	NA	NA	6.63E+00	3.80E-01	1.60E-01	1.60E-01	0.00E+00	0.00E+00
Chromium	0.00E+00	mg/L	0.00E+00	mg/kg	1.80E+01	mg/kg	NA	NA	3.06E-01	4.10E-02	1.08E-01	1.08E-01	0.00E+00	0.00E+00
Cobalt	0.00E+00	mg/L	0.00E+00	mg/kg	6.80E+00	mg/kg	NA	NA	1.22E-01	7.50E-03	2.07E-02	2.07E-02	0.00E+00	0.00E+00
Copper	0.00E+00	mg/L	0.00E+00	mg/kg	1.35E+02	mg/kg	NA	NA	5.15E-01	9.98E-02	1.16E-01	1.16E-01	0.00E+00	0.00E+00
Iron	0.00E+00	mg/L	0.00E+00	mg/kg	3.29E+04	mg/kg	NA	NA	3.60E-02	0.00E+00	1.71E-02	1.71E-02	0.00E+00	0.00E+00
Lead	0.00E+00	mg/L	0.00E+00	mg/kg	1.03E+03	mg/kg	NA	NA	2.11E-01	1.26E-02	2.26E-02	2.26E-02	0.00E+00	0.00E+00
Manganese	0.00E+00	mg/L	0.00E+00	mg/kg	1.55E+03	mg/kg	NA	NA	4.31E-02	7.90E-02	2.05E-02	2.05E-02	0.00E+00	0.00E+00
Mercury	0.00E+00	mg/L	0.00E+00	mg/kg	7.25E-01	mg/kg	NA	NA	1.34E+00	4.27E-01	1.92E-01	1.92E-01	0.00E+00	0.00E+00
Molybdenum	0.00E+00	mg/L	0.00E+00	mg/kg	1.46E+00	mg/kg	NA	NA	9.53E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nickel	0.00E+00	mg/L	0.00E+00	mg/kg	1.46E+01	mg/kg	NA	NA	1.26E+00	5.51E-02	1.87E-01	1.87E-01	0.00E+00	0.00E+00
Silver	0.00E+00	mg/L	0.00E+00	mg/kg	1.05E+00	mg/kg	NA	NA	2.05E+00	1.40E-02	4.00E-03	4.00E-03	0.00E+00	0.00E+00
Thallium	0.00E+00	mg/L	0.00E+00	mg/kg	4.45E-01	mg/kg	NA	NA	0.00E+00	0.00E+00	1.23E-01	1.23E-01	0.00E+00	0.00E+00
Zinc	0.00E+00	mg/L	0.00E+00	mg/kg	2.38E+03	mg/kg	NA	NA	4.60E-01	1.51E-01	5.70E-02	5.70E-02	0.00E+00	0.00E+00

Chemical	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	EEQ N	LOAEL	Adjusted LOAEL	EEQ L	Percent Contribution to EEQ N	Percent Contribution to EEQ L
	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d		mg/kg-d	mg/kg-d		mg/kg-d	mg/kg-d			
2,3,7,8-TCDD-TEQ	5.57E-08	NA	NA	2.32E-06	8.12E-08	0.00E+00	0.00E+00	2.45E-06	10	1.40E-05	1.40E-06	1.75E+00	1.40E-04	1.40E-05	1.75E-01	0.01%	0.25%
Acetone	5.21E-05	NA	NA	7.42E-04	6.10E-02	0.00E+00	0.00E+00	6.18E-02	10	2.01E+02	2.01E+01	3.08E-03	1.01E+03	1.01E+02	6.12E-04	0.00%	0.00%
Anthracene	2.08E-05	NA	NA	4.79E-04	4.05E-04	0.00E+00	0.00E+00	9.04E-04	10	5.53E+02	5.53E+01	1.64E-05	2.77E+03	2.77E+02	3.27E-06	0.00%	0.00%
Benzo(a)anthracene	3.03E-05	NA	NA	4.61E-04	2.48E-04	0.00E+00	0.00E+00	7.40E-04	10	5.53E+02	5.53E+01	1.34E-05	2.77E+03	2.77E+02	2.67E-06	0.00%	0.00%
Benzo(a)pyrene	7.94E-05	NA	NA	9.81E-04	1.74E-04	0.00E+00	0.00E+00	1.23E-03	10	5.53E+02	5.53E+01	2.23E-05	2.77E+03	2.77E+02	4.46E-06	0.00%	0.00%
Benzo(b)fluoranthene	3.53E-05	NA	NA	8.73E-04	1.70E-04	0.00E+00	0.00E+00	1.08E-03	10	5.53E+02	5.53E+01	1.95E-05	2.77E+03	2.77E+02	3.90E-06	0.00%	0.00%
Benzo(g,h,i)perylene	3.90E-04	NA	NA	1.07E-02	1.49E-03	0.00E+00	0.00E+00	1.26E-02	10	5.53E+02	5.53E+01	2.28E-04	2.77E+03	2.77E+02	4.57E-05	0.00%	0.00%
Benzo(k)fluoranthene	2.20E-05	NA	NA	5.43E-04	8.44E-05	0.00E+00	0.00E+00	6.49E-04	10	5.53E+02	5.53E+01	1.17E-05	2.77E+03	2.77E+02	2.35E-06	0.00%	0.00%
Bis(2-ethylhexyl)phthalate	2.39E-03	NA	NA	1.32E+01	8.82E-05	0.00E+00	0.00E+00	1.32E+01	10	1.10E+00	1.10E-01	1.20E+02	5.50E+00	5.50E-01	2.40E+01	1.00%	34.44%
Chrysene	1.01E-04	NA	NA	2.20E-03	5.08E-04	0.00E+00	0.00E+00	2.81E-03	10	5.53E+02	5.53E+01	5.07E-05	2.77E+03	2.77E+02	1.01E-05	0.00%	0.00%
Dibenz(a,h)anthracene	6.12E-05	NA	NA	1.34E-03	1.23E-04	0.00E+00	0.00E+00	1.53E-03	10	5.53E+02	5.53E+01	2.76E-05	2.77E+03	2.77E+02	5.52E-06	0.00%	0.00%
Diesel Fuel	8.03E+00	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.03E+00		NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	6.24E-05	NA	NA	1.78E-03	4.84E-04	0.00E+00	0.00E+00	2.33E-03	10	5.53E+02	5.53E+01	4.21E-05	2.77E+03	2.77E+02	8.41E-06	0.00%	0.00%
Gasoline	5.98E-03	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.98E-03		NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	2.69E-05	NA	NA	7.31E-04	4.59E-05	0.00E+00	0.00E+00	8.04E-04	10	5.53E+02	5.53E+01	1.45E-05	2.77E+03	2.77E+02	2.91E-06	0.00%	0.00%
Methylene chloride	3.56E-05	NA	NA	1.01E-03	9.53E-03	0.00E+00	0.00E+00	1.06E-02		NA	NA	NA	NA	NA	NA	NA	NA
Motor Oil	2.02E+02	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.02E+02		NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	2.96E-03	NA	NA	4.12E-01	2.72E-01	0.00E+00	0.00E+00	6.87E-01	10	6.73E+00	6.73E-01	1.02E+00	2.25E+01	2.25E+00	3.05E-01	0.01%	0.44%
Phenanthrene	4.97E-05	NA	NA	8.02E-04	3.76E-03	0.00E+00	0.00E+00	4.61E-03	10	5.53E+02	5.53E+01	8.33E-05	2.77E+03	2.77E+02	1.67E-05	0.00%	0.00%
Pyrene	1.16E-04	NA	NA	1.98E-03	1.29E-03	0.00E+00	0.00E+00	3.39E-03	10	5.53E+02	5.53E+01	6.14E-05	2.77E+03	2.77E+02	1.23E-05	0.00%	0.00%
Antimony	1.40E-02	NA	NA	1.33E-01	8.05E-03	0.00E+00	0.00E+00	1.55E-01		NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	2.36E-02	NA	NA	3.44E-02	1.38E-02	0.00E+00	0.00E+00	7.17E-02	10	5.50E+00	5.50E-01	1.30E-01	2.20E+01	2.20E+00	3.26E-02	0.00%	0.05%
Barium	3.45E+00	NA	NA	2.99E+00	8.35E+00	0.00E+00	0.00E+00	1.48E+01	10	2.08E+01	2.08E+00	7.11E+00	4.17E+01	4.17E+00	3.55E+00	0.06%	5.09%
Cadmium	1.48E-02	NA	NA	9.33E-01	8.72E-02	0.00E+00	0.00E+00	1.03E+00	10	7.00E-01	7.00E-02	1.48E+01	1.00E+00	1.00E-01	1.03E+01	0.12%	14.85%
Chromium	8.99E-02	NA	NA	2.61E-01	5.71E-02	0.00E+00	0.00E+00	4.08E-01	10	2.66E+00	2.66E-01	1.54E+00	2.78E+00	2.78E-01	1.47E+00	0.01%	2.11%
Cobalt	3.40E-02	NA	NA	3.94E-02	3.95E-03	0.00E+00	0.00E+00	7.73E-02	10	7.61E+00	7.61E-01	1.02E-01	7.80E+00	7.80E-01	9.91E-02	0.00%	0.14%
Copper	6.75E-01	NA	NA	3.30E+00	1.04E+00	0.00E+00	0.00E+00	5.02E+00	10	2.30E+00	2.30E-01	2.18E+01	5.23E+01	5.23E+00	9.60E-01	0.18%	1.38%
Iron	1.65E+02	NA	NA	5.63E+01	0.00E+00	0.00E+00	0.00E+00	2.21E+02		NA	NA	NA	NA	NA	NA	NA	NA
Lead	5.14E+00	NA	NA	1.03E+01	1.00E+00	0.00E+00	0.00E+00	1.64E+01	10	1.40E-02	1.40E-03	1.17E+04	8.75E+00	8.75E-01	1.88E+01	97.90%	26.95%
Manganese	7.76E+00	NA	NA	3.17E+00	9.50E+00	0.00E+00	0.00E+00	2.04E+01	10	7.76E+01	7.76E+00	2.63E+00	7.76E+02	7.76E+01	2.63E-01	0.02%	0.38%
Mercury	3.63E-03	NA	NA	4.62E-02	2.40E-02	0.00E+00	0.00E+00	7.38E-02	10	3.90E-02	3.90E-03	1.89E+01	1.80E-01	1.80E-02	4.10E+00	0.16%	5.88%
Molybdenum	7.28E-03	NA	NA	6.59E-02	0.00E+00	0.00E+00	0.00E+00	7.31E-02	10	3.50E+00	3.50E-01	2.09E-01	3.53E+01	3.53E+00	2.07E-02	0.00%	0.03%
Nickel	7.28E-02	NA	NA	8.68E-01	6.22E-02	0.00E+00	0.00E+00	1.00E+00	10	1.38E+00	1.38E-01	7.27E+00	5.63E+01	5.63E+00	1.78E-01	0.06%	0.26%
Silver	5.23E-03	NA	NA	1.02E-01	1.13E-03	0.00E+00	0.00E+00	1.08E-01	10	2.02E+00	2.02E-01	5.34E-01	2.02E+01	2.02E+00	5.34E-02	0.00%	0.08%
Thallium	2.23E-03	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.23E-03	5	3.50E-01	7.00E-02	3.18E-02	1.75E+00	3.50E-01	6.36E-03	0.00%	0.01%
Zinc	1.19E+01	NA	NA	5.21E+01	2.78E+01	0.00E+00	0.00E+00	9.18E+01	10	1.72E+01	1.72E+00	5.34E+01	1.72E+02	1.72E+01	5.34E+00	0.45%	7.66%
									Hazard Index (Total EEQ):			1.2E+04			7.0E+01	100.00%	100.00%

Intake Equation:

$$Ej = \left(\frac{A}{HR} \left[\sum_{i=1}^{m} \left(\frac{IRi\,x\,Cij}{BW} \right) \right] \right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I) (mg/kg or mg/L)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using FHR =1.
Tier 2 = EEQ using calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box): $\boxed{n}$ See appropriate text tables for equations.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0.62	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0.38	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.00044	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.011	kg/d
Body weight =	0.088	kg
Home range =	1.2	acres
Water intake rate =	0.012	L/d
Site Area =	0.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

TABLE G-6
TIER 2 CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN EEQs AND HAZARD INDICES FOR AMERICAN ROBINS AT MATHER WAA, YOSEMITE

Hazard Estimate - Tier 2
American Robin

Chemical	Surface Water Exposure Point Concentration	Units	Sediment Exposure Point Concentration	Units	Soil Exposure Point Concentration	Units	Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water mg/kg-d	PDE Sediment mg/kg-d	PDE Soil mg/kg-d	PDE Fish mg/kg-d	PDE Aq. Invert. mg/kg-d	PDE Terr. Invert. mg/kg-d	PDE Plants mg/kg-d	PDE Mammals mg/kg-d	PDE Birds mg/kg-d	Total PDE mg/kg-d	Chemical-Specific Toxicity Value UF	NOAEL mg/kg-d	Adjusted NOAEL mg/kg-d	EEQ N	LOAEL mg/kg-d	Adjusted LOAEL mg/kg-d	EEQ L	Percent Contribution to EEQ N	Percent Contribution to EEQ L
							---------------------------- unitless					--																			
2,3,7,8-TCDD-TEQ	0.00E+00	mg/L	0.00E+00	mg/kg	1.11E-05	mg/kg	NA	NA	4.38E+00	9.41E-02	2.20E+00	2.20E+00	0.00E+00	0.00E+00	9.28E-09	NA	NA	3.86E-07	1.35E-08	0.00E+00	0.00E+00	4.09E-07	10	1.40E-05	1.40E-06	2.92E-01	1.40E-04	1.40E-05	2.92E-02	0.01%	0.25%
Acetone	0.00E+00	mg/L	0.00E+00	mg/kg	1.04E-02	mg/kg	NA	NA	1.50E+00	7.56E+01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	8.68E-06	NA	NA	1.24E-04	1.02E-02	0.00E+00	0.00E+00	1.03E-02	10	2.01E+02	2.01E+01	5.13E-04	1.01E+03	1.01E+02	1.02E-04	0.00%	0.00%
Anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	4.16E-03	mg/kg	NA	NA	2.42E+00	1.25E+00	6.40E-01	6.40E-01	0.00E+00	0.00E+00	3.47E-06	NA	NA	7.98E-05	6.74E-05	0.00E+00	0.00E+00	1.51E-04	10	5.53E+02	5.53E+01	2.73E-06	2.77E+03	2.77E+02	5.45E-07	0.00%	0.00%
Benzo(a)anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	6.06E-03	mg/kg	NA	NA	1.60E+00	5.29E-01	3.50E-01	3.50E-01	0.00E+00	0.00E+00	5.05E-06	NA	NA	7.68E-05	4.14E-05	0.00E+00	0.00E+00	1.23E-04	10	5.53E+02	5.53E+01	2.23E-06	2.77E+03	2.77E+02	4.46E-07	0.00%	0.00%
Benzo(a)pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	1.59E-02	mg/kg	NA	NA	1.30E+00	1.41E-01	2.80E-01	2.80E-01	0.00E+00	0.00E+00	1.32E-05	NA	NA	1.63E-04	2.90E-05	0.00E+00	0.00E+00	2.06E-04	10	5.53E+02	5.53E+01	3.72E-06	2.77E+03	2.77E+02	7.44E-07	0.00%	0.00%
Benzo(b)fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	7.07E-03	mg/kg	NA	NA	2.60E+00	3.10E-01	2.80E-01	2.80E-01	0.00E+00	0.00E+00	5.89E-06	NA	NA	1.45E-04	2.83E-05	0.00E+00	0.00E+00	1.80E-04	10	5.53E+02	5.53E+01	3.25E-06	2.77E+03	2.77E+02	6.50E-07	0.00%	0.00%
Benzo(g,h,i)perylene	0.00E+00	mg/L	0.00E+00	mg/kg	7.80E-02	mg/kg	NA	NA	2.90E+00	2.47E-01	2.40E-01	2.40E-01	0.00E+00	0.00E+00	6.50E-05	NA	NA	1.79E-03	2.49E-04	0.00E+00	0.00E+00	2.10E-03	10	5.53E+02	5.53E+01	3.81E-05	2.77E+03	2.77E+02	7.61E-06	0.00%	0.00%
Benzo(k)fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	4.40E-03	mg/kg	NA	NA	2.60E+00	2.48E-01	2.90E-01	2.90E-01	0.00E+00	0.00E+00	3.66E-06	NA	NA	9.05E-05	1.41E-05	0.00E+00	0.00E+00	1.08E-04	10	5.53E+02	5.53E+01	1.96E-06	2.77E+03	2.77E+02	3.91E-07	0.00%	0.00%
Bis(2-ethylhexyl)phthalate	0.00E+00	mg/L	0.00E+00	mg/kg	4.78E-01	mg/kg	NA	NA	5.81E+02	2.38E-03	5.00E-01	5.00E-01	0.00E+00	0.00E+00	3.98E-04	NA	NA	2.20E+00	1.47E-05	0.00E+00	0.00E+00	2.20E+00	10	1.10E+00	1.10E-01	2.00E+01	5.50E+00	5.50E-01	4.00E+00	1.00%	34.44%
Chrysene	0.00E+00	mg/L	0.00E+00	mg/kg	2.02E-02	mg/kg	NA	NA	2.29E+00	3.25E-01	3.50E-01	3.50E-01	0.00E+00	0.00E+00	1.68E-05	NA	NA	3.66E-04	8.47E-05	0.00E+00	0.00E+00	4.68E-04	10	5.53E+02	5.53E+01	8.46E-06	2.77E+03	2.77E+02	1.69E-06	0.00%	0.00%
Dibenz(a,h)anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	1.22E-02	mg/kg	NA	NA	2.31E+00	1.30E-01	2.00E-01	2.00E-01	0.00E+00	0.00E+00	1.02E-05	NA	NA	2.24E-04	2.06E-05	0.00E+00	0.00E+00	2.55E-04	10	5.53E+02	5.53E+01	4.60E-06	2.77E+03	2.77E+02	9.21E-07	0.00%	0.00%
Diesel Fuel	0.00E+00	mg/L	0.00E+00	mg/kg	1.61E+03	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.34E+00	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.34E+00		NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	1.25E-02	mg/kg	NA	NA	3.00E+00	5.00E-01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	1.04E-05	NA	NA	2.97E-04	8.06E-05	0.00E+00	0.00E+00	3.88E-04	10	5.53E+02	5.53E+01	7.01E-06	2.77E+03	2.77E+02	1.40E-06	0.00%	0.00%
Gasoline	0.00E+00	mg/L	0.00E+00	mg/kg	1.20E+00	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.96E-04	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.96E-04		NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	5.38E-03	mg/kg	NA	NA	2.86E+00	1.10E-01	2.30E-01	2.30E-01	0.00E+00	0.00E+00	4.48E-06	NA	NA	1.22E-04	7.64E-06	0.00E+00	0.00E+00	1.34E-04	10	5.53E+02	5.53E+01	2.42E-06	2.77E+03	2.77E+02	4.84E-07	0.00%	0.00%
Methylene chloride	0.00E+00	mg/L	0.00E+00	mg/kg	7.11E-03	mg/kg	NA	NA	3.00E+00	1.73E+01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	5.93E-06	NA	NA	1.69E-04	1.59E-03	0.00E+00	0.00E+00	1.76E-03		NA	NA	NA	NA	NA	NA	NA	NA
Motor Oil	0.00E+00	mg/L	0.00E+00	mg/kg	4.04E+04	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.37E+01	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.37E+01		NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	0.00E+00	mg/L	0.00E+00	mg/kg	5.92E-01	mg/kg	NA	NA	1.46E+01	5.93E+00	2.37E-01	2.37E-01	0.00E+00	0.00E+00	4.93E-04	NA	NA	6.86E-02	4.54E-02	0.00E+00	0.00E+00	1.14E-01	10	6.73E+00	6.73E-01	1.70E-01	2.25E+01	2.25E+00	5.09E-02	0.01%	0.44%
Phenanthrene	0.00E+00	mg/L	0.00E+00	mg/kg	9.94E-03	mg/kg	NA	NA	1.70E+00	4.88E+00	6.00E-01	6.00E-01	0.00E+00	0.00E+00	8.28E-06	NA	NA	1.34E-04	6.26E-04	0.00E+00	0.00E+00	7.68E-04	10	5.53E+02	5.53E+01	1.39E-05	2.77E+03	2.77E+02	2.78E-06	0.00%	0.00%
Pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	2.32E-02	mg/kg	NA	NA	1.80E+00	7.20E-01	5.20E-01	5.20E-01	0.00E+00	0.00E+00	1.93E-05	NA	NA	3.31E-04	2.16E-04	0.00E+00	0.00E+00	5.66E-04	10	5.53E+02	5.53E+01	1.02E-05	2.77E+03	2.77E+02	2.05E-06	0.00%	0.00%
Antimony	0.00E+00	mg/L	0.00E+00	mg/kg	2.81E+00	mg/kg	NA	NA	1.00E+00	3.70E-02	1.40E-01	1.40E-01	0.00E+00	0.00E+00	2.34E-03	NA	NA	2.22E-02	1.34E-03	0.00E+00	0.00E+00	2.59E-02		NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	0.00E+00	mg/L	0.00E+00	mg/kg	4.73E+00	mg/kg	NA	NA	1.53E-01	3.75E-02	5.92E-03	5.92E-03	0.00E+00	0.00E+00	3.94E-03	NA	NA	5.73E-03	2.29E-03	0.00E+00	0.00E+00	1.20E-02	10	5.50E+00	5.50E-01	2.17E-02	2.20E+01	2.20E+00	5.44E-03	0.00%	0.05%
Barium	0.00E+00	mg/L	0.00E+00	mg/kg	6.91E+02	mg/kg	NA	NA	9.10E-02	1.56E-01	4.71E-01	4.71E-01	0.00E+00	0.00E+00	5.76E-01	NA	NA	4.98E-01	1.39E+00	0.00E+00	0.00E+00	2.46E+00	10	2.08E+01	2.08E+00	1.18E+00	4.17E+01	4.17E+00	5.91E-01	0.06%	5.09%
Cadmium	0.00E+00	mg/L	0.00E+00	mg/kg	2.96E+00	mg/kg	NA	NA	6.63E+00	3.80E-01	1.60E-01	1.60E-01	0.00E+00	0.00E+00	2.47E-03	NA	NA	1.55E-01	1.45E-02	0.00E+00	0.00E+00	1.72E-01	10	7.00E-01	7.00E-02	2.46E+00	1.00E+00	1.00E-01	1.72E+00	0.12%	14.85%
Chromium	0.00E+00	mg/L	0.00E+00	mg/kg	1.80E+01	mg/kg	NA	NA	3.06E-01	4.10E-02	1.08E-01	1.08E-01	0.00E+00	0.00E+00	1.50E-02	NA	NA	4.36E-02	9.52E-03	0.00E+00	0.00E+00	6.81E-02	10	2.66E+00	2.66E-01	2.56E-01	2.78E+00	2.78E-01	2.45E-01	0.01%	2.11%
Cobalt	0.00E+00	mg/L	0.00E+00	mg/kg	6.80E+00	mg/kg	NA	NA	1.22E-01	7.50E-03	2.07E-02	2.07E-02	0.00E+00	0.00E+00	5.67E-03	NA	NA	6.57E-03	6.59E-04	0.00E+00	0.00E+00	1.29E-02	10	7.61E+00	7.61E-01	1.69E-02	7.80E+00	7.80E-01	1.65E-02	0.00%	0.14%
Copper	0.00E+00	mg/L	0.00E+00	mg/kg	1.35E+02	mg/kg	NA	NA	5.15E-01	9.98E-02	1.16E-01	1.16E-01	0.00E+00	0.00E+00	1.13E-01	NA	NA	5.50E-01	1.74E-01	0.00E+00	0.00E+00	8.37E-01	10	2.30E+00	2.30E-01	3.64E+00	5.23E+01	5.23E+00	1.60E-01	0.18%	1.38%
Iron	0.00E+00	mg/L	0.00E+00	mg/kg	3.29E+04	mg/kg	NA	NA	3.60E-02	0.00E+00	1.71E-02	1.71E-02	0.00E+00	0.00E+00	2.74E+01	NA	NA	9.39E+00	0.00E+00	0.00E+00	0.00E+00	3.68E+01		NA	NA	NA	NA	NA	NA	NA	NA
Lead	0.00E+00	mg/L	0.00E+00	mg/kg	1.03E+03	mg/kg	NA	NA	2.11E-01	1.26E-02	2.26E-02	2.26E-02	0.00E+00	0.00E+00	8.56E-01	NA	NA	1.71E+00	1.67E-01	0.00E+00	0.00E+00	2.74E+00	10	1.4000E-02	1.40E-03	1.96E+03	8.75E+00	8.75E-01	3.13E+00	97.90%	26.95%
Manganese	0.00E+00	mg/L	0.00E+00	mg/kg	1.55E+03	mg/kg	NA	NA	4.31E-02	7.90E-02	2.05E-02	2.05E-02	0.00E+00	0.00E+00	1.29E+00	NA	NA	5.29E-01	1.58E+00	0.00E+00	0.00E+00	3.40E+00	10	7.76E+01	7.76E+00	4.39E-01	7.76E+02	7.76E+01	4.39E-02	0.02%	0.38%
Mercury	0.00E+00	mg/L	0.00E+00	mg/kg	7.25E-01	mg/kg	NA	NA	1.34E+00	4.27E-01	1.92E-01	1.92E-01	0.00E+00	0.00E+00	6.04E-04	NA	NA	7.70E-03	3.99E-03	0.00E+00	0.00E+00	1.23E-02	10	3.90E-02	3.90E-03	3.15E+00	1.80E-01	1.80E-02	6.83E-01	0.16%	5.88%
Molybdenum	0.00E+00	mg/L	0.00E+00	mg/kg	1.46E+00	mg/kg	NA	NA	9.53E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.21E-03	NA	NA	1.10E-02	0.00E+00	0.00E+00	0.00E+00	1.22E-02	10	3.50E+00	3.50E-01	3.48E-02	3.53E+01	3.53E+00	3.45E-03	0.00%	0.03%
Nickel	0.00E+00	mg/L	0.00E+00	mg/kg	1.46E+01	mg/kg	NA	NA	1.26E+00	5.51E-02	1.87E-01	1.87E-01	0.00E+00	0.00E+00	1.21E-02	NA	NA	1.45E-01	1.04E-02	0.00E+00	0.00E+00	1.67E-01	10	1.38E+00	1.38E-01	1.21E+00	5.63E+01	5.63E+00	2.97E-02	0.06%	0.26%
Silver	0.00E+00	mg/L	0.00E+00	mg/kg	1.05E+00	mg/kg	NA	NA	2.05E+00	1.40E-02	4.00E-03	4.00E-03	0.00E+00	0.00E+00	8.71E-04	NA	NA	1.69E-02	1.89E-04	0.00E+00	0.00E+00	1.80E-02	10	2.02E+00	2.02E-01	8.90E-02	2.02E+01	2.02E+00	8.90E-03	0.00%	0.08%
Thallium	0.00E+00	mg/L	0.00E+00	mg/kg	4.45E-01	mg/kg	NA	NA	0.00E+00	0.00E+00	1.23E-01	1.23E-01	0.00E+00	0.00E+00	3.71E-04	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.71E-04	5	3.50E-01	7.00E-02	5.30E-03	1.75E+00	3.50E-01	1.06E-03	0.00%	0.01%
Zinc	0.00E+00	mg/L	0.00E+00	mg/kg	2.38E+03	mg/kg	NA	NA	4.60E-01	1.51E-01	5.70E-02	5.70E-02	0.00E+00	0.00E+00	1.99E+00	NA	NA	8.68E+00	4.64E+00	0.00E+00	0.00E+00	1.53E+01	10	1.72E+01	1.72E+00	8.89E+00	1.72E+02	1.72E+01	8.89E-01	0.45%	7.66%
																							Hazard Index (Total EEQ):			2.0E+03			1.2E+01	100.00%	100.00%

Intake Equation:

$$Ej = \left(\frac{A}{HR}\left[\sum_{i=1}^{m}\left(\frac{IRi\,x\,Cij}{BW}\right)\right]\right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I) (mg/kg or mg/L)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using FHR =1.
Tier 2 = EEQ using calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box): $\boxed{n}$ See appropriate text tables for equations.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0.62	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0.38	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.00044	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.011	kg/d
Body weight =	0.088	kg
Home range =	1.2	acres
Water intake rate =	0.012	L/d
Site Area =	0.2	acres
Frac. home range (FHR) =	1.67E-01	unitless

TABLE G-7
TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR LONG-TAILED WEASELS AT MATHER WAA, YOSEMITE

Hazard Estimate - Tier 1
Long-tailed Weasel

Chemical	Surface Water Exposure Point Concentration	Units	Sediment Exposure Point Concentration	Units	Soil Exposure Point Concentration	Units	Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	EEQ N	LOAEL	Adjusted LOAEL	EEQ L	Percent Contribution to EEQ N	Percent Contribution to EEQ L
							---------------------------- unitless					--	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d		mg/kg-d	mg/kg-d		mg/kg-d	mg/kg-d			
2,3,7,8-TCDD-TEQ	0.00E+00	mg/L	0.00E+00	mg/kg	1.11E-05	mg/kg	NA	NA	4.38E+00	9.41E-02	2.20E+00	2.20E+00	0.00E+00	0.00E+00	1.99E-08	NA	NA	0.00E+00	0.00E+00	1.26E-06	3.15E-07	1.60E-06	10	1.00E-06	1.00E-07	1.60E+01	1.00E-05	1.00E-06	1.60E+00	15.89%	29.92%
Acetone	0.00E+00	mg/L	0.00E+00	mg/kg	1.04E-02	mg/kg	NA	NA	1.50E+00	7.56E+01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	1.86E-05	NA	NA	0.00E+00	0.00E+00	2.68E-04	6.70E-05	3.54E-04	10	1.00E+01	1.00E+00	3.54E-04	5.00E+01	5.00E+00	7.07E-05	0.00%	0.00%
Anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	4.16E-03	mg/kg	NA	NA	2.42E+00	1.25E+00	6.40E-01	6.40E-01	0.00E+00	0.00E+00	7.42E-06	NA	NA	0.00E+00	0.00E+00	1.37E-04	3.43E-05	1.79E-04	10	6.56E+01	6.56E+00	2.73E-05	1.10E+02	1.10E+01	1.63E-05	0.00%	0.00%
Benzo(a)anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	6.06E-03	mg/kg	NA	NA	1.60E+00	5.29E-01	3.50E-01	3.50E-01	0.00E+00	0.00E+00	1.08E-05	NA	NA	0.00E+00	0.00E+00	1.09E-04	2.73E-05	1.47E-04	10	6.15E-01	6.15E-02	2.40E-03	3.07E+00	3.07E-01	4.80E-04	0.00%	0.01%
Benzo(a)pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	1.59E-02	mg/kg	NA	NA	1.30E+00	1.41E-01	2.80E-01	2.80E-01	0.00E+00	0.00E+00	2.83E-05	NA	NA	0.00E+00	0.00E+00	2.29E-04	5.72E-05	3.14E-04	10	1.31E+00	1.31E-01	2.40E-03	3.28E+01	3.28E+00	9.59E-05	0.00%	0.00%
Benzo(b)fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	7.07E-03	mg/kg	NA	NA	2.60E+00	3.10E-01	2.80E-01	2.80E-01	0.00E+00	0.00E+00	1.26E-05	NA	NA	0.00E+00	0.00E+00	1.02E-04	2.55E-05	1.40E-04	10	6.15E-01	6.15E-02	2.28E-03	3.07E+00	3.07E-01	4.56E-04	0.00%	0.01%
Benzo(g,h,i)perylene	0.00E+00	mg/L	0.00E+00	mg/kg	7.80E-02	mg/kg	NA	NA	2.90E+00	2.47E-01	2.40E-01	2.40E-01	0.00E+00	0.00E+00	1.39E-04	NA	NA	0.00E+00	0.00E+00	9.64E-04	2.41E-04	1.34E-03	10	6.15E-01	6.15E-02	2.18E-02	3.07E+00	3.07E-01	4.38E-03	0.02%	0.08%
Benzo(k)fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	4.40E-03	mg/kg	NA	NA	2.60E+00	2.48E-01	2.90E-01	2.90E-01	0.00E+00	0.00E+00	7.83E-06	NA	NA	0.00E+00	0.00E+00	6.56E-05	1.64E-05	8.99E-05	10	6.15E-01	6.15E-02	1.46E-03	3.07E+00	3.07E-01	2.93E-04	0.00%	0.01%
Bis(2-ethylhexyl)phthalate	0.00E+00	mg/L	0.00E+00	mg/kg	4.78E-01	mg/kg	NA	NA	5.81E+02	2.38E-03	5.00E-01	5.00E-01	0.00E+00	0.00E+00	8.52E-04	NA	NA	0.00E+00	0.00E+00	1.23E-02	3.08E-03	1.62E-02	10	1.83E+01	1.83E+00	8.87E-03	1.83E+02	1.83E+01	8.87E-04	0.01%	0.02%
Chrysene	0.00E+00	mg/L	0.00E+00	mg/kg	2.02E-02	mg/kg	NA	NA	2.29E+00	3.25E-01	3.50E-01	3.50E-01	0.00E+00	0.00E+00	3.60E-05	NA	NA	0.00E+00	0.00E+00	3.64E-04	9.10E-05	4.91E-04	10	6.15E-01	6.15E-02	7.98E-03	3.07E+00	3.07E-01	1.60E-03	0.01%	0.03%
Dibenz(a,h)anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	1.22E-02	mg/kg	NA	NA	2.31E+00	1.30E-01	2.00E-01	2.00E-01	0.00E+00	0.00E+00	2.18E-05	NA	NA	0.00E+00	0.00E+00	1.26E-04	3.15E-05	1.79E-04	10	6.15E-01	6.15E-02	2.92E-03	3.07E+00	3.07E-01	5.84E-04	0.00%	0.01%
Diesel Fuel	0.00E+00	mg/L	0.00E+00	mg/kg	1.61E+03	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.86E+00	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.86E+00		NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	1.25E-02	mg/kg	NA	NA	3.00E+00	5.00E-01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	2.23E-05	NA	NA	0.00E+00	0.00E+00	3.21E-04	8.04E-05	4.24E-04	10	6.56E+01	6.56E+00	6.46E-05	1.10E+02	1.10E+01	3.85E-05	0.00%	0.00%
Gasoline	0.00E+00	mg/L	0.00E+00	mg/kg	1.20E+00	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-03	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-03		NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	5.38E-03	mg/kg	NA	NA	2.86E+00	1.10E-01	2.30E-01	2.30E-01	0.00E+00	0.00E+00	9.59E-06	NA	NA	0.00E+00	0.00E+00	6.37E-05	1.59E-05	8.92E-05	10	6.15E-01	6.15E-02	1.45E-03	3.07E+00	3.07E-01	2.91E-04	0.00%	0.01%
Methylene chloride	0.00E+00	mg/L	0.00E+00	mg/kg	7.11E-03	mg/kg	NA	NA	3.00E+00	1.73E+01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	1.27E-05	NA	NA	0.00E+00	0.00E+00	1.83E-04	4.58E-05	2.41E-04	10	5.85E+00	5.85E-01	4.13E-04	5.00E+01	5.00E+00	4.83E-05	0.00%	0.00%
Motor Oil	0.00E+00	mg/L	0.00E+00	mg/kg	4.04E+04	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.20E+01	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.20E+01		NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	0.00E+00	mg/L	0.00E+00	mg/kg	5.92E-01	mg/kg	NA	NA	1.46E+01	5.93E+00	2.37E-01	2.37E-01	0.00E+00	0.00E+00	1.06E-03	NA	NA	0.00E+00	0.00E+00	7.23E-03	1.81E-03	1.01E-02	10	8.42E+00	8.42E-01	1.20E-02	9.45E+00	9.45E-01	1.07E-02	0.01%	0.20%
Phenanthrene	0.00E+00	mg/L	0.00E+00	mg/kg	9.94E-03	mg/kg	NA	NA	1.70E+00	4.88E+00	6.00E-01	6.00E-01	0.00E+00	0.00E+00	1.77E-05	NA	NA	0.00E+00	0.00E+00	3.07E-04	7.67E-05	4.01E-04	10	6.56E+01	6.56E+00	6.12E-05	1.10E+02	1.10E+01	3.65E-05	0.00%	0.00%
Pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	2.32E-02	mg/kg	NA	NA	1.80E+00	7.20E-01	5.20E-01	5.20E-01	0.00E+00	0.00E+00	4.13E-05	NA	NA	0.00E+00	0.00E+00	6.21E-04	1.55E-04	8.18E-04	10	6.15E-01	6.15E-02	1.33E-02	3.07E+00	3.07E-01	2.66E-03	0.01%	0.05%
Antimony	0.00E+00	mg/L	0.00E+00	mg/kg	2.81E+00	mg/kg	NA	NA	1.00E+00	3.70E-02	1.40E-01	1.40E-01	0.00E+00	0.00E+00	5.00E-03	NA	NA	0.00E+00	0.00E+00	2.03E-02	5.07E-03	3.03E-02	10	1.25E-01	1.25E-02	2.43E+00	1.25E+00	1.25E-01	2.43E-01	2.41%	4.55%
Arsenic	0.00E+00	mg/L	0.00E+00	mg/kg	4.73E+00	mg/kg	NA	NA	1.53E-01	3.75E-02	5.92E-03	5.92E-03	0.00E+00	0.00E+00	8.43E-03	NA	NA	0.00E+00	0.00E+00	1.44E-03	3.61E-04	1.02E-02	10	3.20E-01	3.20E-02	3.20E-01	4.70E+00	4.70E-01	2.18E-02	0.32%	0.41%
Barium	0.00E+00	mg/L	0.00E+00	mg/kg	6.91E+02	mg/kg	NA	NA	9.10E-02	1.56E-01	4.71E-01	4.71E-01	0.00E+00	0.00E+00	1.23E+00	NA	NA	0.00E+00	0.00E+00	1.68E+01	4.19E+00	2.22E+01	10	5.18E+01	5.18E+00	4.28E+00	1.21E+02	1.21E+01	1.83E+00	4.26%	34.34%
Cadmium	0.00E+00	mg/L	0.00E+00	mg/kg	2.96E+00	mg/kg	NA	NA	6.63E+00	3.80E-01	1.60E-01	1.60E-01	0.00E+00	0.00E+00	5.28E-03	NA	NA	0.00E+00	0.00E+00	2.45E-02	6.12E-03	3.59E-02	10	6.00E-02	6.00E-03	5.98E+00	2.64E+00	2.64E-01	1.36E-01	5.95%	2.54%
Chromium	0.00E+00	mg/L	0.00E+00	mg/kg	1.80E+01	mg/kg	NA	NA	3.06E-01	4.10E-02	1.08E-01	1.08E-01	0.00E+00	0.00E+00	3.20E-02	NA	NA	0.00E+00	0.00E+00	9.96E-02	2.49E-02	1.57E-01	10	2.40E+00	2.40E-01	6.52E-01	2.82E+00	2.82E-01	5.55E-01	0.65%	10.40%
Cobalt	0.00E+00	mg/L	0.00E+00	mg/kg	6.80E+00	mg/kg	NA	NA	1.22E-01	7.50E-03	2.07E-02	2.07E-02	0.00E+00	0.00E+00	1.21E-02	NA	NA	0.00E+00	0.00E+00	7.24E-03	1.81E-03	2.12E-02	10	1.20E+00	1.20E-01	1.76E-01	2.00E+01	2.00E+00	1.06E-02	0.18%	0.20%
Copper	0.00E+00	mg/L	0.00E+00	mg/kg	1.35E+02	mg/kg	NA	NA	5.15E-01	9.98E-02	1.16E-01	1.16E-01	0.00E+00	0.00E+00	2.41E-01	NA	NA	0.00E+00	0.00E+00	8.04E-01	2.01E-01	1.25E+00	10	2.67E+00	2.67E-01	4.67E+00	6.32E+02	6.32E+01	1.97E-02	4.64%	0.37%
Iron	0.00E+00	mg/L	0.00E+00	mg/kg	3.29E+04	mg/kg	NA	NA	3.60E-02	0.00E+00	1.71E-02	1.71E-02	0.00E+00	0.00E+00	5.87E+01	NA	NA	0.00E+00	0.00E+00	2.90E+01	7.25E+00	9.49E+01		NA	NA	NA	NA	NA	NA	NA	NA
Lead	0.00E+00	mg/L	0.00E+00	mg/kg	1.03E+03	mg/kg	NA	NA	2.11E-01	1.26E-02	2.26E-02	2.26E-02	0.00E+00	0.00E+00	1.83E+00	NA	NA	0.00E+00	0.00E+00	1.19E+00	2.98E-01	3.32E+00	10	1.00E+00	1.00E-01	3.32E+01	2.41E+02	2.41E+01	1.38E-01	33.04%	2.58%
Manganese	0.00E+00	mg/L	0.00E+00	mg/kg	1.55E+03	mg/kg	NA	NA	4.31E-02	7.90E-02	2.05E-02	2.05E-02	0.00E+00	0.00E+00	2.76E+00	NA	NA	0.00E+00	0.00E+00	1.64E+00	4.09E-01	4.81E+00	10	1.37E+01	1.37E+00	3.51E+00	1.59E+02	1.59E+01	3.03E-01	3.49%	5.67%
Mercury	0.00E+00	mg/L	0.00E+00	mg/kg	7.25E-01	mg/kg	NA	NA	1.34E+00	4.27E-01	1.92E-01	1.92E-01	0.00E+00	0.00E+00	1.29E-03	NA	NA	0.00E+00	0.00E+00	7.17E-03	1.79E-03	1.03E-02	1	2.70E-02	2.70E-02	3.80E-01	2.70E-01	2.70E-01	3.80E-02	0.38%	0.71%
Molybdenum	0.00E+00	mg/L	0.00E+00	mg/kg	1.46E+00	mg/kg	NA	NA	9.53E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.59E-03	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.59E-03	10	2.60E-01	2.60E-02	9.97E-02	2.60E+00	2.60E-01	9.97E-03	0.10%	0.19%
Nickel	0.00E+00	mg/L	0.00E+00	mg/kg	1.46E+01	mg/kg	NA	NA	1.26E+00	5.51E-02	1.87E-01	1.87E-01	0.00E+00	0.00E+00	2.59E-02	NA	NA	0.00E+00	0.00E+00	1.40E-01	3.50E-02	2.01E-01	10	1.33E-01	1.33E-02	1.51E+01	3.16E+01	3.16E+00	6.36E-02	15.05%	1.19%
Silver	0.00E+00	mg/L	0.00E+00	mg/kg	1.05E+00	mg/kg	NA	NA	2.05E+00	1.40E-02	4.00E-03	4.00E-03	0.00E+00	0.00E+00	1.86E-03	NA	NA	0.00E+00	0.00E+00	2.15E-04	5.38E-05	2.13E-03	10	6.02E+00	6.02E-01	3.54E-03	6.02E+01	6.02E+00	3.54E-04	0.00%	0.01%
Thallium	0.00E+00	mg/L	0.00E+00	mg/kg	4.45E-01	mg/kg	NA	NA	0.00E+00	0.00E+00	1.23E-01	1.23E-01	0.00E+00	0.00E+00	7.93E-04	NA	NA	0.00E+00	0.00E+00	2.81E-03	7.03E-04	4.31E-03	10	4.80E-01	4.80E-02	8.97E-02	1.43E+00	1.43E-01	3.01E-02	0.09%	0.56%
Zinc	0.00E+00	mg/L	0.00E+00	mg/kg	2.38E+03	mg/kg	NA	NA	4.60E-01	1.51E-01	5.70E-02	5.70E-02	0.00E+00	0.00E+00	4.25E+00	NA	NA	0.00E+00	0.00E+00	7.00E+00	1.75E+00	1.30E+01	10	9.60E+00	9.60E-01	1.35E+01	4.11E+02	4.11E+01	3.16E-01	13.47%	5.92%
																								Hazard Index (Total EEQ):		1.0E+02			5.3E+00	100.00%	100.00%

Intake Equation:

$$Ej = \left(\frac{A}{HR} \left[\sum_{i=1}^{m} \left(\frac{IRi\,x\,Cij}{BW} \right) \right] \right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I) (mg/kg or mg/L)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using FHR =1.
Tier 2 = EEQ using calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box): n See appropriate text tables for equations.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0	unitless
Mammal diet fraction =	0.8	unitless
Bird diet fraction =	0.2	unitless
Soil ingestion rate =	0.00036	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.013	kg/d
Body weight =	0.202	kg
Home range =	37.5	acres
Water intake rate =	0.023	L/d
Site Area =	0.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

TABLE G-8
TIER 2 CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN EEQs AND HAZARD INDICES FOR LONG-TAILED WEASELS AT MATHER WAA, YOSEMITE

Hazard Estimate - Tier 2
Long-tailed Weasel

Chemical	Surface Water Exposure Point Concentration	Units	Sediment Exposure Point Concentration	Units	Soil Exposure Point Concentration	Units	Fish BAF (unitless)	Aq. Invert. BAF (unitless)	Terr. Invert. BAF (unitless)	Plant BAF (unitless)	Mammal BAF (unitless)	Bird BAF (unitless)	PDE Surface Water mg/kg-d	PDE Sediment mg/kg-d	PDE Soil mg/kg-d	PDE Fish mg/kg-d	PDE Aq. Invert. mg/kg-d	PDE Terr. Invert. mg/kg-d	PDE Plants mg/kg-d	PDE Mammals mg/kg-d	PDE Birds mg/kg-d	Total PDE mg/kg-d	Chemical-Specific Toxicity Value UF	NOAEL mg/kg-d	Adjusted NOAEL mg/kg-d	EEQ N	LOAEL mg/kg-d	Adjusted LOAEL mg/kg-d	EEQ L	Percent Contribution to EEQ N	Percent Contribution to EEQ L
2,3,7,8-TCDD-TEQ	0.00E+00	mg/L	0.00E+00	mg/kg	1.11E-05	mg/kg	NA	NA	4.38E+00	9.41E-02	2.20E+00	2.20E+00	0.00E+00	0.00E+00	1.06E-10	NA	NA	0.00E+00	0.00E+00	6.73E-09	1.68E-09	8.52E-09	10	1.00E-06	1.00E-07	8.52E-02	1.00E-05	1.00E-06	8.52E-03	15.89%	29.93%
Acetone	0.00E+00	mg/L	0.00E+00	mg/kg	1.04E-02	mg/kg	NA	NA	1.50E+00	7.56E+01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	9.90E-08	NA	NA	0.00E+00	0.00E+00	1.43E-06	3.57E-07	1.89E-06	10	1.00E+01	1.00E+00	1.89E-06	5.00E+01	5.00E+00	3.77E-07	0.00%	0.00%
Anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	4.16E-03	mg/kg	NA	NA	2.42E+00	1.25E+00	6.40E-01	6.40E-01	0.00E+00	0.00E+00	3.96E-08	NA	NA	0.00E+00	0.00E+00	7.32E-07	1.83E-07	9.54E-07	10	6.56E+01	6.56E+00	1.46E-07	1.10E+02	1.10E+01	8.68E-08	0.00%	0.00%
Benzo(a)anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	6.06E-03	mg/kg	NA	NA	1.60E+00	5.29E-01	3.50E-01	3.50E-01	0.00E+00	0.00E+00	5.76E-08	NA	NA	0.00E+00	0.00E+00	5.83E-07	1.46E-07	7.86E-07	10	6.15E-01	6.15E-02	1.28E-05	3.07E+00	3.07E-01	2.56E-06	0.00%	0.01%
Benzo(a)pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	1.59E-02	mg/kg	NA	NA	1.30E+00	1.41E-01	2.80E-01	2.80E-01	0.00E+00	0.00E+00	1.51E-07	NA	NA	0.00E+00	0.00E+00	1.22E-06	3.05E-07	1.68E-06	10	1.31E+00	1.31E-01	1.28E-05	3.28E+01	3.28E+00	5.11E-07	0.00%	0.00%
Benzo(b)fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	7.07E-03	mg/kg	NA	NA	2.60E+00	3.10E-01	2.80E-01	2.80E-01	0.00E+00	0.00E+00	6.72E-08	NA	NA	0.00E+00	0.00E+00	5.43E-07	1.36E-07	7.46E-07	10	6.15E-01	6.15E-02	1.21E-05	3.07E+00	3.07E-01	2.43E-06	0.00%	0.01%
Benzo(g,h,i)perylene	0.00E+00	mg/L	0.00E+00	mg/kg	7.80E-02	mg/kg	NA	NA	2.90E+00	2.47E-01	2.40E-01	2.40E-01	0.00E+00	0.00E+00	7.41E-07	NA	NA	0.00E+00	0.00E+00	5.14E-06	1.29E-06	7.17E-06	10	6.15E-01	6.15E-02	1.17E-04	3.07E+00	3.07E-01	2.33E-05	0.02%	0.08%
Benzo(k)fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	4.40E-03	mg/kg	NA	NA	2.60E+00	2.48E-01	2.90E-01	2.90E-01	0.00E+00	0.00E+00	4.18E-08	NA	NA	0.00E+00	0.00E+00	3.50E-07	8.75E-08	4.79E-07	10	6.15E-01	6.15E-02	7.79E-06	3.07E+00	3.07E-01	1.56E-06	0.00%	0.01%
Bis(2-ethylhexyl)phthalate	0.00E+00	mg/L	0.00E+00	mg/kg	4.78E-01	mg/kg	NA	NA	5.81E+02	2.38E-03	5.00E-01	5.00E-01	0.00E+00	0.00E+00	4.54E-06	NA	NA	0.00E+00	0.00E+00	6.56E-05	1.64E-05	8.66E-05	10	1.83E+01	1.83E+00	4.73E-05	1.83E+02	1.83E+01	4.73E-06	0.01%	0.02%
Chrysene	0.00E+00	mg/L	0.00E+00	mg/kg	2.02E-02	mg/kg	NA	NA	2.29E+00	3.25E-01	3.50E-01	3.50E-01	0.00E+00	0.00E+00	1.92E-07	NA	NA	0.00E+00	0.00E+00	1.94E-06	4.85E-07	2.62E-06	10	6.15E-01	6.15E-02	4.26E-05	3.07E+00	3.07E-01	8.53E-06	0.01%	0.03%
Dibenz(a,h)anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	1.22E-02	mg/kg	NA	NA	2.31E+00	1.30E-01	2.00E-01	2.00E-01	0.00E+00	0.00E+00	1.16E-07	NA	NA	0.00E+00	0.00E+00	6.72E-07	1.68E-07	9.57E-07	10	6.15E-01	6.15E-02	1.56E-05	3.07E+00	3.07E-01	3.12E-06	0.00%	0.01%
Diesel Fuel	0.00E+00	mg/L	0.00E+00	mg/kg	1.61E+03	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.53E-02	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.53E-02		NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	1.25E-02	mg/kg	NA	NA	3.00E+00	5.00E-01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	1.19E-07	NA	NA	0.00E+00	0.00E+00	1.71E-06	4.29E-07	2.26E-06	10	6.56E+01	6.56E+00	3.45E-07	1.10E+02	1.10E+01	2.06E-07	0.00%	0.00%
Gasoline	0.00E+00	mg/L	0.00E+00	mg/kg	1.20E+00	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.14E-05	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.14E-05		NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	5.38E-03	mg/kg	NA	NA	2.86E+00	1.10E-01	2.30E-01	2.30E-01	0.00E+00	0.00E+00	5.11E-08	NA	NA	0.00E+00	0.00E+00	3.40E-07	8.49E-08	4.76E-07	10	6.15E-01	6.15E-02	7.74E-06	3.07E+00	3.07E-01	1.55E-06	0.00%	0.01%
Methylene chloride	0.00E+00	mg/L	0.00E+00	mg/kg	7.11E-03	mg/kg	NA	NA	3.00E+00	1.73E+01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	6.76E-08	NA	NA	0.00E+00	0.00E+00	9.76E-07	2.44E-07	1.29E-06	10	5.85E+00	5.85E-01	2.20E-06	5.00E+01	5.00E+00	2.58E-07	0.00%	0.00%
Motor Oil	0.00E+00	mg/L	0.00E+00	mg/kg	4.04E+04	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.84E-01	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.84E-01		NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	0.00E+00	mg/L	0.00E+00	mg/kg	5.92E-01	mg/kg	NA	NA	1.46E+01	5.93E+00	2.37E-01	2.37E-01	0.00E+00	0.00E+00	5.63E-06	NA	NA	0.00E+00	0.00E+00	3.86E-05	9.64E-06	5.38E-05	10	8.42E+00	8.42E-01	6.39E-05	9.45E+00	9.45E-01	5.70E-05	0.01%	0.20%
Phenanthrene	0.00E+00	mg/L	0.00E+00	mg/kg	9.94E-03	mg/kg	NA	NA	1.70E+00	4.88E+00	6.00E-01	6.00E-01	0.00E+00	0.00E+00	9.45E-08	NA	NA	0.00E+00	0.00E+00	1.64E-06	4.09E-07	2.14E-06	10	6.56E+01	6.56E+00	3.26E-07	1.10E+02	1.10E+01	1.95E-07	0.00%	0.00%
Pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	2.32E-02	mg/kg	NA	NA	1.80E+00	7.20E-01	5.20E-01	5.20E-01	0.00E+00	0.00E+00	2.21E-07	NA	NA	0.00E+00	0.00E+00	3.31E-06	8.28E-07	4.36E-06	10	6.15E-01	6.15E-02	7.09E-05	3.07E+00	3.07E-01	1.42E-05	0.01%	0.05%
Antimony	0.00E+00	mg/L	0.00E+00	mg/kg	2.81E+00	mg/kg	NA	NA	1.00E+00	3.70E-02	1.40E-01	1.40E-01	0.00E+00	0.00E+00	2.67E-05	NA	NA	0.00E+00	0.00E+00	1.08E-04	2.70E-05	1.62E-04	10	1.25E-01	1.25E-02	1.29E-02	1.25E+00	1.25E-01	1.29E-03	2.42%	4.55%
Arsenic	0.00E+00	mg/L	0.00E+00	mg/kg	4.73E+00	mg/kg	NA	NA	1.53E-01	3.75E-02	5.00E-03	5.00E-03	0.00E+00	0.00E+00	4.49E-05	NA	NA	0.00E+00	0.00E+00	6.50E-06	1.62E-06	5.31E-05	10	3.20E-01	3.20E-02	1.66E-03	4.70E+00	4.70E-01	1.13E-04	0.31%	0.40%
Barium	0.00E+00	mg/L	0.00E+00	mg/kg	6.91E+02	mg/kg	NA	NA	9.10E-02	1.56E-01	4.71E-01	4.71E-01	0.00E+00	0.00E+00	6.56E-03	NA	NA	0.00E+00	0.00E+00	8.94E-02	2.23E-02	1.18E-01	10	5.18E+01	5.18E+00	2.28E-02	1.21E+02	1.21E+01	9.78E-03	4.26%	34.35%
Cadmium	0.00E+00	mg/L	0.00E+00	mg/kg	2.96E+00	mg/kg	NA	NA	6.63E+00	3.80E-01	1.60E-01	1.60E-01	0.00E+00	0.00E+00	2.82E-05	NA	NA	0.00E+00	0.00E+00	1.30E-04	3.26E-05	1.91E-04	10	6.00E-02	6.00E-03	3.19E-02	2.64E+00	2.64E-01	7.24E-04	5.95%	2.54%
Chromium	0.00E+00	mg/L	0.00E+00	mg/kg	1.80E+01	mg/kg	NA	NA	3.06E-01	4.10E-02	1.08E-01	1.08E-01	0.00E+00	0.00E+00	1.71E-04	NA	NA	0.00E+00	0.00E+00	5.31E-04	1.33E-04	8.35E-04	10	2.40E+00	2.40E-01	3.48E-03	2.82E+00	2.82E-01	2.96E-03	0.65%	10.41%
Cobalt	0.00E+00	mg/L	0.00E+00	mg/kg	6.80E+00	mg/kg	NA	NA	1.22E-01	7.50E-03	2.07E-02	2.07E-02	0.00E+00	0.00E+00	6.46E-05	NA	NA	0.00E+00	0.00E+00	3.86E-05	9.65E-06	1.13E-04	10	1.20E+00	1.20E-01	9.41E-04	2.00E+01	2.00E+00	5.64E-05	0.18%	0.20%
Copper	0.00E+00	mg/L	0.00E+00	mg/kg	1.35E+02	mg/kg	NA	NA	5.15E-01	9.98E-02	1.16E-01	1.16E-01	0.00E+00	0.00E+00	1.28E-03	NA	NA	0.00E+00	0.00E+00	4.29E-03	1.07E-03	6.64E-03	10	2.67E+00	2.67E-01	2.49E-02	6.32E+02	6.32E+01	1.05E-04	4.64%	0.37%
Iron	0.00E+00	mg/L	0.00E+00	mg/kg	3.29E+04	mg/kg	NA	NA	3.60E-02	0.00E+00	1.71E-02	1.71E-02	0.00E+00	0.00E+00	3.13E-01	NA	NA	0.00E+00	0.00E+00	1.55E-01	3.87E-02	5.06E-01		NA	NA	NA	NA	NA	NA	NA	NA
Lead	0.00E+00	mg/L	0.00E+00	mg/kg	1.03E+03	mg/kg	NA	NA	2.11E-01	1.26E-02	2.26E-02	2.26E-02	0.00E+00	0.00E+00	9.76E-03	NA	NA	0.00E+00	0.00E+00	6.36E-03	1.59E-03	1.77E-02	10	1.00E+00	1.00E-01	1.77E-01	2.41E+02	2.41E+01	7.35E-04	33.05%	2.58%
Manganese	0.00E+00	mg/L	0.00E+00	mg/kg	1.55E+03	mg/kg	NA	NA	4.31E-02	7.90E-02	2.05E-02	2.05E-02	0.00E+00	0.00E+00	1.47E-02	NA	NA	0.00E+00	0.00E+00	8.73E-03	2.18E-03	2.57E-02	10	1.37E+01	1.37E+00	1.87E-02	1.59E+02	1.59E+01	1.61E-03	3.49%	5.67%
Mercury	0.00E+00	mg/L	0.00E+00	mg/kg	7.25E-01	mg/kg	NA	NA	1.34E+00	4.27E-01	1.92E-01	1.92E-01	0.00E+00	0.00E+00	6.89E-06	NA	NA	0.00E+00	0.00E+00	3.82E-05	9.56E-06	5.47E-05	1	2.70E-02	2.70E-02	2.02E-03	2.70E-01	2.70E-01	2.02E-04	0.38%	0.71%
Molybdenum	0.00E+00	mg/L	0.00E+00	mg/kg	1.46E+00	mg/kg	NA	NA	9.53E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.38E-05	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.38E-05	10	2.60E-01	2.60E-02	5.32E-04	2.60E+00	2.60E-01	5.32E-05	0.10%	0.19%
Nickel	0.00E+00	mg/L	0.00E+00	mg/kg	1.46E+01	mg/kg	NA	NA	1.26E+00	5.51E-02	1.87E-01	1.87E-01	0.00E+00	0.00E+00	1.38E-04	NA	NA	0.00E+00	0.00E+00	7.47E-04	1.87E-04	1.07E-03	10	1.33E-01	1.33E-02	8.07E-02	3.16E+01	3.16E+00	3.39E-04	15.05%	1.19%
Silver	0.00E+00	mg/L	0.00E+00	mg/kg	1.05E+00	mg/kg	NA	NA	2.05E+00	1.40E-02	4.00E-03	4.00E-03	0.00E+00	0.00E+00	9.93E-06	NA	NA	0.00E+00	0.00E+00	1.15E-06	2.87E-07	1.14E-05	10	6.02E+00	6.02E-01	1.89E-05	6.02E+01	6.02E+00	1.89E-06	0.00%	0.01%
Thallium	0.00E+00	mg/L	0.00E+00	mg/kg	4.45E-01	mg/kg	NA	NA	0.00E+00	0.00E+00	1.23E-01	1.23E-01	0.00E+00	0.00E+00	4.23E-06	NA	NA	0.00E+00	0.00E+00	1.50E-05	3.75E-06	2.30E-05	10	4.80E-01	4.80E-02	4.79E-04	1.43E+00	1.43E-01	1.61E-04	0.09%	0.56%
Zinc	0.00E+00	mg/L	0.00E+00	mg/kg	2.38E+03	mg/kg	NA	NA	4.60E-01	1.51E-01	5.70E-02	5.70E-02	0.00E+00	0.00E+00	2.27E-02	NA	NA	0.00E+00	0.00E+00	3.73E-02	9.33E-03	6.93E-02	10	9.60E+00	9.60E-01	7.22E-02	4.11E+02	4.11E+01	1.69E-03	13.47%	5.93%
																							Hazard Index (Total EEQ):			5.4E-01			2.8E-02	100.00%	100.00%

Intake Equation:

$$Ej = \left(\frac{A}{HR} \left[\sum_{i=1}^{m} \left(\frac{IRi\,x\,Cij}{BW} \right) \right] \right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I) (mg/kg or mg/L)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using FHR =1.
Tier 2 = EEQ using calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box): $\boxed{n}$ See appropriate text tables for equations.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0	unitless
Mammal diet fraction =	0.8	unitless
Bird diet fraction =	0.2	unitless
Soil ingestion rate =	0.00036	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.013	kg/d
Body weight =	0.202	kg
Home range =	37.5	acres
Water intake rate =	0.023	L/d
Site Area =	0.2	acres
Frac. home range (FHR) =	5.33E-03	unitless

TABLE G-9
TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR YELLOW-BELLIED MARMOT AT MATHER WAA, YOSEMITE

Hazard Estimate - Tier 1
Yellow-bellied Marmot

Chemical	Surface Water Exposure Point Concentration	Units	Sediment Exposure Point Concentration	Units	Soil Exposure Point Concentration	Units	Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF
							unitless	unitless	unitless	unitless	unitless	unitless
2,3,7,8-TCDD-TEQ	0.00E+00	mg/L	0.00E+00	mg/kg	1.11E-05	mg/kg	NA	NA	4.38E+00	9.41E-02	2.20E+00	2.20E+00
Acetone	0.00E+00	mg/L	0.00E+00	mg/kg	1.04E-02	mg/kg	NA	NA	1.50E+00	7.56E+01	5.00E-01	5.00E-01
Anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	4.16E-03	mg/kg	NA	NA	2.42E+00	1.25E+00	6.40E-01	6.40E-01
Benzo(a)anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	6.06E-03	mg/kg	NA	NA	1.60E+00	5.29E-01	3.50E-01	3.50E-01
Benzo(a)pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	1.59E-02	mg/kg	NA	NA	1.30E+00	1.41E-01	2.80E-01	2.80E-01
Benzo(b)fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	7.07E-03	mg/kg	NA	NA	2.60E+00	3.10E-01	2.80E-01	2.80E-01
Benzo(g,h,i)perylene	0.00E+00	mg/L	0.00E+00	mg/kg	7.80E-02	mg/kg	NA	NA	2.90E+00	2.47E-01	2.40E-01	2.40E-01
Benzo(k)fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	4.40E-03	mg/kg	NA	NA	2.60E+00	2.48E-01	2.90E-01	2.90E-01
Bis(2-ethylhexyl)phthalate	0.00E+00	mg/L	0.00E+00	mg/kg	4.78E-01	mg/kg	NA	NA	5.81E+02	2.38E-03	5.00E-01	5.00E-01
Chrysene	0.00E+00	mg/L	0.00E+00	mg/kg	2.02E-02	mg/kg	NA	NA	2.29E+00	3.25E-01	3.50E-01	3.50E-01
Dibenz(a,h)anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	1.22E-02	mg/kg	NA	NA	2.31E+00	1.30E-01	2.00E-01	2.00E-01
Diesel Fuel	0.00E+00	mg/L	0.00E+00	mg/kg	1.61E+03	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	1.25E-02	mg/kg	NA	NA	3.00E+00	5.00E-01	5.00E-01	5.00E-01
Gasoline	0.00E+00	mg/L	0.00E+00	mg/kg	1.20E+00	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	5.38E-03	mg/kg	NA	NA	2.86E+00	1.10E-01	2.30E-01	2.30E-01
Methylene chloride	0.00E+00	mg/L	0.00E+00	mg/kg	7.11E-03	mg/kg	NA	NA	3.00E+00	1.73E+01	5.00E-01	5.00E-01
Motor Oil	0.00E+00	mg/L	0.00E+00	mg/kg	4.04E+04	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pentachlorophenol	0.00E+00	mg/L	0.00E+00	mg/kg	5.92E-01	mg/kg	NA	NA	1.46E+01	5.93E+00	2.37E-01	2.37E-01
Phenanthrene	0.00E+00	mg/L	0.00E+00	mg/kg	9.94E-03	mg/kg	NA	NA	1.70E+00	4.88E+00	6.00E-01	6.00E-01
Pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	2.32E-02	mg/kg	NA	NA	1.80E+00	7.20E-01	5.20E-01	5.20E-01
Antimony	0.00E+00	mg/L	0.00E+00	mg/kg	2.81E+00	mg/kg	NA	NA	1.00E+00	3.70E-02	1.40E-01	1.40E-01
Arsenic	0.00E+00	mg/L	0.00E+00	mg/kg	4.73E+00	mg/kg	NA	NA	1.53E-01	3.75E-02	5.92E-03	5.92E-03
Barium	0.00E+00	mg/L	0.00E+00	mg/kg	6.91E+02	mg/kg	NA	NA	9.10E-02	1.56E-01	4.71E-01	4.71E-01
Cadmium	0.00E+00	mg/L	0.00E+00	mg/kg	2.96E+00	mg/kg	NA	NA	6.63E+00	3.80E-01	1.60E-01	1.60E-01
Chromium	0.00E+00	mg/L	0.00E+00	mg/kg	1.80E+01	mg/kg	NA	NA	3.06E-01	4.10E-02	1.08E-01	1.08E-01
Cobalt	0.00E+00	mg/L	0.00E+00	mg/kg	6.80E+00	mg/kg	NA	NA	1.22E-01	7.50E-03	2.07E-02	2.07E-02
Copper	0.00E+00	mg/L	0.00E+00	mg/kg	1.35E+02	mg/kg	NA	NA	5.15E-01	9.98E-02	1.16E-01	1.16E-01
Iron	0.00E+00	mg/L	0.00E+00	mg/kg	3.29E+04	mg/kg	NA	NA	3.60E-02	0.00E+00	1.71E-02	1.71E-02
Lead	0.00E+00	mg/L	0.00E+00	mg/kg	1.03E+03	mg/kg	NA	NA	2.11E-01	1.26E-02	2.26E-02	2.26E-02
Manganese	0.00E+00	mg/L	0.00E+00	mg/kg	1.55E+03	mg/kg	NA	NA	4.31E-02	7.90E-02	2.05E-02	2.05E-02
Mercury	0.00E+00	mg/L	0.00E+00	mg/kg	7.25E-01	mg/kg	NA	NA	1.34E+00	4.27E-01	1.92E-01	1.92E-01
Molybdenum	0.00E+00	mg/L	0.00E+00	mg/kg	1.46E+00	mg/kg	NA	NA	9.53E-01	0.00E+00	0.00E+00	0.00E+00
Nickel	0.00E+00	mg/L	0.00E+00	mg/kg	1.46E+01	mg/kg	NA	NA	1.26E+00	5.51E-02	1.87E-01	1.87E-01
Silver	0.00E+00	mg/L	0.00E+00	mg/kg	1.05E+00	mg/kg	NA	NA	2.05E+00	1.40E-02	4.00E-03	4.00E-03
Thallium	0.00E+00	mg/L	0.00E+00	mg/kg	4.45E-01	mg/kg	NA	NA	0.00E+00	0.00E+00	1.23E-01	1.23E-01
Zinc	0.00E+00	mg/L	0.00E+00	mg/kg	2.38E+03	mg/kg	NA	NA	4.60E-01	1.51E-01	5.70E-02	5.70E-02

Chemical	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	EEQ N	LOAEL	Adjusted LOAEL	EEQ L	Percent Contribution to EEQ N	Percent Contribution to EEQ L
	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d		mg/kg-d	mg/kg-d		mg/kg-d	mg/kg-d			
2,3,7,8-TCDD-TEQ	0.00E+00	0.00E+00	2.03E-08	NA	NA	0.00E+00	7.98E-08	0.00E+00	0.00E+00	1.00E-07	5	1.00E-06	2.00E-07	5.00E-01	1.00E-05	2.00E-06	5.00E-02	0.96%	2.45%
Acetone	0.00E+00	0.00E+00	1.89E-05	NA	NA	0.00E+00	6.00E-02	0.00E+00	0.00E+00	6.00E-02	5	1.00E+01	2.00E+00	3.00E-02	5.00E+01	1.00E+01	6.00E-03	0.06%	0.29%
Anthracene	0.00E+00	0.00E+00	7.57E-06	NA	NA	0.00E+00	3.98E-04	0.00E+00	0.00E+00	4.05E-04	5	6.56E+01	1.31E+01	3.09E-05	1.10E+02	2.20E+01	1.84E-05	0.00%	0.00%
Benzo(a)anthracene	0.00E+00	0.00E+00	1.10E-05	NA	NA	0.00E+00	2.44E-04	0.00E+00	0.00E+00	2.55E-04	5	6.15E-01	1.23E-01	2.08E-03	3.07E+00	6.14E-01	4.16E-04	0.00%	0.02%
Benzo(a)pyrene	0.00E+00	0.00E+00	2.89E-05	NA	NA	0.00E+00	1.71E-04	0.00E+00	0.00E+00	2.00E-04	5	1.31E+00	2.62E-01	7.62E-04	3.28E+01	6.56E+00	3.04E-05	0.00%	0.00%
Benzo(b)fluoranthene	0.00E+00	0.00E+00	1.28E-05	NA	NA	0.00E+00	1.67E-04	0.00E+00	0.00E+00	1.80E-04	5	6.15E-01	1.23E-01	1.46E-03	3.07E+00	6.14E-01	2.93E-04	0.00%	0.01%
Benzo(g,h,i)perylene	0.00E+00	0.00E+00	1.42E-04	NA	NA	0.00E+00	1.47E-03	0.00E+00	0.00E+00	1.61E-03	5	6.15E-01	1.23E-01	1.31E-02	3.07E+00	6.14E-01	2.62E-03	0.03%	0.13%
Benzo(k)fluoranthene	0.00E+00	0.00E+00	7.99E-06	NA	NA	0.00E+00	8.29E-05	0.00E+00	0.00E+00	9.09E-05	5	6.15E-01	1.23E-01	7.39E-04	3.07E+00	6.14E-01	1.48E-04	0.00%	0.01%
Bis(2-ethylhexyl)phthalate	0.00E+00	0.00E+00	8.69E-04	NA	NA	0.00E+00	8.67E-05	0.00E+00	0.00E+00	9.56E-04	5	1.83E+01	3.66E+00	2.61E-04	1.83E+02	3.66E+01	2.61E-05	0.00%	0.00%
Chrysene	0.00E+00	0.00E+00	3.67E-05	NA	NA	0.00E+00	4.99E-04	0.00E+00	0.00E+00	5.36E-04	5	6.15E-01	1.23E-01	4.36E-03	3.07E+00	6.14E-01	8.73E-04	0.01%	0.04%
Dibenz(a,h)anthracene	0.00E+00	0.00E+00	2.23E-05	NA	NA	0.00E+00	1.21E-04	0.00E+00	0.00E+00	1.43E-04	5	6.15E-01	1.23E-01	1.17E-03	3.07E+00	6.14E-01	2.34E-04	0.00%	0.01%
Diesel Fuel	0.00E+00	0.00E+00	2.92E+00	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.92E+00		NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	0.00E+00	0.00E+00	2.27E-05	NA	NA	0.00E+00	4.76E-04	0.00E+00	0.00E+00	4.98E-04	5	6.56E+01	1.31E+01	3.80E-05	1.10E+02	2.20E+01	2.26E-05	0.00%	0.00%
Gasoline	0.00E+00	0.00E+00	2.17E-03	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.17E-03		NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.00E+00	0.00E+00	9.78E-06	NA	NA	0.00E+00	4.51E-05	0.00E+00	0.00E+00	5.49E-05	5	6.15E-01	1.23E-01	4.46E-04	3.07E+00	6.14E-01	8.93E-05	0.00%	0.00%
Methylene chloride	0.00E+00	0.00E+00	1.29E-05	NA	NA	0.00E+00	9.37E-03	0.00E+00	0.00E+00	9.38E-03	5	5.85E+00	1.17E+00	8.02E-03	5.00E+01	1.00E+01	9.38E-04	0.02%	0.05%
Motor Oil	0.00E+00	0.00E+00	7.35E+01	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.35E+01		NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	0.00E+00	0.00E+00	1.08E-03	NA	NA	0.00E+00	2.67E-01	0.00E+00	0.00E+00	2.69E-01	10	8.42E+00	8.42E-01	3.19E-01	9.45E+00	9.45E-01	2.84E-01	0.61%	13.94%
Phenanthrene	0.00E+00	0.00E+00	1.81E-05	NA	NA	0.00E+00	3.69E-03	0.00E+00	0.00E+00	3.71E-03	5	6.56E+01	1.31E+01	2.83E-04	1.10E+02	2.20E+01	1.69E-04	0.00%	0.01%
Pyrene	0.00E+00	0.00E+00	4.22E-05	NA	NA	0.00E+00	1.27E-03	0.00E+00	0.00E+00	1.31E-03	5	6.15E-01	1.23E-01	1.07E-02	3.07E+00	6.14E-01	2.14E-03	0.02%	0.11%
Antimony	0.00E+00	0.00E+00	5.10E-03	NA	NA	0.00E+00	7.91E-03	0.00E+00	0.00E+00	1.30E-02	5	1.25E-01	2.50E-02	5.20E-01	1.25E+00	2.50E-01	5.20E-02	1.00%	2.55%
Arsenic	0.00E+00	0.00E+00	8.60E-03	NA	NA	0.00E+00	1.35E-02	0.00E+00	0.00E+00	2.21E-02	5	3.20E-01	6.40E-02	3.46E-01	4.70E+00	9.40E-01	2.35E-02	0.67%	1.15%
Barium	0.00E+00	0.00E+00	1.26E+00	NA	NA	0.00E+00	8.21E+00	0.00E+00	0.00E+00	9.46E+00	5	5.18E+01	1.04E+01	9.13E-01	1.21E+02	2.42E+01	3.91E-01	1.76%	19.18%
Cadmium	0.00E+00	0.00E+00	5.39E-03	NA	NA	0.00E+00	8.57E-02	0.00E+00	0.00E+00	9.11E-02	5	6.00E-02	1.20E-02	7.59E+00	2.64E+00	5.28E-01	1.73E-01	14.61%	8.46%
Chromium	0.00E+00	0.00E+00	3.27E-02	NA	NA	0.00E+00	5.62E-02	0.00E+00	0.00E+00	8.88E-02	5	2.40E+00	4.80E-01	1.85E-01	2.82E+00	5.64E-01	1.58E-01	0.36%	7.73%
Cobalt	0.00E+00	0.00E+00	1.24E-02	NA	NA	0.00E+00	3.88E-03	0.00E+00	0.00E+00	1.62E-02	5	1.20E+00	2.40E-01	6.77E-02	2.00E+01	4.00E+00	4.06E-03	0.13%	0.20%
Copper	0.00E+00	0.00E+00	2.45E-01	NA	NA	0.00E+00	1.03E+00	0.00E+00	0.00E+00	1.27E+00	5	2.67E+00	5.34E-01	2.38E+00	6.32E+02	1.26E+02	1.01E-02	4.58%	0.49%
Iron	0.00E+00	0.00E+00	5.99E+01	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.99E+01		NA	NA	NA	NA	NA	NA	NA	NA
Lead	0.00E+00	0.00E+00	1.87E+00	NA	NA	0.00E+00	9.88E-01	0.00E+00	0.00E+00	2.85E+00	5	1.00E+00	2.00E-01	1.43E+01	2.41E+02	4.82E+01	5.92E-02	27.47%	2.90%
Manganese	0.00E+00	0.00E+00	2.82E+00	NA	NA	0.00E+00	9.33E+00	0.00E+00	0.00E+00	1.22E+01	5	1.37E+01	2.74E+00	4.44E+00	1.59E+02	3.18E+01	3.82E-01	8.54%	18.74%
Mercury	0.00E+00	0.00E+00	1.32E-03	NA	NA	0.00E+00	2.36E-02	0.00E+00	0.00E+00	2.49E-02	5	2.50E-01	5.00E-02	4.97E-01	4.00E+00	8.00E-01	3.11E-02	0.96%	1.52%
Molybdenum	0.00E+00	0.00E+00	2.65E-03	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.65E-03	5	2.60E-01	5.20E-02	5.09E-02	2.60E+00	5.20E-01	5.09E-03	0.10%	0.25%
Nickel	0.00E+00	0.00E+00	2.65E-02	NA	NA	0.00E+00	6.12E-02	0.00E+00	0.00E+00	8.76E-02	5	1.33E-01	2.66E-02	3.29E+00	3.16E+01	6.32E+00	1.39E-02	6.34%	0.68%
Silver	0.00E+00	0.00E+00	1.90E-03	NA	NA	0.00E+00	1.11E-03	0.00E+00	0.00E+00	3.01E-03	10	6.02E+00	6.02E-01	5.01E-03	6.02E+01	6.02E+00	5.01E-04	0.01%	0.02%
Thallium	0.00E+00	0.00E+00	8.09E-04	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.09E-04	5	4.80E-01	9.60E-02	8.43E-03	1.43E+00	2.86E-01	2.83E-03	0.02%	0.14%
Zinc	0.00E+00	0.00E+00	4.33E+00	NA	NA	0.00E+00	2.73E+01	0.00E+00	0.00E+00	3.17E+01	5	9.60E+00	1.92E+00	1.65E+01	4.11E+02	8.22E+01	3.85E-01	31.75%	18.89%
												Hazard Index (Total EEQ):		5.2E+01			2.0E+00	100.00%	100.00%

Intake Equation:

$$Ej = \left(\frac{A}{HR}\left[\sum_{i=1}^{m}\left(\frac{IRi\,x\,Cij}{BW}\right)\right]\right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I) (mg/kg or mg/L)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using FHR =1.
Tier 2 = EEQ using calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box): $\boxed{n}$ See appropriate text tables for equations.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	1	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.0058	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.243	kg/d
Body weight =	3.19	kg
Home range =	14.8	acres
Water intake rate =	0.28	L/d
Site Area =	0.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

TABLE G-10
TIER 2 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR YELLOW-BELLIED MARMOT AT MATHER WAA, YOSEMITE

Hazard Estimate - Tier 2
Yellow-bellied Marmot

Chemical	Surface Water Exposure Point Concentration	Units	Sediment Exposure Point Concentration	Units	Soil Exposure Point Concentration	Units	Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF
							---------- unitless	----------	----------	----------	----------	----------
2,3,7,8-TCDD-TEQ	0.00E+00	mg/L	0.00E+00	mg/kg	1.11E-05	mg/kg	NA	NA	4.38E+00	9.41E-02	2.20E+00	2.20E+00
Acetone	0.00E+00	mg/L	0.00E+00	mg/kg	1.04E-02	mg/kg	NA	NA	1.50E+00	7.56E+01	5.00E-01	5.00E-01
Anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	4.16E-03	mg/kg	NA	NA	2.42E+00	1.25E+00	6.40E-01	6.40E-01
Benzo(a)anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	6.06E-03	mg/kg	NA	NA	1.60E+00	5.29E-01	3.50E-01	3.50E-01
Benzo(a)pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	1.59E-02	mg/kg	NA	NA	1.30E+00	1.41E-01	2.80E-01	2.80E-01
Benzo(b)fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	7.07E-03	mg/kg	NA	NA	2.60E+00	3.10E-01	2.80E-01	2.80E-01
Benzo(g,h,i)perylene	0.00E+00	mg/L	0.00E+00	mg/kg	7.80E-02	mg/kg	NA	NA	2.90E+00	2.47E-01	2.40E-01	2.40E-01
Benzo(k)fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	4.40E-03	mg/kg	NA	NA	2.60E+00	2.48E-01	2.90E-01	2.90E-01
Bis(2-ethylhexyl)phthalate	0.00E+00	mg/L	0.00E+00	mg/kg	4.78E-01	mg/kg	NA	NA	5.81E+02	2.38E-03	5.00E-01	5.00E-01
Chrysene	0.00E+00	mg/L	0.00E+00	mg/kg	2.02E-02	mg/kg	NA	NA	2.29E+00	3.25E-01	3.50E-01	3.50E-01
Dibenz(a,h)anthracene	0.00E+00	mg/L	0.00E+00	mg/kg	1.22E-02	mg/kg	NA	NA	2.31E+00	1.30E-01	2.00E-01	2.00E-01
Diesel Fuel	0.00E+00	mg/L	0.00E+00	mg/kg	1.61E+03	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fluoranthene	0.00E+00	mg/L	0.00E+00	mg/kg	1.25E-02	mg/kg	NA	NA	3.00E+00	5.00E-01	5.00E-01	5.00E-01
Gasoline	0.00E+00	mg/L	0.00E+00	mg/kg	1.20E+00	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	5.38E-03	mg/kg	NA	NA	2.86E+00	1.10E-01	2.30E-01	2.30E-01
Methylene chloride	0.00E+00	mg/L	0.00E+00	mg/kg	7.11E-03	mg/kg	NA	NA	3.00E+00	1.73E+01	5.00E-01	5.00E-01
Motor Oil	0.00E+00	mg/L	0.00E+00	mg/kg	4.04E+04	mg/kg	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pentachlorophenol	0.00E+00	mg/L	0.00E+00	mg/kg	5.92E-01	mg/kg	NA	NA	1.46E+01	5.93E+00	2.37E-01	2.37E-01
Phenanthrene	0.00E+00	mg/L	0.00E+00	mg/kg	9.94E-03	mg/kg	NA	NA	1.70E+00	4.88E+00	6.00E-01	6.00E-01
Pyrene	0.00E+00	mg/L	0.00E+00	mg/kg	2.32E-02	mg/kg	NA	NA	1.80E+00	7.20E-01	5.20E-01	5.20E-01
Antimony	0.00E+00	mg/L	0.00E+00	mg/kg	2.81E+00	mg/kg	NA	NA	1.00E+00	3.70E-02	1.40E-01	1.40E-01
Arsenic	0.00E+00	mg/L	0.00E+00	mg/kg	4.73E+00	mg/kg	NA	NA	1.53E-01	3.75E-02	5.00E-03	5.00E-03
Barium	0.00E+00	mg/L	0.00E+00	mg/kg	6.91E+02	mg/kg	NA	NA	9.10E-02	1.56E-01	4.71E-01	4.71E-01
Cadmium	0.00E+00	mg/L	0.00E+00	mg/kg	2.96E+00	mg/kg	NA	NA	6.63E+00	3.80E-01	1.60E-01	1.60E-01
Chromium	0.00E+00	mg/L	0.00E+00	mg/kg	1.80E+01	mg/kg	NA	NA	3.06E-01	4.10E-02	1.08E-01	1.08E-01
Cobalt	0.00E+00	mg/L	0.00E+00	mg/kg	6.80E+00	mg/kg	NA	NA	1.22E-01	7.50E-03	2.07E-02	2.07E-02
Copper	0.00E+00	mg/L	0.00E+00	mg/kg	1.35E+02	mg/kg	NA	NA	5.15E-01	9.98E-02	1.16E-01	1.16E-01
Iron	0.00E+00	mg/L	0.00E+00	mg/kg	3.29E+04	mg/kg	NA	NA	3.60E-02	0.00E+00	1.71E-02	1.71E-02
Lead	0.00E+00	mg/L	0.00E+00	mg/kg	1.03E+03	mg/kg	NA	NA	2.11E-01	1.26E-02	2.26E-02	2.26E-02
Manganese	0.00E+00	mg/L	0.00E+00	mg/kg	1.55E+03	mg/kg	NA	NA	4.31E-02	7.90E-02	2.05E-02	2.05E-02
Mercury	0.00E+00	mg/L	0.00E+00	mg/kg	7.25E-01	mg/kg	NA	NA	1.34E+00	4.27E-01	1.92E-01	1.92E-01
Molybdenum	0.00E+00	mg/L	0.00E+00	mg/kg	1.46E+00	mg/kg	NA	NA	9.53E-01	0.00E+00	0.00E+00	0.00E+00
Nickel	0.00E+00	mg/L	0.00E+00	mg/kg	1.46E+01	mg/kg	NA	NA	1.26E+00	5.51E-02	1.87E-01	1.87E-01
Silver	0.00E+00	mg/L	0.00E+00	mg/kg	1.05E+00	mg/kg	NA	NA	2.05E+00	1.40E-02	4.00E-03	4.00E-03
Thallium	0.00E+00	mg/L	0.00E+00	mg/kg	4.45E-01	mg/kg	NA	NA	0.00E+00	0.00E+00	1.23E-01	1.23E-01
Zinc	0.00E+00	mg/L	0.00E+00	mg/kg	2.38E+03	mg/kg	NA	NA	4.60E-01	1.51E-01	5.70E-02	5.70E-02

Chemical	PDE Surface Water mg/kg-d	PDE Sediment mg/kg-d	PDE Soil mg/kg-d	PDE Fish mg/kg-d	PDE Aq. Invert. mg/kg-d	PDE Terr. Invert. mg/kg-d	PDE Plants mg/kg-d	PDE Mammals mg/kg-d	PDE Birds mg/kg-d	Total PDE mg/kg-d	Chemical-Specific Toxicity Value UF	NOAEL mg/kg-d	Adjusted NOAEL mg/kg-d	EEQ N	LOAEL mg/kg-d	Adjusted LOAEL mg/kg-d	EEQ L	Percent Contribution to EEQ N	Percent Contribution to EEQ L
2,3,7,8-TCDD-TEQ	0.00E+00	0.00E+00	2.74E-10	NA	NA	0.00E+00	1.08E-09	0.00E+00	0.00E+00	1.35E-09	5	1.00E-06	2.00E-07	6.76E-03	1.00E-05	2.00E-06	6.76E-04	0.96%	2.45%
Acetone	0.00E+00	0.00E+00	2.56E-07	NA	NA	0.00E+00	8.10E-04	0.00E+00	0.00E+00	8.11E-04	5	1.00E+01	2.00E+00	4.05E-04	5.00E+01	1.00E+01	8.11E-05	0.06%	0.29%
Anthracene	0.00E+00	0.00E+00	1.02E-07	NA	NA	0.00E+00	5.37E-06	0.00E+00	0.00E+00	5.48E-06	5	6.56E+01	1.31E+01	4.17E-07	1.10E+02	2.20E+01	2.49E-07	0.00%	0.00%
Benzo(a)anthracene	0.00E+00	0.00E+00	1.49E-07	NA	NA	0.00E+00	3.30E-06	0.00E+00	0.00E+00	3.45E-06	5	6.15E-01	1.23E-01	2.80E-05	3.07E+00	6.14E-01	5.62E-06	0.00%	0.02%
Benzo(a)pyrene	0.00E+00	0.00E+00	3.90E-07	NA	NA	0.00E+00	2.31E-06	0.00E+00	0.00E+00	2.70E-06	5	1.31E+00	2.62E-01	1.03E-05	3.28E+01	6.56E+00	4.11E-07	0.00%	0.00%
Benzo(b)fluoranthene	0.00E+00	0.00E+00	1.74E-07	NA	NA	0.00E+00	2.26E-06	0.00E+00	0.00E+00	2.43E-06	5	6.15E-01	1.23E-01	1.97E-05	3.07E+00	6.14E-01	3.96E-06	0.00%	0.01%
Benzo(g,h,i)perylene	0.00E+00	0.00E+00	1.92E-06	NA	NA	0.00E+00	1.98E-05	0.00E+00	0.00E+00	2.18E-05	5	6.15E-01	1.23E-01	1.77E-04	3.07E+00	6.14E-01	3.54E-05	0.03%	0.13%
Benzo(k)fluoranthene	0.00E+00	0.00E+00	1.08E-07	NA	NA	0.00E+00	1.12E-06	0.00E+00	0.00E+00	1.23E-06	5	6.15E-01	1.23E-01	9.99E-06	3.07E+00	6.14E-01	2.00E-06	0.00%	0.01%
Bis(2-ethylhexyl)phthalate	0.00E+00	0.00E+00	1.17E-05	NA	NA	0.00E+00	1.17E-06	0.00E+00	0.00E+00	1.29E-05	5	1.83E+01	3.66E+00	3.53E-06	1.83E+02	3.66E+01	3.53E-07	0.00%	0.00%
Chrysene	0.00E+00	0.00E+00	4.96E-07	NA	NA	0.00E+00	6.75E-06	0.00E+00	0.00E+00	7.25E-06	5	6.15E-01	1.23E-01	5.89E-05	3.07E+00	6.14E-01	1.18E-05	0.01%	0.04%
Dibenz(a,h)anthracene	0.00E+00	0.00E+00	3.01E-07	NA	NA	0.00E+00	1.64E-06	0.00E+00	0.00E+00	1.94E-06	5	6.15E-01	1.23E-01	1.58E-05	3.07E+00	6.14E-01	3.16E-06	0.00%	0.01%
Diesel Fuel	0.00E+00	0.00E+00	3.95E-02	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.95E-02		NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	0.00E+00	0.00E+00	3.07E-07	NA	NA	0.00E+00	6.43E-06	0.00E+00	0.00E+00	6.73E-06	5	6.56E+01	1.31E+01	5.13E-07	1.10E+02	2.20E+01	3.06E-07	0.00%	0.00%
Gasoline	0.00E+00	0.00E+00	2.94E-05	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.94E-05		NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.00E+00	0.00E+00	1.32E-07	NA	NA	0.00E+00	6.09E-07	0.00E+00	0.00E+00	7.41E-07	5	6.15E-01	1.23E-01	6.03E-06	3.07E+00	6.14E-01	1.21E-06	0.00%	0.00%
Methylene chloride	0.00E+00	0.00E+00	1.75E-07	NA	NA	0.00E+00	1.27E-04	0.00E+00	0.00E+00	1.27E-04	5	5.85E+00	1.17E+00	1.08E-04	5.00E+01	1.00E+01	1.27E-05	0.02%	0.05%
Motor Oil	0.00E+00	0.00E+00	9.93E-01	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.93E-01		NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	0.00E+00	0.00E+00	1.45E-05	NA	NA	0.00E+00	3.61E-03	0.00E+00	0.00E+00	3.63E-03	10	8.42E+00	8.42E-01	4.31E-03	9.45E+00	9.45E-01	3.84E-03	0.61%	13.94%
Phenanthrene	0.00E+00	0.00E+00	2.44E-07	NA	NA	0.00E+00	4.99E-05	0.00E+00	0.00E+00	5.01E-05	5	6.56E+01	1.31E+01	3.82E-06	1.10E+02	2.20E+01	2.28E-06	0.00%	0.01%
Pyrene	0.00E+00	0.00E+00	5.70E-07	NA	NA	0.00E+00	1.72E-05	0.00E+00	0.00E+00	1.78E-05	5	6.15E-01	1.23E-01	1.44E-04	3.07E+00	6.14E-01	2.89E-05	0.02%	0.11%
Antimony	0.00E+00	0.00E+00	6.89E-05	NA	NA	0.00E+00	1.07E-04	0.00E+00	0.00E+00	1.76E-04	5	1.25E-01	2.50E-02	7.03E-03	1.25E+00	2.50E-01	7.03E-04	1.00%	2.55%
Arsenic	0.00E+00	0.00E+00	1.16E-04	NA	NA	0.00E+00	1.83E-04	0.00E+00	0.00E+00	2.99E-04	5	3.20E-01	6.40E-02	4.67E-03	4.70E+00	9.40E-01	3.18E-04	0.67%	1.15%
Barium	0.00E+00	0.00E+00	1.70E-02	NA	NA	0.00E+00	1.11E-01	0.00E+00	0.00E+00	1.28E-01	5	5.18E+01	1.04E+01	1.23E-02	1.21E+02	2.42E+01	5.28E-03	1.76%	19.18%
Cadmium	0.00E+00	0.00E+00	7.28E-05	NA	NA	0.00E+00	1.16E-03	0.00E+00	0.00E+00	1.23E-03	5	6.00E-02	1.20E-02	1.03E-01	2.64E+00	5.28E-01	2.33E-03	14.61%	8.46%
Chromium	0.00E+00	0.00E+00	4.42E-04	NA	NA	0.00E+00	7.59E-04	0.00E+00	0.00E+00	1.20E-03	5	2.40E+00	4.80E-01	2.50E-03	2.82E+00	5.64E-01	2.13E-03	0.36%	7.73%
Cobalt	0.00E+00	0.00E+00	1.67E-04	NA	NA	0.00E+00	5.25E-05	0.00E+00	0.00E+00	2.20E-04	5	1.20E+00	2.40E-01	9.15E-04	2.00E+01	4.00E+00	5.49E-05	0.13%	0.20%
Copper	0.00E+00	0.00E+00	3.32E-03	NA	NA	0.00E+00	1.39E-02	0.00E+00	0.00E+00	1.72E-02	5	2.67E+00	5.34E-01	3.22E-02	6.32E+02	1.26E+02	1.36E-04	4.58%	0.49%
Iron	0.00E+00	0.00E+00	8.09E-01	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.09E-01		NA	NA	NA	NA	NA	NA	NA	NA
Lead	0.00E+00	0.00E+00	2.52E-02	NA	NA	0.00E+00	1.33E-02	0.00E+00	0.00E+00	3.86E-02	5	1.00E+00	2.00E-01	1.93E-01	2.41E+02	4.82E+01	8.00E-04	27.47%	2.90%
Manganese	0.00E+00	0.00E+00	3.81E-02	NA	NA	0.00E+00	1.26E-01	0.00E+00	0.00E+00	1.64E-01	5	1.37E+01	2.74E+00	5.99E-02	1.59E+02	3.18E+01	5.16E-03	8.54%	18.74%
Mercury	0.00E+00	0.00E+00	1.78E-05	NA	NA	0.00E+00	3.18E-04	0.00E+00	0.00E+00	3.36E-04	5	2.50E-01	5.00E-02	6.72E-03	4.00E+00	8.00E-01	4.20E-04	0.96%	1.52%
Molybdenum	0.00E+00	0.00E+00	3.57E-05	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.57E-05	5	2.60E-01	5.20E-02	6.87E-04	2.60E+00	5.20E-01	6.87E-05	0.10%	0.25%
Nickel	0.00E+00	0.00E+00	3.58E-04	NA	NA	0.00E+00	8.26E-04	0.00E+00	0.00E+00	1.18E-03	5	1.33E-01	2.66E-02	4.45E-02	3.16E+01	6.32E+00	1.87E-04	6.34%	0.68%
Silver	0.00E+00	0.00E+00	2.57E-05	NA	NA	0.00E+00	1.51E-05	0.00E+00	0.00E+00	4.07E-05	10	6.02E+00	6.02E-01	6.77E-05	6.02E+01	6.02E+00	6.77E-06	0.01%	0.02%
Thallium	0.00E+00	0.00E+00	1.09E-05	NA	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.09E-05	5	4.80E-01	9.60E-02	1.14E-04	1.43E+00	2.86E-01	3.82E-05	0.02%	0.14%
Zinc	0.00E+00	0.00E+00	5.86E-02	NA	NA	0.00E+00	3.69E-01	0.00E+00	0.00E+00	4.28E-01	5	9.60E+00	1.92E+00	2.23E-01	4.11E+02	8.22E+01	5.21E-03	31.75%	18.89%
Hazard Index (Total EEQ):														7.0E-01			2.8E-02	100.00%	100.00%

Intake Equation:

$$Ej = \left(\frac{A}{HR}\left[\sum_{i=1}^{m}\left(\frac{IRi\,xCij}{BW}\right)\right]\right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I) (mg/kg or mg/L)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using FHR =1.
Tier 2 = EEQ using calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box): $\boxed{n}$ See appropriate text tables for equations.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	1	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.0058	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.243	kg/d
Body weight =	3.19	kg
Home range =	14.8	acres
Water intake rate =	0.28	L/d
Site Area =	0.2	acres
Frac. home range (FHR) =	1.35E-02	unitless

Appendix C – Human Health and Ecological Risk Assessment

Draft

EE/CA Appendix C

Human Health and Ecological Risk Assessments

Mather Former Waste Disposal Area

Yosemite National Park, California

Prepared by Kane Environmental

July 2021

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List of Abbreviations and Acronyms

95UCL	95 percent upper confidence limit
ABS	absorption fraction
ADD	average daily dose
ALM	adult lead model
AT	averaging time
ATSDR	Agency for Toxic Substances and Disease Registry
AUF	area use factor
BERA	baseline ecological risk assessment
bgs	below ground surface
BW	body weight
C	concentration
CalEPA	California Environmental Protection Agency
CADD	carcinogen average daily dose
CCME	Canadian Council of Ministers of the Environment
CDC	Centers for Disease Control
CF	conversion factor
CFR	Code of Federal Regulations
cm^2	square centimeter
COC	chemical of concern
COEC	chemical of ecological concern
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CSM	conceptual site model
CTE	central tendency exposure
CV	coefficient of variation
DA	absorbed dose
DAD	dermally absorbed dose
DAF	dermal adherence factor
DF	dietary fraction

DI	daily intake
DTSC	California Department of Toxic Substances Control
EcoSSL	ecological soil screening level
EC	exposure concentration
ED	exposure duration
EE/CA	engineering evaluation/cost analysis
EF	exposure frequency
EPC	exposure point concentration
ERA	ecological risk assessment
ERAGS	Ecological Risk Assessment Guidance for Superfund
ESL	ecological screening level
ESV	ecological screening value
ET	exposure time
EU	exposure unit
EV	event frequency
foc	fraction organic carbon
FWDA	Former Waste Disposal Area
g	gram
GLWQI	Great Lakes Water Quality Initiative
HERO	Human and Ecological Risk Office
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
hr	hour
IR	intake rate
ISM	incremental sampling methodology
ITRC	Interstate Technology & Regulatory Council
IUR	inhalation unit risk
kg	kilogram
L	liter
LANL	Los Alamos National Laboratory
LOAEL	lowest observed adverse effect level
m^3	cubic meter
MDL	method detection limit
mg	milligram
NCADD	non-carcinogen average daily dose
NCEA	National Center for Environmental Assessment
NOAEL	no observed adverse effect level
NPS	National Park Service
OEHHA	CalEPA Office of Environmental Health Hazard Assessment
ORNL	Oak Ridge National Laboratory
PAH	polycyclic aromatic hydrocarbon
Park	Yosemite National Park
PEF	particulate emission factor
PQL	practical quantitation limit
PRG	preliminary removal goal
QC	quality control
RAGS	Risk Assessment Guidance for Superfund

RBA	relative bioavailability
RfC	reference concentration
RfD	reference dose
RL	reporting limit
RME	reasonable maximum exposure
RSL	regional screening level
SA	surface area
SF	slope factor
Site	Mather Former Waste Disposal Area
SLERA	screening level ecological risk assessment
SVOC	semi-volatile organic compound
TCDD	2,3,7,8-tetrachlorodibenzodioxin
TEF	toxicity equivalency factor
TEQ	toxic equivalent
TOC	total organic carbon
TPH	total petroleum hydrocarbon
TRV	toxicity reference value
TWA	time-weighted average
UF	uncertainty factor
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
µg	microgram

1. Introduction

1.1. Document Purpose

This document presents the human health and ecological risk assessments for the Mather Former Waste Disposal Area (FWDA) Site (Site) in Yosemite National Park (Park) in California. The purpose of this document is to estimate potential site-related risks to human health and the environment, both now and in the future, from chemicals present in environmental media due to historical activities at the Site. Results of this assessment are intended to help inform risk managers and the public about the magnitude of any human or ecological risks attributable to site-related chemicals and to help determine if there is a need for action at the Site.

This risk assessment is Appendix C of the engineering evaluation/cost analysis (EE/CA) for the response action being conducted at the Site by NPS and complies with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act and the National Oil and Hazardous Substances Pollution Contingency Plan. This risk assessment was generated in basic accordance with the United States Environmental Protection Agency's (USEPA's) *Risk Assessment Guidance for Superfund (RAGS)* for human health (*Part A* [USEPA 1989], *Part E* [USEPA 2004a], and *Part F* [USEPA 2009a]) and *Ecological Risk Assessment Guidance for Superfund (ERAGS)* (USEPA 1997). As appropriate, the California Department of Toxic Substances Control (DTSC)-specific risk assessment guidance provided by the Human and Ecological Risk Office[1] (HERO) was also incorporated.

NPS has a number of regulations that apply to the release of hazardous substances on property under the jurisdiction of NPS (see NPS 2015), including the Organic Act of 1916 (16 U.S. Code § 1, et seq. 36 Code of Federal Regulations [CFR] Part 1), which requires that NPS manage parks in order "*to conserve the scenery and the natural and historic objects, and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.*" Therefore, determining whether contaminants at the Site pose risks to current and future human and ecological receptors is especially relevant to the NPS responsibility to protect park resources.

1.2. Document Organization

In addition to this introduction, this document is organized as follows:

- Section 2 – This section provides a brief overview of the site location, history, geology, hydrology, and local biotic environment; the reason for contamination

[1] http://www.dtsc.ca.gov/AssessingRisk/index.cfm

concern; and a summary of the investigations that have been conducted at the Site

- Section 3 – This section provides a human health risk assessment (HHRA), including the conceptual site model (CSM) of contamination and exposed human populations, the selection of chemicals of potential concern (COPCs) for human health, an exposure assessment, toxicity assessment, risk characterization, and uncertainty assessment

- Section 4 – This section provides an ecological risk assessment (ERA), including the ecological problem formulation, a screening level ecological risk assessment (SLERA) that identifies chemicals of potential ecological concern (COPECs), and an initial baseline ecological risk assessment (BERA) that provides a simple risk characterization for ecological receptors and uncertainty assessment

- Section 5 – This section develops risk-based preliminary removal goals (PRGs) for the chemicals in each exposure medium where unacceptable risks were identified in the risk assessments

- Section 6 – This section provides full citations for all guidance documents, reports, and journal articles cited in this document

All cited tables, figures, and attachments are included at the end of this document.

2. Site Background

This section summarizes the known environmental information and historical activities that have previously occurred at the Site. Detailed information on the site history and previous investigation results is presented in the main EE/CA report and is not repeated in this document.

2.1. Location

The Site is in the northwestern portion of Yosemite National Park, California, approximately one mile north of the Mather Ranger Station along the Hetch Hetchy Road, at an elevation of approximately 5,000 feet above mean sea level. The Site consists of two portions: an upper area and a lower area. Each area is approximately 50 feet by 75 feet, for a combined surface extent of approximately 0.2 acre (7,500 square feet). The Site is considered to cover approximately 0.5 acres. Figure 1 of the main EE/CA report shows the site location.

2.2. Site History

As described in the FIR, the Mather FWDA site was initially a quarry that supplied granite blocks for Yosemite construction projects. The site was subsequently used by crews building the Hetch Hetchy Road, and received both construction and camp debris in the 1920s and 1930s. Debris observed on the surface at the Mather site during site visits in 2001 and 2008 was confined to two areas, referred to as “upper” and “lower”. The debris included glass, rusted cans, and a few corroded battery cores, and occurred mostly in the lower area. A slight mound in the lower area contained evidence of burning, including charcoal and melted glass.

No documentation exists for the types and quantities of materials disposed at the Site. Historical photographs show that trucks drove onto the upper area to dump debris into the lower area. During this activity, some scattered debris was deposited on the surface of the upper area, although the majority of the debris was emplaced in the lower area. Visual observations indicate that the debris in the lower area was burned in place.

2.3. Physical Setting

The Mather FWDA is in a montane forest characterized by pine trees and manzanita shrubs. The Mather FWDA site is sparsely vegetated with clumps of short grass. A survey described in the Shaw (2010) Facility Investigation Report (FIR) and performed in July 2001 found no evidence of threatened or endangered plants growing on the FWDA surface. The closest surface water occurrence is the Tuolumne River, approximately 1.25 miles from the site. The slope and drainage patterns shown on a topographic map provided as Figure 1 in the main EE/CA report indicate that surface flow from the Site travels south and then west toward the Tuolumne River. The nearest wetlands occur intermittently along the banks of the Tuolumne River.

2.4. Environmental Setting

2.4.1. Site Geology and Hydrogeology

As described in the 2010 FIR, the Mather FWDA is located within the Sierra Nevada granitic batholith. The materials encountered at the site during the field investigation indicated rocky material in a silty sand matrix. The materials are primarily granitic in origin with lesser amounts derived from metamorphic rocks. Bedrock at the Mather FWDA Site was not encountered during the investigation, although it is present in former quarry walls adjacent to the Site and in massive granite ledges upgradient from the site.

There are no known drinking water wells within the drainage basin that encompasses the Site. No groundwater monitoring wells exist within or near the boundaries of the Site; therefore, depth to groundwater is unknown at the Site. The topography of the Site suggests that groundwater is not close to the surface.

2.4.2. Site Hydrology

No site-specific hydrologic investigations have been conducted at the Mather FWDA. No surface water, groundwater, or evidence of ponding were observed at the Mather FWDA during the field investigation conducted in August, 2001, and the site is not located within a floodplain.

Similarly, during a habitat study conducted for this risk assessment in 2020 (Harris 2020), no water was observed anywhere near the Site. The closest recorded wetland is 0.2 miles south of the dump sites. This wetland was classified as a Riverine, Intermittent, Streambed, and Temporarily Flooded based on the Cowardin classification system (Harris 2020). This intermittent stream runs southwest to the Tuolumne River, which is 1.25 miles from the Site to the north. A drainage runs east to west along the south end of the site, which should divert runoff from the Site away from the wetland, and runs down to Hetch Hetchy Road.

2.5. Sensitive Environments

The USEPA defines sensitive environments as “a terrestrial or aquatic resource, fragile natural setting, or other area with unique or highly valued environmental or cultural features” (USEPA 1991a). The Site is considered a sensitive environment because it is located inside the Park, and national parks are defined as sensitive environments by the USEPA (USEPA 1992a).

2.6. Current and Future Property Use Scenarios

The nearest residences are at Evergreen Lodge and Camp Mather, which are both located about two miles southwest of the site (see Figure 1 in the main EE/CA report). Both facilities have numerous short-term summer visitors (one to seven days) as well as a few caretakers or permanent residents who are present year-round.

2.7. Reason for Concern

Based on the observations presented in the FIR (Shaw 2010), soil in the area of test pits TP05 contains oily mass observed in the northern portion of the site, and soils at TP09 contain elevated levels of lead detected in the southern portion of the site. A preliminary human health risk assessment performed for the FIR (Shaw 2010) found a potential for human health risks.

2.8. Summary of Site Investigations

The main body of the EE/CA and the 2010 FIR provide detailed discussions of the various historical investigations that have been performed at the Site. These are summarized briefly below:

Prior to the site inspection performed in 2001 and documented in the 2010 FIR, no known geologic, hydrologic, or analytical investigations have been conducted at the Mather FWDA nor in its vicinity.

IT Corporation (IT) conducted a focused site inspection during August 2001 at the Mather FWDA. The inspection was conducted to determine the nature and extent of chemicals in the soil as a result of waste disposal from the construction and camp activities during the 1920s and 1930s (IT 2002). Test pits were excavated within the debris zone. Site and background samples were collected.

In August 2008, based on DTSC comments on the focused site investigation, Shaw (2010) conducted additional field work and data evaluation, documented in the facility investigation report. Similar to 2001, test pits were excavated within the debris zone. Site, background, and downgradient samples were collected. Several metals in soils were found to be related to Site activities rather than naturally-occurring. Risk assessments determined human health risks below levels of concern, or within background risks, and a low possibility of impact to wildlife (Shaw 2010).

2.9. Data Summary

The soil samples collected in 2001 and 2008 for the site investigation and facility investigation report, respectively, are used in this risk assessment to characterize potential exposures and risks for human and ecological receptors at the Site. The Site data are presented in the Final Mather Facility Investigation Report (Shaw 2010), and summarized in the EE/CA report to which this risk assessment is appended.

Data from the EE/CA investigations were used in this risk assessment as per the following:

- Surface soil was deemed to consist of samples collected down to 6 inches depth, and surface soil data from the two sampling events were used to characterize exposures.
- Subsurface soil was assumed to be samples from 1 foot to 6 feet below ground surface (bgs). Subsurface soil data from 2001 and 2008 were used to evaluate subsurface soil exposures.
- Background data are available from three upgradient locations sampled in 2001 and from 10 locations sampled further upgradient in 2008, all collected at 1 foot bgs.
- Data from three downgradient samples from 2001 are not used for risk estimations.

- Concentration data on dioxins/furans were collected from two test pits that contained ash; data were assumed to represent subsurface soil exposures.

- Total petroleum hydrocarbon (TPH) data were collected from surface and subsurface soils, particularly where oily stains were observed. Typically, co-located PAH data would be used in the risk assessment in lieu of TPH data. However, because PAH data were not collected at the same location or depth as the highest TPH concentration (location YWM-TP05-SO-1040), the TPH data are evaluated as surrogate indicators of petroleum contamination for potential risks to humans.

- Chromium VI (hexavalent chromium) was analyzed in soil samples collected in 2001 only, and was not detected in any sample.

- PCB data were collected only in 2008 and no congeners were detected.

- Data qualified as "R" to indicate rejected data were not used in the risk assessment. Data qualified with "J" indicating estimated values, were retained. Estimated results are considered sufficiently certain for use in risk assessment, but the values could be biased high or low. Non-detect results (qualified with "U") were used in the risk assessment.

- Samples from the same location but collected at different depths were treated as separate samples.

- Field quality control (QC) samples (e.g., field, trip, and equipment rinsate blanks) and laboratory QC samples (e.g., matrix spikes, internal standards) were excluded from use in the risk assessment, with the exception of field duplicates, for which the following strategy was followed:

    - Where both samples show detections, the highest detected value was used

    - Where one sample was detected and the other non-detect, the detected sample was used

    - Where both samples were non-detects, the sample with the lower detection limit (DL) was used.

3. Human Health Risk Assessment

This section presents the HHRA for the Site. This section includes the conceptual model of site contamination; summarizes the exposed human populations; presents the COPC selection for human health; and provides the exposure assessment, toxicity assessment, risk characterization, and uncertainty assessment.

3.1. Conceptual Site Exposure Model for Humans

The CSM depicts the understanding of how chemical contaminants have been released to the environment at the Site. The CSM also lists the exposure pathways for human and ecological receptors that were quantitatively evaluated in the risk assessment. The main features of the CSM and the rationale supporting which human receptors and pathways are identified for risk quantification in the HHRA are discussed below. The CSM is depicted graphically in the attached Figure 3-1.

3.1.1. Contaminant Source Areas

According to the 2010 FIR, the Site is characterized by debris in the surface over a 0.2-acre area, with ash detected in test pits of the waste areas. The primary medium of potential concern is soil. Due to the absence of groundwater at the shallow depths of the buried debris, groundwater is assumed to not be of concern at this Site. Although an ephemeral drainage is present, no surface water was observed during either of the two site investigations. Thus, it is expected that water is only present in this drainage during snowmelt and does not provide any aquatic habitat, though it appears to cause some contaminant migration, as noted in low levels of detectable TPH in two of the three samples located downgradient of the waste area.

3.1.2. Transport in the Environment

Chemical contaminants released to soil due to historical waste disposal activities may migrate in the environment by several processes:

- Fine-grained soil particulates may be released into air because of wind erosion and/or human disturbances.
- Contaminants in soil may be dissolved by water (rain or snowmelt). Infiltration of precipitation into subsurface (vadose zone) soils may result in subsurface soil contamination.
- Contaminants in soil may be taken up into the tissues of terrestrial plants and animals (e.g., soil invertebrates, small mammals), which can be ingested by terrestrial wildlife.

3.1.3. Land Use and Populations of Concern

Park visitors engaged in recreation and Park personnel are the primary human populations of concern under both current and future use scenarios. Due to the location of the Site outside of the main Yosemite Valley, it is unlikely that many recreational visitors would spend much time at the Mather site. Recreational visitors and Park employee exposure frequencies are assumed to be occasional. Occasional recreational activities at the Site could include picnicking and hiking. Site receptors are assumed to consist of the following:

- Park worker, adult
- Construction or restoration worker, adult
- Adult visitor (greater than 16 years old)
- Older child visitor (6 to 16 years old)
- Young child visitor (less than 6 years old).

Due to the Site's age, any volatile organic compounds in the soil would likely have volatilized, and exposure through inhalation of volatile contaminants is likely to be low or negligible.

NPS employees could visit the Site as part of normal outdoor maintenance activities under both current and future conditions. Although no construction activities are planned at the Site, restoration projects or construction activities could occur in the future; thus, a future Park worker scenario and construction scenario are evaluated. Construction workers could be exposed to both surface and subsurface soils during excavation activities.

3.1.4. Exposure Routes of Concern

Humans can be exposed to contaminated environmental media by three general routes—ingestion, inhalation, and dermal contact. Human receptors may be exposed to contaminants at the Site through multiple exposure media and routes; however, not all human exposure routes are likely to be of equal concern. To be of concern, an exposure route must be complete. That is, there must be contact between a human receptor and a contaminated environmental medium. The relative importance of one route to another is related to the amount of chemical taken into the body. The following subsections present a more detailed description of these routes and an analysis of their relative importance for human exposure.

Incidental Ingestion of Soil

The primary medium of concern at the Site is soil. Even though few people intentionally ingest soil, anyone who has direct contact with contaminated soil may incidentally ingest small amounts that adhere to their hands during outdoor activities. Incidental ingestion of soil is often one of the most important routes of human exposure; thus, ingestion of soil will be evaluated for all human receptor populations.

For park visitors, the soil depth interval of interest is surface soil, which is usually defined as 0 to 6 inches bgs. For NPS employees, most exposure is likely to occur at the surface. However, during any possible construction activities, exposure could also occur to soils deeper than 6 inches. Both surface and subsurface soils (greater than 6 inches depth) are considered to be the possible soil exposure media for Park worker and construction worker soil exposures.

Dermal Contact with Soil

Park workers and visitors may also be exposed to soil through dermal contact. Information on the rate and extent of dermal absorption of chemicals in soil across the skin is limited, and this route is likely to be minor in comparison to exposure through ingestion. Metal contaminants in particular tend to bind to soils and have a relatively lower absorption across the skin compared to other chemicals. Dermal contact with surface soil (0 to 6 inches) was evaluated quantitatively for all receptors, and dermal contact with subsurface soil (1 to 6 feet) was evaluated for Park workers and construction workers.

Inhalation of Airborne Particulates

Humans may be exposed to airborne particulates when fine-grained particles become suspended in air by wind and/or human activity. When soil is disturbed only by wind or light human activity, such as during walking/hiking, the amount of particulate material inhaled from air is generally quite small compared to the amount that is typically assumed for incidental ingestion.

Inhalation of airborne particulates derived from surface soil (0 to 6 inches) was evaluated quantitatively in the HHRA for all receptors. Inhalation of airborne particulates derived from subsurface soil (1 to 6 feet), which might be generated during excavation/construction activities, was evaluated for Park workers and construction workers.

Inhalation of Volatiles

Since volatile chemicals were not detected in soils, inhalation of volatiles from soils is not an exposure route of concern for the Site.

Exposure to Surface Water or Groundwater

As described above, there are no surface water features at the Site, other than possible ephemeral water flows. Groundwater was not encountered prior to encountering bedrock during soil boring events, and is not presently and would not be useful in the future as a drinking water source. As such, both surface water, and associated sediments, and groundwater exposures are not evaluated further in this risk assessment.

Summary

In summary, the following human exposure routes are complete and were evaluated quantitatively in the HHRA:

- Current and Future Park Visitors (Young Children, Older Children, and Adults)
  - Incidental ingestion of and dermal contact with surface soil
  - Inhalation of airborne particulates derived from surface soil.
- Current and Future NPS Workers (Adults)
  - Incidental ingestion of and dermal contact with surface soil
  - Incidental ingestion of and dermal contact with subsurface soil during construction activities
  - Inhalation of airborne particulates derived from both surface and subsurface soil
- Current and Future Construction Workers (Adults)
  - Incidental ingestion of and dermal contact with surface soil
  - Incidental ingestion of and dermal contact with subsurface soil during construction activities
  - Inhalation of airborne particulates derived from both surface and subsurface soil.

3.2. Selection of COPCs

Chemicals of Potential Concern (COPCs) are chemicals that exist in the environment at the Site at concentration levels that might be a health concern to people. USEPA risk assessment methodology includes the identification of COPCs as those chemicals that are evaluated quantitatively for potential human health risks. The methodology for identifying COPCs consists of a screening process, whereby concentrations of chemicals in a given medium are compared with screening criteria that are designed to be health protective; i.e., any concentration below the screening value would not be expected to pose health risks to human receptor populations. The procedure consists of comparing the maximum concentration across all samples for each analyte in each medium to a risk-based screening level.

The lowest screening level across the following sources was used to identify human health COPCs:

- USEPA regional screening levels (RSLs) (November 2020 version) for residential soil, consistent with NPS guidelines. Although it is recognized that residential receptors are not present at the Site, nor are they anticipated in the future, the COPC selection was performed based on residential RSLs because these are the most conservative values. For carcinogens, the RSL is a concentration that corresponds to an excess cancer risk[2] of 1E-06. For non-carcinogens, the RSL is a concentration that corresponds to a hazard quotient (HQ) of 0.1[3].

- DTSC HERO HHRA Note 3 (DTSC 2018) for soil.

The COPC selection process is designed to eliminate chemicals that would pose little or no concern from further evaluation, and to focus on those chemicals that could pose an unacceptable risk. The Uncertainty Assessment (Section 3.6) discusses uncertainty around chemicals that were excluded as COPCs.

3.2.1. Soil COPC Selection

Human health COPCs for soil were identified by comparing the maximum detected concentrations in soils to the lowest residential soil screening level. COPCs were identified separately for surface soil (0 to 6 inches bgs) and subsurface soil (1 to 6 feet bgs).

The results of the soil COPC selection for human health are summarized in Table 3-1 and presented in further detail in Attachment A-1 (surface soil) and Attachment A-2 (subsurface soil). In total, 12 human health COPCs were identified for surface soil: antimony, arsenic, cobalt, lead, thallium, zinc, aluminum, iron, manganese, dibenz(a,h)anthracene, TPH aromatics medium, and TPH aromatics high. Similar human health COPCs were identified for subsurface soil: arsenic, cadmium, cobalt, lead, mercury, thallium, aluminum, iron, manganese, dibenz(a,h)anthracene, TPH aromatics medium, TPH aromatics high, and dioxins/furans, which are expressed as the 2,3,7,8-tetrachlorodibenzodioxin (TCDD) toxicity equivalent concentration (TEQ).

3.2.2. Evaluation of Laboratory Limits

The COPC selection procedure focuses only on chemicals that have been detected. Excluding chemicals that are not detected is appropriate provided data were collected using analytical methods with detection limits that would have detected the chemical if it were present at a level of concern. Therefore, to ensure that analytical detection limits were adequate to support risk

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[2] Excess cancer risk can be expressed in several formats. A cancer risk expressed in a scientific notation format as 1E-06 is equivalent to 1 in 1,000,000 or 10^{-6}. For the purposes of this document, all cancer risks are presented in a scientific notation format (i.e., 1E-06).

[3] Use of a target HQ of 0.1 differs from the recommendation in DTSC HERO Note 3 (which states a target HQ of 1 should be used). Use of a target HQ of 0.1 is preferred by NPS and is a more conservative (i.e., health protective) approach for the purposes of identifying COPCs.

management decision-making, method-specific limits for each non-detected analyte in each medium were compared to the risk-based screening levels.

There are two different types of laboratory limits identified in the laboratory deliverables—a method detection limit (MDL) and a reporting limit (RL). The MDL is defined as the minimum concentration of a chemical that can be measured and reported with 99% confidence it is present above zero. The RL is an arbitrary number defined by the laboratory and is sometimes set equal to the practical quantitation limit (PQL). PQLs are often equal to the lowest laboratory standard level within the sample set and are normally about 3 to 10 times higher than the MDL. Confidence in reported concentrations above the PQL is higher than for concentrations between the MDL and the PQL.

For the soil analytical results provided in the FIR (Shaw, 2010), the detect/non-detect status (i.e., U-qualified) for a chemical was determined based on the MDL. If the chemical was not present at a level above the MDL, the result was qualified with "U" and reported as non-detect. When the chemical was present at a concentration between the MDL and the RL, the result was qualified with the "J" qualifier and reported as an estimated concentration. Note that J-qualified data are considered by regulatory agencies as acceptable for use in risk assessments.

Whether the MDL for each chemical was low enough to detect a concentration that might be of concern for human health risk was determined by comparing the maximum MDL (across all non-detect samples) to the lowest available human health screening level. The comparisons for surface soil and subsurface soil analytical results are presented in Attachments A-1 and A-2. For those chemicals in which the maximum MDL is higher than the lowest available screening level, the MDL was deemed to be inadequate. Only three chemicals in soil samples were found for which the MDL was not adequate relative to the human health screening levels:

- Antimony
- Thallium
- Dibenz(a,h)anthracene.

Each of these three chemicals was identified as a COPC based on a detected exceedance of the screening value in at least one sample from surface or subsurface soils. The 2010 FIR only tabulated chemicals with detected concentrations in at least one sample; those chemicals that were never detected, which consist of all VOCs and most non-PAH SVOCs, were not tabulated in the FIR (Shaw 2010) and the MDLs are not tabulated in Attachment A. However, the raw laboratory analytical data presented in Appendix D of the FIR provides MDLs for non-detected VOCs and SVOCs. The MDLs range for VOCs from 2.0 to 2.6 µg/kg and for SVOCs from 170 to 350 µg/kg. These MDLs are sufficiently low to be adequate for purposes of identifying COPCs for human health risk.

3.3. Exposure Assessment

Exposure is the process by which human or ecological receptors come into contact with chemicals in the environment. In general, receptors can be exposed to chemicals in a variety of environmental media (e.g., soil, water, air), and these exposures can occur through several routes (e.g., ingestion, inhalation, dermal contact). The following sections describe the basic equations and selected parameter inputs used to quantify exposures for the populations of interest for the Site.

3.3.1. Basic Equations

Ingestion Exposures

The amount of a chemical that is ingested is referred to as "intake" or "dose." For chemicals other than lead, exposure is quantified using an equation of the following general form:

$$DI = C \times (IR / BW) \times (EF \times ED / AT) \times RBA$$

where:

DI = daily intake of chemical (milligram of chemical per kilogram of body weight per day [mg/kg BW-day]).

C = concentration of the chemical in the contaminated environmental medium (soil) to which the person is exposed. The units are milligrams per kilogram (mg/kg) for soil.

IR = intake rate of the contaminated environmental medium. The units are kg/day for soil.

BW = body weight of the exposed person (kg).

EF = exposure frequency (days/year). This describes how often a person is likely to be exposed to the contaminated medium over the course of a typical year.

ED = exposure duration (years). This describes how long a person is likely to be exposed to the contaminated medium during their lifetime.

AT = averaging time (days). This term specifies the length of time over which the average dose is calculated. Two different averaging times are considered:

- Chronic exposure includes averaging times on the scale of years. For this Site, exposures for exposures to non-carcinogenic chemicals are averaged for recreational time periods for children and adults, and for assumed working time periods for Park workers. This exposure duration is used when assessing non-cancer risks.

- Lifetime exposure is used for evaluated risks from exposure to carcinogenic chemicals, and assumes an averaging time of 70 years.

RBA = relative bioavailability (unitless). This is a ratio of the amount absorbed from site media compared to amount absorbed in toxicity tests.

Dermal Exposures

Dermal exposures are evaluated following the methodology presented in USEPA's Risk Assessment Guidance for Superfund (RAGS) Part E: Supplemental Guidance for Dermal Risk Assessment (USEPA 2004a). Exposure to a chemical by the dermal route is generally expressed in terms of the amount of chemical that is absorbed into the body, rather than the amount ingested or inhaled. The amount of a chemical absorbed across the skin is referred to as the dermally absorbed dose (DAD), which is quantified using an equation of the following general form (USEPA 2004a):

$$DAD = DAevent \times EF \times ED \times EV \times SA / (BW \times AT)$$

where:

DAD = dermally absorbed dose (mg/kg BW-day).

DAevent = absorbed dose per event (mg of chemical per square centimeter of skin surface area per event [mg/cm^2/event]). This factor is media-specific and further described below.

EF = exposure frequency (days/year). This describes how often a person is likely to be exposed to the contaminated medium over the course of a typical year.

ED = exposure duration (years). This describes how long a person is likely to be exposed to the contaminated medium during their lifetime.

EV = event frequency (events/day). This describes the number of times per day a person comes into contact with a contaminant in soil.

SA = surface area (cm^2). This describes the amount of skin exposed to the contaminated media.

BW = body weight of the exposed person (kg).

AT = averaging time (days). This term specifies the length of time over which the average dose is calculated.

For chemicals in soil, DAevent is estimated as follows:

$$DAevent = EPC \times CF \times DAF \times ABSd$$

where:

EPC = exposure point concentration in soil (mg/kg).

CF = conversion factor (10^{-6} kg/mg)

DAF = dermal adherence factor (mg/cm^2/event). This describes the amount of soil that adheres to the skin per unit of surface area

ABSd = dermal absorption fraction (unitless). This value is chemical-specific and represents the contribution of absorption of a chemical across a person's skin from soil to the systemic dose.

Inhalation Exposures

Inhalation exposures are evaluated in accordance with the inhalation dosimetry methodology presented in USEPA's Risk Assessment Guidance for Superfund (RAGS) Part F: Inhalation Risk Assessment (USEPA 2009a).

In accordance with USEPA (2009a), the human intake equation does not include an inhalation rate (cubic meter [m^3]/day) or body weight because the amount of the chemical that reaches the target site is not a simple function of these factors. Instead, the interaction of the inhaled contaminant with the respiratory tract is affected by factors such as species-specific relationships of exposure concentrations to deposited/delivered doses and physiochemical characteristics of the inhaled contaminant (USEPA 2009a).

Therefore, the inhaled exposure concentration (EC) for chronic exposures is calculated as follows:

$$EC = EPC_{air} \times (ET \times EF \times ED / AT)$$

where:

EC = exposure concentration (milligrams or micrograms per cubic meter [mg/m^3 or µg/m^3] of air). This is the time-weighted average (TWA) concentration based on the characteristics of the exposure scenario being evaluated.

EPC_{air} = concentration of the chemical in air (mg/m^3) to which the person is exposed.

ET = exposure time (hours/day). This describes how long a person is likely to be exposed to the contaminated medium over the course of a typical day.

EF = exposure frequency (days/year). This describes how often a person is likely to be exposed to the contaminated medium over the course of a typical year.

ED = exposure duration (years). This describes how long a person is likely to be exposed to the contaminated medium during their lifetime.

AT = averaging time (hours). This term specifies the length of time over which the TWA concentration is calculated.

3.3.2. Exposure Parameters

For every exposure pathway and route of potential concern, it is expected that there will be differences between different individuals in the level of exposure at a specific location due to differences in intake rates, body weights, exposure frequencies, and exposure durations. Thus, there is normally a wide range of average daily intakes between different members of an exposed population. In order to account for this range, daily intake calculations are based on intakes that are considered average or are otherwise near the central portion of the range, and on intakes that are near the upper end of the range. These two exposure estimates are intended to capture the range of exposures that would reasonably be expected for a given human population, and are referred to as central tendency exposure (CTE) and reasonable maximum exposure (RME), respectively. Both CTE and RME receptors are evaluated in the HHRA; however, in accordance with risk assessment guidance (USEPA 1991b), risk management decisions are based on the RME.

Tables 3-2 and 3-3 present the CTE and RME exposure parameters for Park workers and visitors, respectively. The values were selected based on site information, USEPA or DTSC HERO default guidelines (USEPA 2011, 2014; DTSC HERO Note 1), or professional judgement, which includes considering precedence set at similar sites in Yosemite National Park, which are based on recommendations from Park personnel and agency regulators. Note that while the total amount of time spent at the Park may be higher, it is not reasonable to assume the entirety of a receptor's time at the Park would be spent at the Site, particularly given its location. Therefore, lower exposure time, frequency, and duration values were selected for use in estimating site-specific risks.

3.3.3. Exposure Point Concentrations

Soil

An exposure point (also referred to as an exposure unit or exposure area) is an area where a receptor may be exposed to one or more environmental media. Based on the assumption of random exposure over an exposure area, risk from a chemical is related to the arithmetic mean concentration of that chemical averaged over the entire exposure area. Because the true arithmetic mean concentration cannot be calculated with certainty from a limited number of measurements, USEPA recommends that the 95 percent upper confidence limit (95UCL) of the arithmetic mean be used as the exposure point concentration (EPC) when calculating exposure and risk at that location (USEPA 1992b). The mathematical approach that is most appropriate for computing the 95UCL of a dataset depends on several factors, including the number of data points available, the shape of the distribution of the values, and the degree of censoring (USEPA 2002a).

For most receptors, given the long-term nature of the exposure scenario (i.e., multiple days and years of exposure) and small size of the Site, it is likely that human receptors would be exposed to soils across the Site, rather than preferentially to one part of the Site, with the exception of the construction activities discussed below. Therefore, for surface soil (0 to 6 inches bgs) and subsurface soils (1 to 6 feet bgs), exposures were evaluated on a sitewide basis. For both surface and subsurface soils, 95UCLs were derived using the USEPA ProUCL model. The EPC was set equal to the recommended 95UCL, unless the 95UCL was higher than the maximum concentration, then the maximum value was used.

EPCs for surface soil were also calculated for the background samples. Background soil samples are available from samples located upgradient of the Site, at 1 foot bgs. Background EPCs are used to provide a frame of reference for interpreting site risks, by comparing risks associated with background exposures.

Tables 3-4 and 3-5 present the EPCs for surface soil and subsurface soil, respectively, that are used to quantify exposures in the HHRA.

Air

No measured data on air concentrations at the Site are available. Therefore, air concentrations were estimated from soil to evaluate inhalation exposures from airborne fugitive dust. There were no volatile COPCs identified for soil; therefore, no evaluation of inhalation of chemical vapors derived from soil was performed. A particulate emission factor (PEF) was used to estimate chemical concentrations in airborne dust for non-volatile contaminants from fugitive dust emission. Chemical concentrations in outdoor air were calculated as follows:

$$EPC_{air} = EPC_{soil} / (PEF) \times \text{fraction contaminated}$$

where:

EPC_{air} = exposure point concentration in air (milligrams per cubic meter [mg/m^3])

EPC_{soil} = concentration in soil (mg/kg); as presented as the EPCs in Tables 3-4 and 3-5

PEF = soil-to-air particulate emission factor (m^3/kg)

fraction contaminated = assumed to be 100% of the soil is contaminated.

For park visitors, the PEF is equal to the default value of 1.36E+09 m^3/kg (USEPA 2002b; DTSC HERO Note 1). For NPS employees and construction workers, because both types of worker may engage in digging activities, the PEF is equal to the default construction worker value of 1.00E+06 m^3/kg, as recommended in DTSC HERO Note 1.

The derivation of air particulate EPCs for each human receptor population is presented in Table 3-6.

3.4. Toxicity Assessment

3.4.1. Overview

The objective of a toxicity assessment is to identify the adverse health effects caused by a chemical and how the appearance of these adverse effects relates to the exposure dose. The toxic effects of a chemical often depend on the route of exposure (oral, inhalation, dermal) and the duration of exposure. Thus, a full description of the toxic effects of a chemical includes a listing of what adverse health effects the chemical may cause and how the occurrence of these effects depends upon dose, route, and duration of exposure.

The toxicity assessment process is usually divided into two parts: the first characterizes and quantifies the non-carcinogenic (non-cancer) effects of the chemical, and the second addresses the carcinogenic (cancer) effects of the chemical. This two-part approach is employed because there are typically major differences in the time-course of action and the shape of the dose-response curve for cancer and non-cancer effects.

3.4.2. Non-cancer Effects

Essentially all chemicals can cause adverse health effects at a sufficient dose. However, when the dose is sufficiently low, typically no adverse effect is observed. Thus, in characterizing the non-cancer effects of a chemical, the key parameter is the threshold dose at which an adverse effect first becomes evident. Doses below the threshold are considered safe, whereas doses above the threshold are likely to cause an effect.

The threshold dose is typically estimated from toxicological data (derived from studies of humans and/or animals) by finding the highest dose that does not produce an observable adverse effect and the lowest dose that does produce an effect. These are referred to as the “no observed adverse effect level” (NOAEL) and the “lowest observed adverse effect level” (LOAEL), respectively. The threshold is presumed to lie in the interval between the NOAEL and the LOAEL. However, to be conservative (protective), non-cancer risk evaluations are not based directly on the threshold exposure level but on a value referred to as the reference dose (RfD) for oral exposures or the reference concentration (RfC) for inhalation exposures.

The RfD and RfC are estimates (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

The RfD and RfC values are derived from the NOAEL or LOAEL by dividing by an uncertainty factor (UF) that reflects the limitations of the data used. If the data are from studies in humans and if the observations are considered reliable, the UF may be as small as 1.0. However, the UF is normally at least 10 and can be much higher if the data are limited. UFs are assigned to account for uncertainty arising from extrapolation of animal data to humans, the use of a LOAEL instead of a NOAEL, the use of less than chronic exposure, and other limitations in the available data (e.g., lack of reproductive data).

The effect of dividing the NOAEL or the LOAEL by a UF is to ensure that the RfD or RfC is not higher than the threshold level for adverse effects. Thus, there is always a margin of safety built into an RfD and RfC, and levels equal to or less than the RfD or RfC are nearly certain to be without any risk of adverse effect. Levels higher than the RfD or RfC may carry some risk, but because of the margin of safety, a level above the RfD or RfC does not mean that an effect will necessarily occur. The protectiveness of this margin of safety will vary from chemical to chemical, depending upon the quality of the data and the size of any applied UF. A chemical for which a large UF has been applied will generally have a higher margin of safety than a chemical with a smaller UF.

3.4.3. Cancer Effects

For cancer effects, the toxicity assessment process has two components. The first is a qualitative evaluation of the weight of evidence (WOE) that the chemical does or does not cause cancer in humans. Previously, this evaluation was performed by USEPA using the system summarized below:

WOE Group	Meaning	Description
A	Known human carcinogen	Sufficient evidence of cancer in humans
B1	Probable human carcinogen	Suggestive evidence of cancer incidence in humans
B2	Probable human carcinogen	Sufficient evidence of cancer in animals but lack of data or insufficient data in humans
C	Possible human carcinogen	Suggestive evidence of carcinogenicity in animals
D	Cannot be evaluated	No evidence or inadequate evidence of cancer in animals or humans
E	Not carcinogenic to humans	Strong evidence that it does not cause cancer in humans

USEPA has developed a revised classification system for characterizing WOE for carcinogens (USEPA 2005a). However, this system has not yet been implemented for several chemicals; thus, the older classification system is retained for use in this assessment.

For chemicals classified in Groups A, B1, B2, or C, using the USEPA guidelines (USEPA 1986), the second part of the toxicity assessment is to describe the carcinogenic potency of the chemical. This is done by quantifying how the number of cancers observed in exposed animals or humans increases as the dose increases. Typically, it is assumed that the dose-response curve for cancer has no threshold, arising from the origin and increasing linearly until high doses are reached. Thus, the most convenient descriptor of cancer potency is the slope of the dose-response curve at low doses (where the slope is still linear). This slope is referred to as the slope factor (SF), which has dimensions of risk of cancer per unit dose.

Estimating the cancer SF is often complicated by the fact that observable increases in cancer incidence usually occur only at relatively high doses, frequently in the part of the dose-response curve that is no longer linear. Thus, it is necessary to use mathematical models to extrapolate from the observed high dose data to the desired (but unmeasurable) slope at low dose. To account for the uncertainty in this extrapolation process, USEPA typically chooses to employ the 95UCL of the slope as the SF. That is, there is a 95% probability that the true cancer potency is lower than the value chosen for the SF. This approach ensures that there is a margin of safety in cancer and non-cancer risk estimates.

For inhalation exposures, cancer risk is characterized by an inhalation unit risk (IUR) value. This value represents the upper-bound excess lifetime cancer risk estimated to result from continuous lifetime exposure to a chemical at a concentration of 1 $\mu g/m^3$ in air.

3.4.4. Toxicity Values

Ingestion and Inhalation Exposures

Toxicity values (RfD, RfC, SF, and IUR values) established by USEPA are listed in the Integrated Risk Information System (IRIS) (USEPA 2020a). Other toxicity values are available as interim recommendations from USEPA's Superfund Technical Assistance Center operated by the National Center for Environmental Assessment (NCEA). A toxicity value hierarchy was developed by USEPA for use in site-specific risk assessments (USEPA 2003a). This hierarchy provides an order of preference of toxicity values, with Tier 1 being the preferred source of toxicity information if available, then Tier 2, followed by Tier 3. The recommended hierarchy of toxicity values is as follows:

- Tier 1 – USEPA’s IRIS: IRIS assessments have undergone external peer review in accordance with USEPA peer review guidance at the time of the assessment. IRIS health assessments contain USEPA consensus toxicity values.

- Tier 2 – USEPA’s PPRTVs: The Office of Research and Development/NCEA/Superfund Health Risk Technical Support Center develops PPRTVs on a chemical-specific basis when requested by USEPA’s Superfund program.

- Tier 3 – Other Toxicity Values: Tier 3 includes additional USEPA and non-USEPA sources of toxicity information, such as CalEPA and the Agency for Toxic Substances and Disease Registry (ATSDR). Priority should be given to those sources of information that are the most current, the basis for which is transparent and publicly available, and which have been peer-reviewed.

A table of toxicity values derived from these sources using the tiered system described above is maintained by USEPA as part of the RSL tables and updated bi-annually (USEPA 2020b). All toxicity values used in this assessment were taken from the most recent version of the RSL tables. Table 3-7 presents the human health toxicity values for each COPC:

For several chemicals (e.g., arsenic), the CalEPA OEHHA has developed alternate toxicity values for use in California, which differ from the values identified in IRIS. In addition, CalEPA has specified an alternate toxicity value hierarchy (DTSC HERO Note 10), in which CalEPA OEHHA toxicity values are given preference over IRIS, unless the IRIS values are more stringent. The CalEPA toxicity values that are used in this HHRA are presented in Table 3-7 (identified under Source "C"). For the purposes of this HHRA, risk calculations are performed using the USEPA hierarchy (i.e., preferentially using IRIS toxicity values).

Additional considerations for specific COPCs are discussed below:

- For cadmium, two oral RfD values are available, depending on exposure medium (diet or water). The value for water is assumed to apply to surface water exposures, of which there are none at this Site, whereas the value for diet is assumed to apply to all other media (i.e., soil and air).

- In the environment, chromium may be present in various valence states, but the trivalent form and the hexavalent form are the most predominant, depending upon the nature of the contamination source and environmental conditions (Shahid *et al.* 2017). Hexavalent chromium was not detected in site soils, and human health risk calculations were performed assuming the form of chromium present in the collected soil samples was trivalent.

Dermal Exposures

Oral toxicity factors (oral RfDs and oral SFs) are expressed in terms of toxicity per unit dose of chemical ingested, rather than in terms of toxicity per unit amount of chemical absorbed. However, the equations for characterizing dermal contact with chemicals provides exposure values that are based on absorbed dose rather than ingested dose. Thus, oral RfD and SF values must be adjusted for use in evaluating dermal exposures as follows:

$$RfD(dermal) = RfD(oral) \times \text{oral absorption fraction}$$

$$SF(dermal) = SF(oral) / \text{oral absorption fraction.}$$

Table 3-7 lists the oral absorption fractions (GIABS) used to adjust oral toxicity values for use in assessing dermal exposure, as recommended in USEPA (2004a). If chemical-specific oral absorption fractions are not available or if the GIABS value is greater than 0.5 (50%), a value of 1.0 (100%) is assumed in accordance with dermal guidance (USEPA 2004a).

3.4.5. Relative Bioavailability

An accurate assessment of human exposure to ingested chemicals requires knowledge of the amount of chemical absorbed from the gastrointestinal tract into the body from site media compared to the amount of absorption that occurred in the toxicity studies used to derive the toxicity factors. This ratio (amount absorbed from site media compared to the amount absorbed in toxicity tests) is referred to as RBA.

In general, metals in soil exist in mineral forms that are not rapidly solubilized in gastrointestinal fluids when ingested, whereas toxicity studies often utilize readily soluble forms of the test chemical. Thus, oral RBA values for metals in soil are often less than 1.0. For the purposes of the risk estimates, with the exception of arsenic, it was assumed the oral RBA values for all COPCs was 1.0. This assumption is likely to result in an overestimation of exposure and risk, especially for metals in soil. For arsenic, because no site-specific estimates of bioavailability are available, the USEPA default RBA of 0.60 was assumed (USEPA 2012).

3.5. Risk Characterization

3.5.1. Basic Approach

The following subsections provide the basic approach for characterizing risks for non-cancer and cancer effects from exposure to non-lead COPCs.

Non-cancer Effects

Hazards from Ingestion and Dermal Contact

The potential for non-cancer effects from site-related ingestion exposures is evaluated by comparing the estimated exposure from site media to an exposure level that is believed to be safe (USEPA 1989). This ratio is called an HQ and is calculated as follows for ingestion and dermal contact exposures:

$$HQ = NCADD / RfD$$

where:

HQ = hazard quotient

NCADD = non-carcinogen average daily dose (mg/kg-day)

RfD = reference dose (mg/kg-day)

Hazards from Inhalation

For inhalation exposures, the potential for non-cancer effects is evaluated by comparing the time-weighted EC over a specific period to the RfC for that chemical as follows (USEPA 1994) :

$$HQ = NEC / RfC$$

where:

HQ = hazard quotient

NEC = non-carcinogen exposure concentration (mg/m^3)

RfC = inhalation reference concentration (mg/m^3).

Hazard Interpretation

If the HQ for a chemical is less than or equal to 1, it is believed there is no appreciable risk that non- cancer health effects will occur. If an HQ exceeds 1, non-cancer effects could occur although an HQ above 1 does not indicate an effect will definitely occur. This is because the margin of safety inherent in the derivation of all RfD values will likely lead to overestimation of non-cancer hazards. However, the larger the HQ value above 1, the greater is the concern that adverse health effects may occur.

If an individual is exposed to more than one chemical, a screening level estimate of the total non-cancer risk is derived simply by summing the HQ values for that individual. This total is referred to as the hazard index (HI). If the HI value is less than or equal to 1, non-cancer risks are not expected from any chemical, alone or in combination with others. If the screening level HI exceeds 1, it may be appropriate to perform a follow-on evaluation in which HQ values are added only across chemicals that affect the same target tissue or organ system. This is because chemicals that do not cause toxicity in the same tissues are not likely to cause additive effects.

Cancer Effects

Risks from Ingestion and Dermal Contact

The excess risk of cancer from exposure to a chemical is described in terms of the probability that an exposed individual will develop cancer because of that exposure. The excess risk of cancer from ingestion and dermal contact exposure to a chemical is calculated as follows (USEPA 1989):

$$\text{Excess cancer risk} = 1 - \exp(-CADD \times SF)$$

where:

CADD = carcinogen

average daily dose, averaged over a lifetime (mg/kg-day)

SF = slope factor $(\text{mg/kg-day})^{-1}$

In most cases (except when the product of CADD × SF is larger than about 0.01), this equation may be approximated by the following:

$$\text{Excess cancer risk} = \text{CADD} \times \text{SF}$$

Risks from Inhalation

The excess risk of cancer from inhalation exposure for non-radionuclide chemicals is calculated based on IUR values as follows (USEPA 2009a):

$$\text{Excess cancer risk} = \text{CEC} \times \text{IUR}$$

where:

CEC = carcinogen exposure concentration $(\mu g/m^3)$

IUR = inhalation unit risk $(\mu g/m^3)^{-1}$

Risk Interpretation

Excess cancer risks are summed across all carcinogenic chemicals and all exposure routes that contribute to exposure of an individual in a given population. In general, NPS employs a threshold of 1E- 06 when evaluating the potential need for remedial actions. Risks that are below 1E-06 are so small as to be negligible, and risks that are above 1E-06 may warrant additional evaluation or some sort of remediation.

3.5.2. Risk Summary

Detailed risk estimates for each receptor, exposure route, and COPC are presented in Attachment B. Tables 3-8 and 3-9 summarize the total HI and cancer risks, respectively, for exposures to surface soil and subsurface soil for each human receptor population. These tables highlight which exposure scenarios have total excess cancer risks greater than 1E-06 or non-cancer HIs greater than 1. Risk estimates for the site-specific background samples are provided for those COPCs for which risk estimates exceed the target levels. Only TPH fractions in subsurface soils were found to have non-cancer risk estimates exceeding the target level of HQ of 1, for the construction worker; risk estimates for exposures of construction workers to background subsurface soil samples are provided to provide a frame of reference for interpreting risk estimates for that receptor population.

As Tables 3-8 and 3-9 illustrate, only the construction worker exposed to subsurface soils resulted in non-cancer HIs greater than 1 for both the CTE and RME scenarios, at HQs of 2 and 4, respectively. The non-cancer risks are driven largely by dermal contact with TPH in subsurface soils under the construction worker scenario exposures assumptions (Table 3-8). No scenarios resulted in cancer risks greater than 1E-06 based on either RME or CTE exposures. Background non-cancer risks for TPH fractions are far below the target level.

These risk estimates support a conclusion that current and future exposures to non-lead contaminants at the Site would not result in unacceptable human health risks for current park visitors or NPS employees that are not exposed to subsurface soils, but could present unacceptable risks to future construction workers. Potential risks from exposure to lead in Site soils are described in the following section.

3.6. Risk Characterization for Lead

As shown in Table 3-1, lead was identified as a COPC for surface and subsurface soils. The exposure equations and toxicity values presented in Sections 3.3 and 3.4 are specific to non-lead COPCs; risks from lead are evaluated using a different approach than for most other chemicals. First, because lead is widespread in the environment, exposure can occur from many different sources. Thus, lead risks are usually based on consideration of total exposure (all sources) rather than just site-related sources. Second, because studies of lead exposures and resultant health effects in humans have traditionally been described in terms of blood lead level, lead exposures and risks are typically assessed by describing the levels of lead that may occur in the blood of exposed populations and comparing these to blood lead levels of potential health concern[4]. For convenience, the concentration of lead in blood is usually abbreviated PbB, and is expressed in units of micrograms per deciliter (µg/dL).

Concern over health effects from elevated blood lead levels is greatest for young children or the fetus of pregnant women. There are several reasons for this focus on young children or the fetus, including the following: (1) young children typically have higher exposures to lead-contaminated media per unit body weight than adults, (2) young children typically have higher lead absorption rates than adults, and (3) young children and fetuses are more susceptible to effects of lead than are adults. When adults are exposed, the sub-population of chief concern is pregnant women and women of child-bearing age, because the blood lead level of a fetus is nearly equal to the blood lead level of the mother (Goyer 1990).

[4] https://www.epa.gov/superfund/lead-superfund-sites-risk-assessment

The Centers for Disease Control (CDC)[12] has identified a reference level of 5 µg/dL to identify children with elevated blood lead levels. This PbB level is based on the U.S. population of children ages 1 to 5 years who are in the highest 2.5% of children when tested for lead in their blood. The reference level is based on the 97.5th percentile of the National Health and Nutrition Examination Survey (NHANES) blood lead distribution in children (based on data from 2007–2010). USEPA has set a goal when quantifying lead exposures in risk assessment that there should be no more than a 5% chance that a child will have a blood lead value above the target level, which for CDC is 5 µg/dL.

USEPA has identified 10 µg/dL as the concentration level at which effects begin to occur that warrant avoidance and has set as a goal that there should be no more than a 5% chance that a child will have a blood lead value above 10 µg/dL (USEPA 1994b). However, USEPA's Office of Land and Emergency Management Directive 9200.2-167 (USEPA 2016a), discusses evidence that adverse health effects are associated with PbB less than 10 µg/dL. USEPA's Office of Research and Development reviewed the health effects evidence for lead and found that several studies have observed "clear evidence of cognitive function decrements [as measured by Full Scale intelligence quotient (IQ), academic performance, and executive function] in young children with mean or group PbB between 2 and 8 µg/dL" (USEPA 2016a).

CalEPA's OEHHA has identified a different basis for the child-specific health guidance value for lead (OEHHA 2007). OEHHA identified a change of 1 IQ point as the benchmark response. One µg/dl is the estimated incremental increase in children's PbB that would reduce IQ by up to 1 point (DTSC HERO Note 3).

3.6.1. Exposure Models

USEPA recommends the use of toxicokinetic models to correlate blood lead concentrations with exposure and adverse health effects. USEPA recommends the use of the Integrated Exposure Uptake Biokinetic (IEUBK) model to evaluate exposures from lead-contaminated media in young children in a residential setting (USEPA 1994b) and Adult Lead Methodology (ALM) to evaluate potential risks from lead exposure in adults (females of child-bearing age) (USEPA 2003b). Both the IEUBK model and ALM can be used to predict PbB concentrations in exposed individuals and estimate the probability of a PbB concentration exceeding a level of concern. DTSC has also developed a lead exposure model, referred to as LeadSpread, which quantifies potential levels of concern based on a 1-µg/dL increase in PbB. LeadSpread is intended to evaluate lead exposures for children under a residential land use scenario (DTSC 2011).

3.6.2. Evaluation of Intermittent Exposures

All the standard PbB models (i.e., IEUBK, ALM, LeadSpread) are designed to evaluate approximately continuous exposures (e.g., residential exposures over 350 days per year) and assume a near steady-state relationship between the lead concentration in the environmental exposure media and the PbB level in the exposed individual. However, for the exposure scenarios of concern at the Site, exposures are intermittent and occur much less frequently than a residential exposure. When exposures are intermittent, use of these PbB models becomes more challenging.

The USEPA Technical Review Workgroup for Lead (USEPA 2003c) has recommended the IEUBK model and ALM only be applied to exposures that satisfy two criteria:

- The exposure frequency during the exposure interval is at least 1 day per week.
- The duration of the exposure interval is at least 3 consecutive months.

Three months is considered to be the minimum exposure duration to produce a quasi-steady-state PbB concentration. The reliability of the models for predicting PbB concentrations for exposure durations shorter than 3 months has not been assessed. As shown in Tables 3-2 and 3-3, only the construction worker exposure scenarios meet these minimum criteria. Risks to adults and children are less than those estimated for the developing fetus, due to less exposure as well as less sensitivity.

3.6.3. Long-term Exposures for Adult Workers

Lead risks for NPS employees and restoration workers were calculated using ALM and assume these workers are adult women of child-bearing age. The following sections describe the basic approach for estimating lead risks, specify the input parameters used in the model, and summarize the estimated risks.

Basic Approach

The ALM (USEPA 2003b, 2009b) predicts the blood lead level in a person with a site-related lead exposure by summing the baseline blood lead level (PbB0) (that which would occur in the absence of any site-related exposures) with the increment in blood lead that is expected as a result of increased exposure due to contact with a lead-contaminated site medium. The latter is estimated by multiplying the average daily absorbed dose of lead from site-related exposures by a biokinetic slope factor (BKSF). Thus, the basic equation for exposure to lead is:

$$PbB = PbB0 + BKSF \times \Sigma\, (Cm \times IRm \times AFm)$$

where:

PbB = Geometric mean blood lead concentration (µg/dL) in women of child-bearing age that are exposed at the Site

PbB0 = Background geometric mean blood lead concentration (µg/dL) in women of child-bearing age in the absence of exposures to the Site

BKSF = Biokinetic slope factor (µg/dL blood lead increase per µg/day lead absorbed)

C_m = Lead concentration in medium "m", expressed in units of µg/gram (g) (soil), µg/kg (tissue), µg/L (water), or µg/m^3 (air)

IR_m = Intake rate of medium "m", expressed in units of g/day (soil), g/day (tissue), L/day (water), or m^3/day (air)

AF_m = Absorption fraction of lead from medium "m" (dimensionless).

Once the geometric mean (GM) blood lead value in adult women who are exposed at the Site is calculated, the full distribution of likely blood lead values in the population of exposed individuals can then be estimated by assuming the distribution is lognormal with a specified individual geometric standard deviation (GSDi). The 95th percentile of the predicted distribution is given by the following equation:

$$95^{th} = GM \cdot GSDi^{1.645}$$

ALM Input Parameters

In accordance with USEPA guidance, inputs to the blood lead models are recommended to be central tendency point estimates, meaning exposure parameters are intended to represent CTE (not RME) exposure parameters. For this modeling, both CTE and RME assumptions are modeled. Table 3-2 presents the CTE and RME exposure parameters for NPS employees and construction workers. Because the construction worker has the highest soil ingestion rate and exposure frequency, lead risk estimates focused on this receptor.

USEPA guidance states that EPCs for lead in environmental source media should be set equal to the arithmetic mean (USEPA 1994b). However, CalEPA recommends the use of 95UCLs (DTSC HERO Note 3). For conservatism and consistency with the EPCs used for non-lead COPCs, 95UCLs were also used as the basis of the EPC for lead in soil. Tables 3-4 and 3-5 present the EPCs for lead in surface soil and subsurface soil, respectively.

Table 3-10 presents the ALM site-specific input values for construction worker exposures and the USEPA-recommended default values for the model input factors (USEPA 2017).

Risk Summary

The results of the ALM for exposures of construction workers to lead in surface and subsurface soils are presented in Table 3-10 for both CTE and RME scenarios. The table shows the probabilities of PbB values exceeding 5 µg/dL (the target PbB for CDC) and 10 µg/dL (the target PbB for USEPA) in the fetuses of pregnant women exposed as construction workers at the Site. As the table depicts, the probability of exceeding the target PbB of 5 µg/dL is well below 5% for surface soils; however, the probability of exceeding the target PbB due to subsurface soil exposures is 26% and 98% under the CTE and RME scenarios, respectively. These results suggest that risks to a fetus from maternal exposure to subsurface soils under the construction worker scenario at the Mather FWDA site would be at unacceptable levels.

3.6.4. Short-term Exposures for Park Visitors

As described above, the recommended PbB models are designed to evaluate long-term (chronic) exposures and the reliability of the models for exposure durations shorter than 3 months has not been assessed. Park visitors are likely to have short and infrequent exposures to site media much less than the minimum recommended frequency to allow use of the conventional PbB models. USEPA is in the process of updating the All Ages Lead Model, which will allow for the evaluation of shorter episodic lead exposures; however, this model has not been formally released for use and is not available on the USEPA lead model website. Therefore, for the purposes of this risk assessment, short-term lead exposures for Park visitors were only evaluated qualitatively.

Given that adult Park visitors have a lower exposure frequency and soil ingestion rate than the construction worker, and are exposed only to surface soils, and that construction worker exposures to surface soils did not result in unacceptable risks for blood lead levels, it is likely that the less frequent adult Park visitor exposures to lead would also be below a level of concern.

3.7. Uncertainty Assessment

Confidence in quantitative estimates of risks to humans from environmental contamination may be limited by uncertainty regarding several key data items. These uncertainties are usually addressed by making assumptions or estimates for uncertain parameters based on whatever limited data are available. Because of these assumptions and estimates, the results of risk calculations are themselves uncertain, and it is important for risk managers and the public to keep this in mind when interpreting the results of a risk assessment. The following sections review the main sources of uncertainty in the risk calculations performed at the Site.

3.7.1. Exposure Assessment

Uncertainties from Exposure Pathways and Routes Not Evaluated

As discussed above, humans may be exposed to site-related chemicals by several pathways and routes, but not all pathways and routes were evaluated quantitatively in this risk assessment. This is because the contribution of the pathways or routes excluded from the quantitative assessment is believed to be minor compared to one or more other pathways or routes that were evaluated.

For example, ingestion and dermal contact exposures to surface water in the ephemeral flows are theoretically complete exposure routes for park visitors and NPS employees. Because of the transient nature of the ephemeral flowing water, quantitation of exposures and risks associated with ingestion or dermal contact with the surface water would be highly uncertain and would not pose risks higher than exposures to soil or dust through inhalation. In other words, routes that were not evaluated in the HHRA are likely insignificant compared to the other complete routes that were quantitatively evaluated. Exclusion of exposure to ephemeral surface water flows could result in a small underestimation of exposure and risk, but the magnitude of this underestimation is expected to be too small to affect the conclusions of the risk assessment.

Uncertainties from Chemicals Not Evaluated Quantitatively

Chemicals for which the maximum detected concentration was below the respective screening level were not retained as COPCs and were not evaluated quantitatively in this assessment. Exclusion of these chemicals is not a significant source of uncertainty because the highest level of the chemical detected did not exceed conservative screening levels.

Chemicals that were never detected in Site soils but detection limits exceeded screening levels were not identified as COPCs and were excluded from quantitative evaluation in the risk assessment. Excluding chemicals that are not detected is appropriate provided that the achieved detection limits were low enough to detect a chemical if it were present at a level of concern. The maximum MDL for only a few chemicals in soil were deemed to be inadequate relative to the residential screening levels. The analytical methods employed in the investigation provide the best available detection limits using conventional analytical instruments. As discussed previously in Section 3.2, in many instances, the achieved MDLs were variable; thus, for some chemicals, only a subset of the samples achieved adequate MDLs. Additionally, the residential screening levels used to select COPCs are based on a default exposure frequency of 350 days per year for 26 years, whereas receptor exposures to on-site media are likely to be much less frequent (e.g., 30 days per year at most).

Uncertainties from Excluding Chemicals without Toxicity Factors.

As discussed above, toxicity factors are needed to quantify risks from exposure to chemicals detected in environmental media. Toxicity factors are available for all but a couple of PAH chemicals detected at the Site (see Attachment A). Although no strong conclusions can be reached regarding the potential for risk from chemicals without toxicity factors, it is suspected that the magnitude of the error that results from excluding these chemicals is usually likely to be low. This is because the absence of toxicity information for a chemical is most often because toxicological concern over that chemical is low. That is, chemicals that lack toxicity values have often not been well studied because existing data suggest relatively low toxicity to humans and researchers have focused their studies on chemicals with a higher potential for toxicity.

Uncertainties in Exposure Point Concentrations

In all exposure calculations, the desired input parameter is the true mean concentration of a contaminant within a medium, averaged over the area where random exposure occurs. However, because the true mean cannot be calculated based on a limited set of measurements, USEPA (1989, 1992b) recommends that the exposure estimate be based on the 95UCL. When data are plentiful and inter-sample variability is not large, the 95UCL may be only slightly higher than the mean of the data. However, when data are sparse or are highly variable, the 95UCL may be much higher than the mean of available data. Despite the availability of only five surface soil samples, the 95 UCLs were nonetheless below the maximum concentrations for all COPCs (see Table 3-4).

Compared with the low number of surface soil samples, subsurface soil samples were not as limited, with 11 samples available for most COPCs. With such a small area for this Site, which has an area of approximately 0.5 acres, the high number of subsurface soil samples are assumed to provide a good representation of the levels of contaminants within the waste sources. Due to the focused sampling, measured soil concentrations within each waste pile may be biased high relative to levels in the surrounding area. Thus, because actual receptor exposure areas would encompass locations outside the main waste piles, risk estimates would likely be lower than what is presented in this risk assessment.

In the case of exposures from dust released into air from soil, no measured data were available; therefore, airborne concentrations were estimated using soil-to-air transfer factors (i.e., PEF for airborne dust). In general, such predicted concentration values have high uncertainty compared to measured values; thus, the actual concentrations of COPCs in air are uncertain, and true values might be either higher or lower than the estimated values.

Uncertainties in Human Exposure Parameters

Accurate calculation of risk values requires accurate estimates of the level of human exposure that is occurring. However, many of the required exposure parameters are not known with certainty and must be estimated from limited data or knowledge. For example, data are absent on the exposure frequency and amount of actual soil ingested by park visitors to the Site, and the US EPA (2011) *Exposure Factors Handbook* does not present data on recreational visitors, so the values used in the calculations are based mainly on professional judgment. In general, when exposure data were limited or absent, exposure parameters were chosen in a way that was intended to be conservative. For example, the construction worker RME scenario assumed exposures to subsurface soil would occur for 30 days per year over a period of 3 years (see Table 3-2); given the small areal extent of the Site (i.e., only about 0.5 acres), these exposure assumptions are likely to be conservative.

As illustrated, the values selected are thought to be more likely to overestimate than underestimate actual exposure and risk.

Uncertainties in Chemical Absorption (RBA)

The risk from an ingested chemical depends on how much of the ingested chemical is absorbed from the gastrointestinal tract into the body. This issue is especially important for metals in soil because some of the metals may exist in poorly absorbable forms and failure to account for this may result in a substantial overestimation of exposure and risk. In this assessment, with the exception of arsenic and lead, it was assumed that the RBA was 1.0 (100%) for all COPCs. Use of this assumption is likely to overestimate the true risk, with the magnitude of the error depending on the true RBA value. For arsenic, the USEPA default RBA value was used; i.e., 0.6 (60%) (USEPA 2012). Because risk estimates are already below levels of concern for metals, this uncertainty is unlikely to affect the conclusions of the risk assessment.

3.7.2. Toxicity Assessment

Toxicity information for many chemicals is often limited. Consequently, there are varying degrees of uncertainty associated with toxicity values (e.g., SF, IUR, RfD, RfC). For example, uncertainties can arise from the following sources:

- Extrapolation from animal studies to humans
- Extrapolation from high to low dose
- Extrapolation from continuous to intermittent exposure
- Limited or inconsistent toxicity studies.

In general, uncertainty in toxicity factors is one of the main sources of uncertainty in risk estimates at a site. Because of the conservative methods USEPA uses in dealing with the uncertainties in toxicological information, it is more likely that the uncertainty will result in an overestimation rather than an underestimation of risk.

As noted previously, the CalEPA OEHHA developed alternate toxicity values for several chemicals that differ from the values identified in USEPA's IRIS. The calculations in this risk assessment use the IRIS values. Based on the IRIS toxicity values, cancer risks and non-cancer hazards are below a level of concern. If risks were estimated based on the CalEPA toxicity values for arsenic and chromium, the estimated cancer risk and non- cancer hazard values would be higher, but overall risk conclusions would not change (i.e., risks would still be below a level of concern for all receptor populations).

Uncertainties with Toxicity Values for TPH Fractions

TPH fractions are the only COPCs other than lead to be identified as COCs for human health. Typically, TPH fractions would not be evaluated quantitatively in a risk assessment, instead the assessment would rely on risk estimates associated with the PAH constituents of each TPH fraction. However, as mentioned, the samples with the highest TPH levels were not analyzed for PAH constituents. Because USEPA provides toxicity values for aromatic TPH fractions, risks were estimated for exposures to these TPH fractions, assuming that the fractions could represent exposures to petroleum products at the Site. However, the toxicity values assigned to each TPH fraction is based on the toxicity values developed for a single representative PAH that would be a constituent of that fraction. This method assumes that the toxicity of the measured TPH fraction is equivalent to the toxicity of the representative PAH. For example, the non-cancer toxicity values for the aromatic TPH-High fraction are based on fluoranthene, the representative non-carcinogenic chemical for that fraction, and the cancer toxicity values are based on benzo(a)pyrene, the representative carcinogenic chemical for that fraction (USEPA 2009c).

However, TPH fractions contain multiple PAHs at varying concentrations, each with their own toxicity values, which are proportionally less toxic than the PAHs that represent the fraction. Due to weathering of petroleum hydrocarbons when present in the environment as contaminants, the concentrations of PAH constituents of each aromatic TPH fraction can vary considerably. Therefore, the actual toxicity that may be associated with any TPH fraction measured in environmental media is highly uncertain. Based on this discussion, the toxicity values provided for TPH fractions by USEPA in the PPRTV database[5] are considered to over-predict actual risks associated with the aromatic TPH fractions.

3.7.3. *Risk Characterization*

Because risk estimates for a chemical are derived by combining uncertain estimates of exposure and toxicity (see above), risk estimates for each chemical are more uncertain than either the exposure estimate or the toxicity estimate alone. Additional uncertainty arises from the issue of how to combine risk estimates across different chemicals. In some cases, the effects caused by one chemical do not influence the effects caused by other chemicals. In other cases, the effects of one chemical may interact with effects of other chemicals, causing responses that are approximately additive, greater than additive (synergistic), or less than additive (antagonistic). In most cases, available toxicity data are not sufficient to define what type of interaction is expected; therefore, USEPA generally assumes effects are additive for non- carcinogens that act on the same target tissue and for all carcinogens (all target tissues). Because documented cases of synergistic interactions between chemicals are relatively uncommon at levels of exposure that are environmentally relevant, this approach is likely to be reasonable for most chemicals.

For non-carcinogens, summing HQ values across different chemicals is properly applied only to compounds that induce the same effect by the same mechanism of action. Consequently, summation of HQ values for compounds that are not expected to include the same type of effects or that do not act by the same mechanisms could overestimate the potential for adverse health effects. Thus, all the HI values in this risk assessment, which sum HQ values across multiple COPCs, are likely to overestimate the true level of human health non-cancer hazard.

3.8. Human Health Risk Assessment Conclusions

The HHRA evaluated potential risks to humans, both now and in the future, from exposures to contaminants that may be present at the Site due to the waste debris, assuming no steps are taken to remediate the environment or to reduce human contact with contaminated environmental media. The receptor populations of interest for the risk assessment include Park visitors, NPS employees, and construction workers. The HHRA included an evaluation of chronic exposures to COPCs in soil (surface and subsurface).

Chronic exposures and risks to humans from COPCs were evaluated based on both cancer and non-cancer effects. Estimated total overall risks to Park visitors, NPS employees, and

[5] https://cfpub.epa.gov/ncea/pprtv/chemicalLanding.cfm?pprtv_sub_id=1995

construction workers were below NPS's acceptable risk thresholds for non-cancer and cancer effects (i.e., cancer risks were at or below 1E-06 and non-cancer hazards were less than 1) for all chemicals detected at the Site except for aromatic TPH fractions and lead.

Aromatic TPH fractions were evaluated as surrogates for PAHs, which were not analyzed in the subsurface soil samples with the highest TPH measurements. The risk assessment procedure used USEPA toxicity values for TPH-medium (diesel range fraction) and TPH-high (heavy oil). Based on the TPH results, it can be concluded that site-related chronic exposures to constituents of TPH could result in unacceptable health risks for future construction workers that might be exposed to subsurface soils. For the remaining COPCs, except lead, exposures to surface or subsurface soils would not result in unacceptable risks for any current or future recreational or occupational receptor populations.

Risks from lead were evaluated using a different approach than for the other COPCs, in which exposure models were used to estimate PbB levels for women of child-bearing age. The lead exposure modeling results show that predicted PbB levels from site exposures would exceed target PbB levels of concern for on-site construction workers exposed to subsurface soils. For Park visitors, however, a qualitative evaluation suggests short-term exposures to lead are likely to be below a level of concern. Based on this, it is concluded that exposures to lead in subsurface soils would result in unacceptable risks for construction workers, but Park visitors would unlikely be exposed to lead from surface soils at levels that would present health risks.

Summary of COCs for Human Health

Surface Soil – None

Subsurface Soil:

- Aromatic TPH Fractions
- Lead.

4. Ecological Risk Assessment

This section presents the Ecological Risk Assessment (ERA) for the Site and includes both a Screening Level ERA (SLERA) and an initial Baseline ERA (BERA). The ERA describes the problem formulation, including a summary of the ecological setting, the conceptual model of site contamination, and the ecological management goals and evaluation endpoints for the risk characterization. The BERA provides the exposure assessment, toxicity assessment, risk characterization, and uncertainty assessment for the evaluation of ecological risks at the Site.

4.1. Problem Formulation

Problem formulation is a systematic planning step that identifies the major concerns and issues to be considered in an ecological risk assessment and describes the basic approaches that will be used to characterize ecological risks (USEPA 1997). The following sections summarize the ecological setting of the Site, CSM, and the site management goals.

4.1.1. Ecological Setting

Discussion of the ecological setting of the Mather FWDA includes a general discussion of Yosemite National Park habitat and vegetative communities, sources for species inventory, and a discussion on threatened and endangered species.

Habitat

The Park is located within the Sierra Nevada Ecoregion. The Park contains five major vegetation zones: foothill/woodland, lower montane, upper montane, subalpine, and alpine (NPS 2017). The Mather FWDA is located in the lower montane zone. Vegetation ranges from valley grasslands and woodlands through chaparral-covered slopes to montane coniferous forests and alpine meadows. The Mather Site is within the Ponderosa Pine-California Black Oak-Whiteleaf Manzanita Woodland Association (Harris 2020). No perennial surface water, aquatic habitat, or wetlands are present within the Site.

Field observations performed by Harris (2020) of the access area alongside Hetch Hetchy Road showed about 40% canopy cover with gray pine, ponderosa pine, fir, incense cedar and black oak. There is a midstory of white and greenleaf manzanita at about 30% cover. There is heavy needle litter ground cover and 10% grass cover in the understory. South from the road towards the dump sites transitions into shrub dominated with only 10% tree canopy cover and 40% shrub cover. The manzanita is about 4-6 feet tall. The center of the dump sites is mostly bare ground, with sparse non-native grasses, along with sparse native grasses and herbs. Old trash was found in 2020 to be scattered throughout the tall manzanita.

Wildlife

The Park encompasses 1,200 square miles of scenic wild lands and supports a diversity of plants and wildlife. The Park has more than 300 species of vertebrate animals, and 85 of these are native mammals. Yosemite supports approximately 9 species of amphibians, 20 species of reptiles, 165 species of birds, and 81 species of mammals. Yosemite has a large number of native amphibian and reptile species: 2 toads, 1 chorus frog, 1 true frog, 5 newts and salamanders, 12 snakes (one poisonous), 7 lizards, and 1 turtle. The mammal species inhabiting Yosemite consist of a diverse array, including: five shrews and one mole; seventeen species of bats (including 12 special-status species); seventeen carnivores (e.g., black bear, bobcat, coyote, raccoon, gray fox, mountain lion, ringtail, and several weasel species). Additionally, six species of squirrels, six species of chipmunks, nine species of mice, and other species of rodents, including woodrats, voles, and pocket gophers. Over 150 species of birds regularly occur in the Park, including great gray owls (*Strix nebulosi*) (NPS 2017). Ungulates include large numbers of mule deer. Bighorn sheep formerly populated the Sierra crest, but have been reduced to several remnant populations.

During site visits performed for the 2010 FIR, no wildlife was observed at the site, nor were tracks or burrows noted within or near the FWDA footprint. There was no indication of permanent habitation observed on the ground surface within or near the site.

The Harris (2020) survey found evidence of wildlife, including observations of individuals, their sign (e.g., scat and tracks), and potential habitat. A large snag was observed containing numerous holes that were likely evidence of use by acorn woodpeckers. Snags provide important habitat for forest wildlife and are important nesting and foraging habitat to many cavity-nesting birds and mammals. Coarse woody debris that includes fallen trees and large branches are also used for nesting, denning, roosting, foraging, and shelter. For example, salamanders forage for invertebrates and seek cover in rotting logs. Coarse woody debris is also host to numerous invertebrate species.

Species of Special Concern

There is suitable habitat or documented records for more than 160 rare plants in the Park (NPS 2017), and about 40 species have special status in the park. Some of the Park’s threatened, endangered, and sensitive animal species include the Yosemite toad, mastiff and spotted bats, the Sierra Nevada red fox, the spotted owl, the California wolverine, the northern goshawk, the willow flycatcher, and Bohart’s blue butterfly.

No federally-listed rare plants are documented within Yosemite National Park, however, six federal Species of Concern have been documented in Yosemite National Park, including: Sierra false coolwort (*Bolandra californica),* mountain lady’s slipper (*Cypripedium montanum),* stream orchid (*Epipactis gigantea),* short-leaved hulsea (*Hulsea brevifolia),* and Torrey’s popcorn flower (*Plagiobothrys torreyi* var. *torreyi)* (NPS 2016).

Harris (2020) queried the U.S. Fish and Wildlife Service's (USFWS) Information, Planning, and Conservation System (IPaC)[6] to review species and critical habitat occurring within one or more delineated US Geological Survey 7.5- minute quadrangles intersecting the project area. None of these species are expected to reside or forage within the boundaries of the Site, due to the lack of suitable habitat, such as surface water. Federal status species occurring within two miles of the Mather Site include the following:

Common Name	Scientific Name	Status
Fisher	*Martes pennanti*	Endangered, California Threatened
Sierra Nevada yellow-legged frog	*Rana sierrae*	Endangered, California Threatened
Yosemite toad	*Anaxyrus canorus*	Threatened, California Species of Concern
Delta smelt	*Hypomesus transpacificus*	Threatened
California red-legged frog	*Rana draytonii*	Threatened

Further detail regarding Endangered and Threatened species that may occur at or near the Site is provided in NPS (2014). It is uncertain whether fishers may occur near the Site. California red-legged frogs rarely occur above 3,500 feet, while Sierra Nevada yellow-legged frogs are not known to occur in the Park. The Yosemite toad is observed in habitats above 7,000 feet. Therefore, these species are not expected to be present at the Site. While no California-designated endangered or threatened species are known to be present at the Site, those that may potentially be present in the Site vicinity include the Great gray owl (*Strix nebulosi*, California endangered). This species prefers montane meadows surrounded by white or red fir forests located at 4,000 to 8,000 feet in elevation, a description matching the Site in elevation, though not in habitat type (NPS, 2014).

4.1.2. Conceptual Site Model for Ecological Exposures

Figure 4-1 presents the CSM for ecological exposures. The CSM depicts the understanding of how chemical contaminants have been released to the environment at the Site, and lists the exposure pathways and routes for ecological receptor groups that are quantitatively evaluated in the risk assessment. The main features of this CSM and the rationale supporting which ecological receptors and pathways/routes are identified for risk quantification in the ERA are discussed below.

[6] https://ecos.fws.gov/ipac/

Sources of Contamination

As described in the FIR, sources of potential environmental contamination at the Mather FWDA site are generally related to waste disposal activities and associated burning over the years. The Site received construction and camp debris in the 1920s and 1930s, included glass, rusted cans, and a few corroded battery cores. Some scattered debris was deposited on the surface of the upper area of the Site, although the majority of the debris was emplaced in the lower area. Visual observations indicate that the debris in the lower area was burned in place.

Because it has been decades since such disposal and/or burning occurred, VOCs are only a minor concern at the FWDA, since any present would have likely evaporated since dumping ended over 70 years ago. Only two VOCs were detected at the Site (acetone and methylene chloride). Both of these chemicals are known laboratory contaminants and given their high volatility, it is very likely that laboratory contamination is a source for the few detections. However, as a conservative approach, both of these VOCs were carried forward to the SLERA.

Exposure Pathways

Chemical contaminants released to soil due to historical waste disposal activities may migrate in the environment by several processes. Section 3.1.2 summarized the various migration pathways. In brief, contaminants in soil may be released to air as particulates, and infiltrate into subsurface soil. Soil contaminants can be taken up into terrestrial and aquatic tissues, which can be ingested by wildlife. Due to the absence of surface water at the Site, aquatic pathways of exposure are not evaluated.

Receptors of Concern and Exposure Routes

Numerous ecological species are present in the Park[7]; however, specific information on species present at the Site is not available. Several species of mammals, birds, plants, and soil invertebrates adapted to mountain climates are expected to be present at the Site and could be exposed to site- related contaminants. However, it is generally not feasible or necessary to evaluate risks to each species individually. Rather, it is usually appropriate to group receptors with similar behaviors and exposure patterns and evaluate the risks to each receptor group. Due to the absence of surface water at the Site, aquatic ecological receptors are not evaluated. Terrestrial ecological receptor groups that are anticipated to be present at the Site consist of the following:

- Terrestrial plants
- Soil invertebrates

[7] https://www.nps.gov/yose/learn/nature/npspecies.htm

- Birds
- Mammals

As mentioned, no threatened or endangered species have been identified at the Site. Potential ecological risks are evaluated for these four receptor groups; in the more detailed BERA, representative wildlife species within the birds and mammals groupings are evaluated, as described in a subsequent section.

Terrestrial Plants and Soil Invertebrates

The structure and function of the terrestrial plant and invertebrate community is important because it provides a significant portion of the energy, organic matter, and nutrient inputs for terrestrial systems. Plant communities also provide habitat and forage for a variety of wildlife species. Terrestrial plants and soil organisms are good indicators of soil condition because they reside directly in the soil and are not mobile.

Because there are limited toxicity data on plants or invertebrates in the available technical literature for many chemicals, quantitatively assessing risk to plants and invertebrates from constituent concentrations has high uncertainty. Appropriate toxicity data are available for limited species, and those toxicity data are used to evaluate potential risks to the plant and invertebrate communities. Both plant assemblages and a general terrestrial invertebrate group are also evaluated as food sources for higher trophic consumers, based on modeling of tissue concentrations into plants and earthworms, as the terrestrial invertebrate for which data are most available, using biotransfer factors. Thus, terrestrial plant and soil invertebrate communities are selected as Measurement Receptors, and potential risks to upper trophic level receptors (such as birds and/or mammals) are assessed via food chain exposures based on the consumption of plants and invertebrates that may take up soil contaminants.

The primary exposure route for soil invertebrates is direct contact with (and ingestion of) contaminated soils. For terrestrial plants, the primary exposure route is direct contact of the roots with contaminants in soil. Although most terrestrial plants (e.g., ground cover and grasses) and invertebrates would only be exposed to surface soils (0 to 6 inches bgs), it is possible deeper soils (up to 4 feet bgs) could be encountered by plants with deeper roots (e.g., trees) and burrowing soil invertebrates. For terrestrial plants, exposure may also occur from deposition of dust on foliar (leaf) surfaces. However, because foliar surfaces have an insoluble waxy coating (cuticle) that limits chemical uptake, exposures due to foliar deposition are believed to be minor compared to root exposures. Most plants and soil invertebrates are exposed to surficial soils, which generally contains the vast majority of biological activity (USEPA 2015b). For this risk assessment, surface soil is defined as soils from 0 to 6 inches bgs.

Birds and Mammals

Birds and mammals may be exposed to site-related contaminants by two primary routes: (1) ingestion of contaminants in or on food items and (2) incidental ingestion of soil while feeding or digging. Direct contact (i.e., dermal exposure) of birds and mammals to soil may occur in some cases, and inhalation exposure to airborne dusts is possible for all birds and mammals, but these exposure routes (i.e., dermal and inhalation) are usually considered to be minor compared to exposures from ingestion (USEPA 2005b).

Exposure Media and Routes of Exposure

Surface water is not present at the Site and groundwater does not discharge to the surface in the immediate vicinity of Mather FWDA, so there is no potential exposure for ecological receptors to surface water, sediment, or groundwater at the Site. Site contaminants can be taken up by biota, so only soil and biota are considered to be relevant exposure media for this ERA.

Complete and potentially important exposure routes for birds and mammals include ingestion of surface soils (0 to 6 inches bgs), subsurface soils for burrowing mammals (6 inches to 6 feet bgs), and terrestrial dietary items. Except for burrowing mammals, most wildlife exposures to soil are likely to occur at the surface (i.e., in the upper 6 inches of soil). For burrowing mammals, it is assumed burrowing activities could occur at depths up to 6 feet. The rationale for selecting this depth for burrowing animals at the Site is consistent with CalEPA guidance provided in DTSC HERO EcoNote 1. Burrowing mammals at Yosemite include the California ground squirrel, yellow-bellied marmot, and the montane shrew.

4.1.3. Evaluation Endpoints

Evaluation endpoints consist of the ecological characteristics that are to be protected (referred to as *Assessment Endpoints*) and the approach and methods for evaluating those characteristics (referred to as *Measurement Endpoints*).

Assessment Endpoints

Assessment endpoints are explicit statements of the characteristics of the ecological system that are to be protected. Because the risk management goals are formulated in terms of the protection of populations and communities of ecological receptors, the assessment endpoints selected for use in this problem formulation focus on endpoints that are directly related to the management goals, such as survival, growth, and reproduction (USEPA 2004b). Specific ecological assessment endpoints for this Site can be identified as the following:

- Ensure that contaminants in soils at the Site do not cause unacceptable impacts to terrestrial plant and soil invertebrate communities

- Ensure that contaminants in biota and environmental media at the Site do not cause unacceptable impacts to bird and mammal populations.

Measures of Exposure/Effect

Measurement endpoints are quantifiable environmental or ecological characteristics that can be measured, interpreted, and related to the valued ecological components chosen as the assessment endpoints (USEPA 1997, 1998). Measures of exposure must be compatible with the measures of effects. For example, if effects are evaluated as toxicity benchmarks for soil that is a concentration of a chemical that is below a level of risk to an ecological receptor, then the measure of exposure must be the concentration of that chemical in the soil that the receptor could be exposed to. Similarly, if the effect is measured by a toxicity value that is based on the dose of a chemical to an organism (typically in units of mg/kg-day), then the measure of exposure is also expressed in terms of dose, with the same units. Doses are modeled based on the intake of chemicals from various environmental media that the receptor could be exposed to.

Additional more advanced methods for evaluating exposures and effects, which would be incorporated into a BERA, include a) toxicity testing, either in the laboratory using soil from the site, or *in situ* at the Site itself, and b) community or population studies, whereby various metrics of an exposed population are compared with metrics from a similar population located in a reference area that is free of the contamination. These more advanced methods for evaluating ecological risk entail substantial data that are not available for this site, and are not used in this risk assessment.

4.2. Screening Level Ecological Risk Assessment

A SLERA is an intentionally conservative risk evaluation with the goal of determining if there is the potential for unacceptable ecological risk. The purpose of the SLERA is to determine if a more-refined BERA is necessary and, if so, which media, chemicals, exposure pathways, exposure routes, and receptors should be retained for further evaluation.

4.2.1. Selection of COPECs

COPECs were identified by comparing the maximum soil concentrations in Site soils to screening levels for ecological receptors. Screening levels used in this SLERA are the ecological screening values (ESVs) presented in NPS's *Protocol for the Selection and Use of Ecological Screening Values for Non-Radiological Analytes (Revision 3)* (NPS 2018) (hereafter referred to as the NPS Protocol). Screening levels are not available in the NPS Protocol for TPH as diesel fuel/motor oil; however, because ESVs are available for many of the TPH chemical constituents (e.g., PAHs), the lack of an ESV is not expected to limit risk interpretations. For that reason, TPH was not selected as a COPEC.

For soil, maximum concentrations were compared to the lowest NPS COPEC selection soil ESV for terrestrial plants, soil invertebrates, birds, and mammals. While most terrestrial ecological receptors are primarily exposed to surface soil (0 to 6 inches bgs), for simplicity, COPECs were identified for both surface soil and subsurface soil (0.5 to 6 feet bgs) using the lowest soil ESV.

The results of the COPEC selection for ecological receptors are summarized in Table 4-1 and presented in further detail in Attachment C. A total of 16 COPECs were identified for surface soil (see Attachment C-1), consisting of 15 metals (antimony, arsenic, barium, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, thallium, vanadium, zinc, aluminum, and manganese), and bis(2-ethylhexyl)phthalate. The list of COPECs for subsurface soil is similar to surface soil but with the addition of selenium, silver, and dioxins/furans (as TEQ), and with the exclusion of manganese.

4.2.2. *Evaluation of Laboratory Limits*

Section 3.2 provides a brief discussion of laboratory limits. The adequacy of each chemical MDL to be protective of ecological receptors was determined by comparing the maximum MDL to the lowest NPS ESV. For those chemicals where the maximum MDL is greater than the lowest ESV and there is a low detection frequency (less than 10%), the MDL was deemed to be inadequate. The MDLs provided in the Shaw (2010) FIR for all analytes were deemed to be adequate to support a SLERA.

4.2.3. *Refined Screening Level*

After the selection of COPECs, the methodology outlined in the NPS protocol for a SLERA is to refine the list of COPECs by screening against *refined ESVs*. This step of the SLERA calculates screening level risks using the hazard quotient (HQ) method. The HQ is the ratio of the estimated exposure of a receptor to a benchmark that is believed to be without significant risk of unacceptable adverse effect:

HQ = Exposure / Toxicity Benchmark

For this Site, where the environmental medium with measured contaminant concentrations is soil, the screening level hazard quotient is expressed as:

HQ = Exposure Concentration in Soil / Soil Toxicity Benchmark

The exposure concentration in soil at the site and the soil toxicity benchmark are expressed in the same units of mg chemical / kg soil. The exposure concentration is the maximum detected concentration of each COPEC in soil. The benchmarks for this step are the *refined SLERA ESVs* in the NPS (2018) protocol. The refined SLERA ESVs for soil are considered to be no-effect levels, determined from the basis of each value. They are designed to be protective of all species within the receptor group, and are intended to be protective of populations and communities of organisms. They are selected to represent the threshold for a toxicity endpoint that is relevant to population sustainability (e.g., survival, growth, reproduction).

Refined SLERA HQs for soil were calculated separately for surface and subsurface soil for each terrestrial receptor of interest (i.e., terrestrial plants, soil invertebrates, birds, mammals), except birds are not exposed to subsurface soils. If the value of an HQ is less than 1, it is assumed that the risk of adverse effects to the receptor is acceptable. If the HQ is greater than or equal to 1, the risk of adverse effects to the receptor may be of concern, and the chemical may be evaluated further or identified for risk management. It is further assumed that the likelihood and/or severity of adverse effects increase as the value of the HQ increases.

Terrestrial Plants

Tables 4-2 and 4-3 provide the refined screening level HQ results for terrestrial plants exposed to COPECs in surface soil and subsurface soil, respectively. Nine COPECs (barium, chromium, copper, lead, mercury, selenium, vanadium, zinc, manganese) have refined HQs greater than 1 for surface or subsurface soils based on the no-effect ESV.

Soil Invertebrates

Tables 4-4 and 4-5 provide the refined screening level HQ results for soil invertebrates exposed to COPECs in surface soil and subsurface soil, respectively. Barium, chromium, copper, lead, mercury, zinc, and manganese have refined HQs greater than 1 based on the no-effect ESV.

Birds

Table 4-6 provides the refined screening level HQ results for birds exposed to COPECs in surface soil. Seven chemicals have refined HQs greater than 1 for surface soils based on the no-effect ESV (cadmium, copper, lead, mercury, vanadium, zinc, bis(2-ethylhexyl)phthalate). These chemicals are identified as *refined COPECs* for birds for further evaluation in the BERA.

Mammals

Tables 4-6 and 4-7 provide the refined screening level HQ results for mammals exposed to COPECs in surface soil and subsurface soil, respectively. Six chemicals (antimony, cadmium, copper, lead, molybdenum, zinc) have refined HQs greater than 1 for surface soils based on the no-effect ESV. In subsurface soils, eight chemicals (antimony, cadmium, copper, lead, molybdenum, selenium, zinc, dioxin/furan TEQ) have refined HQs greater than 1. These COPECs are identified as *refined COPECs* for mammals for further evaluation in the BERA.

Summary of Refined COPECs

Based on the refined screening level HQ results, the following refined COPECs in soil were retained for further evaluation in the BERA:

- *Terrestrial Plants:* barium, chromium, copper, lead, mercury, selenium, vanadium, zinc, manganese
- *Soil Invertebrates*: barium, chromium, copper, lead, mercury, zinc, and manganese
- *Birds:* cadmium, copper, lead, mercury, vanadium, zinc, bis(2-ethylhexyl)phthalate

- *Mammals:* antimony, cadmium, copper, lead, molybdenum, selenium, zinc, dioxins/furans (as TEQ).

4.3. Baseline Ecological Risk Assessment

Typically, the BERA further evaluates potential ecological risk by refining the evaluation of COPECs through more involved methodology. As described earlier, these might include incorporation of site-specific bioaccumulation factors, revised species-specific toxicity values, laboratory or *in situ* toxicity tests, field-based assessments of community density and diversity, habitat evaluations, and tissue burden estimates. Consistent with the initial steps for BERA described in USEPA (2001) guidance on ecological risk assessment, COPECs identified in this SLERA undergo further refinement, which consists of the following:

- Evaluate alternate (non-maximum) EPC values
- Compare species-specific estimated exposure doses to toxicity thresholds for select receptors of concern
- Compare concentrations in soil to background concentrations to determine potential non-site-related concentrations of COPECs (both natural and anthropogenic).

4.3.1. BERA Evaluation Endpoints

The Assessment Endpoints described above in the Problem Formulation step for the SLERA are applicable to the BERA:

- Ensure that contaminants in soils at the Site do not cause unacceptable impacts to terrestrial plant and soil invertebrate communities.
- Ensure that contaminants in biota and environmental media at the Site do not cause unacceptable impacts to bird and mammal populations (i.e., in general, maintenance of populations of ecological receptors).

Measurement endpoints for the BERA use the same soil data as in the SLERA, but the estimation of exposures and toxicity values for wildlife are more specific to the types of species that may be present at the Site. The general methodology follows the HQ approach described above for the SLERA, except that wildlife risks are estimated through a dose evaluation, which consists of evaluating exposures via ingestion of food items, as described more fully in subsequent sections.

The assessment endpoint is based on the sustainability of exposed populations, and risks to some individuals in a population may be acceptable if the population is expected to remain healthy and stable. The HQ approach is intended to characterize population risks by quantifying individual HQ values that are greater than 1 and by the magnitude of the exceedances. Whether all of the HQ values or a fraction of them should be less than 1 for the population to remain stable depends on the species being evaluated and the toxicological endpoint underlying the toxicity value. In addition, reliable characterization of the impact of a chemical stressor on an exposed population requires knowledge of population size, birth and death rates, and immigration and emigration rates. This type of detailed knowledge of population dynamics is not available for this Site, and extrapolation from a distribution of individual HQ values to a characterization of population-level risks is generally uncertain.

HQ values are predictions and subject to the uncertainties that are inherent in both the estimates of exposure and the estimates of toxicity values. In lieu of more detailed risk evaluations and population studies conducted under a BERA, HQ values above 1 should be interpreted as indicators of potential risk rather than definitive evidence that adverse effects are occurring.

4.3.2. Plants and Soil Invertebrates Evaluation

As described above in the conceptual site model, toxicity data on plant and invertebrate species are limited, and are used to evaluate potential risks to communities of plants and invertebrates rather than to individual organisms.

Exposure Assessment

Exposure Routes

The primary exposure route for plants and soil invertebrates is direct contact with contaminated soils, and ingestion of soils for invertebrates. Although most terrestrial plants (e.g., ground cover and grasses) and invertebrates would only be exposed to surface soils (0 to 6 inches bgs), it is possible deeper soils (up to 4 feet bgs) could be encountered by plants with deeper roots (e.g., trees) and burrowing soil invertebrates.

Exposure Point Concentrations

For the simple BERA, exposures are evaluated using the 95 UCL on the mean surface soil and subsurface soil concentrations as the EPC. The 95UCLs were derived using the USEPA ProUCL model. The EPC was set equal to the recommended 95UCL, unless the 95UCL was higher than the maximum concentration, then the maximum value was used.

Toxicity Assessment

The toxicity benchmarks used to evaluate terrestrial plants and soil invertebrates are similar to those used above to select COPECs, but are designed to be estimates of the thresholds for toxic effects. The benchmarks used to identify COPECs are based primarily on no-effect levels. As mentioned above, a second benchmark for each COPEC has been identified as a low-effect level. The low-effect level benchmarks selected for each COPEC are the Ecological Screening Levels (ESL) from the LANL database (2017), except for molybdenum, for which values are not available in the LANL database. For molybdenum, a screening value was taken from the Risk Assessment Information System (RAIS) database (ORNL 2020), which provides the Dutch

Intervention Value[8]. The low-effects benchmark is designed to relate to potential impacts to a small portion of a population, usually less than 20%, which has been identified as a level above which effects to populations may occur. This low-effects level is based on the understanding that a small portion of a population may be impacted without impacting the population itself or impacting the community or ecosystem of which the population is a component.

The threshold-based benchmark for adverse effects lies between the no-effect level and the low-effect level benchmarks. For each COPEC, the threshold benchmark is calculated as the geometric mean of the no-effect-based and the low-effect-based benchmarks (USEPA 1998).It is expected that the adverse effect threshold will vary from species to species within any receptor group. Because toxicity data are not available for most plant and soil invertebrate species, single plant and soil invertebrate threshold benchmarks are used to represent the communities of organisms.

Risk Characterization

This step of the BERA for terrestrial plants and soil invertebrates calculates potential risks using the hazard quotient (HQ) method, similar to the method used to select refined COPECs. As mentioned, the EPC used for the BERA is the 95UCL, or the maximum detected concentration if the 95 UCL exceeds the maximum, of each refined COPEC in soil. The benchmarks for this step are the *Threshold-Based ESLs*. The risk results are expressed as the *Threshold-Based HQ* for each refined COPEC:

Threshold-Based HQ = 95UCL or Maximum / Threshold Benchmark

Where the threshold-based HQ > 1, the refined COPEC is identified as a chemical of ecological concern (COEC).

Results of the calculation of threshold-based HQs, and identification of COECs, are presented in Tables 4-2 and 4-3 for terrestrial plants exposed to contaminants in surface and subsurface soils, respectively, and in Tables 4-4 and 4-5 for soil invertebrates exposed to contaminants in surface and subsurface soils, respectively.

[8] The ecological Intervention Value is the concentration expected to be hazardous to 50% of the species in the ecosystem. It cannot be assumed that sensitive species will be protected at the Intervention levels. Site concentrations less than Target Values indicate no restrictions necessary; concentrations between Target Values and Intervention Values suggests further investigation or restrictions may be warranted.

COECs identified for terrestrial plants exposed to surface soils consist of chromium, lead, vanadium, zinc, and manganese. COECs identified for terrestrial plants exposed to subsurface soils consist of barium, chromium, lead, vanadium, and zinc.

COECs identified for soil invertebrates exposed to surface soils consist of chromium and zinc. COECs identified for soil invertebrates exposed to subsurface soils consist of chromium, lead, and zinc.

4.3.3. Wildlife Evaluation

Birds and mammals may be exposed to site-related contaminants by three primary routes: (1) ingestion of contaminants in or on food items; (2) incidental ingestion of soil while feeding, preening, or digging; and (3) ingestion of drinking water. Since contaminated surface water is not a medium of concern for this Site, ingestion of drinking water was not identified as an exposure route for wildlife in the CSM. Direct contact (i.e., dermal exposure) of birds and mammals to environmental media may occur in some cases, and inhalation exposure to airborne dusts is possible for all birds and mammals, but these exposure routes (i.e., dermal and inhalation) are usually considered to be minor in comparison to exposures from ingestion (USEPA 2005b).

The method for evaluating risks to wildlife differs from that used for plants or invertebrates. The exposures of birds and mammals are evaluated through dose modeling, based on the ingestion of food items and the ingestion of soil. The modeling methodology and input parameters are discussed below.

COPECs

As presented in Tables 4-6 and 4-7, six metals (cadmium, copper, lead, mercury, vanadium, zinc) and bis(2-ethylhexyl)phthalate were identified as COPECs in soil for birds, and seven metals (antimony, cadmium, copper, lead, molybdenum, selenium, zinc) and dioxins/furans (as TEQ) were identified as COPECs in soil for mammals. These COPECs are further evaluated in this BERA.

Exposure Assessment

Daily Dose Equation

The basic equation used for calculation of exposure of a wildlife receptor to a chemical by ingestion of an environmental medium is as a daily dose:

$$Dose_r = \Sigma(C_{i,m} \times IR_{m,r}) \times AUF_r$$

where:

$Dose_r$ = average daily ingested dose of chemical by receptor *r*

$C_{i,m}$ = concentration of chemical *i* in medium *m* (e.g., mg/kg)

$IR_{m,r}$ = intake rate of medium *m* by receptor *r* (e.g., kg food/kg BW-day)

AUF = area use factor by receptor *r*.

For each receptor, the specific food items that are ingested, and the rates of ingestion, are identified. Concentrations of COPECs in each ingested food item are modeled using soil concentration data, as described below.

Surrogate Receptors

The Park website[9] provides detailed species lists of the types of wildlife expected at the Site. More than 350 different bird and mammal species are expected to be present at the Park. It is not feasible to evaluate exposures and risks for every bird and mammal species potentially present at the Site. For this reason, surrogate species are selected to serve as representatives of birds and mammals. An effective way to group ecological receptors is according to their feeding guild. Feeding guilds are based on the type of food item that is mostly consumed by the receptor. The following are the typical feeding guilds for birds and mammals:

- Herbivores – consuming plants
- Insectivores – consuming soil invertebrates and insects
- Carnivores – consuming small mammals.

For each of these feeding guilds, USEPA (2005b) has identified the bird and mammal species for which the highest exposures are expected to occur, based on their natural history, i.e., the food items they consume, the rate the food items are consumed, the body weight of the receptor. Each of these components of their behavior characterize their metabolic intake on a daily basis. The surrogate species selected by USEPA are similar to the representative species recommended by DTSC and the NPS for the Shaw (2010) FIR. For this BERA, the surrogate species developed by USEPA are used to represent the feeding guilds. The surrogate species selected in the EcoSSL guidance (USEPA 2005b) for each guild are the following:

- **Avian herbivore: Mourning dove** (*Zenaida macroura*) - representing local herbivorous species, such as the mountain chickadee, song sparrow, ruby-crowned

9 https://www.nps.gov/yose/learn/nature/npspecies.htm Accessed January 21, 2021

kinglet, Brewer's blackbird, and Western scrub jay). The avian herbivore is assumed to consume 100% plants with inadvertent soil ingestion.

- **Avian insectivore: American woodcock** (*Scolopax minor*) - representing local insectivorous species, such as the acorn woodpecker, Northern flicker, and American robin. The avian insectivore is assumed to consume 100% earthworms as surrogates for all invertebrates, with inadvertent soil ingestion.

- **Avian carnivore: Red-tailed hawk** (*Buteo jamaicensis*) - representing local carnivorous species, such as the red-tailed hawk, great horned owl, and Western screech-owl. The avian carnivore is assumed to consume 100% small mammals, with inadvertent soil ingestion.

- **Mammalian herbivore: Meadow vole** (*Microtus pennsylvanicus*) - representing local herbivorous species, such as the montane vole, lodgepole chipmunk, California ground squirrel, Western jumping mouse, pika, and mountain pocket gopher. The mammalian herbivore is assumed to consume 100% plants with inadvertent soil ingestion.

- **Mammalian insectivore: Short-tailed shrew** (*Blarina brevicauda*) - representing local invertivorous, insectivorous, and omnivorous species, such as the dusky shrew, deer mouse, and broad-footed mole. The mammalian insectivore is assumed to consume 100% earthworms as surrogates for all invertebrates, with inadvertent soil ingestion.

- **Mammalian carnivore: Long-tailed weasel** (*Mustela frenata*) - representing local carnivorous species, such as the gray fox, striped skunk, marten, and badger. The mammalian carnivore is assumed to consume 100% small mammals, with inadvertent soil ingestion.

While these surrogate species may not necessarily occur at the Site, they serve as indicators for local species within the same feeding guild with similar home range sizes, such as those identified above. The key species that could use the habitat near the site and for which the surrogate species represent are described below, with information taken from the FIR (Shaw 2010) and California Department of Fish and Game (CDFG 2008).

American Robin – represented by the American Woodcock

The American robin (*Turdus migratorius*) is an omnivore that feeds on both plants (primarily fruit) and terrestrial invertebrates including earthworms. The robin lives in a variety of habitats, including woodlands, wetlands, suburbs and parks. Robins are likely to forage throughout Yosemite and are present year-round. Most robins build nests of mud and vegetation on the ground or in the crotches of trees or shrubs. Robins have an average home range of 1.2 acres. The average longevity of a robin that survives to its first January is from 1.3 to 1.4 years.

The robin is an insectivorous bird and the feeding guild is represented by the woodcock in this ERA, as recommended by USEPA (2005a).

California Vole – represented by the meadow vole

The California vole (*Microtus californicus*) occurs in the Sierra Nevada and other mountains in California. It occupies a wide variety of habitats, but is most abundant in early seral stages of montane riparian, dense annual grassland, and wet meadow. The vole feeds mainly on leafy parts of grasses, sedges, and herbs. It forages on the ground, clipping grasses and forbs at the bases, forming a network of runways leading from the burrow. Burrows are constructed in soft soil. The vole is active year-round, with circadian activity.

Mean home range sizes for the vole vary from 0.25 to 2.5 ac (0.37 ac average). Territorial behavior is weak; the size of area defended is unknown. The vole breeds throughout the year, reaching peaks whenever food and cover are abundant. Its abundance and widespread distribution, along with daylong activity, make it an important prey. Predators include nocturnal and diurnal birds of prey, predatory mammals, and snakes. (Information extracted from the CDFG, 2008).

The vole represents herbivorous mammals for this ERA.

Dusky Shrew – represented by the short-tailed shrew

The dusky shrew (*Sorex monticolus*), also commonly known as the montane shrew, is found in montane habitats in the high Sierra Nevada including Yosemite National Park. Their preferred foods include insects, arachnids, snails, and earthworms, typically in a layer of debris on the forest floor. The shrew is active year-round and does not hibernate. They frequently use burrows for reproduction (Thomas, 1979), breeding from February through October, with a peak in late spring-early summer (Ingles, 1965).

The shrew is rarely found more than a few meters from water in the summer (Ingles, 1965), and prefers riparian and wet meadow habitats. Thomas (1979) indicated that suitable habitat (home range) of at least 2 hectare (ha) (5 ac) is required to support a population of shrews. Size of home range averages 0.04 ha (0.1 ac) (Hawes, 1977) but varies greatly. The shrews are notoriously solitary, but home ranges may overlap.

The shrew is representative of insectivorous mammals and burrowing mammals for this ERA.

Long-Tailed Weasel

The long-tailed weasel (*Mustela frenata*) is a common to uncommon, permanent resident of most habitats, except xeric brush, shrub, and desert scrub. It mostly uses intermediate cover stages of conifer and deciduous habitats, interspersed with lower seral stages and open forest, woodland areas and shrubs, from sea level to alpine meadows. Long-tailed weasels are carnivorous, consuming small mammals such as mice, gophers, chipmunks, ground squirrels, and rabbits. They will also consume birds, some insects, salamanders, and small amounts of fruit. Foraging occurs on ground, among rocks, in snags, stumps, logs, wood piles, in brush, and occasionally in trees.

Nests are often located in burrows of chipmunks, ground squirrels, gophers, moles, or mountain beavers. The weasel is active year-round, nocturnal and diurnal. Suggested home ranges are 25-50 ac. The weasel may be territorial, and mates in July or August. They are major predators of voles and mice, and they, themselves are preyed upon occasionally by minks, martens, fishers, bobcats, coyotes, red foxes, and gray foxes.

The weasel is representative of carnivorous mammals for this ERA.

Exposure Factors

Exposure parameters and dietary intake factors used in the modeling of doses to each receptor were taken from USEPA (2007) guidance on deriving EcoSSLs (EcoSSL Attachment 4-1). Food ingestion rates were calculated from the mean food intake rates presented in Table 1 of EcoSSL Attachment 4-1. Soil ingestion rates were calculated from the mean values of the fraction of diet that is soil (Psoil) provided in Table 3 of EcoSSL Attachment 4-1. Table 4-8 summarizes the exposure parameters selected for each representative wildlife receptor.

Exposure Areas

The FIR collected samples from throughout the 0.5-acre site; i.e., the site was not separated into Decision Units (DUs) for the purposes of sample collection. The size of the contaminated area at the Site was found to not to exceed about 0.5 acre. This size of area is consistent with the approximate home range size for a small bird or mammal (e.g., shrew). Because the home range of the smaller receptors that may be exposed to Site soils is similar to the size of the contaminated area, all surface soil data were assumed to represent a single exposure unit. Thus, for the purposes of estimating risks to wildlife receptors from incidental ingestion of soil and ingestion of terrestrial prey items, exposures were assumed to occur throughout the site. Receptors were assumed to be exposed to soils and prey only within the site, such that the area use factor (AUF) for each receptor was assumed to be 1.0. Because the contaminated area of the site is small relative to the size of the home ranges of ecological receptors that may frequent the Site, this assumption is likely to overestimate potential exposures, particularly for receptors with larger home ranges such as the hawk.

Exposure Point Concentrations

Wildlife receptors are likely to move at random across an exposure area. Therefore, exposure is best characterized as the arithmetic mean concentration across the exposure area. Because the true arithmetic mean concentration cannot be calculated with certainty from a limited number of measurements, USEPA recommends that the 95UCL of the arithmetic mean for each exposure area be used as the EPC when calculating exposure and risk (USEPA 1992b). The mathematical approach that is most appropriate for computing the 95UCL of a dataset depends on several factors, including the number of data points available, the shape of the distribution of the values, and the degree of censoring (USEPA 2002a). For surface soil and subsurface soil, 95UCLs were calculated using the most recently available version of the USEPA program ProUCL v 5.1 (USEPA 2015a). The value recommended by the program for each COPEC was selected to represent the exposure point concentration.

Except for burrowing mammals, most wildlife exposures to soil are likely to occur at the surface (i.e., in the upper 6 inches of soil). For burrowing mammals, it was assumed burrowing activities could occur at depths up to 6 feet. Table 4-9 (surface soil) and Table 4-10 (subsurface soil) presents the EPCs for all COPECs.

Estimating Dietary Tissue Concentrations

Measured data on concentrations in terrestrial dietary items are not available for the Site. Therefore, dietary concentrations were estimated using uptake factors and/or bioaccumulation models from the literature. Uptake factors, uptake equations, and bioaccumulation models were developed for the following dietary items:

- Soil to plant
- Soil to earthworm
- Soil to small mammal.

The uptake factors and equations used to model the concentrations of each COPEC in each of these three dietary items are shown in Table 4-11. As shown in the table, earthworm tissue concentrations for most metals were estimated from soil using the same uptake models as those used in the development of the EcoSSLs (USEPA 2007). For mercury uptake into earthworm and small mammal tissues, tissue concentrations were estimated using regression models developed for use by ORNL (Sample et al. 1998a, 1998b). Uptake values were not available for molybdenum; antimony was used as a surrogate source of values. Uptake of dioxins/furans (TEQ) into plant tissue was estimated using a default regression model for uptake of organic chemicals into foliage in Attachment 4-1, Figure 5, Panel B, of the Eco-SSL document (USEPA 2007). Uptake factors for dioxin/furan congeners into soil invertebrates and small mammal tissues were the uptake factor for 2,3,7,8-TCDD multiplied by a congener-specific bioaccumulation equivalency factor (BEF), shown in Table 4-12. The dioxin/furan congener BEFs are taken from Table 11 of USEPA (1995).

Dioxins and furans are measured and expressed as concentrations of individual congeners. The data for individual congener results are transformed into a single toxicity-weighted concentration value based on the relative potency of the congener to the potency of 2,3,7,8-tetrachlorodibenzodioxin (TCDD). This weighted concentration is considered to be the concentration of TCDD that would be of equivalent toxicity to humans and is referred to as TEQ (toxic equivalent).

The relative potency of an individual congener compared to TCDD is expressed by a toxicity equivalency factor (TEF). The TEFs range from a value of 1, being equivalent in toxicity to TCDD, to small fractions (e.g., 0.0003) of the TCDD toxicity. Avian and mammalian TEF values were developed by a panel of experts assembled by the World Health Organization (Van den Berg et al. 2006); values are presented in Table 4-12. These TEFs were adopted by California Environmental Protection Agency (CalEPA) Office of Environmental Health Hazard Assessment (OEHHA) in 2011 (DTSC HERO Note 2). Many TEFs are based on limited data and thus are considered to be approximations of the relative toxicity of each congener, rounded up (to be conservative) to the nearest half order of magnitude. Most TEFs are based on relative binding affinity of the congener for the aryl-hydrocarbon receptor rather than based on exposures of test organisms, and do not account for potential differences from TCDD in absorption and distribution to target tissues.

Using the TEF values, the toxicity of any mixture of dioxin/furan congeners in a site medium is estimated by calculating the TEQ concentration in the medium as the TEF-weighted sum of each of the dioxin-like congeners, as follows:

$$TEQ = \sum(C_i \times TEF_i)$$

where:

C_i = concentration of congener *i* [Non-detect congeners are evaluated at zero.]

TEF_i = toxicity equivalency factor for congener *i*.

TEFs are available for both humans and wildlife receptors. Using the above equation, TEQs are calculated for exposures of birds and mammals using TEFs specific to birds and mammals. Once TEQ concentrations are calculated through the above summation process, they are compared to avian and mammalian toxicity values (i.e., benchmark screening values or toxicity reference values) for TCDD to estimate ecological risk.

Toxicity Assessment

Dose-based Toxicity Reference Values

For wildlife, two types of dose-based toxicity reference values (TRVs) are identified in the literature. The first TRV is an estimate of the dose (mg/kg BW-day) that is not associated with any adverse effects and is referred to as the no-observed-adverse-effect level (NOAEL) TRV. The second TRV is an estimation of the dose that causes an observable adverse effect and is referred to as the low-observed-adverse-effect level (LOAEL) TRV. The threshold for adverse effects lies between the NOAEL and LOAEL TRVs. For each COPEC for all soil receptors, the threshold

TRV is calculated as the geometric mean of the NOAEL-based and LOAEL-based TRVs (USEPA 1998).

It is expected that the adverse effect threshold will vary from species to species within any wildlife group. However, toxicity data are not available for most birds and mammals, and therefore, a single bird TRV and a single mammal TRV for each COPEC are used to represent all bird and all mammal species, respectively. Intertaxon extrapolation (i.e., using allometric scaling to adjust laboratory study dose to wildlife species-specific dose level), taxonomic scaling (i.e., using phylogenic factors to adjust dose level across organism family or order) and extrapolation of toxicity data across taxonomic classes (i.e., mammalian toxicity data extrapolated to birds or vice-versa) were not performed due to the associated uncertainties (USEPA 2005b; Allard et al. 2010).

Because the purpose of this assessment was to evaluate wildlife exposures from ingestion of contaminated media at the Site over the lifetime of the receptor, TRVs derived from studies in which the exposure route was oral (e.g., via ingestion in diet or water or via gavage) and dosing occurred over a long period of time (chronic exposure) or during a critical life stage period were given preference. In addition, to the extent feasible, wildlife TRVs were selected to represent relevant toxicity endpoints for population sustainability (e.g., growth, reproduction, survival).

Dose-based TRVs for wildlife were mainly compiled from secondary literature sources. As per guidance from DTSC, the following hierarchy was used to select wildlife TRVs:

- **EcoSSL[10].** EcoSSLs NOAEL dose-based TRVs for birds and wildlife were preferentially selected for use because they are derived from toxicity data drawn from multiple studies across multiple species and because these values have undergone review. Dose-based LOAEL TRVs for birds and mammals have also been derived from the same underlying EcoSSL toxicity datasets and setting the TRV equal to the geometric mean of growth and reproduction endpoints (TechLaw, 2008). As such, these LOAEL TRVs likely represent the mid-range of adverse effects and not necessarily a LOAEL.

- **LANL ECORISK Database[11]**. LANL developed and maintains a database of ESLs and toxicity data for use in quantifying hazards to the environment and associated exposure to radioactive and chemical wastes from past treatment, storage, and disposal practices at LANL (LANL 2017). This Microsoft Access® database can be downloaded from the LANL website and searched by chemical or screening receptor to

[10] https://www.epa.gov/ecobox/epa-ecobox-tools-effects-terrestrial
[11] http://www.lanl.gov/environment/protection/eco-risk-assessment.php Version 4.1

provide printable reports for all ESLs, dose-based TRVs, exposure parameters, and uptake factors used to develop ESLs. TRVs that were selected from the ECORISK Database are used to represent LOAEL-based benchmarks and doses.

- **DTSC HERO EcoNOTE-4**[12]. The U.S. Department of the Navy/USEPA Region 9 Biological Technical Assistance Group developed TRVs for several inorganic and organic COCs at hazardous waste sites (Engineering Field Activity West 1998). The TRVs were selected from the published literature following a consensus effort among several federal and state agencies. TRVs were calculated that represent no-effect levels (TRV-Low) and mid-range adverse effect levels (TRV-High). Note that the TRV-High represents the mid-point of a variety of adverse effects levels and therefore is not necessarily a LOAEL. A TRV-Low dose would not be expected to produce an adverse effect and is protective of an individual or population of organisms; a TRV- High dose would be expected to produce an adverse effect to an individual or population of organisms.

- **ORNL**. Sample et al. (1996) summarized available literature on the toxicity of contaminants to a variety of wildlife receptors. After reviewing the literature, Sample et al. (1996) selected a critical study for mammals and a critical study for birds that identified dose-based NOAEL and LOAEL TRVs. Although the selection of a single critical study to establish TRVs is a less robust derivation procedure than EcoSSL or LANL (which derives TRVs in consideration of multiple studies), the basis of the selected TRVs is well documented.

In identifying the NOAEL TRV, values were selected according to the hierarchy listed above, except for the avian TRVs for lead. In identifying the LOAEL TRV, unless the TechLaw (2008) values were lower, the LOAEL values provided by LANL were given preference to TechLaw (2008) as the LANL values were more likely to represent the low end of the effects range. The avian TRVs for lead were taken from Sample et al. (2019), who re-evaluated avian toxicity data contained in the EcoSSL compilation. Table 4-13 shows the selected dose-based TRVs for birds, and Table 4-14 shows the dose-based TRVs used for mammals in this BERA. As seen, no TRVs were derived from DTSC HERO, (i.e., the selected NOAEL and LOAEL TRVs are primarily based on the Sample et al. [1996] TRVs, the LANL ECORISK TRVs, or the TechLaw TRVs).

Relative Bioavailability

Dose-based TRVs from literature studies are generally expressed in units of ingested dose (mg/kg BW-day). However, the toxicity of an ingested dose depends on how much of the ingested dose is

[12] https://dtsc.ca.gov/wp-content/uploads/sites/31/2019/05/HHRA-Note-Number-4-May-14-2019.pdf

absorbed, which in turn depends on the properties of both the chemical and the exposure medium. Ideally, toxicity studies would be available that establish empiric TRVs for the site media of concern (i.e., food, soil). However, most laboratory tests use either food or water as the exposure medium, and essentially no studies use soil. Therefore, in cases where a TRV is based on a study in which the oral absorption fraction is different than what would be expected for a site medium, it is desirable to adjust the TRV to account for the difference in absorption whenever data permit. For the purposes of this assessment, the absorption for all COPECs in all site media was assumed to be 100%. This approach is likely to be realistic for contaminants in food but may tend to overestimate exposure and risk from incidental ingestion of soil.

However, no site-specific information on RBA was available that would provide a basis to modify this assumption.

Risk Estimates

HQ Equation

The basic equation for calculating HQ values for the exposure of wildlife receptors to COPECs in soil is:

$$HQ_{i,r} = Dose_{i,r} / TRV_{i,r}$$

where:

$HQ_{i,r}$ = hazard quotient for chemical ‘i’ by receptor ‘r’

$Dose_{i,r}$ = average daily ingested dose of chemical *i* by receptor *r* (mg/kg BW-day)

$TRV_{i,r}$ = toxicity reference value for chemical *i* for receptor *r* (mg/kg BW-day)

Interpretation of the HQ estimates depends upon the basis of the TRV. If the HQ based on the NOAEL TRV is less than or equal to 1, risk is considered acceptable. If the HQ based on the NOAEL TRV is greater than 1 and the HQ based on the LOAEL TRV is less than 1, there is the potential that risks would be unacceptable. However, this would depend upon the proximity of the site dose to the threshold for adverse effects. If the HQ based on the LOAEL TRV exceeds 1, risk of adverse effects in the exposed organisms may be of potential concern. The threshold TRV is the geometric mean of the NOAEL and LOAEL TRVs, and as explained in the Toxicity Assessment above, is intended to represent the threshold where potential effects might occur between the level of no effects (NOAEL) and the level of low effects (LOAEL). Threshold-based HQs greater than 1 suggest a potential for adverse effects.

Risk Results

Attachment D presents the detailed wildlife HQ calculations for surface and subsurface soil. Tables 4-15 summarizes the threshold-based HQs for each COPEC in surface and subsurface soil.

- *Surface Soil*

As Table 4-15 shows, insectivorous birds and mammals are the primary receptors with threshold-based HQs exceeding 1; other than herbivorous bird exposures to lead, none of the other feeding guilds had threshold-based HQs greater than 1. This finding is partly because bioaccumulation of contaminants into terrestrial invertebrate (earthworm) tissues often tends to be greater than into plants and small mammal tissues. The highest HQs were for exposures of insectivorous mammals (shrew) to lead in subsurface soil.

Herbivorous Birds (see Table D-1, Attachment D) – No COPECs were found to exceed threshold-based HQ of 1; no COECs were identified for this avian feeding guild.

Insectivorous Birds (see Table D-2, Attachment D) – Threshold-based HQs were greater than 1 for copper, lead, mercury, and zinc in surface soil (Table 4-15). For lead, the threshold-based HQ of 4 is associated with ingestion of soil and invertebrates, with ingestion of invertebrates accounting for almost all the exposure. For the remaining COPECs, the threshold-based HQs for surface soil are low and considered uncertain as to risk potential.

Carnivorous Birds (see Table D-3, Attachment D) – No COPECs were found to exceed threshold-based HQ of 1; no COECs were identified for this avian feeding guild.

Herbivorous and Carnivorous Mammals (see Tables D-4 and D-7, Attachment D) – No COPECs were found to exceed a threshold-based HQ of 1; no COECs were identified for these mammalian feeding guilds.

Insectivorous Mammals (see Table D-5, Attachment D) – Threshold-based HQs were greater than 1 in surface soil for antimony, cadmium, copper, and lead (Table 4-15). These chemicals are retained as COECs. The majority of the exposures to these COECs was due to ingestion of contaminants in food (earthworms); incidental ingestion of soil contributed lesser to the total exposure.

- *Subsurface Soil*

Insectivorous Mammals (see Table D-6, Attachment D) – As shown in Table 4-15, threshold-based HQs were greater than 1 in subsurface soil for antimony, cadmium, copper, lead, and total TCDD-TEC, and are retained as COECs. The threshold-based HQ of 38, and the LOAEL-based HQ of 27 (Table D-6), for exposure of burrowing insectivores to lead suggests a high risk for adverse health effects.

4.3.4. Comparisons to Background

COPEC concentrations in on-site soil samples were compared statistically to concentrations in the upgradient background area using several two-sample hypothesis testing approaches recommended by USEPA (2002c). Hypothesis testing was performed based on a one-tailed Student's t-test, using both a Form 1 and Form 2 null hypothesis and an α of 0.05, and based on a two-tailed test with an α of 0.1 (USEPA 2002c). Hypothesis testing was performed using the ProUCL statistical tests module.

Site concentrations were also compared with background by two approaches:

- Comparison of mean concentrations of site COPECs to background mean concentrations
- Comparison of the maximum concentration to a background threshold level (BTV).

BTVs were developed using ProUCL, and are based on upper threshold levels (UTLs) or upper prediction limits (UPLs), whichever was recommended in the ProUCL output. The background data UTL is defined as the upper 95th confidence limit on the 95th percentile value, which is designated as UTL 95%-95% or UTL95-95. Typically for a data set, the UTL95-95 is higher than the 95UPL, which in turn is higher than the 95th percentile value. The UPL95 is a 95% upper prediction limit. As per ProUCL guidance (USEPA 2015a), a single exceedance of the BTV by an onsite concentration may be considered an indication of the presence of contamination at the site, and suggests that further investigation or cleanup may be necessary.

Table 4-16 presents the results of the background evaluation for surface soil for the wildlife COPECs. Panel A of Table 4-16 presents the background sample statistics, the 95 UCL values, and the BTVs for each COPEC. Panel B of Table 4-16 presents the ratio of the mean soil concentration of each COPEC to the mean background concentration, and the ratio of the maximum soil concentration to the BTV. These comparisons provide information on the magnitude of the difference in soil concentrations when site levels are elevated.

The elevations above background for surface soil concentrations are highest for lead in surface soil (exceeding the mean background concentration and the BTV by 78-fold) and for lead in subsurface soil (exceeding the mean background concentration by 245-fold and the BTV by 1131-fold). Six other metals exceed their background means and BTVs by greater than 10-fold in either surface or subsurface soils, including antimony, barium, cadmium, copper, mercury, and zinc. In subsurface soil, dioxin/furan TEQ exceeded the background sample TEQ by 126-fold; background data are insufficient to develop a BTV for dioxin/furan TEQ. The FIR (Shaw 2010) also concluded that concentrations of antimony, arsenic, barium, cadmium, calcium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, sodium, thallium, and zinc in site soils are elevated above background and could not be explained as the result of natural processes. Although identified as a COPEC based on HQs, vanadium was not found to be elevated above background levels.

These findings suggest that on-site soil concentrations of these COPECs, particularly lead and TEQ in subsurface soils, are attributable, at least in part, to site-related contamination.

4.4. ERA Uncertainty Assessment

There are a variety of sources of uncertainty in each line of evidence used in the risk assessment that need to be evaluated and considered when developing the weight of evidence and making risk management decisions. This section discusses the uncertainties associated with the ERA.

This section provides a detailed discussion of the main sources of uncertainty in the HQ-based evaluation along with a qualitative estimate of the direction and magnitude of the likely errors attributable to the uncertainty. Because of the inherent conservatism in the derivation of many of the exposure estimates and toxicity benchmarks, HQ values presented in this risk assessment should generally be viewed as being more likely to be high than low, and conclusions should be interpreted accordingly.

4.4.1. Nature and Extent of Contamination

Representativeness of Sampling Data.

For surface and subsurface soil, samples were collected with a focus on the waste debris and the pits containing ash from waste burning. The samples are considered highly biased and not necessarily representative of the concentrations over an exposure area that would represent a foraging area or population of ecological receptors. Only five samples are available to quantify surface soil contamination, which is less than USEPA recommendations for discrete sampling of an exposure area, which is generally a minimum of eight samples. Substantially more samples are available for subsurface soils and background. Overall, soil results may be biased high relative to the Site as a whole.

Accuracy of Analytical Measurements

Laboratory analysis of environmental samples is subject to technical difficulties, and values reported by the laboratory may not always be correct. The magnitude of analytical error is usually small compared to other sources of uncertainty although the relative uncertainty increases for results that are near the MDL. However, MDLs were found to generally be adequate for almost all the analytes measured. The risk assessment includes J-qualified results, which are considered estimated values for varying reasons, recognizing there is a higher degree of analytical uncertainty in these estimated values.

4.4.2. Exposure Assessment

Exposure Pathways and Routes not Evaluated.

Exposure pathways and routes selected for quantitative evaluation in this assessment do not include all potential exposure pathways or routes for all ecological receptors. Omission of these pathways or routes will tend to lead to an underestimation of total risk to the exposed receptors. As discussed previously, many of these exposure pathways and routes (e.g., dermal exposures of wildlife) are likely to be minor compared to other routes that were evaluated, and the magnitude of the underestimation is not likely to be significant in most cases.

Chemicals not Detected

The analyte list for samples collected at the Site was extensive, and several chemicals were not detected in soil. Any chemical that was not detected in any sample was not included as a COPEC. Omission of these chemicals is not likely to result in an underestimation of risk, provided that the data were collected using an analytical method that would have detected the chemical if it were present at a level of concern.

As was shown earlier, the MDLs were generally low enough to be adequate for evaluating potential ecological risk. The samples were analyzed in accordance with standard analytical methods; thus, for a few chemicals, available instrumentation is simply not able to achieve MDLs low enough to support meaningful ecological risk estimates. For chemicals that do not bioaccumulate, although inadequate MDLs are a source of uncertainty and might lead to an underestimation of risk, it is not likely to be a significant limitation.

Wildlife Exposure Parameters and Dose Modeling

The intake (ingestion) rates for food and soil used to estimate exposure of wildlife at the Site are subject to uncertainty from multiple sources. Most intake rates are derived from literature reports of intake rates, body weights, and dietary compositions in receptors at other locations or from measurements of laboratory-raised organisms. These values may or may not serve as appropriate models for site-specific intake rates of typical wildlife receptors at this Site. For this BERA, receptors were assumed to have a diet that was 100% of the food item with the highest uptake of soil chemicals, such as the assumption that insectivorous birds and mammals consume only earthworms. However, the actual dietary composition of an organism will vary daily and seasonally. These uncertainties could either under- or overestimate the actual exposures of wildlife to chemicals in soil and diet.

Data on incidental ingestion of soil by wildlife species are generally limited; therefore, the intake rates for soil used in these calculations are uncertain, and actual values might be either higher or lower than assumed.

Exposure estimates were derived assuming that the absorption of all COPECs in site soils was 100%. However, for some metals, it is considered likely that absorption may not be as high as from food or water; thus, this approach is likely to overestimate risks from incidental ingestion of soil.

For this assessment, it was assumed that wildlife exposures were continuous and receptor home ranges were located entirely within the site DUs (i.e., the entire total dietary intake was from the Site). In the case of resident receptors with small home ranges, this assumption may be appropriate. However, this assumption likely overestimates exposures for receptors that have larger home ranges and/or migratory species that may not be exposed on-site most of the time.

Concentrations in Tissues of Dietary Items

Measured data on concentrations in dietary items are not available for the Site. Therefore, to estimate exposures to wildlife, dietary tissue concentrations were estimated using uptake factors and/or bioaccumulation models from the literature. These uptake models may not account for site-specific factors that may influence accumulation into biota. Therefore, predictions of wildlife risk based on estimated tissue concentrations are considered uncertain and are likely to overestimate the actual exposures of wildlife to chemicals in dietary items.

4.4.3. Toxicity Assessment

Receptors Evaluated

Risks to wildlife were assessed for a selected subset of avian and mammalian species that were representative of feeding guilds (i.e., insectivores, herbivores, carnivores) likely to be present at the Site. Although the wildlife receptors evaluated in the risk assessment were selected to represent species within each feeding guild, they may not represent the full range of sensitivities present in species at the Site. The species selected may be more or less sensitive to chemical exposure than typical species located within the area.

Selected Toxicity Values

In the risk evaluation, HQs were calculated using toxicity values compiled from the literature (i.e., not site-specific toxicity values). There are several sources of uncertainty associated with the selected toxicity values that are discussed in more detail below. In general, the HQs are more likely to be overestimated than underestimated. Therefore, when NOAEL-based HQs are below 1, it is possible to draw meaningful conclusions regarding the low likelihood of risks despite the uncertainties in the selected toxicity values. However, when NOAEL-based HQs are above 1 and LOAEL-based HQs are below 1, the uncertainties in the selected toxicity values should be carefully considered in making risk management decisions.

Soil ESVs for Terrestrial Plants and Invertebrates

The toxicity benchmarks used in HQ calculations for terrestrial plants and invertebrates are usually based on laboratory studies in which soluble forms of test metals are added to test soils. Thus, these values do not account for occurrence of metals in mineral forms in soil that are largely insoluble and do not contribute as much toxicity as soluble forms. For example, the available chromium toxicity benchmarks for terrestrial plants and soil invertebrates were based on hexavalent chromium, Cr(VI), which is more soluble and generally more toxic than trivalent chromium, Cr(III) (Efroymson et al. 1997a). However, Efroymson et al. (1997b) point out that the relative toxicity of Cr(III) and Cr(VI) to soil invertebrates is not clear from the available toxicity studies. Cr(VI) ions can pass through cell membranes with much greater ease than Cr(III) ions. However, it is thought that Cr(VI) is reduced to Cr(III) inside the cell (Molnar et al., 1989); this latter may be the final active form. Molnar et al. (1989) found that soil invertebrate reproduction and mass gain of juveniles were more sensitive to Cr(III) than to Cr(VI), despite other studies summarized in Efroymson et al. (1997b) showing higher sensitivity to Cr(VI). Efroymson et al. (1997b) state that without a better understanding of chromium transformations in soil, transport across earthworm cell membranes, and reactions within the cell, it is difficult to separate the effects of the two different forms. The soil data collected in 2001 did not detect any hexavalent chromium (Shaw, 2010), so the form of chromium in Site soils is likely to be trivalent (Shahid et al., 2017; ATSDR 2012; Han et al. 2004). Note that if the concentration of chromium in soil was assumed to be 15 percent in the hexavalent form Cr(VI), the threshold-based HQs for chromium would still exceed 1 for terrestrial plants and soil invertebrates, and chromium would continue to be selected as a COEC.

For molybdenum, the low-effect ESL for soil organisms is taken from a Dutch compilation and is intended to represent a concentration associated with high risks, not low effects. The molybdenum ESL may under-estimate the potential risk to terrestrial plants and soil invertebrates.

Another limitation of the toxicity benchmarks is that the values do not account for variations in environmental factors, such as pH and TOC content, which may influence the toxicity of metals in soils. In addition, the laboratory tests may not utilize test species that are likely to occur at the Site.

Based on these considerations, confidence in the risk estimates for terrestrial plants and soil invertebrates is low, and risks are likely to be overestimated.

Toxicity Values for Wildlife

The TRVs used in the dose-based HQ calculations for the evaluation of wildlife exposures to contaminants in soil do not account for site-specific environmental attributes that may influence uptake and toxicity. As noted above, these uncertainties in wildlife TRVs limit the reliability of the risk estimates and calculated HQs are more likely to overestimate than underestimate actual risk.

Extrapolation from Laboratory to Field Conditions

Available toxicity data are usually generated under laboratory conditions, and extrapolation of those data to free-living receptors in the field is uncertain. One factor is that laboratory organisms are more homogeneous than wild populations. For example, laboratory test populations are usually all the same genetic strain, age, and sex, and all are usually healthy. In contrast, wild populations are genetically diverse, consist of individuals of different ages and genders, and health status may vary widely between individuals. In addition, laboratory animals are generally free from the stresses experienced by a wild population. Because of these factors, extrapolation of dose-response data and toxicity factors from laboratory species to wild populations is uncertain. The magnitude and direction of error introduced by this extrapolation is unknown.

Absence of Toxicity Data

Evaluation of risks from chemicals using the HQ approach requires the availability of reliable toxicity data. When no reliable toxicity data are available, it is not possible to calculate HQ values, thus, precluding this approach as a potential line of evidence in drawing risk conclusions. Tables 4-13 and 4-14 identify the ecological wildlife toxicity data for COPECs at the Site. No COPEC was lacking an avian or mammalian toxicity value.

For chemicals without toxicity data, which occurs with molybdenum, silver, thallium, and vanadium for soil invertebrates, and with aluminum for plants, the inability to quantify risks from these chemicals could result in an underestimation of total risk. However, for most chemicals, it is suspected that the magnitude of any underestimation of risk is likely to be low, at least in comparison to chemicals where toxicity values exist. This is based on the assumption that absence of laboratory studies to establish a toxicity value reflects a relatively low level of concern for the chemical. To the extent that this assumption is true, risks from detected chemicals without toxicity benchmark values are likely not to contribute risks of the same magnitude as those predicted for detected chemicals that do have a toxicity benchmark value.

4.4.4. Risk Characterization

Chemical Interactions

Most toxicity benchmark values are derived from studies of the adverse effects of a single contaminant. However, exposures to ecological receptors usually involve multiple contaminants, raising the possibility that synergistic or antagonistic interactions might occur. Generally, data are not adequate to permit any quantitative adjustment in toxicity values or risk calculations based on inter-chemical interactions. In accordance with USEPA guidance, effects from different chemicals are not added unless reliable data are available to indicate that the two (or more) chemicals act on the same target tissue by the same mode of action. In this risk assessment, ecological risk estimates were not added across different COPECs. If any of the COPECs at the Site act by a similar mode of action, total risks could be higher than estimated. Conversely, if the COPECs at the Site act antagonistically, total risks could be lower than estimated.

Estimation of Population-Level Impacts

Assessment endpoints for the receptors at this site are based on the sustainability of exposed populations (i.e., the ability of a population to maintain normal levels of diversity and density), and risks to some individuals in a population can occur and still allow for a healthy and stable population. However, even if it is possible to accurately characterize the distribution of risks or effects across the members of the exposed population, estimating the impact of those effects on the population is generally difficult and uncertain.

The relationship between adverse effects on individuals and effects on the population is complex and depends on the demographic and life history characteristics of the receptor being considered and the nature, magnitude, and frequency of the chemical stresses and associated adverse effects. Thus, the actual risks that will lead to population-level adverse effects will vary from receptor to receptor.

Uncertainties Specific to Insectivorous Birds and Mammals

Highest risk estimates were found for insectivorous birds and mammals, especially for lead in surface soils for birds and in subsurface soils for mammals. The representative bird species was the American woodcock, which also serves to represent the American robin, and the representative mammal species was the long-tailed and dusky shrew. Ecological risks are intended to estimate potential impacts on populations of organisms, or on communities, even though the toxicity values used to estimate risks are typically based on laboratory studies. The endpoints of the laboratory studies are based on factors that could impact a population of organisms, such as reproduction, growth, and mortality.

Avian risks from exposure to lead are based on a recent re-evaluation of the EcoSSL data for lead. Sample et al. (2019) suggests that the existing EcoSSL avian TRV for lead is inappropriate for evaluating risks to wild birds since it is based on reduced egg production in Japanese quail (Coturnix japonica), which may be too variable and unreliable an effect endpoint upon which to base toxicity-based screening criteria. That study presents threshold TRVs based on 10 percent and 20 percent effects, which serve as avian NOAEL and LOAEL TRVs, respectively (see Table 4-13). Use of these TRVs resulted in lower HQs for lead for avian receptors when compared with HQs based on the lead TRVs recommended in the current EcoSSL document.

For insectivorous mammals, the risk estimates are based on shrews, which at a threshold-based HQ of 38 for exposure to subsurface soils, is high enough to suggest that shrews could experience adverse impacts at the Site. However, whether the risk estimates indicate that a population of shrews or other insectivorous mammals, rather than a number of individual organisms, could be impacted is uncertain. The size of the Site is about 0.5 acres. This is about two times the size of the foraging range of the shrew receptor. At the threshold-based HQ for lead suggests, impacts could be expected for foraging pairs of shrews at the Site. However, whether such impacts would affect a reproducing population of shrews in the vicinity of the Site is unknown. The size of an area necessary to maintain a population of shrews or other small mammals has been suggested to be around 5 acres (Thomas 1979). Hence, whether the high HQs found for shrew exposure to lead at the 0.5-acre Site would impact a local population of shrews or other small insectivorous mammals is uncertain.

Contribution from Background

All of the COPECs identified in the ERA have the potential to be present at the Site because they are naturally occurring (e.g., metals and dioxins/furans). The comparisons of Site data to background data illustrate that the Site concentrations for many COPECs are substantially elevated above background, most by more than 10-fold, and lead and dioxins/furans by over 100-fold. Background risks would be substantially lower than Site-associated risks for the key drivers in the risk assessment. Vanadium was found to not be elevated above background, and risks attributed to vanadium for plants and wildlife are likely associated with background levels. Similarly, for molybdenum, although statistically elevated above background, the ratio of means and comparison to BTV suggests it may be within the range of background, and associated risks may be attributable to background. In general, the background comparisons show that several COPECs, particularly lead and dioxins/furans, are clearly elevated relative to background, indicating exposures are site-related.

4.5. Ecological Risk Assessment Conclusions

The SLERA identified the list of COPECs for further evaluation in the BERA. Based on the BERA, several metals and dioxins/furans in surface and subsurface soils are elevated above background and have the potential to be present at concentrations that may result in unacceptable ecological exposures. There are several different evaluation methods, or lines of evidence, that can be used in the BERA for determining the impact of site releases on ecological receptors (e.g., HQ estimates, toxicity tests, and habitat and community evaluations). Each of these lines of evidence has inherent advantages and limitations. For this reason, conclusions based on only one line of evidence may be incomplete. The best approach for reaching reliable conclusions about potential ecological risks is to combine the findings across all the evaluation methods for which data are available, taking the relative strengths and weaknesses of each method into account. If the methods all yield similar conclusions, confidence in the conclusion is increased. If different methods yield different conclusions, a careful review must be performed to identify the basis of the discrepancy (if possible) and decide which methods provide the most reliable information.

For the present BERA at the Mather FWDA site, there is one primary line of evidence—the modeled HQs—available for characterizing potential ecological risks, with additional lines of evidence including vegetation and wildlife observations (Harris Environmental Group, 2020) and a qualitative evaluation of the likelihood of exposures by comparison of receptor home range sizes with the size of site contamination. Thus, risk conclusions based on HQs should be viewed as having substantial uncertainty, and HQ values presented in this risk assessment should generally be viewed as being more likely to be over-estimated rather than under-estimated. Those COPECs with concentrations exceeding NOAEL-based ESVs or with NOAEL-HQs exceeding 1 are considered to be chemicals of ecological concern, except for those with Site concentrations not elevated above background.

For plants and invertebrates, the HQ results show that several metals detected in Site soils have concentrations sufficiently elevated to result in adverse impacts for terrestrial plants and/or soil invertebrate communities.

For mammals and birds, threshold-based HQs were substantially greater than 1 for lead in both surface and subsurface soils, and greater than 1 for several other metals, based on exposures of insectivorous birds and mammals to surface soil and terrestrial food items. The threshold-based HQ was also greater than 1 for Total TCDD-TEC in subsurface soils for insectivorous mammals.

Insectivorous receptors have higher HQs than the other two feeding guilds (i.e., herbivores, carnivores). This is not unexpected as bioaccumulation of contaminants into terrestrial invertebrate (earthworm) tissues often tends to be greater than into plants and small mammal tissue, which is the case in this risk assessment. Thus, if risk management decisions are based on this feeding guild, they will be adequately protective of other feeding guilds with lower exposures.

The list of COECs identified in the ecological risk assessment consist of the following:

- Terrestrial Plants: barium, chromium, lead, vanadium, zinc, manganese
- Soil Invertebrates: chromium, lead, zinc
- Wildlife: antimony, cadmium, copper, lead, mercury, zinc, and total TCDD-TEC.

Soil concentrations of all of these COECs were higher than background, which suggests on-site soil concentrations are attributable, at least in part, to site-related impacts. The area of contamination that presents potential risks to insectivorous birds and mammals is about 0.2 acres; because of its relatively small size, whether this area presents actual risks to the populations of those receptors is uncertain.

5. Development of Risk-Based Thresholds

The human health and ecological risk assessments identify contaminants at the Site that have the potential to pose unacceptable risks for a range of different receptors. For the Mather FWDA site, human health risks were considered to exceed a level of unacceptability for lead and two TPH fractions, which serve as surrogates for PAHs and petroleum products; ecological risks were found to be potentially unacceptable for numerous metals. Once potentially unacceptable risks are found, the subsequent risk management steps at the Site typically include either collecting additional data to address data gaps and uncertainties identified in the risk assessments; or concluding that remedial actions are necessary to address unacceptable exposures. The types and extent of remedial actions are based on several considerations, including the desired concentrations of contaminants that should be remediated. Those concentrations can be based on several factors, including results of the risk assessments. Remediation concentrations associated with specific risks are termed risk-based concentrations. For remediation purposes, risk-based concentration are typically those concentrations associated with an acceptable level of risk. These concentrations useful to support decisions on how and where these remedial actions would be performed.

In this section, risk-based concentrations are identified as preliminary removal goals (PRGs), as per NPS guidelines. The PRGs are developed for each contaminant and exposure medium where the risk assessment determined there is the potential for unacceptable risk. PRGs are intended to be protective of the human and ecological exposure scenarios of interest for the Site, and are based on the same exposure and toxicity information and derived using the same risk assessment methods that were used in the risk assessments for the Site.

In accordance with USEPA guidance (USEPA 2002c), PRGs were developed for all COCs from the human health risk assessment and all COECs from the ecological risk assessment. In addition to the development of risk-based PRGs, this section recommends background concentrations of naturally occurring COCs and COECs that may also be considered in the final determination of removal goals. As previously noted, most metals are naturally occurring in the environment, and some portion of the total risk is likely to be attributable to background. The background contributions to total exposures may be important when determining whether actions are needed to address unacceptable risks, the extent of these actions, and appropriate cleanup levels. Generally, site cleanup levels are not set at concentrations below natural background levels (USEPA 2002d).

5.1. Approaches to Preliminary Removal Goals

A PRG is the concentration of a chemical in an exposure medium associated with a target risk level such that concentrations at or below the PRG do not pose an unacceptable risk. PRGs are only developed for those chemicals identified as COCs in the HHRA and as COECs in the BERA. In the HHRA, cancer risks and non-cancer HQs are the lines of evidence for evaluating risks of chemicals. In the BERA, HQ values are the only line of evidence. For all of these lines of evidence, PRGs are derived by reversing the “forward-going” equations that calculate cancer risks and HQs to solve for the exposure concentration at a specified target risk level. When multiple lines of evidence are employed in the risk characterization, PRG development typically is based on the line(s) of evidence with the highest confidence.

The development of PRGs is easiest illustrated using human receptor populations with non-cancer risks, or ecological receptors that are exposed to site contaminants through direct contact. For the non-cancer endpoint for human populations, a PRG is developed as the following:

Forward equations: $HQ = Dose\ (EPC_{soil})\ /\ RfD$

Reverse equation: $Dose\ (EPC_{soil}) = Target\ HQ \times RfD$

where:

HQ = Hazard quotient for chemical resulting from exposure to soil

Dose = Total dose (Soil ingestion + Dermal contact + Inhalation of soil particulates), with each route of exposure dependent on EPC_{soil}

EPC_{soil} = Exposure point concentration in soil (mg/kg)

RfD = Reference dose

PRG = Preliminary removal goal (mg/kg), chemical concentration in soil that results in the target HQ.

As shown, the PRG is dependent on multiple components that make up the total dose, each one derived from the soil concentration (EPC_{soil}).

Similarly for the cancer risk endpoint, the PRG is a function of the same three routes of exposure, each one based on the EPC, and the resultant PRG is associated with the target cancer risk value. The target risk values for human health are HQ=1 and cancer risk of 1E-06.

For ecological receptors, the equations to derive a PRG for terrestrial plants are provided below as a similar simple illustration of the PRG derivation:

Forward equations: $HQ = EPC_{soil}\ /\ ESV$

Reverse equation: $EPC_{soil}\ [PRG] = Target\ HQ \times ESV$

where:

HQ = Hazard quotient for chemical resulting from exposure to soil

EPC_{soil} = Exposure point concentration in soil (mg/kg)

ESV = Ecological screening value for soil for terrestrial plants (mg/kg)

PRG = Preliminary removal goal (mg/kg), chemical concentration in soil that results in the target HQ.

For an ecological PRG for terrestrial plants or invertebrates, the target HQ is 1 and the PRG is equal to the ESV.

5.2. Human Health Preliminary Removal Goals

Human health PRGs are derived for COCs identified in Section 3. The equations for estimating cancer risks and non-cancer HQs were presented in Section 3.5.1, where both cancer risks and non-cancer HQs are developed from toxicity values and doses estimated from modeling. Totals doses were estimated for multiple routes of exposure: ingestion of soil, dermal contact with soil, and inhalation of airborne contaminants from soil dust. The total doses are modeled from EPCs in soil and modeling parameters to estimate doses from each of the three routes of exposure.

Rather than develop and display reverse equations for deriving a risk-based soil concentration from multiple exposure routes, the soil concentration that is equivalent to the target risk level is derived through the multiple forward calculations in Excel spreadsheets, varying soil concentrations until the target risk level is achieved, with rounding to a single digit. For cancer risks, the target risk level is 1E-06, or one in one million chance of cancer. For non-cancer endpoint, the target risk level in HQ = 1. Thus, the human health PRGs for non-lead COCs were derived using the same exposure parameters and toxicity values used in the HHRA but essentially reversing the risk equation to solve for EPC_{soil} for a given COC, with a pre-set target risk level. The resultant soil concentration (EPC_{soil}) is the PRG for that COC.

The COCs identified for human receptor populations are lead and aromatic TPH fractions. The highest risks and exposures were estimated for the construction worker scenario, for exposure to subsurface soils, and PRGs are developed for that scenario. TPH fractions present non-cancer risks with HQs exceeding 1, and do not present carcinogenic risk estimates above 1E-06. Thus, PRGs for the two TPH fractions are developed from a non-cancer HQ of 1. Human health PRGs for TPH fractions are presented in Table 5-1 for soil.

For lead, PRGs are developed for exposures of construction workers to subsurface soils, where lead was found through the ADM to present unacceptable levels of blood lead to the fetus of a construction worker. Two target blood lead levels were evaluated in the model: 5 µg/dL and 10 µg/dL. The ADM provides a module for deriving PRGs for lead in soil based on the exposure parameters used for the CTE and RME construction worker scenarios, for both target blood lead levels. The modeled PRGs for these scenarios for each of the target blood lead levels are provided in Table 5-2.

5.3. Ecological Preliminary Removal Goals

Ecological PRGs are derived for COECs identified in the ecological risk assessment. PRGs are derived for terrestrial plants and soil invertebrates by a relatively simple method, and for wildlife by a more complex method, described below.

5.3.1. Terrestrial Plants and Soil Invertebrates

Several COECs were identified for terrestrial plants and soil invertebrates. Although the HQs in the BERA are calculated from no-effect benchmarks (i.e., refined ESVs) and low-effect ESLs, for the purposes of developing PRGs, a single PRG was calculated for each COEC based on an estimated threshold-effects benchmark. The effects threshold is presumed to lie in the interval between the no-effect level and the low-effect level. The threshold-effects benchmarks are estimated as the geometric mean of the low-effect ESLs from LANL (2017) and the NPS (2018) refined ESVs. PRGs are developed to equal the threshold-based HQ of 1.

For terrestrial plants and soil invertebrates, COECs were identified as six metals in surface and subsurface soils. PRGs were developed for these COECs, and are presented in Table 5-3 as estimated PRGs for exposures of these receptor populations to surface and subsurface soils.

5.3.2. Wildlife

The equations for calculating risk estimates for wildlife were presented in Section 4.3.2, where HQs are developed from TRVs and doses were estimated from modeling parameters characterizing exposures from ingestion of contaminated soil and food items. Rather than develop and display reverse equations for deriving a risk-based soil concentration from multiple exposure routes, the soil concentration that is equivalent to HQ =1 is derived through the multiple forward calculations in Excel spreadsheets, varying soil concentrations until the HQ equals 1, with rounding to a single digit. Thus, the wildlife risk-based PRGs were derived using the same exposure parameters and toxicity values used in the BERA but essentially reversing the risk equation to solve for EPC_{soil} for a given COEC. The resultant soil concentration (EPC_{soil}) is the PRG for that COEC.

Although the HQs presented in the BERA are based on no-effect and low-effect levels, as well as on an estimated threshold effect level, for the purposes of developing PRGs, a single PRG was calculated based on the estimated effects threshold level. The effects threshold is presumed to lie in the interval between the no-effect level and the low-effect level. For wildlife, the effects threshold TRVs are estimated as the geometric mean of the NOAEL and LOAEL TRVs (USEPA 1998), and the PRGs are developed to equal the threshold-based HQ.

PRGs were developed for all COECs identified in the BERA. Since soil was the only medium for which risks were estimated, PRGs were developed only for soil. Where risk-based concentrations can be calculated for both birds and mammals for the same COEC, the lower value was selected as the final soil PRG for that chemical.

For both mammals and birds, insectivorous receptors had higher HQs than the other two terrestrial feeding guilds (i.e., herbivores, carnivores). Terrestrial invertebrates often have a higher uptake of contamination compared to other dietary items (e.g., plants or small mammals), and insectivorous receptors tend to have a higher incidental ingestion rate of soil. Thus, ecological PRGs were developed for insectivorous wildlife only. If risk management decisions are based on this feeding guild, they will be adequately protective of other feeding guilds with lower exposures.

For mammals and birds, numerous metals and dioxins/furans were identified as COECs for exposures to surface and subsurface soils and terrestrial food items. PRGs were developed for these COECs, and are presented in Table 5-3 as estimated wildlife PRGs for soil.

The lowest PRG for ecological receptors was selected from the four receptor groups of terrestrial plants, soil invertebrates, birds, mammals. The lowest ecological PRG for each COEC is also shown in Table 5-3.

5.4. Use of Risk-Based PRGs in Remedial Actions

Final selected risk-based PRGs for the Mather FWDA Site soils are based on the lowest of combined human health-based and ecological-based PRGs. The final combined PRGs are shown in Table 5-4. Application of the PRGs to Site remedial actions should take into account the background levels of the COCs and COECs. As mentioned, USEPA recommends not cleaning up sites to levels below background (USEPA 2002d). Background reference values derived as BTVs from background samples are provided for the Site COCs and COECs in Table 5-4. For chromium, the threshold-based PRG for plants and terrestrial invertebrates was developed from chromium VI data, whereas the BTV, which is higher than the PRG, was developed from data on total chromium.

Risk interpretations presented in this risk assessment are based on site-wide data, under the assumption that both human and ecological receptors may move about the Site and be exposed to soils equally throughout the Site. For each receptor, risk estimates were developed based on an EPC, which was usually computed as the 95UCL on the mean concentration of site-wide data. Likewise, application of a PRG should also be applied on site-wide basis for each receptor type and interpreted in terms of the 95UCL on the mean. This means the soil PRG should not be applied to discrete samples that are not representative of the entire exposure area of interest, i.e., the entire contaminated area. Essentially, the 95UCL on the mean concentration of data from an area equivalent to expected future exposures at the Site based on post-removal sampling should meet the PRG. The confirmation sampling program must also consider the appropriate application of the PRG in evaluating post-cleanup conditions.

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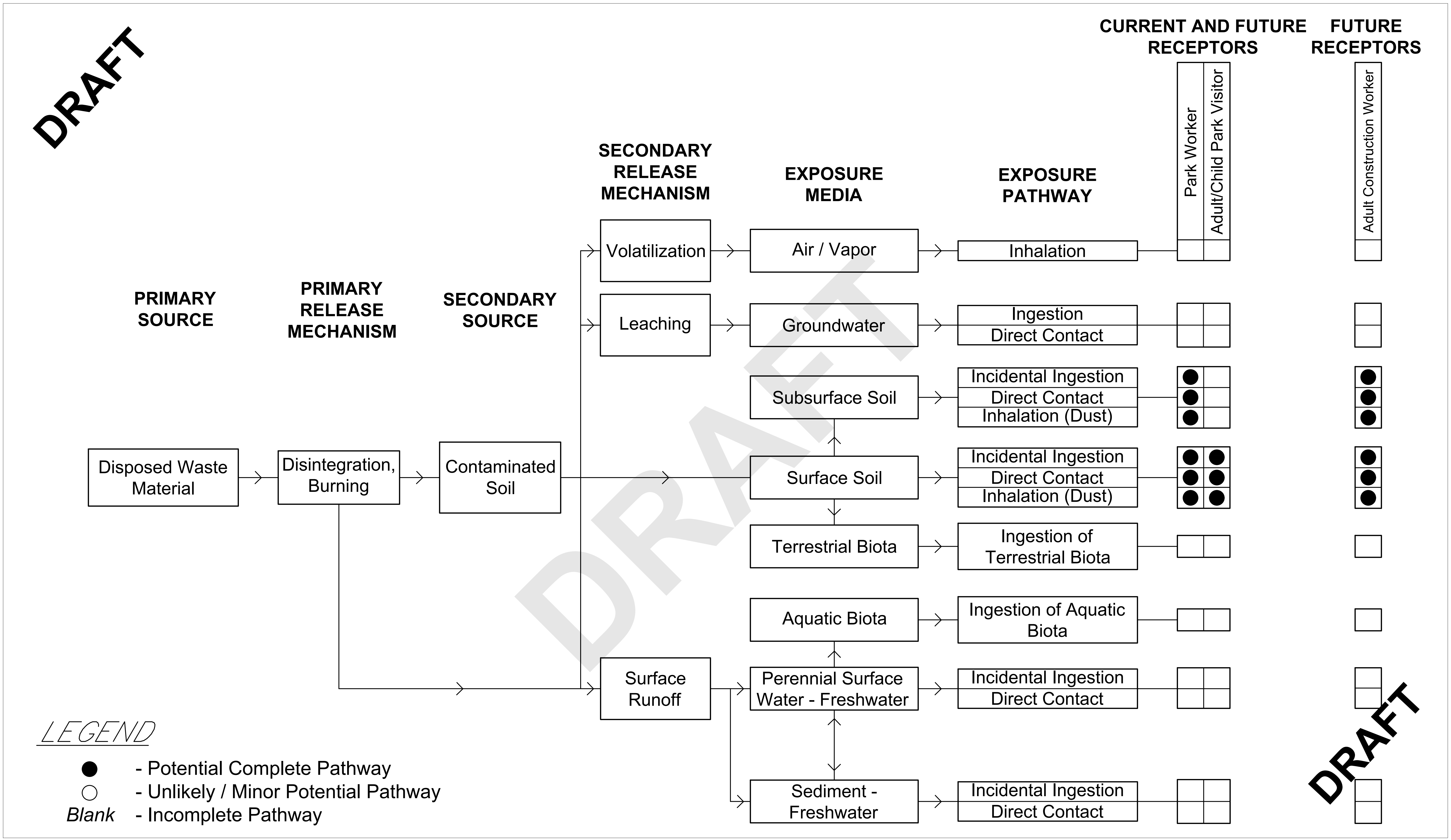
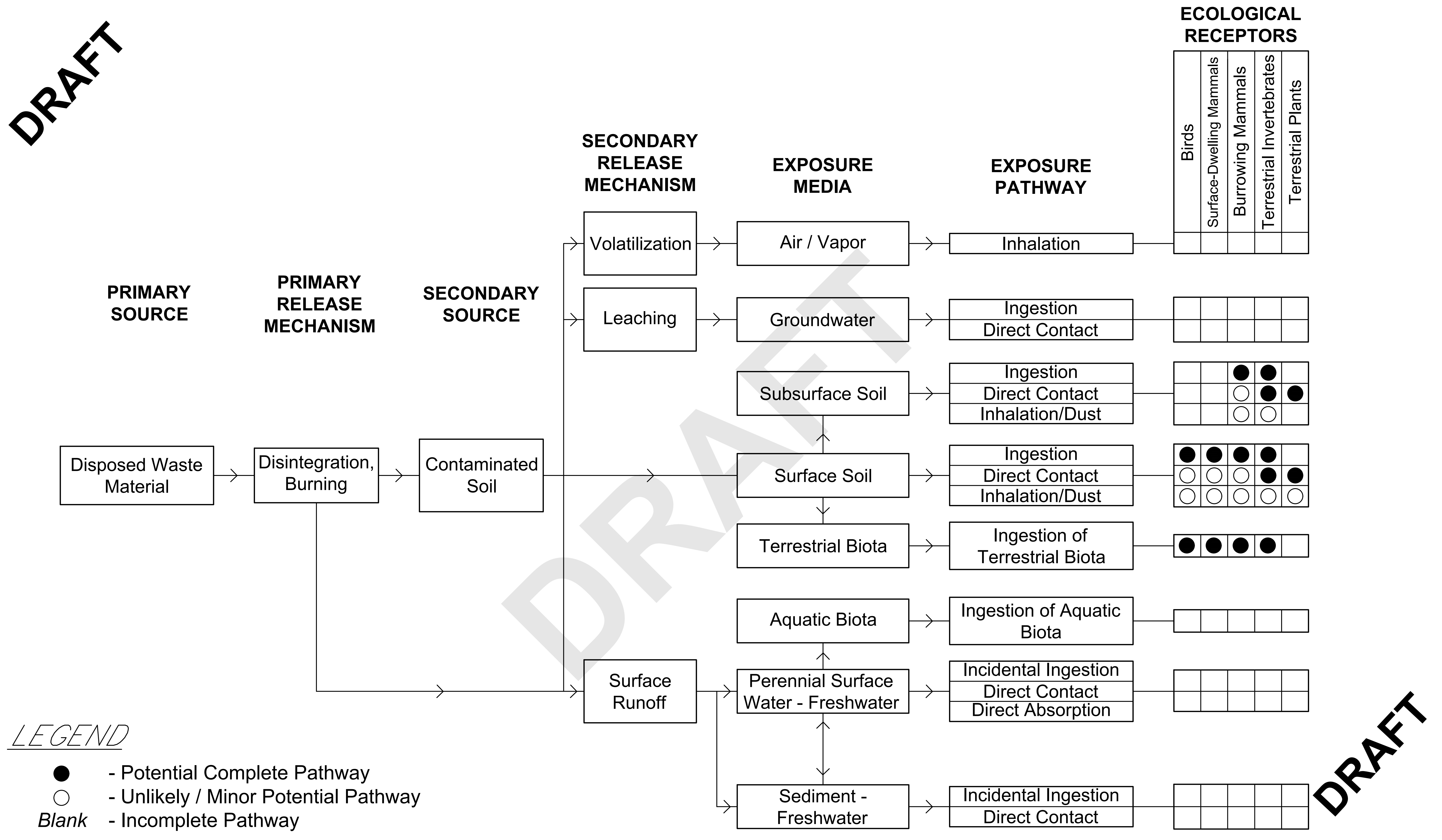
FIGURES



KANE ENVIRONMENTAL INC
Project #49721

Engineering Evaluation / Cost Analysis
Mather Former Waste Disposal Area Site
Yosemite National Park, California

Figure 3-1
Conceptual Site Model For Human Exposures



Project #49721

Human Health and Ecological Risk Assessment
Mather Former Waste Disposal Area Site
Yosemite National Park, California

Figure 4-1
Conceptual Site Model For Ecological Exposures

TABLES

Table 3-1. COPC Selection Summary for Human Health

Chemical Group	Human Health	
	Surface Soil	Subsurface Soil
Metals	Antimony	--
	Arsenic	Arsenic
	--	Cadmium
	Cobalt	Cobalt
	Lead	Lead
	--	Mercury
	Thallium	Thallium
	Zinc	--
	Aluminum	Aluminum
	Iron	Iron
	Manganese	Manganese
PAHs	Dibenz(a,h)anthracene	Dibenz(a,h)anthracene
TPH	TPH Aromatics Medium	TPH Aromatics Medium
	TPH Aromatics High	TPH Aromatics High
Dioxins/Furans	--	TEQ

Notes:

CASRN = Chemical Abstracts Service Registry Number

COPEC - Chemcial of Potential Ecological Concern

EPA = Environmental Protection Agency

Table 3-2. Exposure Parameters for Park Workers

			CTE		RME		CTE		RME	
Exposure Pathway	**Exposure Input Parameter**	**Units**	**Adult Employee**	**Source**	**Adult Employee**	**Source**	**Construction Worker**	**Source**	**Construction Worker**	**Source**
General	Body weight (adult)	kg	80	[1,2]	80	[1,2]	80	[1,2]	80	[1,2]
	Exposure frequency	days/yr	12	[4,b]	24	[4,a]	15	[4,b]	30	[4,a]
	Exposure duration	yr	5	[4]	10	[4,c]	1	[4]	3	[4,d]
	Averaging time, non-cancer	dy	1825	[1,3]	3650	[1,3]	365	[1,3]	1095	[1,3]
	Averaging time, cancer	dy	25550	[1,3]	25550	[1,3]	25550	[1,3]	25550	[1,3]
Incidental Ingestion of Soil	Ingestion rate	mg/day	50	[4,b]	100	[1,2]	165	[4,b]	330	[1,6]
	Conversion factor	kg/mg	1.E-06	--	1.E-06	--	1.E-06	--	1.E-06	--
Dermal Contact with Soil	Exposed surface area	cm^2/event	2,479	[5,e]	6,032	[1]	6,032	[1]	6,032	[1]
	Adherence factor	mg/cm^2	0.02	[5]	0.2	[5]	0.8	[1]	0.8	[1]
	Event frequency	events/day	1	[5]	1	[5]	1	[5]	1	[5]
	Conversion factor	kg/mg	1.E-06	--	1.E-06	--	1.E-06	--	1.E-06	--
Inhalation of Airborne Dust (Derived from	Exposure time	hr/day	4	[4,b]	8	[4]	8	[4]	10	[7]
	Conversion factor	µg/mg	1.E+03	--	1.E+03	--	1.E+03	--	1.E+03	--

Sources:

[1] DTSC HERO Note 1. Recommended DTSC Default Exposure Factors, Adults Industrial and Construction.

[2] USEPA 2014. OSWER Directive 9200.1-120. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Parameters.

[3] USEPA 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). EPA/540/1-89/002. December.

[4] Professional judgment.

[5] USEPA 2004a. Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part E- Dermal), average of males and females. CTE = face, forearms, and hands; RME =

[6] USEPA 2002b. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

[7] USEPA 2009. Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual (Part F- Inhalation).

Notes:

[a] Assumes exposure occurs over 24 weeks (May-October) for a worker, and 30 weeks for a construction/restoration worker, when ground is not covered with snow, for 1 day per week.

[b] Assumes CTE receptor is half that of the RME receptor.

[c] The default outdoor worker exposure duration is 25 years; however, it is not reasonable to assume all 25 years of an NPS employees' outdoor working time at the Park would be spent at the

[d] Assumes construction and restoration projects could take up to 3 years to complete.

[e] Face, forearms, hands

cm2 = square centimeter
CTE = central tendency exposure
DTSC = Department of Toxic Substances Control
HERO = Human and Ecological Risk Office
HIF = human intake factor
hr = hour
kg = kilogram
mg = milligram
NPS = National Park Service
OSWER = Office of Solid Waste and Emergency Response
RME = reasonable maximum exposure
TWF = time-weighting factor
USEPA = United States Environmental Protection Agency
yr = year

Table 3-3. Exposure Parameters for Park Visitors

			CTE				RME			
Exposure Pathway	**Exposure Input Parameter**	**Units**	**Young Child**	**Older Child [d]**	**Adult**	**Source**	**Young Child**	**Older Child [d]**	**Adult**	**Source**
General	Body weight	kg	15	44	80	[1,3]	15	44	80	[1,3]
	Exposure frequency	days/yr	1	5	5	[4,a]	2	10	10	[4,a,e]
	Exposure duration	yr	2	5	5	[4]	6	10	10	[4, e]
	Averaging time, non-cancer	dy	730	1825	1825	[1,2]	2190	3650	3650	[1,2]
	Averaging time, cancer	dy	25550	25550	25550	[1,2]	25550	25550	25550	[1,2]
Incidental Ingestion of Soil	Ingestion rate	mg/day	100	50	50	[b]	200	100	100	[1,3,c]
	Conversion factor	kg/mg	1.E-06	1.E-06	1.E-06	--	1.E-06	1.E-06	1.E-06	--
Dermal Contact with Soil	Exposed surface area	cm2/event	1558	2,479	2,479	[4,g]	2,208	4,849	4,849	[4,h]
	Adherence factor	mg/cm2	0.2	0.07	0.07	[1]	0.2	0.07	0.07	[1]
	Event frequency	events/day	1	1	1	[5]	1	1	1	[5]
	Conversion factor	kg/mg	1.E-06	1.E-06	1.E-06	--	1.E-06	1.E-06	1.E-06	--
Inhalation of Airborne Dust	Exposure time	hr/day	0.5	0.5	0.5	[4, f]	2	2	2	[4, f]
	Conversion factor	µg/mg	1.E+03	1.E+03	1.E+03	--	1.E+03	1.E+03	1.E+03	--

Sources:

[1] DTSC HERO Note 1. Recommended DTSC Default Exposure Factors, Children.
[2] USEPA 1989. Risk Assessment Guidance for Superfund, Volume I, Part A.
[3] USEPA 2014. OSWER Directive 9200.1-120. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Parameters.
[4] Professional judgement.
[5] USEPA 2004a. Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part E - Dermal). CTE = face, forearms, and hands; RME = CTE plus lower legs.

Notes:

[a] Assumes exposure for an RME visitor is limited to 10 days/year (5 weekends/year), and a CTE visitor's exposure is half of the RME visitor (i.e., 5 days).
[b] Assumes CTE value is half of the RME value.
[c] Assumes RME soil ingestion by a park visitor is equal to a resident defualt ingestion rate.
[d] An older child is assumed to be between 6 and 16 years old; an adult is assumed to be 16 years and older.
[e] While the amount of time spent at Yosemite National Park may be higher, it is not reasonable to assume the entirety of a visitors' time at the Park would be spent at the Vogelsang Site.
[f] RME time assumes about 2 hours would be spent at the Site while camping or staying nearby. CTE is based on a through -hiker scenario; assumes it would take 30 minutes to hike across
[g] Face, forearms, hands
[h] Face, forearms, hands,lower legs

cm2 = square centimeter
CTE = central tendency exposure
DTSC = Department of Toxic Substances Control
HERO = Human and Ecological Risk Office
HIF = human intake factor
hr = hour
kg = kilogram
mg = milligram
OSWER = Office of Solid Waste and Emergency Response
RME = reasonable maximum exposure
TWF = time weighting factor
USEPA = United States Environmental Protection Agency
yr = year

Table 3-4. Exposure Point Concentrations, Human Health - Surface Soil

Chemical Group	COPC	CASRN	Number of Samples	Number of Detects	Maximum (mg/kg)	Mean (mg/kg)	Calculated 95UCL (mg/kg)	Exposure Point Concentration (EPC)	
								(mg/kg)	EPC Basis
Metals	Antimony	7440-36-0	5	5	4.6	1.9	3.549	3.5	95% Student's-t UCL
	Arsenic	7440-38-2	5	5	7.4	4.5	6.840	6.8	95% Student's-t UCL
	Cobalt	7440-48-4	5	5	9.2	6.6	8.746	8.7	95% Student's-t UCL
	Lead	7439-92-1	5	5	689	364.8	634.3	634	95% Student's-t UCL
	Thallium	7440-28-0	5	5	0.6	0.4	0.506	0.51	95% Student's-t UCL
	Zinc	7440-66-6	5	5	2420	1267	2322	2322	95% Student's-t UCL
	Aluminum	7429-90-5	5	5	12000	9978	11663	11663	95% Student's-t UCL
	Iron	7439-89-6	5	5	40200	27520	36818	36818	95% Student's-t UCL
	Manganese	7439-96-5	5	5	1900	1059.4	1664	1664	95% Student's-t UCL
PAHs	Dibenz(a,h)anthracene	53-70-3	5	1	0.049	0.049	NC	0.049	Maximum
TPH	TPH Aromatics High	E1790676	5	2	2000	1370	NC	2000	Maximum
	TPH Aromatics Medium	E1790674	5	2	89	60	NC	89	Maximum

Notes:

Maximum and Mean values are for detected values only. 95 U

COPC = Chemical of Potential Concern

95UCL = 95 percent upper confidence limit

CASRN = Chemical Abstracts Service Registry Number

EPC = exposure point concentration

mg/kg - milligrams per kilogram

NC = not calculated

UCL = upper confidence level

PAH = polycyclic aromatic hydrocarbon

TPH = total petroleum hydrocarbon

Table 3-5. Exposure Point Concentrations, Human Health - Suburface Soil

Chemical Group	COPC	CASRN	Number of Samples	Number of Detects	Maximum (mg/kg)	Mean (mg/kg)	Calculated 95UCL (mg/kg)	Exposure Point Concentration (EPC) (mg/kg)	EPC Basis
Metals	Antimony	7440-36-0	11	5	2.4	1.6	1.978	2.0	95% KM (t) UCL
	Arsenic	7440-38-2	11	11	8.4	3.2	5.218	5.2	95% Adjusted Gamma UCL
	Cadmium	7440-43-9	11	6	11.8	3.8	4.163	4.2	95% KM (t) UCL
	Cobalt	7440-48-4	11	11	6.8	4.3	5.121	5.1	95% Student's-t UCL
	Lead	7439-92-1	11	11	9930	1151.4	9972	9930	Maximum
	Mercury	7439-97-6	11	9	1.6	0.703	0.917	0.92	95% KM (t) UCL
	Thallium	7440-28-0	11	5	0.4	0.28	0.33	0.33	95% KM (t) UCL
	Aluminum	7439-89-6	5	5	12000	10134	11242	11242	95% Student's-t UCL
	Iron	7439-96-5	5	5	29700	16826	25076	25076	95% Student's-t UCL
	Manganese	67-64-1	5	5	1790	672	1347	1347	95% Student's-t UCL
PAHs	Dibenz(a,h)anthracene	53-70-3	11	2	0.030	0.0235	0.0139	0.014	95% KM (t) UCL
TPH	TPH Aromatics High	E1790676	15	10	110000	20182	104995	104995	99% KM (Chebyshev) UCL
	TPH Aromatics Medium	E1790674	15	10	4800	608	4705	4705	99% KM (Chebyshev) UCL
Dioxin / Furan	TEQ	TEQ	2	2	1.11E-05	5.60E-06	NC	1.11E-05	Maximum
Background Subsurface Soil Statistics									
TPH	TPH Aromatics High	E1790676	3	3	31	24	42	31	Maximum
	TPH Aromatics Medium	E1790674	3	3	3	3	NC	3	Maximum

Notes:

Maximum and Mean values are for detected values only. 95 UCLs are those recommended in ProUCL for detects and non-detects (ND).

COPC = Chemical of Potential Concern

95UCL = 95 percent upper confidence limit

CASRN = Chemical Abstracts Service Registry Number

EPC = exposure point concentration

mg/kg - milligrams per kilogram

NC = not calculated

UCL = upper confidence level

PAH = polycyclic aromatic hydrocarbon

TPH = total petroleum hydrocarbon

TEQ = toxicity equivalency quotient

Table 3-6. Air Particulate Modeling from Surface and SubSurface Soil

			Adult Park Worker						Adult Park Worker		Adult and Child Visitor
Chemical Group	COPC	CASRN	Surface Soil C_{soil} mg/kg	Subsurface Soil $C_{subsoil}$ mg/kg	Adult and Child Visitors C_{soil} mg/kg	Worker / Construction PEF m^3/kg	Recreational PEF m^3/kg	Fraction Contaminated 100%	Surface Soil C_{air}, Particulate mg/m^3	Subsurface Soil C_{air}, Particulate mg/m^3	C_{air}, Particulate mg/m^3
Metals	Antimony	7440-36-0	3.55E+00	1.98E+00	3.55E+00	1.00E+06	1.36E+09	1	3.55E-06	1.98E-06	2.61E-09
	Arsenic	7440-38-2	6.84E+00	5.22E+00	6.84E+00	1.00E+06	1.36E+09	1	6.84E-06	5.22E-06	5.03E-09
	Cadmium	7440-43-9	Not COPC	4.16E+00	Not COPC	1.00E+06	1.36E+09	1	NA	4.16E-06	NA
	Cobalt	7440-48-4	8.75E+00	5.12E+00	8.75E+00	1.00E+06	1.36E+09	1	8.75E-06	5.12E-06	6.43E-09
	Lead	7439-92-1	6.34E+02	9.93E+03	6.34E+02	1.00E+06	1.36E+09	1	6.34E-04	9.93E-03	4.66E-07
	Mercury	7439-97-6	Not COPC	9.17E-01	Not COPC	1.00E+06	1.36E+09	1	NA	9.17E-07	NA
	Thallium	7440-28-0	5.06E-01	3.30E-01	5.06E-01	1.00E+06	1.36E+09	1	5.06E-07	3.30E-07	3.72E-10
	Zinc	7440-66-6	2.32E+03	Not COPC	2.32E+03	1.00E+06	1.36E+09	1	2.32E-03	NA	1.71E-06
	Aluminum	7429-90-5	1.17E+04	1.12E+04	1.17E+04	1.00E+06	1.36E+09	1	1.17E-02	1.12E-02	8.58E-06
	Iron	7439-89-6	3.68E+04	2.51E+04	3.68E+04	1.00E+06	1.36E+09	1	3.68E-02	2.51E-02	2.71E-05
	Manganese	7439-96-5	1.66E+03	1.35E+03	1.66E+03	1.00E+06	1.36E+09	1	1.66E-03	1.35E-03	1.22E-06
PAHs	Dibenz(a,h)anthracene	53-70-3	4.90E-02	1.39E-02	4.90E-02	1.00E+06	1.36E+09	1	4.90E-08	1.39E-08	3.60E-11
TPH	TPH Aromatics High	E1790676	2.00E+03	1.05E+05	2.00E+03	1.00E+06	1.36E+09	1	2.00E-03	1.05E-01	1.47E-06
	TPH Aromatics Medium	E1790674	8.90E+01	4.71E+03	8.90E+01	1.00E+06	1.36E+09	1	8.90E-05	4.71E-03	6.54E-08
Dioxin/Furans	2,3,7,8-TCDD TEQ	1746-01-6	Not COPC	1.11E-05	Not COPC	1.00E+06	1.36E+09	1	NA	1.11E-11	NA
Background Subsurface Soil											
TPH	TPH Aromatics High	E1790676	Not COPC	3.10E+01	Not COPC	1.00E+06	--	1	NA	3.10E-05	NA
	TPH Aromatics Medium	E1790674	Not COPC	3.00E+00	Not COPC	1.00E+06	--	1	NA	3.00E-06	NA

Notes:

$C_{air,}$ Particulate = C_{soil}/PEF x fraction contaminated

PEF = Particulate Emission Factor, default values from Cal DTSC HERO Note 1 (DTSC 2019b).

COPC = chemical of potential concern

NA = not available, chemical not a COPC for that scenario

Table 3-7. Toxicity Values for COPCs

Chemical Group	COPC	CASRN	Cancer Slope Factor (CSF_o)[1] Oral $(mg/kg\text{-}day)^{-1}$	Source	Inhalation Unit Risk Factor (IUR) Inhalation $(\mu g/m^3)^{-1}$	Source	Reference Dose (RfD_o)[1] Oral (mg/kg-day)	Source	Reference Concentration (RFC_i)[1] Inhalation mg/m^3	Source	Cancer Slope Factor (CSF_d)[2] Dermal $(mg/kg\text{-}day)^{-1}$	Reference Dose (RfD_d)[2] Dermal (mg/kg-day)	GI Absorption Factor (GIABS)[3] Unitless	Dermal Absorption Factor (ABS_d)[3] Unitless
Metals	Antimony	7440-36-0	NA		NA		4.0E-04	I	3.0E-04	A	NA	6.00E-05	0.15	NA
	Arsenic	7440-38-2	1.5E+00	I	4.3E-03	I	3.0E-04	I	1.5E-05	C	1.50E+00	3.00E-04	1	0.03
	Cadmium	7440-43-9	NA		1.8E-03	I	1.0E-03	I	1.0E-05	A	NA	2.50E-05	0.025	0.001
	Cobalt	7440-48-4	NA		9.0E-03	P	3.0E-04	P	6.0E-06	P	NA	3.00E-04	1.000	NA
	Lead	7439-92-1	NA		NA		NA		NA		NA	NA	NA	NA
	Mercury	7439-97-6	NA		NA		3.0E-04	I	3.0E-04	G	NA	2.10E-05	0.07	NA
	Thallium	7440-28-0	NA		NA		1.0E-05	X	NA		NA	1.00E-05	1	NA
	Zinc	7440-66-6	NA		NA		3.0E-01	I	NA		NA	3.00E-01	1	NA
	Aluminum	7429-90-5	NA		NA		1.0E+00	P	5.0E-03	P	NA	1.00E+00	1	NA
	Iron	7439-89-6	NA		NA		7.0E-01	P	NA		NA	7.00E-01	1	NA
	Manganese	7439-96-5	NA		NA		1.4E-01	I	5.0E-05	I	NA	1.40E-01	1	NA
PAHs	Dibenz(a,h)anthracene	53-70-3	1.0E+00	E	6.0E-04	E	NA		NA		1.00E+00	NA	1	0.13
TPH	TPH Aromatics High	E1790676	NA		NA		4.0E-02	P	NA		NA	4.00E-02	1	0.13
	TPH Aromatics Medium	E1790674	NA		NA		4.0E-03	P	3.0E-03	P	NA	4.00E-03	1	0.13
Dioxin/Furans	2,3,7,8-TCDD TEQ	1746-01-6	1.3E+05	C	3.8E+01	C	7.0E-10	I	4.0E-08	C	1.30E+05	7.00E-10	1	0.03

Notes:

[1] - Toxicity values (RfD, CSF, IUR) are taken from the USEPA RSL database, May 2020 (I=IRIS; A=ATSDR, C=CalEPA, G=RSL User's Guide, H=HEAST, O=OEHHA, P=PPRTV, X=PPRTV Screening Level), except where noted.

[2] - The dermal reference doses and cancer slope factors are develped by adjusting the oral values as recommended by the USEPA Risk Assessment Guidance for Superfund (RAGS), Part E (USEPA, 2004).

[3] - Gastrointestinal absorption (GIABS) factors and dermal absorption (ABSd) factors were obtained from the RSL dataabase (November 2020).

NA - Toxicity or chemical-specific parameters were not available.
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/m^3 - milligrams per cubic meter
$(\mu g/m^3)^{-1}$ -per microgram per cubic meter
OEHHA = California EPA's Office of Environmental Health Hazard Assessment (OEHHA) Technical Support Document for Cancer Potency https://oehha.ca.gov/media/CPFs042909.pdf
CASRN = Chemical Abstracts Service Registry Number COPC = chemical of potential concern
COPC - Chemcial of Potential Concern
PAH = polycyclic aromatic hydrocarbon
RSL = Regional Screening Level Database, USEPA, May 2020 https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
TEQ = toxicity equivalents (2,3,7,8-TCDD)
mercury = mercuric chloride
thallium = soluble salts

Table 3-8. Summary of NonCancer Hazard Quotients

Route of Exposure	Adult Park Worker		Construction/Restoration Worker		Young Child Visitor Scenario		Older Child Visitor Scenario		Adult Visitor Scenario	
	CTE	RME	CTE	RME	CTE	RME	CTE	RME	CTE	RME
Surface Soil										
Incidental Ingestion of Surface Soil	0.004	0.02	0.02	0.1	0.004	0.01	0.003	0.01	0.002	0.01
Dermal Contact with Surface Soil	0.00001	0.001	0.002	0.003	0.00004	0.0001	0.00004	0.0001	0.00002	0.0001
Inhalation of Particles from Surface Soil	0.2	0.8	0.5	1	0.000002	0.00001	0.000008	0.00006	0.000008	0.0001
Cumulative Risk Across All Routes of Exposure	0.2	0.8	0.5	1	0.004	0.01	0.003	0.01	0.002	0.007
TPH Cumulative Risk Across All Routes of Exposure	0.002	0.016	0.03	0.07	0.002	0.007	0.002	0.007	0.001	0.004
Subsurface Soil										
Incidental Ingestion of SubSurface Soil	NE	NE	0.01	0.1	NE	NE	NE	NE	NE	NE
Dermal Contact with SubSurface Soil	NE	NE	0.003	0.006	NE	NE	NE	NE	NE	NE
Inhalation of Particles from SubSurface Soil	NE	NE	0.4	1	NE	NE	NE	NE	NE	NE
Cumulative Risk Across All Routes of Exposure	NE	NE	0.4	1	NE	NE	NE	NE	NE	NE
TPH Risks - Subsurface Soil										
Incidental Ingestion of SubSurface Soil	NE	NE	0.3	1.3	NE	NE	NE	NE	NE	NE
Dermal Contact with SubSurface Soil	NE	NE	1.2	2.4	NE	NE	NE	NE	NE	NE
Inhalation of Particles from SubSurface Soil	NE	NE	0.02	0.1	NE	NE	NE	NE	NE	NE
TPH Cumulative Risk Across All Routes of Exposure	NE	NE	**2**	**4**	NE	NE	NE	NE	NE	NE
TPH Background Cumulative Risk	NE	NE	0.001	0.002	NE	NE	NE	NE	NE	NE

Notes:

Non-cancer risks are expressed as a Hazaard Index, which is the sum of all Hazard Quotients for the particular scenario.

NE - Pathway not evaluated under this exposure scenario.

CTE =Central Tendency Exposure

RME = Reasonable Maximum Exposure

Bold = HQ>1

Table 3-9. Summary of Excess Lifetime Cancer Risk Estimates

Route of Exposure	Adult Park Worker		Construction/Restoration Worker		Young Child Visitor Scenario		Older Child Visitor Scenario		Adult Visitor Scenario	
	CTE	RME	CTE	RME	CTE	RME	CTE	RME	CTE	RME
Surface Soil										
Incidental Ingestion of Surface Soil	1.5E-08	1.2E-07	1.2E-08	1.5E-07	5.4E-09	6.5E-08	1.1E-08	9.2E-08	6.3E-09	5.0E-08
Dermal Contact with Surface Soil	4.6E-10	4.5E-08	1.1E-08	6.7E-08	5.1E-10	4.3E-09	1.2E-09	9.5E-09	6.7E-10	5.2E-09
Inhalation of Particles from Surface Soil	4.2E-08	3.4E-07	2.1E-08	1.6E-07	1.3E-13	3.1E-12	1.6E-12	2.6E-11	1.6E-12	2.6E-11
Cumulative Risk Across All Routes of Exposure	6.E-08	5.E-07	4.E-08	4.E-07	6.E-09	7.E-08	1.E-08	1.E-07	7.E-09	6.E-08
TPH Cumulative Risk Across All Routes of Exposure	0.E+00	0.E+00	0.E+00	0.E+00	0.E+00	0.E+00	0.E+00	0.E+00	0.E+00	0.E+00
Subsurface Soil										
Incidental Ingestion of SubSurface Soil	NE	NE	1.1E-08	1.3E-07	NE	NE	NE	NE	NE	NE
Dermal Contact with SubSurface Soil	NE	NE	9.9E-09	6.0E-08	NE	NE	NE	NE	NE	NE
Inhalation of Particles from SubSurface Soil	NE	NE	1.5E-08	1.1E-07	NE	NE	NE	NE	NE	NE
Cumulative Risk Across All Routes of Exposure	NE	NE	4.E-08	3.E-07	NE	NE	NE	NE	NE	NE
TPH Cumulative Risk Across All Routes of Exposure	NE	NE	0.E+00	0.E+00	NE	NE	NE	NE	NE	NE

Notes:

NE - Pathway not evaluated under this exposure scenario.

Bold - Value exceeds cancer risk threshold of 1 x 10^{-6}.

The excess lifetime cancer risk are rounded to one significant figure.

CTE - Central Tendency Exposure

RME - Reasonable Maximum Exposure

Table 3-10. Evaluation of Fetal Risk from Lead Exposure Using the Adult Lead Model

Variable	Description of Variable	Units	Construction Worker Surface Soil CTE	Construction Worker Surface Soil RME	Construction Worker Subsurface Soil CTE	Construction Worker Subsurface Soil RME
PbS	Soil lead concentration	µg/g or ppm	634	634	9930	9930
Rfetal/maternal	Fetal/maternal PbB ratio	--	0.9	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4	0.4	0.4	0.4
GSDi	Geometric standard deviation PbB	--	1.8	1.8	1.8	1.8
PbB0	Baseline PbB	µg/dL	0.6	0.6	0.6	0.6
IRS	Soil ingestion rate	g/day	0.165	0.330	0.165	0.330
AFS, D	Absorption fraction	--	0.12	0.12	0.12	0.12
EFS, D	Exposure frequency	days/yr	15	30	15	30
ATS, D	Averaging time	days/yr	365	365	365	365
PbBadult	PbB of adult worker, geometric mean	µg/dL	0.8	1.4	3.8	13.5
PbBfetal, 0.95	95th percentile PbB among fetuses of adult workers	µg/dL	1.9	3.4	9.1	32.0
PbBt	Target PbB level of concern (e.g., 2-8 ug/dL)	µg/dL	**5.0**	**5.0**	**5.0**	**5.0**
P(PbBfetal > PbBt)	**Probability that fetal PbB exceeds target PbB, assuming lognormal distribution**	**%**	**0.1%**	**1.0%**	**26.4%**	**93.5%**
PbBt	Target PbB level of concern (e.g., 2-8 ug/dL)	µg/dL	**10.0**	**10.0**	**10.0**	**10.0**
P(PbBfetal > PbBt)	**Probability that fetal PbB exceeds target PbB, assuming lognormal distribution**	**%**	**0.0004%**	**0.02%**	**3.5%**	**63.1%**

Calculations of Blood Lead Concentrations (PbBs) and Risk in Nonresidential Areas
U.S. EPA Technical Review Workgroup for Lead
Version date 06/14/2017
Using the GSDi and PbBo from Analysis of NHANES 2009-2014

Basic Equations
PbB(fetus) = PbB(mother) * Ratio
PbB(mother) = PbB0 + BKSF*∑[Csitemedia*IRsitemedia*AFsitemedia*EF/365]

Notes:

PbS = EPC (95 UCL for CTE, maximum for RME)
EPC = exposure point concentration
µg = microgram
95UCL = 95 percent upper confidence limit
ALM = adult lead model
C = concentration
CTE = central tendency exposure
dL = deciliter
g = gram
GSD = geometric standard deviation
IR = ingestion rate
NHANES = National Health and Nutrition Examination Survey
P10 = probability of exceeding a blood lead leved of 10 µg/d
PbB = blood lead level
PbB0 = baseline blood lead level
RBA = relative bioavailability
USEPA = United States Environmental Protection Agency

TABLE 4-1. COPEC Selection Summary For Ecological Receptors

Chemical Group	Chemical Name	CASRN	Surface Soil		Suburface Soil	
			Plants/Inverts COPEC	Birds/Mammals COPEC	Plants/Inverts COPEC	Birds/Mammals COPEC
Metals	Antimony	7440-36-0		X		X
	Arsenic	7440-38-2	X	X	X	X
	Barium	7440-39-3	X	X	X	X
	Cadmium	7440-43-9	X	X	X	X
	Chromium, total	7440-47-3	X	X	X	X
	Copper	7440-50-8	X	X	X	X
	Lead	7439-92-1	X	X	X	X
	Mercury	7439-97-6	X	X	X	X
	Molybdenum	7439-98-7	X	X	X	X
	Nickel	7440-02-0		X		X
	Selenium	7782-49-2			X	X
	Silver	7440-22-4			X	
	Thallium	7440-28-0	X	X	X	X
	Vanadium	7440-62-2	X	X	X	X
	Zinc	7440-66-6	X	X	X	X
	Aluminum	7429-90-5	X		X	
	Manganese	7439-96-5	X			
SVOCs	Bis(2-ethylhexyl)phthalate	117-81-7		X		X
Dioxins/Furans	TEQ	TEQ				X

Notes:

CASRN = Chemical Abstracts Service Registry Number

COPEC - Chemcial of Potential Ecological Concern

EPA = Environmental Protection Agency

SVOC = semi-volatile organic compound

TEQ = toxic equivalent

Surface soil identified as 0-0.5 fbgs

Subsurface soil identified as 1-6 fbgs

Table 4-2. Refined COPEC and COEC Selection for Terrestrial Plants, Surface Soil

Chemical Group	COPEC	CASRN	Maximum Surface Soil Conc. (mg/kg)	Refined SLERA ESV (mg/kg)	Refined ESV-Based Hazard Quotient	Terrestrial Plants Refined COPEC Surface Soil	95 UCL Surface Soil Conc. (mg/kg)	LANL Low-Effect ESL (mg/kg)	Threshold ESL (mg/kg)	Threshold-Based Hazard Quotient	Terrestrial Plants COEC Surface Soil
Metals	Arsenic	7440-38-2	7.37	18	0.4	--	Not Refined COPEC	91	40	NA	--
	Barium	7440-39-3	918	500	**2**	Barium	720	1400	837	0.9	--
	Cadmium	7440-43-9	6.78	32	0.2	--	Not Refined COPEC	160	72	NA	--
	Chromium, total	7440-47-3	23.6	1	**24**	Chromium, total	23.8	4.7	2.2	**11**	Chromium, total
	Copper	7440-50-8	198	70	**3**	Copper	160	490	185	0.9	--
	Lead	7439-92-1	689	120	**6**	Lead	634	570	262	**2**	Lead
	Mercury	7439-97-6	0.75	0.3	**2**	Mercury	0.63	64	4	0.1	--
	Molybdenum[a]	7439-98-7	2.22	2	1	--	Not Refined COPEC	200	20	NA	--
	Thallium	7440-28-0	0.57	1	0.6	--	Not Refined COPEC	3.2	2	NA	--
	Vanadium	7440-62-2	37.4	2	**19**	Vanadium	32.2	80	13	**3**	Vanadium
	Zinc	7440-66-6	2420	160	**15**	Zinc	2322	810	360	**6**	Zinc
	Aluminum	7429-90-5	12000	b	NC	--	Not Refined COPEC	No ESL	No ESL	NA	--
	Manganese	7439-96-5	1900	220	**9**	Manganese	1664	1500	574	**3**	Manganese

Notes:

Refined SLERA ESVs from NPS 2018, except where noted; low-level effect ESLs are from LANL (2017)

Threshold ESLs are calculated as the geometric mean of the Refined ESV and the LANL Low-Level ESL

COPECs selected where Maximum Concentration > Refined ESV

COECs selected where 95 UCL (or maximum if lower) > Threshold-Based ESL

CASRN = Chemical Abstracts Service Registry Number

COPEC = chemical of potential ecological concern

ESL = ecological screening level

ESV = ecological screening value

mg/kg = millgrams per kilogram

SLERA = Screening level ecological risk assessment

NC - Not calculated

a. LANL Low-Effect ESL value not available; Low Effect screening level is the Dutch Intervention Soil Screening Benchmark, which is the concentration expected to be hazardous to 50% of the species in the ecosystem. Site concentrations between Target Values (no effect levels) and Intervention Values suggests further investigation or restrictions may be warranted. (RAIS 2020)

b. Aluminum is selected as a refined COPEC if soil pH<5 (NPS 2018)

HQ>1

Table 4-3. Refined COPEC and COEC Selection for Terrestrial Plants, Suburface Soil

Chemical Group	COPEC	CASRN	Maximum Subsurface Soil Conc. (mg/kg)	Refined SLERA ESV (mg/kg)	Refined ESV-Based Hazard Quotient	Terrestrial Plants Refined COPEC Subsurface Soil	95 UCL Subsurface Soil Conc. (mg/kg)	LANL Low-Effect ESL (mg/kg)	Threshold ESL (mg/kg)	Threshold-Based Hazard Quotient	Terrestrial Plants COEC Subsurface Soil
Metals	Arsenic	7440-38-2	8.4	18	0.5	--	Not Refined COPEC	91	40	NA	--
	Barium	7440-39-3	1420	500	**3**	Barium	1420	1400	837	**2**	Barium
	Cadmium	7440-43-9	11.8	32	0.4	--	Not Refined COPEC	160	72	NA	--
	Chromium, total	7440-47-3	36.4	1	**36**	Chromium, total	29.0	4.7	2.2	**13**	Chromium, total
	Copper	7440-50-8	260	70	**4**	Copper	260	490	185	1	--
	Lead	7439-92-1	9930	120	**83**	Lead	9930	570	262	**38**	Lead
	Mercury	7439-97-6	1.6	0.3	**5**	Mercury	0.9	64	4	0.2	--
	Molybdenum[a]	7439-98-7	2.3	2	1	--	Not Refined COPEC	200	20	NA	--
	Selenium	7782-49-2	1.1	0.52	**2**	Selenium	0.9	15	2.8	0.3	--
	Silver	7440-22-4	2.6	560	0.005	--	Not Refined COPEC	2800	1252	NA	--
	Thallium	7440-28-0	0.38	1	0.4	--	Not Refined COPEC	3.2	1.8	NA	--
	Vanadium	7440-62-2	24.2	2	**12**	Vanadium	22.7	80	13	**2**	Vanadium
	Zinc	7440-66-6	2120	160	**13**	Zinc	2120	810	360	**6**	Zinc
	Aluminum	7429-90-5	12000	b	NC	--	Not Refined COPEC	No ESL	No ESL	NA	--

Notes:

Refined SLERA ESVs from NPS 2018, except where noted; low-level effect ESLs are from LANL (2017)

Threshold ESLs are calculated as the geometric mean of the Refined ESV and the LANL Low-Level ESL

COPECs selected where Maximum Concentration > Refined ESV

COECs selected where 95 UCL (or maximum if lower) > Threshold-Based ESL

CASRN = Chemical Abstracts Service Registry Number

COPEC = chemical of potential ecological concern

ESL = ecological screening level

ESV = ecological screening value

mg/kg = millgrams per kilogram

SLERA = Screening level ecological risk assessment

NC - Not calculated

a. LANL Low-Effect ESL value not available; Low Effect screening level is the Dutch Intervention Soil Screening Benchmark, which is the concentration expected to be hazardous to 50% of the species in the ecosystem. Site concentrations between Target Values (no effect levels) and Intervention Values suggests further investigation or restrictions may be warranted. (RAIS 2020)

b. Aluminum is selected as a refined COPEC if soil pH<5 (NPS 2018)

HQ>1

Table 4-4. Refined COPEC and COEC Selection for Soil Invertebrates, Surface Soil

Chemical Group	COPEC	CASRN	Maximum Surface Soil Conc. (mg/kg)	Refined SLERA ESV (mg/kg)	Refined ESV-Based Hazard Quotient	Soil Invertebrates Refined COPEC Surface Soil	95 UCL Surface Soil Conc. (mg/kg)	LANL Low-Effect ESL (mg/kg)	Threshold ESL (mg/kg)	Threshold-Based Hazard Quotient	Soil Invertebrates COEC Surface Soil
Metals	Arsenic	7440-38-2	7.37	60	0.12	--	Not Refined COPEC	68	64	NA	--
	Barium	7440-39-3	918	330	**3**	Barium	720	3200	1028	0.7	--
	Cadmium	7440-43-9	6.78	140	0.05	--	Not Refined COPEC	760	326	NA	--
	Chromium, total	7440-47-3	23.6	0.4	**59**	Chromium, total	23.8	4.7	1.4	**17**	Chromium, total
	Copper	7440-50-8	198	80	**2**	Copper	160	530	206	0.8	--
	Lead	7439-92-1	689	1700	0.41	--	Not Refined COPEC	8,400	3779	NA	--
	Mercury	7439-97-6	0.75	0.1	**7**	Mercury	0.6	390	6.2	0.1	--
	Molybdenum	7439-98-7	2.22	No ESV	NA	--	Not Refined COPEC	No ESL	No ESL	NA	--
	Thallium	7440-28-0	0.57	No ESV	NA	--	Not Refined COPEC	No ESL	No ESL	NA	--
	Vanadium	7440-62-2	37.4	No ESV	NA	--	Not Refined COPEC	No ESL	No ESL	NA	--
	Zinc	7440-66-6	2420	120	**20**	Zinc	2322	930	334	**7**	Zinc
	Aluminum	7429-90-5	12000	a	NA	--	Not Refined COPEC	No ESL	No ESL	NA	--
	Manganese	7439-96-5	1900	450	**4**	Manganese	1664	4500	1423	1	--

Notes:

Refined SLERA ESVs from NPS 2018, except where noted; low-level effect ESLs are from LANL (2017)

Threshold ESLs are calculated as the geometric mean of the Refined ESV and the LANL Low-Level ESL

COPECs selected where Maximum Concentration > Refined ESV

COECs selected where 95 UCL (or maximum if lower) > Threshold-Based ESL

CASRN = Chemical Abstracts Service Registry Number

COPEC = chemical of potential ecological concern

ESL = ecological screening level

ESV = ecological screening value

mg/kg = millgrams per kilogram

SLERA = Screening level ecological risk assessment

NC - Not calculated

a. Aluminum is selected as a refined COPEC if soil pH<5 (NPS 2018)

HQ>1

Table 4-5. Refined COPEC and COEC Selection for Soil Invertebrates, Suburface Soil

Chemical Group	COPEC	CASRN	Maximum Suburface Soil Conc. (mg/kg)	Refined SLERA ESV (mg/kg)	Refined ESV-Based Hazard Quotient	Soil Invertebrates Refined COPEC Subsurface Soil	95 UCL Subsurface Soil Conc. (mg/kg)	LANL Low-Effect ESL (mg/kg)	Threshold ESL (mg/kg)	Threshold-Based Hazard Quotient (HQ)	Soil Invertebrates COEC Subsurface Soil
Metals	Arsenic	7440-38-2	8.4	60	0.14	--	Not Refined COPEC	68	64	NA	--
	Barium	7440-39-3	1420	330	**4**	Barium	1420	3200	1028	1	--
	Cadmium	7440-43-9	11.8	140	0.08	--	Not Refined COPEC	760	326	NA	--
	Chromium, total	7440-47-3	36.4	0.4	**91**	Chromium, total	29	4.7	1.4	**21**	Chromium, total
	Copper	7440-50-8	260	80	**3**	Copper	260	530	206	1	--
	Lead	7439-92-1	9930	1700	**6**	Lead	9930	8400	3779	**3**	Lead
	Mercury	7439-97-6	1.6	0.1	**16**	Mercury	0.9	390	6	0.1	--
	Molybdenum	7439-98-7	2.3	No ESV	NA	--	Not Refined COPEC	No ESL	No ESL	NA	--
	Selenium	7782-49-2	1.1	4.1	0.27	--	Not Refined COPEC	41	13	NA	--
	Silver	7440-22-4	2.6	No ESV	NA	--	Not Refined COPEC	No ESL	No ESL	NA	--
	Thallium	7440-28-0	0.38	No ESV	NA	--	Not Refined COPEC	No ESL	No ESL	NA	--
	Vanadium	7440-62-2	24.2	No ESV	NA	--	Not Refined COPEC	No ESL	No ESL	NA	--
	Zinc	7440-66-6	2120	120	**18**	Zinc	2120	930	334	**6**	Zinc
	Aluminum	7429-90-5	12000	a	NA	--	Not Refined COPEC	No ESL	No ESL	NA	--

Notes:

Refined SLERA ESVs from NPS 2018, except where noted; low-level effect ESLs are from LANL (2017)

Threshold ESLs are calculated as the geometric mean of the Refined ESV and the LANL Low-Level ESL

COPECs selected where Maximum Concentration > Refined ESV

COECs selected where 95 UCL (or maximum if lower) > Threshold-Based ESL

CASRN = Chemical Abstracts Service Registry Number

COPEC = chemical of potential ecological concern

ESL = ecological screening level

ESV = ecological screening value

mg/kg = millgrams per kilogram

SLERA = Screening level ecological risk assessment

NC - Not calculated

a. Aluminum is selected as a refined COPEC if soil pH<5 (NPS 2018)

HQ>1

Table 4-6. Refined COPEC Selection for Birds and Mammals, Surface Soil

Chemical Group	COPEC	CASRN	Maximum Surface Soil Conc. (mg/kg)	Refined SLERA ESV (mg/kg)		Screening Level Hazard Quotient (HQ)		Birds Refined COPECs Surface Soil	Mammals Refined COPECs Surface Soil
				Birds	Mammals	Birds	Mammals		
Metals	Antimony	7440-36-0	4.63	No ESV	0.27	NA	**17**	--	Antimony
	Arsenic	7440-38-2	7.37	43	46	0.2	0.2	--	--
	Barium	7440-39-3	918	720	2000	1	0.5	--	--
	Cadmium	7440-43-9	6.78	0.77	0.36	**9**	**19**	Cadmium	Cadmium
	Chromium, total	7440-47-3	23.6	23	63	1	0.4	--	--
	Copper	7440-50-8	198	28	49	**7**	**4**	Copper	Copper
	Lead	7439-92-1	689	36.3	56	**19**	**12**	Lead	Lead
	Mercury	7439-97-6	0.75	0.013	1.7	**57**	0.4	Mercury	--
	Molybdenum	7439-98-7	2.22	15	0.52	0.1	**4**	--	Molybdenum
	Nickel	7440-02-0	27.9	210	130	0.1	0.2	--	--
	Thallium	7440-28-0	0.57	4.5	0.42	0.1	1	--	--
	Vanadium	7440-62-2	37.4	7.8	280	**5**	0.1	Vanadium	--
	Zinc	7440-66-6	2420	46	79	**53**	**31**	Zinc	Zinc
SVOCs	Bis(2-ethylhexyl)phthalate	117-81-7	0.72	0.02	0.6	**36**	1	Bis(2-ethylhexyl)phthalate	--

Notes:

CASRN - Chemical Abstracts Service Registry Number

COPEC - chemical of potential ecological concern

ESV - ecological screening value

mg/kg - millgrams per kilogram

SVOC - semivolatile organic compound

HQ>1

Table 4-7. Refined COPEC Selection for Mammals, Suburface Soil

Chemical Group	COPEC	CASRN	Maximum Suburface Soil Conc. (mg/kg)	Refined SLERA ESV (mg/kg)	Refined SLERA Hazard Quotient (HQ)	Mammals Refined COPECs Suburface Soil
				Mammals	Mammals	
Metals	Antimony	7440-36-0	2.4	0.27	**9**	Antimony
	Arsenic	7440-38-2	8.4	46	0.2	--
	Barium	7440-39-3	1420	2000	0.7	--
	Cadmium	7440-43-9	11.8	0.36	**33**	Cadmium
	Chromium, total	7440-47-3	36.4	63	0.6	--
	Copper	7440-50-8	260	49	**5**	Copper
	Lead	7439-92-1	9930	56	**177**	Lead
	Mercury	7439-97-6	1.6	1.7	0.9	--
	Molybdenum	7439-98-7	2.3	0.52	**4**	Molybdenum
	Nickel	7440-02-0	12.5	130	0.1	--
	Selenium	7782-49-2	1.1	0.63	**2**	Selenium
	Thallium	7440-28-0	0.38	0.42	0.9	--
	Vanadium	7440-62-2	24.2	280	0.1	--
	Zinc	7440-66-6	2120	79	**27**	Zinc
SVOCs	Bis(2-ethylhexyl)phthalate	117-81-7	0.29	0.6	0.5	--
Dioxins/Furans	TEQ Mammalian	1746-01-6	1.2E-05	2.9E-07	**40**	TEQ Mammalian

Notes:

Birds are excluded from expsoures to subsurface soils, as per the CSM.

Refined SLERA ESVs are from NPS 2018, except dioxin TEQ ESV is from LANL 2017

CASRN = Chemical Abstracts Service Registry Number

COPEC = chemical of potential ecological concern

ESV = ecological screening value

mg/kg = millgrams per kilogram

SLERA = Screening level ecological risk assessment

TEQ = toxicity equivalency quotient

HQ>1

Table 4-8. Exposure Parameters for Ecological Wildlife Receptors

Parameter	Herbivorous Bird: Dove	Insectivorous Bird: Woodcock	Carnivorous Bird: Hawk	Herbivorous Mammal: Vole	Insectivorous Mammal: Shrew	Carnivorous Mammal: Weasel
Food Ingestion Rate (kg dw/kg bw-d)[a]	0.137	0.142	0.026	0.076	0.167	0.071
Proportion Soil in Diet (Psoil)[b]	0.068	0.075	0.026	0.013	0.011	0.016
Soil Intake Rate (kg dw/kg BW/d)[c]	0.0093	0.011	0.00068	0.001	0.0018	0.0011
Dietary Compositiion[d]:						
Terrestrial Plants	100%	0%	0%	100%	0%	0%
Terrestrial Invertebrates	0%	100%	0%	0%	100%	0%
Small Mammals	0%	0%	100%	0%	0%	100%
Area Use Factor	1	1	1	1	1	1

Notes:

a - Mean value calculated from specied-specific ingestion rates in Eco-SSL Attachment 4-1 (USEPA 2007)

b - Fraction of diet that is soil; based on the mean value reported in EcoSSL Attachment 4-1, Table 3.

c - Calculated as Psoil x Food Ingestion Rate

d - Dietary proportions were assumed to be 100% of the primary food source for the represented guild. Risks for receptors that consume a mixed diet are bracketed by representative receptors. For example, risks for an omnivorous bird are bracketed by calculated risks for an invertivore and an herbivore.

EcoSSL = Ecological Soil Screening Level

% = percent

bw = body weight

d = day

dw = dry weight

kg = kilogram

Table 4-9. Exposure Point Concentrations, Ecological - Surface Soil

Chemical Group	Refined COPEC	CASRN	Number of Samples	Number of Detects	Maximum (mg/kg)	Mean (mg/kg)	Calculated 95UCL (mg/kg)	Exposure Point Concentration (EPC)	
								(mg/kg)	EPC Basis
Metals	Antimony	7440-36-0	5	5	4.63	1.89	3.549	3.5	95% Student's-t UCL
	Barium	7440-39-3	5	5	918	397	720.1	720	95% Student's-t UCL
	Cadmium	7440-43-9	5	5	6.8	2.5	4.977	5.0	95% Student's-t UCL
	Chromium, total	7440-47-3	5	5	23.6	16.0	23.83	23.8	95% Student's-t UCL
	Copper	7440-50-8	5	5	198	109	160.3	160	95% Student's-t UCL
	Lead	7439-92-1	5	5	689	365	634.3	634	95% Student's-t UCL
	Manganese	7439-96-5	5	5	1900	1059	1664	1664	95% Student's-t UCL
	Mercury	7439-97-6	5	5	0.75	0.45	0.63	0.63	95% Student's-t UCL
	Molybdenum	7439-98-7	5	5	2.22	1.45	2.162	2.2	95% Student's-t UCL
	Nickel	7440-02-0	5	5	27.9	14.8	23.59	23.6	95% Student's-t UCL
	Thallium	7440-28-0	5	5	0.57	0.39	0.506	0.51	95% Student's-t UCL
	Vanadium	7440-62-2	5	5	37.40	24.36	32.21	32.2	95% Student's-t UCL
	Zinc	7440-66-6	5	5	2420	1267	2322	2322	95% Student's-t UCL
SVOCs	Bis(2-ethylhexyl)phthalate	117-81-7	5	2	0.72	0.48	NC	0.72	Maximum

Notes:

Maximum and Mean values are for detected values only. 95 UCLs are those recommended in ProUCL for detects and non-detects (ND).

COPEC - Chemical of Potential Ecological Concern

95UCL = 95 percent upper confidence limit

CASRN = Chemical Abstracts Service Registry Number

EPC = exposure point concentration

mg/kg - milligrams per kilogram

UCL = upper confidence level

Table 4-10. Exposure Point Concentrations, Ecological - Subsurface Soil

Chemical Group	COPEC	CASRN	Number of Samples	Number of Detects	Maximum (mg/kg)	Mean (mg/kg)	Calculated 95UCL (mg/kg)	Exposure Point Concentration (EPC)	
								(mg/kg)	EPC Basis
Metals	Antimony	7440-36-0	11	5	2.4	1.62	1.978	2.0	95% KM (t) UCL
	Barium	7440-39-3	11	11	1420	370.4	1924	1420	99% Chebyshev (Mean, Sd) UCL
	Cadmium	7440-43-9	11	6	11.8	3.8	4.163	4.2	95% KM (t) UCL
	Chromium, total	7440-47-3	11	11	36.4	11.9	29.02	29.02	95% Chebyshev (Mean, Sd) UCL
	Copper	7440-50-8	11	11	260	55.8	157.2	260	95% Adjusted Gamma UCL
	Lead	7439-92-1	11	11	9930	1151.4	9972	9930	Maximum
	Mercury	7439-97-6	11	9	1.6	0.70	0.917	0.92	95% KM (t) UCL
	Molybdenum	7439-98-7	11	11	2.3	0.73	1.06	1.1	95% Student's-t UCL
	Selenium	7782-49-2	11	6	1.1	0.32	0.891	0.89	95% KM (Chebyshev) UCL
	Vanadium	7440-62-2	11	11	24.2	21.2	22.67	22.7	95% Student's-t UCL
	Zinc	7440-66-6	11	11	2120	597	3123	2120	Maximum
SVOCs	Bis(2-ethylhexyl)phthalate		5	1	290	290	NC	290	Maximum
Dioxin / Furan	TEQ Mammalian	1746-01-6	2	2	1.2E-05	5.81E-06	NA	1.2E-05	Maximum

Notes:

Maximum and Mean values are for detected values only. 95 UCLs are those recommended in ProUCL for detects and non-detects (ND).

COPC - Chemical of Potential Concern

95UCL = 95 percent upper confidence limit

CASRN = Chemical Abstracts Service Registry Number

EPC = exposure point concentration

mg/kg - milligrams per kilogram

UCL = upper confidence level

Subsurface soil identified as 1-6 fbgs

Table 4-11. Terrestrial Uptake Factors

COPEC	CASRN	log Kow		Koc		Plant Uptake Factor or Equation (dry weight basis)	Source	Invertebrate Uptake Factor or Equation (dry weight basis)	Source	Small Mammal Uptake Factor or Equation (dry weight basis)	Source
		Value (unitless)	Source	Value (L/kg)	Source						
Metals											
Antimony		N/A		N/A		ln(Cp) = 0.938 * ln(Cs) - 3.233	a	Ce = 1.0 * Csoil	e	Cm = 0.001 * 50 * Cdiet	a, p
Cadmium		N/A		N/A		ln(Cp) = 0.546 * ln(Cs) - 0.475	a	ln(Ce) = 0.795*ln(Cs) + 2.114	a	ln(Cm) = 0.4723 * ln(Cs) - 1.2571	a
Copper		N/A		N/A		ln(Cp) = 0.394 * ln(Cs) + 0.668	a	Ce = 0.515 * Csoil	a	ln(Cm) = 0.1444 * ln(Cs) + 2.042	a
Lead		N/A		N/A		ln(Cp) = 0.561 * ln(Cs) - 1.328	a	ln(Ce) = 0.807 * ln(Cs) - 0.218	a	ln(Cm) = 0.4422 * ln(Cs) + 0.0761	a
Mercury		N/A		N/A		ln(Cp) = 0.544 * ln(Cs) - 0.996	b, k	ln(Ce) = 0.3369*ln(Cs) + 0.0781	c, k	Cm = 0.0543 * Csoil	s
Molybdenum		N/A		N/A		ln(Cp) = 0.938 * ln(Cs) - 3.233	p, v	Ce = 0.953 * Csoil	q	Cm = 0.001 * 50 * Cdiet	p, v
Vanadium		N/A		N/A		Cp = 0.0075 * Csoil	a	Ce = 0.042 * Csoil	a	Cm = 0.0123 * Cs	a
Zinc		N/A		N/A		ln(Cp) = 0.554 * ln(Cs) + 1.575	a	ln(Ce) = 0.328 * ln(Cs) + 4.449	a	ln(Cm) = 0.0706 * ln(Cs) + 4.3632	a
Dioxins, Furans, and Dioxin-like PCBs											
2,3,7,8-TCDD	1746-01-6	6.80	e	2.491E+05	f	0.11	g	Ce = EXP(1.182 * ln(Cs) + 3.533)	c	Cm = EXP(1.0993 * ln(Cs) + 0.8113)	s
1,2,3,7,8-PeCDD	40321-76-4	6.64	i	4.161E+05	i	0.12	g	Ce = (EXP(1.182 * ln(Cs) + 3.533)) * BEF	m	Cm = (EXP(1.0993 * ln(Cs) + 0.8113)) * BEF	m
1,2,3,4,7,8-HxCDD	39227-28-6	7.80	i	6.952E+05	i	0.041	g	Ce = (EXP(1.182 * ln(Cs) + 3.533)) * BEF	m	Cm = (EXP(1.0993 * ln(Cs) + 0.8113)) * BEF	m
1,2,3,6,7,8-HxCDD	57653-85-7	8.21	i	6.952E+05	i	0.028	g	Ce = (EXP(1.182 * ln(Cs) + 3.533)) * BEF	m	Cm = (EXP(1.0993 * ln(Cs) + 0.8113)) * BEF	m
1,2,3,7,8,9-HxCDD	19408-74-3	8.21	i	6.952E+05	i	0.028	g	Ce = (EXP(1.182 * ln(Cs) + 3.533)) * BEF	m	Cm = (EXP(1.0993 * ln(Cs) + 0.8113)) * BEF	m
1,2,3,4,6,7,8-HpCDD	35822-46-9	8.00	i	1.161E+06	i	0.034	g	Ce = (EXP(1.182 * ln(Cs) + 3.533)) * BEF	m	Cm = (EXP(1.0993 * ln(Cs) + 0.8113)) * BEF	m
OCDD	3268-87-9	8.20	i	1.940E+06	i	0.028	g	Ce = (EXP(1.182 * ln(Cs) + 3.533)) * BEF	m	Cm = (EXP(1.0993 * ln(Cs) + 0.8113)) * BEF	m
2,3,7,8-TCDF	51207-31-9	6.53	e	1.395E+05	i	0.14	g	Ce = (EXP(1.182 * ln(Cs) + 3.533)) * BEF	m	Cm = (EXP(1.0993 * ln(Cs) + 0.8113)) * BEF	m
1,2,3,7,8-PeCDF	57117-41-6	6.79	i	2.330E+05	i	0.11	g	Ce = (EXP(1.182 * ln(Cs) + 3.533)) * BEF	m	Cm = (EXP(1.0993 * ln(Cs) + 0.8113)) * BEF	m
2,3,4,7,8-PeCDF	57117-31-4	6.79	i	2.330E+05	i	0.11	g	Ce = (EXP(1.182 * ln(Cs) + 3.533)) * BEF	m	Cm = (EXP(1.0993 * ln(Cs) + 0.8113)) * BEF	m
1,2,3,4,7,8-HxCDF	70648-26-9	7.92	i	3.893E+05	i	0.037	g	Ce = (EXP(1.182 * ln(Cs) + 3.533)) * BEF	m	Cm = (EXP(1.0993 * ln(Cs) + 0.8113)) * BEF	m
1,2,3,6,7,8-HxCDF	57117-44-9	7.92	i	3.893E+05	i	0.037	g	Ce = (EXP(1.182 * ln(Cs) + 3.533)) * BEF	m	Cm = (EXP(1.0993 * ln(Cs) + 0.8113)) * BEF	m
1,2,3,7,8,9-HxCDF	72918-38-8	7.92	i, l	3.893E+05	i, l	0.037	g	Ce = (EXP(1.182 * ln(Cs) + 3.533)) * BEF	m	Cm = (EXP(1.0993 * ln(Cs) + 0.8113)) * BEF	m
2,3,4,6,7,8-HxCDF	60851-34-5	7.92	i	3.893E+05	i	0.037	g	Ce = (EXP(1.182 * ln(Cs) + 3.533)) * BEF	m	Cm = (EXP(1.0993 * ln(Cs) + 0.8113)) * BEF	m
1,2,3,4,6,7,8-HpCDF	67562-39-4	7.92	i	6.503E+05	i	0.037	g	Ce = (EXP(1.182 * ln(Cs) + 3.533)) * BEF	m	Cm = (EXP(1.0993 * ln(Cs) + 0.8113)) * BEF	m
1,2,3,4,7,8,9-HpCDF	55673-89-7	7.92	i	6.503E+05	i	0.037	g	Ce = (EXP(1.182 * ln(Cs) + 3.533)) * BEF	m	Cm = (EXP(1.0993 * ln(Cs) + 0.8113)) * BEF	m
OCDF	39001-02-0	8.60	i	1.086E+06	i	0.020	g	Ce = (EXP(1.182 * ln(Cs) + 3.533)) * BEF	m	Cm = (EXP(1.0993 * ln(Cs) + 0.8113)) * BEF	m
Other Bioaccumulative Organics											
Bis(2-ethylhexyl)phthalate	117-81-7	5.1	u	87100	t	0.52	g	2.0	h	Cm = Cs	

Sources and notes:

N/A -- log Kow and/or Koc were not tabulated because they were not needed to determine uptake factors for this chemical.

a - Eco-SSL Attachment 4-1, Table 4a. (USEPA 2007)

b - Bechtel Jacobs 1998

c - Sample et al. 1998b, Table 4.

d - Eco-SSL Attachment 4-1, Table 4b. (USEPA 2007)

e - Not available, uptake assumed to be equal to 1 (i.e., equal to soil concentration)

f - EPI Suite value, as reported in USEPA Regional Screening Levels, Chemical Specific Parameters table, November 2010, http://www.epa.gov/region9/superfund/prg/

g - Calculated based on the equation from Eco-SSL Attachment 4-1 (Figure 5, Panel B), $\log(C_p) = (-0.4057*\log Kow) + 1.781$.

h - Calculated according to the following equations from Eco-SSL Attachment 4-1 (USEPA 2007), Table 5:

Soil-to-Earthworm Uptake Factor = Kww (L/kg worm dw) / Kd (L/kg soil dw)

where:

$Kww = 10^{(0.87 * \log Kow - 2.0)} / 0.16$

Kd = foc * Koc

foc = 0.01 (assumed value)

i - USEPA. 2012. Estimation Programs Interface (EPI) Suite™ for Microsoft® Windows, v 4.10. http://www.epa.gov/opptintr/exposure/pubs/episuite.htm

j - EcoSSL Attachment 4-1, Table 4c. (USEPA 2007)

k - Total mercury uptake factors are used for both inorganic and methylmercury.

l - This congener is not included in the SRC PP or EPI databases. Log Kow and Koc values are the values for other HxCDFs.

m - Uptake Factor = Uptake Factor for 2,3,7,8-TCDD * congener-specific bioaccumulation equivalency factor (BEF).

Table 4-11. Terrestrial Uptake Factors

COPEC	CASRN	log Kow		Koc		Plant Uptake Factor or Equation (dry weight basis)	Source	Invertebrate Uptake Factor or Equation (dry weight basis)	Source	Small Mammal Uptake Factor or Equation (dry weight basis)	Source
		Value (unitless)	Source	Value (L/kg)	Source						

n - Congener-specific soil-Invertebrate uptake factor is not available. Regression equation for PCBs was used for all PCB congeners.

o - Uptake equations unavailable; antimony used as surrogate based on similar earthworm uptake factor.

p - Mammal diet (C_d) is assumed to be earthworms (i.e., insectivore)

q - The median uptake factor for earthworms (n=4) in Table C-1, Appendix C, in Sample et al. (1998)

r - Eco-SSL Attachment 4-1, Table 4c. (USEPA 2007)

s - Sample et al. (1998b) [ES/ER/TM-219], Table 7, median uptake factor

t - RAIS database, USEPA Risk Assessment Information System

u - USEPA 2004. Protocol

v - Not available, uptake factor for antimony used as surrogate

Table 4-12. Toxic Equivalency Factors (TEFs) for Mammals and Birds

COPEC	Mammal TEF	Bird TEF	BEF
2,3,7,8-TCDD	1	1	1
1,2,3,7,8-PeCDD	1	1	0.92
1,2,3,4,7,8-HxCDD	0.1	0.05	0.31
1,2,3,6,7,8-HxCDD	0.1	0.01	0.12
1,2,3,7,8,9-HxCDD	0.1	0.1	0.14
1,2,3,4,6,7,8-HpCDD	0.01	0.001	0.051
OCDD	0.0003	0.0001	0.012
2,3,7,8-TCDF	0.1	1	0.8
1,2,3,7,8-PeCDF	0.03	0.1	0.22
2,3,4,7,8-PeCDF	0.3	1	1.59
1,2,3,4,7,8-HxCDF	0.1	0.1	0.094
1,2,3,6,7,8-HxCDF	0.1	0.1	0.23
1,2,3,7,8,9-HxCDF	0.1	0.1	0.78
2,3,4,6,7,8-HxCDF	0.1	0.1	0.84
1,2,3,4,6,7,8-HpCDF	0.01	0.01	0.015
1,2,3,4,7,8,9-HpCDF	0.01	0.01	0.52
OCDF	0.0003	0.0001	0.023

Notes:

Mammal TEFs (unitless) are from Van den Berg et al. (2005).

Bird TEFs (unitless) are from Van den Berg et al. (1998).

Bioaccumulation equivalency factors (BEFs) (unitless) are from Table 11 of EPA (1995).

Table 4-13. Avian Toxicity Reference Values

COPEC	Avian NOAEL[a] (mg/kg bw-d)	Avian LOAEL[b] (mg/kg bw-d)	Avian Threshold (Geometric Mean) (mg/kg bw-d)	Sources/Notes
Inorganics				
Cadmium	1.47	6.35	3.06	1,2
Copper	4.05	12.1	7.00	1,3
Lead	4.4	9.8	6.57	4
Mercury	0.019	0.19	0.06	3,c
Vanadium	0.344	0.688	0.49	1,3
Zinc	66.1	171	106	1,2
Organics				
Bis(2-ethylhexyl)phthalate	0.91	9.1	2.9	3,c

Sources:

1 - USEPA EcoSSL NOAEL TRV

2 - TechLaw LOAEL TRV; as derived from EcoSSL toxicity dataset

3 - Los Alamos National Laboratory ECORISK Database (version 4.1)

4 - Sample et al. (2019)

Notes:

mg/kg bw-d - milligram per kilogram per body weight per day

NA - No TRV available.

Threshold TRV = Geometric mean of the NOAEL and LOAEL.

COPEC = chemical of potential ecological concern

EcoSSL = Ecological Soil Screening Level

LOAEL = lowest observed adverse effect level

NOAEL = no observed adverse effect level

TEQ = toxic equivalent quotient

TRV = toxicity reference value

USEPA = United States Environmental Protection Agency

a - NOAELs are toxicity reference values used in EcoSSL documents, unless otherwise noted.

b - Unless otherwise noted, LOAELs are calculated as the tenth percentile of growth and reproduction LOAELs presented in EcoSSL documents (using natural log-transformed data).

c - LOAEL based on 10x NOAEL

Table 4-14. Mammalian Toxicity Reference Values

COPEC	Mammalian NOAEL[a] (mg/kg bw-d)	Mammalian LOAEL[b] (mg/kg bw-d)	Mammalian Threshold (Geometric Mean) (mg/kg bw-d)	Sources/Notes
Inorganics				
Antimony	0.059	0.59	0.187	1,3
Cadmium	0.77	1.12	0.93	1
Copper	5.60	9.34	7.23	1,3
Lead	4.7	8.9	6.5	1,3
Molybdenum	0.24	2.4	0.76	4
Selenium	0.143	0.215	0.18	1
Zinc	75.4	298	150	1,3
Organics				
2,3,7,8-TCDD	5.62E-07	3.76E-06	1.45E-06	3

Sources:

1 - USEPA EcoSSL NOAEL TRV

3 - Los Alamos National Laboratory ECORISK Database (version 4.1)

4 - Sample et al. (1996)

Notes:

mg/kg bw-d - milligram per kilogram per body weight per day

NA - No TRV available.

Threshold TRV - Geometric mean of the NOAEL and LOAEL.

COPEC - chemical of potential ecological concern

EcoSSL - Ecological Soil Screening Level

LOAEL - lowest observed adverse effect level

NOAEL - no observed adverse effect level

TRV - toxicity reference value

USEPA - United States Environmental Protection Agency

a - NOAELs are toxicity reference values (TRVs) used in EcoSSL documents, unless otherwise noted.

b - Unless otherwise noted, LOAELs are calculated as the tenth percentile of growth and reproduction LOAELs presented in EcoSSL documents (using natural log-transformed data).

Table 4-15. Summary of Risks to Birds and Mammals

Chemical Group	COPEC	Threshold-Based HQ					
		Birds			Mammals		
		Herbivore	Insectivore	Carnivore	Herbivore	Insectivore	Carnivore
Surface Soils (0-0.5 fbgs)							
Metals	Antimony		---- Not a COPEC ----		0.07	**3**	0.09
	Cadmium	0.08	1	0.006	0.1	**5**	0.05
	Copper	0.5	**2**	0.075	0.2	**2**	0.2
	Lead	1	**4**	0.140	0.2	**4**	0.3
	Mercury	0.8	**2**	0.022		---- Not a COPEC ----	
	Molybdenum		---- Not a COPEC ----		0.011	0.5	0.01
	Vanadium	0.7	1	0.066		---- Not a COPEC ----	
	Zinc	0.7	**2**	0.048	0.19	1.2	0.08
SVOCs	Bis(2-ethylhexyl)phthalate	0.02	0.07	0.01		---- Not a COPEC ----	
Subsurface Soils (1-6 fbgs)							
Metals	Antimony		NC		NC	**2**	NC
	Cadmium		NC		NC	**5**	NC
	Copper		NC		NC	**3**	NC
	Lead		NC		NC	**38**	NC
	Molybdenum		NC		NC	0.2	NC
	Selenium		NC		NC	0.8	NC
	Zinc		NC		NC	1	NC
Dioxins/Furans	Total TCDD-TEQ		NC		NC	**3**	NC

Notes:

bold Identified as a COEC for selected receptor and soil type, based on the threshold-Based HQ>1

COPEC - Chemical of Potential Ecological Concern

SVOC - Semi-Volatile Organic Chemical

TEQ - Toxicity Equivalents

NC - Not calculated, not exposed to subsurface soils

Table 4-16. Background Statistical Analyses

PANEL A: Background, Soil

COPEC	Maximum (mg/kg)	Mean (mg/kg)	95 UCL (mg.kg)	BTV (mg/kg)	BTV Basis
Surface Soil (0-1 fbgs)[a]					
Antimony	0.191	0.149	0.135	0.242	95% KM Chebyshev UPL
Barium	64.6	46.68	51.37	64.6	95% UTL with 95% Coverage
Cadmium	0.144	0.135	0.124	0.41	95% UTL with 95% Coverage
Chromium	7.9	4.887	5.4	7.9	95% UTL with 95% Coverage
Copper	10	5.521	6.7	10.0	95% UTL with 95% Coverage
Lead	8.78	4.698	5.4	8.8	95% UTL with 95% Coverage
Mercury	0.081	0.0602	0.1	0.1	95% UTL with 95% Coverage
Molybdenum	1.47	0.792	0.9	1.5	95% UTL with 95% Coverage
Vanadium	51.2	25.25	30.0	51.2	95% UTL with 95% Coverage
Zinc	52.8	31.64	35.8	52.8	95% UTL with 95% Coverage
Manganese	267	177	206.0	267	95% UTL with 95% Coverage
Subsuface Soil (1-6 fbgs)[a]					
Antimony	0.191	0.149	0.1	0.242	95% KM Chebyshev UPL
Barium	64.6	46.68	51.4	64.6	95% UTL with 95% Coverage
Cadmium	0.144	0.135	0.1	0.41	95% UTL with 95% Coverage
Chromium	7.9	4.887	5.4	7.9	95% UTL with 95% Coverage
Copper	10	5.521	6.7	10.0	95% UTL with 95% Coverage
Lead	8.78	4.698	5.4	8.8	95% UTL with 95% Coverage
Mercury	0.081	0.0602	0.1	0.1	95% UTL with 95% Coverage
Molybdenum	1.47	0.792	0.9	1.5	95% UTL with 95% Coverage
Selenium	0.464	0.286	0.3	2.1	95% UTL with 95% Coverage
Vanadium	51.2	25.25	30.0	51.2	95% UTL with 95% Coverage
Zinc	52.8	31.64	35.8	52.8	95% UTL with 95% Coverage
TEQ	4.3E-08	4.3E-08	NC	4.3E-08	Single Value

Notes:

a. Background data from 13 upgradient sample locations collected at 1 fbgs

BTV - Background threhold value, recommended by ProUCL

COPEC - chemical of potential ecological concern

fbgs - feet below ground surface

NC - not calculated, insufficnet data

Table 4-16. Background Statistical Analyses

Panel B: Site Data, Soil

COPEC	Maximum (mg/kg)	Mean (mg/kg)	95 UCL (mg.kg)	Ratio Site Mean:Bkg	Ratio Site Max:BTV	2-tail, Hypothesis H0:B=S		1-tail, Form 1 Hypothesis H0: B<=S		1-tail, Form 2 Hypothesis H0: B>=S	
						p value	Outcome?	p value	Outcome?	p value	Outcome?
Surface Soil (0-1 fbgs)											
Antimony	4.63	1.89	3.55	13	19	0.00264	Bkgnd <> Site	0.999	Bkgnd <= Site	0.00132	Bkgnd < Site
Barium	918	397	720	9	14	0.082	Bkgnd <> Site	0.959	Bkgnd <= Site	0.041	Bkgnd < Site
Cadmium	6.8	2.5	4.977	18	17	2.5906E-4	Bkgnd <> Site	1	Bkgnd <= Site	1.2953E-4	Bkgnd < Site
Chromium	23.6	16.0	23.8	3	3	0.040	Bkgnd <> Site	0.980	Bkgnd <= Site	0.020	Bkgnd < Site
Copper	198.0	109.1	160	20	20	0.012	Bkgnd <> Site	0.994	Bkgnd <= Site	0.006	Bkgnd < Site
Lead	689	364.8	634	78	78	0.047	Bkgnd <> Site	0.977	Bkgnd <= Site	0.023	Bkgnd < Site
Mercury	0.75	0.448	0.63	7	9	4.7345E-4	Bkgnd <> Site	1	Bkgnd <= Site	2.3672E-4	Bkgnd < Site
Molybdenum	2.2	1.45	2.16	2	2	0.0862	Bkgnd <> Site	0.957	Bkgnd <= Site	0.0431	Bkgnd < Site
Vanadium	37.4	24.36	32.2	1	1	0.845	Bkgnd = Site	0.422	Bkgnd <= Site	0.578	Bkgnd >= Site
Zinc	2420	1267	2322	40	46	0.067	Bkgnd <> Site	0.967	Bkgnd <= Site	0.033	Bkgnd < Site
Manganese	1900	1059	1664	6	7	0.036	Bkgnd <> Site	0.982	Bkgnd <= Site	0.018	Bkgnd < Site
Subsuface Soil (1-6 fbgs)											
Antimony	2.4	1.6	2.0	11	10	0.0205	Bkgnd <> Site	0.0103	Bkgnd <= Site	0.99	Bkgnd < Site
Barium	1420	370	1924	8	22	0.065	Bkgnd <> Site	0.032	Bkgnd <= Site	0.968	Bkgnd < Site
Cadmium	11.8	3.8	4.2	28	29	0.0067	Bkgnd <> Site	0.00335	Bkgnd < Site	0.997	Bkgnd <= Site
Chromium	36.4	11.9	29.0	2	5	0.108	Bkgnd = Site	0.054	Bkgnd >= Site	0.946	Bkgnd <= Site
Copper	260	56	157	10	26	0.059	Bkgnd <> Site	0.03	Bkgnd < Site	0.97	Bkgnd <= Site
Lead	9930	1151	9972	245	1131	0.225	Bkgnd = Site	0.112	Bkgnd >= Site	0.888	Bkgnd <= Site
Mercury	1.6	0.7	0.9	12	20	0.00683	Bkgnd <> Site	0.00342	Bkgnd < Site	0.997	Bkgnd <= Site
Molybdenum	2.3	0.7	1.1	1	2	0.355	Bkgnd = Site	0.823	Bkgnd >= Site	0.177	Bkgnd <= Site
Vanadium	24.2	21.2	22.7	1	0.5	0.127	Bkgnd = Site	0.937	Bkgnd >= Site	0.063	Bkgnd <= Site
Zinc	2120	597	3123	19	40	0.05	Bkgnd <> Site	0.025	Bkgnd < Site	0.975	Bkgnd <= Site
TEQ	1.1E-05	5.5E-06	NA	126	NC	NC	--	NC	--	NC	--

Notes:

Ratio >1, <5

Ratio >5, <10

Ratio >10

Site concentrations are statistically higher than background

COPEC - chemical of potential ecological concern

H0 - Null hypothesis

Test results with all detects were based on Student's t where variances are equal, and Welch-Satterthwaite where variances unequal.

Test results with nondetects were based on Gehan.

Table 5-1. Soil PRGs for Human Health COCs

COC	Units	Construction Worker RME
TPH-High	mg/kg	40000
TPH-Medium	mg/kg	2000

Notes:

PRGs based on non-cancer endpoint, for HQ=1

PRG = preliminary removal goal

Table 5-2. PRGs for Lead Based on Construction Worker Scenarios

Variable	Description of Variable	Units	Construction Worker CTE	Construction Worker RME	Construction Worker CTE	Construction Worker RME
$PbB_{fetal,\ 0.95}$	Target PbB in fetus (e.g., 2-8 µg/dL)	µg/dL	10	10	5	5
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4	0.4	0.4	0.4
GSD_i	Geometric standard deviation PbB	--	1.8	1.8	1.8	1.8
PbB_0	Baseline PbB	µg/dL	0.6	0.6	0.6	0.6
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.165	0.330	0.165	0.330
$AF_{S,\ D}$	Absorption fraction (same for soil and dust)	--	0.12	0.12	0.12	0.12
$EF_{S,\ D}$	Exposure frequency (same for soil and dust)	days/yr	15	30	15	30
$AT_{S,\ D}$	Averaging time (same for soil and dust)	days/yr	365	365	365	365
PRG in Soil for no more than 5% probability that fetal PbB exceeds target PbB		**mg/kg**	**11,138**	**2,784**	**4,647**	**1,162**

Calculations of Preliminary Remediation Goals (PRGs) for Soil in Nonresidential Areas

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 06/14/2017

Table 5-3. Preliminary Removal Goals for Ecological Receptors

Chemical Group	COEC	Soil PRG (mg/kg) Threshold TRV-Based[a]		Soil PRG (mg/kg) Threshold TRV-Based, HQ=1[b]						Final Soil Ecological PRG (mg/kg)
				Birds			Mammals			
		Plants	Invertebrates	Herbivore	Insectivore	Carnivore	Herbivore	Insectivore	Carnivore	
Surface Soils (0-0.5 fbgs)										
Metals	Antimony	Not a COEC	Not a COEC		---- Not a COEC ----		Not a COEC	1.6	Not a COEC	1.6
	Cadmium	Not a COEC	Not a COEC		---- Not a COEC ----		Not a COEC	1.0	Not a COEC	1.0
	Chromium[c]	2.2	1.4		---- Not a COEC ----			---- Not a COEC ----		1.4
	Copper	Not a COEC	Not a COEC	Not a COEC	125	Not a COEC	Not a COEC	123	Not a COEC	123
	Lead	262	Not a COPEC	279	54	Not a COEC	Not a COEC	192	Not a COEC	54
	Mercury	Not a COEC	Not a COEC	Not a COEC	0.19	Not a COEC		---- Not a COPEC ----		0.19
	Vanadium	13	Not a COEC		---- Not a COEC ----			---- Not a COEC ----		13
	Zinc	360	334	Not a COEC	1754	Not a COEC		---- Not a COEC ----		334
	Manganese	574	Not COPEC		---- Not a COEC ----			---- Not a COEC ----		574
Subsurface Soils (1-6 fbgs)										
Metals	Antimony	Not a COEC	Not a COEC		---- Not a COEC ----		Not a COEC	1.6	Not a COEC	1.6
	Barium	837	Not a COEC		---- Not a COEC ----			---- Not a COEC ----		837
	Cadmium	Not a COEC	Not a COEC		---- Not a COEC ----		Not a COEC	1.0	Not a COEC	1.0
	Chromium[c]	2.2	1.4		---- Not a COEC ----			---- Not a COEC ----		1.4
	Copper	Not a COEC	Not a COEC		---- Not a COEC ----		Not a COEC	123	Not a COEC	123
	Lead	262	3,779		---- Not a COEC ----		Not a COEC	192	Not a COEC	192
	Vanadium	13	Not a COPEC		---- Not a COEC ----			---- Not a COEC ----		13
	Zinc	360	334		---- Not a COEC ----			---- Not a COEC ----		334
Dioxins/Furans	Total TCDD-TEQ	Not a COEC	Not a COEC		---- Not a COEC ----		Not a COEC	7.E-06	Not a COEC	7.E-06

Notes:

PRGs are developed for COECs, which are identified as COPECs with Threshold-Based HQ>1.

PRGs are calculated to result in HQ=1, rounded off to a single significant figure.

COEC - Chemical of Ecological Concern

COPEC - Chemical of Potential Ecological Concern

PRG = Preliminary Removal Goal

TEQ - toxic equivalent quotient

TRV - toxicity reference value

a - Based on the geometric mean of LANL (2017) Low-Effect ESL and NPS (2018) Refined ESV

b - Based on the geometric mean of the NOAEL and LOAEL TRV

Table 5-4. Summary Preliminary Removal Goals and Background Values - Mather WAA Site

COC/COEC	PRG (mg/kg)	PRG Basis	Background[a] (mg/kg)	Background Basis[b]
Surface Soils (0-0.5 fbgs)				
Antimony	1.6	Target HQ of 1 for insectivorous mammal, based on the threshold TRV	0.242	95% KM Chebyshev UPL
Cadmium	1.0	Target HQ of 1 for insectivorous mammal, based on the threshold TRV	0.41	95% UTL with 95% Coverage
Chromium[c]	1.4	Target HQ of 1 for soil invertebrates, based on the threshold ESL	7.9	95% UTL with 95% Coverage
Copper	123	Target HQ of 1 for insectivorous mammal, based on the threshold TRV	10.0	95% UTL with 95% Coverage
Lead	54	Target HQ of 1 for insectivorous birds. based on the threshold TRV	8.8	95% UTL with 95% Coverage
Lead	1162	Construction worker RME scenario, target blood lead level of 5 µg/dL		
Mercury	0.19	Target HQ of 1 for insectivorous birds. based on the threshold TRV	0.1	95% UTL with 95% Coverage
Molybdenum	13	Target HQ of 1 for terrestrial plants, based on the threshold ESL	51.2	95% UTL with 95% Coverage
Zinc	334	Target HQ of 1 for terrestrial plants, based on the threshold ESL	52.8	95% UTL with 95% Coverage
Manganese	574	Target HQ of 1 for terrestrial plants, based on the threshold ESL	267	95% UTL with 95% Coverage
Subsurface Soils (1-6 fbgs)				
Antimony	1.6	Target HQ of 1 for insectivorous mammal, based on the threshold TRV	0.242	95% KM Chebyshev UPL
Barium	837	Target HQ of 1 for terrestrial plants, based on the threshold ESL	64.6	95% UTL with 95% Coverage
Cadmium	1.0	Target HQ of 1 for insectivorous mammal, based on the threshold TRV	0.41	95% UTL with 95% Coverage
Chromium[c]	1.4	Target HQ of 1 for soil invertebrates, based on the threshold ESL	7.9	95% UTL with 95% Coverage
Copper	123	Target HQ of 1 for insectivorous mammal, based on the threshold TRV	10.0	95% UTL with 95% Coverage
Lead	192	Target HQ of 1 for insectivorous mammal, based on the threshold TRV	8.8	95% UTL with 95% Coverage
Lead	1162	Construction worker RME scenario, target blood lead level of 5 µg/dL		
Vanadium	13	Target HQ of 1 for terrestrial plants, based on the threshold ESL	51.2	95% UTL with 95% Coverage
Zinc	334	Target HQ of 1 for terrestrial plants, based on the threshold ESL	52.8	95% UTL with 95% Coverage
TPH-High	40000	Construction worker RME scenario, sum of exposure routes, target HQ=1	31	Maximum
TPH-Medium	2000	Construction worker RME scenario, sum of exposure routes,target HQ=1	3	Maximum
Total TCDD-TEQ	7.E-06	Target HQ of 1 for insectivorous mammal, based on the threshold TRV	4.3E-08	Single Value

Notes:

COC = Chemical of concern

COEC = Chemical of ecological concern

PRG = Preliminary Removal Goal

TEQ - Toxicity Equivalents

a. Background data from 13 upgradient sample locations (1 fbgs):

b. Background based on Background Threshold Values (BTVs) recommended by ProUCL

ATTACHMENTS

Attachment A – Selection of Chemicals of Potential Concern

Attachment A-1. Selection of COPCs in Surface Soil

Chemical Group	Analyte	CASRN	Units	Number of Samples		Detection Frequency (%)	Mean of Detects	Maximum Detect	Maximum MDL for Non-detects	USEPA RSL [HQ=0.1]	DTSC HERO	Lowest Screening Level	Maximum Detect Above Lowest SL? (Select COPC)	Maximum DL Above Lowest SL? (Inadequate MDL)	Selected COPCs in Surface Soil	Notes
				Detects	Total					Resident Soil	Resident Soil					
Metals	Antimony	7440-36-0	mg/kg	5	5	100%	1.89	4.63	--	3.1	--	3.1	YES	--	Antimony	Max detect>SL
	Arsenic	7440-38-2	mg/kg	5	5	100%	4.5	7.4	--	0.68	0.11	0.11	YES	--	Arsenic	Max detect>SL
	Barium	7440-39-3	mg/kg	5	5	100%	397	918	--	1500	--	1500	no	--	--	Max<SL
	Beryllium	7440-41-7	mg/kg	5	5	100%	0.17	0.22	--	16	16	16	no	--	--	Max<SL
	Cadmium	7440-43-9	mg/kg	5	5	100%	2.46	6.78	--	7.1	71	7.1	no	--	--	Max<SL
	Chromium, Total	7440-47-3	mg/kg	5	5	100%	16.0	23.6	--	12000	--	12000	no	--	--	Max<SL
	Cobalt	7440-48-4	mg/kg	5	5	100%	6.59	9.24	--	2.3	--	2.3	YES	--	Cobalt	Max detect>SL
	Copper	7440-50-8	mg/kg	5	5	100%	109	198	--	310	--	310	no	--	--	Max<SL
	Lead	7439-92-1	mg/kg	5	5	100%	365	689	--	400	80	80	YES	--	Lead	Max detect>SL
	Mercury	7439-97-6	mg/kg	5	5	100%	0.45	0.75	--	1.1	1	1	no	--	--	Max<SL
	Molybdenum	7439-98-7	mg/kg	5	5	100%	1.45	2.22	--	39	--	39	no	--	--	Max<SL
	Nickel	7440-02-0	mg/kg	5	5	100%	14.8	27.9	--	150	820	150	no	--	--	Max<SL
	Selenium	7782-49-2	mg/kg	5	5	100%	0.16	0.20	--	39	--	39	no	--	--	Max<SL
	Silver	7440-22-4	mg/kg	4	5	80%	0.72	1.07	0.1	39	390	39	no	no	--	Max<SL
	Thallium	7440-28-0	mg/kg	5	5	100%	0.392	0.567	--	0.078	--	0.078	YES	--	Thallium	Max detect>SL
	Vanadium	7440-62-2	mg/kg	5	5	100%	24.4	37.4	--	39	--	39	no	--	--	Max<SL
	Zinc	7440-66-6	mg/kg	5	5	100%	1267	2420	--	2300	--	2300	YES	--	Zinc	Max detect>SL
	Aluminum	7429-90-5	mg/kg	5	5	100%	9978	12000	--	7700	--	7700	YES	--	Aluminum	Max detect>SL
	Iron	7439-89-6	mg/kg	5	5	100%	27520	40200	--	5500	--	5500	YES	--	Iron	Max detect>SL
	Manganese	7439-96-5	mg/kg	5	5	100%	1059	1900	--	180	--	180	YES	--	Manganese	Max detect>SL
VOCs	Acetone	67-64-1	mg/kg	2	5	40%	0.010	0.015	0.009	6100	--	6100	no	no	--	Max<SL
	Methylene chloride	75-09-2	mg/kg	2	5	40%	0.005	0.007	0.002	35	2.2	2.2	no	no	--	Max<SL
SVOCs	Bis(2-ethylhexyl)phthalate	117-81-7	mg/kg	2	5	40%	0.480	0.720	0.350	39	39	39	no	no	--	Max<SL
	Pentachlorophenol	87-86-5	mg/kg	1	5	20%	0.190	0.190	0.370	1	1	1	no	no	--	Max<SL
PAHs	Anthracene	120-12-7	mg/kg	0	5	0%	ND	ND	0.005	1800	17000	1800	All ND	no	--	All ND; max DL<SL
	Benzo(a)anthracene	56-55-3	mg/kg	0	5	0%	ND	ND	0.005	1.1	1.1	1.1	All ND	no	--	All ND; max DL<SL
	Benzo(a)pyrene	50-32-8	mg/kg	1	5	20%	0.062	0.062	0.005	0.11	0.11	0.11	no	no	--	Max<SL
	Benzo(b)fluoranthene	205-99-2	mg/kg	0	5	0%	ND	ND	0.005	1.1	1.1	1.1	All ND	no	--	All ND; max DL<SL
	Benzo(g,h,i)perylene	191-24-2	mg/kg	2	5	40%	0.043	0.078	0.005	--	--	--	No SL	No SL	--	No SL
	Benzo(k)fluoranthene	207-08-9	mg/kg	0	5	0%	ND	ND	0.005	11	11	11	All ND	no	--	All ND; max DL<SL
	Chrysene	218-01-9	mg/kg	1	5	20%	0.051	0.051	0.005	110	110	110	no	no	--	Max<SL
	Dibenz(a,h)anthracene	53-70-3	mg/kg	1	5	20%	0.049	0.049	0.005	0.11	0.028	0.028	YES	no	Dibenz(a,h)anthracene	Max detect>SL
	Fluoranthene	206-44-0	mg/kg	1	5	20%	0.005	0.005	0.005	240	2400	240	no	no	--	Max<SL
	Indeno(1,2,3-c,d)pyrene	193-39-5	mg/kg	1	5	20%	0.005	0.005	0.005	1.1	1.1	1.1	no	no	--	Max<SL
	Phenanthrene	85-01-8	mg/kg	0	5	0%	ND	ND	0.005	--	--	--	All ND	No SL	--	All ND; no SL
	Pyrene	129-00-0	mg/kg	2	5	40%	0.012	0.019	0.005	180	1800	180	no	no	--	Max<SL

Notes:

% = percent

CASRN = Chemical Abstracts Service Registry Number

COPC = Chemical of Potential concern

DTSC HERO = Department of Toxic Substances Human Health Risk

DL = detection limit

mg/kg = milligram per kilogram

ND = non-detect

PAH = Polycyclic Aromatic Hydrocarbon

RSL = Regional Screening Level

SVOC = Semi-Volatile Organic Compounds

USEPA = U.S. Environmental Protection Agency

Attachment A-2. Selection of COPCs in Subsurface Soil

Chemical Group	Analyte	CASRN	Units	Number of Samples: Detects	Number of Samples: Total	Detection Frequency (%)	Mean of Detects	Maximum Detect	Maximum MDL for Non-detects	USEPA RSL [HQ=0.1] Resident Soil	DTSC HERO Resident Soil	Lowest Screening Level	Maximum Detect Above Lowest SL? (Select COPC)	Maximum DL Above Lowest SL? (Inadequate MDL)	Selected COPCs in Suburface Soil	Notes
Metals	Antimony	7440-36-0	mg/kg	5	11	45%	1.6	2.4	21	3.1	--	3.1	no	YES	Antimony	DL>SL
	Arsenic	7440-38-2	mg/kg	11	11	100%	3.2	8.4	--	0.68	0.11	0.11	YES	--	Arsenic	Max detect>SL
	Barium	7440-39-3	mg/kg	11	11	100%	370	1420	--	1500	--	1500	no	--	--	<SL
	Beryllium	7440-41-7	mg/kg	5	11	45%	0.216	0.251	0.83	16	16	16	no	no	--	<SL
	Cadmium	7440-43-9	mg/kg	6	11	55%	3.8	11.8	0.41	7.1	71	7.1	YES	no	Cadmium	Max detect>SL
	Chromium, Total	7440-47-3	mg/kg	11	11	100%	11.9	36.4	--	12000	--	12000	no	--	--	Max detect>SL
	Cobalt	7440-48-4	mg/kg	11	11	100%	4.3	6.8	--	2.3	--	2.3	YES	--	Cobalt	Max detect>SL
	Copper	7440-50-8	mg/kg	11	11	100%	55.8	260	--	310	--	310	no	--	--	<SL
	Lead	7439-92-1	mg/kg	11	11	100%	1151	9930	--	400	80	80	YES	--	Lead	Max detect>SL
	Mercury	7439-97-6	mg/kg	9	11	82%	0.703	1.6	0.034	1.1	1	1	YES	no	Mercury	Max detect>SL
	Molybdenum	7439-98-7	mg/kg	11	11	100%	0.73	2.3	--	39	--	39	no	--	--	<SL
	Nickel	7440-02-0	mg/kg	11	11	100%	5.4	12.5	--	150	820	150	no	--	--	<SL
	Selenium	7782-49-2	mg/kg	6	11	55%	0.32	1.1	2.1	39	--	39	no	no	--	<SL
	Silver	7440-22-4	mg/kg	5	11	45%	1.1	2.6	2.1	39	390	39	no	no	--	<SL
	Thallium	7440-28-0	mg/kg	5	11	45%	0.281	0.381	2.1	0.078	--	0.078	YES	YES	Thallium	Max detect>SL
	Vanadium	7440-62-2	mg/kg	11	11	100%	21.2	24.2	--	39	--	39	no	--	--	<SL
	Zinc	7440-66-6	mg/kg	11	11	100%	597	2120	--	2300	--	2300	no	--	--	<SL
	Hexavalent Chromium	18540-29-9	mg/kg	0	6	0%	--	--	0.53	12000	--	12000	--	no	--	All ND; max DL<SL
	Aluminum	7429-90-5	mg/kg	5	5	100%	10134	12000	--	7700	--	7700	YES	--	Aluminum	Max detect>SL
	Iron	7439-89-6	mg/kg	5	5	100%	16826	29700	--	5500	--	5500	YES	--	Iron	Max detect>SL
	Manganese	7439-96-5	mg/kg	5	5	100%	672	1790	--	180	--	180	YES	--	Manganese	Max detect>SL
VOCs	Acetone	67-64-1	mg/kg	1	5	20%	0.044	0.044	0.007	6100	--	6100	no	no	--	<SL
	Methylene Chloride	75-09-2	mg/kg	1	5	20%	0.003	0.003	0.003	35	2.2	2.2	no	no	--	<SL
SVOCs	Bis(2-ethylhexyl)phthalate	117-81-7	mg/kg	1	5	20%	0.290	0.290	0.170	39	39	39	no	no	--	<SL
	Pentachlorophenol	87-86-5	mg/kg	0	5	0%	ND	ND	0.180	1	1	1	All ND	no	--	All ND; max DL<SL
PAHs	Anthracene	120-12-7	mg/kg	2	11	18%	0.004	0.006	0.041	1800	17000	1800	no	no	--	<SL
	Benzo(a)anthracene	56-55-3	mg/kg	3	11	27%	0.012	0.019	0.041	1.1	1.1	1.1	no	no	--	<SL
	Benzo(a)pyrene	50-32-8	mg/kg	3	11	27%	0.022	0.034	0.041	0.11	0.11	0.11	no	no	--	<SL
	Benzo(b)fluoranthene	205-99-2	mg/kg	3	11	27%	0.022	0.028	0.041	1.1	1.1	1.1	no	no	--	<SL
	Benzo(g,h,i)perylene	191-24-2	mg/kg	1	11	9%	0.011	0.011	0.041	--	--	--	No SL	No SL	--	No SL
	Benzo(k)fluoranthene	207-08-9	mg/kg	2	11	18%	0.008	0.009	0.041	11	11	11	no	no	--	<SL
	Chrysene	218-01-9	mg/kg	5	11	45%	0.014	0.035	0.041	110	110	110	no	no	--	<SL
	Dibenz(a,h)anthracene	53-70-3	mg/kg	2	11	18%	0.024	0.030	0.100	0.11	0.028	0.028	YES	YES	Dibenz(a,h)anthracene	Max detect>SL
	Fluoranthene	206-44-0	mg/kg	3	11	27%	0.040	0.050	0.041	240	2400	240	no	no	--	<SL
	Indeno(1,2,3-c,d)pyrene	193-39-5	mg/kg	3	11	27%	0.014	0.020	0.041	1.1	1.1	1.1	no	no	--	<SL
	Phenanthrene	85-01-8	mg/kg	3	11	27%	0.024	0.038	0.041	--	--	--	No SL	No SL	--	No SL
	Pyrene	129-00-0	mg/kg	3	11	27%	0.041	0.044	0.041	180	1800	180	no	no	--	<SL
Dioxins/Furans	1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin		mg/kg	2	2	100%	1.1E-06	2.1E-06	--	evaluated as	TEQ	--	--	--	--	--
	1,2,3,4,7,8-hexachlorodibenzo-p-dioxin		mg/kg	1	2	50%	1.9E-07	3.8E-07	--	evaluated as	TEQ	--	--	--	--	--
	1,2,3,6,7,8-hexachlorodibenzo-p-dioxin		mg/kg	1	2	50%	7.0E-07	1.4E-06	--	evaluated as	TEQ	--	--	--	--	--
	1,2,3,7,8,9-hexachlorodibenzo-p-dioxin		mg/kg	1	2	50%	5.0E-07	1.0E-06	--	evaluated as	TEQ	--	--	--	--	--
	1,2,3,7,8-pentachlorodibenzo-p-dioxin		mg/kg	1	2	50%	9.3E-07	1.9E-06	--	evaluated as	TEQ	--	--	--	--	--
	2,3,7,8-tetrachlorodibenzo-p-dioxin	1746-01-6	mg/kg	1	2	50%	4.5E-07	9.0E-07	--	evaluated as	TEQ	--	--	--	--	--
	Octachlorodibenzo-p-Dioxin		mg/kg	2	2	100%	3.0E-07	5.8E-07	--	evaluated as	TEQ	--	--	--	--	--
	1,2,3,4,6,7,8-heptachlorodibenzofuran		mg/kg	1	2	50%	8.0E-08	1.6E-07	--	evaluated as	TEQ	--	--	--	--	--
	1,2,3,4,7,8,9-heptachlorodibenzofuran		mg/kg	0	2	0%	0.0E+00	0.0E+00	--	evaluated as	TEQ	--	--	--	--	--
	1,2,3,4,7,8-hexachlorodibenzofuran		mg/kg	1	2	50%	1.7E-07	3.3E-07	--	evaluated as	TEQ	--	--	--	--	--
	1,2,3,6,7,8-hexachlorodibenzofuran		mg/kg	1	2	50%	1.3E-07	2.6E-07	--	evaluated as	TEQ	--	--	--	--	--
	1,2,3,7,8,9-hexachlorodibenzofuran		mg/kg	0	2	0%	0.0E+00	0.0E+00	--	evaluated as	TEQ	--	--	--	--	--
	1,2,3,7,8-pentachlorodibenzofuran		mg/kg	1	2	50%	7.3E-08	1.5E-07	--	evaluated as	TEQ	--	--	--	--	--
	2,3,4,6,7,8-hexachlorodibenzofuran		mg/kg	0	2	0%	0.0E+00	0.0E+00	--	evaluated as	TEQ	--	--	--	--	--
	2,3,4,7,8-pentachlorodibenzofuran		mg/kg	1	2	50%	8.3E-07	1.7E-06	--	evaluated as	TEQ	--	--	--	--	--
	2,3,7,8-tetrachlorodibenzofuran		mg/kg	1	2	50%	1.9E-07	3.7E-07	--	evaluated as	TEQ	--	--	--	--	--
	Octachlorodibenzofuran		mg/kg	1	2	50%	7.0E-09	1.4E-08	--	evaluated as	TEQ	--	--	--	--	--
	TEQ	TEQ	mg/kg	2	2	100%	5.6E-06	1.1E-05	--	4.8E-06	4.8E-06	0.0000048	YES	--	TEQ	Max detect>SL

Notes:

% = percent
CASRN = Chemical Abstracts Service Registry Number
COPC = Chemical of Potential concern
DTSC HERO = Department of Toxic Substances Human Health Risk
DL = detection limit
mg/kg = milligram per kilogram
ND = non-detect
PAH = Polycyclic Aromatic Hydrocarbon
RSL = Regional Screening Level
SVOC = Semi-Volatile Organic Compounds
USEPA = U.S. Environmental Protection Agency

Appendix B – Risk Calculations for Human Receptor Populations

Table B-1. Estimates of Cancer and Noncancer Risks for Current Adult Park Worker Scenario
CTE- Incidental Ingestion of Soil

CTE- Incidental Ingestion of Soil

Body Weight = BW	80	kg
Exposure Frequency = EF	12	days/yr
Exposure Duration = ED	5	yr
Averaging Time (Noncancer) = AT	1,825	dy
Averaging Time (Cancer) = AT	25,550	dy
Ingestion Rate = IR	50	mg/day
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * IR * EF * ED *CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	NCADD (mg/kg-day)	CADD (mg/kg-day)	Chronic Oral RfD (mg/kg-day)	Oral SF $(mg/kg\text{-}day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E+00	7.29E-08	5.21E-09	4.00E-04	NA	1.82E-04	--
	Arsenic	6.84E+00	1.41E-07	1.00E-08	3.00E-04	1.50E+00	4.68E-04	1.51E-08
	Cobalt	8.75E+00	1.80E-07	1.28E-08	3.00E-04	NA	5.99E-04	--
	Lead	6.34E+02	1.30E-05	9.31E-07	NA	NA	--	--
	Thallium	5.06E-01	1.04E-08	7.43E-10	1.00E-05	NA	1.04E-03	--
	Zinc	2.32E+03	4.77E-05	3.41E-06	3.00E-01	NA	1.59E-04	--
	Aluminum	1.17E+04	2.40E-04	1.71E-05	1.00E+00	NA	2.40E-04	--
	Iron	3.68E+04	7.57E-04	5.40E-05	7.00E-01	NA	1.08E-03	--
	Manganese	1.66E+03	3.42E-05	2.44E-06	1.40E-01	NA	2.44E-04	--
PAHs	Dibenz(a,h)anthracene	4.90E-02	1.01E-09	7.19E-11	NA	1.00E+00	--	7.19E-11
Cumulative Risk							**4.0E-03**	**1.5E-08**
TPH	TPH Aromatics High	2.00E+03	4.11E-05	2.94E-06	4.00E-02	NA	1.03E-03	--
	TPH Aromatics Medium	8.90E+01	1.83E-06	1.31E-07	4.00E-03	NA	4.57E-04	--
TPH Cumulative Risk							**1.E-03**	**0.E+00**

Notes:
NA - Not applicable because toxicity value is not available.
CTE = Central Tendency Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-2. Estimates of Cancer and Noncancer Risks for Current Adult Park Worker Scenario
RME- Incidental Ingestion of Soil

RME- Incidental Ingestion of Soil

Body Weight = BW	80	kg
Exposure Frequency = EF	24	days/yr
Exposure Duration = ED	10	yr
Averaging Time (Noncancer) = AT	3,650	dy
Averaging Time (Cancer) = AT	25,550	dy
Ingestion Rate = IR	100	mg/day
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * IR * EF * ED *CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	NCADD (mg/kg-day)	CADD (mg/kg-day)	Chronic Oral RfD (mg/kg-day)	Oral SF $(mg/kg\text{-}day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E+00	2.92E-07	4.17E-08	4.0E-04	NA	7.29E-04	--
	Arsenic	6.84E+00	5.62E-07	8.03E-08	3.0E-04	1.5E+00	1.87E-03	1.20E-07
	Cobalt	8.75E+00	7.19E-07	1.03E-07	3.0E-04	NA	2.40E-03	--
	Lead	6.34E+02	5.21E-05	7.45E-06	NA	NA	--	--
	Thallium	5.06E-01	4.16E-08	5.94E-09	1.0E-05	NA	4.16E-03	--
	Zinc	2.32E+03	1.91E-04	2.73E-05	3.0E-01	NA	6.36E-04	--
	Aluminum	1.17E+04	9.59E-04	1.37E-04	1.0E+00	NA	9.59E-04	--
	Iron	3.68E+04	3.03E-03	4.32E-04	7.0E-01	NA	4.32E-03	--
	Manganese	1.66E+03	1.37E-04	1.95E-05	1.4E-01	NA	9.77E-04	--
PAHs	Dibenz(a,h)anthracene	4.90E-02	4.03E-09	5.75E-10	NA	1.0E+00	--	5.75E-10
Cumulative Risk							**1.6E-02**	**1.2E-07**
TPH	TPH Aromatics High	2.00E+03	1.64E-04	2.35E-05	4.0E-02	NA	4.11E-03	--
	TPH Aromatics Medium	8.90E+01	7.32E-06	1.05E-06	4.0E-03	NA	1.83E-03	--
TPH Cumulative Risk							**6.E-03**	**0.E+00**

Notes:

NA - Not applicable because toxicity value is not available.
RME = Reasonable Maximum Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-3. Estimates of Cancer and Noncancer Risks for Current Adult Park Worker Scenario
CTE- Dermal Contact with Soil

CTE- Dermal Contact with Soil

Surface Area for Contact=SA	2,479	cm2/event
Adherence Factor=AF	0.02	mg/cm2
Dermal Absorption Fraction=ABS_d	chemical-specific	
Body Weight = BW	80	kg
Exposure Frequency = EF	12	days/yr
Exposure Duration = ED	5	yr
Averaging Time (Noncancer) = AT	1,825	dy
Averaging Time (Cancer) = AT	25,550	dy
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * SA * AF * ABS_d * EF * ED * CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	ABS_d	NCADD (mg/kg-day)	CADD (mg/kg-day)	Dermal RfD (mg/kg-day)	Dermal SF $(mg/kg\text{-}day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E+00	NA	--	--	6.00E-05	NA	--	--
	Arsenic	6.84E+00	3.00E-02	4.18E-09	2.99E-10	3.00E-04	1.50E+00	1.39E-05	4.48E-10
	Cobalt	8.75E+00	NA	--	--	3.00E-04	NA	--	--
	Lead	6.34E+02	NA	--	--	NA	NA	--	--
	Thallium	5.06E-01	NA	--	--	1.00E-05	NA	--	--
	Zinc	2.32E+03	NA	--	--	3.00E-01	NA	--	--
	Aluminum	1.17E+04	NA	--	--	1.00E+00	NA	--	--
	Iron	3.68E+04	NA	--	--	7.00E-01	NA	--	--
	Manganese	1.66E+03	NA	--	--	1.40E-01	NA	--	--
PAHs	Dibenz(a,h)anthracene	4.90E-02	1.30E-01	1.30E-10	9.27E-12	NA	1.00E+00	--	9.27E-12
Cumulative Risk								**1.4E-05**	**4.6E-10**
TPH	TPH Aromatics High	2.00E+03	1.30E-01	5.30E-06	3.78E-07	4.00E-02	NA	1.32E-04	--
	TPH Aromatics Medium	8.90E+01	1.30E-01	2.36E-07	1.68E-08	4.00E-03	NA	5.89E-05	--
TPH Cumulative Risk								**1.9E-04**	**0.0E+00**

Notes:

NA - Not applicable because toxicity value is not available.
CTE = Central Tendency Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-4. Estimates of Cancer and Noncancer Risks for Current Adult Park Worker Scenario
RME- Dermal Contact with Soil

RME- Dermal Contact with Soil

Surface Area for Contact=SA	6,032	cm2/event
Adherence Factor=AF	0.20	mg/cm2
Dermal Absorption Fraction=ABS_d	chemical-specific	
Body Weight = BW	80	kg
Exposure Frequency = EF	24	days/yr
Exposure Duration = ED	10	yr
Averaging Time (Noncancer) = AT	3,650	dy
Averaging Time (Cancer) = AT	25,550	dy
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * SA * AF * ABS_d * EF * ED * CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	ABS_d	NCADD (mg/kg-day)	CADD (mg/kg-day)	Dermal RfD (mg/kg-day)	Dermal SF $(mg/kg\text{-}day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E+00	NA	--	--	6.00E-05	NA	--	--
	Arsenic	6.84E+00	3.00E-02	2.03E-07	2.91E-08	3.00E-04	1.50E+00	6.78E-04	4.36E-08
	Cobalt	8.75E+00	NA	--	--	3.00E-04	NA	--	--
	Lead	6.34E+02	NA	--	--	NA	NA	--	--
	Thallium	5.06E-01	NA	--	--	1.00E-05	NA	--	--
	Zinc	2.32E+03	NA	--	--	3.00E-01	NA	--	--
	Aluminum	1.17E+04	NA	--	--	1.00E+00	NA	--	--
	Iron	3.68E+04	NA	--	--	7.00E-01	NA	--	--
	Manganese	1.66E+03	NA	--	--	1.40E-01	NA	--	--
PAHs	Dibenz(a,h)anthracene	4.90E-02	1.30E-01	6.32E-09	9.02E-10	NA	1.00E+00	--	9.02E-10
Cumulative Risk								**6.8E-04**	**4.5E-08**
TPH	TPH Aromatics High	2.00E+03	1.30E-01	2.58E-04	3.68E-05	4.00E-02	NA	6.45E-03	--
	TPH Aromatics Medium	8.90E+01	1.30E-01	1.15E-05	1.64E-06	4.00E-03	NA	2.87E-03	--
TPH Cumulative Risk								**9.3E-03**	**0.0E+00**

Notes:

NA - Not applicable because toxicity value is not available.
RME = Reasonable Maximum Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-5. Estimates of Cancer and Noncancer Risks for Adult Worker Scenario
CTE- Inhalation of Particles from Soil

CTE- Inhalation of Particles from Soil

Exposure Time = ET	4	hr/day
Exposure Frequency = EF	12	days/yr
Exposure Duration = ED	5	yr
Averaging Time (Noncancer) = AT	43,800	hrs
Averaging Time (Cancer) = AT	613,200	hrs
Conversion Factor = CF	1,000	µg/mg

EPC = Exposure concentration (mg/m^3) = EPC * ET * EF * ED / AT

NEC = Exposure Concentration - Noncarcinogens

CEC = Exposure Concentration - Carcinogens

HQ = Hazard Quotient, Noncarcinogens = NEC / RfD

Risk = Cancer Risk = CEC * IUR *CF

Chemical of Potential Concern		EPC (mg/m^3)	NEC (mg/m^3)	CEC (mg/m^3)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk (IUR) Factor (µg/m^3)$^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E-06	1.94E-08	1.39E-09	3.0E-04	NA	6.48E-05	--
	Arsenic	6.84E-06	3.75E-08	2.68E-09	1.5E-05	4.3E-03	2.50E-03	1.15E-08
	Cobalt	8.75E-06	4.79E-08	3.42E-09	6.0E-06	9.0E-03	7.99E-03	3.08E-08
	Lead	6.34E-04	3.48E-06	2.48E-07	NA	NA	--	--
	Thallium	5.06E-07	2.77E-09	1.98E-10	NA	NA	--	--
	Zinc	2.32E-03	1.27E-05	9.09E-07	NA	NA	--	--
	Aluminum	1.17E-02	6.39E-05	4.56E-06	5.0E-03	NA	1.28E-02	--
	Iron	3.68E-02	2.02E-04	1.44E-05	NA	NA	--	--
	Manganese	1.66E-03	9.12E-06	6.51E-07	5.0E-05	NA	1.82E-01	--
PAHs	Dibenz(a,h)anthracene	4.90E-08	2.68E-10	1.92E-11	NA	6.0E-04	--	1.15E-11
Cumulative Risk							**2.1E-01**	**4.2E-08**
TPH	TPH Aromatics High	2.00E-03	1.10E-05	7.83E-07	NA	NA	--	--
	TPH Aromatics Medium	8.90E-05	4.88E-07	3.48E-08	3.0E-03	NA	1.6E-04	--
TPH Cumulative Risk							**1.6E-04**	**0.0E+00**

Notes:

NA - Not applicable because toxicity value is not available.

CTE = Central Tendency Exposure

hr/day - hours per day

day/yr - days per year

yr - year

kg - kilogram

µg/mg -micrograms per milligram

mg/kg-day - milligrams per kilogram-day

mg/m^3 - milligrams per cubic meter

(µg/m^3)$^{-1}$ -per microgram per cubic meter

Table B-6. Estimates of Cancer and Noncancer Risks for Adult Worker Scenario
RME- Inhalation of Particles from Soil

RME- Inhalation of Particles from Soil

Exposure Time = ET	8	hr/day
Exposure Frequency = EF	24	days/yr
Exposure Duration = ED	10	yr
Averaging Time (Noncancer) = AT	87,600	hrs
Averaging Time (Cancer) = AT	613,200	hrs
Conversion Factor = CF	1,000	µg/mg

EPC = Exposure concentration (mg/m^3) = EPC * ET * EF * ED / AT

NEC = Exposure Concentration - Noncarcinogens
CEC = Exposure Concentration - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NEC / RfD
Risk = Cancer Risk = CEC * IUR *CF

Chemical of Potential Concern		EPC (mg/m^3)	NEC (mg/m^3)	CEC (mg/m^3)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk (IUR) (µg/m^3)$^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E-06	7.78E-08	1.11E-08	3.0E-04	NA	2.59E-04	--
	Arsenic	6.84E-06	1.50E-07	2.14E-08	1.5E-05	4.3E-03	9.99E-03	9.21E-08
	Cobalt	8.75E-06	1.92E-07	2.74E-08	6.0E-06	9.0E-03	3.19E-02	2.46E-07
	Lead	6.34E-04	1.39E-05	1.99E-06	NA	NA	--	--
	Thallium	5.06E-07	1.11E-08	1.58E-09	NA	NA	--	--
	Zinc	2.32E-03	5.09E-05	7.27E-06	NA	NA	--	--
	Aluminum	1.17E-02	2.56E-04	3.65E-05	5.0E-03	NA	5.11E-02	--
	Iron	3.68E-02	8.07E-04	1.15E-04	NA	NA	--	--
	Manganese	1.66E-03	3.65E-05	5.21E-06	5.0E-05	NA	7.29E-01	--
PAHs	Dibenz(a,h)anthracene	4.90E-08	1.07E-09	1.53E-10	NA	6.0E-04	--	9.21E-11
Cumulative Risk							**8.2E-01**	**3.4E-07**
TPH	TPH Aromatics High	2.00E-03	4.38E-05	6.26E-06	NA	NA	--	--
	TPH Aromatics Medium	8.90E-05	1.95E-06	2.79E-07	3.0E-03	NA	6.50E-04	--
TPH Cumulative Risk							**6.5E-04**	**0.0E+00**

Notes:

NA - Not applicable because toxicity value is not available.
RME = Reasonable Maximum Exposure
hr/day - hours per day
day/yr - days per year
yr - year
kg - kilogram
µg/mg -micrograms per milligram
mg/kg-day - milligrams per kilogram-day
mg/m^3 - milligrams per cubic meter
(µg/m^3)$^{-1}$ -per microgram per cubic meter

Table B-7. Estimates of Cancer and Noncancer Risks for Consruction Worker Scenario
CTE- Incidental Ingestion of Soil

CTE- Incidental Ingestion of Soil

Body Weight = BW	80	kg
Exposure Frequency = EF	15	days/yr
Exposure Duration = ED	1	yr
Averaging Time (Noncancer) = AT	365	dy
Averaging Time (Cancer) = AT	25,550	dy
Ingestion Rate = IR	165	mg/day
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * IR * EF * ED *CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	NCADD (mg/kg-day)	CADD (mg/kg-day)	Chronic Oral RfD (mg/kg-day)	Oral SF $(mg/kg\text{-}day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E+00	3.01E-07	4.30E-09	4.00E-04	NA	7.52E-04	--
	Arsenic	6.84E+00	5.80E-07	8.28E-09	3.00E-04	1.50E+00	1.93E-03	1.24E-08
	Cobalt	8.75E+00	7.41E-07	1.06E-08	3.00E-04	NA	2.47E-03	--
	Lead	6.34E+02	5.38E-05	7.68E-07	NA	NA	--	--
	Thallium	5.06E-01	4.29E-08	6.13E-10	1.00E-05	NA	4.29E-03	--
	Zinc	2.32E+03	1.97E-04	2.81E-06	3.00E-01	NA	6.56E-04	--
	Aluminum	1.17E+04	9.89E-04	1.41E-05	1.00E+00	NA	9.89E-04	--
	Iron	3.68E+04	3.12E-03	4.46E-05	7.00E-01	NA	4.46E-03	--
	Manganese	1.66E+03	1.41E-04	2.01E-06	1.40E-01	NA	1.01E-03	--
PAHs	Dibenz(a,h)anthracene	4.90E-02	4.15E-09	5.93E-11	NA	1.00E+00	--	5.93E-11
Cumulative Risk							**1.7E-02**	**1.2E-08**
TPH	TPH Aromatics High	2.0E+03	1.70E-04	2.42E-06	4.00E-02	NA	4.24E-03	--
	TPH Aromatics Medium	8.9E+01	7.54E-06	1.08E-07	4.00E-03	NA	1.89E-03	--
TPH Cumulative Risk							**6.E-03**	**0.E+00**

Notes:

NA - Not applicable because toxicity value is not available.
CTE = Central Tendency Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-8. Estimates of Cancer and Noncancer Risks for Consruction Worker Scenario
RME- Incidental Ingestion of Soil

RME- Incidental Ingestion of Soil

Body Weight = BW	80	kg
Exposure Frequency = EF	30	days/yr
Exposure Duration = ED	3	yr
Averaging Time (Noncancer) = AT	1,095	dy
Averaging Time (Cancer) = AT	25,550	dy
Ingestion Rate = IR	330	mg/day
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * IR * EF * ED *CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	NCADD (mg/kg-day)	CADD (mg/kg-day)	Chronic Oral RfD (mg/kg-day)	Oral SF $(mg/kg\text{-}day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E+00	1.20E-06	5.16E-08	4.0E-04	NA	3.01E-03	--
	Arsenic	6.84E+00	2.32E-06	9.94E-08	3.0E-04	1.5E+00	7.73E-03	1.49E-07
	Cobalt	8.75E+00	2.97E-06	1.27E-07	3.0E-04	NA	9.88E-03	--
	Lead	6.34E+02	2.15E-04	9.22E-06	NA	NA	--	--
	Thallium	5.06E-01	1.72E-07	7.35E-09	1.0E-05	NA	1.72E-02	--
	Zinc	2.32E+03	7.87E-04	3.37E-05	3.0E-01	NA	2.62E-03	--
	Aluminum	1.17E+04	3.95E-03	1.69E-04	1.0E+00	NA	3.95E-03	--
	Iron	3.68E+04	1.25E-02	5.35E-04	7.0E-01	NA	1.78E-02	--
	Manganese	1.66E+03	5.64E-04	2.42E-05	1.4E-01	NA	4.03E-03	--
PAHs	Dibenz(a,h)anthracene	4.90E-02	1.66E-08	7.12E-10	NA	1.0E+00	--	7.12E-10
Cumulative Risk							**6.6E-02**	**1.5E-07**
TPH	TPH Aromatics High	2000	6.78E-04	2.91E-05	4.00E-02	NA	1.70E-02	--
	TPH Aromatics Medium	89	3.02E-05	1.29E-06	4.00E-03	NA	7.54E-03	--
TPH Cumulative Risk							**2.E-02**	**0.E+00**

Notes:

NA - Not applicable because toxicity value is not available.
RME = Reasonable Maximum Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-9. Estimates of Cancer and Noncancer Risks for Construction Worker Scenario
CTE- Dermal Contact with Soil

CTE- Dermal Contact with Soil

Surface Area for Contact=SA	6,032	cm2/event
Adherence Factor=AF	0.80	mg/cm2
Dermal Absorption Fraction=ABS_d	chemical-specific	
Body Weight = BW	80	kg
Exposure Frequency = EF	15	days/yr
Exposure Duration = ED	1	yr
Averaging Time (Noncancer) = AT	365	dy
Averaging Time (Cancer) = AT	25,550	dy
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * SA * AF * ABS_d * EF * ED * CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	ABS_d	NCADD (mg/kg-day)	CADD (mg/kg-day)	Dermal RfD (mg/kg-day)	Dermal SF $(mg/kg\text{-}day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E+00	NA	--	--	6.00E-05	NA	--	--
	Arsenic	6.84E+00	3.00E-02	5.09E-07	7.27E-09	3.00E-04	1.50E+00	1.70E-03	1.09E-08
	Cobalt	8.75E+00	NA	--	--	3.00E-04	NA	--	--
	Lead	6.34E+02	NA	--	--	NA	NA	--	--
	Thallium	5.06E-01	NA	--	--	1.00E-05	NA	--	--
	Zinc	2.32E+03	NA	--	--	3.00E-01	NA	--	--
	Aluminum	1.17E+04	NA	--	--	1.00E+00	NA	--	--
	Iron	3.68E+04	NA	--	--	7.00E-01	NA	--	--
	Manganese	1.66E+03	NA	--	--	1.40E-01	NA	--	--
PAHs	Dibenz(a,h)anthracene	4.90E-02	1.30E-01	1.58E-08	2.26E-10	NA	1.00E+00	--	2.26E-10
Cumulative Risk								**1.7E-03**	**1.1E-08**
TPH	TPH Aromatics High	2.00E+03	1.30E-01	6.45E-04	9.21E-06	4.00E-02	NA	1.61E-02	--
	TPH Aromatics Medium	8.90E+01	1.30E-01	2.87E-05	4.10E-07	4.00E-03	NA	7.17E-03	--
TPH Cumulative Risk								**2.3E-02**	**0.0E+00**

Notes:

NA - Not applicable because toxicity value is not available.
CTE = Central Tendency Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-10. Estimates of Cancer and Noncancer Risks for Construction Worker Scenario
RME- Dermal Contact with Soil

RME- Dermal Contact with Soil

Surface Area for Contact=SA	6,032	cm2/event
Adherence Factor=AF	0.80	mg/cm2
Dermal Absorption Fraction=ABS_d	chemical-specific	
Body Weight = BW	80	kg
Exposure Frequency = EF	30	days/yr
Exposure Duration = ED	3	yr
Averaging Time (Noncancer) = AT	1,095	dy
Averaging Time (Cancer) = AT	25,550	dy
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * SA * AF * ABS_d * EF * ED * CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	ABS_d	NCADD (mg/kg-day)	CADD (mg/kg-day)	Dermal RfD (mg/kg-day)	Dermal SF $(mg/kg\text{-}day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E+00	NA	--	--	6.00E-05	NA	--	--
	Arsenic	6.84E+00	3.00E-02	1.02E-06	4.36E-08	3.00E-04	1.50E+00	3.39E-03	6.54E-08
	Cobalt	8.75E+00	NA	--	--	3.00E-04	NA	--	--
	Lead	6.34E+02	NA	--	--	NA	NA	--	--
	Thallium	5.06E-01	NA	--	--	1.00E-05	NA	--	--
	Zinc	2.32E+03	NA	--	--	3.00E-01	NA	--	--
	Aluminum	1.17E+04	NA	--	--	1.00E+00	NA	--	--
	Iron	3.68E+04	NA	--	--	7.00E-01	NA	--	--
	Manganese	1.66E+03	NA	--	--	1.40E-01	NA	--	--
PAHs	Dibenz(a,h)anthracene	4.90E-02	1.30E-01	3.16E-08	1.35E-09	NA	1.00E+00	--	1.35E-09
Cumulative Risk								**3.4E-03**	**6.7E-08**
TPH	TPH Aromatics High	2.00E+03	1.30E-01	1.29E-03	5.52E-05	4.00E-02	NA	3.22E-02	--
	TPH Aromatics Medium	8.90E+01	1.30E-01	5.74E-05	2.46E-06	4.00E-03	NA	1.43E-02	--
TPH Cumulative Risk								**4.7E-02**	**0.0E+00**

Notes:

NA - Not applicable because toxicity value is not available.
RME = Reasonable Maximum Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-11. Estimates of Cancer and Noncancer Risks for Construction Worker Scenario
CTE- Inhalation of Particles from Soil

CTE- Inhalation of Particles from Soil

Exposure Time = ET	8	hr/day
Exposure Frequency = EF	15	days/yr
Exposure Duration = ED	1	yr
Averaging Time (Noncancer) = AT	8,760	hrs
Averaging Time (Cancer) = AT	613,200	hrs
Conversion Factor = CF	1,000	µg/mg

EPC = Exposure concentration (mg/m^3) = EPC * ET * EF * ED / AT

NEC = Exposure Concentration - Noncarcinogens
CEC = Exposure Concentration - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NEC / RfD
Risk = Cancer Risk = CEC * IUR *CF

Chemical of Potential Concern		EPC (mg/m^3)	NEC (mg/m^3)	CEC (mg/m^3)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk (IUR) Factor (µg/m^3)$^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E-06	4.86E-08	6.95E-10	3.0E-04	NA	1.62E-04	--
	Arsenic	6.84E-06	9.37E-08	1.34E-09	1.5E-05	4.3E-03	6.25E-03	5.76E-09
	Cobalt	8.75E-06	1.20E-07	1.71E-09	6.0E-06	9.0E-03	2.00E-02	1.54E-08
	Lead	6.34E-04	8.69E-06	1.24E-07	NA	NA	--	--
	Thallium	5.06E-07	6.93E-09	9.90E-11	NA	NA	--	--
	Zinc	2.32E-03	3.18E-05	4.54E-07	NA	NA	--	--
	Aluminum	1.17E-02	1.60E-04	2.28E-06	5.0E-03	NA	3.20E-02	--
	Iron	3.68E-02	5.04E-04	7.21E-06	NA	NA	--	--
	Manganese	1.66E-03	2.28E-05	3.26E-07	5.0E-05	NA	4.56E-01	--
PAHs	Dibenz(a,h)anthracene	4.90E-08	6.71E-10	9.59E-12	NA	6.0E-04	--	5.75E-12
Cumulative Risk							**5.1E-01**	**2.1E-08**
TPH	TPH Aromatics High	2.00E-03	2.74E-05	3.91E-07	NA	NA	--	--
	TPH Aromatics Medium	8.90E-05	1.22E-06	1.74E-08	3.0E-03	NA	4.1E-04	--
TPH Cumulative Risk							**4.1E-04**	**0.0E+00**

Notes:
NA - Not applicable because toxicity value is not available.
CTE = Central Tendency Exposure
hr/day - hours per day
day/yr - days per year
yr - year
kg - kilogram
µg/mg -micrograms per milligram
mg/kg-day - milligrams per kilogram-day
mg/m^3 - milligrams per cubic meter
(µg/m^3)$^{-1}$ -per microgram per cubic meter

Table B-12. Estimates of Cancer and Noncancer Risks for Construction Worker Scenario
RME- Inhalation of Particles from Soil

RME- Inhalation of Particles from Soil

Exposure Time = ET	10	hr/day
Exposure Frequency = EF	30	days/yr
Exposure Duration = ED	3	yr
Averaging Time (Noncancer) = AT	26,280	hrs
Averaging Time (Cancer) = AT	613,200	hrs
Conversion Factor = CF	1,000	µg/mg

EPC = Exposure concentration (mg/m^3) = EPC * ET * EF * ED / AT

NEC = Exposure Concentration - Noncarcinogens
CEC = Exposure Concentration - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NEC / RfD
Risk = Cancer Risk = CEC * IUR *CF

Chemical of Potential Concern		EPC (mg/m^3)	NEC (mg/m^3)	CEC (mg/m^3)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk (IUR) (µg/m^3)$^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E-06	1.22E-07	5.21E-09	3.0E-04	NA	4.05E-04	--
	Arsenic	6.84E-06	2.34E-07	1.00E-08	1.5E-05	4.3E-03	1.56E-02	4.32E-08
	Cobalt	8.75E-06	3.00E-07	1.28E-08	6.0E-06	9.0E-03	4.99E-02	1.16E-07
	Lead	6.34E-04	2.17E-05	9.31E-07	NA	NA	--	--
	Thallium	5.06E-07	1.73E-08	7.43E-10	NA	NA	--	--
	Zinc	2.32E-03	7.95E-05	3.41E-06	NA	NA	--	--
	Aluminum	1.17E-02	3.99E-04	1.71E-05	5.0E-03	NA	7.99E-02	--
	Iron	3.68E-02	1.26E-03	5.40E-05	NA	NA	--	--
	Manganese	1.66E-03	5.70E-05	2.44E-06	5.0E-05	NA	1.14E+00	--
PAHs	Dibenz(a,h)anthracene	4.90E-08	1.68E-09	7.19E-11	NA	6.0E-04	--	4.32E-11
Cumulative Risk							**1.3E+00**	**1.6E-07**
TPH	TPH Aromatics High	2.00E-03	6.85E-05	2.94E-06	NA	NA	--	--
	TPH Aromatics Medium	8.90E-05	3.05E-06	1.31E-07	3.0E-03	NA	1.02E-03	--
TPH Cumulative Risk							**1.0E-03**	**0.0E+00**

Notes:

NA - Not applicable because toxicity value is not available.
RME = Reasonable Maximum Exposure
hr/day - hours per day
day/yr - days per year
yr - year
kg - kilogram
µg/mg -micrograms per milligram
mg/kg-day - milligrams per kilogram-day
mg/m^3 - milligrams per cubic meter
(µg/m^3)$^{-1}$ -per microgram per cubic meter

Table B-13. Estimates of Cancer and Noncancer Risks for Construction Worker Scenario
CTE- Incidental Ingestion of Subsurface Soil

CTE- Incidental Ingestion of Subsurface Soil

Body Weight = BW	80	kg
Exposure Frequency = EF	15	days/yr
Exposure Duration = ED	1	yr
Averaging Time (Noncancer) = AT	365	dy
Averaging Time (Cancer) = AT	25,550	dy
Ingestion Rate = IR	165	mg/day
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * IR * EF * ED *CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	NCADD (mg/kg-day)	CADD (mg/kg-day)	Chronic Oral RfD (mg/kg-day)	Oral SF $(mg/kg\text{-}day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	1.98E+00	1.68E-07	2.40E-09	4.0E-04	NA	4.19E-04	--
	Arsenic	5.22E+00	4.42E-07	6.32E-09	3.0E-04	1.5E+00	1.47E-03	9.48E-09
	Cadmium	4.16E+00	3.53E-07	5.04E-09	1.0E-03	NA	3.53E-04	--
	Cobalt	5.12E+00	4.34E-07	6.20E-09	3.0E-04	NA	1.45E-03	--
	Lead	9.93E+03	8.42E-04	1.20E-05	NA	NA	--	--
	Mercury	9.17E-01	7.77E-08	1.11E-09	3.0E-04	NA	2.59E-04	--
	Thallium	3.30E-01	2.80E-08	4.00E-10	1.0E-05	NA	2.80E-03	--
	Aluminum	1.12E+04	9.53E-04	1.36E-05	1.0E+00	NA	9.53E-04	--
	Iron	2.51E+04	2.13E-03	3.04E-05	7.0E-01	NA	3.04E-03	--
	Manganese	1.35E+03	1.14E-04	1.63E-06	1.4E-01	NA	8.16E-04	--
PAHs	Dibenz(a,h)anthracene	1.39E-02	1.18E-09	1.68E-11	NA	1.0E+00	--	1.68E-11
Dioxin / Furan	TEQ	1.11E-05	9.44E-13	1.35E-14	7.0E-10	1.3E+05	1.35E-03	1.75E-09
Cumulative Risk							**1.3E-02**	**1.1E-08**
TPH	TPH Aromatics High	1.05E+05	8.90E-03	1.27E-04	4.0E-02	NA	2.22E-01	--
	TPH Aromatics Medium	4.71E+03	3.99E-04	5.70E-06	4.0E-03	NA	9.97E-02	--
TPH Cumulative Risk							**3.E-01**	**0.E+00**
Background Subsurface Soil Risks								
TPH	TPH Aromatics High	3.10E+01	2.63E-06	3.75E-08	4.0E-02	NA	6.57E-05	--
	TPH Aromatics Medium	3.00E+00	2.54E-07	3.63E-09	4.0E-03	NA	6.36E-05	--
TPH Background Cumulative Risk							**1.E-04**	**0.E+00**

<u>**Notes:**</u>

NA - Not applicable because toxicity value is not available.
CTE = Central Tendency Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-14. Estimates of Cancer and Noncancer Risks for ConstructionWorker Scenario
RME- Incidental Ingestion of Subsurface Soil

RME- Incidental Ingestion of Subsurface Soil

Body Weight = BW	80	kg
Exposure Frequency = EF	30	days/yr
Exposure Duration = ED	3	yr
Averaging Time (Noncancer) = AT	1,095	dy
Averaging Time (Cancer) = AT	25,550	dy
Ingestion Rate = IR	330	mg/day
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * IR * EF * ED *CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	NCADD (mg/kg-day)	CADD (mg/kg-day)	Chronic Oral RfD (mg/kg-day)	Oral SF $(mg/kg\text{-}day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	1.98E+00	6.71E-07	2.87E-08	4.0E-04	NA	1.68E-03	--
	Arsenic	5.22E+00	1.77E-06	7.58E-08	3.0E-04	1.5E+00	5.90E-03	1.14E-07
	Cadmium	4.16E+00	1.41E-06	6.05E-08	1.0E-03	NA	1.41E-03	--
	Cobalt	5.12E+00	1.74E-06	7.44E-08	3.0E-04	NA	5.79E-03	--
	Lead	9.93E+03	3.37E-03	1.44E-04	NA	NA	--	--
	Mercury	9.17E-01	3.11E-07	1.33E-08	3.0E-04	NA	1.04E-03	--
	Thallium	3.30E-01	1.12E-07	4.80E-09	1.0E-05	NA	1.12E-02	--
	Aluminum	1.12E+04	3.81E-03	1.63E-04	1.0E+00	NA	3.81E-03	--
	Iron	2.51E+04	8.50E-03	3.64E-04	7.0E-01	NA	1.21E-02	--
	Manganese	1.35E+03	4.57E-04	1.96E-05	1.4E-01	NA	3.26E-03	--
PAHs	Dibenz(a,h)anthracene	1.39E-02	4.71E-09	2.02E-10	NA	1.0E+00	--	2.02E-10
Dioxin / Furan	TEQ	1.11E-05	3.78E-12	1.62E-13	7.0E-10	1.3E+05	5.40E-03	2.10E-08
Cumulative Risk							**5.2E-02**	**1.3E-07**
TPH	TPH Aromatics High	1.05E+05	3.56E-02	1.53E-03	4.0E-02	NA	8.90E-01	--
	TPH Aromatics Medium	4.71E+03	1.60E-03	6.84E-05	4.0E-03	NA	3.99E-01	--
TPH Cumulative Risk							**1.E+00**	**0.E+00**
Background Subsurface Soil Risks								
TPH	**TPH Aromatics High**	3.10E+01	1.05E-05	4.50E-07	4.0E-02	NA	2.63E-04	--
	TPH Aromatics Medium	3.00E+00	1.02E-06	4.36E-08	4.0E-03	NA	2.54E-04	--
TPH Background Cumulative Risk							**5.E-04**	**0.E+00**

Notes:

NA - Not applicable because toxicity value is not available.
RME = Reasonable Maximum Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-15. Estimates of Cancer and Noncancer Risks for Construction Worker Scenario
CTE- Dermal Contact with Subsurface Soil

CTE- Dermal Contact with Subsurface Soil

Surface Area for Contact=SA	6,032	cm2/event
Adherence Factor=AF	0.80	mg/cm2
Dermal Absorption Fraction=ABS_d	chemical-specific	
Body Weight = BW	80	kg
Exposure Frequency = EF	15	days/yr
Exposure Duration = ED	1	yr
Averaging Time (Noncancer) = AT	365	dy
Averaging Time (Cancer) = AT	25,550	dy
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * SA * AF * ABS_d * EF * ED * CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	ABS_d	NCADD (mg/kg-day)	CADD (mg/kg-day)	Dermal RfD (mg/kg-day)	Dermal SF $(mg/kg-day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	1.98E+00	NA	--	--	6.00E-05	NA	--	--
	Arsenic	5.22E+00	3.00E-02	3.88E-07	5.54E-09	3.00E-04	1.50E+00	1.29E-03	8.32E-09
	Cadmium	4.16E+00	1.00E-03	1.03E-08	1.47E-10	2.50E-05	NA	4.13E-04	--
	Cobalt	5.12E+00	NA	--	--	3.00E-04	NA	--	--
	Lead	9.93E+03	NA	--	--	NA	NA	--	--
	Mercury	9.17E-01	NA	--	--	2.10E-05	NA	--	--
	Thallium	3.30E-01	NA	--	--	1.00E-05	NA	--	--
	Aluminum	1.12E+04	NA	--	--	1.00E+00	NA	--	--
	Iron	2.51E+04	NA	--	--	7.00E-01	NA	--	--
	Manganese	1.35E+03	NA	--	--	1.40E-01	NA	--	--
PAHs	Dibenz(a,h)anthracene	1.39E-02	1.30E-01	4.48E-09	6.40E-11	NA	1.00E+00	--	6.40E-11
Dioxin / Furan	TEQ	1.11E-05	3.00E-02	8.28E-13	1.18E-14	7.00E-10	1.30E+05	1.18E-03	1.54E-09
Cumulative Risk								**2.9E-03**	**9.9E-09**
TPH	TPH Aromatics High	1.05E+05	1.30E-01	3.38E-02	4.83E-04	4.00E-02	NA	8.46E-01	--
	TPH Aromatics Medium	4.71E+03	1.30E-01	1.52E-03	2.17E-05	4.00E-03	NA	3.79E-01	--
TPH Cumulative Risk								**1.2E+00**	**0.0E+00**
Background Subsurface Soil Risks									
TPH	TPH Aromatics High	3.10E+01	1.30E-01	9.99E-06	1.43E-07	4.00E-02	NA	2.50E-04	--
	TPH Aromatics Medium	3.00E+00	1.30E-01	9.67E-07	1.38E-08	4.00E-03	NA	2.42E-04	--
TPH Background Cumulative Risk								**4.9E-04**	**0.0E+00**

Notes:

NA - Not applicable because toxicity value is not available.
CTE = Central Tendency Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg-day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-16. Estimates of Cancer and Noncancer Risks for Construction Worker Scenario
RME- Dermal Contact with Subsurface Soil

RME- Dermal Contact with Subsurface Soil

Surface Area for Contact=SA	6,032	cm2/event
Adherence Factor=AF	0.80	mg/cm2
Dermal Absorption Fraction=ABS_d	chemical-specific	
Body Weight = BW	80	kg
Exposure Frequency = EF	30	days/yr
Exposure Duration = ED	3	yr
Averaging Time (Noncancer) = AT	1,095	dy
Averaging Time (Cancer) = AT	25,550	dy
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * SA * AF * ABS_d * EF * ED * CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	ABS_d	NCADD (mg/kg-day)	CADD (mg/kg-day)	Dermal RfD (mg/kg-day)	Dermal SF $(mg/kg\text{-}day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	1.98E+00	NA	--	--	6.00E-05	NA	--	--
	Arsenic	5.22E+00	3.00E-02	7.76E-07	3.33E-08	3.00E-04	1.50E+00	2.59E-03	4.99E-08
	Cadmium	4.16E+00	1.00E-03	2.06E-08	8.85E-10	2.50E-05	NA	8.26E-04	--
	Cobalt	5.12E+00	NA	--	--	3.00E-04	NA	--	--
	Lead	9.93E+03	NA	--	--	NA	NA	--	--
	Mercury	9.17E-01	NA	--	--	2.10E-05	NA	--	--
	Thallium	3.30E-01	NA	--	--	1.00E-05	NA	--	--
	Aluminum	1.12E+04	NA	--	--	1.00E+00	NA	--	--
	Iron	2.51E+04	NA	--	--	7.00E-01	NA	--	--
	Manganese	1.35E+03	NA	--	--	1.40E-01	NA	--	--
PAHs	Dibenz(a,h)anthracene	1.39E-02	1.30E-01	8.96E-09	3.84E-10	NA	1.00E+00	--	3.84E-10
Dioxin / Furan	TEQ	1.11E-05	3.00E-02	1.66E-12	7.10E-14	7.00E-10	1.30E+05	2.37E-03	9.23E-09
Cumulative Risk								**5.8E-03**	**6.0E-08**
TPH	TPH Aromatics High	1.05E+05	1.30E-01	6.77E-02	2.90E-03	4.00E-02	NA	1.69E+00	--
	TPH Aromatics Medium	4.71E+03	1.30E-01	3.03E-03	1.30E-04	4.00E-03	NA	7.58E-01	--
TPH Cumulative Risk								**2.4E+00**	**0.0E+00**
Background Subsurface Soil Risks									
TPH	TPH Aromatics High	3.10E+01	1.30E-01	2.00E-05	8.56E-07	4.00E-02	NA	4.99E-04	--
	TPH Aromatics Medium	3.00E+00	1.30E-01	1.93E-06	8.29E-08	4.00E-03	NA	4.83E-04	--
TPH Background Cumulative Risk								**9.8E-04**	**0.0E+00**

Notes:

NA - Not applicable because toxicity value is not available.
RME = Reasonable Maximum Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-17. Estimates of Cancer and Noncancer Risks for Construction Worker Scenario
CTE- Inhalation of Particles from Subsurface Soil

CTE- Inhalation of Particles from Subsurface Soil

Exposure Time = ET	8	hr/day
Exposure Frequency = EF	15	days/yr
Exposure Duration = ED	1	yr
Averaging Time (Noncancer) = AT	8,760	hrs
Averaging Time (Cancer) = AT	613,200	hrs
Conversion Factor = CF	1,000	µg/mg

Exposure concentration (mg/m^3) = EPC * ET * EF * ED / AT

NEC = Exposure Concentration - Noncarcinogens
CEC = Exposure Concentration - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NEC / RfD
Risk = Cancer Risk = CEC * IUR *CF

Chemical of Potential Concern		EPC (mg/m^3)	NEC (mg/m^3)	CEC (mg/m^3)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk (IUR) Factor (µg/m^3)$^{-1}$	HQ	Cancer Risk
Metals	Antimony	1.98E-06	2.71E-08	3.87E-10	3.0E-04	NA	9.03E-05	--
	Arsenic	5.22E-06	7.15E-08	1.02E-09	1.5E-05	4.3E-03	4.77E-03	4.39E-09
	Cadmium	4.16E-06	5.70E-08	8.15E-10	1.0E-05	1.8E-03	5.70E-03	1.47E-09
	Cobalt	5.12E-06	7.02E-08	1.00E-09	6.0E-06	9.0E-03	1.17E-02	9.02E-09
	Lead	9.93E-03	1.36E-04	1.94E-06	NA	NA	--	--
	Mercury	9.17E-07	1.26E-08	1.79E-10	3.0E-04	NA	4.19E-05	--
	Thallium	3.30E-07	4.52E-09	6.46E-11	NA	NA	--	--
	Aluminum	1.12E-02	1.54E-04	2.20E-06	5.0E-03	NA	3.08E-02	--
	Iron	2.51E-02	3.44E-04	4.91E-06	NA	NA	--	--
	Manganese	1.35E-03	1.85E-05	2.64E-07	5.0E-05	NA	3.69E-01	--
PAHs	Dibenz(a,h)anthracene	1.39E-08	1.90E-10	2.72E-12	NA	6.0E-04	--	1.63E-12
Dioxin / Furan	TEQ	1.11E-11	1.53E-13	2.18E-15	4.0E-08	3.8E+01	3.81E-06	8.28E-11
Cumulative Risk							**4.2E-01**	**1.5E-08**
TPH	TPH Aromatics High	1.05E-01	1.44E-03	2.05E-05	NA	NA	--	--
	TPH Aromatics Medium	4.71E-03	6.45E-05	9.21E-07	3.0E-03	NA	2.1E-02	--
TPH Cumulative Risk							**2.1E-02**	**0.0E+00**
Background Subsurface Soil Risks								
TPH	TPH Aromatics High	3.10E-05	4.25E-07	6.07E-09	NA	NA	--	--
	TPH Aromatics Medium	3.00E-06	4.11E-08	5.87E-10	3.0E-03	NA	1.4E-05	--
TPH Background Cumulative Risk							**1.E-05**	**0.E+00**

Notes:

NA - Not applicable because toxicity value is not available.
CTE = Central Tendency Exposure
hr/day - hours per day
day/yr - days per year
yr - year
kg - kilogram
µg/mg -micrograms per milligram
mg/kg-day - milligrams per kilogram-day
mg/m^3 - milligrams per cubic meter
(µg/m^3)$^{-1}$ -per microgram per cubic meter

Table B-18. Estimates of Cancer and Noncancer Risks for Construction Worker Scenario
RME- Inhalation of Particles from Subsurface Soil

RME- Inhalation of Particles from Subsurface Soil

Exposure Time = ET	10	hr/day
Exposure Frequency = EF	30	days/yr
Exposure Duration = ED	3	yr
Averaging Time (Noncancer) = AT	26,280	hrs
Averaging Time (Cancer) = AT	613,200	hrs
Conversion Factor = CF	1,000	µg/mg

Exposure concentration (mg/m^3) = EPC * ET * EF * ED / AT

NEC = Exposure Concentration - Noncarcinogens
CEC = Exposure Concentration - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NEC / RfD
Risk = Cancer Risk = CEC * IUR *CF

Chemical of Potential Concern		EPC (mg/m^3)	NEC (mg/m^3)	CEC (mg/m^3)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk (IUR) (µg/m^3)$^{-1}$	HQ	Cancer Risk
Metals	Antimony	1.98E-06	6.77E-08	2.90E-09	3.0E-04	NA	2.26E-04	--
	Arsenic	5.22E-06	1.79E-07	7.66E-09	1.5E-05	4.3E-03	1.19E-02	3.29E-08
	Cadmium	4.16E-06	1.43E-07	6.11E-09	1.0E-05	1.8E-03	1.43E-02	1.10E-08
	Cobalt	5.12E-06	1.75E-07	7.52E-09	6.0E-06	9.0E-03	2.92E-02	6.76E-08
	Lead	9.93E-03	3.40E-04	1.46E-05	NA	NA	--	--
	Mercury	9.17E-07	3.14E-08	1.35E-09	3.0E-04	NA	1.05E-04	--
	Thallium	3.30E-07	1.13E-08	4.84E-10	NA	NA	--	--
	Aluminum	1.12E-02	3.85E-04	1.65E-05	5.0E-03	NA	7.70E-02	--
	Iron	2.51E-02	8.59E-04	3.68E-05	NA	NA	--	--
	Manganese	1.35E-03	4.61E-05	1.98E-06	5.0E-05	NA	9.23E-01	--
PAHs	Dibenz(a,h)anthracene	1.39E-08	4.76E-10	2.04E-11	NA	6.0E-04	--	1.22E-11
Dioxin / Furan	TEQ	1.11E-11	3.81E-13	1.63E-14	4.0E-08	3.8E+01	9.54E-06	6.21E-10
Cumulative Risk							**1.E+00**	**1.1E-07**
TPH	TPH Aromatics High	1.05E-01	3.60E-03	1.54E-04	NA	NA	--	--
	TPH Aromatics Medium	4.71E-03	1.61E-04	6.91E-06	3.0E-03	NA	5.37E-02	--
TPH Cumulative Risk							**5.4E-02**	**0.0E+00**
Background Subsurface Soil Risks								
TPH	**TPH Aromatics High**	3.10E-05	1.06E-06	4.55E-08	NA	NA	--	--
	TPH Aromatics Medium	3.00E-06	1.03E-07	4.40E-09	3.0E-03	NA	3.42E-05	--
TPH Background Cumulative Risk							**3.E-05**	**0.E+00**

Notes:

NA - Not applicable because toxicity value is not available.
RME = Reasonable Maximum Exposure
hr/day - hours per day
day/yr - days per year
yr - year
kg - kilogram
µg/mg -micrograms per milligram
mg/kg-day - milligrams per kilogram-day
mg/m^3 - milligrams per cubic meter
(µg/m^3)$^{-1}$ -per microgram per cubic meter

Table B-19. Estimates of Cancer and Noncancer Risks for Adult Visitor Scenario
CTE- Incidental Ingestion of Soil

CTE- Incidental Ingestion of Soil

Body Weight = BW	80	kg
Exposure Frequency = EF	5	days/yr
Exposure Duration = ED	5	yr
Averaging Time (Noncancer) = AT	1,825	dy
Averaging Time (Cancer) = AT	25,550	dy
Ingestion Rate = IR	50	mg/day
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * IR * EF * ED *CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	NCADD (mg/kg-day)	CADD (mg/kg-day)	Chronic Oral RfD (mg/kg-day)	Oral SF $(mg/kg\text{-}day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E+00	3.04E-08	2.17E-09	4.0E-04	NA	7.60E-05	--
	Arsenic	6.84E+00	5.86E-08	4.18E-09	3.0E-04	1.5E+00	1.95E-04	6.27E-09
	Cobalt	8.75E+00	7.49E-08	5.35E-09	3.0E-04	NA	2.50E-04	--
	Lead	6.34E+02	5.43E-06	3.88E-07	NA	NA	--	--
	Thallium	5.06E-01	4.33E-09	3.09E-10	1.0E-05	NA	4.33E-04	--
	Zinc	2.32E+03	1.99E-05	1.42E-06	3.0E-01	NA	6.63E-05	--
	Aluminum	1.17E+04	9.99E-05	7.13E-06	1.0E+00	NA	9.99E-05	--
	Iron	3.68E+04	3.15E-04	2.25E-05	7.0E-01	NA	4.50E-04	--
	Manganese	1.66E+03	1.42E-05	1.02E-06	1.4E-01	NA	1.02E-04	--
PAHs	Dibenz(a,h)anthracene	4.90E-02	4.20E-10	3.00E-11	NA	1.0E+00	--	3.00E-11
Cumulative Risk							**1.7E-03**	**6.3E-09**
TPH	TPH Aromatics High	2.00E+03	1.71E-05	1.22E-06	4.00E-02	NA	4.28E-04	--
	TPH Aromatics Medium	8.90E+01	7.62E-07	5.44E-08	4.00E-03	NA	1.90E-04	--
TPH Cumulative Risk							**6.E-04**	**0.E+00**

Notes:

NA - Not applicable because toxicity value is not available.
CTE = Central Tendency Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-20. Estimates of Cancer and Noncancer Risks for Adult Visitor Scenario
RME- Incidental Ingestion of Soil

RME- Incidental Ingestion of Soil

Body Weight = BW	80	kg
Exposure Frequency = EF	10	days/yr
Exposure Duration = ED	10	yr
Averaging Time (Noncancer) = AT	3,650	dy
Averaging Time (Cancer) = AT	25,550	dy
Ingestion Rate = IR	100	mg/day
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * IR * EF * ED *CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	NCADD (mg/kg-day)	CADD (mg/kg-day)	Chronic Oral RfD (mg/kg-day)	Oral SF $(mg/kg\text{-}day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E+00	1.22E-07	1.74E-08	4.0E-04	NA	3.04E-04	--
	Arsenic	6.84E+00	2.34E-07	3.35E-08	3.0E-04	1.5E+00	7.81E-04	5.02E-08
	Cobalt	8.75E+00	3.00E-07	4.28E-08	3.0E-04	NA	9.98E-04	--
	Lead	6.34E+02	2.17E-05	3.10E-06	NA	NA	--	--
	Thallium	5.06E-01	1.73E-08	2.48E-09	1.0E-05	NA	1.73E-03	--
	Zinc	2.32E+03	7.95E-05	1.14E-05	3.0E-01	NA	2.65E-04	--
	Aluminum	1.17E+04	3.99E-04	5.71E-05	1.0E+00	NA	3.99E-04	--
	Iron	3.68E+04	1.26E-03	1.80E-04	7.0E-01	NA	1.80E-03	--
	Manganese	1.66E+03	5.70E-05	8.14E-06	1.4E-01	NA	4.07E-04	--
PAHs	Dibenz(a,h)anthracene	4.90E-02	1.68E-09	2.40E-10	NA	1.0E+00	--	2.40E-10
Cumulative Risk							**6.7E-03**	**5.0E-08**
TPH	TPH Aromatics High	2.00E+03	6.85E-05	9.78E-06	4.0E-02	NA	1.71E-03	--
	TPH Aromatics Medium	8.90E+01	3.05E-06	4.35E-07	4.0E-03	NA	7.62E-04	--
TPH Cumulative Risk							**2.E-03**	**0.E+00**

Notes:

NA - Not applicable because toxicity value is not available.
RME = Reasonable Maximum Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-21. Estimates of Cancer and Noncancer Risks for Adult Visitor Scenario
CTE- Dermal Contact with Soil

CTE- Dermal Contact with Soil

Surface Area for Contact=SA	2,479	cm2/event
Adherence Factor=AF	0.07	mg/cm2
Dermal Absorption Fraction=ABS_d	chemical-specific	
Body Weight = BW	80	kg
Exposure Frequency = EF	5	days/yr
Exposure Duration = ED	5	yr
Averaging Time (Noncancer) = AT	1,825	dy
Averaging Time (Cancer) = AT	25,550	dy
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * SA * AF * ABS_d * EF * ED * CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	ABS_d	NCADD (mg/kg-day)	CADD (mg/kg-day)	Dermal RfD (mg/kg-day)	Dermal SF $(mg/kg\text{-}day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E+00	NA	--	--	6.00E-05	NA	--	--
	Arsenic	6.84E+00	3.00E-02	6.10E-09	4.36E-10	3.00E-04	1.50E+00	2.03E-05	6.53E-10
	Cobalt	8.75E+00	NA	--	--	3.00E-04	NA	--	--
	Lead	6.34E+02	NA	--	--	NA	NA	--	--
	Thallium	5.06E-01	NA	--	--	1.00E-05	NA	--	--
	Zinc	2.32E+03	NA	--	--	3.00E-01	NA	--	--
	Aluminum	1.17E+04	NA	--	--	1.00E+00	NA	--	--
	Iron	3.68E+04	NA	--	--	7.00E-01	NA	--	--
	Manganese	1.66E+03	NA	--	--	1.40E-01	NA	--	--
PAHs	Dibenz(a,h)anthracene	4.90E-02	1.30E-01	1.89E-10	1.35E-11	NA	1.00E+00	--	1.35E-11
Cumulative Risk								**2.0E-05**	**6.7E-10**
TPH	TPH Aromatics High	2.00E+03	1.30E-01	7.73E-06	5.52E-07	4.00E-02	NA	1.93E-04	--
	TPH Aromatics Medium	8.90E+01	1.30E-01	3.44E-07	2.46E-08	4.00E-03	NA	8.59E-05	--
TPH Cumulative Risk								**2.8E-04**	**0.0E+00**

Notes:

NA - Not applicable because toxicity value is not available.
CTE = Central Tendency Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-22. Estimates of Cancer and Noncancer Risks for Adult Visitor Scenario
RME- Dermal Contact with Soil

RME- Dermal Contact with Soil

Surface Area for Contact=SA	4,849	cm2/event
Adherence Factor=AF	0.07	mg/cm2
Dermal Absorption Fraction=ABS_d	chemical-specific	
Body Weight = BW	80	kg
Exposure Frequency = EF	10	days/yr
Exposure Duration = ED	10	yr
Averaging Time (Noncancer) = AT	3,650	dy
Averaging Time (Cancer) = AT	25,550	dy
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * SA * AF * ABS_d * EF * ED * CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		**EPC (mg/kg)**	**ABS_d**	**NCADD (mg/kg-day)**	**CADD (mg/kg-day)**	**Dermal RfD (mg/kg-day)**	**Dermal SF $(mg/kg\text{-}day)^{-1}$**	**HQ**	**Cancer Risk**
Metals	Antimony	3.55E+00	NA	--	--	6.00E-05	NA	--	--
	Arsenic	6.84E+00	3.00E-02	2.39E-08	3.41E-09	3.00E-04	1.50E+00	7.95E-05	5.11E-09
	Cobalt	8.75E+00	NA	--	--	3.00E-04	NA	--	--
	Lead	6.34E+02	NA	--	--	NA	NA	--	--
	Thallium	5.06E-01	NA	--	--	1.00E-05	NA	--	--
	Zinc	2.32E+03	NA	--	--	3.00E-01	NA	--	--
	Aluminum	1.17E+04	NA	--	--	1.00E+00	NA	--	--
	Iron	3.68E+04	NA	--	--	7.00E-01	NA	--	--
	Manganese	1.66E+03	NA	--	--	1.40E-01	NA	--	--
PAHs	Dibenz(a,h)anthracene	4.90E-02	1.30E-01	7.40E-10	1.06E-10	NA	1.00E+00	--	1.06E-10
Cumulative Risk								**8.0E-05**	**5.2E-09**
TPH	TPH Aromatics High	2.00E+03	1.30E-01	3.02E-05	4.32E-06	4.00E-02	NA	7.56E-04	--
	TPH Aromatics Medium	8.90E+01	1.30E-01	1.34E-06	1.92E-07	4.00E-03	NA	3.36E-04	--
TPH Cumulative Risk								**1.1E-03**	**0.0E+00**

Notes:

NA - Not applicable because toxicity value is not available.
RME = Reasonable Maximum Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-23. Estimates of Cancer and Noncancer Risks for Adult Visitor Scenario
CTE- Inhalation of Particles from Soil

CTE- Inhalation of Particles from Soil

Exposure Time = ET	0.5	hr/day
Exposure Frequency = EF	5	days/yr
Exposure Duration = ED	5	yr
Averaging Time (Noncancer) = AT	43,800	hrs
Averaging Time (Cancer) = AT	613,200	hrs
Conversion Factor = CF	1,000	µg/mg

Exposure concentration (mg/m^3) = EPC * ET * EF * ED / AT

NEC = Exposure Concentration - Noncarcinogens
CEC = Exposure Concentration - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NEC / RfD
Risk = Cancer Risk = CEC * IUR *CF

Chemical of Potential Concern		EPC (mg/m^3)	NEC (mg/m^3)	CEC (mg/m^3)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk (IUR) Factor (µg/m^3)$^{-1}$	HQ	Cancer Risk
Metals	Antimony	2.61E-09	7.45E-13	5.32E-14	3.0E-04	NA	2.48E-09	--
	Arsenic	5.03E-09	1.44E-12	1.03E-13	1.5E-05	4.3E-03	9.57E-08	4.41E-13
	Cobalt	6.43E-09	1.84E-12	1.31E-13	6.0E-06	9.0E-03	3.06E-07	1.18E-12
	Lead	4.66E-07	1.33E-10	9.51E-12	NA	NA	--	--
	Thallium	3.72E-10	1.06E-13	7.58E-15	NA	NA	--	--
	Zinc	1.71E-06	4.87E-10	3.48E-11	NA	NA	--	--
	Aluminum	8.58E-06	2.45E-09	1.75E-10	5.0E-03	NA	4.89E-07	--
	Iron	2.71E-05	7.73E-09	5.52E-10	NA	NA	--	--
	Manganese	1.22E-06	3.49E-10	2.49E-11	5.0E-05	NA	6.98E-06	--
PAHs	Dibenz(a,h)anthracene	3.60E-11	1.03E-14	7.34E-16	NA	6.0E-04	--	4.41E-16
Cumulative Risk							**7.9E-06**	**1.6E-12**
TPH	TPH Aromatics High	2.00E-03	5.71E-07	4.08E-08	NA	NA	--	--
	TPH Aromatics Medium	8.90E-05	2.54E-08	1.81E-09	3.0E-03	NA	8.5E-06	--
TPH Cumulative Risk							**8.5E-06**	**0.0E+00**

Notes:

NA - Not applicable because toxicity value is not available.
CTE = Central Tendency Exposure
hr/day - hours per day
day/yr - days per year
yr - year
kg - kilogram
µg/mg -micrograms per milligram
mg/kg-day - milligrams per kilogram-day
mg/m^3 - milligrams per cubic meter
(µg/m^3)$^{-1}$ -per microgram per cubic meter

Table B-24. Estimates of Cancer and Noncancer Risks for Adult Visitor Scenario
RME- Inhalation of Particles from Soil

RME- Inhalation of Particles from Soil

Exposure Time = ET	2.0	hr/day
Exposure Frequency = EF	10	days/yr
Exposure Duration = ED	10	yr
Averaging Time (Noncancer) = AT	87,600	hrs
Averaging Time (Cancer) = AT	613,200	hrs
Conversion Factor = CF	1,000	µg/mg

Exposure concentration (mg/m^3) = EPC * ET * EF * ED / AT

NEC = Exposure Concentration - Noncarcinogens
CEC = Exposure Concentration - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NEC / RfD
Risk = Cancer Risk = CEC * IUR *CF

Chemical of Potential Concern		EPC (mg/m^3)	NEC (mg/m^3)	CEC (mg/m^3)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk (IUR) ($(\mu g/m^3)^{-1}$)	HQ	Cancer Risk
Metals	Antimony	2.61E-09	5.96E-12	8.51E-13	3.0E-04	NA	1.99E-08	--
	Arsenic	5.03E-09	1.15E-11	1.64E-12	1.5E-05	4.3E-03	7.66E-07	7.05E-12
	Cobalt	6.43E-09	1.47E-11	2.10E-12	6.0E-06	9.0E-03	2.45E-06	1.89E-11
	Lead	4.66E-07	1.06E-09	1.52E-10	NA	NA	--	--
	Thallium	3.72E-10	8.49E-13	1.21E-13	NA	NA	--	--
	Zinc	1.71E-06	3.90E-09	5.57E-10	NA	NA	--	--
	Aluminum	8.58E-06	1.96E-08	2.80E-09	5.0E-03	NA	3.92E-06	--
	Iron	2.71E-05	6.18E-08	8.83E-09	NA	NA	--	--
	Manganese	1.22E-06	2.79E-09	3.99E-10	5.0E-05	NA	5.59E-05	--
PAHs	Dibenz(a,h)anthracene	3.60E-11	8.23E-14	1.18E-14	NA	6.0E-04	--	7.05E-15
Cumulative Risk							**6.3E-05**	**2.6E-11**
TPH	TPH Aromatics High	2.00E-03	4.57E-06	6.52E-07	NA	NA	--	--
	TPH Aromatics Medium	8.90E-05	2.03E-07	2.90E-08	3.0E-03	NA	6.77E-05	--
TPH Cumulative Risk							**6.8E-05**	**0.0E+00**

Notes:

NA - Not applicable because toxicity value is not available.
RME = Reasonable Maximum Exposure
hr/day - hours per day
day/yr - days per year
yr - year
kg - kilogram
µg/mg -micrograms per milligram
mg/kg-day - milligrams per kilogram-day
mg/m^3 - milligrams per cubic meter
$(\mu g/m^3)^{-1}$ -per microgram per cubic meter

Table B-25. Estimates of Cancer and Noncancer Risks for Young Child Visitor Scenario
CTE- Incidental Ingestion of Soil

CTE- Incidental Ingestion of Soil

Body Weight = BW	15	kg
Exposure Frequency = EF	1	days/yr
Exposure Duration = ED	2	yr
Averaging Time (Noncancer) = AT	730	dy
Averaging Time (Cancer) = AT	25,550	dy
Ingestion Rate = IR	100	mg/day
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * IR * EF * ED *CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	NCADD (mg/kg-day)	CADD (mg/kg-day)	Chronic Oral RfD (mg/kg-day)	Oral SF $(mg/kg\text{-}day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E+00	6.48E-08	1.85E-09	4.0E-04	NA	1.62E-04	--
	Arsenic	6.84E+00	1.25E-07	3.57E-09	3.0E-04	1.5E+00	4.16E-04	5.35E-09
	Cobalt	8.75E+00	1.60E-07	4.56E-09	3.0E-04	NA	5.32E-04	--
	Lead	6.34E+02	1.16E-05	3.31E-07	NA	NA	--	--
	Thallium	5.06E-01	9.24E-09	2.64E-10	1.0E-05	NA	9.24E-04	--
	Zinc	2.32E+03	4.24E-05	1.21E-06	3.0E-01	NA	1.41E-04	--
	Aluminum	1.17E+04	2.13E-04	6.09E-06	1.0E+00	NA	2.13E-04	--
	Iron	3.68E+04	6.72E-04	1.92E-05	7.0E-01	NA	9.61E-04	--
	Manganese	1.66E+03	3.04E-05	8.68E-07	1.4E-01	NA	2.17E-04	--
PAHs	Dibenz(a,h)anthracene	4.90E-02	8.95E-10	2.56E-11	NA	1.0E+00	--	2.56E-11
Cumulative Risk							**3.6E-03**	**5.4E-09**
TPH	TPH Aromatics High	2.00E+03	3.65E-05	1.04E-06	4.00E-02	NA	9.13E-04	--
	TPH Aromatics Medium	8.90E+01	1.63E-06	4.64E-08	4.00E-03	NA	4.06E-04	--
TPH Cumulative Risk							**1.E-03**	**0.E+00**

Notes:

NA - Not applicable because toxicity value is not available.
CTE = Central Tendency Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-26. Estimates of Cancer and Noncancer Risks for Child Visitor Scenario
RME- Incidental Ingestion of Soil

RME- Incidental Ingestion of Soil

Body Weight = BW	15	kg
Exposure Frequency = EF	2	days/yr
Exposure Duration = ED	6	yr
Averaging Time (Noncancer) = AT	2,190	dy
Averaging Time (Cancer) = AT	25,550	dy
Ingestion Rate = IR	200	mg/day
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * IR * EF * ED *CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	NCADD (mg/kg-day)	CADD (mg/kg-day)	Chronic Oral RfD (mg/kg-day)	Oral SF $(mg/kg\text{-}day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E+00	2.59E-07	2.22E-08	4.0E-04	NA	6.48E-04	--
	Arsenic	6.84E+00	5.00E-07	4.28E-08	3.0E-04	1.5E+00	1.67E-03	6.43E-08
	Cobalt	8.75E+00	6.39E-07	5.48E-08	3.0E-04	NA	2.13E-03	--
	Lead	6.34E+02	4.63E-05	3.97E-06	NA	NA	--	--
	Thallium	5.06E-01	3.70E-08	3.17E-09	1.0E-05	NA	3.70E-03	--
	Zinc	2.32E+03	1.70E-04	1.45E-05	3.0E-01	NA	5.65E-04	--
	Aluminum	1.17E+04	8.52E-04	7.30E-05	1.0E+00	NA	8.52E-04	--
	Iron	3.68E+04	2.69E-03	2.31E-04	7.0E-01	NA	3.84E-03	--
	Manganese	1.66E+03	1.22E-04	1.04E-05	1.4E-01	NA	8.68E-04	--
PAHs	Dibenz(a,h)anthracene	4.90E-02	3.58E-09	3.07E-10	NA	1.0E+00	--	3.07E-10
Cumulative Risk							**1.4E-02**	**6.5E-08**
TPH	TPH Aromatics High	2.00E+03	1.46E-04	1.25E-05	4.0E-02	NA	3.65E-03	--
	TPH Aromatics Medium	8.90E+01	6.50E-06	5.57E-07	4.0E-03	NA	1.63E-03	--
TPH Cumulative Risk							**5.E-03**	**0.E+00**

Notes:

NA - Not applicable because toxicity value is not available.
RME = Reasonable Maximum Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-27. Estimates of Cancer and Noncancer Risks for Young Child Visitor Scenario
CTE- Dermal Contact with Soil

CTE- Dermal Contact with Soil

Surface Area for Contact=SA	1,558	cm2/event
Adherence Factor=AF	0.20	mg/cm2
Dermal Absorption Fraction=ABS_d	chemical-specific	
Body Weight = BW	15	kg
Exposure Frequency = EF	1	days/yr
Exposure Duration = ED	2	yr
Averaging Time (Noncancer) = AT	730	dy
Averaging Time (Cancer) = AT	25,550	dy
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * SA * AF * ABS_d * EF * ED * CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	ABS_d	NCADD (mg/kg-day)	CADD (mg/kg-day)	Dermal RfD (mg/kg-day)	Dermal SF $(mg/kg\text{-}day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E+00	NA	--	--	6.00E-05	NA	--	--
	Arsenic	6.84E+00	3.00E-02	1.17E-08	3.34E-10	3.00E-04	1.50E+00	3.89E-05	5.01E-10
	Cobalt	8.75E+00	NA	--	--	3.00E-04	NA	--	--
	Lead	6.34E+02	NA	--	--	NA	NA	--	--
	Thallium	5.06E-01	NA	--	--	1.00E-05	NA	--	--
	Zinc	2.32E+03	NA	--	--	3.00E-01	NA	--	--
	Aluminum	1.17E+04	NA	--	--	1.00E+00	NA	--	--
	Iron	3.68E+04	NA	--	--	7.00E-01	NA	--	--
	Manganese	1.66E+03	NA	--	--	1.40E-01	NA	--	--
PAHs	Dibenz(a,h)anthracene	4.90E-02	1.30E-01	3.63E-10	1.04E-11	NA	1.00E+00	--	1.04E-11
Cumulative Risk								**3.9E-05**	**5.1E-10**
TPH	TPH Aromatics High	2.00E+03	1.30E-01	1.48E-05	4.23E-07	4.00E-02	NA	3.70E-04	--
	TPH Aromatics Medium	8.90E+01	1.30E-01	6.58E-07	1.88E-08	4.00E-03	NA	1.65E-04	--
TPH Cumulative Risk								**5.3E-04**	**0.0E+00**

Notes:

NA - Not applicable because toxicity value is not available.
CTE = Central Tendency Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-28. Estimates of Cancer and Noncancer Risks for Young Child Visitor Scenario
RME- Dermal Contact with Soil

RME- Dermal Contact with Soil

Surface Area for Contact=SA	2,208	cm2/event
Adherence Factor=AF	0.20	mg/cm2
Dermal Absorption Fraction=ABS_d	chemical-specific	
Body Weight = BW	15	kg
Exposure Frequency = EF	2	days/yr
Exposure Duration = ED	6	yr
Averaging Time (Noncancer) = AT	2,190	dy
Averaging Time (Cancer) = AT	25,550	dy
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * SA * AF * ABS_d * EF * ED * CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	ABS_d	NCADD (mg/kg-day)	CADD (mg/kg-day)	Dermal RfD (mg/kg-day)	Dermal SF $(mg/kg\text{-}day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E+00	NA	--	--	6.00E-05	NA	--	--
	Arsenic	6.84E+00	3.00E-02	3.31E-08	2.84E-09	3.00E-04	1.50E+00	1.10E-04	4.26E-09
	Cobalt	8.75E+00	NA	--	--	3.00E-04	NA	--	--
	Lead	6.34E+02	NA	--	--	NA	NA	--	--
	Thallium	5.06E-01	NA	--	--	1.00E-05	NA	--	--
	Zinc	2.32E+03	NA	--	--	3.00E-01	NA	--	--
	Aluminum	1.17E+04	NA	--	--	1.00E+00	NA	--	--
	Iron	3.68E+04	NA	--	--	7.00E-01	NA	--	--
	Manganese	1.66E+03	NA	--	--	1.40E-01	NA	--	--
PAHs	Dibenz(a,h)anthracene	4.90E-02	1.30E-01	1.03E-09	8.81E-11	NA	1.00E+00	--	8.81E-11
Cumulative Risk								**1.1E-04**	**4.3E-09**
TPH	TPH Aromatics High	2.00E+03	1.30E-01	4.19E-05	3.60E-06	4.00E-02	NA	1.05E-03	--
	TPH Aromatics Medium	8.90E+01	1.30E-01	1.87E-06	1.60E-07	4.00E-03	NA	4.67E-04	--
TPH Cumulative Risk								**1.5E-03**	**0.0E+00**

Notes:
NA - Not applicable because toxicity value is not available.
RME = Reasonable Maximum Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-29. Estimates of Cancer and Noncancer Risks for Young Child Visitor Scenario
CTE- Inhalation of Particles from Soil

CTE- Inhalation of Particles from Soil

Exposure Time = ET	0.5	hr/day
Exposure Frequency = EF	1	days/yr
Exposure Duration = ED	2	yr
Averaging Time (Noncancer) = AT	17,520	hrs
Averaging Time (Cancer) = AT	613,200	hrs
Conversion Factor = CF	1,000	µg/mg

Exposure concentration (mg/m^3) = EPC * ET * EF * ED / AT

NEC = Exposure Concentration - Noncarcinogens
CEC = Exposure Concentration - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NEC / RfD
Risk = Cancer Risk = CEC * IUR *CF

Chemical of Potential Concern		EPC (mg/m^3)	NEC (mg/m^3)	CEC (mg/m^3)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk (IUR) Factor (µg/m^3)$^{-1}$	HQ	Cancer Risk
Metals	Antimony	2.61E-09	1.49E-13	4.26E-15	3.0E-04	NA	4.96E-10	--
	Arsenic	5.03E-09	2.87E-13	8.20E-15	1.5E-05	4.3E-03	1.91E-08	3.53E-14
	Cobalt	6.43E-09	3.67E-13	1.05E-14	6.0E-06	9.0E-03	6.12E-08	9.44E-14
	Lead	4.66E-07	2.66E-11	7.61E-13	NA	NA	--	--
	Thallium	3.72E-10	2.12E-14	6.07E-16	NA	NA	--	--
	Zinc	1.71E-06	9.75E-11	2.78E-12	NA	NA	--	--
	Aluminum	8.58E-06	4.89E-10	1.40E-11	5.0E-03	NA	9.79E-08	--
	Iron	2.71E-05	1.55E-09	4.41E-11	NA	NA	--	--
	Manganese	1.22E-06	6.98E-11	2.00E-12	5.0E-05	NA	1.40E-06	--
PAHs	Dibenz(a,h)anthracene	3.60E-11	2.06E-15	5.88E-17	NA	6.0E-04	--	3.53E-17
Cumulative Risk							**1.6E-06**	**1.3E-13**
TPH	TPH Aromatics High	2.00E-03	1.14E-07	3.26E-09	NA	NA	--	--
	TPH Aromatics Medium	8.90E-05	5.08E-09	1.45E-10	3.0E-03	NA	1.7E-06	--
TPH Cumulative Risk							**1.7E-06**	**0.0E+00**

Notes:
NA - Not applicable because toxicity value is not available.
CTE = Central Tendency Exposure
hr/day - hours per day
day/yr - days per year
yr - year
kg - kilogram
µg/mg -micrograms per milligram
mg/kg-day - milligrams per kilogram-day
mg/m^3 - milligrams per cubic meter
(µg/m^3)$^{-1}$ -per microgram per cubic meter

Table B-30. Estimates of Cancer and Noncancer Risks for Young Child Visitor Scenario
RME- Inhalation of Particles from Soil

RME- Inhalation of Particles from Soil

Exposure Time = ET	2.0	hr/day
Exposure Frequency = EF	2	days/yr
Exposure Duration = ED	6	yr
Averaging Time (Noncancer) = AT	52,560	hrs
Averaging Time (Cancer) = AT	613,200	hrs
Conversion Factor = CF	1,000	µg/mg

Exposure concentration (mg/m^3) = EPC * ET * EF * ED / AT

NEC = Exposure Concentration - Noncarcinogens
CEC = Exposure Concentration - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NEC / RfD
Risk = Cancer Risk = CEC * IUR *CF

Chemical of Potential Concern		EPC (mg/m^3)	NEC (mg/m^3)	CEC (mg/m^3)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk (IUR) ($(\mu g/m^3)^{-1}$)	HQ	Cancer Risk
Metals	Antimony	2.61E-09	1.19E-12	1.02E-13	3.0E-04	NA	3.97E-09	--
	Arsenic	5.03E-09	2.30E-12	1.97E-13	1.5E-05	4.3E-03	1.53E-07	8.46E-13
	Cobalt	6.43E-09	2.94E-12	2.52E-13	6.0E-06	9.0E-03	4.89E-07	2.27E-12
	Lead	4.66E-07	2.13E-10	1.83E-11	NA	NA	--	--
	Thallium	3.72E-10	1.70E-13	1.46E-14	NA	NA	--	--
	Zinc	1.71E-06	7.80E-10	6.68E-11	NA	NA	--	--
	Aluminum	8.58E-06	3.92E-09	3.36E-10	5.0E-03	NA	7.83E-07	--
	Iron	2.71E-05	1.24E-08	1.06E-09	NA	NA	--	--
	Manganese	1.22E-06	5.59E-10	4.79E-11	5.0E-05	NA	1.12E-05	--
PAHs	Dibenz(a,h)anthracene	3.60E-11	1.65E-14	1.41E-15	NA	6.0E-04	--	8.46E-16
Cumulative Risk							**1.3E-05**	**3.1E-12**
TPH	TPH Aromatics High	2.00E-03	9.13E-07	7.83E-08	NA	NA	--	--
	TPH Aromatics Medium	8.90E-05	4.06E-08	3.48E-09	3.0E-03	NA	1.35E-05	--
TPH Cumulative Risk							**1.4E-05**	**0.0E+00**

Notes:

NA - Not applicable because toxicity value is not available.
RME = Reasonable Maximum Exposure
hr/day - hours per day
day/yr - days per year
yr - year
kg - kilogram
µg/mg -micrograms per milligram
mg/kg-day - milligrams per kilogram-day
mg/m^3 - milligrams per cubic meter
$(\mu g/m^3)^{-1}$ -per microgram per cubic meter

Table B-31. Estimates of Cancer and Noncancer Risks for Older Child Visitor Scenario
CTE- Incidental Ingestion of Soil

CTE- Incidental Ingestion of Soil

Body Weight = BW	44	kg
Exposure Frequency = EF	5	days/yr
Exposure Duration = ED	5	yr
Averaging Time (Noncancer) = AT	1,825	dy
Averaging Time (Cancer) = AT	25,550	dy
Ingestion Rate = IR	50	mg/day
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * IR * EF * ED *CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	NCADD (mg/kg-day)	CADD (mg/kg-day)	Chronic Oral RfD (mg/kg-day)	Oral SF $(mg/kg-day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E+00	5.52E-08	3.95E-09	4.0E-04	NA	1.38E-04	--
	Arsenic	6.84E+00	1.06E-07	7.61E-09	3.0E-04	1.5E+00	3.55E-04	1.14E-08
	Cobalt	8.75E+00	1.36E-07	9.72E-09	3.0E-04	NA	4.54E-04	--
	Lead	6.34E+02	9.87E-06	7.05E-07	NA	NA	--	--
	Thallium	5.06E-01	7.88E-09	5.63E-10	1.0E-05	NA	7.88E-04	--
	Zinc	2.32E+03	3.61E-05	2.58E-06	3.0E-01	NA	1.20E-04	--
	Aluminum	1.17E+04	1.82E-04	1.30E-05	1.0E+00	NA	1.82E-04	--
	Iron	3.68E+04	5.73E-04	4.09E-05	7.0E-01	NA	8.19E-04	--
	Manganese	1.66E+03	2.59E-05	1.85E-06	1.4E-01	NA	1.85E-04	--
PAHs	Dibenz(a,h)anthracene	4.90E-02	7.63E-10	5.45E-11	NA	1.0E+00	--	5.45E-11
Cumulative Risk							**3.0E-03**	**1.1E-08**
TPH	TPH Aromatics High	2.00E+03	3.11E-05	2.22E-06	4.00E-02	NA	7.78E-04	--
	TPH Aromatics Medium	8.90E+01	1.39E-06	9.90E-08	4.00E-03	NA	3.46E-04	--
TPH Cumulative Risk							**1.E-03**	**0.E+00**

Notes:

NA - Not applicable because toxicity value is not available.
CTE = Central Tendency Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg-day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-32. Estimates of Cancer and Noncancer Risks for Older Child Visitor Scenario
RME- Incidental Ingestion of Soil

RME- Incidental Ingestion of Soil

Body Weight = BW	44	kg
Exposure Frequency = EF	10	days/yr
Exposure Duration = ED	10	yr
Averaging Time (Noncancer) = AT	3,650	dy
Averaging Time (Cancer) = AT	25,550	dy
Ingestion Rate = IR	100	mg/day
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * IR * EF * ED *CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens

CADD = Average Daily Dose - Carcinogens

HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD

Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	NCADD (mg/kg-day)	CADD (mg/kg-day)	Chronic Oral RfD (mg/kg-day)	Oral SF $(mg/kg\text{-}day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E+00	2.21E-07	3.16E-08	4.0E-04	NA	5.52E-04	--
	Arsenic	6.84E+00	4.26E-07	6.08E-08	3.0E-04	1.5E+00	1.42E-03	9.13E-08
	Cobalt	8.75E+00	5.45E-07	7.78E-08	3.0E-04	NA	1.82E-03	--
	Lead	6.34E+02	3.95E-05	5.64E-06	NA	NA	--	--
	Thallium	5.06E-01	3.15E-08	4.50E-09	1.0E-05	NA	3.15E-03	--
	Zinc	2.32E+03	1.45E-04	2.07E-05	3.0E-01	NA	4.82E-04	--
	Aluminum	1.17E+04	7.26E-04	1.04E-04	1.0E+00	NA	7.26E-04	--
	Iron	3.68E+04	2.29E-03	3.28E-04	7.0E-01	NA	3.28E-03	--
	Manganese	1.66E+03	1.04E-04	1.48E-05	1.4E-01	NA	7.40E-04	--
PAHs	Dibenz(a,h)anthracene	4.90E-02	3.05E-09	4.36E-10	NA	1.0E+00	--	4.36E-10
Cumulative Risk							**1.2E-02**	**9.2E-08**
TPH	TPH Aromatics High	2.00E+03	1.25E-04	1.78E-05	4.0E-02	NA	3.11E-03	--
	TPH Aromatics Medium	8.90E+01	5.54E-06	7.92E-07	4.0E-03	NA	1.39E-03	--
TPH Cumulative Risk							**4.E-03**	**0.E+00**

Notes:

NA - Not applicable because toxicity value is not available.

RME = Reasonable Maximum Exposure

yr - year

kg - kilograms

kg/mg - kilograms per milligrams

mg/kg-day - milligrams per kilogram-day

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

mg/kg - milligrams per kilogram

Table B-33. Estimates of Cancer and Noncancer Risks for Older Child Visitor Scenario
CTE- Dermal Contact with Soil

CTE- Dermal Contact with Soil

Surface Area for Contact=SA	2,479	cm2/event
Adherence Factor=AF	0.07	mg/cm2
Dermal Absorption Fraction=ABS_d	chemical-specific	
Body Weight = BW	44	kg
Exposure Frequency = EF	5	days/yr
Exposure Duration = ED	5	yr
Averaging Time (Noncancer) = AT	1,825	dy
Averaging Time (Cancer) = AT	25,550	dy
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * SA * AF * ABS_d * EF * ED * CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	ABS_d	NCADD (mg/kg-day)	CADD (mg/kg-day)	Dermal RfD (mg/kg-day)	Dermal SF $(mg/kg\text{-}day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E+00	NA	--	--	6.00E-05	NA	--	--
	Arsenic	6.84E+00	3.00E-02	1.11E-08	7.92E-10	3.00E-04	1.50E+00	3.70E-05	1.19E-09
	Cobalt	8.75E+00	NA	--	--	3.00E-04	NA	--	--
	Lead	6.34E+02	NA	--	--	NA	NA	--	--
	Thallium	5.06E-01	NA	--	--	1.00E-05	NA	--	--
	Zinc	2.32E+03	NA	--	--	3.00E-01	NA	--	--
	Aluminum	1.17E+04	NA	--	--	1.00E+00	NA	--	--
	Iron	3.68E+04	NA	--	--	7.00E-01	NA	--	--
	Manganese	1.66E+03	NA	--	--	1.40E-01	NA	--	--
PAHs	Dibenz(a,h)anthracene	4.90E-02	1.30E-01	3.44E-10	2.46E-11	NA	1.00E+00	--	2.46E-11
Cumulative Risk								**3.7E-05**	**1.2E-09**
TPH	TPH Aromatics High	2.00E+03	1.30E-01	1.40E-05	1.00E-06	4.00E-02	NA	3.51E-04	--
	TPH Aromatics Medium	8.90E+01	1.30E-01	6.25E-07	4.46E-08	4.00E-03	NA	1.56E-04	--
TPH Cumulative Risk								**5.1E-04**	**0.0E+00**

Notes:

NA - Not applicable because toxicity value is not available.
CTE = Central Tendency Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-34. Estimates of Cancer and Noncancer Risks for Older Child Visitor Scenario
RME- Dermal Contact with Soil

RME- Dermal Contact with Soil

Surface Area for Contact=SA	4,849	cm2/event
Adherence Factor=AF	0.07	mg/cm2
Dermal Absorption Fraction=ABS_d	chemical-specific	
Body Weight = BW	44	kg
Exposure Frequency = EF	10	days/yr
Exposure Duration = ED	10	yr
Averaging Time (Noncancer) = AT	3,650	dy
Averaging Time (Cancer) = AT	25,550	dy
Conversion Factor = CF	1.E-06	kg/mg

Intake (mg/kg-day) = Conc * SA * AF * ABS_d * EF * ED * CF / (BW * AT)

NCADD = Average Daily Dose - Noncarcinogens
CADD = Average Daily Dose - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NCADD/ RfD
Risk = Cancer Risk = CADD * SF

Chemical of Potential Concern		EPC (mg/kg)	ABS_d	NCADD (mg/kg-day)	CADD (mg/kg-day)	Dermal RfD (mg/kg-day)	Dermal SF $(mg/kg\text{-}day)^{-1}$	HQ	Cancer Risk
Metals	Antimony	3.55E+00	NA	--	--	6.00E-05	NA	--	--
	Arsenic	6.84E+00	3.00E-02	4.34E-08	6.20E-09	3.00E-04	1.50E+00	1.45E-04	9.29E-09
	Cobalt	8.75E+00	NA	--	--	3.00E-04	NA	--	--
	Lead	6.34E+02	NA	--	--	NA	NA	--	--
	Thallium	5.06E-01	NA	--	--	1.00E-05	NA	--	--
	Zinc	2.32E+03	NA	--	--	3.00E-01	NA	--	--
	Aluminum	1.17E+04	NA	--	--	1.00E+00	NA	--	--
	Iron	3.68E+04	NA	--	--	7.00E-01	NA	--	--
	Manganese	1.66E+03	NA	--	--	1.40E-01	NA	--	--
PAHs	Dibenz(a,h)anthracene	4.90E-02	1.30E-01	1.35E-09	1.92E-10	NA	1.00E+00	--	1.92E-10
Cumulative Risk								**1.4E-04**	**9.5E-09**
TPH	TPH Aromatics High	2.00E+03	1.30E-01	5.50E-05	7.85E-06	4.00E-02	NA	1.37E-03	--
	TPH Aromatics Medium	8.90E+01	1.30E-01	2.45E-06	3.49E-07	4.00E-03	NA	6.11E-04	--
TPH Cumulative Risk								**2.0E-03**	**0.0E+00**

Notes:

NA - Not applicable because toxicity value is not available.
RME = Reasonable Maximum Exposure
yr - year
kg - kilograms
kg/mg - kilograms per milligrams
mg/kg-day - milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$ - per milligrams per kilogram-day
mg/kg - milligrams per kilogram

Table B-35. Estimates of Cancer and Noncancer Risks for Older Child Visitor Scenario
CTE- Inhalation of Particles from Soil

CTE- Inhalation of Particles from Soil

Exposure Time = ET	0.5	hr/day
Exposure Frequency = EF	5	days/yr
Exposure Duration = ED	5	yr
Averaging Time (Noncancer) = AT	43,800	hrs
Averaging Time (Cancer) = AT	613,200	hrs
Conversion Factor = CF	1,000	µg/mg

Exposure concentration (mg/m^3) = EPC * ET * EF * ED / AT

NEC = Exposure Concentration - Noncarcinogens
CEC = Exposure Concentration - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NEC / RfD
Risk = Cancer Risk = CEC * IUR *CF

Chemical of Potential Concern		EPC (mg/m^3)	NEC (mg/m^3)	CEC (mg/m^3)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk (IUR) Factor (µg/m^3)$^{-1}$	HQ	Cancer Risk
Metals	Antimony	2.61E-09	7.45E-13	5.32E-14	3.0E-04	NA	2.48E-09	--
	Arsenic	5.03E-09	1.44E-12	1.03E-13	1.5E-05	4.3E-03	9.57E-08	4.41E-13
	Cobalt	6.43E-09	1.84E-12	1.31E-13	6.0E-06	9.0E-03	3.06E-07	1.18E-12
	Lead	4.66E-07	1.33E-10	9.51E-12	NA	NA	--	--
	Thallium	3.72E-10	1.06E-13	7.58E-15	NA	NA	--	--
	Zinc	1.71E-06	4.87E-10	3.48E-11	NA	NA	--	--
	Aluminum	8.58E-06	2.45E-09	1.75E-10	5.0E-03	NA	4.89E-07	--
	Iron	2.71E-05	7.73E-09	5.52E-10	NA	NA	--	--
	Manganese	1.22E-06	3.49E-10	2.49E-11	5.0E-05	NA	6.98E-06	--
PAHs	Dibenz(a,h)anthracene	3.60E-11	1.03E-14	7.34E-16	NA	6.0E-04	--	4.41E-16
Cumulative Risk							**7.9E-06**	**1.6E-12**
TPH	TPH Aromatics High	2.00E-03	5.71E-07	4.08E-08	NA	NA	--	--
	TPH Aromatics Medium	8.90E-05	2.54E-08	1.81E-09	3.0E-03	NA	8.5E-06	--
TPH Cumulative Risk							**8.5E-06**	**0.0E+00**

Notes:
NA - Not applicable because toxicity value is not available.
CTE = Central Tendency Exposure
hr/day - hours per day
day/yr - days per year
yr - year
kg - kilogram
µg/mg -micrograms per milligram
mg/kg-day - milligrams per kilogram-day
mg/m^3 - milligrams per cubic meter
(µg/m^3)$^{-1}$ -per microgram per cubic meter

Table B-36. Estimates of Cancer and Noncancer Risks for Older Child Visitor Scenario
RME- Inhalation of Particles from Soil

RME- Inhalation of Particles from Soil

Exposure Time = ET	2.0	hr/day
Exposure Frequency = EF	10	days/yr
Exposure Duration = ED	10	yr
Averaging Time (Noncancer) = AT	87,600	hrs
Averaging Time (Cancer) = AT	613,200	hrs
Conversion Factor = CF	1,000	µg/mg

Exposure concentration (mg/m^3) = EPC * ET * EF * ED / AT

NEC = Exposure Concentration - Noncarcinogens
CEC = Exposure Concentration - Carcinogens
HQ = Hazard Quotient, Noncarcinogens = NEC / RfD
Risk = Cancer Risk = CEC * IUR *CF

Chemical of Potential Concern		EPC (mg/m^3)	NEC (mg/m^3)	CEC (mg/m^3)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk (IUR) (µg/m^3)$^{-1}$	HQ	Cancer Risk
Metals	Antimony	2.61E-09	5.96E-12	8.51E-13	3.0E-04	NA	1.99E-08	--
	Arsenic	5.03E-09	1.15E-11	1.64E-12	1.5E-05	4.3E-03	7.66E-07	7.05E-12
	Cobalt	6.43E-09	1.47E-11	2.10E-12	6.0E-06	9.0E-03	2.45E-06	1.89E-11
	Lead	4.66E-07	1.06E-09	1.52E-10	NA	NA	--	--
	Thallium	3.72E-10	8.49E-13	1.21E-13	NA	NA	--	--
	Zinc	1.71E-06	3.90E-09	5.57E-10	NA	NA	--	--
	Aluminum	8.58E-06	1.96E-08	2.80E-09	5.0E-03	NA	3.92E-06	--
	Iron	2.71E-05	6.18E-08	8.83E-09	NA	NA	--	--
	Manganese	1.22E-06	2.79E-09	3.99E-10	5.0E-05	NA	5.59E-05	--
PAHs	Dibenz(a,h)anthracene	3.60E-11	8.23E-14	1.18E-14	NA	6.0E-04	--	7.05E-15
Cumulative Risk							**6.3E-05**	**2.6E-11**
TPH	TPH Aromatics High	2.00E-03	4.57E-06	6.52E-07	NA	NA	--	--
	TPH Aromatics Medium	8.90E-05	2.03E-07	2.90E-08	3.0E-03	NA	6.77E-05	--
TPH Cumulative Risk							**6.8E-05**	**0.0E+00**

Notes:

NA - Not applicable because toxicity value is not available.
RME = Reasonable Maximum Exposure
hr/day - hours per day
day/yr - days per year
yr - year
kg - kilogram
µg/mg -micrograms per milligram
mg/kg-day - milligrams per kilogram-day
mg/m^3 - milligrams per cubic meter
(µg/m^3)$^{-1}$ -per microgram per cubic meter

Appendix C – Selection of Chemicals of Potential Ecological Concern

Attachment C-1. COPEC Selection - Surface Soil

Chemical Group	Preliminary COPEC	CASRN	Maximum Surface Soil Conc. (mg/kg)	SLERA COPEC ESV Plants/Inverts (mg/kg)	SLERA COPEC ESV Birds/Mammals (mg/kg)	Max/ESV Plants/Inverts	Max/ESV Birds/Mammals	Plants/Inverts COPEC	Birds/Mammals COPEC
Metals	Antimony	7440-36-0	4.63	5.0	0.248	0.9	19	--	Antimony
	Arsenic	7440-38-2	7.37	6.8	0.25	1.1	29	Arsenic	Arsenic
	Barium	7440-39-3	918	110	17.2	8.3	53	Barium	Barium
	Beryllium	7440-41-7	0.22	2.5	2.42	0.1	0.1	--	--
	Cadmium	7440-43-9	6.78	4.0	0.27	1.7	25	Cadmium	Cadmium
	Chromium, Total	7440-47-3	23.6	0.34	23	69	1.0	Chromium, Total	Chromium, Total
	Cobalt	7440-48-4	9.24	13	76	0.7	0.1	--	--
	Copper	7440-50-8	198	50	14	4.0	14	Copper	Copper
	Lead	7439-92-1	689	50	0.94	14	733	Lead	Lead
	Mercury	7439-97-6	0.75	0.050	0.013	15	57	Mercury	Mercury
	Molybdenum	7439-98-7	2.22	2.0	0.52	1.1	4.3	Molybdenum	Molybdenum
	Nickel	7440-02-0	27.9	30	10	0.9	2.8	--	Nickel
	Selenium	7782-49-2	0.20	0.52	0.331	0.4	0.6	--	--
	Silver	7440-22-4	1.07	2.0	2.6	0.5	0.4	--	--
	Thallium	7440-28-0	0.567	0.050	0.027	11	21	Thallium	Thallium
	Vanadium	7440-62-2	37.4	2.0	0.714	19	52	Vanadium	Vanadium
	Zinc	7440-66-6	2420	6.6	12	366	202	Zinc	Zinc
	Hexavalent Chromium	18540-29-9	NS	--	--	--	--	--	--
	Aluminum	7429-90-5	12000	50	[f]	240.0	NA	Aluminum	--
	Iron	7429-90-5	40200	No ESV	[g]	NA	NA	--	--
	Manganese	7439-89-6	1900	220	322	8.6	NA	Manganese	--
VOCs	Acetone	67-64-1	0.015	No ESV	1.2	NA	0.01	--	--
	Methylene chloride	75-09-2	0.0072	1600	2.6	0.000005	0.003	--	--
SVOCs	Bis(2-ethylhexyl)phthalate	117-81-7	0.72	No ESV	0.02	NA	36	--	Bis(2-ethylhexyl)phthalate
	Pentachlorophenol	87-86-5	0.19	3	0.36	0.06	0.53	--	--
PAHs	Anthracene	120-12-7	ND	6.8	210	NA	NA	--	--
	Benzo(a)anthracene	56-55-3	ND	18	0.73	NA	NA	--	--
	Benzo(a)pyrene	50-32-8	0.062	No ESV	1.98	NA	0.03	--	--
	Benzo(b)fluoranthene	205-99-2	ND	18	44	NA	NA	--	--
	Benzo(g,h,i)perylene	191-24-2	0.078	No ESV	25	NA	0.003	--	--
	Benzo(k)fluoranthene	207-08-9	ND	No ESV	71	NA	NA	--	--
	Chrysene	218-01-9	0.051	No ESV	3.1	NA	0.02	--	--
	Dibenz(a,h)anthracene	53-70-3	0.049	No ESV	14	NA	0.004	--	--
	Fluoranthene	206-44-0	0.0052	10	22	0.0005	0.0002	--	--
	Indeno(1,2,3-c,d)pyrene	193-39-5	0.0052	No ESV	71	NA	0.0001	--	--
	Phenanthrene	85-01-8	ND	5.5	11	NA	NA	--	--
	Pyrene	129-00-0	0.019	10	23	0.002	0.001	--	--

Attachment C-1. COPEC Selection - Surface Soil

Chemical Group	Preliminary COPEC	CASRN	Maximum Surface Soil Conc. (mg/kg)	SLERA COPEC ESV Plants/Inverts (mg/kg)	SLERA COPEC ESV Birds/Mammals (mg/kg)	Max/ESV Plants/Inverts	Max/ESV Birds/Mammals	Plants/Inverts COPEC	Birds/Mammals COPEC

Notes:

COPEC Selection ESVs from NPS 2016; except molybdenum ESV for plants/invertebrates and no-effect ESL for birds are from LANL (2017)

CASRN = Chemical Abstracts Service Registry Number

COPEC = chemical of potential ecological concern

ESV = ecological screening value

mg/kg = millgrams per kilogram

PAHs = polycyclic aromatic hydrocarbons

SLERA = Screening level ecological risk assessment

TEQ = toxicity equivalency quotient

VOCs - Volatile Organic Chemicals

SVOCs - Semi-Volatile Organic Chemicals

a. NPS ESV for molybdenum not available; the ESV level is the Dutch Target Value

Attachment C-2. COPEC Selection - Subsurface Soil

Chemical Group	Preliminary COPEC	CASRN	Maximum Subsurface Soil Conc. (mg/kg)	SLERA COPEC ESV Plants/Inverts (mg/kg)	SLERA COPEC ESV Birds/Mammals (mg/kg)	Max/ESV Plants/Inverts	Max/ESV Birds/Mammals	Plants/Inverts COPEC	Birds/Mammals COPEC
Metals	Antimony	7440-36-0	2.4	5.0	0.2	0.5	9.7	--	Antimony
	Arsenic	7440-38-2	8.4	6.8	0.3	1.2	34	Arsenic	Arsenic
	Barium	7440-39-3	1420	110.0	17.2	13	83	Barium	Barium
	Beryllium	7440-41-7	0.3	2.5	2.4	0.1	0.1	--	--
	Cadmium	7440-43-9	11.8	4.0	0.3	3.0	44	Cadmium	Cadmium
	Chromium, Total	7440-47-3	36.4	0.3	23.0	107	1.6	Chromium, Total	Chromium, Total
	Cobalt	7440-48-4	6.8	13.0	76.0	0.5	0.1	--	--
	Copper	7440-50-8	260	50.0	14.0	5.2	18.6	Copper	Copper
	Lead	7439-92-1	9930	50.0	0.9	199	10564	Lead	Lead
	Mercury	7439-97-6	1.6	0.05	0.0	32	123	Mercury	Mercury
	Molybdenum	7439-98-7	2.3	2.0	0.5	1.2	4.4	Molybdenum	Molybdenum
	Nickel	7440-02-0	12.5	30.0	10.0	0.4	1.3	--	Nickel
	Selenium	7782-49-2	1.1	0.5	0.3	2.1	3.3	Selenium	Selenium
	Silver	7440-22-4	2.6	2.0	2.6	1.3	1.0	Silver	--
	Thallium	7440-28-0	0.38	0.1	0.0	7.6	14	Thallium	Thallium
	Vanadium	7440-62-2	24.2	2.0	0.7	12	34	Vanadium	Vanadium
	Zinc	7440-66-6	2120	6.6	12.0	320	177	Zinc	Zinc
	Hexavalent Chromium	18540-29-9	ND	No ESV	7.21	NA	NA	--	--
	Aluminum	7429-90-5	12000	50	[f]	240	NA	Aluminum	--
	Iron	7439-89-6	29700	No ESV	[g]	NA	NA	--	--
	Manganese	7439-95-4	1790	220	332	8.1	5.4	Manganese	Manganese
VOCs	Acetone	67-64-1	0.044	No ESV	1.2	NA	0.04	--	--
	Methylene Chloride	75-09-2	0.0027	1600	2.6	0.000002	0.001	--	--
SVOCs	Bis(2-ethylhexyl)phthalate	117-81-7	0.29	No ESV	0.02	NA	15	--	Bis(2-ethylhexyl)phthalate
	Pentachlorophenol	87-86-5	ND	3	0.36	NA	NA	--	--
PAHs	Anthracene	120-12-7	6.0E-03	6.8	210	0.001	0.000	--	--
	Benzo(a)anthracene	56-55-3	1.9E-02	18	0.73	0.001	0.03	--	--
	Benzo(a)pyrene	50-32-8	3.4E-02	No ESV	1.98	NA	0.02	--	--
	Benzo(b)fluoranthene	205-99-2	2.8E-02	18	44	0.002	0.001	--	--
	Benzo(g,h,i)perylene	191-24-2	1.1E-02	No ESV	25	NA	0.0004	--	--
	Benzo(k)fluoranthene	207-08-9	9.1E-03	No ESV	71	NA	0.0001	--	--
	Chrysene	218-01-9	3.5E-02	No ESV	3.1	NA	0.01	--	--
	Dibenz(a,h)anthracene	53-70-3	3.0E-02	No ESV	14	NA	0.002	--	--
	Fluoranthene	206-44-0	5.0E-02	10	22	0.01	0.002	--	--
	Indeno(1,2,3-c,d)pyrene	193-39-5	2.0E-02	No ESV	71	NA	0.0003	--	--
	Phenanthrene	85-01-8	3.8E-02	5.5	11	0.01	0.003	--	--
	Pyrene	129-00-0	4.4E-02	10	23	0.004	0.002	--	--

Attachment C-2. COPEC Selection - Subsurface Soil

Chemical Group	Preliminary COPEC	CASRN	Maximum Subsurface Soil Conc. (mg/kg)	SLERA COPEC ESV Plants/Inverts (mg/kg)	SLERA COPEC ESV Birds/Mammals (mg/kg)	Max/ESV Plants/Inverts	Max/ESV Birds/Mammals	Plants/Inverts COPEC	Birds/Mammals COPEC
Dioxins/Furans	1,2,3,4,6,7,8-HpCDD	35822-46-9	210	evaluated as TEQ					
pg/g	1,2,3,4,7,8-HxCDD	39227-28-6	3.8	evaluated as TEQ					
	1,2,3,6,7,8-HxCDD	57653-85-7	14	evaluated as TEQ					
	1,2,3,7,8,9-HxCDD	19408-74-3	10	evaluated as TEQ					
	1,2,3,7,8-PeCDD	40321-76-4	3.7	evaluated as TEQ					
	2,3,7,8-TCDD	1746-01-6	0.9	evaluated as TEQ					
	OCDD	3268-87-9	580	evaluated as TEQ					
	1,2,3,4,6,7,8-HpCDF	67562-39-4	16	evaluated as TEQ					
	1,2,3,4,7,8,9-HpCDF	55673-89-7	0	evaluated as TEQ					
	1,2,3,4,7,8-HxCDF	70648-26-9	3.3	evaluated as TEQ					
	1,2,3,6,7,8-HxCDF	57117-44-9	2.6	evaluated as TEQ					
	1,2,3,7,8,9-HxCDF	72918-21-9	0	evaluated as TEQ					
	2,3,4,6,7,8-HxCDF	60851-34-5	0	evaluated as TEQ					
	1,2,3,7,8-PeCDF	57117-41-6	2.9	evaluated as TEQ					
	2,3,4,7,8-PeCDF	57117-31-4	3.3	evaluated as TEQ					
	2,3,7,8-TCDF	51207-31-9	3.7	evaluated as TEQ					
	OCDF	39001-02-0	14	evaluated as TEQ					
mg/kg	TEQ	1746-01-6	1.2E-05	5	1.99E-07	2.4E-06	60	--	TEQ

Notes:

COPEC Selection ESVs from NPS 2016; except molybdenum and dioxin TEQ are from LANL (2017) and RAIS database, respectively

CASRN = Chemical Abstracts Service Registry Number

COPEC = chemical of potential ecological concern

ESV = ecological screening value

mg/kg = millgrams per kilogram

PAHs = polycyclic aromatic hydrocarbons

SLERA = Screening level ecological risk assessment

TEQ = toxicity equivalency quotient

VOCs - Volatile Organic Chemicals

SVOCs - Semi-Volatile Organic Chemicals

a. NPS ESV for molybdenum not available; the ESV level is the Dutch Target Value

Appendix D – Risk Calculations for Ecological Receptors

Attachment D

Table D-1. Dose and Risk Calculations - Herbivorous Bird

COPEC	C_{soil} (mg/kg)	C_p (mg/kg dw)	C_e (mg/kg dw)	C_m (mg/kg dw)	Soil Dose (mg/kg-d)	Plant Dose (mg/kg-d)	Earthworm Dose (mg/kg-d)	Small Mammal Dose (mg/kg-d)	Total Dose (mg/kg-d)	NOAEL TRV (mg/kg-d)	LOAEL TRV (mg/kg-d)	Threshold TRV (mg/kg-d)	NOAEL-Based HQ	LOAEL-Based HQ	Threshold-Based HQ
<u>Metals</u>															
Cadmium	5.0	1.49	29.7	0.61	4.63E-02	2.05E-01	0.00E+00	0.00E+00	2.51E-01	1.47	6.35	3.06	0.2	0.04	0.08
Copper	160	14.4	82.6	16.0	1.49E+00	1.98E+00	0.00E+00	0.00E+00	3.47E+00	4.05	12.10	7.00	0.9	0.3	0.5
Lead	634	9.89	146.8	18.7	5.90E+00	1.36E+00	0.00E+00	0.00E+00	7.25E+00	4.40	9.80	6.57	**2**	1	1
Mercury	0.63	0.29	0.93	0.03	5.86E-03	3.94E-02	0.00E+00	0.00E+00	4.52E-02	0.02	0.19	0.06	**2**	0.2	0.8
Vanadium	32.2	0.24	1.4	0.40	3.00E-01	3.31E-02	0.00E+00	0.00E+00	3.33E-01	0.34	0.69	0.49	1	0.5	0.7
Zinc	2322	354	1087	136	2.16E+01	4.85E+01	0.00E+00	0.00E+00	7.01E+01	66.1	171	106	1	0.4	0.7
<u>Other Bioaccumulative VOCs and SVOCs</u>															
Bis(2-ethylhexyl)phthalate	0.72	0.37	1.41	0.72	6.70E-03	5.08E-02	0.00E+00	0.00E+00	5.75E-02	0.91	9.10	2.88	0.1	0.01	0.02

Notes:

kg dw - kilograms dry weight

kg ww - kilograms wet weight

kg bw - kilograms body weight (wet weight basis)

mg/kg bw-d - milligrams chemical per kilogram body weight per day

C_s - soil concentration

C_p - plant concentration

C_e - earthworm concentration

C_m = small mammal concentration

NOAEL - no observed adverse effect level

LOAEL - lowest observed adverse effect level

TRV - toxicity reference value

Threshold TRV = Geometric Mean of NOAEL and LOAEL TRVs

HQ - hazard quotient

Soil Dose = SIR * C_s * AUF

Plant Dose = IRp * C_p * AUF

Invertebrate Dose = IR_i * C_e * AUF

Small Mammal Dose = IR_m * C_m * AUF

Attachment D

Table D-2. Dose and Risk Calculations - Insectivorous Bird

COPEC	C_{soil} (mg/kg)	C_p (mg/kg dw)	C_e (mg/kg dw)	C_m (mg/kg dw)	Soil Dose (mg/kg-d)	Plant Dose (mg/kg-d)	Earthworm Dose (mg/kg-d)	Small Mammal Dose (mg/kg-d)	Total Dose (mg/kg-d)	NOAEL TRV (mg/kg-d)	LOAEL TRV (mg/kg-d)	Threshold TRV (mg/kg-d)	NOAEL-Based HQ	LOAEL-Based HQ	Threshold-Based HQ
Metals															
Cadmium	5.0	1.49	29.66	0.61	5.30E-02	0.00E+00	4.21E+00	0.00E+00	4.26E+00	1.47	6.35	3.06	**3**	0.67	1
Copper	160	14.42	82.55	16.04	1.71E+00	0.00E+00	1.17E+01	0.00E+00	1.34E+01	4.05	12.10	7.00	**3**	1	**2**
Lead	634	9.89	146.82	18.72	6.76E+00	0.00E+00	2.08E+01	0.00E+00	2.76E+01	4.40	9.80	6.57	**6**	**3**	**4**
Mercury	0.63	0.29	0.925	0.03	6.71E-03	0.00E+00	1.31E-01	0.00E+00	1.38E-01	0.02	0.19	0.06	**7**	1	**2**
Vanadium	32.2	0.24	1.35	0.40	3.43E-01	0.00E+00	1.92E-01	0.00E+00	5.35E-01	0.34	0.69	0.49	**2**	0.78	1
Zinc	2322	353.75	1086.9	135.69	2.47E+01	0.00E+00	1.54E+02	0.00E+00	1.79E+02	66.1	171	106	**3**	1	**2**
Other Bioaccumulative VOCs and SVOCs															
Bis(2-ethylhexyl)phthalate	0.72	0.37	1.41	0.72	7.67E-03	0.00E+00	2.01E-01	0.00E+00	2.08E-01	0.91	9.10	2.88	0.2	0.02	0.1

Notes:

kg dw - kilograms dry weight

kg ww - kilograms wet weight

kg bw - kilograms body weight (wet weight basis)

mg/kg bw-d - milligrams chemical per kilogram body weight per day

C_s - soil concentration

C_p - plant concentration

C_e - earthworm concentration

C_m = small mammal concentration

NOAEL - no observed adverse effect level

LOAEL - lowest observed adverse effect level

TRV - toxicity reference value

Threshold TRV = Geometric Mean of NOAEL and LOAEL TRVs

HQ - hazard quotient

Soil Dose = SIR * C_s * AUF

Plant Dose = IRp * C_p * AUF

Invertebrate Dose = IR_i * C_e * AUF

Small Mammal Dose = IR_m * C_m * AUF

Attachment D

Table D-3. Dose and Risk Calculations - Carnivorous Bird

COPEC	C_{soil} (mg/kg)	C_p (mg/kg dw)	C_e (mg/kg dw)	C_m (mg/kg dw)	Soil Dose (mg/kg-d)	Plant Dose (mg/kg-d)	Earthworm Dose (mg/kg-d)	Small Mammal Dose (mg/kg-d)	Total Dose (mg/kg-d)	NOAEL TRV (mg/kg-d)	LOAEL TRV (mg/kg-d)	Threshold TRV (mg/kg-d)	NOAEL-Based HQ	LOAEL-Based HQ	Threshold-Based HQ
Metals															
Cadmium	5.0	1.49	29.66	0.61	3.38E-03	0.00E+00	0.00E+00	1.58E-02	1.92E-02	1.47	6.35	3.06	0.01	0.003	0.006
Copper	160	14.42	82.55	16.04	1.09E-01	0.00E+00	0.00E+00	4.17E-01	5.26E-01	4.05	12.10	7.00	0.13	0.04	0.08
Lead	634	9.89	146.82	18.72	4.31E-01	0.00E+00	0.00E+00	4.87E-01	9.18E-01	4.40	9.80	6.57	0.21	0.09	0.1
Mercury	0.63	0.29	0.925	0.03	4.28E-04	0.00E+00	0.00E+00	8.89E-04	1.32E-03	0.02	0.19	0.06	0.07	0.01	0.02
Vanadium	32.2	0.24	1.35	0.40	2.19E-02	0.00E+00	0.00E+00	1.03E-02	3.22E-02	0.34	0.69	0.49	0.094	0.05	0.07
Zinc	2322	353.75	1086.9	135.69	1.58E+00	0.00E+00	0.00E+00	3.53E+00	5.11E+00	66.1	171	106	0.08	0.03	0.05
Other Bioaccumulative VOCs and SVOCs															
Bis(2-ethylhexyl)phthalate	0.72	0.37	1.41	0.72	4.90E-04	0.00E+00	0.00E+00	1.87E-02	1.92E-02	0.91	9.10	2.88	0.02	0.002	0.007

kg dw - kilograms dry weight

kg ww - kilograms wet weight

kg bw - kilograms body weight (wet weight basis)

Notes:

mg/kg bw-d - milligrams chemical per kilogram body weight per day

C_s - soil concentration

C_p - plant concentration

C_e - earthworm concentration

C_m = small mammal concentration

NOAEL - no observed adverse effect level

LOAEL - lowest observed adverse effect level

TRV - toxicity reference value

Threshold TRV = Geometric Mean of NOAEL and LOAEL TRVs

HQ - hazard quotient

Soil Dose = SIR * C_s * AUF

Plant Dose = IRp * C_p * AUF

Invertebrate Dose = IR_i * C_e * AUF

Small Mammal Dose = IR_m * C_m * AUF

Attachment D

Table D-4. Dose and Risk Calculations - Herbivorous Mammal

COPEC	C_{soil} (mg/kg)	C_p (mg/kg dw)	C_e (mg/kg dw)	C_m (mg/kg dw)	Soil Dose (mg/kg-d)	Plant Dose (mg/kg-d)	Earthworm Dose (mg/kg-d)	Mammal Dose (mg/kg-d)	Total Dose (mg/kg-d)	NOAEL TRV (mg/kg-d)	LOAEL TRV (mg/kg-d)	Threshold TRV (mg/kg-d)	NOAEL-Based HQ	LOAEL-Based HQ	Threshold-Based HQ
Metals															
Antimony	3.5	0.13	3.55	0.18	3.55E-03	9.83E-03	0.00E+00	0.00E+00	1.34E-02	0.059	0.59	0.187	0.2	0.02	0.07
Cadmium	5.0	1.49	29.66	0.61	4.98E-03	1.14E-01	0.00E+00	0.00E+00	1.18E-01	0.77	1.12	0.93	0.2	0.1	0.1
Copper	160	14.42	82.55	16.04	1.60E-01	1.10E+00	0.00E+00	0.00E+00	1.26E+00	5.60	9.34	7.23	0.2	0.1	0.2
Lead	634	9.89	146.82	18.72	6.34E-01	7.52E-01	0.00E+00	0.00E+00	1.39E+00	4.7	8.9	6.5	0.3	0.2	0.2
Molybdenum	2	0.08	2.06	0.10	2.16E-03	6.18E-03	0.00E+00	0.00E+00	8.34E-03	0.24	2.40	0.76	0.03	0.003	0.01
Zinc	2322	353.75	1086.9	135.69	2.32E+00	2.69E+01	0.00E+00	0.00E+00	2.92E+01	75.4	298	150	0.4	0.1	0.2

Notes:

kg dw - kilograms dry weight

kg ww - kilograms wet weight

kg bw - kilograms body weight (wet weight basis)

mg/kg bw-d - milligrams chemical per kilogram body weight per day

C_s - soil concentration

C_p - plant concentration

C_e - earthworm concentration

C_m = small mammal concentration

NOAEL - no observed adverse effect level

LOAEL - lowest observed adverse effect level

TRV - toxicity reference value

Threshold TRV = Geometric Mean of NOAEL and LOAEL TRVs

HQ - hazard quotient

Soil Dose = SIR * C_s * AUF

Plant Dose = IRp * C_p * AUF

Invertebrate Dose = IR_i * C_e * AUF

Small Mammal Dose = IR_m * C_m * AUF

Attachment D

Table D-5. Dose and Risk Calculations - Insectivorous Mammal

COPEC	C_{soil} (mg/kg)	C_p (mg/kg dw)	C_e (mg/kg dw)	C_m (mg/kg dw)	Soil Dose (mg/kg-d)	Plant Dose (mg/kg-d)	Earthworm Dose (mg/kg-d)	Mammal Dose (mg/kg-d)	Total Dose (mg/kg-d)	NOAEL TRV (mg/kg-d)	LOAEL TRV (mg/kg-d)	Threshold TRV (mg/kg-d)	NOAEL-Based HQ	LOAEL-Based HQ	Threshold-Based HQ
Metals															
Antimony	3.5	0.13	3.55	0.18	6.39E-03	0.00E+00	5.93E-01	0.00E+00	5.99E-01	0.059	0.590	0.187	**10**	1	**3**
Cadmium	5.0	1.49	29.66	0.61	8.96E-03	0.00E+00	4.95E+00	0.00E+00	4.96E+00	0.77	1.12	0.93	**6**	**4**	**5**
Copper	160	14.42	82.55	16.04	2.89E-01	0.00E+00	1.38E+01	0.00E+00	1.41E+01	5.60	9.34	7.23	**3**	**2**	**2**
Lead	634	9.89	146.82	18.72	1.14E+00	0.00E+00	2.45E+01	0.00E+00	2.57E+01	4.7	8.9	6.5	**5**	**3**	**4**
Molybdenum	2	0.08	2.06	0.10	3.89E-03	0.00E+00	3.44E-01	0.00E+00	3.48E-01	0.24	2.40	0.76	1	0.1	0.5
Zinc	2322	353.75	1086.9	135.69	4.18E+00	0.00E+00	1.82E+02	0.00E+00	1.86E+02	75.4	298	150	**2**	0.6	1

Notes:

kg dw - kilograms dry weight

kg ww - kilograms wet weight

kg bw - kilograms body weight (wet weight basis)

mg/kg bw-d - milligrams chemical per kilogram body weight per day

C_s - soil concentration

C_p - plant concentration

C_e - earthworm concentration

C_m = small mammal concentration

NOAEL - no observed adverse effect level

LOAEL - lowest observed adverse effect level

TRV - toxicity reference value

Threshold TRV = Geometric Mean of NOAEL and LOAEL TRVs

HQ - hazard quotient

Soil Dose = SIR * C_s * AUF

Plant Dose = IRp * C_p * AUF

Invertebrate Dose = IR_i * C_e * AUF

Small Mammal Dose = IR_m * C_m * AUF

Attachment D

Table D-6. Dose and Risk Calculations - Insectivorous Mammal, Subsurface Soil

COPEC	C_{soil} (mg/kg)	C_p (mg/kg dw)	C_e (mg/kg dw)	C_m (mg/kg dw)	Soil Dose (mg/kg-d)	Plant Dose (mg/kg-d)	Earthworm Dose (mg/kg-d)	Mammal Dose (mg/kg-d)	Total Dose (mg/kg-d)	NOAEL TRV (mg/kg-d)	LOAEL TRV (mg/kg-d)	Threshold TRV (mg/kg-d)	NOAEL-Based HQ	LOAEL-Based HQ	Threshold-Based HQ
Metals															
Antimony	2.0	0.07	1.98	0.10	3.56E-03	0.00E+00	3.30E-01	0.00E+00	3.34E-01	0.059	0.590	0.187	**6**	0.6	**2**
Cadmium	4.2	1.35	25.74	0.56	7.49E-03	0.00E+00	4.30E+00	0.00E+00	4.31E+00	0.77	1.12	0.93	**6**	**4**	**5**
Copper	260	17.44	133.90	17.20	4.68E-01	0.00E+00	2.24E+01	0.00E+00	2.28E+01	5.60	9.34	7.23	**4**	**2**	**3**
Lead	9930	46.30	1351.64	63.17	1.79E+01	0.00E+00	2.26E+02	0.00E+00	2.44E+02	4.7	8.9	6.5	**52**	**27**	**38**
Molybdenum	1.06	0.04	1.01	0.05	1.91E-03	0.00E+00	1.69E-01	0.00E+00	1.71E-01	0.24	2.40	0.76	0.7	0.1	0.2
Selenium	0.89	0.45	0.85	0.63	1.60E-03	0.00E+00	1.42E-01	0.00E+00	1.44E-01	0.14	0.22	0.18	1	0.7	0.8
Zinc	2120	336.36	1054.9	134.82	3.82E+00	0.00E+00	1.76E+02	0.00E+00	1.80E+02	75.4	298.0	149.9	**2**	0.6	1
Dioxins, Furans															
2,3,7,8-TCDD	9.0E-07	9.47E-08	2.44E-06	5.08E-07	---	---	---	---	---	---	---	---	---	---	---
1,2,3,7,8-PeCDD	3.7E-06	4.52E-07	1.20E-05	2.21E-06	---	---	---	---	---	---	---	---	---	---	---
1,2,3,4,7,8-HxCDD	3.8E-06	1.57E-07	4.16E-06	7.68E-07	---	---	---	---	---	---	---	---	---	---	---
1,2,3,6,7,8-HxCDD	1.4E-05	3.95E-07	7.52E-06	1.25E-06	---	---	---	---	---	---	---	---	---	---	---
1,2,3,7,8,9-HxCDD	1.0E-05	2.82E-07	5.90E-06	1.00E-06	---	---	---	---	---	---	---	---	---	---	---
1,2,3,4,6,7,8-HpCDD	2.1E-04	7.20E-06	7.85E-05	1.04E-05	---	---	---	---	---	---	---	---	---	---	---
OCDD	5.8E-04	1.65E-05	6.14E-05	7.47E-06	---	---	---	---	---	---	---	---	---	---	---
2,3,7,8-TCDF	3.7E-06	5.01E-07	1.04E-05	1.92E-06	---	---	---	---	---	---	---	---	---	---	---
1,2,3,7,8-PeCDF	2.9E-06	3.08E-07	2.14E-06	4.05E-07	---	---	---	---	---	---	---	---	---	---	---
2,3,4,7,8-PeCDF	3.3E-06	3.51E-07	1.81E-05	3.37E-06	---	---	---	---	---	---	---	---	---	---	---
1,2,3,4,7,8-HxCDF	3.3E-06	1.22E-07	1.07E-06	1.99E-07	---	---	---	---	---	---	---	---	---	---	---
1,2,3,6,7,8-HxCDF	2.6E-06	9.61E-08	1.97E-06	3.75E-07	---	---	---	---	---	---	---	---	---	---	---
1,2,3,7,8,9-HxCDF	0.0E+00	0.00E+00	0.00E+00	0.00E+00	---	---	---	---	---	---	---	---	---	---	---
2,3,4,6,7,8-HxCDF	0.0E+00	0.00E+00	0.00E+00	0.00E+00	---	---	---	---	---	---	---	---	---	---	---
1,2,3,4,6,7,8-HpCDF	1.6E-05	5.92E-07	1.10E-06	1.80E-07	---	---	---	---	---	---	---	---	---	---	---
1,2,3,4,7,8,9-HpCDF	0.0E+00	0.00E+00	0.00E+00	0.00E+00	---	---	---	---	---	---	---	---	---	---	---
OCDF	1.4E-05	2.74E-07	1.44E-06	2.39E-07	---	---	---	---	---	---	---	---	---	---	---
Total TCDD-TEC	*1.2E-05*	*9.0E-07*	*2.4E-05*	*4.4E-06*	*2.1E-08*	*0.0E+00*	*4.0E-06*	0.0E+00	4.0E-06	*5.62E-07*	*3.76E-06*	*1.45E-06*	**7**	1	**3**

Notes:

kg dw - kilograms dry weight

kg ww - kilograms wet weight

kg bw - kilograms body weight (wet weight basis)

mg/kg bw-d - milligrams chemical per kilogram body weight per day

C_s - soil concentration

C_p - plant concentration

C_e - earthworm concentration

C_m = small mammal concentration

NOAEL - no observed adverse effect level

LOAEL - lowest observed adverse effect level

TRV - toxicity reference value

Threshold TRV = Geometric Mean of NOAEL and LOAEL TRVs

HQ - hazard quotient

TCDD-TEC - 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalence concentration

Soil Dose = SIR * C_s * AUF

Plant Dose = IRp * C_p * AUF

Invertebrate Dose = IR_i * C_e * AUF

Small Mammal Dose = IR_m * C_m * AUF

For 2,3,7,8-TCDD, the uptake factor is calculate according to the following equation: Soil-to-Earthworm Uptake Factor = (EXP(1.182 * ln[Cs] + 3.533))/Cs. For all other dioxin and furan congeners, the uptake factor is calculated as follows: Soil-to-Earthworm Uptake Factor = Uptake Factor for 2,3,7,8-TCDD * congener-specific bioaccumulation equivalency factor (BEF).

TCDD-TECs are calculated in accordance with EPA guidance (USEPA 2008). The TEC is the product of the TEF for each congener multiplied by the concentration for the congener (result not shown). The total TEC is calculated as the sum of TECs for all congeners present. For simplicity, congener-specific doses are not shown.

Attachment D

Table D-7. Dose and Risk Calculations - Carnivorous Mammal

COPEC	C_{soil} (mg/kg)	C_p (mg/kg dw)	C_e (mg/kg dw)	C_m (mg/kg dw)	Soil Dose (mg/kg-d)	Plant Dose (mg/kg-d)	Earthworm Dose (mg/kg-d)	Mammal Dose (mg/kg-d)	Total Dose (mg/kg-d)	NOAEL TRV (mg/kg-d)	LOAEL TRV (mg/kg-d)	Threshold TRV (mg/kg-d)	NOAEL-Based HQ	LOAEL-Based HQ	Threshold-Based HQ
<u>Metals</u>															
Antimony	3.5	0.13	3.55	0.18	3.90E-03	0.00E+00	0.00E+00	1.26E-02	1.65E-02	0.059	0.590	0.187	0.3	0.03	0.09
Cadmium	5.0	1.49	29.66	0.61	5.47E-03	0.00E+00	0.00E+00	4.31E-02	4.86E-02	0.77	1.12	0.93	0.06	0.04	0.05
Copper	160	14.42	82.55	16.04	1.76E-01	0.00E+00	0.00E+00	1.14E+00	1.32E+00	5.60	9.34	7.23	0.2	0.1	0.2
Lead	634	9.89	146.82	18.72	6.98E-01	0.00E+00	0.00E+00	1.33E+00	2.03E+00	4.7	8.9	6.5	0.4	0.2	0.3
Molybdenum	2	0.08	2.06	0.10	2.38E-03	0.00E+00	0.00E+00	7.31E-03	9.69E-03	0.24	2.40	0.76	0.04	0.004	0.013
Zinc	2322	353.75	1086.9	135.69	2.55E+00	0.00E+00	0.00E+00	9.63E+00	1.22E+01	75.4	298	150	0.2	0.04	0.08

Notes:

kg dw - kilograms dry weight

kg ww - kilograms wet weight

kg bw - kilograms body weight (wet weight basis)

mg/kg bw-d - milligrams chemical per kilogram body weight per day

C_s - soil concentration

C_p - plant concentration

C_e - earthworm concentration

C_m = small mammal concentration

NOAEL - no observed adverse effect level

LOAEL - lowest observed adverse effect level

TRV - toxicity reference value

Threshold TRV = Geometric Mean of NOAEL and LOAEL TRVs

HQ - hazard quotient

Soil Dose = SIR * C_s * AUF

Plant Dose = IRp * C_p * AUF

Invertebrate Dose = IR_i * C_e * AUF

Small Mammal Dose = IR_m * C_m * AUF

Appendix D – Detailed Cost Estimates

Cost Estimate Summary
Alternative 2 - In-Place Capping of Contaminated Soils

Capital Costs:

Description	QTY	UNIT	UNIT COST	TOTAL	Notes
Pre-Design Investigation					
Soil Sampling	1	LS	$ 13,170.72	$ 13,171	
Analytical Laboratory	1	LS	$ 11,625.00	$ 11,625	
Cultural Resources Oversight	1	LS	$ 11,346.88	$ 11,347	
Report Generation	1	LS	$ 6,407.78	$ 6,408	
Subtotal				**$ 42,550**	
Cap Construction					
Mob/Demob	1	LS	$ 5,000.00	$ 5,000	
Site Preperation	1	LS	$ 11,348.38	$ 11,348	Clear Site, establish access road, place erosion control
Cap Construction Activities	7	DY	$ 7,125.00	$ 49,875	Includes Site dust control
Cap Materials - Non-NPS Source	1	LS	$ 22,809.65	$ 22,810	
Cap Materials - NPS Source	1	LS	$ 23,902.81	$ 23,903	From NPS Upper River Borrow Pit, Yosemite Valley
Cap Construction Oversight	1	LS	$ 8,791.07	$ 8,791	
Analytical Laboratory	1	LS	$ 7,000.00	$ 7,000	
Cap Initial Survey	2	DY	$ 4,625.00	$ 9,250	
Site Restoration	1	LS	$ 32,574.00	$ 32,574	NPS revegetation of cap areas and temporary road
Report Generation	1	LS	$ 8,727.29	$ 8,727	
Subtotal				**$ 179,278**	
Subtotal				**$ 221,829**	
Contingency (Scope and Bid)	20%			$ 44,366	10% Scope, 10% Bid, within ranges of EPA 540-R-00-002
Subtotal				**$ 266,194**	
Project Management	8%			$ 21,296	Per Exhibit 5-8 in EPA 540-R-00-002
Remedial Design	15%			$ 39,929	Per Exhibit 5-8 in EPA 540-R-00-002
Construction Management	10%			$ 26,619	Per Exhibit 5-8 in EPA 540-R-00-002
Total				**$ 354,038**	
TOTAL CAPITAL COST				**$ 355,000**	Total capital cost is rounded to the nearest $1,000

Annual Post Removal Site Control (PRSC) Costs - Years 1 through 30:					
Description	QTY	UNIT	UNIT COST	TOTAL	Notes
Site Visit and Cap Maintenance					
Site Inspection	1	LS	1,865.63	1,866	
Cap Maintenance	1	LS	1,331.36	1,331	Weed cap surface, other minor maintenance
Report Generation	1	LS	6,059.57	3,170	
Subtotal				**6,367**	
Contingency (Scope and Bid)	20%			1,273	10% Scope, 10% Bid, within ranges of EPA 540-R-00-002
Subtotal				**7,641**	
Project Management	10%			764	Per Exhibit 5-8 in EPA 540-R-00-002
Technical Support	15%			1,146	Middle range per EPA 540-R-00-002
Total				**9,551**	
PRSC COST PER TASK EVENT				**10,000**	Total PRSC cost is rounded to the nearest $1,000

Periodic Post Removal Site Control (PRSC) Costs - Every 5 Years, Years 1 through 30:					
Description	QTY	UNIT	UNIT COST	TOTAL	Notes
Periodic Review and Cap Survey Monitoring					
Site Inspection	1	LS	1,865.63	1,866	
Site Survey	1	LS	9,250.00	9,250	
Report Generation	1	LS	8,572.66	8,573	
Subtotal				**19,688**	
Contingency (Scope and Bid)	20%			3,938	10% Scope, 10% Bid, within ranges of EPA 540-R-00-002
Subtotal				**23,626**	
Project Management	10%			2,363	Per Exhibit 5-8 in EPA 540-R-00-002
Total				**25,989**	
PRSC COST PER TASK EVENT				**26,000**	

Post Removal Site Control (PRSC) Costs - Years 1-3					
Description	QTY	UNIT	UNIT COST	TOTAL	Notes
Invasive Species Control					
Invasive Species Control	1	LS	4,500.00	4,500	
Subtotal				**4,500**	
Contingency (Scope and Bid)	20%			900	10% Scope, 10% Bid, within ranges of EPA 540-R-00-002
Subtotal				**5,400**	
Project Management	10%			540	Per Exhibit 5-8 in EPA 540-R-00-002
Total				**5,940**	
PRSC COST PER TASK EVENT				**6,000**	
TOTAL NON-DISCOUNTED ALTERNATIVE COST				**829,000**	
TOTAL PRESENT VALUE ALTERNATIVE COST				**551,000**	

Notes:

EPA 540-R-00-002 - EPA, A Guide to Developing and Documenting Cost Estimates During the Feasibility Study. July, 2000

LS - Lump sum

DY - Day

CY - Cubic yard

Cost estimates are subject to variability. Costs were prepared only for comparison of alternatives in EE/CA Report

Present Value Analysis
Alternative 2 - In-Place Capping of Contaminated Soils

Year	Capital Costs[1]	PRSC Costs	Total Annual Expenditure[2]	Discount Factor[3]	Present Value[4]
0	$ 353,000.00	$ -	$ 353,000.00	$ 1.00	$ 353,000.00
1	$ -	$ 16,000.00	$ 16,000.00	$ 0.93	$ 14,953.27
2	$ -	$ 16,000.00	$ 16,000.00	$ 0.87	$ 13,975.02
3	$ -	$ 16,000.00	$ 16,000.00	$ 0.82	$ 13,060.77
4	$ -	$ 10,000.00	$ 10,000.00	$ 0.76	$ 7,628.95
5	$ -	$ 36,000.00	$ 36,000.00	$ 0.71	$ 25,667.50
6	$ -	$ 10,000.00	$ 10,000.00	$ 0.67	$ 6,663.42
7	$ -	$ 10,000.00	$ 10,000.00	$ 0.62	$ 6,227.50
8	$ -	$ 10,000.00	$ 10,000.00	$ 0.58	$ 5,820.09
9	$ -	$ 10,000.00	$ 10,000.00	$ 0.54	$ 5,439.34
10	$ -	$ 36,000.00	$ 36,000.00	$ 0.51	$ 18,300.57
11	$ -	$ 10,000.00	$ 10,000.00	$ 0.48	$ 4,750.93
12	$ -	$ 10,000.00	$ 10,000.00	$ 0.44	$ 4,440.12
13	$ -	$ 10,000.00	$ 10,000.00	$ 0.41	$ 4,149.64
14	$ -	$ 10,000.00	$ 10,000.00	$ 0.39	$ 3,878.17
15	$ -	$ 36,000.00	$ 36,000.00	$ 0.36	$ 13,048.06
16	$ -	$ 10,000.00	$ 10,000.00	$ 0.34	$ 3,387.35
17	$ -	$ 10,000.00	$ 10,000.00	$ 0.32	$ 3,165.74
18	$ -	$ 10,000.00	$ 10,000.00	$ 0.30	$ 2,958.64
19	$ -	$ 10,000.00	$ 10,000.00	$ 0.28	$ 2,765.08
20	$ -	$ 36,000.00	$ 36,000.00	$ 0.26	$ 9,303.08
21	$ -	$ 10,000.00	$ 10,000.00	$ 0.24	$ 2,415.13
22	$ -	$ 10,000.00	$ 10,000.00	$ 0.23	$ 2,257.13
23	$ -	$ 10,000.00	$ 10,000.00	$ 0.21	$ 2,109.47
24	$ -	$ 10,000.00	$ 10,000.00	$ 0.20	$ 1,971.47
25	$ -	$ 36,000.00	$ 36,000.00	$ 0.18	$ 6,632.97
26	$ -	$ 10,000.00	$ 10,000.00	$ 0.17	$ 1,721.95
27	$ -	$ 10,000.00	$ 10,000.00	$ 0.16	$ 1,609.30
28	$ -	$ 10,000.00	$ 10,000.00	$ 0.15	$ 1,504.02
29	$ -	$ 10,000.00	$ 10,000.00	$ 0.14	$ 1,405.63
30	$ -	$ 36,000.00	$ 36,000.00	$ 0.13	$ 4,729.22
TOTALS	**$ 353,000.00**	**$ 474,000.00**	**$ 827,000.00**		**$ 548,939.54**

Notes:

1 - Estimated removal timeframes discussed in Section 6.2 of EE/CA Report

2 - Total annual expenditure is total cost per year with no escalation or discounting

3 - Discount factor calculated using 7% discount rate

4 - Present value is total cost per year including a 7.0% discount factor for that year

Cost estimates were prepared only for comparison between alternatives in EE/CA Report

Alternative 2 - In-Place Capping of Contaminated Soils

Scope:	***Pre-design Investigation***															
Applies:	**Year 0**															
Description	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	SUBTOTAL	REMOTE LOCATION*	SUBTOTAL	25% SUB MARKUP	TOTAL TO PRIME	15% PRIME OHEAD	10% PRIME PROFIT	LABOR MARKUP	CONTRACT COST	Notes
Soil Sampling																
Environmental Scientist - Surface Soil	136	HR	42.71			42.71	5,808.56			0.00	5,808.56			4,182.16	9,991	6 days of surface soil sample collection - 10 hours per day, two staff. 8 hours travel time. Wage based on FLC Data Center wage for Environmental Scientist for area
Per diem - Meals - Yosemite National Park	12	DY				76.00	912.00			0.00	912.00	136.80	91.20		1,140	GSA Rates, two staff
Per diem - Lodging - Yosemite National Park	12	DY			136.00	136.00	1,632.00			0.00	1,632.00	244.80	163.20		2,040	GSA Rates, two staff
Subtotal											8,352.56				**13,171**	
Laboratory Analytical																
CAM17 Metals by EPA Method 6020 and 7471	10	EA				90.00	900.00		900.00		900.00	135.00	90.00		1,125.00	
Hexavalent Chromium by SM 7196A	10	EA				47.50	475.00		475.00		475.00	71.25	47.50		593.75	
PAHs by EPA Method 8270-sim	10	EA				95.00	950.00		950.00		950.00	142.50	95.00		1,187.50	
DRO/MRO with SC Cleanup by EPA Method 8015B	10	EA				55.00	550.00		550.00		550.00	82.50	55.00		687.50	
Dibenzodioxins/furans by EPA Method 8290	10	EA				450.00	4,500.00		4,500.00		4,500.00	675.00	450.00		5,625.00	Per Eurofins TestAmerica Sacramento Quote - 2/26/21. Assumes 10 total ISM surface soil samples.
Organochlorine Pesticides by EPA Method 8081A	10	EA				85.00	850.00		850.00		850.00	127.50	85.00		1,062.50	
ISM Prep	10	EA				100.00	1,000.00		1,000.00		1,000.00	150.00	100.00		1,250.00	
Lab Disposal	10	EA				2.50	25.00		25.00		25.00	3.75	2.50		31.25	
Sample Delivery	1	LS				50.00	50.00		50.00		50.00	7.50	5.00		62.50	
Subtotal											9,300.00				**11,625**	
Cultural Resources Oversight																
Cultural Resources Technician	6	DY	165.00			165.00	990.00		990.00	247.50	1,237.50	185.63	123.75		1,546.88	3 days of oversight during soil sampling - 10 hours per day
Report Generation	1	LS				5,000.00	5,000.00		5,000.00	1,250.00	6,250.00	937.50	625.00		7,812.50	
Per diem - Meals - Yosemite National Park	6	DY				76.00	456.00		456.00	114.00	570.00	85.50	57.00		712.50	GSA Rates
Per diem - Lodging - Yosemite National Park	6	DY			136.00	136.00	816.00		816.00	204.00	1,020.00	153.00	102.00		1,275.00	GSA Rates
Subtotal											9,077.50				**11,347**	
Report Generation																
Environmental Engineer	30	HR	51.70			51.70	1,551.00		1,551.00		1,551.00			1,116.72	2,667.72	Wage based on FLC Data Center wage for Environmental Engineer for area
Environmental Scientist	30	HR	42.71			42.71	1,281.30		1,281.30		1,281.30			922.54	2,203.84	Wage based on FLC Data Center wage for Environmental Scientist for area
Drafter - Figures/Tables	25	HR	22.51			22.51	562.75		562.75		562.75			405.18	967.93	Wage based on FLC Data Center wage for Architectural and Civil Drafters for area
Admin	8	HR	18.59			18.59	148.72		148.72		148.72			107.08	255.80	Wage based on FLC Data Center wage for Office Clerk for area
Print / Deliver Report	1	LS				250.00	250.00		250.00		250.00	37.50	25.00		312.50	
Subtotal											3,793.77				**6,408**	

Notes:
All costs listed in US dollars ($)
* - Used for RSMeans cost estimates only. Increases cost 1% for every 10 miles from Modesto, CA. Site is 90 miles from Modesto, CA.
LS - Lump sum
ACR - Acre
SY - Square yards
DY - Day
HR - Hour
EA - Each
CY - Cubic yard
MSF - Thousand square feet
Contract cost rounded up to total dollars

Alternative 2 - In-Place Capping of Contaminated Soils

Scope:	Construct Soil Cap							9%		25%		15%	10%			
Applies:	Year 0					UNIT		REMOTE		SUB	TOTAL TO	PRIME	PRIME	LABOR	CONTRACT COST	
Description	QTY	UNIT	LABOR	EQUIP	MTRL	TOTAL	SUBTOTAL	LOCATION*	SUBTOTAL	MARKUP	PRIME	OHEAD	PROFIT	MARKUP		Notes
Mob/demob	1	LS				4,000.00	4,000.00		4,000.00		4,000.00	600.00	400.00		**5,000**	Per CVE Quote - 2/26/21
Site Preparation																
Clear Vegetation	0.5	ACR	1,001.00	198.34		1,199.34	599.67	53.97	653.64	163.41	817.05	122.56	81.71		1,021.31	RSMeans 311313100020 for Modesto, CA
Construct Access	520	SY	2.95	0.28	5.40	8.63	4,487.60	403.88	4,891.48	1,222.87	6,114.36	917.15	611.44		7,642.94	RSMeans 015523500050 for Modesto, CA
Erosion Control	800	LF	1.27	0.27	0.43	1.97	1,576.00	141.84	1,717.84	429.46	2,147.30	322.10	214.73		2,684.13	RSMeans 312514161000 for Modesto, CA
Subtotal											6,931.41				**11,348**	
Construction Activities	7	DY	3,800.00	1,900.00		5,700.00	39,900.00		39,900.00		39,900.00	5,985.00	3,990.00		**49,875**	Per CVE Quote - 2/26/21. Includes cap contruction and loading activities at NPS material source
Cap Materials - Non-NPS Source																
Biointrusion (crushed rock) - 12 inch thick layer	163	CY			95.12	95.12	15,504.56		15,504.56		15,504.56	2,325.68	1,550.46		19,380.70	Per Outback Materials Quote - 2/24/21. Includes delivery to the Site.
Pea gravel - 1 inch thick layer	28	CY			97.97	97.97	2,743.16		2,743.16		2,743.16	411.47	274.32		3,428.95	
Subtotal															**22,810**	
Cap Materials - NPS Source																
Sub-soil - 12 inch thick layer	163	CY			0.00	0.00	0.00		0.00		0.00	0.00	0.00		0.00	Assumes NPS source within Park, provided at no cost
Sub-soil - 12 inch thick layer - Trucking	195	HR				57.05	11,124.75		11,124.75		11,124.75	1,668.71	1,112.48		13,905.94	
Sandy loam topsoil - 6 inch thick layer	82	CY			0.00	0.00	0.00		0.00		0.00	0.00	0.00		0.00	Assumes NPS source within Park, provided at no cost
Sandy loam topsoil - 6 inch thick layer - Trucking	195	HR				20.50	3,997.50		3,997.50		3,997.50	599.63	399.75		4,996.88	
Mob/demob for loader/operator to NPS soil piles	1	LS				4,000.00	4,000.00		4,000.00		4,000.00	600.00	400.00		5,000	For loading trucks at Yosemite Valley borrow pit
Subtotal											19,122.25				**23,903**	
Cap Construction Oversight																
Environmental Engineer	78	HR	51.70			51.70	4,032.60		4,032.60		4,032.60			2,903.47	6,936.07	7 days of cap construction oversight - 10 hours per day. 8 hours travel time. Wage based on FLC Data Center mean wage for Environmental Engineer for area
Per diem - Meals - Yosemite National Park	7	DY				76.00	532.00		532.00		532.00	79.80	53.20		665.00	
Per diem - Lodging - Yosemite National Park	7	DY			136.00	136.00	952.00		952.00		952.00	142.80	95.20		1,190.00	
Subtotal															**8,791**	
Laboratory Analytical																
CAM17 Metals by EPA Method 6020 and 7471	6	EA				90.00	540.00		540.00		540.00	81.00	54.00		675.00	
Hexavalent Chromium by SM 7196A	6	EA				47.50	285.00		285.00		285.00	42.75	28.50		356.25	
PAHs by EPA Method 8270-sim	6	EA				95.00	570.00		570.00		570.00	85.50	57.00		712.50	
DRO/MRO with SC Cleanup by EPA Method 8015B	6	EA				55.00	330.00		330.00		330.00	49.50	33.00		412.50	
Dibenzodioxins/furans by EPA Method 8290	6	EA				450.00	2,700.00		2,700.00		2,700.00	405.00	270.00		3,375.00	Per Eurofins TestAmerica Sacramento Quote - 2/26/21. Assumes 6 total soil samples to test imported cap material
Organochlorine Pesticides by EPA Method 8081A	6	EA				85.00	510.00		510.00		510.00	76.50	51.00		637.50	
ISM prep	6	EA				100.00	600.00		600.00		600.00	90.00	60.00		750.00	
Lab Disposal	6	EA				2.50	15.00		15.00		15.00	2.25	1.50		18.75	
Sample Delivery	1	LS				50.00	50.00		50.00		50.00	7.50	5.00		62.50	
Subtotal															**7,000**	
Site Survey	2	DY				3,700.00	7,400.00		7,400.00		7,400.00	1,110.00	740.00		**9,250**	2 days survey. Per Bedrock Engineering Quote - 2/18/21
Site Restoration																
NPS pre/post photodocumentation of Site	1	LS				675	675.00		675.00		675.00				675.00	Per Erin Dickman, NPS - email - 5/5/21. Conducted by NPS.
NPS revegetation of cap and road areas	1	LS				27,399	27,399.00		27,399.00		27,399.00				27,399.00	Per Alisa Simonoff-Smith, NPS - quote - 5/6/21. Conducted by NPS
NPS invasive species control	1	LS				4,500	4,500.00		4,500.00		4,500.00				4,500.00	Per David Campbell, NPS - email - 5/6/21. Conducted by NPS.
Subtotal															**32,574**	
Report Generation																
Environmental Engineer	50	HR	51.70			51.70	2,585.00		2,585.00		2,585.00			1,861.20	4,446.20	Wage based on FLC Data Center wage for Environmental Engineer for area
Environmental Scientist	50	HR	42.71			42.71	2,135.50		1,708.40		1,708.40			1,230.05	2,938.45	Wage based on FLC Data Center wage for Environmental Scientist for area
Drafter - Figures/Tables	25	HR	22.51			22.51	562.75		450.20		450.20			324.14	774.34	Wage based on FLC Data Center wage for Architectural and Civil Drafters for area
Admin	10	HR	18.59			18.59	185.90		148.72		148.72			107.08	255.80	Wage based on FLC Data Center wage for Office Clerk for area
Print / Deliver Report	1	LS				250.00	250.00		250.00		250.00	37.50	25.00		312.50	
Subtotal															**8,727**	

Notes:
All costs listed in US dollars ($)

* - Used for RSMeans cost estimates only. Increases cost 1% for every 10 miles from Modesto, CA. Site is 90 miles from Modesto, CA.
LS - Lump sum
ACR - Acre
SY - Square yards
DY - Day
HR - Hour
EA - Each
CY - Cubic yard
MSF - Thousand square feet
Contract cost rounded up to total dollars

Alternative 2 - In-Place Capping of Contaminated Soils

Scope: **Annual Cap Integrity Monitoring Inspection and Maintenance**

Applies: **Years 1-30**

Description	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	SUBTOTAL	9% REMOTE LOCATION*	SUBTOTAL	25% SUB MARKUP	TOTAL TO PRIME	15% PRIME OHEAD	10% PRIME PROFIT	LABOR MARKUP	CONTRACT COST	Notes
Site Inspection - 1 visit per year																
Environmental Engineer	18	HR	51.70			51.70	930.60		930.60		930.60			670.03	1,600.63	1 day of cap inspection/year - 10 hours per day. 8 hours travel time. Wage based on FLC Data Center mean wage for Environmental Engineer for area
Per diem - Meals - Yosemite National Park	1	DY				76.00	76.00		76.00		76.00	11.40	7.60		95.00	
Per diem - Lodging - Yosemite National Park	1	DY			136.00	136.00	136.00		136.00		136.00	20.40	13.60		170.00	
Subtotal															**1,866**	
Cap Maintenance - 1 event per year																
Weed removal/manual invasive species control	489	SY	0.44			0.44	215.16	19.36	234.52	58.63	293.16	43.97	29.32		366.44	1 event/year. RSMeans 320190290100 for Modesto, CA
Topsoil replacement	10	CY			0.00	0.00	0.00		0.00		0.00	0.00	0.00		0.00	Assumes NPS source within Park, provided at no cost
Topsoil replacement trucking	10	HR				20.50	205.00		205.00		205.00	30.75	20.50		256.25	
Topsoil placement and compaction	10	CY	39.86	1.75		41.61	416.10	37.45	453.55	113.39	566.94	85.04	56.69		708.67	1 event per year. RSMeans 312323131100 for Modesto, CA
															1,331	
Annual Cap Monitoring and Maintenance Reporting																
Environmental Engineer	12	HR	51.70			51.70	620.40		620.40		620.40			446.69	1,067.09	Wage based on FLC Data Center wage for Environmental Engineer for area
Environmental Scientist	20	HR	42.71			42.71	854.20		854.20		854.20			615.02	1,469.22	Wage based on FLC Data Center wage for Environmental Scientist for area
Drafter - Figures/Tables	5	HR	22.51			22.51	112.55		112.55		112.55			81.04	193.59	Wage based on FLC Data Center wage for Architectural and Civil Drafters for area
Admin	4	HR	18.59			18.59	74.36		74.36		74.36			53.54	127.90	Wage based on FLC Data Center wage for Office Clerk for area
Print / Deliver Report	1	LS				250.00	250.00		250.00		250.00	37.50	25.00		312.50	
Subtotal															**3,170**	

Notes:
All costs listed in US dollars ($)
* - Used for RSMeans cost estimates only. Increases cost 1% for every 10 miles from Modesto, CA. Site is 90 miles from Modesto, CA.
LS - Lump sum
ACR - Acre
SY - Square yards
DY - Day
HR - Hour
EA - Each
CY - Cubic yard
MSF - Thousand square feet
Contract cost rounded up to total dollars

Alternative 2 - In-Place Capping of Contaminated Soils

Scope:	**Five-Year Monitoring Tasks: Periodic Review, Cap Survey**															
Applies:	**Years 5, 10, 15, 20, 25, 30**							9%		25%		15%	10%			
						UNIT		REMOTE		SUB	TOTAL TO	PRIME	PRIME	LABOR		
Description	QTY	UNIT	LABOR	EQUIP	MTRL	TOTAL	SUBTOTAL	LOCATION*	SUBTOTAL	MARKUP	PRIME	OHEAD	PROFIT	MARKUP	CONTRACT COST	Notes
Periodic Review Site Inspection																
Environmental Engineer	18	HR	51.70			51.70	930.60		930.60		930.60			670.03	1,600.63	1 day of cap inspection - 10 hours per day. 8 hours travel time. Wage based on FLC Data Center mean wage for Environmental Engineer for area
Per diem - Meals - Yosemite National Park	1	DY				76.00	76.00		76.00		76.00	11.40	7.60		95.00	
Per diem - Lodging - Yosemite National Park	1	DY			136.00	136.00	136.00		136.00		136.00	20.40	13.60		170.00	
Subtotal															**1,866**	
Cap and Site Survey	1	LS				7,400.00	7,400.00		7,400.00		7,400.00	1,110.00	740.00		**9,250**	2 days surveying/survey reporting. Per Bedrock Engineering Quote - 2/18/21
Periodic Review Report Generation																
Environmental Engineer	40	HR	51.70			51.70	2,068.00		2,068.00		2,068.00			1,488.96	3,556.96	Wage based on FLC Data Center wage for Environmental Engineer for area
Environmental Scientist	50	HR	42.71			42.71	2,135.50		2,135.50		2,135.50			1,537.56	3,673.06	Wage based on FLC Data Center wage for Environmental Scientist for area
Drafter - Figures/Tables	20	HR	22.51			22.51	450.20		450.20		450.20			324.14	774.34	Wage based on FLC Data Center wage for Architectural and Civil Drafters for area
Admin	8	HR	18.59			18.59	148.72		148.72		148.72			107.08	255.80	Wage based on FLC Data Center wage for Office Clerk for area
Print / Deliver Report	1	LS				250.00	250.00		250.00		250.00	37.50	25.00		312.50	
Subtotal															**8,573**	

Notes:
All costs listed in US dollars ($)
* - Used for RSMeans cost estimates only. Increases cost 1% for every 10 miles from Modesto, CA. Site is 90 miles from Modesto, CA.
LS - Lump sum
ACR - Acre
SY - Square yards
DY - Day
HR - Hour
EA - Each
CY - Cubic yard
MSF - Thousand square feet
Contract cost rounded up to total dollars

Alternative 2 - In-Place Capping of Contaminated Soils

Scope:	NPS Invasive Species Control							9%		25%		15%	10%			
Applies:	Years 1-3					UNIT		REMOTE		SUB	TOTAL TO	PRIME	PRIME	LABOR		
Description	QTY	UNIT	LABOR	EQUIP	MTRL	TOTAL	SUBTOTAL	LOCATION*	SUBTOTAL	MARKUP	PRIME	OHEAD	PROFIT	MARKUP	CONTRACT COST	Notes
Invasive Species Control																
NPS invasive species control	1	LS				4,500	4,500.00		4,500.00		4,500.00				4,500.00	Per David Campbell, NPS - email - 5/6/21. Conducted by NPS, repeated for 3 years post-removal.
Subtotal															**4,500**	

Notes:
All costs listed in US dollars ($)
* - Used for RSMeans cost estimates only. Increases cost 1% for every 10 miles from Modesto, CA. Site is 90 miles from Modesto, CA.
LS - Lump sum
ACR - Acre
SY - Square yards
DY - Day
HR - Hour
EA - Each
CY - Cubic yard
MSF - Thousand square feet
Contract cost rounded up to total dollars

Cost Estimate Summary
Alternative 3 - Excavation and Disposal of Contaminated Soils at Licensed Disposal Facility

Capital Costs:

Description	QTY	UNIT	UNIT COST	TOTAL	Notes
Pre-Design Investigation					
Drilling Activities	1	LS	$ 11,637.50	$ 11,638	
Drilling Oversight/Soil Sampling	1	LS	$ 11,407.65	$ 11,408	
Analytical Laboratory	1	LS	$ 29,475.00	$ 29,475	
Cultural Resources Oversight	1	LS	$ 11,346.88	$ 11,347	
Report Generation	1	LS	$ 6,407.78	$ 6,408	
Subtotal				**$ 70,275**	
Soil Excavation					
Mob/Demob	2	LS	$ 5,000.00	$ 10,000	Assumes two separate mobs for excavation and backfill
Site Preperation	1	LS	$ 11,348.38	$ 11,348	Clear Site, construct access road, place erosion control
Excavation Activities	8	DY	$ 7,125.00	$ 57,000	Includes Site dust control
Soil Disposal/Transportation - Designated	287	TON	$ 277.50	$ 79,643	
Soil Disposal/Transportation - RCRA-Haz	147	TON	$ 440.00	$ 64,680	
Excavation Oversight/Soil Sampling	1	LS	$ 22,910.50	$ 22,910	
Analytical Laboratory	1	LS	$ 13,937.50	$ 13,938	
Excavation Backfill	1	LS	$ 64,875.00	$ 64,875	
Site Survey	1	LS	$ 4,625.00	$ 4,625	
Site Restoration	1	LS	$ 37,199.00	$ 37,199	Revegetate excavation areas and temporary access road
Cultural Resources Oversight	1	LS	$ 18,415.63	$ 18,416	
Report Generation	1	LS	$ 8,727.29	$ 8,727	
Subtotal				**$ 393,361**	
Subtotal				**$ 463,636**	
Contingency (Scope and Bid)	45%			$ 208,636	35% Scope, 10% Bid. Exhibit 5-6 in EPA 540-R-00-002
Subtotal				**$ 672,272**	
Project Management	6%			$ 40,336	Per Exhibit 5-8 in EPA 540-R-00-002
Remedial Design	12%			$ 80,673	Per Exhibit 5-8 in EPA 540-R-00-002
Construction Management	8%			$ 53,782	Per Exhibit 5-8 in EPA 540-R-00-002
Total				**$ 847,062**	
TOTAL CAPITAL COST				**$ 848,000**	Total capital cost is rounded to the nearest $1,000

Post Removal Site Control (PRSC) Costs - Years 1-3 Description	QTY	UNIT	UNIT COST	TOTAL	Notes
Invasive Species Control					
Invasive Species Control	1	LS	4,500.00	4,500	
Subtotal				**4,500**	
Contingency (Scope and Bid)	20%			900	10% Scope, 10% Bid, within ranges of EPA 540-R-00-002
Subtotal				**5,400**	
Project Management	10%			540	Per Exhibit 5-8 in EPA 540-R-00-002
Total				**5,940**	
PRSC COST PER TASK EVENT				**$ 6,000.00**	

TOTAL NON-DISCOUNTED ALTERNATIVE COST	**$ 866,000**
TOTAL PRESENT VALUE ALTERNATIVE COST	**$ 864,000**

Notes:

EPA 540-R-00-002 - EPA, A Guide to Developing and Documenting Cost Estimates During the Feasibility Study. July, 2000

LS - Lump sum

DY - Day

Cost estimates are subject to variability. Costs were prepared only for comparison of alternatives in EE/CA Report

Present Value Analysis
Alternative 3 - Excavation and Disposal of Contaminated Soils at Licensed Disposal Facility

Year	Capital Costs[1]	PRSC Costs	Total Annual Expenditure[2]	Discount Factor[3]	Present Value[4]
0	$ 843,000.00	$ -	$ 843,000.00	$ 1.00	$ 843,000.00
1	$ -	$ 6,000.00	$ 6,000.00	$ 0.93	$ 5,607.48
2	$ -	$ 6,000.00	$ 6,000.00	$ 0.87	$ 5,240.63
3	$ -	$ 6,000.00	$ 6,000.00	$ 0.82	$ 4,897.79
4	$ -	$ -	$ -	$ 0.76	$ -
5	$ -	$ -	$ -	$ 0.71	$ -
6	$ -	$ -	$ -	$ 0.67	$ -
7	$ -	$ -	$ -	$ 0.62	$ -
8	$ -	$ -	$ -	$ 0.58	$ -
9	$ -	$ -	$ -	$ 0.54	$ -
10	$ -	$ -	$ -	$ 0.51	$ -
11	$ -	$ -	$ -	$ 0.48	$ -
12	$ -	$ -	$ -	$ 0.44	$ -
13	$ -	$ -	$ -	$ 0.41	$ -
14	$ -	$ -	$ -	$ 0.39	$ -
15	$ -	$ -	$ -	$ 0.36	$ -
16	$ -	$ -	$ -	$ 0.34	$ -
17	$ -	$ -	$ -	$ 0.32	$ -
18	$ -	$ -	$ -	$ 0.30	$ -
19	$ -	$ -	$ -	$ 0.28	$ -
20	$ -	$ -	$ -	$ 0.26	$ -
21	$ -	$ -	$ -	$ 0.24	$ -
22	$ -	$ -	$ -	$ 0.23	$ -
23	$ -	$ -	$ -	$ 0.21	$ -
24	$ -	$ -	$ -	$ 0.20	$ -
25	$ -	$ -	$ -	$ 0.18	$ -
26	$ -	$ -	$ -	$ 0.17	$ -
27	$ -	$ -	$ -	$ 0.16	$ -
28	$ -	$ -	$ -	$ 0.15	$ -
29	$ -	$ -	$ -	$ 0.14	$ -
30	$ -	$ -	$ -	$ 0.13	$ -
TOTALS	**$ 843,000.00**	**$ 18,000.00**	**$ 861,000.00**		**$ 858,745.90**

Notes:

1 - Estimated removal timeframes discussed in Section 6.2 of EE/CA Report

2 - Total annual expenditure is total cost per year with no escalation or discounting

3 - Discount factor calculated using 7% discount rate

4 - Present value is total cost per year including a 7.0% discount factor for that year

Cost estimates were prepared only for comparison between alternatives in EE/CA Report

Alternative 3 - Excavation and Disposal of Contaminated Soils at Licensed Disposal Facility

Scope:	***Pre-design Investigation***									25%		15%	10%			
Applies:	**Year 0**							REMOTE		SUB	TOTAL TO	PRIME	PRIME	LABOR		
Description	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	SUBTOTAL	LOCATION*	SUBTOTAL	MARKUP	PRIME	OHEAD	PROFIT	MARKUP	CONTRACT COST	Notes
Drilling Activities																
Mob/demob	1	LS				3,500.00	3,500.00			0.00	3,500.00	525.00	350.00		4,375	
Drilling	2	DY				2,840.00	5,680.00			0.00	5,680.00	852.00	568.00		7,100	2 days of drilling
IDW Handling	1	LS				130.00	130.00			0.00	130.00	19.50	13.00		163	2 drums provided by drilling subcontractor
Subtotal											9,310.00				**11,638**	
Drilling Oversight / Soil Sampling																
Environmental Scientist - Surface Soil	88	HR	42.71			42.71	3,758.48			0.00	3,758.48			2,706.11	6,465	4 days of surface soil sample collection - 10 hours per day, two staff. 4 hours travel time. Wage based on FLC Data Center wage for Environmental Scientist for area
Environmental Scientist - Suburface Soil	24	HR	42.71			42.71	1,025.04			0.00	1,025.04			738.03	1,763	2 days of subsurface soil sample collection - 10 hours per day. 4 hours travel time. Wage based on FLC Data Center wage for Environmental Scientist for area
Per diem - Meals - Yosemite National Park	12	DY				76.00	912.00			0.00	912.00	136.80	91.20		1,140	GSA Rates, two staff
Per diem - Lodging - Yosemite National Park	12	DY			136.00	136.00	1,632.00			0.00	1,632.00	244.80	163.20		2,040	GSA Rates, two staff
Subtotal											7,327.52				**11,408**	
Laboratory Analytical																
CAM17 Metals by EPA Method 6020 and 7471	26	EA				90.00	2,340.00		2,340.00		2,340.00	351.00	234.00		2,925.00	
Hexavalent Chromium by SM 7196	26	EA				47.50	1,235.00		1,235.00		1,235.00	185.25	123.50		1,543.75	
PAHs by EPA Method 8270-sim	26	EA				95.00	2,470.00		2,470.00		2,470.00	370.50	247.00		3,087.50	
DRO/MRO with SC Cleanup by EPA Method 8015B	26	EA				55.00	1,430.00		1,430.00		1,430.00	214.50	143.00		1,787.50	
Dibenzodioxins/furans by EPA Method 8290	26	EA				450.00	11,700.00		11,700.00		11,700.00	1,755.00	1,170.00		14,625.00	Per Eurofins TestAmerica Sacramento Quote - 2/26/21. Assumes analysis of 13 total ISM surface soil samples for total concentration measurement, and 13 samples of soil leachate to characterize soils for disposal.
Organochlorine Pesticides by EPA Method 8081A	26	EA				85.00	2,210.00		2,210.00		2,210.00	331.50	221.00		2,762.50	
California Waste Extraction Test w/ Citrate Leach	13	EA				45.00	585.00		585.00		585.00	87.75	58.50		731.25	
Paint Filter Test	13	EA				15.00	195.00		195.00		195.00	29.25	19.50		243.75	
ISM Prep	13	EA				100.00	1,300.00		1,300.00		1,300.00	195.00	130.00		1,625.00	
Lab Disposal	26	EA				2.50	65.00		65.00		65.00	9.75	6.50		81.25	
Sample Delivery	1	LS				50.00	50.00		50.00		50.00	7.50	5.00		62.50	
Subtotal											23,580.00				**29,475**	
Cultural Resources Oversight																
Cultural Resources Technician	6	DY	165.00			165.00	990.00		990.00	247.50	1,237.50	185.63	123.75		1,546.88	5 days of oversight during drilling/soil sampling - 10 hours per day
Report Generation	1	LS				5,000.00	5,000.00		5,000.00	1,250.00	6,250.00	937.50	625.00		7,812.50	
Per diem - Meals - Yosemite National Park	6	DY				76.00	456.00		456.00	114.00	570.00	85.50	57.00		712.50	GSA Rates
Per diem - Lodging - Yosemite National Park	6	DY			136.00	136.00	816.00		816.00	204.00	1,020.00	153.00	102.00		1,275.00	GSA Rates
Subtotal											9,077.50				**11,347**	
Report Generation																
Environmental Engineer	30	HR	51.70			51.70	1,551.00		1,551.00		1,551.00			1,116.72	2,667.72	Wage based on FLC Data Center wage for Environmental Engineer for area
Environmental Scientist	30	HR	42.71			42.71	1,281.30		1,281.30		1,281.30			922.54	2,203.84	Wage based on FLC Data Center wage for Environmental Scientist for area
Drafter - Figures/Tables	25	HR	22.51			22.51	562.75		562.75		562.75			405.18	967.93	Wage based on FLC Data Center wage for Architectural and Civil Drafters for area
Admin	8	HR	18.59			18.59	148.72		148.72		148.72			107.08	255.80	Wage based on FLC Data Center wage for Office Clerk for area
Print / Deliver Report	1	LS				250.00	250.00		250.00		250.00	37.50	25.00		312.50	
Subtotal											3,793.77				**6,408**	

Notes:
All costs listed in US dollars ($)
* - Used for RSMeans cost estimates only. Increases cost 1% for every 10 miles from Modesto, CA. Site is 90 miles from Modesto, CA.
LS - Lump sum
ACR - Acre
SY - Square yards
DY - Day
HR - Hour
EA - Each
CY - Cubic yard
MSF - Thousand square feet
Contract cost rounded up to total dollars

Alternative 3 - Excavation and Disposal of Contaminated Soils at Licensed Disposal Facility

Scope:	Soil Excavation							9%		25%		15%	10%			
Applies:	**Year 0**					UNIT		REMOTE		SUB	TOTAL TO	PRIME	PRIME	LABOR		
Description	QTY	UNIT	LABOR	EQUIP	MTRL	TOTAL	SUBTOTAL	LOCATION*	SUBTOTAL	MARKUP	PRIME	OHEAD	PROFIT	MARKUP	CONTRACT COST	Notes
Mob/demob	2	LS				4,000.00	8,000.00		8,000.00		8,000.00	1,200.00	800.00		**10,000**	Per CVE Quote - 2/26/21. Assumes 2 separate mobilizations for excavation and backfill
Site Preparation																
Clear Vegetation	0.5	ACR	1,001.00	198.34		1,199.34	599.67	53.97	653.64	163.41	817.05	122.56	81.71		1,021.31	RSMeans 311313100020 for Modesto, CA
Construct Access	520	SY	2.95	0.28	5.40	8.63	4,487.60	403.88	4,891.48	1,222.87	6,114.36	917.15	611.44		7,642.94	RSMeans 015523500050 for Modesto, CA
Erosion Control	800	LF	1.27	0.27	0.43	1.97	1,576.00	141.84	1,717.84	429.46	2,147.30	322.10	214.73		2,684.13	RSMeans 312514161000 for Modesto, CA
Subtotal											9,078.71				**11,348**	
Excavation Activities	8	DY	3,800.00	1,900.00		5,700.00	45,600.00		45,600.00		45,600.00	6,840.00	4,560.00		**57,000**	Per CVE Quote - 2/26/21
Soil Disposal/Transportation - Cal-Haz																
Soil Disposal	287.00	TON			100.00	100.00	28,700.00		28,700.00		28,700.00	4,305.00	2,870.00		35,875.00	205 cubic yards = approximately 287 tons
Transportation	287.00	TON			122.00	122.00	35,014.00		35,014.00		35,014.00	5,252.10	3,501.40		43,767.50	Per CVE Quote - 2/26/21. Assumes $195/hr, hauling 80 tons/day, 50 hours/week
Subtotal											63,714.00				**79,643**	
Soil Disposal/Transportation - RCRA-Haz																
Soil Disposal	147.00	TON			230.00	230.00	33,810.00		33,810.00		33,810.00	5,071.50	3,381.00		42,262.50	105 cubic yards = approximately 147 tons
Transportation	147.00	TON			122.00	122.00	17,934.00		17,934.00		17,934.00	2,690.10	1,793.40		22,417.50	Per CVE Quote - 2/26/21. Assumes $195/hr, hauling 80 tons/day, 50 hours/week
Subtotal											51,744.00				**64,680**	
Excavation Oversight / Soil Sampling																
Environmental Engineer	88	HR	51.70			51.70	4,549.60		4,549.60		4,549.60			3,275.71	7,825.31	8 days of excavation oversight - 10 hours per day. 8 hours travel time. Wage based on FLC Data Center mean wage for Environmental Engineer for area
Environmental Engineer	58	HR	51.70			51.70	2,998.60		2,998.60		2,998.60			2,158.99	5,157.59	5 days of confirmation soil sampling - 10 hours per day. 8 hours travel time. Wage based on FLC Data Center mean wage for Environmental Engineer for area
Environmental Engineer	58	HR	51.70			51.70	2,998.60		2,998.60		2,998.60			2,158.99	5,157.59	5 days of backfill oversight - 10 hours per day. 8 hours travel time. Wage based on FLC Data Center wage for mean Environmental Engineer for area
Per diem - Meals - Yosemite National Park	18	DY				76.00	1,368.00		1,368.00		1,368.00	205.20	136.80		1,710.00	
Per diem - Lodging - Yosemite National Park	18	DY			136.00	136.00	2,448.00		2,448.00		2,448.00	367.20	244.80		3,060.00	
Subtotal															**22,910**	
Laboratory Analytical																
CAM17 Metals by EPA Method 6020 and 7471	12	EA				90.00	1,080.00		1,080.00		1,080.00	162.00	108.00		1,350.00	Per Euorins TestAmerica Sacramento Quote - 2/26/21. Assumes 18 total ISM confirmation soil samples to be collected from excavation sidewalls and bottoms
Hexavalent Chromium by SM 7196	12	EA				47.50	570.00		570.00		570.00	85.50	57.00		712.50	
PAHs by EPA Method 8270-sim	12	EA				95.00	1,140.00		1,140.00		1,140.00	171.00	114.00		1,425.00	
DRO/MRO with SC Cleanup by EPA Method 8015B	12	EA				55.00	660.00		660.00		660.00	99.00	66.00		825.00	
Dibenzodioxins/furans by EPA Method 8290	12	EA				450.00	5,400.00		5,400.00		5,400.00	810.00	540.00		6,750.00	
Organochlorine Pesticides by EPA Method 8081A	12	EA				85.00	1,020.00		1,020.00		1,020.00	153.00	102.00		1,275.00	
ISM prep	12	EA				100.00	1,200.00		1,200.00		1,200.00	180.00	120.00		1,500.00	
Lab Disposal	12	EA				2.50	30.00		30.00		30.00	4.50	3.00		37.50	
Sample Delivery	1	LS				50.00	50.00		50.00		50.00	7.50	5.00		62.50	
Subtotal															**13,938**	
Excavation Backfill - NPS Material Source																
Subsoil backfill material	300	CY			0.00	0.00	0.00		0.00		0.00	0.00	0.00		0.00	Assumes NPS source from Park
Subsoil backfill material - trucking	195	HR			105.00	105.00	20,475.00		20,475.00		20,475.00	3,071.25	2,047.50		25,593.75	Per CVE quote - 2/26/21
Sandy loam topsoil	60	CY			0.00	0.00	0.00		0.00		0.00	0.00	0.00		0.00	Assumes NPS source from Park
Sandy loam topsoil - Trucking	195	HR			15.00	15.00	2,925.00		2,925.00		2,925.00	438.75	292.50		3,656.25	Per CVE quote - 2/26/21
Backfill Excavation Areas	5	DY	3,800.00	1,900.00		5,700.00	28,500.00		28,500.00		28,500.00	4,275.00	2,850.00		35,625.00	Per CVE quote - 2/26/21
Subtotal															**64,875**	
Site Survey	1	LS				3,700.00	3,700.00		3,700.00		3,700.00	555.00	370.00		**4,625**	Post-excavation. Per Bedrock Engineering Quote - 2/18/21
Site Restoration																
NPS pre/post photodocumentation of Site	1	LS				675	675.00		675.00		675.00				675.00	Per Erin Dickman, NPS - email - 5/5/21. Conducted by NPS.
NPS revegetation of cap and road areas	1	LS				27,399	27,399.00		27,399.00		27,399.00				27,399.00	Per Alisa Simonoff-Smith, NPS - quote - 5/6/21. Conducted by NPS
NPS invasive species control	1	LS				4,500	4,500.00		4,500.00		4,500.00				4,500.00	Per David Campbell, NPS - email - 5/6/21. Conducted by NPS.
Subtotal															**37,199**	

Scope:	Soil Excavation							9%		25%		15%	10%			
Applies:	Year 0					UNIT		REMOTE		SUB	TOTAL TO	PRIME	PRIME	LABOR	CONTRACT COST	
Description	QTY	UNIT	LABOR	EQUIP	MTRL	TOTAL	SUBTOTAL	LOCATION*	SUBTOTAL	MARKUP	PRIME	OHEAD	PROFIT	MARKUP		Notes
Cultural Resources Oversight																
Cultural Resources Technician	18	DY	165.00			165.00	2,970.00		2,970.00	742.50	3,712.50	556.88	371.25		4,640.63	18 days of oversight. - 10 hours per day
Report Generation	1	LS				5,000.00	5,000.00		5,000.00	1,250.00	6,250.00	937.50	625.00		7,812.50	
Per diem - Meals - Yosemite National Park	18	DY				76.00	1,368.00		1,368.00	342.00	1,710.00	256.50	171.00		2,137.50	
Per diem - Lodging - Yosemite National Park	18	DY			136.00	136.00	2,448.00		2,448.00	612.00	3,060.00	459.00	306.00		3,825.00	
Subtotal															**18,416**	
Report Generation																
Environmental Engineer	50	HR	51.70			51.70	2,585.00		2,585.00		2,585.00			1,861.20	4,446.20	Wage based on FLC Data Center wage for Environmental Engineer for area
Environmental Scientist	50	HR	42.71			42.71	2,135.50		1,708.40		1,708.40			1,230.05	2,938.45	Wage based on FLC Data Center wage for Environmental Scientist for area
Drafter - Figures/Tables	25	HR	22.51			22.51	562.75		450.20		450.20			324.14	774.34	Wage based on FLC Data Center wage for Architectural and Civil Drafters for area
Admin	8	HR	18.59			18.59	148.72		148.72		148.72			107.08	255.80	Wage based on FLC Data Center wage for Office Clerk for area
Print / Deliver Report	1	LS				250.00	250.00		250.00		250.00	37.50	25.00		312.50	
Subtotal															**8,727**	

Notes:
All costs listed in US dollars ($)
* - Used for RSMeans cost estimates only. Increases cost 1% for every 10 miles from Modesto, CA. Site is 90 miles from Modesto, CA.
LS - Lump sum
ACR - Acre
SY - Square yards
DY - Day
HR - Hour
EA - Each
CY - Cubic yard
MSF - Thousand square feet
Contract cost rounded up to total dollars

Alternative 3 - Excavation and Disposal of Contaminated Soils at Licensed Disposal Facility

Scope:	**NPS Invasive Species Control**							9%		25%		15%	10%			
Applies:	**Years 1-3**					UNIT		REMOTE		SUB	TOTAL TO	PRIME	PRIME	LABOR		
Description	QTY	UNIT	LABOR	EQUIP	MTRL	TOTAL	SUBTOTAL	LOCATION*	SUBTOTAL	MARKUP	PRIME	OHEAD	PROFIT	MARKUP	CONTRACT COST	Notes
Invasive Species Control																
NPS invasive species control	1	LS				4,500	4,500.00		4,500.00		4,500.00				4,500.00	Per David Campbell, NPS - email - 5/6/21. Conducted by NPS, repeated for 3 years post-removal.
Subtotal															**4,500**	

Notes:
All costs listed in US dollars ($)
* - Used for RSMeans cost estimates only. Increases cost 1% for every 10 miles from Modesto, CA. Site is 90 miles from Modesto, CA.
LS - Lump sum
ACR - Acre
SY - Square yards
DY - Day
HR - Hour
EA - Each
CY - Cubic yard
MSF - Thousand square feet
Contract cost rounded up to total dollars

Appendix E – Compliance with ARARs Analysis

Compliance with ARARs is one of the evaluation criteria for removal actions pursuant to CERCLA section 106 as required by NCP Section 300.415. Section 4 of the Engineering Evaluation/Cost Analysis (EE/CA) summarizes the potential chemical-, location-, and action-specific ARARs identified for the removal action. This appendix provides a detailed alternative analysis of the compliance with ARARs for each retained removal alternative in the EE/CA. The purpose of this appendix to supplement the analysis of compliance with ARARs that is summarized in Section 6 of the EE/CA.

Table E-1 Compliance with Chemical-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives		
			Alternative 1 **No Action**	**Alternative 2** **In-Place Capping of Contaminated Soils**	**Alternative 3** **Excavation and Disoposal of Contaminated Soils at Licensed Disposal Facilities**
Permissible Exposure Limits	8 CCR 5155 [29 CFR 1910.1001]	Standards for worker exposure to airborne contaminants.	Because this alternativewould involve no action, worker exposure standards from this ARAR would not be pertinent to this alternative.	Compliance with standards would be attained during implementation through use of engineering measures, primarily dust control and personal protective equipment (PPE).	

Table E-1 Compliance with Chemical-Specific Applicable or Relevant and Appropriate Requirements					
			Alternatives		
ARAR	Citation	Description	Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Air Basins and Air Quality Standards	17 CCR Div. 3, Chapter 1, Subchapter 1.5	Establishes California Air Basins and sets limits for air emissions and air quality levels that protect public health.	Compliance would be attained because this alternative would involve no action and would not result in newsources of emissions, therefore it would achieve emission standards from this ARAR.	Compliance would likely be attained because emissions from this alternative are expected to be minor and attributed to the useof trucks and heavy equipment. Therefore, given the scale of the cover required for this removal alternative andthe use of dust suppression measures, it is expected that it would achieve emission standards from this ARAR.	Compliance would likely be attained because emissions from this alternative are expected to be minor and attributed to the useof trucks and heavy equipment. Therefore, given the small scale of the excavation and backfill required for this removal alternative andthe use of dust suppression measures, it is expected that it would achieve emissions standards from this ARAR.

Table E-1 Compliance with Chemical-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives		
			Alternative 1 No Action	**Alternative 2 In-Place Capping of Contaminated Soils**	**Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
Hazardous Waste Determination - General	22 CCR Div. 4.5, Chapter 11, Article 1, §66261.2 §66261.3	A waste is classified as a Resource Conservation and Recovery Act (RCRA) hazardous waste if appears on a list and originates from a either a non-specific or specific source. Defines a waste and outlines the process for determining whether a waste is also a hazardous waste.	Because this alternativewould involve no action, waste classifications from this ARAR would not be pertinent to this alternative.	ARAR would likely not be pertinent since no waste is expected to be generated during construction of the cover. Contaminated soils with higher COC concentrations within the Cascades Former Creosote Dip Tank Site (the Site) would not be disturbed or generated during cover construction.	Compliance would be attained through characterization of waste generated during the excavation of contaminated soil to determine whether the waste is also a hazardous waste.

Table E-1 Compliance with Chemical-Specific Applicable or Relevant and Appropriate Requirements					
ARAR	Citation	Description	Alternatives		
			Alternative 1 **No Action**	**Alternative 2** **In-Place Capping of Contaminated Soils**	**Alternative 3** **Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
Hazardous Waste Determination - Characteristic of Toxicity	22 CCR Div. 4.5, Chapter 11, Article 4, §66261.24(a)(1) §66261.24(a)(2)	A waste is classified as a RCRA hazardous waste if the extract produced by the Toxicity Characteristic Leaching Procedure (TCLP) exceeds specified levels. A waste is classified as a non-RCRA, State-only hazardous wastes if the total concentration exceeds the Total Threshold Limit Concentration (TTLC) or if the extract produced by application of the Waste Extraction Test (WET) exceeds the Soluble Threshold Limit Concentration (STLC).	Because this alternative would involve no action, waste classifications from this ARAR would not be pertinent to this alternative.	ARAR would likely notbe pertinent since no waste is expected to be generated during construction of the cover. Contaminated soils with higher COC concentrations within the Site would not be disturbed or generated during cover construction.	Compliance would be attained through characterization of waste generated during the excavation of contaminated soil to determine whether the waste is also a non-RCRA, state-only hazardous waste.

Table E-1 Compliance with Chemical-Specific Applicable or Relevant and Appropriate Requirements					
			Alternatives		
ARAR	**Citation**	**Description**	**Alternative 1 No Action**	**Alternative 2 In-Place Capping of Contaminated Soils**	**Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
RCRA Hazardous Waste Determination - Listed Wastes	22 CCR Div. 4.5, Chapter 11, Article 4, §66261.30 §66261.31 §66261.32	A waste is classified as a RCRA hazardous waste if it appears on a list and originates from a either a non-specific or specific source.	Because this alternative would involve no action, waste classifications from this ARAR would not be pertinent to this alternative.	ARAR would likely notbe pertinent since no waste is expected to be generated during construction of the cover. Contaminated soils with higher COC concentrations within the Site would not be disturbed or generated during cover construction.	Compliance would be attained through characterization of waste generated during pre-design investigation and, if necessary, during excavation activities, to determine whether the waste is also a hazardous waste.

Table E-1 Compliance with Chemical-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives		
			Alternative 1 No Action	**Alternative 2 In-Place Capping of Contaminated Soils**	**Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
RCRA Hazardous Waste Determination	22 CCR Div. 4.5, Chapter 11, Article 4.1, §66261.100 §66261.101	Criteria for determining whether a waste is a RCRA, or non-RCRA California, hazardous waste. In order to be characterized as a non-RCRA California hazardous waste it must first be established that the waste is not a RCRA waste.	Because this alternative would involve no action, waste classifications from this ARAR would not be pertinent to this alternative.	ARAR would likely not be pertinent since no waste is expected to be generated during construction of the cover. Contaminated soils with higher COC concentrations within the Site would not be disturbed or generated during cover construction.	Compliance would be attained through characterization of waste generated during the excavation of contaminated soil to determine whether the waste is also a RCRA, or non-RCRA California, hazardous waste.

Table E-1 Compliance with Chemical-Specific Applicable or Relevant and Appropriate Requirements					
			Alternatives		
ARAR	Citation	Description	Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
California Land Disposal Restrictions	22 CCR Div. 4.5, Chapter 18, Article 4, §66268.40 §66268.48	Treatment standards that must be attained prior to land disposal of certain wastes. Establishes numerical universal treatment standards by chemical constituent that may not be exceeded under the land disposal restrictions (LDRs). Following excavation, contaminated soil determined to be a hazardous waste may be subject to LDRs if placed on land in a waste management unit outside the Area of Contamination from where the waste was generated.	Because this alternative would involve no action, waste classifications from this ARAR would not be pertinent to this alternative.	ARAR would likely not be pertinent since no waste is expected to be generated during construction of the cover. Contaminated soils with higher COC concentrations that potentially have characteristics of hazardous waste within the Site would not be disturbed or generated during cover construction.	Compliance would be attained through characterization of waste generated during the excavation of contaminated soil to determine whether the waste exceeds LDRs.

Table E-1 Compliance with Chemical-Specific Applicable or Relevant and Appropriate Requirements					
ARAR	Citation	Description	Alternatives		
			Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Waste Classification	27 CCR Div. 2, Sub-division 1, Chapter 3, Sub-chapter 2, Article 2	Definitions of designated waste, non-hazardous waste, and inert waste.	Because this alternative would involve no action, waste classifications from this ARAR would not be pertinent to this alternative.	This ARAR pertains to classifications of waste for disposal at off-site facilities. Because this alternative would involve covering withinthe Site and would not involve removal and disposal of waste off- site, it is unlikely that this ARAR would be pertinent.	Compliance would be attained through characterization of waste generated during the excavation of contaminated soil to determine the waste classification.

Table E-1 Compliance with Chemical-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives		
			Alternative 1 No Action	**Alternative 2 In-Place Capping of Contaminated Soils**	**Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
Risk Assessment Standards	H&SC 25356.1.5(b)	In addition to meeting NCP requirements, risk assessments must include the most current sound scientific methods, knowledge, and practices of public health and environmental professionals.	Because this alternative would involve no action, implementation of risk assessment standards from this ARAR would not be pertinent to this alternative.	Risk assessments performed as part of this response action follow CalEPA DTSC and other guidance for these assessments that comply with this ARAR. If implementation of the removal alternative involves the performance of additional risk assessments, particularly post-construction risk assessments, compliance would be attained through consideration of substantive requirements in the development of risk assessments.	

Table E-1 Compliance with Chemical-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives		
			Alternative 1 **No Action**	**Alternative 2** **In-Place Capping of Contaminated Soils**	**Alternative 3** **Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
Tuolumne County Air Pollution Control Standards	Tuolumne County Air Pollution Control District (APCD) Rules 202, 205, 207, 209, 210, 413, 414 APCD Regulation IV	Establishes rules for visible and/or nuisance emissions. Establishes emission standards for NO_x, CO, and particulate matter. Establishes emissions standards for toxic air contaminants.	Compliance would be attained because this alternative would involve no action and would not result in newsources of emissions, therefore it would achieve emission standards from this ARAR.	Compliance would likely be attained because emissions from this alternative are expected to be minor and attributed to the use of trucks and heavy equipment. Therefore, given the scale of the cover required for this removal alternative and the use of dust suppression measures, it is expected that it would achieve emission standards from this ARAR.	Compliance would likely be attained because emissions from this alternative are expected to be minor and attributed to the use of trucks and heavy equipment. Most contaminants that may be exposed in the excavation are not volatile contaminants and therefore vapor emissions from the excavations are considered unlikely to be significant. Therefore, given the scale of the excavation and backfill required for this removal alternative and the use of dust suppression measures, it is expected that it would achieve emission standards from this ARAR.

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives		
			Alternative 1 No Action	**Alternative 2 In-Place Capping of Contaminated Soils**	**Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
NPS mandate to ensure non-impairment of national park resources for the enjoyment of future generations and the non-degradation of national park values and purposes	National Park Service Organic Act of 1916 16 U.S.C. §§ 1 *et seq.* 36 CFR Part 1 General Authorities Act, as amended 16 U.S.C § 1a-1	The Organic Act directs the National Park Service "to promote and regulate the use of … national parks … by such means and measures as conform to the fundamental purpose of the said parks … which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."	Compliance would not be attained since no response measures would be undertaken toaddress unacceptable human health and ecological risks that would not allow for full enjoyment and utilization of park resources.	Surface grading and capping with a vegetated protective cap would be compliant with the Organic Act and the non-impairment mandate because it would not restrict or otherwise limit the enjoyment of the park by future visitors, based on the current and future use as a wilderness area. In addition, the implementation of a soil cover that would restore the surface layer approximately matching surface conditions would result in a remedy that addresses the unacceptable human health and ecological risks while also complying with the non-impairment mandate.	Excavation and offsite disposal of contaminated soils would be compliant with the Organic Act and the non-impairment mandate because it would not restrict or otherwise limit the enjoyment of the park by future visitors, basedon the current and future use as a wilderness area. In addition, the backfill and restoration of the excavation areas would include restoring the surface layer to match the current surface conditions, which would result in a remedy that addresses the unacceptable human health and ecological risks while also complying with the non-impairment mandate.

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives: Alternative 1 No Action	Alternatives: Alternative 2 In-Place Capping of Contaminated Soils	Alternatives: Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Yosemite National Park enabling legislation	16 U.S.C. §§ 47-1 *et seq*.	"The Secretary of the Interior shall make and publish such general rules and regulations as he may deem necessaryand proper for the management and care of the park and for the protection of the property therein, especially for the preservation from injury or spoliation of all timber, mineral deposits other than those legally located prior to the date of passage of the respective Acts creating and establishing said parks, natural curiosities or wonderful objects within said parks, and for the protection of the animals in the park from capture or destruction, and to prevent their being frightened or driven from the said parks."	Compliance would be attained since no response measures would be undertaken and timber, mineral deposits, and animals are not anticipated to be further injured or spoiled by the presence of the Site beneath the existing parking lot.	In compliance with this ARAR, the construction and maintenance of protective caps would be designed and implemented in a manner to protect timber, mineral deposits, and other parkresources. Specific issues to be considered include protection of trees and wildlife adjacent to the Site and the acquisition of borrow from acceptable sources.	In compliance with this ARAR, the excavation of contaminated soils and backfill of excavated areas would be designed and implemented in a manner to protect timber, mineral deposits, and other park resources. Specific issues to be considered include protection of trees and wildlife adjacent to the Site and the acquisition of borrow from acceptable sources.

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements					
			Alternatives		
ARAR	**Citation**	**Description**	**Alternative 1** **No Action**	**Alternative 2** **In-Place Capping of Contaminated Soils**	**Alternative 3** **Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
Restrictions on solid waste disposal sites in National Parks	16 U.S.C. § 460*l*-22(c) 36 CFR Part 6	Prohibits operation of any solid waste disposal site that was not in operation on September 1, 1984, except for sites used only for disposal of wastes generated within the park unit, so long as such site will not degrade any natural or cultural resources of the park unit. Prohibits the operation of any solid waste disposal site, except as specifically provided	Compliance would be attained since no response measures would be undertaken and the Site is no longer used for placement of wastes or any other waste operations.	Compliance would be attained as the response measures associated with this alternative include covering of the Site rather than creatingor continuing use of a solid waste disposal site.	Compliance would be attained as offsite disposal of contaminated soils will not create new solid waste disposal sites norcontinue use of existing solid waste disposal sites.

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements					
ARAR	Citation	Description	Alternatives		
			Alternative 1 **No Action**	**Alternative 2** **In-Place Capping of Contaminated Soils**	**Alternative 3** **Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
Restrictions on solid waste disposal sites in National Parks	16 U.S.C. § 460*l*-22(c) 36 CFR Part 6	Prohibits operation of any solid waste disposal site that was not in operation on September1, 1984, except for sitesused only for disposal of wastes generated within the park unit, so long as such site will not degrade any natural or cultural resources of the park unit. Prohibits the operation of any solid waste disposal site, except as specifically provided or by the regulations. 36 CFR § 6.4 specifies 12 conditions that must be met before a new solid waste disposal sitemay be authorized in a National Park, including the condition that there will be no disposal of the site of solid waste containing hazardous waste, polychlorinated biphenyls (PCBs), or radioactive materials.	Compliance would be attained since no response measures would be undertaken and the Site is no longer used for placement of wastes or any other waste operations.	Compliance would be attained as the response measures associated with this alternative include covering of the Site rather than creating or continuing use of a solid waste disposal site.	Compliance would be attained as off-Site disposal of contaminated soils will not create new solid waste disposal sites norcontinue use of existing solid waste disposal sites.

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements					
			Alternatives		
ARAR	Citation	Description	Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
NPS restrictions of public use and recreation activities to protect national park resources	36 CFR Part 2: Resource Protection, Public Use and Recreation 36 CFR Part 7	Prohibits specific public use and recreational activities in national parks in order to protect park resources. For example, 36 CFR § 2.1(a) prohibits " (1) Possessing, destroying, injuring, defacing, removing, digging, or disturbing from its natural state: (i) wildlife or fish (ii) Plants or the parts or products thereof [or] (2) Introducing plants into a park area ecosystem." 36 CFR § 2.2(a)(2) prohibits "feeding, touching, teasing, frightening or intentional disturbing ofwildlife nesting, breeding or other activities." 36 CFR § 2.14(a) prohibits "(1) Disposing of refuse in other than refuse receptacles (6) Polluting or contaminating park area waters or water courses." Park-specific public use and recreational rules.	Because this alternative would involve no action, prohibitions on park uses and activities from this ARAR would not be pertinent to this alternative.	In compliance with this ARAR, the construction and maintenance of protective caps would be designed and implemented in a manner to protect park resources and would avoid restricted or prohibited activities. Specific issues to be considered include protection of trees and wildlife adjacent to the Site and use of erosion and sedimentation controls and best management practices for stormwater.	In compliance with this ARAR, the excavation of contaminated soils and backfill of excavated areas would be designed and implemented in a manner to protect park resources and would avoid restricted or prohibited activities. Specific issues to be considered include protection of trees and wildlife adjacent to the Site and use of erosionand sedimentation controls and best management practices for stormwater.

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives		
			Alternative 1 **No Action**	**Alternative 2** **In-Place Capping of Contaminated Soils**	**Alternative 3** **Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
Restrictions on solid waste disposal sites in National Parks	16 U.S.C. § 460*l*-22(c) 36 CFR Part 6	Prohibits operation of any solid waste disposal site that was not in operation on September 1, 1984, except for sites used only for disposal of wastes generated within the park unit, so long as such site will not degrade any natural or cultural resources of the park unit. Prohibits the operation of any solid waste disposal site, except as specifically provided	Compliance would be attained since no response measures would be undertaken and the Site is no longer used for placement of wastes or any other waste operations.	Compliance would be attained as the response measures associated with this alternative include covering of the Site rather than creatingor continuing use of a solid waste disposal site.	Compliance would be attained as offsite disposal of contaminated soils will not create new solid waste disposal sites norcontinue use of existing solid waste disposal sites.

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives		
			Alternative 1 No Action	**Alternative 2 In-Place Capping of Contaminated Soils**	**Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
NPS restrictions of commercial and private operations in national parks, including the prohibition of nuisances	36 CFR Part 5 36 CFR § 5.13	Regulates commercial use of national parks and the resources therein (e.g., commercial notices, advertisements, photography, business operations). Prohibits the creation or maintenance of a nuisance upon federal or private lands within a park area.	Because this alternative would involve no action, prohibitions on nuisances and regulations on commercial or private use of a park unit from this ARAR would not be pertinent to this alternative.	The implementation and maintenance of protective caps would be designed in a manner to not create a nuisance or involve commercial or private use of a park unit in compliance with this ARAR.	The implementation of the excavation and offsite disposal of contaminated soils would be designed in a manner to not create a nuisance or involve commercial or private use of a park unit in compliance with this ARAR.

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives		
			Alternative 1 **No Action**	**Alternative 2** **In-Place Capping of Contaminated Soils**	**Alternative 3** **Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
National Historic Preservation Act	16 U.S.C. §§ 470 *et seq.* 36 CFR Part 800	Requires federal agencies to consider the effect of any federally assisted undertaking on any district, site building, structure, or object that is included in, or eligible for, the Register of Historic Places and to minimize or mitigate reasonably unavoidable effects. Indian cultural and historical resources must be evaluated, and effects avoided, minimized, or mitigated.	Because this alternative would involve no action, requirements from this ARAR for identification and protection of any existing historic or cultural resources would not be pertinent to this alternative.	Past investigations indicate the likely presence of historic and cultural resources at the Site. Compliance would be attained through identification of any existing historic or cultural resources and coordination and consultation with appropriate governmental agencies to ensure that the removal action would be comply with this ARAR.	

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives		
			Alternative 1 **No Action**	**Alternative 2** **In-Place Capping of Contaminated Soils**	**Alternative 3** **Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
Historic Sites, Buildings, and Antiquities Act	16 U.S.C. §§ 461 *et seq*.	Requires federal agencies to consider the existence and location of historic or prehistoric sites, buildings, objects,and properties of national historical or archaeological significance when evaluating removal alternatives.	Because this alternative would involve no action, requirements from this ARAR for identification and protection of any existing areas of historic or archaeological significance would not be pertinent to this alternative.	Compliance would be attained through identification of any existing areas of historical or archaeological significance. If such areas are found, those areas would be avoided or the removal action would be modified to comply with this ARAR.	

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives: Alternative 1 No Action	Alternatives: Alternative 2 In-Place Capping of Contaminated Soils	Alternatives: Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Archaeological and Historic Preservation Act	16 U.S.C. §§ 469 *et seq*.	Establishes requirements for evaluation and preservation of historical and archaeological data, including Indian cultural and historic data, which may be destroyed through alteration of terrain as a result of federal construction projects, *inter alia*. If eligible scientific, pre-historical,or archaeological data are discovered during site activities, such data must be preserved in accordance with these requirements.	Because this alternative would involve no action, requirements from this ARAR for identification and protection of any existing archaeological or historical resources would not be pertinent to this alternative.	Past investigations indicate the likely presence of historical and archeological resources at the Site. Compliance would be attained through identification of any existing historic or cultural resources and coordination and consultation with appropriate governmental agencies.	

<table>
<tr><th colspan="6">Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements</th></tr>
<tr><th rowspan="2">ARAR</th><th rowspan="2">Citation</th><th rowspan="2">Description</th><th colspan="3">Alternatives</th></tr>
<tr><th>Alternative 1
No Action</th><th>Alternative 2
In-Place Capping of Contaminated Soils</th><th>Alternative 3
Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities</th></tr>
<tr><td>Archaeological Resources Protection Act</td><td>16 U.S.C. §§ 470 aa-ii et seq.

43 CFR §§ 7.1 et seq.</td><td>Provides for the protection of archeological resources located on public and tribal lands. Establishes criteria that must be metfor the land manager's approval of any excavation or removal of archaeological resources if a proposed activity involves soil disturbances.</td><td>Because this alternativewould involve no action, requirements from this ARAR for identification and protection of any existing archaeological resources would not be pertinent to this alternative.</td><td colspan="2">Past investigations indicate the likely presence of historical and archeological resources at the Site. Compliance would be attained through identification of any existing historic or cultural resources and coordination and consultation with appropriate governmental agencies.</td></tr>
</table>

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives: Alternative 1 No Action	Alternatives: Alternative 2 In-Place Capping of Contaminated Soils	Alternatives: Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Native American Graves Protection and Repatriation Act (NAGPRA)	25 U.S.C. § 3001 25 U.S.C. § 3002(d) 43 CFR §§ 10.1 – 10.17	Provides for the disposition of Native American remains and objects inadvertently discovered on federal or tribal lands after November 1990. If the response activities result in the discovery of Native American human remains or related objects, the activity must stop while the head of the federal land management agency (in this case, NPS) and appropriate Indian tribes are notified of the discovery. After the discovery, the response activity must cease and a reasonable effort must be made to protect the Native American human remains or related objects. The response activity may later resume (43 CFR Section 10.4).	Because this alternative would involve no action, requirements from this ARAR for identification and protection of any existing Native American remains and objects would not be pertinent to this alternative.	Compliance would be attained through identification of any existing Native American remains and objects. Since the alternative would primarily involve the placement of protective cap materials over a small area that has already been the subject of an archeological study, the likelihood of those features being present and not already identified would be low. However, if such remains or objects are found, work on the removal action would not begin or would pause in compliance with the ARAR. If necessary, the removal action would be modified to protect those objects and comply with this ARAR.	Compliance would be attained through identification of any existing Native American remains and objects. Since the alternative would primarily excavation and backfill over a small area that has already been the subject of an archeological study, the likelihood of those features being present and not already identified would be low. However, if such remains or objects are found, work on the removal action would not begin or would pause in compliance with the ARAR. If necessary, the removal action would be modified to protect those objects and comply with this ARAR.

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements					
			Alternatives		
ARAR	Citation	Description	Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Endangered Species Act	16 U.S.C. §§ 1531 – 1544 50 CFR Part 402	No federal activity or federally authorized activity may jeopardize the continued existence of any threatened or endangered species known to live or to havelived in the affected environment; nor may any federal activity destroy or adversely modify a critical habitat. This ARAR requires NPS to ensure that the selected remedy is sufficiently protective of the environment containing the threatened or endangered species, with an emphasis on reducing the risks from the contaminants of concern to the listed species described in the ecological risk assessment to an acceptable level, with consideration given to the special status of the listed or threatened species. Also requires that NPS ensure that the selected remedy is implemented in a manner such that effects on any existing threatened or endangered species are avoided or mitigated.	Because this alternative would involve no action, requirements from this ARAR for identification and protection of any threatened or endangered species would not be pertinent to this alternative.	As discussed in Section 2.8.1 of this evaluation, no federally threatened, endangered, or sensitive animal species are expected to be present at the Site. Screening values used in the SLERA conducted as part of this evaluation are sufficient for protection of threatened and endangered species (NPS, 2018). Approaches used in the BERA conducted for the Site as part of this evaluation are intended to be protective of all ecological receptors, using conservative assumptions. If threatened or endangered species are identified within the Site, activities would be designed to conserve the species and their habitat and avoid disturbances for compliance with this ARAR.	

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements					
			Alternatives		
ARAR	Citation	Description	Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Wilderness Act	16 U.S.C. §§ 1131 – 1136	Requires that federally-owned, designated Wilderness Areas be administered in such manner as will leave them unimpaired for future use and enjoyment, and to protect and preserve the wilderness character of these areas. Requires that there shall be no commercial enterprise or permanent road within designated wilderness areas, and, except as necessary to meet minimum requirements for the administration of the wilderness area for the purpose of the Act (including emergency measures to protect public health and safety), no temporary roads, use of motorized equipment, landing of aircraft, mechanical transport, or installation of any structures should be used or constructed in these areas.	Because this alternative would involve no action, limitations on uses and activities from this ARAR would not be pertinent to this alternative.	This alternative requires the use of methods (motorized equipment, temporary roadway, and creation of a protective soil cap that may be identified as an “installation”) that are prohibited by this ARAR, except as necessary to meet the minimum requirements for preservation of wilderness values. The removal action is necessary to meet requirements of other Federal laws, and to restore and preserve the untrammeled and natural characteristics of the wilderness area from the damages caused by contamination. To fully comply with this ARAR, a minimum requirements analysis may be required to document the rationale to proceed with a removal action.	This alternative requires the use of methods (motorized equipment, temporary roadway) that are prohibited by this ARAR, except as necessary to meet the minimum requirements for preservation of wilderness values. The removal action is necessary to meet requirements of other Federal laws, and to restore and preserve the untrammeled and natural characteristics of the wilderness area from the damages caused by contamination. To fully comply with this ARAR, a minimum requirements analysis may be required to document the rationale to proceed with a removal action.

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements					
ARAR	Citation	Description	Alternatives		
			Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
STATE					
Rare or Endangered Native Plants	FGC 1908 (Added by Stats. 1977, c. 1181, p. 3869, section 8) / 14 CCR §670.2	No person shall take, possess, or sell any native plant or any part of product thereof, which the California Fish and Game Commission (commission) determines to be an endangered native plant or rare native plant.	Because this alternative would involve no action, requirements from this ARAR for identification and protection of any rare or endangered plants would not be pertinent to this alternative.	As discussed in Section 2.8.1, no state threatened, endangered, or sensitive plant species are expected to be present at the Site. However, if rare or endangered plants are identified within the Site, activities would be designed and implemented to conserve the plant species and their habitat and avoid disturbances for compliance with this ARAR.	

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements					
			Alternatives		
ARAR	Citation	Description	Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Endangered Species	FGC 2080 (Added by Stats. 1984, c. 1240, section 2)	This section prohibits the take, possession, purchase or sale within the state, any species (including rare native plant species), or any product thereof, that the commission determines to be an endangered or threatened species, or the attempt of any of these acts. This section prohibits releases and/or actions that would have a deleterious effect on species or their habitat.	Because this alternativewould involve no action, requirements from this ARAR for identification and protection of any threatened or endangered species would not be pertinent to this alternative.	As discussed in Section 2.8.1, no state threatened, endangered, or sensitive animal and plant species are known to be present at the Site. However, if threatened or endangered species are identified within the Site, activities would be designed to conserve the species and their habitat and avoid disturbances for compliance with this ARAR.	

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives		
			Alternative 1 No Action	**Alternative 2 In-Place Capping of Contaminated Soils**	**Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
Areas used by Endangered or Threatened Species	FGC 2081(b)	The Department may authorize, by permit, the take of endangered or threatened species, and candidate species if the take is incidental to an otherwise lawful activity and the impacts are minimized and fully mitigated.	Because this alternative would involve no action, requirements from this ARAR for identification and protection of any endangered, threatened or candidate species would not be pertinent to this alternative.	As discussed in Section 2.8.1, no state threatened, endangered, or sensitive animal and plant species are known to be present at the Site. However, if endangered, threatened or candidate species would be identified within the Site, activities would be designed and implemented to minimize the impacts on the species for compliance with this ARAR.	

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements					
			Alternatives		
ARAR	Citation	Description	Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Wildlife Species	FGC 3005 (Stats. 1957, c. 456, p. 1353 section 3005)	This code section prohibits the taking of birds and mammals, including taking by poison.	Because this alternativewould involve no action, prohibitions on the “taking” or “poisoning” of wildlife from this ARAR wouldnot be pertinent to this alternative.	Since the alternative would primarily involve the placement of protective cap materials over small areas, the likelihood of the killing of or other adverse effects on birds and mammals is low. However, activities would be designed and implemented to minimize the exposure of birds and mammals to COCs and activities that have the potential for “poisoning” or “killing” them for compliance with this ARAR.	Since the alternative would primarily involve excavation and backfill over a small area, the likelihood of the killing of or other adverse effects on birds and mammals is low. However, activities would be designed and implemented to minimize the exposure of birds and mammals to COCs and activities that have the potential for “poisoning” or “killing” them for compliance with this ARAR.

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements					
ARAR	Citation	Description	Alternatives		
			Alternative 1 **No Action**	**Alternative 2** **In-Place Capping of Contaminated Soils**	**Alternative 3** **Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
Birds	FGC 3503	This section prohibits the take, possession, or needless destruction of the nest or eggs of any bird, except as otherwise provided by this code or any regulation made pursuant thereto.	Because this alternative would involve no action, requirements from this ARAR for identification and protection of nests or eggs of any bird would not be pertinent to this alternative.	Since the alternative would primarily involve the placement of protective cap materials over small areas, the likelihood of eggs or nests being present would be low. However, if nests or eggs of any bird are identified within the Site, activities would be designed and implemented to conserve the nests or eggs for compliance with this ARAR.	Since the alternative would primarily involve excavation and backfill over a small area, the likelihood of eggs or nests being present would be low. However, if nests or eggs of any bird are identified within the Site, activities would be designed and implemented to conserve the nests or eggs for compliance with this ARAR.

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements					
ARAR	Citation	Description	Alternatives		
			Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Birds of Prey	FGC 3503.5 (Added by Stats. 1985, c. 1334, section 6)	This section prohibits the take, possession, or destruction of any birds in the orders of Falconiformes or Strigiformes (birds-of-prey) or to take, possess, or destroy the nest or eggs of any such bird except as otherwise provided by this code or any regulation adopted pursuant thereto.	Because this alternative would involve no action, requirements from this ARAR for identification and protection of any birds of prey would not be pertinent to this alternative.	Since the alternative would primarily involve the protective cap materials over small areas, the likelihood of birds of prey being present would be low. However, if American Peregrine Falcons, Long-eared Owls, Great Grey Owls, California Spotted Owls, and/or their eggs are identified within the Site, activities would be designed and implemented to protect these species and conserve the nests and eggs of these species for compliance with this ARAR.	Since the alternative would primarily involve excavation and backfill over a small area, the likelihood of birds of prey being present would be low. However, if American Peregrine Falcons, Long-eared Owls, Great Grey Owls, California Spotted Owls, and/or their eggs are identified within the Site, activities would be designed and implemented to protect these species and conserve the nests and eggs of these species for compliance with this ARAR.

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements					
			Alternatives		
ARAR	Citation	Description	Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Migratory Birds	FGC 3513	This section makes it unlawful to take or possess any migratory nongame bird as designated in the Migratory Bird Treaty Act or any part of such migratory nongame bird except as provided by rules and regulations adopted by the Secretary of the Interior under provisions of the Migratory Bird Treaty Act.	Because this alternative would involve no action, requirements from this ARAR for identification and protection of any rare or endangered plants would not be pertinent to this alternative.	Since the alternative would primarily involve the placement of protective cap materials over small areas, the likelihood of migratory nongame birds being present would be low. However, if migratory nongame birds are identified within the Site, activities would be designed and implemented to protect these species for compliance with this ARAR.	Since the alternative would primarily involve excavation and backfill over a small area, the likelihood of migratory nongame birds being present would be low. However, if migratory nongame birds are identified within the Site, activities would be designed and implemented to protect these species for compliance with this ARAR.

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements					
			Alternatives		
ARAR	Citation	Description	Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Fully protected bird species / habitat	FGC 3511 (Added by Stats. 1970, c. 1036, p. 1848 section 4)	It is unlawful to take or possess California fully protected birds, the following of which have been identified within the Park and therefore may be located on or near the Site: American Peregrine Falcon Golden Eagle Southern Bald Eagle	Because this alternative would involve no action, requirements from this ARAR for identification and protection of any fully protected birds would not be pertinent to this alternative.	Since the alternative would primarily involve the placement of protective cap materials over small areas, the likelihood of protected birds being present would be low. However, if fully protected bird species are identified within the Site, activities would be designed and implemented to protect these species for compliance with this ARAR.	Since the alternative would primarily involve excavation and backfill over a small area, the likelihood of protected birds being present would be low. However, if fully protected bird species are identified within the Site, activities would be designed and implemented to protect these species for compliance with this ARAR.

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements					
ARAR	Citation	Description	Alternatives		
			Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Fully protected Mammals	FGC 4700 (Added by Stats. 1970, c. 1036, p. 1848 section 6)	This section prohibits the take or possession of California fully protected mammals or their parts. The following fully protected mammals have been identified within the Park: Ring-tailed Cat Sierra Nevada Bighorn Sheep	Because this alternative would involve no action, requirements from this ARAR for identification and protection of any fully protected mammals would not be pertinent to this alternative.	Since the alternative would primarily involvethe placement of protective cap materials over small areas, the likelihood of protected mammals being present would be low. However, if ring-tailed cats or Sierra Nevada Bighorn Sheep are identified within theSite, activities would be designed and implemented to protect these species for compliance with this ARAR.	Since the alternative would primarily involve excavation and backfill over a small area, the likelihood of protected mammals being present would be low. However, if ring-tailed cats or wolverines are identified within the Site, activities would be designed and implemented to protect these species for compliance with this ARAR.

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements					
			Alternatives		
ARAR	Citation	Description	Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Specially Protected Mountain Lion	FGC 4800 et. seq.	Mountain lions are specially protected mammals in California. It is unlawful to take, injure, possess, transport, or sell any mountain lion or any part or product thereof.	Because this alternative would involve no action, requirements from this ARAR for identification and protection of specially protected mountain lions would not be pertinent to this alternative.	As discussed in Section 2.8.1, no state threatened or endangered animal species are known to be present at the Site. However, if mountain lions are identified within the Site, activities would be designed and implemented to protect this species, for compliance with this ARAR.	

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements					
ARAR	Citation	Description	Alternatives		
			Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Fully protected Reptiles and Amphibians	FGC 5050	Prohibits the take or possession of California fully protected species of reptiles and amphibians.	Because this alternative would involve no action, requirements from this ARAR for identification and protection of any fully protected reptiles and amphibians would not be pertinent to this alternative.	Since the alternative would primarily involve the placement of protective cap materials over small areas, the likelihood of protected reptiles and amphibians being present would be low. However, if fully protected reptile or amphibian species are identified within the Site, activities would bedesigned and implemented to protect these species for compliance with this ARAR.	Since the alternative would primarily involve excavation and backfill over a small area, the likelihood of protected reptiles and amphibiansbeing present would be low. However, if fully protected reptile or amphibian species are identified within the Site, activities would be designed and implemented to protect these species for compliance with this ARAR.

Table E-2 Compliance with Location-Specific Applicable or Relevant and Appropriate Requirements					
			Alternatives		
ARAR	Citation	Description	Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Furbearing Mammals	14 CCR Div. 1, Sub-division 2, Chapter 5, §460	Regulation makes it unlawful to take fisher, marten, river otter, desert kit fox, or red fox.	Because this alternative would involve no action, requirements from this ARAR for identification and protection of any furbearing mammals would not be pertinent to this alternative.	Since the alternative would primarily involve the placement of protective cap materials over small areas, the likelihood of furbearing mammals being present would be low. However, if fishers, martens, river otters, desert kit foxes, or red foxes are identified within the Site, activities would bedesigned and implemented to protect these species for compliance with this ARAR.	Since the alternative would primarily involve excavation and backfill over a small area, the likelihood of furbearing mammals being present would be low. However, if fishers, martens, river otters, desert kit foxes, or red foxes are identified within the Site, activities would be designed and implemented to protect these species for compliance with this ARAR.

Table E-3 Compliance with Action-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives		
			Alternative 1 No Action	**Alternative 2 In-Place Capping of Contaminated Soils**	**Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
FEDERAL					
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR 264 Subpart I (§264.170 - §264.179)	Provides requirements for use and management of containers for storage of RCRA hazardous waste.	Because this alternative would involve no action, requirements from this ARAR for use and management ofcontainers for storage of RCRA hazardous waste would not be pertinent to this alternative.	ARAR would likely not be pertinent since no waste is expected to be generated during construction of the cover. However, if waste were to be containerized, compliance with this ARAR would be attained through adherence to substantive requirements for use and management of storage containers for RCRA hazardous waste.	Compliance would be attained through characterization of waste generated during the excavation of contaminated soil to determine whether the waste is also a hazardous waste and adherence to substantive requirements for use and management of storage containers for RCRA hazardous waste.

Table E-3 Compliance with Action-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives		
			Alternative 1 No Action	**Alternative 2 In-Place Capping of Contaminated Soils**	**Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
STATE					
General Hazardous Waste Disposal Facility Standards	22 CCR, Division 4.5, Chapter 14, Article 2: §66264.15 and §66264.19(c)(1 and 2)	§66264.15 provides substantive general inspection requirements applying to all hazardous waste facilities. §66264.19(c)(1 and2) provides substantive requirements for a Construction Quality Assurance (CQA) program including inspection and testing.	The Site is not by definition a hazardous waste transfer, treatment, storage, and disposal facility. Because this alternative would involve no action, requirements from this ARAR related to inspections and CQA during construction would not be pertinent to this alternative.	The Site is not by definition a hazardous waste transfer, treatment, storage, and disposal facility. However, compliance with this ARAR would be attained through adherence with substantive requirements related to inspections and CQA during construction of the cover.	The Site is not by definition a hazardous waste transfer, treatment, storage, and disposal facility. However, compliance with this ARAR would be attained through adherence with substantive requirements related to inspections and CQA during implementation of the removal alternative.

Table E-3 Compliance with Action-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives		
			Alternative 1 **No Action**	**Alternative 2** **In-Place Capping of Contaminated Soils**	**Alternative 3** **Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
Post-closure Care and Use of Property	22 CCR, Division 4.5, Chapter 14, Article 7 §66264.117 (b through d)	Provides requirements for hazardous waste management units pertaining to post-closure care, security requirements, and restriction on disturbance for facilities,where contaminated materials and contaminated soils are left in place during closure.	The Site is not by definition a hazardous waste transfer, treatment, storage, anddisposal facility. Because this alternative would involve no action, requirements from this ARAR related to post-closure care of covers would not be pertinent to this alternative.	The Site is not by definition a hazardous waste transfer, treatment, storage, anddisposal facility. However, compliance with this ARAR would be attained through adherence with substantive requirements related to post-closure care during operation and maintenance (O&M) of the cover.	The Site is not by definitiona hazardous waste transfer, treatment, storage, and disposal facility. Because this alternative would involve excavation and offsite disposal rather than in-place containment, requirements from this ARAR related to post-closure care of covers would not be pertinent to this alternative.

Table E-3 Compliance with Action-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives		
			Alternative 1 No Action	**Alternative 2 In-Place Capping of Contaminated Soils**	**Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
Use and Management of Containers	22 CCR, Division 4.5, Chapter 14, Article 9 §66264.178	Provides requirements for decontamination of remaining containers.	Because this alternative would involve no action, requirements from this ARAR for use and management of containers would not be pertinent to this alternative.	ARAR would likely not be pertinent since no waste is expected to be generated during construction of the cover.	Compliance would be attained through characterization of waste generated during the PDI and excavation of contaminated soil to determine whether the excavated soil is a hazardous waste and adherence to substantive requirements for use and management of storage containers for hazardous waste.

Table E-3 Compliance with Action-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives		
			Alternative 1 **No Action**	**Alternative 2** **In-Place Capping of Contaminated Soils**	**Alternative 3** **Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
Monitoring and Inspection of Landfill	22 CCR, Division 4.5, Chapter 14, Article 14 §66264. 303 (a) (1 through 2)	Provides requirements for monitoring and inspection of landfill during installation and operation	The Site is not by definition a hazardous waste transfer, treatment, storage, and disposal facility. Because this alternative would involve no action, requirements from this ARAR related to monitoring and inspections of covers would not be pertinent to this alternative.	The Site is not by definition a hazardous waste transfer, treatment, storage, and disposal facility. However, compliance with this ARAR would be attained through adherence with substantive requirements related to monitoring and inspections during construction of the cover.	The Site is not by definition a hazardous waste transfer, treatment, storage, and disposal facility. Because this alternative would involve excavation and offsite disposal rather than in-place containment, requirements from this ARAR related to monitoring and inspections of covers would not be pertinent to this alternative.

Table E-3 Compliance with Action-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives		
			Alternative 1 No Action	**Alternative 2 In-Place Capping of Contaminated Soils**	**Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
Closure and Post-Closure Care for Landfill	22 CCR, Division 4.5, Chapter 14, Article 14 §66264. 310 (a) (2 through 5) and (b) (1, 4 through 5)	Provides requirements for closure and post-closure care of landfill.	The Site is not by definition a hazardous waste transfer, treatment, storage, and disposal facility. Because this alternative would involve no action, requirements from this ARAR related to closure of covers would not be pertinent to this alternative.	The Site is not by definition a hazardous waste transfer, treatment, storage, and disposal facility. However, compliance with this ARAR would be attained through adherence with substantive requirements related to closure during construction of the cover and post-closure care during O&M of the cover.	The Site is not by definitiona hazardous waste transfer, treatment, storage, and disposal facility. Because this alternative would involve excavation and offsite disposal rather than in-place containment, requirements from this ARAR related to closure ofcovers would not be pertinent to this alternative.

Table E-3 Compliance with Action-Specific Applicable or Relevant and Appropriate Requirements					
			Alternatives		
ARAR	Citation	Description	Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Temporary Units	22 CCR Div. 4.5, Chapter 14, Article 15.5 §66264.553 (b)	Provides requirements for use of temporary units and storage of hazardous remediation waste during corrective action activities.	Because this alternative would involve no action, requirements from this ARAR for use of temporary units and storage for hazardous waste wouldnot be pertinent to this alternative.	ARAR would likely not be pertinent since no waste is expected to be generated during construction of the cover.	Compliance would be attained through characterization of contaminated soils during the PDI and excavation determine whether the excavated soils are a hazardous waste and adherence to substantive requirements for use and management of storage containers for hazardous waste.

Table E-3 Compliance with Action-Specific Applicable or Relevant and Appropriate Requirements					
			Alternatives		
ARAR	Citation	Description	Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
General Closure and Post-Closure Maintenance Standards Applicable to Waste Management Units (Units) forSolid Waste	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 5, Article 1, §20950 (d through e)	Provides performance standards and requirements for closure of waste management units for solid waste, including surveying, monuments, and vegetation.	The Site is not by definition a classified waste management unit. Because this alternative would involve no action, requirements fromthis ARAR related to surveying, monumentation, and vegetation of covers would not be pertinent to this alternative.	The Site is not by definition a solid waste management unit. However, compliance with this ARAR would be attained through adherence with substantive requirements related to surveying, monumentation, and vegetation during construction of the cover over the Site and post-closure care during O&M of the cover.	Because this alternative would involve excavation and offsite disposal rather than in-place containment, requirements from this ARAR would not be pertinent to this alternative.

Table E-3 Compliance with Action-Specific Applicable or Relevant and Appropriate Requirements					
ARAR	Citation	Description	Alternatives		
			Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Construction Quality Assurance Requirements	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 2, Article 4, §20324 (e through i)	§20324 (e through i) provides substantive requirements for a CQA program including inspection and testing.	The Site is not by definition a solid waste management unit. Because this alternative would involve no action, requirements from this ARAR related to inspections and CQA during construction of covers would not be pertinent to this alternative.	The Site is not by definition a solid waste management unit. However, compliance with this ARAR would be attained through adherence with substantive requirements related to inspections and CQA during construction of the cover.	Because this alternative would involve excavation and offsite disposal rather than in-place containment, requirements from this ARAR would not be pertinent to this alternative.

Table E-3 Compliance with Action-Specific Applicable or Relevant and Appropriate Requirements					
			Alternatives		
ARAR	Citation	Description	Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Precipitation and Drainage Controls	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 2, Article 4, §20365 (c through d and f)	Provides requirements for precipitation and drainage controls for waste management unitsand containment structures.	The Site is not by definition a solid wastemanagement unit. Because this alternative would involve no action, requirements from this ARAR related to performance standards for precipitation and drainage controls for covers would not be pertinent to this alternative.	The Site is not by definition a solid waste management unit. However, compliance with this ARAR would be attained through adherence with substantive requirements related to performance standards for precipitation and drainage controls during design and construction of the cover.	Because this alternative would involve excavation and offsite disposal rather than in-place containment, requirements from this ARAR related to performance standards for precipitation and drainage controls for covers would not be pertinent to this alternative.

Table E-3 Compliance with Action-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives		
			Alternative 1 No Action	**Alternative 2 In-Place Capping of Contaminated Soils**	**Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
Seismic Design	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 2, Article 4, §20370	Provides criteria for seismic design structures within solid waste management units.	The Site is not by definition a solid waste management unit. Because this alternative would involve no action, requirements from this ARAR related to seismic performance standards for covers would not be pertinent to this alternative.	The Site is not by definition a solid waste management unit. However, compliance with this ARAR would be attained through adherence with substantive requirements related to seismic performance standards during design of the cover.	Because this alternative would involve excavation and offsite disposal rather than in-place containment, requirements from this ARAR related to seismic performance standards for covers would not be pertinent to this alternative.

Table E-3 Compliance with Action-Specific Applicable or Relevant and Appropriate Requirements					
			Alternatives		
ARAR	Citation	Description	Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Closure and Post-Closure Maintenance Requirements for Solid Waste Landfills	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 5, Article 2, §21090 (a(1); a(3)(A); a(4)(B)1. through 2.,4. through 7.; a(4)(D); (b); c(1) and(4) through (5); e)	Provides closure and post-closure maintenance requirements for solid waste landfill.	The Site is not by definition a solid waste landfill. Because this alternative would involve no action, requirements from this ARAR related to post-closure care of covers would not be pertinent to this alternative.	The Site is not by definition a solid waste landfill. However, compliance with this ARAR would be attained through adherence with substantive requirements related to covers during design and construction of the cover and requirements for cover post-closure care during O&M of the cover.	Because this alternative would involve excavation and offsite disposal rather than in-place containment, requirements from this ARAR related to post-closure care of covers would not be pertinent to this alternative.

Table E-3 Compliance with Action-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives		
			Alternative 1 No Action	**Alternative 2 In-Place Capping of Contaminated Soils**	**Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
Closure and Post-Closure Care for Landfill	22 CCR, Division 4.5, Chapter 14, Article 14 §66264. 310 (a) (2 through 5) and (b) (1, 4 through 5)	Provides requirements for closure and post-closure care of landfill.	The Site is not by definition a hazardous waste transfer, treatment, storage, and disposal facility. Because this alternative would involve no action, requirements from this ARAR related to closure of covers would not be pertinent to this alternative.	The Site is not by definition a hazardous waste transfer, treatment, storage, and disposal facility. However, compliance with this ARAR would be attained through adherence with substantive requirements related to closure during construction of the cover and post-closure care during O&M of the cover.	The Site is not by definitiona hazardous waste transfer, treatment, storage, and disposal facility. Because this alternative would involve excavation and offsite disposal rather than in-place containment, requirements from this ARAR related to closure ofcovers would not be pertinent to this alternative.

Table E-3 Compliance with Action-Specific Applicable or Relevant and Appropriate Requirements					
			Alternatives		
ARAR	Citation	Description	Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Final Cover	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 5, Article 2, §21140(a)	Provides requirements for final cover for disposal site and landfill	The Site is not by definition a solid waste landfill. Because this alternative would involve no action, requirements from this ARAR related to final covers would not be pertinent to this alternative.	The Site is not by definition a solid waste landfill. However, compliance with this ARAR would be attained through adherence with substantive requirements related to final covers during design and construction of the cover.	Because this alternative would involve excavation and offsite disposal rather than in-place containment, requirements from this ARAR related to final covers would not be pertinent to this alternative.

Table E-3 Compliance with Action-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives		
			Alternative 1 No Action	**Alternative 2 In-Place Capping of Contaminated Soils**	**Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
Final Grading	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 5, Article 2, §21142(a)	Provides requirements for final grading for disposal site and landfill.	The Site is not by definition a solid waste landfill. Because this alternative would involve no action, requirements from this ARAR related to final grading of covers would not be pertinent to this alternative.	The Site is not by definition a solid waste landfill. However, compliance with this ARAR would be attained through adherence with substantive requirements related to final grading during design and construction of the cover.	Because this alternative would involve excavation and offsite disposal rather than in-place containment, requirements from thisARAR related to final grading of covers would not be pertinent to this alternative.

Table E-3 Compliance with Action-Specific Applicable or Relevant and Appropriate Requirements

ARAR	Citation	Description	Alternatives		
			Alternative 1 No Action	**Alternative 2 In-Place Capping of Contaminated Soils**	**Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities**
Slope Stability	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 5, Article 2, §21145(a)	Provides requirements for slope stability for disposal site and landfill	The Site is not by definition a solid waste landfill. Because this alternative would involve no action, requirements from this ARAR related to slope stability of covers would not be pertinent to this alternative.	The Site is not by definition a solid waste landfill, and steep slopesare not anticipated to exist on the cover. However, compliance with this ARAR would be attained through adherence with substantive requirements related to slope stability during design and construction of the cover.	Because this alternative would involve excavation and offsite disposal rather than in-place containment, requirements from this ARAR related to slope stability of covers would not be pertinent to this alternative.

Table E-3 Compliance with Action-Specific Applicable or Relevant and Appropriate Requirements					
			Alternatives		
ARAR	Citation	Description	Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Drainage and Erosion Control	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 5, Article 2, §21150(a and c)	Provides requirements for drainage and erosioncontrol for disposal site and landfill	The Site is not by definition a solid waste landfill. Because this alternative would involve no action, requirements from this ARAR related to performance standardsfor drainage and erosion controls of covers would not be pertinent to this alternative.	The Site is not by definition a solid waste landfill. However, compliance with this ARAR would be attained through adherence with substantive requirements related to performance standards for drainage and erosion controls during design and construction of the cover.	Because this alternative would involve excavation and offsite disposal rather than in-place containment, requirements from this ARAR related to performance standards for drainage and erosion controls of covers would not be pertinent to this alternative.

Table E-3 Compliance with Action-Specific Applicable or Relevant and Appropriate Requirements					
			Alternatives		
ARAR	Citation	Description	Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Post-closure Maintenance	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 5, Article 2, §21180(b)	Provides that non-liquid waste exposed during post-closure maintenance may be returned to the landfill provided the integrity of the final cover is maintained	The Site is not by definition a solid waste landfill. Because this alternative would involve no action, requirements from this ARAR related to return of non-liquid wastes to beneath covers would not be pertinent to this alternative.	The Site is not by definition a solid waste landfill, and non-liquidwaste is not anticipatedto be exposed during post-closure O&M due to the topography. However, compliance with this ARAR would be attained through adherence with substantive requirements related to return of non-liquid wastes to beneath the cover during O&M.	Because this alternative would involve excavation and offsite disposal rather than in-place containment, requirements from this ARAR related to return of non-liquid wastes to beneath covers would not be pertinent to this alternative.

Table E-3 Compliance with Action-Specific Applicable or Relevant and Appropriate Requirements					
ARAR	Citation	Description	Alternatives		
			Alternative 1 No Action	Alternative 2 In-Place Capping of Contaminated Soils	Alternative 3 Excavation and Disposal of Contaminated Soils at Licensed Disposal Facilities
Post-closure Land Use	27 CCR Div. 2, Sub-div. 1, Chapter 3, Sub-chpt. 5, Article 2, §21190 (a (1 and 2) and e (2 and 4 through 7))	Provides requirements for post-closure use of land where the disposal site and landfill are located	The Site is not by definition a solid waste landfill. Because this alternative would involve no action, requirements from this ARAR related to installation of structural improvements within covers would not be pertinent to this alternative.	The Site is not by definition a solid waste landfill, and structural improvements as defined in the ARAR are not anticipated to be constructed in the cover. However, compliance with this ARAR would be attained through adherence with substantive requirements related to installation of structural improvements within the cover during post-closure O&M.	Because this alternative would involve excavation and offsite disposal rather than in-place containment, requirements from this ARAR related to installation of structural improvements within covers would not be pertinent to this alternative.