GENERAL SERVICES ADMINISTRATION

Contract #GS-10F-0076K Delivery Order N62474-03-F-4033

Feasibility Study
Installation Restoration Site 29

Naval Weapons Station Seal Beach Detachment Concord
Concord, California

GSA.0120.004

DRAFT FINAL

October 16, 2003

Department of the Navy
Engineering Field Activity West
Daly City, California

TETRA TECH, INC.

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Prepared for

DEPARTMENT OF THE NAVY
Engineering Field Activity West
Daly City, California

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ACRONYMS AND ABBREVIATIONS

2,4-DB	2,4-dichlorophenoxybutyric acid
µg/L	Micrograms per liter
ACM	Asbestos-containing materials
AOC	Area of contamination
ARAR	Applicable or relevant and appropriate requirement
BAAQMD	Bay Area Air Quality Management District
BAF	Bioaccumulation factors
bgs	Below ground surface
BTAG	Biological Technical Advisory Group
BW	Body weight
Cal/EPA	California Environmental Protection Agency
CCR	*California Code of Regulations*
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
COC	Chemical of concern
COEC	Chemical of ecological concern
COPC	Chemical of potential concern
COPEC	Chemical of potential ecological concern
CSF	Cancer slope factor
CSM	Conceptual site model
DDT	Dichlorodiphenyltrichloroethane
DoD	U.S. Department of Defense
DOT	U.S. Department of Transportation
DTSC	California Environmental Protection Agency Department of Toxic Substances Control
EFA West	Naval Facilities Engineering Command, Engineering Field Activities West
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration
ERA	Ecological risk assessment
ESA	Endangered Species Act
FCM	Food-chain modeling
FETAX	Frog Embryo Teratogenesis Assay *Xenopus* Test
FS	Feasibility study
FWS	U.S. Fish and Wildlife Service
GRA	General response action
HI	Hazard index
HQ	Hazard quotient
IEUBK	Integrated Exposure Uptake Biokinetic
IRP	Installation restoration program

ACRONYMS AND ABBREVIATIONS (Continued)

IT Corporation	International Technology Corporation
kg/day	kilograms per day
LC50	Lethal concentration causing 50 percent mortality
LDR	Land disposal restrictions
LUC RD	Land use control remedial design
mg/kg	Milligrams per kilogram
mg/kg-day	Milligrams per kilogram per day
mg-iron/kg-soil	Milligrams of iron per kilogram of soil
Navy	U.S. Department of the Navy
NCEA	National Center for Environmental Assessment
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NESHAP	National Emission Standard for Hazardous Air Pollutants
NOAEL	No observed adverse effect level
NOEC	No adverse effect concentration
NRC	National Research Council
NWSSBD	Naval Weapons Station Seal Beach Detachment
O&G	Oil and grease
O&M	Operation and maintenance
OSHA	Occupational Safety and Health Administration
PAH	Polynuclear aromatic hydrocarbons
PCB	Polychlorinated biphenyls
ppm	Parts per million
PRC	PRC Environmental Management, Inc.
PRG	Preliminary remediation goal
RACM	Regulated Asbestos Containing Materials
RAO	Remedial action objective
RCRA	Resource Conservation and Recovery Act
RDA	Recommended daily allowance
RFA	RCRA facility assessment
RFACS	RCRA facility assessment confirmation study
RfD	Reference dose
RI	Remedial investigation
ROD	Record of decision
SFRWQCB	San Francisco Bay Regional Water Quality Control Board
SLERA	Screening-level ecological risk assessment
SLHHRA	Screening-level human health risk assessment
STLC	Soluble threshold limit concentration
SUF	Site use factor
SVOC	Semivolatile organic compound
SWMU	Solid waste management unit

ACRONYMS AND ABBREVIATIONS (Continued)

TBC	To be considered
TCE	Trichloroethene
TCLP	Toxicity characteristic leaching procedure
TPH	Total petroleum hydrocarbon
TRV	Toxicity reference values
TtEMI	Tetra Tech EM Inc.
TTLC	Total threshold limit concentration
URTD	Upper respiratory tract disease
USC	*United States Code*
VOC	Volatile organic compound
WDR	Waste Discharge Requirements

EXECUTIVE SUMMARY

Tetra Tech EM Inc. (TtEMI) has prepared this focused feasibility study (FS) for Site 29, Naval Weapons Station Seal Beach Detachment (NWSSBD) Concord located in Concord, California.

INTRODUCTION

This focused FS has been prepared to identify and evaluate remedial alternatives for addressing surface soils affected with metal contaminants at Site 29. Site 29 comprises Building IA-25 and solid waste management unit (SWMU) 13. Building IA-25 was reportedly used to manufacture and test military explosives. The building also included a paint spray booth for repainting components. The spray booth was located in the southwest corner of the building at the approximate location illustrated on Figure 2-3 (Weston Solutions 2003). The building was renovated significantly for rework of explosives in the late 1970s. SWMU 13 consists of a septic tank, a storm drain outfall, a sanitary sewer line, and a leach field northeast of the Building IA-25.

This FS was prepared in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan and with U.S. Environmental Protection Agency (EPA) guidance (EPA 1988) under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA). The remedial alternatives evaluated vary in (1) effectiveness for protecting human health and the environment, (2) implementability, and (3) cost. The FS report was prepared using data that are also presented in the draft NWSSBD Concord site investigation report (TtEMI 1999).

PREVIOUS INVESTIGATIONS

Previous sampling at the site consists of two primary events. These include one sampling event conducted below the building within the open crawl space area in 1998 and 1989, and a second sampling event conducted in 1999. These previous investigations are summarized below.

A Resource Conservation and Recovery Act (RCRA) Facility Assessment Confirmation Study (RFACS) was conducted in the intervening time between these two sampling events, but the focus of the RFACS was to investigate the existing septic tank and drain field.

1988 through 1989 Building Crawl Space Surface Soils Sampling Event

Site investigations were conducted by International Technology Corporation (IT Corporation) from 1988 through 1989 to evaluate potential soil contamination beneath Building IA-25. In 1988 and 1989, surface soil and shallow soil samples were collected in the crawl space beneath Building IA-25. Throughout this report, these 1988 and 1989 samplings are referred to collectively as the "building crawl space surface soils sampling event".

Based on sampling results, the U.S. Department of the Navy (Navy) concluded (as documented by IT Corporation [IT Corporation 1990]) that shallow soils beneath the building contain metals and low-level detections of explosives, volatile organic compounds, semivolatile organic compounds, pesticides, polychlorinated biphenyls, polynuclear aromatic hydrocarbons, and chlorinated herbicides. A focused human health risk assessment (worker hazard assessment) was performed using the data from this sampling event; it concluded that no chronic exposure or long-term health effects to construction and maintenance workers were anticipated from compounds detected in surface and shallow soils beneath and just west of Building IA-25. The highest hazard index (HI) calculated from this assessment was an order of magnitude below the HI benchmark value of 1 (IT Corporation 1990).

1999 Subsurface Soils Sampling Event

In January and February of 1999, TtEMI and LFR Levine Fricke conducted the investigation that is referred to in this FS as the "subsurface soils sampling event." Soil borings were drilled east of Building IA-25 at Site 29 to a maximum depth of 15 feet below ground surface (bgs). Although explosives were not detected, metals were detected from all soil samples collected. Arsenic, iron, manganese, and thallium are the only metals detected at concentrations exceeding federal EPA Region IX residential preliminary remediation goals (PRG) (EPA 2002a). Of these four metals, however, only arsenic was detected at concentrations exceeding industrial PRGs, and only manganese and thallium were detected at concentrations exceeding estimated ambient concentrations.

SCREENING-LEVEL HUMAN HEALTH RISK ASSESSMENT

A screening-level human health risk assessment (SLHHRA) was completed for two areas at Site 29: (1) the Building IA-25 crawl space and (2) subsurface soils east of Building IA-25. The SLHHRA was conducted to identify chemicals detected in soil at Site 29 that could be associated with potential human health concerns. During the SLHHRA, data collected during the building crawl space surface soils sampling event and the subsurface soils sampling event were evaluated separately for reasons described in the text of the FS. Although land use at Site 29 will likely remain industrial, potential human health risks were estimated under both residential and industrial land-use scenarios. The results of the SLHHRA were presented in the draft site investigation report for Site 29 (TtEMI 1999) and have been updated in this FS report to incorporate current EPA Region IX PRGs (EPA 2002a). The SLHHRA was conducted as a PRG screen using the maximum concentration of each detected chemical as the exposure point concentration. The PRG screening approach provided an expedited but conservative evaluation. Chemicals were eliminated from further evaluation if their concentrations did not their respective PRG values. A summary of the risk assessment for the crawl space sampling event and the subsurface soils sampling event are presented below.

Building Crawl Space Surface Soils Data

Total cancer risks posed by building crawl space surface soil under the residential exposure scenario (2×10^{-5}) exceed 10^{-6} but are within the EPA risk management range of 10^{-6} to 10^{-4}. Chemical risk drivers for the residential exposure scenario are benzo(a)pyrene, benzo(b/k)fluoranthene, and chromium. The total noncancer HI for the residential exposure scenario was 4, which exceeds the threshold HI of 1; however, HIs may be segregated and separately summed for specific target organs because the hazard risk is not considered cumulative over multiple organs. Segregated noncancer HIs were all below the threshold HI of 1.

Total cancer risks posed by building crawl space surface soils for the industrial exposure scenarios (7×10^{-6}) exceed 10^{-6} but are within the EPA risk management range of 10^{-6} to 10^{-4}. Chromium was the chemical risk driver for the industrial exposure scenario. The total noncancer HI for the industrial exposure scenario (0.3) did not exceed the threshold HI of 1.

Lead was identified as a chemical of potential concern from the building crawl space surface soils data set. The maximum detected concentration of lead of 3,400 milligrams per kilogram (mg/kg) exceeds both the EPA and "California-modified" (Cal-modified) residential PRGs of 400 mg/kg and 150 mg/kg, respectively, and the EPA industrial PRG of 750 mg/kg. Lead concentrations measured in 10 of the 27 surface soil samples exceeded the Cal-modified PRG of 150 mg/kg; of these, 5 samples contained lead concentrations that exceeded the EPA residential soil PRG of 400 mg/kg. Three of the 27 surface soil samples contained lead concentrations that exceeded the EPA industrial soil PRG of 750 mg/kg.

Subsurface Soils Data

Total cancer risks posed by subsurface soils east of Building IA-25 for the residential exposure scenario (4×10^{-8}) are below the EPA target risk level of 1×10^{-6}. The noncancer HI for the residential exposure scenario was 6, which exceeds the threshold HI of 1. Segregated HIs for two target organs, the central nervous system and the liver, exceeded the threshold HI of 1. The segregated HI for the central nervous system was 3.7 (primarily as a result of manganese) and 1.4 for the liver (primarily as a result of thallium).

Manganese was detected at a depth of approximately 5 feet bgs in two out of the nine locations above the ambient concentrations of 1,300 mg/kg and the residential PRG of 1,800 mg/kg. Thallium was detected above the ambient concentration of 1.4 mg/kg and the residential PRG of 5.2 mg/kg in 1 out of the 5 samples at a depth of approximately 5 feet bgs. (The highest thallium detection was detected in the same sample that contained manganese above the ambient level.) Based upon our visual evaluation of the materials and depth below the original ground surface, the high concentrations of manganese and thallium were collected from undisturbed native soil materials at Site 29. The potential source for these contaminants is not known because operations previously conducted at Site 29 (pilot scale testing of ammunitions) are not typically associated with manganese and thallium. Manganese and thallium are not anticipated to pose a health risk assuming current conditions because measured concentrations exceeding PRGs are present at a depth of 5 feet in subsurface soils and represent a limited volume of soil at the site.

Total cancer risks posed by subsurface soils east of Building IA-25 under the industrial exposure scenario (2×10^{-8}) were acceptable because they were less than the EPA target risk level of 1×10^{-6}. The total noncancer HI for the industrial exposure scenario (0.5) did not exceed the threshold HI of 1.

Results and Conclusions

The results of the SLHHRA indicate that lead is the only chemical of concern in the Building IA-25 crawl space surface soils. Although benzo(a)pyrene, benzo(b/k)fluoranthene, and chromium were identified as chemical risk drivers in Building IA-25 crawl space surface soils, the total cancer risk from exposure to Building IA-25 crawl space surface soils is within the EPA risk management range of 10^{-6} to 10^{-4}.

The results of the SLHHRA for subsurface soils east of Building IA-25 indicate that cancer risks from exposure to subsurface soils are less than the EPA target risk level of 10^{-6}. Segregated HIs for two target organs, the central nervous system and the liver, exceed the threshold HI of 1 for the residential exposure scenario, primarily because of manganese and thallium. However, manganese and thallium are not associated with historical site operations. In addition, these metals are not anticipated to pose a health risk assuming current conditions because measured concentrations exceeding PRGs are present at a depth of 5 feet in subsurface soils and represent a limited volume of soil at the site.

SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT

This screening-level ecological risk assessment (SLERA) was conducted as a part of the FS for Site 29 at the NWSSBD Concord, California. The purpose of this SLERA was to determine whether chemicals of potential ecological concern (COPEC) in surface and subsurface soils pose unacceptable risk to upper trophic level species at the site. Representative bird and mammal species that were the focus of the assessment included the American robin, red-tailed hawk, and western harvest mouse. Federally threatened California red-legged frog and the California tiger salamander, a candidate for federal listing and currently a State of California Species of Special Concern are both known to exist in certain areas of NWSSBD Concord. Therefore, these two species were also assessed qualitatively in the SLERA. Because no native or sensitive plant species are known to occur at the site, and because the general quality of habitat at Site 29 is low, only risk to upper trophic level receptors was evaluated.

The SLERA has the following four primary phases: (1) problem formulation, (2) exposure estimates, (3) ecological effects, and (4) risk characterization. During the problem formulation phase, an ecological conceptual site model was developed for the site, and assessment and measurement endpoints were selected. During the exposure estimate phase, exposure parameters were determined for representative receptors identified in the problem formulation phase. During the ecological effects evaluation, contaminant exposure levels were compared to conservative thresholds for adverse ecological effects. Finally, during the risk characterization phase, the potential risk to assessment endpoints associated with the site was evaluated.

During this SLERA, data collected during the building crawl space surface soils sampling event and the subsurface soils sampling event were evaluated separately.

By design, a SLERA is designed with conservative assumptions and thus is likely to overstate the risk to ecological receptors.

Based on the results of the SLERA, aluminum, barium, cadmium, chromium, copper, lead, selenium, vanadium, and zinc in surface soils appear to pose immediate and significant risk to birds and mammals.

In subsurface soils, barium, manganese, and vanadium appear to pose immediate and significant risk to birds and mammals; however, sampling location S29SB02 clearly accounts for the calculated risk, and without this sample, ecological risk associated with exposure to subsurface soils would be minimal. Sample S29SB02 was collected 5 feet bgs. Based upon visual observations at the time of drilling and the depth of sample S29SB02 from the original ground surface, the sample was taken from natural, undisturbed soils; therefore, the elevated concentrations of barium, manganese, and vanadium may represent naturally occurring metals. Both barium and vanadium are detected in concentrations less than ambient in sample S29SB02. In addition, risk to receptors is reliant upon a complete exposure pathway, which would occur only if the soils associated with sample S29SB02 are disturbed by construction activities and brought closer to the ground surface.

Estimates of soil ingestion are not readily available for amphibians as they are for some birds and mammals. Most of the toxicity studies on amphibians are based on acute toxicity endpoints and are not based on soil or soil ingestion as a route of exposure. Because of this, literature toxicity data were only available for chromium, copper, lead, mercury, and zinc. A qualitative evaluation is sufficient, particularly since there is poor habitat and no clear evidence that amphibians frequent Site 29 and more specifically, the crawl space underneath Building IA-25. Due to sparse toxicity data, it is difficult to complete even a qualitative evaluation of amphibians. Under the circumstances, representative mammalian and avian receptors were used in a food chain model to evaluate potential risks at the site. The results are summarized below.

Aluminum, barium, cadmium, chromium, copper, lead, manganese, mercury, nickel, selenium, vanadium, zinc, bis(2-ethylhexyl)phthalate, and dichlorodiphenyltrichloroethane are likely to pose some level of risk to ecological receptors exposed to shallow surface soils in the building crawl space area. The risk associated with a number of these COPECs is either driven by a hot spot (for example, IA25-1) or is very limited (hazard quotients are slightly greater than 1). The primary risk drivers in surface soil are aluminum, lead, and zinc. In summary, the results of the SLERA indicate that potential adverse ecological effects may occur in surface soil at the site below the building crawl space because of exposure to a variety of metals and several organic compounds. Therefore, the site should either be evaluated further in a Tier II (baseline) ecological risk assessment or undergo a remedial action for crawl space soils.

SETTING REMEDIAL ACTION OBJECTIVES

Given the relatively small size of the building, the fact that the SLHHRA indicates risk to humans, and the possibility for ecological risk in its current state, the Navy has decided to pursue cleanup of the property rather than to continue investigative efforts and refining of risk estimates. Remedial action objectives are set to define the objectives of the proposed remediation.

Surface soils represent the sole medium of concern at Site 29. Groundwater is not a medium of concern because the contaminants present in site soils have been found at depths much shallower than anticipated groundwater depths (estimated at 20 to 30 feet bgs). In addition, metallic compounds are likely immobile and have not been detected at concentrations that would raise concerns about them leaching to groundwater. Surface water runoff from the site is also not a medium of concern, because surface water bodies are not present in the immediate vicinity of Site 29, and because the presence of earthen berms and buildings significantly limits runoff from rainfall events.

To address the concern for both ecological and human health risks under an unrestricted land-use scenario (including residential use), remedial action objectives (RAO) were developed to identify and evaluate remedial alternatives. RAOs for the unrestricted land use scenario are to prevent exposure of human receptors to concentrations exceeding established EPA Region IX residential lead PRG (400 mg/kg) and the residential Cal-modified lead PRG (150 mg/kg), which are considered protective of human health. Ecological RAOs are to prevent ingestion of and direct contact of chemicals of ecological concern by ecological receptors in surface soils at concentrations greater than the larger value of either established background soil concentrations or ecological soil PRGs.

EVALUATION OF THREE REMEDIAL ALTERNATIVES

Three remedial alternatives for soil were identified and developed under the FS.

Alternative 1: No Action

Under this alternative, no remedial action would be taken. Rather, Site 29 soil would be left as is, without implementation of institutional controls, containment, treatment, or removal. The "no action" alternative has been included for comparative analysis as required under CERCLA.

Alternative 2: Capping with Institutional Controls

Under this alternative, a concrete surface cap is proposed for construction over a 4,400 square foot area of affected soils directly beneath Building IA-25 to reduce exposure pathways for both human and ecological receptors. Land use restrictions associated with Site 29 under this alternative would be identified in the Real Estate Summary/Base Mapping System or the Base Master Plan and or other Navy Planning document required for land/facility development. All potential future land use changes normally would be identified and controlled through the "site approval process" during the Navy project planning and development. Encumbrances, constraints, and restrictions identified in the Real Estate Summary/Base Mapping System and Base Master Plan will determine whether site approval can be granted.

Alternative 3: Removal with Off-Site Disposal

This alternative includes demolition of Building IA-25 with excavation and off-site landfill disposal of approximately 165 cubic yards of soil presenting a potential human health or ecological risk.

Each remedial alternative was individually evaluated against seven of the nine CERCLA criteria. Then a comparative analysis was conducted to evaluate the relative performance of the remedial alternatives.

The individual and comparative analyses indicate that Alternatives 2 and 3 would provide acceptable levels of protection of human health and the environment and of long-term effectiveness. They would comply with applicable or relevant and appropriate requirements. Alternative 1 presents no short-term risks, has no action to implement, and has no cost. Alternative 1 does not provide adequate protection for human health under unrestricted future use or a reduction in ecological risks. None of the three alternatives reduce the toxicity, mobility, or volume of contaminants at Site 29. Alternative 3 is most effective in the long term and provides greater protection of human health and the environment as compared with alternatives 1 and 2. Overall, Alternative 3 was ranked higher than both Alternative 2 and Alternative 1.

1.0 INTRODUCTION

Tetra Tech EM Inc. (TtEMI), under direction from the U.S. Department of the Navy (Navy), Naval Facilities Engineering Command, Engineering Field Activity West (EFA West), has prepared this focused feasibility study (FS) report for Site 29 at Naval Weapons Station Seal Beach Detachment (NWSSBD) Concord in Concord, California. This work has been conducted under the General Service Administration Contract No. GS–10F-0076K, Delivery Order No. N62474-03-F-4033.

During previous investigation activities at Site 29, several metals have been identified in soils at concentrations above both ambient concentrations and the U.S. Environmental Protection Agency (EPA) Region IX preliminary remedial goals (PRG). A screening-level human health risk assessment (SLHHRA) was completed for two areas at Site 29: (1) the Building IA-25 crawl space and (2) subsurface soils east of Building IA-25. The SLHHRA (see Section 2.2.6) was conducted to identify chemicals detected in soil at Site 29 that could be associated with potential human health concerns. The results of the SLHHRA indicate that under a residential land-use scenario, potential risk to human health may occur because of exposure to lead in building crawl space surface soils. Lead in subsurface soils was not identified as a potential risk to human health under both a residential and industrial-use scenario.

A screening-level ecological risk assessment (SLERA) was conducted to determine whether chemicals and ecological receptors of concern are present at Site 29. The results of the SLERA (see Section 2.2.7) indicate that potential adverse ecological effects may occur because of exposure to aluminum, barium, cadmium, chromium, copper, lead, manganese, mercury, nickel, selenium, vanadium, zinc, bis(2-ethylhexyl)phthalate, and dichlorodiphenyltrichloroethane (DDT). This FS has also been developed to identify and evaluate a set of remedial alternatives to eliminate or reduce risks posed by these metals to ecological receptors.

This FS has been prepared in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and is conducted as part of the Installation Restoration Program (IRP) at NWSSBD Concord. As part of this program, the U.S. Department of Defense (DoD) is identifying, evaluating, and remediating past hazardous waste sites. This work is coordinated through a Federal Facilities Agreement negotiated and signed on June 14, 2001. The Navy initiated environmental studies at NWSSBD Concord under a precursor to the current IRP entitled, “Navy Assessment and Control of Installation Pollutants” in 1983. The EPA listed the Concord as a National Priorities List site on December 16, 1994. NWSSBD Concord is divided into two major landholdings: the Tidal Area and the Inland Area. The locations of the Tidal and Inland Areas are illustrated in Figure 2-1. The Tidal Area is located to the north and continues to support active military operations. The Inland Area, to the south, is not active. Site 29 is located within the Inland Area portion of NWSSBD Concord. Although the Inland Area of NWSSBD Concord is not active, it is not slated for military base closure in the foreseeable future. In addition to the Navy, other branches of the DoD reside within or partly occupy the NWSSBD Concord including the U.S. Department of the Army.

The purpose of this FS was to develop and evaluate a range of remedial alternatives that (1) eliminate or reduce unacceptable human health exposures to contaminated soil at Site 29, (2) minimize effects of contaminants on the environment, and (3) are feasible, implementable, and cost effective.

The organization of this report generally follows the suggested format found in the interim final EPA document titled "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (EPA 1988). The EPA guidance points out that where "circumstances limit the number of available options, and therefore the number of alternatives that are developed, it may not be necessary to screen alternatives prior to the detailed analysis" (EPA 1988). Because the principal purpose of this FS is to evaluate a limited number of risk control alternatives for an unrestricted land use (not the anticipated future use of Site 29), this FS has been streamlined according to the EPA guidance. This FS limits the number of remedial alternatives developed and eliminates the step of screening both process options and remedial alternatives before detailed analysis. This FS report therefore includes the following steps:

- Summarize previous investigation results
- Conduct SLHHRA and SLERA
- Develop remedial action objectives (RAO)
- Develop general response actions (GRA) that address the RAOs
- Identify and develop a set of three remedial alternatives
- Further evaluate the remedial alternatives through detailed analysis
- Present a comparative analysis of the remedial alternatives

The FS report contains six sections and three appendices. Section 1.0 describes the FS purpose and organization. Section 2.0 describes the history of NWSSBD Concord and Site 29 as well as past investigation activities, geology and hydrogeology, the nature and extent of contamination, and contaminant fate and transport. Section 2.0 also presents the updated human health SLHHRA and SLERA. Section 3.0 develops the RAOs for Site 29, presents GRAs, and identifies three remedial alternatives for evaluation. Section 4.0 provides a detailed evaluation of the remedial alternatives. Section 5.0 includes a comparative analysis of the remedial alternatives. Section 6.0 lists references cited in this report. Tables and figures are presented after Section 6.0.

A summary of soil sample analytical results from the surface soils sampling conducted by International Technology Corporation (IT Corporation) in 1988 and 1999 (Table 2-1) and from subsurface soils sampling conducted by TtEMI in 1999 (Table 2-2). Appendix A includes a full data set from the 1999 subsurface soils sampling. Appendix B includes regulatory agency comments on the draft FS and Navy responses to the agency comments. Appendix C includes the SLERA tables. Appendix D includes detailed design and construction cost estimates for Alternatives 2 and 3.

2.0 BACKGROUND INFORMATION

NWSSBD Concord is the major munitions transshipment facility on the West Coast and is located in the north-central portion of Contra Costa County, California, approximately 30 miles northeast of San Francisco (Figure 2-1). The facility encompasses approximately 13,000 acres and is bounded by Suisun Bay to the north, the Los Medanos Hills to the east, and the city of Concord to the south and west. Currently, the facility contains two separate primary land holdings divided by State Route 4, including the Tidal Area and the Inland Area (Figure 2-1). Site 29 is located within the south-central portion of the Inland Area (Figure 2-2).

Site 29 is approximately 1,800 feet southwest of the intersection of L Street and Kinne Boulevard (see Figures 2-1 and 2-2). Site 29 is approximately 600 feet southwest of Seal Creek and 110 feet higher in elevation (Mt. Diablo Creek is known as Seal Creek where it enters NWSSBD Concord property). It is located on the side of a hill sloping northeastward toward Seal Creek. Building IA-25 within Site 29 is surrounded on three sides by manmade earthen berms approximately 8 feet high (Figure 2-3).

2.1 HISTORY

Facilities located in the greater Tidal Area are dedicated to ordnance operations and are located on the original property of the Naval Magazine, Port Chicago, acquired by the Navy in 1942. Ammunition storage, which constitutes the largest single land use at NWSSBD Concord, is maintained in five magazine groups and two groups of barricaded railroad sidings. Various production facilities for the inspection and maintenance of ordnance are located throughout the Inland Area.

Site 29 comprises Building IA-25 and solid waste management unit (SWMU) 13. SWMU 13 consists of a septic tank, the inflow line to the septic tank, the drain field for the septic tank (located northeast of the Building IA-25), and an area where a storm drain from Building IA-25 discharges to the ground (Figure 2-3).

Building IA-25 was reportedly used to manufacture and test military explosives. The building also included a paint spray booth for repainting components. The spray booth was located in the southwest corner of the building. The building was renovated significantly for rework of explosives in the late 1970s.

The septic tank associated with SWMU 13 was cleaned out in 1997. The sewer system remains operational, although the building is not currently in use.

2.2 SITE PROFILE

The following subsections include descriptions of the Site 29 (1) site investigation activities, (2) geology, (3) hydrogeology, (4) nature and extent of contamination, (5) contaminant fate and transport, (6) SLHHRA, (7) SLERA, and (8) applicable or relevant and appropriate requirements (ARAR). A detailed description of the Site 29 setting is presented in Section 3.0 of the draft NWSSBD Concord site investigation report (TtEMI 1999).

2.2.1 Summary of Investigation Activities

The investigation site history at Site 29 spans several areas as well as several investigation programs. Details regarding four investigations are presented in the following subsections. In terms of data used in developing this FS, there were two main, distinct sampling events at Site 29; they are summarized in Sections 2.2.1.1 and 2.2.1.3, respectively. In addition, there was a Resource Conservation and Recovery Act (RCRA) Facility Assessment Confirmation Study and a Feasibility Study; these studies are summarized in Sections 2.2.1.2 and 2.2.1.4, respectively.

2.2.1.1 Building Crawl Space Surface Soil Sampling

Initial investigations were conducted from 1988 through 1989 to evaluate potential soil contamination beneath Building IA-25. In 1988, 7 surface soil samples were collected in the crawl space beneath Building IA-25, and 1 surface soil sample was collected just west of Building IA-25. In 1989, eight shallow soil borings were completed beneath Building IA-25, and two soil borings were completed immediately west of Building IA-25. At each of the 10 soil boring locations completed in 1989, soil samples were typically collected at 6 inches and 12 inches below grade. A total of 27 soil samples were collected during these two sampling events (in the crawl space and immediately to the west of the crawl space) and these samples are collectively referred to as the "building crawl space surface soils" sampling event throughout this report and are considered representative of the surface and near surface soils that exist below the building crawl space.

The 27 shallow soil samples were collected from depths of between 0 and 18 inches from the soil borings whose locations are shown on Figure 2-3. Analytical results from the 1988 and 1989 sampling are summarized in Appendix A. Sample analyses included metals, explosives, volatile organic compounds (VOC), semivolatile organic compounds (SVOC), pesticides and polychlorinated biphenyls (PCB), polynuclear aromatic hydrocarbons (PAH), and chlorinated herbicides. Not all analyses were conducted on each sample.

Based on sampling results, the Navy concluded that shallow soils beneath the building contain organic compounds, pesticides, and metals. A focused human health risk assessment (worker hazard assessment), however, concluded that no long-term health effects to construction and maintenance workers were anticipated from compounds found in the building crawl space surface soil samples. The site investigation at Building IA-25 report prepared by IT Corporation (IT Corporation 1990) presents and discusses the results of the building crawl space surface soil sampling event in more detail.

2.2.1.2 RCRA Facility Assessment Confirmation Study

In June 1992, the California Environmental Protection Agency (Cal/EPA) Department of Toxic Substances Control (DTSC) performed a RCRA facility assessment (RFA) to investigate potentially contaminated areas throughout NWSSBD Concord. The RFA was performed to evaluate the potential for release of hazardous substances from 24 SWMUs. In 1996, the Navy performed a RCRA facility assessment confirmation study (RFACS) to further evaluate the RFA findings. The RFACS was issued in draft form on November 4, 1996, and in final form on August 8, 1997 (PRC Environmental Management, Inc. [PRC] 1997). The RFACS was reviewed by the EPA and the San Francisco Bay Regional Water Quality Control Board (SFRWQCB). The Navy received comments from EPA and SFRWQCB on the draft RFACS and provided responses to agency comments in the final RFACS. Additional agency comments were not received by the Navy on the final RFACS.

The septic tank, storm drain discharge area, and septic tank drain lines were investigated as SWMU 13 during the RFACS (PRC 1997). Two soil borings (13-01 and 13-02) were advanced to a maximum depth of 16.5 feet below ground surface (bgs) in the vicinity of the septic tank drain field, approximately 100 feet northeast of Building IA-25 during the RFACS (Figure 2-3). Soil samples collected from the leach field area contained oil and grease (O&G), SVOCs (phenol at 1 sampling location), and metals.

One shallow boring near the storm drain outfall (13-03) contained the most significant quantities of contaminants. The near-surface sample from this boring contained 920 milligrams per kilogram (mg/kg) of O&G, 0.004 mg/kg of endosulfan II, 0.1 mg/kg of 4-nitrotoluene, and concentrations of metals. The analytical results of adjacent soil samples in the same boring and adjacent borings show that these constituents are limited in both vertical and horizontal extents. Because of the immobility of these constituents in soil at Site 29 and the relatively low concentrations detected, the RFACS concluded that there is no evidence of a significant release of contaminants to soil (PRC 1997). Soil samples from borings 13-01 through 13-30 and samples from the septic tank are not included in this FS data set. Because samples from the septic tank contained hazardous wastes; however, an interim RCRA corrective action was conducted to remove the septic tank contents for off-site disposal and thoroughly cleanse the tank.

Based on the RFACS, SWMU 13 was recommended for no further action under RCRA. Further investigation of subsurface soils in the vicinity of Building IA-25 was recommended under CERCLA to evaluate the extent of detected contaminants in the vicinity of Building IA-25 and to evaluate the inflow line to the septic tank for potential breaks (PRC 1997).

2.2.1.3 Site Investigation Subsurface Soils Sampling

The recommended site investigation sampling was conducted in January and February of 1999. This sampling event was the beginning of the Navy's IRP CERCLA evaluation of the site. The 1999 sampling event is hereafter referred to as the "subsurface soils sampling event" throughout this report.

The proposed subsurface soils sampling for the site investigation report was originally proposed in the draft site investigation work plan dated May 8, 1998. The Navy received comments from the EPA on July 9, 1998. Revisions were made to the draft site investigation work plan to incorporate EPA comments, and the plan was issued in draft final form (TtEMI 1998). Additional comments were not received from the EPA or any other state or federal agencies, and the field work was executed according to the work plan and data quality objectives.

The results of the sampling were presented in detail in the draft site investigation report (TtEMI 1999). Three soil borings (S29SB01, S292SB02 and S29SB03) were drilled at Site 29 to a maximum depth of 15 feet bgs using standard hollow-stem auger drilling techniques (Figure 2-3). Boring S29SB01 was placed immediately adjacent to the inflow line to the septic tank, as recommended by the RFACS study. Soil samples were collected for lithologic description using a continuous core barrel sampler lined with brass tubes. Soil samples were collected at 5-foot intervals for chemical analysis. Three soil samples were collected from each boring. The soil samples were collected in January and February of 1999 and were analyzed for VOCs, SVOCs, pesticides, PCBs, total petroleum hydrocarbons (TPH) as extractables, TPH as purgeables, and inorganic compounds. The 3 samples collected from boring SB-1 also were analyzed for explosive compounds. The results of organic and inorganic analysis of subsurface soil collected at Site 29 during the subsurface soils sampling event are discussed in the following text and are summarized in Table 2-2. Appendix A includes a full data report (including a listing of all nondetected constituents and detection limits) from the subsurface soils sampling event.

Metals were detected in all 9 soil samples collected during the subsurface soils sampling event. The metals antimony, barium, beryllium, chromium, copper, mercury, selenium, and vanadium were detected in soil samples collected at Site 29 at concentrations exceeding Inland Area estimated ambient metals concentrations for soil but below their respective residential PRGs. Samples collected from all three of the borings contained at least one metal at concentrations greater than the estimated ambient concentrations.

Arsenic, iron, manganese, and thallium were the only metals detected at concentrations exceeding residential PRGs. None of these metals were detected at concentrations exceeding industrial PRGs except arsenic, which was detected at a concentration exceeding the industrial PRG in 3 samples. Although arsenic exceeded both residential and industrial PRGs, the maximum concentration (10 mg/kg) did not exceed the estimated ambient concentration of 15 mg/kg in any sample (the ambient concentration for arsenic exceeds both the residential and industrial PRGs).

Although an ambient limit for iron has not been established for the Inland Area soils at Concord NWSSBD, the maximum detected concentration of iron (42,400 mg/kg) is well within the background range of iron (10,000 to 87,000 mg/kg) reported for soils in California (Bradford and others 1996). The maximum detected concentration of iron is also below the ambient limit (58,000 mg/kg) established for the Tidal Area.

Organic compounds, specifically trichloroethene and TPH as purgeables, were also detected in soil samples collected during the subsurface soil sampling event. Pesticides, PCBs, SVOCs, TPH as extractables, and explosive compounds were not detected in soil samples collected during this event.

The VOC trichloroethene (TCE) was detected in 1 sample collected from boring S29SB01 at an estimated concentration of 2 micrograms per kilogram. This concentration is below both the residential and industrial PRGs. TPH as gasoline was detected in 1 sample at a concentration of 0.7 mg/kg. There are no established EPA Region IX PRGs for TPH in soil, and these low concentrations of gasoline do not appear to be of concern for further evaluation based on the SFRWQCB residential screening level of 100 mg/kg for TPH as gasoline (see Table A of SFRWQCB 2001).

The results of the site investigation indicated unacceptable risk to human health for unrestricted residential exposure. During the October 1999 remedial project managers meeting, the EPA concluded that although remedial action in the form of institutional controls was appropriate for the site, a record of decision (ROD) would be required to support that decision. The EPA issued comments on the draft site investigation report on September 9, 1999, and the Navy provided responses to the EPA comments on December 9, 1999.

2.2.1.4 Remedial Investigation and Feasibility Study

On January 25, 2000, the Navy discussed the site again with the EPA, DTSC, and SFRWQCB during the remedial project managers meeting. Because the site contamination was limited and did not require additional characterization, the Navy announced their plan to proceed with a focused FS for the site; the site investigation report would not be finalized. At the meeting, the Navy suggested that a remedial investigation (RI) was unnecessary and should not be undertaken. The results of the draft site investigation were considered sufficient to assess the risk and select an appropriate remedial alternative for the site.

The Navy prepared a draft FS for the site on November 13, 2001. The EPA reviewed the draft FS and submitted comments to the Navy on January 31, 2003. The SFRWQCB submitted an e-mail to the Navy dated December 14, 2002, and stated that the SFRWQCB would not prepare comments pertaining to the Site 29 FS. No comments were received from the DTSC. Navy responses to the EPA comments on the draft FS are included with this report as Appendix B.

2.2.2 Geology

Regional geologic features include several northwest-trending fault systems that divide Contra Costa County into large tectonic blocks. An uplifted block feature topographically separates the Inland and Tidal Areas.

Two major faults are known to exist in the vicinity of NWSSBD Concord: the Concord and Clayton faults. The Concord Fault passes approximately 2 miles south of NWSSBD Concord and is classified as an active, right-lateral strike-slip fault. The Clayton Fault lies at the base of Los Medanos Hills as it passes through NWSSBD Concord. The Clayton Fault is classified as active or potentially active (PRC 1997). Broad lowlands are underlain by thick, unconsolidated Pleistocene-age alluvial sediments eroded from up-thrown blocks.

Soils in the north-central portions (Tidal Area) of NWSSBD Concord are clay-rich alluvium derived from nearby hills. They are well-sorted, pebbly alluviums from upstream areas of Seal Creek. Soils in the central area (Inland Area) tend to be coarser at shallow depths but grade comparatively finer than do soils in the north-central area.

The surface geology of the Inland Area is divided into two alluvial areas. The surface geology of the Tidal Area is composed of alluvial formations derived from erosion products associated with the geologic units of Los Medanos Hills intermixed with deltaic sediments from Suisun Bay. The second area consists of Quaternary age sedimentary formation and alluvial by-products in the low and gently sloped hills to the southwest. Alluvium in this area consists of beds of sandy, silty, and clayey soils, which are detrital deposits made by streams on riverbeds. Silty soils appear to predominate. A 3-foot-thick layer of dark brown or gray, clayey soil is consistently present on the alluvium throughout the region (PRC 1997). Bedrock at the Inland Area is a Pliocene nonmarine sedimentary rock formation.

These two geologic areas are separated by the approximate alignment of Seal Creek (PRC 1997). Site 29 is located on the west side of Seal Creek on the side of a gently sloped hill of the Quaternary age sedimentary formation.

Based on recorded lithology from the three soil borings drilled to a depth of 15 feet at Site 29 during the subsurface soils sampling event (TtEMI 1999), soils at Site 29 (in the immediate vicinity of Building IA-25) consist primarily of native silty clay materials as well as gravelly silts and sands.

2.2.3 Hydrogeology

Site 29 lies within the Mt. Diablo/Seal Creek Watershed, which drains an area of approximately 36 square miles. This watershed is bounded on the south by the northern peak of Mt. Diablo and on the north by Suisun Bay. Streams that drain the watershed have their headwaters on the slopes of Mt. Diablo and flow via Mt. Diablo Creek (Seal Creek) through Clayton Valley and NWSSBD Concord to the outlet at Suisun Bay. The nearest water to the site is located at the ephemeral Seal Creek drainage, located approximately 1,600 feet from Site 29.

Groundwater levels have never been recorded at Site 29. Depth to first-encountered groundwater at Site 29 is estimated to be 20 to 30 feet bgs based on historical groundwater sampling within the Inland Area. Groundwater was not encountered in borings drilled at Site 29 to a depth of 15 feet bgs (PRC 1997). Based on local topography, the groundwater is estimated to flow generally to the northeast.

The closest well to the site is an irrigation well for the municipal golf course. The well is located approximately 10,000 feet from Site 29. Several groundwater wells operated by Contra Costa County Water District are located adjacent to Mallard Reservoir, more than 13,000 feet west of Site 29. Groundwater is available beneath the Inland Area in the unconsolidated formations and the bedrock. North of State Route 4, the water table ranges from 30 to 40 feet bgs in low surface elevation areas and deeper as ground surface rises. Local variations in groundwater flow direction occur because of manmade structures and natural variations in local surface and subsurface features.

2.2.4 Nature and Extent of Contamination

This report presents the results of the building crawl space surface soils sampling event and the subsurface soils sampling event to quantify the nature and extent of the contamination at Site 29. A complete list of detected constituents is presented for both sampling events in Tables 2-1 and 2-2 and Appendix A.

Aluminum was detected in 20 of the 27 surface soil samples and 9 of the 9 subsurface samples at a maximum detected soil concentration of 27,500 mg/kg. The maximum detected concentration exceeded in Inland Area estimated ambient level of 21,000 mg/kg.

The maximum detected concentration of arsenic (10 mg/kg) in both surface soil samples and in the subsurface soils sampling event did not exceed the Inland Area estimated ambient concentration of 15 mg/kg.

Barium was detected in all 27 surface soil samples at a maximum detected soil concentration of 1,660 mg/kg. Barium was detected at high concentrations in only three sampling locations, SS-07-1 (1,660 mg/kg), SS-08-1 (1310 mg/kg), and SS-08-2 (1150 mg/kg), which might suggest that these sampling locations are probably isolated hot spots and not representative of barium concentrations across Site 29 (PRC 1997). Barium also was detected in all 9 subsurface soil samples at a maximum detected soil concentration of 439 mg/kg.

Beryllium was detected at a maximum concentration of 16.0 mg/kg, which exceeds the estimated ambient concentration of 0.12 mg/kg. The sample containing the maximum detected concentration of beryllium was collected during the building crawl space surface soil sampling event.

Cadmium was detected in 8 of the 27 crawl space surface soil samples but was not detected in the subsurface soil sample data set. The maximum detected concentration of cadmium (32 mg/kg) exceeded the Inland Area estimated ambient concentration of 0.28 mg/kg. Cadmium was not detected in the subsurface soil sampling event.

Cobalt was detected in all collected soil samples. The maximum detected concentration of cobalt (32 mg/kg) exceeded the Inland Area estimated ambient concentration of 25 mg/kg.

Chromium was detected in all 27 crawl space surface samples and 9 subsurface samples collected at a maximum concentration of 2,600 mg/kg. Chromium was detected at an unusually high concentration at IA25-1, 2,600 mg/kg, in the building crawl space surface soil sampling event, suggesting a possible hot spot.

Copper was detected at a high concentration (1,190 mg/kg) at only 1 surface soil sampling location, SS-02-1. Copper was also detected in all 9 subsurface soil samples at a maximum soil concentration of 62 mg/kg.

Iron was detected in all soil samples. The maximum detected concentration of iron was 42,400 mg/kg. While no Inland Area estimated ambient concentration for iron has been established (Navy identifies iron as an essential nutrient and not a contaminant subject to risk assessment [Navy 2001]), these concentrations are within California soil background concentration ranges (Bradford and others 1996).

Lead was detected in all 27 surface samples with an average soil concentration of 308 mg/kg and a maximum detected concentration of 3,400 mg/kg. Lead was also detected in all 9 subsurface soil samples at a maximum detected soil concentration of 6 mg/kg. The estimated ambient concentration for lead in the Inland Area is 32 mg/kg.

The maximum detected concentration of magnesium was 42,400 mg/kg. There is no established Inland Area estimated ambient concentration for magnesium; magnesium is an essential trace nutrient (Navy 2001; EPA 1989).

Manganese was detected in 22 surface soil samples at a maximum detected soil concentration of 1,440 mg/kg. Manganese also was detected in 2 of the 9 subsurface soils sampling event samples at a concentration above the Inland Area estimated ambient concentration for manganese of 1,300 mg/kg. These samples were collected at a depth of 4.5 to 5.0 feet and 5.0 to 5.5 feet and contained manganese concentrations of 1,840 mg/kg and 6,560 mg/kg, respectively.

Mercury was detected in 18 surface soil samples at a maximum detected concentration of 1.4 mg/kg. Mercury was also detected in subsurface sampling events. It was detected in all 9 samples at an average soil concentration of 0.1 mg/kg and a maximum detected concentration of 0.25 mg/kg.

The maximum detected concentration of nickel was 160 mg/kg, which exceeded the Inland Area estimated ambient concentration for nickel of 110 mg/kg.

Selenium was detected in 7 samples collected during the building crawl space surface soil sampling event at a maximum concentration of 4.4 mg/kg. No background selenium concentrations are available. Selenium was detected in only 1 subsurface soil sample at a concentration of 1.5 mg/kg.

Silver was detected only in the crawl space surface soils sampling event at a maximum concentration of 0.30 mg/kg. There is no established Inland Area estimated ambient concentration for magnesium.

Thallium was detected in 1 of the 9 subsurface soils samples at a concentration of 7.0 mg/kg. The sample was collected from a depth of 5.0 to 5.5 feet. During the building crawl space surface soils sampling event, thallium was not detected; however, it is unclear whether analysis for thallium was conducted by IT Corporation.

Vanadium was detected in all 9 subsurface soil samples at a maximum concentration of 164 mg/kg. Vanadium was also detected in all 27 surface soil samples at a maximum concentration of 110 mg/kg.

Zinc was detected in all 27 surface samples collected during the building crawl space surface soil sampling event at a maximum concentration of 20,000 mg/kg. Zinc was also detected in all 9 subsurface soil samples at a maximum detected soil concentration of 91.9 mg/kg.

Several organic constituents were detected during the building crawl space surface soil sampling event. These include VOCs (2-butanone, 1,1,1-trichloroethane, methylene chloride, TCE, and total xylenes), TPH as gasoline, SVOC (bis[2-ethylhexyl]phthalate), PAHs (acenaphthene, anthracene, chysene, benzo[b/k]fluorananthene, benzo[a]pyrene, fluoranthene. naphthalene, phenanthrene, and pyrene), chlorinated herbicides (2,4,5 trichlorophenoxypropionic acid, 2,4-dichlorophenoxybutyric acid [2,4-DB], and dinoseb) and the explosives (tetryl and diphenylamine). Almost all of these organic constituents occur at low concentrations, and all are thoroughly evaluated in the SLHHRA and SLERA. Of the above constituents, three (bis[2-ethylhexyl]phthalate, 2-butanone, and methylene chloride) are common laboratory contaminants; therefore, they may not represent environmental contamination at the site.

No groundwater sampling has been conducted at Site 29. The previous site investigation report prepared for Site 29 (TtEMI 1999), as reviewed and approved by the regulatory agencies did not identify groundwater as a potential medium of concern. As discussed in Section 2.2.5, groundwater contamination is not suspected because the contamination is shallow relative to anticipated groundwater levels at Site 29.

2.2.5 Contaminant Fate and Transport

The major migration pathway for movement of metal chemicals of concern (COC) and chemicals of ecological concern (COEC) from Site 29 is wind transport of dry surface soils potentially containing contaminants. Surface water bodies are not present in the immediate vicinity of Site 29, and surface runoff from rainfall events is limited because of the presence of earthen berms and buildings constructed in the area. The potential for transport of contaminants by groundwater is not considered a viable migration pathway for two reasons. First, the contaminants present in site soils have been identified at depths much shallower (less than 5.5 feet bgs) than anticipated groundwater depths at Site 29 (estimated at 20 to 30 feet bgs). Second, metals in soil are likely immobile and have not been identified at concentrations that would suggest leaching to groundwater is of concern.

The most likely transport of the metal COCs and COECs in soils throughout Site 29 would be from erosion of the soil by surface water or wind. These inorganic COCs and COECs are indigenous and present in soil throughout Site 29. The presence of these COCs and COECs throughout Site 29 may result from deposition of ambient concentrations during ponding and evaporation cycles. Lead concentrations in surface soil beneath Building IA-25 may be attributable to the use of lead-based paint on exterior surfaces of the building or pilot-scale ammunition testing operations conducted with lead-containing ammunition.

2.2.6 Screening-Level Human Health Risk Assessment

A SLHHRA was completed for two areas at Site 29: (1) the Building IA-25 crawl space soils and (2) subsurface soils east of Building IA-25. The SLHHRA was conducted to evaluate potential human health risks associated with the chemicals detected in soil at Site 29. The results of the SLHHRA were presented in the site investigation report for Site 29 (TtEMI 1999) and have been updated in this FS report to incorporate current EPA Region IX PRGs (EPA 2002a). The SLHHRA was conducted as a PRG screen, using the maximum concentration of each detected chemical as the exposure point concentration (EPC). The PRG screening approach provided an expedited but conservative evaluation.

The methods applied in the SLHHRA are consistent with DTSC guidance in “Recommended Outline for Using U.S. EPA Environmental Protection Agency Region IX Preliminary Remediation Goals in Screening Risk Assessments at Military Facilities” memorandum (DTSC 1994). Though land use at Site 29 will likely remain industrial, potential human health risks were estimated under both residential and industrial land-use scenarios.

In accordance with EPA guidance (EPA 1989), the SLHHRA is composed of the following components:

- Data evaluation and identification of chemicals of potential concern (COPC)
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Uncertainty analysis

These components are described in Sections 2.2.6.1 through 2.2.6.5, and the results and conclusions of the SLHHRA are summarized in Section 2.2.6.6. Tables 2-3 through 2-8 presents residential and industrial cancer risks and non-cancer hazard indices (HI), maximum detected concentrations, and EPA Region IX residential and industrial soil PRGs.

2.2.6.1 Data Evaluation and Identification of COPCs

This SLHHRA includes data collected from the Building IA-25 crawl space, referred to as the building crawl space surface soils sampling event data, and data collected from subsurface soils east of Building IA-25, referred to as the subsurface soils sampling event data. As described in Section 2.2.1, data collected from the building crawl space surface soils sampling event were collected from 0 to 18 inches bgs, and the majority of the samples were collected from 0 to 12 inches bgs. Data from the subsurface soils sampling event were collected from 0 to 15 feet bgs. This update to the SLHHRA did not evaluate potential risks from exposure to subsurface soils below 10 feet bgs because exposure to soil greater than 10 feet bgs depths is unlikely under current and potential future land use scenarios. Further, assessment of soils to a depth of 10 feet bgs is consistent with State of California risk assessment guidance (DTSC 1992). In the SLHHRA, discussion of the subsurface soils sampling event data refers to data collected from 0 to 10 feet bgs.

Although the quality of the data collected during the building crawl space surface soils sampling event cannot be verified because a complete data set is not available (only detected results are available), the data were included in the SLHHRA. The building crawl space surface soils sampling event data represent surface soil conditions beneath Building IA-25, and the subsurface soils sampling event data represent subsurface soil conditions outside Building IA-25. Based on the spatial distribution of the COPCs in the two areas, the data sets for the two sampling events are evaluated separately in this SLHHRA as two separate areas.

COPCs were identified for evaluation in the SLHHRA to estimate total potential health risks associated with contaminants present in soils at Site 29 through a three-step process, as follows:

1. Preliminary lists of COPCs were developed that included all analytes detected in 1 or more soil samples.
2. Metals considered to be essential human nutrients (that is, calcium, iron, magnesium, potassium, and sodium) were compared to the range of background concentrations of these nutrients in soil in California, as reported by Bradford and others (1996). Metals present at levels within the range of background concentrations for essential nutrients were eliminated from further evaluation.

3. Metals present at ambient levels (80 percent lower confidence limit on the 95^{th} percentile of the ambient data set, Table 2-3 through 2-8 of RFACS) were reviewed and eliminated from further evaluation.

Although total petroleum results (for example, TPH as gasoline) were not used in the SLHHRA, the principal toxic constituents in petroleum products (that is, certain metals, benzene, toluene, ethylbenzene, xylenes, and PAHs), if detected, were evaluated in the SLHHRA, consistent with State of California guidance (DTSC 1993).

The COPCs identified using the three-step process above are listed in Tables 2-3 and 2-4 for the building crawl space surface soils sampling event and the subsurface soil sampling event chemical data sets, respectively. As shown in the Tables 2-3 and 2-4, VOCs, SVOCs (including PAHs), organochlorine pesticides, PCBs, chlorinated herbicides, metals, and explosives byproducts were identified as COPCs in the building crawl space surface soils. VOCs and metals were identified as COPCs in the subsurface soils.

Tables 2-3 and 2-4 also present the EPA Region IX residential and industrial PRGs for each of the chemicals detected during the surface and subsurface soil sampling events. The PRGs are shown in the tables for informational purposes and were not used to select COPCs. Although iron was eliminated as a COPC based on the screening process described previously, the maximum detected concentration of iron in both the building crawl space surface soils and subsurface soils sampling data sets exceeds the residential PRG for iron. The maximum detected concentration of iron (42,000 mg/kg) is, however, well within the background range of iron reported in soils in California (Bradford and others 1996) and is less the ambient limit (58,000 mg/kg) established for the Tidal Area for Concord NWSSBD. An ambient limit for iron in the Inland Area of Concord has not been established. In the absence of a site-specific ambient level for iron, a qualitative evaluation of risks from exposure to iron is included in Section 2.2.6.4.

2.2.6.2 Exposure Assessment

Potential human health risks associated with chemicals detected in soil at Site 29 were conservatively evaluated under both the industrial and unrestricted (residential) land-use scenarios.

The exposure pathways evaluated for potential receptors under both the residential and industrial land-use scenarios are consistent with those evaluated within the PRG framework (EPA 2002a) and include the following:

- Incidental ingestion of soils
- Inhalation of particulates and volatiles emitted from soils
- Dermal contact with soils

The maximum detected concentrations for COPCs in soil were conservatively used as EPCs for estimating potential health risks. EPCs and summary statistics for the two sampling event data sets are presented in Tables 2-3 and 2-4.

2.2.6.3 Toxicity Assessment

Typically, the toxicity assessment involves a review of agency literature and the subsequent compilation of cancer slope factors (CSF) and reference doses (RfD) used to estimate cancer risks and HIs. Issues regarding the evaluation of appropriate toxicity values that include selecting appropriate surrogate toxicity values, route-to-route extrapolation, and an analysis of sources used to identify and select toxicity values are also considered. The development of PRGs already incorporates the results of these analyses. A complete list of all toxicity values used to develop the PRGs is presented in the PRG table (EPA 2002a).

To provide for a conservative estimate of potential toxic responses measured by using DTSC toxicity values, DTSC advocates use of State of California toxicity values. These California toxicity values are used in developing the "Cal-modified" PRGs used by EPA Region IX. Cal-modified-PRGs were used in the SLHHRA when available (EPA 2002a). Cal-modified PRGs are significantly more conservative than risk-based concentrations calculated by EPA Region IX.

For some carcinogens, separate PRGs are available to assess their carcinogenic effects and their noncancer adverse health effects (EPA 2002a). For these compounds, both the cancer risks and potential for noncancer adverse health effects were evaluated and quantitatively assessed in this SLHHRA. Additional issues related to PRGs, including the hierarchy of toxicity values, route-to-route extrapolation, chromium, and lead, are discussed in detail in the following text.

Hierarchy of Toxicity Values

Toxicity values (CSFs and RfDs) used by EPA Region IX to develop PRGs were obtained from the following toxicological sources in order to preference:

- Integrated Risk Information System (EPA 2002b)
- National Center for Environmental Assessment
- Health Effects Assessment Summary Tables (EPA 1997a)

Route-to-Route Extrapolation

Route-to-route extrapolations were used by EPA Region IX to develop PRGs when no toxicity values were available for a given route of exposure as discussed below:

- When an oral toxicity value but no inhalation toxicity value was available, the oral toxicity value was used as the inhalation toxicity value.
- When an inhalation toxicity value but no oral toxicity value was available, the inhalation toxicity value was used as the oral toxicity value.
- Oral RfDs and CSFs were used to quantify effects associated with dermal exposures for all COPCs (except for cadmium, where a dermal-specific RfD has been developed) because dermal toxicity values have not been developed.

In general, toxic effects associated with exposure to metals are heavily dependent on the exposure route. For this reason, route-to-route extrapolations were not conducted for metals.

Chromium Assessment

For chromium toxicity, the CSF is dependent on the oxidation state of the metal (that is, whether chromium is present as trivalent chromium or hexavalent chromium). Specifically, hexavalent chromium is a known human carcinogen while trivalent chromium is not. In addition, the RfD for trivalent chromium differs from the RfD for hexavalent chromium. In general, chromium is present in soil as trivalent chromium unless industrial discharges of hexavalent chromium occur (Fetter 1993). The PRGs for total chromium, which assumes a one-to-six ratio in soils of hexavalent chromium to trivalent chromium, was used in the SLHHRA.

Lead Assessment

Risks and HIs are not evaluated for lead in the same manner as other human health COPCs because the nature of the toxicological data for lead differs for assessment of health effects. Health effects associated with lead are correlated with measured blood lead levels rather than external dose; physiologically based pharmacokinectic models have been developed to evaluate exposure to lead by predicting blood lead levels. EPA has developed the Integrated Exposure Uptake Biokinetic (IEUBK) model to evaluate the intake and subsequent blood lead levels of receptors based on exposure to soil, groundwater, and other sources. EPA's IEUBK model predicts blood lead levels in adults, children, and fetuses, and estimate the probability that fetal blood lead concentrations will exceed a specified concentration, based on a given lead concentration in soil.

DTSC has also developed a blood lead model (Leadspread) that estimates occupational and residential blood lead levels corresponding to the 50th through 99th percentiles of the population on the basis of total lead uptake from exposure via five pathways. The five pathways are soil ingestion, dermal contact with soil, inhalation of dust, ingestion of drinking water that contains lead, and ingestion of homegrown produce grown in lead-contaminated soil. Using the Leadspread model, DTSC developed a Cal-modified residential soil PRG for lead of 150 mg/kg.

The EPA PRGs of 400 mg/kg for lead in residential soil and 750 mg/kg for lead in industrial soil as well as the Cal-modified residential soil PRG of 150 mg/kg for lead were used for assessing lead exposures at Site 29.

2.2.6.4 Risk Characterization

This section presents a quantitative analysis of the potential risk to human health from COPCs detected in soils. Tables 2-5 and 2-6 present the risk calculations for Building IA-25 crawl space surface soil data set. Tables 2-7 and 2-8 present the risk calculations for the subsurface soil data set.

Consideration of Carcinogenic Endpoints

Potential cancer risks were estimated using the ratios of the chemical concentrations and EPA Region IX PRGs in accordance with DTSC guidance (DTSC 1994). COPCs whose PRGs are based on carcinogenic effects are designated with "ca" (PRG_{ca}). PRGs for carcinogenic chemicals are risk-based chemical concentrations that correspond to a one-in-one-million (10^{-6}) cancer risk using current EPA CSFs (discussed in Section 2.2.6.3) and regulatory default “standard” exposure factors in the intake equation (EPA 2000). The cancer risk for a carcinogenic COPC was calculated using the maximum detected concentration (C_{max}) and PRG_{ca} in the following equation:

$$\text{Chemical-Specific Risk} = (C_{max} / PRG_{ca}) \times 10^{-6}$$

The total cancer risk for Site 29 was estimated by summing the cancer risks for all carcinogenic chemicals.

EPA guidance on exposure levels considered protective of human health is presented to aid in the interpretation of the results of the risk assessment. In the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), EPA defined general remedial action goals for sites on the National Priorities List (Title 40 *Code of Federal Regulations* [CFR] 300.430). These goals include a range for residual carcinogenic risk, which is "an excess upper bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6}," or 1 in 10,000 to 1 in 1,000,000. The goals set out in the NCP are applied once a decision to remediate a site has been made. A more recent EPA directive (EPA 1991) provides additional guidance on the role of the SLHHRA in supporting risk management decisions and in particular, determining whether remedial action is necessary at a site. Specifically, the guidance states the following: "Where cumulative carcinogenic site risk to an individual based on reasonable maximum exposure for both current and future land use is less than 1×10^{-4}, and the noncarcinogenic hazard quotient (HQ) is less than 1, action generally is not warranted unless there are adverse environmental impacts." In comments to the Navy, however, EPA Region IX has stated that action may be taken to address risks between 1×10^{-4} and 1×10^{-6} (EPA 1997a), and Cal/EPA has stated that the agency considers 1×10^{-6} as the point of departure for risk management decisions. For this reason, the range between 1×10^{-4} and 1×10^{-6} is referred to as the "risk management range" in this discussion, enabling readers to frame quantitative risk results in relative terms; it does not imply a final risk management decision. In addition, a chemical termed a "chemical risk driver" is identified when the risk for the chemical exceeds 1×10^{-6}.

Consideration of Noncarcinogenic Endpoints

Potential noncancer hazards were estimated using the ratios of the chemical concentrations and EPA Region IX PRGs in accordance with DTSC guidance (DTSC 1994). COPCs whose PRGs are based on noncarcinogenic effects are designated with "nc" (PRG_{nc}). PRGs for noncarcinogenic chemicals are risk-based chemical concentrations that correspond to a noncancer HQ of 1 using the current EPA RfDs (discussed in Section 2.2.6.3) and the regulatory default "standard" exposure factors in the intake equation (EPA 2000). The noncancer HQs for a noncarcinogenic COPC were calculated using the maximum detected concentration (C_{max}) and PRG_{nc} in the following equation:

$$HQ = C_{max} / PRG_{nc}$$

The noncancer HI for Site 29 was estimated by summing the HQ for all COPCs. If the HI is greater than 1, then an HI organ segregation analysis is performed where the HI for chemicals that have the same toxic manifestation are summed according to the target organ affected. The total cancer risk and noncancer HI for Site 29 are summarized in Section 2.2.6.6.

Iron Evaluation

Iron is not quantitatively evaluated in this SLHHRA based on several reasons. Maximum concentrations of iron detected at the site were below established ambient concentrations in Concord, as summarized in the following table.

Summary Statistics for Iron Concentrations in Soil					
Data Set	**Detection Frequency**	**Range (mg/kg)**	**Ambient Limit (mg/kg)[a]**	**Number of Locations Exceeding Residential Soil PRG**	**Number of Locations Exceeding Ambient Limit and PRG**
Crawl Space Surface Soil	20/20	3,880 to 42,400	58,000	16	0
Subsurface Soil	5/5	16,300 to 31,800	58,000	2	0

Note:

a An ambient concentration for iron in soil has not been established for the Inland Area. The value shown is the ambient limit established for the Tidal Area.

The concentrations of iron in surface and subsurface soils are within the range of concentrations reported in soils in California (10,000 to 87,000 mg/kg) (Bradford and others 1996). Adverse health effects associated with background concentrations of iron in soils in California have not been reported.

The maximum detected concentration of iron in the Building IA-25 crawl space surface soils and subsurface soils sampling data exceeds the EPA Region IX soil PRG of 23,000 milligrams per kilogram (mg/kg) for residential land use (EPA 2002a). However, the iron PRG is based on a provisional RfD (0.3 mg/kg-day) developed by the National Center for Environmental Assessment (NCEA). The provisional RfD of 0.3 mg/kg-day is the average intake for all Americans, measured in the second National Health and Nutritional Examination Survey. NCEA's use of an average intake rate indicates that a large fraction of the U.S. population has a higher intake rate than the provisional RfD of 0.3 mg/kg-day; NCEA does not discuss the risks borne by that fraction of the population (EPA 1999a). The NCEA notes that the provisional RfD is within the range of the recommended daily allowance (RDA) (National Research Council [NRC] 1989) but maybe higher or lower depending on the specific population. For example, the RDA for children ages 6 months to 1 year is 1.11 mg/kg-day which is higher than the RfD while the RDA for young adult men is 0.13 mg/kg-day which is lower than the RfD. The NCEA also notes that the provisional RfD may not be protective for people with inherited disorders in iron metabolism.

The RDA is a minimum requirement for proper nutrition that is routinely supplied in vitamin supplements (NRC 1989). Iron is considered an essential nutrient and has different RDA depending on age and gender. Based on the soil ingestion rate assumption of 100 mg/day for an adult receptor used in the PRG, an RDA for iron of 15 mg/day for adult females and 10 mg/day for males would have equivalent concentrations of 150,000 milligrams of iron per kilogram of soil (mg-iron/kg-soil) for adult female receptors and 100,000 mg-iron/kg-soil for adult male receptors. A child receptor with an assumed ingestion rate of 200 mg/day in the PRG and an RDA of 10 mg/day would have an equivalent concentration of 50,000 mg-iron/kg-soil. The maximum concentrations of iron detected at the site are below the equivalent soil concentrations of published RDA.

Based on these considerations, iron in the Building IA-25 crawl space surface soils and in subsurface soils east of Building IA-25 is not anticipated to be a potential risk to human health.

2.2.6.5 Uncertainty Analysis

Varying degrees of uncertainty at each stage of the SLHHRA arise from assumptions made in the risk assessment and limitations of the data used to calculate risk estimates. Uncertainty and variability are inherent in the identification of COPCs, exposure assessment, toxicity values, and risk characterization. Risks were estimated in the SLHHRA by comparison to PRGs; therefore, risks were only assessed for those exposure pathways addressed within the PRG framework. For soil exposures, the PRGs evaluate the following exposure pathways: incidental soil ingestion, dermal contact with soil, and inhalation of particulate and volatile chemicals released from soil to air.

For this SLHHRA, the homegrown produce ingestion exposure pathway was not assessed for the residential exposure scenario for several reasons. This pathway is not assessed within the PRG framework, and since the SLHHRA is a screening-level assessment based on California guidance (DTSC 1994), the pathway is not included. Because future residential homegrown produce ingestion is not a reasonably anticipated pathway (as the pathway is more likely to be complete for farmers and rural areas) and workers are not likely to be exposed via this pathway (EPA 1989), no assessment of this hypothetical exposure was included. Such an assessment of residential produce consumption is conducted “where appropriate,” based upon the criteria EPA has outlined (EPA 1991). The exclusion of the homegrown produce exposure pathway from the SLHHRA for Building IA-25 crawl space surface soils and subsurface soils outside of Building IA-25 is not likely to result in an underestimate of potential risks because use of Site 29 is likely to remain industrial. A detailed discussion of other uncertainties associated with the SLHHRA for Site 29 was presented in Section 5.4.5 of the Site 29 site investigation report (TtEMI 1999) and is not presented in this report. If the use of site changes to residential in the future, hypothetical homegrown produce consumption would be a potentially complete pathway for exposure to site contaminants.

2.2.6.6 Summary and Conclusion of Screening-Level Human Health Risk Assessment

The SLHHRA results and conclusions for the building crawl space surface soils sampling event and the subsurface soils sampling event are summarized in the following sections. Tables 2-5 through 2-8 show the risk calculations for surface and subsurface soils.

Building Crawl Space Surface Soils Data

Total cancer risks posed by surface soil from the building crawl space under the residential exposure scenario (2×10^{-5}) exceed 10^{-6}, but are within the EPA risk management range of 10^{-6} to 10^{-4} (Table 2-5). Chemical risk drivers for the residential exposure scenario were benzo(a)pyrene, benzo(b/k)fluoranthene, and chromium. The total noncancer HI for the residential exposure scenario was 4, which exceeds the threshold HI of 1; however, segregated noncancer HIs were all below the threshold HI of 1.

Total cancer risks posed by building crawl space surface soil for the industrial exposure scenarios (7×10^{-6}) exceeded 10^{-6}, but was within the EPA risk management range of 10^{-6} to 10^{-4} (Table 2-6). Chromium in soil (evaluated as total chromium) was the chemical risk driver under the industrial exposure scenario. The total noncancer HI for the industrial exposure scenario (0.3) did not exceed the threshold HI of 1.

Lead was identified as a COPC from the building crawl space surface soils data set. The maximum detected concentration of lead (3,400 mg/kg) exceeds both the EPA and Cal-modified residential PRGs of 400 mg/kg and 150 mg/kg, respectively, as well as the EPA industrial PRG of 750 mg/kg. Lead concentrations in surface soil range from 10 mg/kg to 3,400 mg/kg. Lead concentrations measured in 10 of the 27 surface soil samples exceeded the Cal/EPA-modified PRG of 150 mg/kg; of these, 5 samples contained lead concentrations that exceeded the EPA residential soil PRG of 400 mg/kg. Three of the 27 surface soil samples contained lead concentrations that exceeded the EPA industrial soil PRG of 750 mg/kg.

Subsurface Soils Data

Total cancer risk posed by subsurface soils east of Building IA-25 under the residential exposure scenario (4×10^{-8}) is below the EPA target risk level (and DTSC point of departure) of 1×10^{-6} (Table 2-7). The noncancer HI for the residential exposure scenario was 6 and exceeded the threshold HI of 1. Segregated HIs for two target organs, the central nervous system and the liver, exceeded the threshold HI of 1. The segregated HI for the central nervous system was 3.7 (primarily as a result of manganese) and 1.4 for the liver (primarily as a result of thallium).

Manganese was detected at a depth of approximately 5 feet bgs in two of the nine locations above the ambient concentrations of 1,300 mg/kg and the residential PRG of 1,800 mg/kg. Thallium was detected above the ambient concentration of 1.4 mg/kg and the residential PRG of 5.2 mg/kg in 1 of the 5 samples at a depth of approximately 5 feet bgs (the highest thallium detection was in the same sample with manganese above the ambient level). The maximum concentrations of manganese and thallium were detected in samples collected in undisturbed native materials at Site 29. The potential source for these contaminants is not known because operations previously conducted at Site 29 (pilot scale testing of ammunitions) typically are not associated with manganese and thallium.

Although concentrations of manganese and thallium exceed the established Inland Area ambient concentrations, professional judgment suggests that these concentrations may be a naturally occurring small-scale geologic anomaly. The presence of manganese and thallium is unexpected in this soil sample because of the depth of the detected metals, the undisturbed nature of the soil sample, the isolated occurrence of manganese and thallium at the site, and the lack of a known source of manganese and thallium contamination at the site.

Total cancer risk posed by subsurface soils east of Building IA-25 under the industrial exposure scenario (2×10^{-8}) is below the EPA target risk level of 1×10^{-6} (Table 2-8). The total noncancer HI for the industrial exposure scenario (0.5) did not exceed the threshold HI of 1.

Results and Conclusions

The results of the SLHHRA indicate that lead in Building IA-25 crawl space surface soils is the only chemical of concern. Measured concentrations of lead in several samples exceed both residential and industrial screening levels. Although benzo(a)pyrene, benzo(b/k)fluoranthene, and chromium were identified as chemical risk drivers in Building IA-25 crawl space surface soils, the total cancer risk from exposure to Building IA-25 crawl space surface soils is within the EPA risk management range of 10^{-6} to 10^{-4}.

The results of the SHHRA for subsurface soils east of Building IA-25 indicate that cancer risks from exposure to subsurface soils are less than the EPA target risk level of 10^{-6}. Segregated HIs for two target organs, the central nervous system and the liver, exceed the threshold HI of 1 for the residential exposure scenario, primarily because of manganese and thallium. However, manganese and thallium are not associated with historical site operations. In addition, these chemicals are unlikely to pose a health risk because measured concentrations exceeding PRGs are present at depth in subsurface soils and represent a limited volume of soil at the site.

2.2.7 Screening-Level Ecological Risk Assessment

This SLERA was conducted as a part of the FS for Site 29 at the NWSSBD Concord. The purpose of this SLERA was to determine whether chemicals of potential ecological concern (COPEC) in surface and subsurface soils pose unacceptable risk to upper trophic level species at the site. Representative bird and mammal species that were the focus of the assessment included the American robin (*Turdus migratorius*), red-tailed hawk (*Buteo jamaicensis*), and western harvest mouse (*Reithrodontomys megalotis*). In addition, NWSSBD Concord is a known locale for the federally threatened California red-legged frog (*Rana aurora draytonii*) and the California tiger salamander (*Ambystoma californiense*), a candidate for federal listing and currently a State of California Species of Special Concern (California Department of Fish and Game [CDFG] 2000); therefore, these two species also were assessed qualitatively in the SLERA. Because no native or sensitive plant species are known to occur at the site, and because the general quality of habitat at Site 29 is low, only risk to upper trophic level receptors was evaluated.

The SLERA was prepared in accordance with EPA guidance (1997b). EPA characterizes the assessment of ecological risk as a complex, nonlinear process that involves many parallel activities and emphasizes that the ecological risk assessment (ERA) framework was designed to be flexible, thereby allowing studies to be scaled in a manner appropriate to the requirements of and conditions at each site (EPA 1997b). EPA separates the ERA process into eight steps:

- Step 1: Screening-level problem formulation and evaluation of ecological effects
- Step 2: Screening-level preliminary exposure estimate and risk calculation
- Step 3: Baseline risk assessment problem formulation
- Step 4: Study design and data quality objectives
- Step 5: Field verification of sampling design
- Step 6: Site investigation and analysis of exposure and effects
- Step 7: Risk characterization
- Step 8: Risk management

Steps 1 and 2 constitute the SLERA and are usually conducted using conservative exposure assumptions. The SLERA has four primary phases: (1) problem formulation, (2) exposure estimates, (3) ecological effects, and (4) risk characterization. During the problem formulation phase, an ecological conceptual site model (CSM) was developed for the site and assessment and measurement endpoints were selected. During the exposure estimate phase, exposure parameters were determined for representative receptors identified in the problem formulation phase. During the ecological effects evaluation, contaminant exposure levels were compared to conservative thresholds for adverse ecological effects. Finally, during the risk characterization phase, the potential risk to assessment endpoints associated with the site was evaluated.

In accordance with EPA guidance, the SLERA conclusions can be used by risk managers to determine which of the following descriptions applies to the information gathered regarding preliminary risks associated with exposure to COPECs:

- Adequate to conclude that ecological risks are negligible; therefore, no remediation is necessary
- Adequate to indicate a potential for adverse ecological effects; therefore, request either a site-specific baseline ERA be conducted to refine the risk estimate and reduce the uncertainty associated with the SLERA or a remedial action based on the SLERA
- Inadequate to make a decision and, therefore, request a site-specific baseline ERA be conducted to refine the risk estimate and reduce the uncertainty associated with the SLERA

2.2.7.1 Step 1: Problem Formulation and Ecological Effects

Problem formulation and ecological effects correspond to Step 1 of the SLERA process, as described in EPA guidance (EPA 1997b). The remainder of this section provides the problem formulation for Site 29, including a CSM, which provides descriptions of known and potential stressors, evaluation of potential exposure pathways, discussion of chemical fate and transport, and identification of assessment and measurement endpoints. An evaluation of ecological and toxicological effects is also conducted as part of the SLERA and is described in the following sections.

Conceptual Site Model

The CSM illustrates exposure pathways to be evaluated in the ERA and provides other key information such as chemical sources, release and transport mechanisms, and the relative importance of exposure pathways to specific receptor groups. The CSM includes the following components:

- Stressors
- Exposure pathways
- Fate and transport
- Assessment and measurement endpoints

The following sections briefly describe the ecology at Site 29 and the components of the CSM for Site 29, which is illustrated in Figure 2-4.

Ecological Surveys Conducted at Site 29

To characterize the ecology of Site 29, existing surveys (Downard and others 1999) combined with existing CDFG natural diversity database (CDFG 2000) were reviewed. Vegetation of the Inland Area was mapped during the summer of 1999 (Downard and others 1999). Plant communities documented in the Inland Area include valley and foothill grassland, which comprise greater than 50 percent of the Inland Area. Dominant plant species are primarily nonnative and invasive grass species such as wild oat (*Avena fatua*), rigput grass (*Bromus diandrus*), Mediterranean barley (*Hordeum marinum*), and Italian rye grass (*Lolium multiflorum*). A nonnative forb species, star thistle (*Cantaurea solstitialis*), is widely distributed within grasslands.

Amphibian and reptilian surveys were also conducted at NWSSBD Concord. Seven amphibian and 15 reptile species were observed at NWSSBD Concord from July 1998 to September 1999. A more recent survey was conducted in April 2003. The April 2003 survey consisted of a visual inspection of the site and notation of site conditions by TtEMI's wildlife biologist. NWSSBD Concord includes known locale for the federally threatened California red-legged frog (*Rana aurora draytonii*) and the California tiger salamander (*Ambystoma californiense*), a candidate for federal listing and currently a State of California Species of Special Concern (CDFG 2000).

California red-legged frogs primarily require nearby fresh water and have been observed in ponds on NWSSBD Concord property and within Seal Creek. The closest sighting of red-legged frogs (Downard and others 1999) is near the junction of L Street and Seal Creek, approximately 1,600 feet from Site 29. High quality habitat for red-legged frogs at NWSSBD Concord is found at the freshwater ponds approximately 7,000 feet (Indian Springs Pond) and 9,000 feet (Cistern Pond) from Site 29. Red-legged frogs and frog eggs have been counted at these pond locations on several occasions (Downard and others 1999). The U.S. Fish and Wildlife Service (FWS) considers the red-legged frog habitat to include a 5-mile radius around known locations. Although Site 29 lies within 5 miles of a number of identified red-legged frog habitats at NWSSBD Concord, most of Site 29 is either paved or unvegetated around Building IA-25; therefore, the site provides poor quality or marginal habitat for the red-legged frog.

California tiger salamanders have been known to occur in the freshwater ponds at NWSSBD Concord. Tiger salamanders are common at the Hilltop Ponds located approximately 9,000 feet to the east of Site 29. California tiger salamanders have been known to spend the majority of their time in burrows created by rodents, or in dark, moist places under buildings, old pipes, rip-rap etc. Although tiger salamanders have not been sighted in the immediate vicinity of Site 29, the rodent burrows at Site 29 and the crawl space below Building IA-25 could potentially offer habitat for California tiger salamanders.

Because much of the area around Building IA-25 at Site 29 is paved or unvegetated, however, the potentially contaminated crawl space area of Building IA-25 appears to provide marginal or poor quality habitat for the California tiger salamander. Because of the marginal habitat quality, it is unlikely that the salamander would frequent the contaminated portion of Site 29.

Other avian and mammalian receptors identified at NWSSBD Concord include raptors, coyotes, and ground squirrels.

Stressors and COPEC Selection

Stressors can be defined as any factor that causes adverse ecological impacts at the site. For the SLERA, only chemical stressors were evaluated. A preliminary list of COPECs were identified for evaluation in the SLERA to estimate potential ecological risks associated with contaminants present in soils at Site 29. This evaluation followed a tiered process, as follows:

- A preliminary list of COPECs was developed that included all analytes detected in more than 1 soil sample in the surface soil data set and in at least 1 sample in the subsurface soil data set.
- Essential nutrients that are not priority pollutants, such as calcium, iron, magnesium, potassium, and sodium, were not retained as COPECs. Elimination of essential nutrients from the SLERA was conducted as described in Section 2.2.6 for the SLHHRA.
- Based on the Navy's "Interim Final Policy on the Use of Background Chemical Levels" (Navy 2000), naturally occurring and anthropogenic chemicals present at levels below background concentrations are eliminated from consideration in the risk assessment process. Maximum detected chemical concentrations at Site 29 were compared to background chemical concentrations as presented in Table 2-9 (crawl space soils) and Table 2-10 (subsurface soils). Chemicals for which background concentrations are not available were automatically retained as COPECs and evaluated in the SLERA.

Petroleum products (for example, gasoline) were not included as COPECs in the SLERA; however, concentrations of the principal toxic constituents in petroleum products (that is, certain metals, benzene, toluene, ethylbenzene, xylenes, and PAHs), if detected, were evaluated in the SLERA.

In the surface soil data set, organic chemicals detected in only 1 sample were eliminated from the evaluation process. In addition, several chlorinated herbicides (2,4-DB and dinoseb), explosives and explosive by-products (tetryl and diphenylamine), and general chemistry by-products (cyanide, nitrate, and sulfate), were evaluated qualitatively because there is little or no toxicity information available for these chemicals. As presented in the human health risk section (Section 2.2.6**)** none of these chemicals is of concern for human health because of either low concentrations, a limited number of detections, and/or limited toxicity; therefore, these potential COPECs were not analyzed further in this SLERA.

COPECs were identified using the previous three-step screening process for each data set and are listed in Table 2-9 (crawl space surface soil) and Table 2-10 (subsurface soil). VOCs, SVOCs (including PAHs), organochlorine pesticides, PCBs, chlorinated herbicides, metals, and explosives by-products were identified as COPECs based on the crawl space surface soils sampling event data set. VOCs and metals were identified as COPECs based on the subsurface soils sampling event data set.

For those COPECs present in site media at concentrations above the corresponding background values, maximum detected soil concentrations were also compared to available ecological soil PRGs (Efroymson and others 1997) as presented in Table 2-9 (crawl space surface soil) and Table 2-10 (subsurface soil). Soil PRGs represent no observed adverse effect levels (NOAEL) for the wildlife organisms that serve as the basis for the PRGs. Ecological soil PRGs are based on toxicity data relevant to the following specific categories of organisms: plants, earthworms, short-tailed shrew, American woodcock, red fox, white-tailed deer, white-footed mouse, and red-tailed hawk (Efroymson and others 1997). The final PRG for each chemical is based on the most sensitive receptor from the above list.

Exposure Pathways

For an exposure pathway to be considered complete, a chemical must be able to travel from the source to the representative receptor and must be taken up by the receptor through one or more exposure routes. Thus, complete exposure pathways present the greatest potential risk of adverse effects for receptors of concern at a given site. Potential exposure pathways resulting in receptor contact with chemicals include soils, surface water, groundwater, air, and food-chain transfer.

Potential exposure pathways at Site 29 are diagrammed in the CSM (Figure 2-4), which shows that the soil is the predominant exposure pathway. Windblown dust could represent a complete exposure pathway because exposed soil exists in areas at Site 29. Therefore, the air exposure pathway is complete at Site 29; however, it is postulated to be insignificant in comparison to food-chain transfer and direct exposure to soils (see discussion in the following text) and is not considered in this SLERA. Surface water bodies are not present in the immediate vicinity of Site 29, and surface runoff from rainfall events is limited. The potential for transport of contaminants by groundwater is also not considered a viable migration pathway (see Section 2.2.5).

Exposure routes, or the point of entry of a chemical into a receptor, include root uptake and leaf sorption for plants and inhalation, dermal contact, and ingestion of contaminated soil, surface water, and food for animals (Figure 2-4). Plants exposed to chemicals in soil may accumulate chemical concentrations that cause adverse effects on growth, reproduction, or survival. Independent of direct effects on the plant, chemicals in plant tissues may be transferred to herbivores, omnivores, and detritivores, which in turn may be consumed by omnivores and carnivores. Such food chain transfer and associated bioaccumulation may result in unacceptably high doses of chemicals to higher-trophic-level consumers. The SLERA focused only on risk to representative birds and mammals at the site; risk to plants and invertebrates were not evaluated.

Ingestion of chemicals in soil and prey was considered to be the predominant exposure pathway for birds, mammals, and other terrestrial vertebrates at Site 29; exposure via inhalation and dermal contact are not considered in most SLERAs (EPA 1997b). Terrestrial animals may ingest soil directly while feeding, grooming, and burrowing (Beyer and others 1994). Soil on or in the bodies of prey may also be consumed with the prey. For example, a bird feeding on an earthworm may ingest soil incidentally while probing for and eating the worm. A food-chain modeling (FCM) approach was used to evaluate potential effects of ingestion of chemicals by representative birds and mammals. Reptiles and amphibians were not included in this approach because there is little or no toxicity information to successfully complete a food-chain model.

During the dose assessment for higher-trophic-level receptors, it was assumed that the ingestion of contaminated prey and soil was the dominant exposure route and that other exposure routes were negligible (Suter 1993). Bioaccumulation factors (BAF) were used to estimate the chemical burden in prey tissues for each of the chemicals based on site soil concentrations. BAFs describe bioaccumulation in terms of the ratio between the concentration of a substance in an organism because of chemical uptake and the concentration in the surrounding environment. BAFs used in this SLERA are presented in Table 2-11.

Fate and Transport

Physical fate processes of concern include transport to groundwater, volatilization to air, transfer to surface water, and movement of contaminated soil particles through windblown dust or as suspended soil particles in surface water. Chemicals may also be transported in plant and animal tissues (biotic transport). For example, chemicals in the bodies of mobile receptors such as migrating birds, flying insects, and far-ranging predators may be carried off site and deposited in other locations in the form of feces or corpses. These are described in terms of exposure to ecological receptors identified in the previous section.

Although exposure is a simple concept, accurately describing the fate and transport of chemicals from their source to a site of toxic action in living organisms can be quite complicated. In general, for exposure to occur, a chemical must leave the environmental matrix, move across several biological membranes, and concentrate in a tissue to the extent that its toxic action is exerted. A chemical that can move from the environmental matrix to the tissue of a receptor is said to be bioavailable to that receptor. The SLERA focuses on chemicals in the environment that are bioavailable or potentially bioavailable to receptors.

Assessment and Measurement Endpoints

EPA defines assessment endpoints as "explicit expressions of the actual environmental values (e.g., ecological resources) that are to be protected" (EPA 1997b). Assessment endpoints are environmental characteristics that, if significantly impaired, would indicate a need for action by risk managers. Various definitions of valuable ecological resources include those without which ecosystem function would be significantly impaired; those providing critical resources, such as habitat or fisheries; and those perceived by humans as being valuable, such as endangered species and other issues addressed by legislation. Useful assessment endpoints define both the valuable ecological entities at the site and a characteristic of the entity to protect, such as reproductive success or production per unit area.

During this assessment, the focus was on endpoints most likely to be affected given the fate and transport mechanisms of the chemicals, the ecotoxicological properties of the chemicals, the habitats at the site, and the potential receptors existing at the site. Because no native or sensitive plant species are known to occur at the site, and because the general quality of habitat is low at Site 29, only risk to upper trophic level receptors was evaluated. Because of the presence of special status amphibians and reptiles near Site 29, a qualitative evaluation of risk to amphibians and reptiles using current toxicity literature was conducted. A lack of amphibian and reptilian toxicity benchmarks precluded a more quantitative assessment. The following assessment endpoints were used to evaluate the potential ecological risk at Site 29:

- **Sufficient rates of survival, growth, and reproduction to protect populations of omnivorous birds typical to the area.** Secondary avian consumers that provide a food source for upper-trophic-level consumers, such as avian and mammalian carnivores, are an important ecological resource for a healthy environment. Maintenance of populations of secondary avian consumers was considered an ecological value to be protected.
- **Sufficient rates of survival, growth, and reproduction to protect populations of carnivorous birds typical to the area.** Carnivorous birds are important tertiary consumers at the site and are susceptible to the effects of bioaccumulative chemicals. Effects on the raptor populations at Site 29 would also be undesirable because of the effects that the loss of predation would have on lower trophic levels. Maintenance of populations of raptors was considered an ecological value to be protected.

- **Sufficient rates of survival, growth, and reproduction to protect populations of herbivorous mammals typical to the area.** Herbivorous mammals provide a major food source for upper-trophic-level consumers. Adverse effects on the populations of these primary consumers could result in a reduction of food available to higher-trophic-level consumers. Maintenance of populations of herbivorous mammals was considered an ecological value to be protected.

Assessment endpoints are usually not amenable to direct measurement; therefore, measurement endpoints related to assessment endpoints were identified. A measurement endpoint is defined by EPA as "a measurable ecological characteristic that is related to the valued characteristic chosen as the assessment endpoint and is a measure of biological effects (such as mortality, reproduction, or growth)" (EPA 1997b). Measurement endpoints more closely reflect technical considerations in the risk assessment process; that is, measurement endpoints are focused on both direct measures of ecological effects such as toxicity tests and indirect measures such as FCM that allow for an evaluation of risk to representative receptors. Measurement endpoints can include measures of exposure or effect and are frequently numerical expressions of observations. Measurement endpoints are often expressed as statistical or arithmetic summaries of observations and can include both measures of effect and measures of exposure. Each measurement endpoint correlates directly with one of the defined assessment endpoints and was based on available literature regarding mechanisms of toxicity. A species was selected to be representative of each assessment endpoint. Food-chain models were used to estimate site-specific exposure (dose) to representative species; doses were compared to toxicity references values (TRV) in an HQ approach.

The following measurement endpoints were used in evaluating potential ecological impacts on the assessment endpoints identified for Site 29:

- **For omnivorous birds, reproductive or physiological impacts on the American robin:** The American robin (*Turdus migratorius*) was used as a surrogate to represent the terrestrial bird population associated with Site 29. Potential reproductive or physiological impacts were evaluated by comparing estimated site-specific doses with literature-derived TRVs. Chemicals without an existing TRV were evaluated qualitatively. A conservative daily dose was calculated based on site chemical concentrations and natural history information on the American robin. HQs were developed by dividing the estimated daily dose for each chemical by the appropriate TRV.
- **For carnivorous birds, reproductive or physiological impacts on the red-tailed hawk:** The red-tailed hawk (*Buteo jamaicensis*) was used as a surrogate to represent the raptor populations associated with Site 29. Potential reproductive or physiological impacts were evaluated using literature-derived TRVs. Chemicals without an existing TRV were evaluated qualitatively. A conservative daily dose was calculated based on site chemical concentrations and natural history information on the red-tailed hawk. HQs were developed by dividing the daily dose by the appropriate TRV for each chemical.
- **For herbivorous mammals, reproductive or physiological impacts on the western harvest mouse:** The western harvest mouse (*Reithrodontomys megalotis*) was used as

a surrogate to represent the herbivorous mammal population associated with Site 29. Potential reproductive or physiological impacts were evaluated using literature-derived TRVs. Chemicals without an existing TRV were evaluated qualitatively. Conservative daily doses were calculated based on site chemical concentrations and natural history information on the western harvest mouse. HQs were developed by dividing the daily doses by the appropriate TRV for each chemical.

2.2.7.2 Step 2: Exposure Estimate and Risk Calculation

The following sections describe the exposure estimate and risk calculation for Site 29, including the selection of COPECs and COECs and evaluation of exposure to the selected assessment endpoints. Exposure estimates and risk calculation correspond to Step 2 of the screening-level risk assessment process, as described in EPA guidance (EPA 1997b).

Exposure and Effects on Terrestrial Vertebrates

The evaluation of risk to terrestrial vertebrates, such as birds and mammals, focused on selected assessment endpoints identified in the previous section. FCM was the primary tool used to assess the potential effects from exposure of terrestrial vertebrates to chemicals present at Site 29. Food-chain models are used to assess the exposure of higher-trophic-level receptors to chemicals in their diet (for example, evaluation of exposure through the ingestion pathway). These models are conceptually simple and focus on ecological receptors of concern. Food-chain models are one method of integrating ecological and chemical information into the risk assessment process, especially for chemicals that tend to bioconcentrate or bioaccumulate (Pascoe and others 1996).

This section describes the model that was used to estimate ingested doses of site chemicals for higher-level avian and mammalian receptors using estimated prey concentrations obtained from the literature. Exposure models for birds and mammals are based on the assumption that exposure to chemicals is primarily through ingestion of contaminated soil and prey. Surface water ingestion, dermal contact, and inhalation are other possible routes of exposure, but they were not evaluated in these models. The exposure models estimate the mass of a chemical internalized daily by a receptor per kilogram of body weight (daily chemical dosage). Estimates of exposure are generally based on knowledge of the spatial and temporal distribution of both chemicals and receptors and on specific natural and life history characteristics that influence exposure to chemicals. For each measurement endpoint and COPEC, a conservative estimate of the daily dose to the organism was developed using literature-based life history information, site-specific COPEC soil concentrations, and literature-derived BAFs to estimate tissue concentrations.

Maximum daily chemical doses were estimated for each COPEC and representative receptor using maximum site concentrations in soil and estimating concentrations in prey tissue using BAFs. These doses were then compared with high and low TRVs to estimate the potential adverse biological effects on the receptor. Based on this comparison, the risk to each representative species was characterized using an HQ approach [HQ=dose/TRV].

The total exposure from ingestion for each receptor of concern was calculated as the sum of the dietary exposure estimates. The following generic equation was adapted for each representative receptor:

$$Dose_{total} = \frac{([IR_{prey} \times C_{prey}] + [IR_{soil} \times C_{soil}]) \times SUF}{BW}$$

where

$Dose_{total}$	=	Estimated dose from ingestion (mg/kg body weight-day)
IR_{prey}	=	Ingestion rate of prey (kilograms per day [kg/day])
C_{prey}	=	Concentration in dry weight of chemical in prey (mg/kg)
IR_{soil}	=	Ingestion rate of soil (kg/day)
C_{soil}	=	Concentration in dry weight of chemical in soil (mg/kg)
SUF	=	Site use factor (unitless)
BW	=	Adult body weight (kg)

Conservative SLERA risk estimates ensure that the assessment does not indicate little or no risk when a risk actually exists; therefore, in the absence of site- or species-specific data, conservative assumptions were used in this analysis. Exposure was assessed within the context of the following linear food chains to evaluate potential ecological effects on secondary consumer birds and mammals:

- Soil → Plants and Invertebrates → American Robin
- Soil → Small Mammals → Red-tailed Hawk
- Soil → Plants → Western Harvest Mouse

The components of the exposure model were (1) temporal and spatial characterization of exposure, (2) ingestion rates and diet composition, and (3) life history and behavioral information. The following paragraphs include specific assumptions and model parameters for each representative receptor evaluated at Site 29. For each receptor and COPEC, a conservative estimate of the dose to the organism was developed using literature-based life history information, site-specific concentrations, and literature-derived BAFs to estimate tissue concentrations.

American Robin Dose Calculation Parameters

The American robin (*Turdus migratorius*) was selected to represent omnivorous passerine birds. The following summarizes the parameters used in dose calculations for the American robin:

Parameter	Average Adult	Units	Reference/Notes
Ingestion Rate$_{total}$	0.012273	kg/day	Calculated with body weight of 77.3 grams using the Nagy (2001) dry matter intake food requirement equation for passerine birds (a= 0.630; b= 0.683).
Ingestion Rate$_{soil}$	0.00000123	kg/day	0.01 percent of total ingestion rate, based on the rate for the western meadowlark (EPA 1999a).
Soil Concentrations	Maximum	mg/kg	Soil data collected from site.
Ingestion Rate$_{prey}$	0.012272	kg/day	99.99 percent of total ingestion rate, based on soil ingestion rate.
Prey Composition	55 (invertebrates) 45 (fruits)	percent	Diet composed of 45 percent plant matter (fruits) and 55 percent invertebrates for adults in the western United States (Wheelwright 1986 as cited in EPA 1993).
Prey Concentrations	BAF	unitless	Concentrations estimated using plant and invertebrate BAFs from EPA (1999a), multiplied by the maximum soil concentration.
Foraging Range	7.7 to 14.3	acres	Based on 7 to 13 males per 100 acres in the central Valley reported by Gaines (1974a) as cited in Zeiner and others (1990a).
SUF	1	unitless	Conservative estimate of site use.
BW	0.0773	kg	Mean body weight of adult robins throughout the United States (Clench & Leberman 1978 as cited in EPA 1993).

With regard to the prey composition parameters, animal matter predominates in the breeding season while in the nonbreeding season, the American robins eats more berries and other fruits, seeds, seedlings and spouts (Bent 1949 and Martin and others 1961, both as cited in Zeiner and others 1990a). The American robin searches visually for earthworms, caterpillars, beetles, snails, and arthropods on the ground, preferring short plant cover, occasional bare earth, and forest litter. The American robin food-chain model assumes a diet of 55 percent invertebrate tissue and 45 percent plant tissue (average of data for American robins in the western United States [Wheelwright 1986 as cited in EPA 1993]). Tissue concentrations were derived from BAFs for plants and invertebrates from Sample and others (1996) and EPA (1998, 1999a) and multiplied by the appropriate soil concentration.

The SUF accounts for the size of the area of concern in comparison with the foraging range used by the receptor species. If the area of the habitat used in the area of concern is greater than the foraging range of the species, it is likely that individuals may spend 100 percent of their time there. The SUF is determined by dividing the estimated home range by the habitat area in the area of concern. Home ranges for the American robin vary from 1.68 to 2.32 acres, depending on location, topography, habitat, and prey availability (Zeiner and others 1990a). To be conservative for the SLERA, an SUF of 1.0 was assumed for the dose calculations, indicating that the robin spends 100 percent of its time feeding and foraging at the site.

Red-Tailed Hawk Dose Calculation Parameters

The red-tailed hawk (*Buteo jamaicensis*) was selected to represent carnivorous raptors. The following summarizes the parameters used in dose calculations for the red-tailed hawk:

Parameter	Average Adult	Units	Reference/Notes
Ingestion Rate$_{total}$	0.0804	kg/day	Calculated with body weight of 957 grams using the Nagy (2001) dry matter intake food requirement equation for carnivorous birds (a= 0.849; b= 0.663).
Ingestion Rate$_{soil}$	0.000563	kg/day	0.7 percent of total ingestion rate, based on the rate for the Bald Eagle (Pascoe and others 1996).
Soil Concentrations	Maximum	mg/kg	Soil data collected from site.
Ingestion Rate$_{prey}$	0.0798	kg/day	99.3 percent of total ingestion rate, based on soil ingestion rate.
Prey Composition	100	percent	Diet composed of 100 percent animal matter (small rodents, reptiles, and birds) (Zeiner and others 1990a). Diet of 100 percent rodents was assumed for food chain model.
Prey Concentrations	BAF	unitless	Concentration estimated using rodent BAFs from EPA (1999a), multiplied by the maximum soil concentration.
Tissue Moisture	68	percent	Mouse tissue moisture from EPA (1993).
Foraging Range	247 -2,471	acres	Zeiner and others 1990a.
SUF	1	unitless	Conservative estimate of site use.
BW	0.96	kg	Average of adult males throughout the United States (Steenhof 1983 as cited in EPA 1993).

With regard to the prey composition parameter, red-tailed hawks are swooping, pouncing carnivores with a diet that consists of small mammals, insects, earthworms, reptiles, and amphibians (Ehrlich and others 1988; Zeiner and others 1990a). The red-tailed hawk food-chain model assumes a diet of 100 percent rodent tissue. Tissue concentrations derived from BAFs for rodents from Sample and others (1996) and EPA (1999a) were multiplied by the maximum soil concentration. Literature BAFs were converted from wet to dry weight using percent moisture for mouse tissue from the literature (EPA 1993).

With regard to the SUF, home ranges for the red-tailed hawk vary from less than 247 to 2,471 acres (Zeiner and others 1990a). Although the acreage of Site 29 is much smaller, to be conservative for the SLERA, an SUF of 1.0 was assumed for the dose calculations, indicating that the receptor spends 100 percent of its time feeding and foraging at the site.

Western Harvest Mouse Dose Calculation Parameters

The western harvest mouse (*Reithrodontomys megalotis*) was selected to represent small mammals. The following summarizes the parameters used in dose calculations for the western harvest mouse:

Parameter	Average Adult	Units	Reference/Notes
Ingestion Rate$_{total}$	0.0024	kg/day	Calculated with average adult body weight of 13 grams using the Nagy (2001) dry matter intake food requirement equation for rodents (a= 0.332; b= 0.774)
Ingestion Rate$_{soil}$	0.000048	kg/day	2 percent of ingestion rate; white-footed mouse data from Beyer and others (1994).
Soil Concentrations	Maximum	mg/kg	Soil data collected from site.
Ingestion Rate$_{prey}$	0.002352	kg/day	98 percent of total ingestion rate, based on soil ingestion rate.
Prey Composition	100 Plant	percent	Diet composed primarily of plant matter, but mouse also consumes seeds, insects, and fruit (Zeiner and others 1990b). Diet assumed to be 100 percent plant for food chain model.
Prey Concentrations	BAF	unitless	Concentrations estimated using plant BAFs from EPA (1999a), multiplied by the maximum soil concentration.
Foraging Range	1.0 - 1.38	acres	Brant 1962 and Meserve 1977, both as cited in Zeiner and others 1990b.
SUF	1	unitless	Conservative estimate of site use.
BW	0.013	kg	Average body weight from Davis and Schmidly 1994

With regard to the prey composition parameter, the western harvest mouse feeds on primarily on plant matter eating seeds, insects, fruits, and shoots from ground surface, and in bushes (EPA 1993). The western harvest mouse prefers thick grass or shrub cover for foraging and nesting. The FCM assumes a diet of 100 percent plant matter. Tissue concentrations were derived from BAFs for plants from Sample and others (1996) and EPA (1999a) and multiplied by the maximum soil concentration.

With regard to the SUF, home ranges for the western harvest mouse vary from 1 to 1.38 acres (less than 1 square kilometer), depending on location, topography, habitat, and prey availability (Zeiner and others 1990b). A SUF of 1.0 was assumed for the dose calculations.

Toxicity Reference Values and Hazard Quotient Approach

TRVs are screening-level benchmark values for higher-trophic-level receptors such as birds and mammals (Table 2-12). A TRV is a daily dose level with known biological effects on laboratory animals. Calculated dose estimates for each receptor and COPEC are compared with TRVs. TRVs derived from peer-reviewed literature studies were compared to site-specific estimated doses and used to evaluate risk caused by ingested chemicals. Each TRV represents a critical exposure level from a toxicological study and is supported by a data set of toxicological exposures and effects (EFA West 1998). TRVs were derived for chemicals and receptors specific to Navy installations by a work group through a collaborative effort involving the Navy and its contractors as well as the EPA Region IX Biological Technical Advisory Group (BTAG). BTAG includes federal, state, and local regulatory agencies and resource trustees. The derivation of TRVs and the use of food-chain analysis in the HQ approach were described in detail in a technical memorandum (EFA West 1998).

For this assessment, the Navy/BTAG TRVs (EFA West 1998) were used whenever possible. For COPECs for which no Navy/BTAG TRVs were available, toxicological benchmarks for wildlife developed by Sample and others (1996) were used. These benchmarks include lowest observed adverse effect levels and NOAEL. For chemicals for which no TRVs were available, a qualitative assessment of risk was performed based on available information in the scientific literature.

General TRVs for mammals and birds must be converted for each site-specific receptor of concern. The extrapolation of data based on body scaling is called allometric conversion. The underlying assumption of allometric conversions is that physiological functions, such as metabolic rates, are a function of body size and BW (Opresko and others 1993). Allometric conversions assume that smaller animals have higher metabolic rates and are typically able to detoxify ingested chemicals more quickly than larger animals (Opresko and others 1993; Sample and others 1996). Several allometric conversion equations are available in the literature; for the SLERA, body scaling equations recommended by Sample and others (1998) were used to extrapolate doses according to methods described by Opresko and others (1993) and Sample and others (1996). The following allometric conversion equations were used for this SLERA:

$$\text{Birds:}\quad TRV_{receptor} = TRV_{test\ organism}\,(BW_{test\ organism} / BW_{receptor})^{1 - 1.2}$$

$$\text{Mammals:}\quad TRV_{receptor} = TRV_{test\ organism}\,(BW_{test\ organism} / BW_{receptor})^{1 - 0.94}$$

Site-specific daily dose estimates were compared to high and low TRVs to estimate the potential adverse biological effects on each receptor. Based on this comparison, the risk to representative receptors was characterized; this comparison was performed in a manner consistent with EPA's HQ methodology (EPA 1986), as follows:

$$HQ = \frac{Dose}{TRV} = \frac{(mg/kg-day)}{(mg/kg-day)}$$

where

HQ	=	Hazard quotient (unitless)
Dose	=	Chemical-, receptor-, and site-specific daily dose estimate (mg/kg-day)
TRV	=	Chemical- and receptor-specific toxicity reference value (mg/kg-day)

Because of differences in the degree of conservatism in selection of TRVs for various chemicals and receptors, it is Navy policy that resulting HQ values should not be compared between chemicals or receptors; they should be considered individually (Navy 1999).

As explained in EPA regulatory guidance (EPA 1989), the HQ approach indicates that receptors may be at risk if the HQ exceeds 1.0. Maximum doses were calculated for receptors using maximum soil and tissue concentrations and average literature values for exposure parameters such as BW and ingestion rate. As such, an $HQ_{(dose/high\ TRV)}$ and $HQ_{(dose/low\ TRV)}$ evaluate risk to the typical individual within the population from the highest levels of contaminants observed at the site.

The interpretation of each HQ is summarized as follows:

HQ = Dose/TRV	Low TRV	High TRV	Between Low and High TRV
Dose to typical receptor based on maximum soil concentrations	$HQ_{(dose/low\ TRV)} < 1.0$ indicates little or no risk to typical receptor	$HQ_{(dose/high\ TRV)} > 1.0$ indicates significant or immediate risk to typical receptor	$HQ_{(dose/high\ TRV)} < 1.0$ and $HQ_{(dose/low\ TRV)} > 1.0$ indicates potential for risk to typical receptor

HQs could not be calculated if there was no TRV. In cases in which TRVs were unavailable, a dose was calculated for each chemical, and the dose was compared to literature-reported doses associated with effect or no effect levels, if available. The primary literature source was Agency of Toxic Substances and Disease Registry profiles of each chemical. Best professional judgment was used in interpreting literature data when information on a chemical was limited.

2.2.7.3 Evaluation of Potential Risk to Birds and Mammals

The evaluation of risk to birds and mammals focused on selected assessment endpoints identified in Section 2.2.7.1 and evaluated exposure through the ingestion pathway. Risk to representative birds (American robin and red-tailed hawk) and mammals (western harvest mouse) at Site 29 were evaluated using a FCM, based on an HQ approach (see Appendix C).

For the surface soil data set, VOCs, SVOCs, PAHs, pesticides and metals were identified as COPECs as presented in Table 2-9. The following metals, selected as COPECs because the maximum detected site-specific concentration exceeded the corresponding background soil concentration or the soil PRG for ecological endpoints (Efroymson and others 1997), were evaluated in the FCM: aluminum, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, vanadium, and zinc. Organic COPECs evaluated using the FCM included anthracene, benzo(b/k)fluoranthene, bis(2-ethylhexyl)phthalate, chrysene, DDT, fluoranthene, methylene chloride, pyrene, and xylene.

For the subsurface soil data set, VOCs and metals were identified as COPECs as presented in Table 2-10. The following inorganic COPECs were evaluated in the FCM: barium, copper, manganese, mercury, selenium, thallium, and vanadium. TCE was the only detected VOC identified as a COPEC (even though it was only detected in one location, it was retained as a COPEC because of the small data set [n = 3]).

Exposure and Effects Assessment

Based on the life history and foraging habits, an estimated daily dose for each COPEC was calculated for the American robin, red-tailed hawk, and the western harvest mouse. As specified in both Navy (1999) and EPA (1997b) guidance for conducting SLERAs, all estimated doses were calculated using the maximum site-specific soil concentrations and literature-derived BAFs (to estimate prey concentrations).

Estimated daily doses for each receptor for each chemical were compared to low and high TRVs to calculate an HQ; calculations are presented in their entirety in Appendix C. For some COPECs, HQs could not be calculated because there was no TRV. For the American robin and red-tailed hawk, HQs could not be calculated for beryllium, cobalt, thallium, benzo(b/k)fluoranthene, chrysene, fluoranthene, methylene chloride, pyrene, and xylene. While TRVs were unavailable for these COPECs, an estimated dose was calculated for these chemicals when sufficient site-specific soil chemical data and a literature-derived tissue estimate were available (Appendix C). In addition, no avian high TRVs were available for aluminum, vanadium, and bis(2-ethylhexyl)phthalate; therefore, HQs were only calculated based on low TRVs. Mammalian low TRVs were available for all COPECs while mammalian high TRVs were available for all

COPECs except chromium. COPECs without TRVs and associated HQs are evaluated qualitatively later in this section.

Only COPECs with at least one HQ greater than 1.0 for the American robin, red-tailed hawk, and western harvest mouse are presented in the following tables. A complete presentation of all HQs is provided in Appendix C.

HAZARD QUOTIENTS GREATER THAN 1.0 FOR THE AMERICAN ROBIN

Chemical	Dose/High TRV	Dose/Low TRV
Surface Soil		
Aluminum	No high TRV	36.98
Barium	6.04	12.12
Cadmium	1.81	371.45
Chromium	5.78	28.91
Copper	1.65	40.95
Lead	12.83	5,110.06
Manganese	0.26	2.58
Mercury	0.34	1.56
Nickel	0.06	2.57
Selenium	1.02	4.13
Vanadium	No high TRV	2.27
Zinc	62.67	626.75
Bis(2-ethylhexyl)phthalate	No high TRV	3,077.01
DDT	0.23	31.31
Subsurface Soil		
Barium	4.51	9.05
Copper	0.09	2.3
Manganese	1.16	11.75
Selenium	0.35	1.41
Vanadium	No high TRV	2.06

In surface soils, barium, cadmium, chromium, copper, lead, selenium and zinc appear to pose an immediate and significant risk ($HQ_{[dose/high\ TRV]}$), while aluminum, manganese, mercury, nickel, vanadium, bis(2-ethylhexyl)phthalate, and DDT pose potential risk ($HQ_{[dose/low\ TRV]}$) to the American robin. In subsurface soils, barium and manganese appear to pose an immediate and significant risk ($HQ_{[dose/high\ TRV]}$), while copper, selenium, and vanadium pose a potential risk ($HQ_{[dose/low\ TRV]}$) to the American robin. The significance of these HQs is discussed in more detail in the following text.

HAZARD QUOTIENTS GREATER THAN 1.0 FOR THE RED-TAILED HAWK

Chemical	Dose/High TRV	Dose/Low TRV
Surface Soils		
Chromium	0.32	1.62
Lead	0.22	87.81

In surface soil, the only potential risks ($HQ_{[dose/low\ TRV]}$) identified for the red-tailed hawk was from exposure to chromium and lead. The significance of these HQs is discussed in more detail in the following text.

HAZARD QUOTIENTS GREATER THAN 1.0 FOR THE WESTERN HARVEST MOUSE

Chemical	Dose/High TRV	Dose/Low TRV
Surface Soil		
Aluminum	5.98	59.84
Barium	2.12	8.24
Cadmium	0.80	35.28
Copper	0.14	32.24
Lead	0.16	33.02
Manganese	0.22	2.20
Nickel	0.04	9.56
Vanadium	1.11	11.12
Zinc	0.15	7.39
Subsurface Soil		
Barium	1.58	6.15
Copper	0.01	1.81
Manganese	1.02	10.01
Vanadium	1.01	10.08

In surface soils, aluminum, barium, and vanadium appear to pose an immediate and significant risk ($HQ_{[dose/high\ TRV]}$), while cadmium, copper, lead, manganese, nickel, and zinc pose potential risk ($HQ_{[dose/low\ TRV]}$) to the western harvest mouse. In subsurface soils, barium, manganese and vanadium appear to pose an immediate and significant risk ($HQ_{[dose/high\ TRV]}$), while copper poses a potential risk ($HQ_{[dose/low\ TRV]}$). The significance of these HQs is discussed in more detail in the following text.

Surface Soil

Aluminum was detected in 20 surface soil samples. The average soil concentration was 20,281 mg/kg. This average concentration is slightly below the background soil concentration for aluminum (21,000 mg/kg). In the risk calculations in the FCM, aluminum poses an immediate and significant risk to the western harvest mouse and a potential risk to the American robin exposed to surface soils at the site.

Barium was detected in all 27 surface soil samples and was detected at an order of magnitude higher at three sampling locations, SS-07-1 (1,660 mg/kg), SS-08-1 (1,310 mg/kg), and SS-08-2 (1,150 mg/kg). The results suggest that these sampling locations are isolated hot spots and not representative of barium concentrations across Site 29. To support this assumption, the average soil concentration (571 mg/kg) is just slightly above the background soil concentration for barium (560 mg/kg). HQs calculated in the FCM based on the maximum concentration suggest that barium poses an immediate and significant risk to both the western harvest mouse and the American robin.

Beryllium was detected in 13 surface soil samples at an average soil concentration of 3.6 mg/kg and a maximum detected concentration of 16 mg/kg. This maximum concentration at SS-02-2 appears to be a localized hot spot because all other samples are less than the ecological soil PRG of 10 mg/kg, based on the most sensitive biota studied (plants). HQs calculated in the FCM based on the maximum concentration do not exceed 1 for the western harvest mouse. There are no avian TRVs for beryllium; therefore, HQ calculations could not be calculated for the American robin or the red-tailed hawk. It is reasonable to assume, however, that the minimal risk to the mouse is probably indicative of minimal risk to other nonmammalian species that may frequent the site. Beryllium in surface soils is not likely to be associated with ecological risk, even at sampling location SS-02-2.

Cadmium was detected in 12 surface soil samples at an average concentration of 6.8 mg/kg and a maximum detected concentration of 32 mg/kg. HQs calculated in the FCM based on the maximum concentration suggest that cadmium poses an immediate and significant risk to the American robin and a potential risk to the western harvest mouse. Among the 12 surface soil samples where cadmium was detected, one sampling location (IA25-1) reported an unusually high concentration of cadmium at 32 mg/kg. The average soil concentration, excluding this unusual observation, is 4.3 mg/kg, which is comparable to the ecological soil PRG value for cadmium (4 mg/kg). Risk to the American robin and western harvest mouse may not be as significant as suggested because of this localized hot spot.

Chromium was detected in all 27 samples at an average concentration of 156 mg/kg and a maximum detected concentration of 2,600 mg/kg, which is an order of magnitude higher than the average chromium concentration. Chromium was detected at an unusually high concentration at IA25-1 (2,600 mg/kg). The maximum detected soil concentration excluding the sample at IA25-1 is 160.0 mg/kg. HQs calculated in the FCM based on the maximum concentration (2,600 mg/kg) suggest that chromium poses an immediate and significant risk to the American robin and a potential risk to the red-tailed hawk; however, risk to these two species would be significantly reduced if sample IA25-1 was excluded from the data set. Risk to the American robin and the red-tailed hawk may not be as significant as suggested because of this localized hot spot.

Cobalt was detected in all 27 surface soil samples at a maximum detected concentration of 32 mg/kg. This maximum concentration is a good representation of the concentrations of cobalt throughout the data set. HQs calculated in the FCM based on the maximum concentration (32 mg/kg) suggest that exposure to cobalt is not of potential concern for the western harvest mouse. HQs could not be derived for the two avian species because of a lack of an appropriate TRV. It is reasonable to assume, however, that the minimal risk to the mouse is probably indicative of minimal risk to other nonmammalian species that may frequent the site.

Copper was detected in all 27 samples at an average concentration of 103 mg/kg and a maximum detected concentration of 1,190 mg/kg. HQs calculated in the FCM based on the maximum concentration suggest that copper poses an immediate and significant risk to the American robin and a potential risk to the western harvest mouse; however, copper was detected at an unusually high concentration (1,190 mg/kg) at only one sampling location (SS-02-2). The average soil copper concentration excluding this localized hot spot is 63.11 mg/kg, which is less than the background copper soil concentration of 65 mg/kg (see Table 2-9). Based on this analysis, risk is likely to be minimal if the hot spot is excluded from the analysis.

Lead was detected in all 27 samples with an average soil concentration of 308 mg/kg and a maximum detected concentration of 3,400 mg/kg. These concentrations are much higher than the ambient and ecological soil PRG concentrations. HQs calculated in the FCM based on the maximum concentration suggest that lead poses an immediate and significant risk to the American robin and a potential risk to the western harvest mouse and the red-tailed hawk. Although lead was detected at an unusually high concentration (3,400 mg/kg) at only one sampling location (IA25-1), fairly high concentrations of lead (for example, 1,500 mg/kg at IA25-4) were detected at other locations. Based on the concentrations of lead identified at the different sampling locations and the magnitude of HQs calculated, lead is likely to be associated with some ecological risk in surface soils even if the hot spot (3,400 mg/kg) were omitted from the data set.

Manganese was detected in 20 samples with an average concentration of 1,108 mg/kg and a maximum concentration of 1,440 mg/kg. Concentrations of manganese were fairly uniform throughout the data set. HQs calculated in the FCM based on the maximum concentration suggest that manganese poses a potential risk to the American robin and the western harvest mouse. HQs using low TRVs were 2.58 and 2.2 for the American robin and western harvest mouse, respectively.

Mercury was detected in 18 samples at an average soil concentration of 0.4 mg/kg and a maximum detected concentration of 1.4 mg/kg. HQs calculated in the FCM based on the maximum concentration suggest that mercury poses a potential risk to the American robin (HQ of 1.56).

Nickel was detected in all 27 samples at an average concentration of 79.5 mg/kg and a maximum detected concentration of 160 mg/kg. Concentrations of nickel were fairly uniform throughout the data set. HQs calculated in the FCM based on the maximum concentration suggest that nickel poses a potential risk to the American robin and the western harvest mouse.Selenium was detected in 7 samples at an average concentration of 2.6 mg/kg and a maximum detected concentration of 4.4 mg/kg. HQs calculated in the FCM based on the maximum concentration suggest that selenium may pose an immediate and significant risk to the American robin. The HQs were 1.02 (low TRV) and 4.3 (high TRV), however, suggesting the overall risk may be minimal, particularly if the maximum concentration at IA25-1 was omitted from the data set.

Vanadium was detected in all 27 samples at an average concentration of 66.02 mg/kg and a maximum detected concentration of 110 mg/kg at sampling location SS-08-2. This is the only sample that is greater than the background soil concentration of 95 mg/kg (Table 2-9). HQs calculated in the FCM based on the maximum concentration suggest that vanadium may pose an immediate risk to the western harvest mouse and a potential risk to the American robin. No avian high TRV was available for American robin or the red-tailed hawk. Based on the relatively low HQs for these two avian species using the low TRV, however, vanadium is likely to be associated with minimal ecological risk at this location.

Zinc was also detected in all 27 samples at an average concentration of 1,079.75 mg/kg and a maximum detected concentration of 20,000 mg/kg. These concentrations are much higher that the ambient and ecological PRG concentration (Table 2-9). HQs calculated in the FCM based on the maximum concentration suggest that zinc poses an immediate and significant risk to the American robin and a potential risk to the western harvest mouse. The unusually high concentration (20,000 mg/kg) was, however, detected in only one location (IA25-1). The next highest concentration (5,220 mg/kg) was detected at sampling location SS-08-02. Based on the magnitude of the HQs, zinc is likely to be associated with ecological risk in surface samples from the building crawl space.

Information on the effects of PAH exposure on wildlife is limited, especially for birds. PAHs cause embryotoxicity to Mallard eggs when applied externally. For example, PAHs such as 7,12-dimethyl-benz(a)anthracene and chrysene are highly embryotoxic. Several investigations have suggested that the presence of PAHs in petroleum significantly enhances the overall embryotoxicity in avian species. Investigations also suggest that the relatively small percent of the aromatic hydrocarbons contributed by PAHs in petroleum may confer much of the adverse biological effects reported after eggs have been exposed to microliter quantities of constituent PAHs, frequently characterized in crude oils (Albers 1983, Hoffman and Gay 1981, both as cited in Eisler 1987). This general PAH toxicity information is helpful in evaluating the toxicity of the PAHs (anthracene, benzo(b/k)fluoranthene, chrysene, fluoranthene and pyrene) discussed in the following paragraphs.

Anthracene was detected in 6 out of 11 samples at a maximum concentration of 7.0 mg/kg. HQs calculated in the FCM based on the maximum concentration suggest that anthracene does not pose a risk to the western harvest mouse. There are no avian TRVs for PAHs; therefore, HQs could not be calculated for the American robin or the red-tailed hawk. It is reasonable to assume, however, that the minimal risk to the mouse is probably indicative of minimal risk to other nonmammalian species that may frequent the site.

Benzo(b)fluoranthene or benzo(k)fluoranthene was detected in 3 out of 11 samples at a maximum concentration of 0.48 mg/kg. HQs calculated in the FCM based on the maximum concentration suggest that benzo(b)fluoranthene or benzo(k)fluoranthene do not pose a risk to the western harvest mouse. There are no avian TRVs for PAHs; therefore, HQs could not be calculated for the American robin or the red-tailed hawk. It is reasonable to assume, however, that the minimal risk to the mouse is probably indicative of minimal risk to other nonmammalian species that may frequent the site.

Chrysene was detected in 3 out of 11 samples at a maximum concentration of 1.9 mg/kg. HQs calculated in the FCM based on the maximum concentration suggest that chrysene does not pose a risk to the western harvest mouse. There are no avian TRVs for PAHs; therefore, HQs could not be calculated for the American robin or the red-tailed hawk. It is reasonable to assume, however, that the minimal risk to the mouse is probably indicative of minimal risk to other nonmammalian species that may frequent the site.

Fluoranthene was detected in 6 out of 11 samples at a maximum concentration of 4.5 mg/kg. HQs calculated in the FCM based on the maximum concentration suggest that pyrene does not pose a risk to the western harvest mouse. There are no avian TRVs for PAHs; therefore, HQ calculations could not be calculated for the American robin or the red-tailed hawk. It is reasonable to assume, however, that the minimal risk to the mouse is probably indicative of minimal risk to other nonmammalian species that may frequent the site.

Pyrene was detected in 6 out of 11 samples at a maximum concentration of 7.0 mg/kg. HQs calculated in the FCM based on the maximum concentration suggest that anthracene does not pose a risk to the western harvest mouse. There are no avian TRVs for PAHs; therefore, HQs could not be calculated for the American robin or the red-tailed hawk. It is reasonable to assume, however, that the minimal risk to the mouse is probably indicative of minimal risk to other nonmammalian species that may frequent the site.

Bis(2-ethylhexyl)phthalate was detected in 2 out of 11 samples at a maximum concentration of 3.9 mg/kg. HQs calculated in the FCM based on the maximum concentration suggest that bis(2-ethylhexyl)phthalate does not pose a risk to the western harvest mouse. There are no high avian TRVs for bis(2-ethylhexyl)phthalate; therefore, HQs could not be calculated for the American robin or the red-tailed hawk. Calculations using a low TRV suggest potential risk to the American robin but not to the red-tailed hawk. Bis(2-ethylhexyl)phthalate is a known laboratory contaminant, and the two detections in soils samples at the site could be associated with laboratory procedures and not environmental contamination.

DDT was detected in 7 out of 11 samples at a maximum concentration of 0.23 mg/kg. HQs calculated in the FCM based on the maximum concentration suggest that DDT does not pose a risk to the western harvest mouse or the red-tailed hawk. Calculations using the low TRV, however, suggest that DDT may pose potential risk to the American robin.

Methylene chloride was detected in 4 out of 11 samples at a maximum concentration of 0.011 mg/kg. HQs calculated in the FCM based on the maximum concentration suggest that methylene chloride does not pose a risk to the western harvest mouse. There are no avian TRVs for methylene chloride; therefore, HQ calculations could not be calculated for the American robin or the red-tailed hawk. It is reasonable to assume, however, that the minimal risk to the mouse is probably indicative of minimal risk to other nonmammalian species that may frequent the site.

Xylene was detected in 2 out of 11 samples at a maximum concentration of 0.015 mg/kg. HQs calculated in the FCM based on the maximum concentration suggest that xylene does not pose a risk to the western harvest mouse. There are no avian TRVs for xylene; therefore, HQ calculations could not be calculated for the American robin or the red-tailed hawk. It is reasonable to assume, however, that the minimal risk to the mouse is probably indicative of minimal risk to other nonmammalian species that may frequent the site.

Subsurface Soils

Three soil samples were included in the subsurface data set for evaluation. The samples were collected from depths of 5.0 to 5.5 feet. Each of these samples represents native materials and not disturbed fill soils. Deeper samples from 10 and 15 feet were not included in the evaluated subsurface data set for ecological receptors.

Barium was detected in all 3 subsurface soil samples and was detected at an order of magnitude higher (1,240 mg/kg) at only one sampling depth (location S29SB02, 5.0 to 5.5 feet). This suggests that this sampling location is a hot spot. The other two subsurface soil samples (438 and 236 mg/kg) contained less than the ambient barium soil concentration of 560 mg/kg. HQs calculated in the FCM based on the maximum concentration suggest that barium may pose an immediate and significant risk to the American robin and the western harvest mouse. Barium is only likely to pose an immediate and significant risk at sampling location S29SB02 and only if the pathway is complete.

Copper was detected in all 3 samples at a maximum detected concentration of 66.8 mg/kg. The ambient background soil concentration for copper is 65 mg/kg, and the ecological soil PRG is 60 mg/kg. The maximum detected soil concentration is just slightly above these two screening concentrations (Table 2-10). HQs calculated in the FCM based on the maximum concentration suggest that copper may pose a potential risk to the American robin and the western harvest mouse. Because the HQ is barely above 1 (1.41 and 2.14, respectively), however, and the maximum concentration is just above the ambient concentration and the soil PRG, copper is not likely to pose an ecological risk in subsurface soil.

Manganese was detected in all 3 subsurface soil samples. The concentration detected at only one location (6,560 mg/kg) was significantly higher than ambient concentration (location S29SB02, 5.0 to 5.5 feet). Similar to barium, the manganese concentration from this sample is greater than the established Inland Area ambient concentration. HQs calculated in the FCM based on the maximum concentration suggest that manganese may pose an immediate and significant risk to the American robin and the western harvest mouse. Manganese is only likely to pose an immediate and significant risk at sampling location S29SB02 and only if the pathway is complete.

Mercury was detected in all 3 samples at a maximum detected concentration of 0.22 mg/kg. HQs calculated in the FCM based on the maximum concentration suggest that mercury in subsurface soil does not pose a risk to any of the three ecological receptors.

Selenium was detected in only 1 subsurface soil sample at a concentration of 1.5 mg/kg. No corresponding background soil concentration values are available for selenium. HQs calculated in the FCM based on the maximum concentration suggest that selenium may pose a slight risk to the American robin; however, the HQ was only slightly above 1 (1.41) and was only detected at S29SB02. It is, therefore, unlikely that selenium poses a significant risk in subsurface soil to ecological receptors.

Thallium was detected in only 1 subsurface soil sample at a concentration of 7.0 mg/kg at sampling location S29SB02. HQs calculated in the FCM based on the maximum concentration suggest that thallium does not pose a risk in subsurface soil to the western harvest mouse. An HQ could not be calculated for the American robin or red-tailed hawk because no avian TRV was available. It is unlikely, however, that there would be risk to avian species from exposure to this low concentration particularly since there is no risk to the mouse and thallium was only detected at one location in subsurface soil.

Vanadium was detected in all 3 samples at a maximum detected concentration of 99.7 mg/kg. The ambient background soil concentration for vanadium is 95 mg/kg; therefore, the maximum detected soil concentration is just slightly above this ambient concentration (Table 2-10). HQs calculated in the FCM based on the maximum concentration suggest that vanadium poses an immediate risk to the western harvest mouse and a potential risk to the American robin. Because the maximum concentration is just above ambient (the other 2 samples are well below ambient), vanadium may not pose a significant risk to ecological receptors in subsurface soil because the sampling location represents only a limited soil volume at a relatively deep depth (5.0 to 5.5 feet). If the pathway is not complete, vanadium cannot pose an unacceptable risk.

TCE was detected in 1 sample at a maximum concentration of 0.002 mg/kg. No TCE HQs could be calculated because there are no BAFs for avian or mammalian receptors and no TRVs for avian receptors. The one detection is well below the industrial PRG for human health, however, and given the isolated nature of the sample (it was not identified in the deeper samples), it is unlikely to pose a risk to ecological receptors at the site.

Qualitative Evaluation of Risk to Amphibians and Reptiles

Site 29 is presumed to offer potential habitat for the federally threatened California red-legged frog (*Rana aurora draytonii*) and the California tiger salamander (*Ambystoma californiense)*, a candidate for federal listing and currently a State of California Species of Special Concern (CDFG 2000). Because of the potential presence of special status amphibian and reptilian species as well as the apparent lack of relevant toxicological criteria pertaining to these species, a qualitative evaluation of toxicological data pertinent to amphibians and reptiles has been prepared. Among the naturally occurring elements, the ones that have most frequently been associated with toxicity from environmental exposure include the heavy metals cadmium, chromium, cobalt, copper, iron, mercury, molybdenum, nickel, lead, silver, tin, and zinc as well as lighter elements such as aluminum, arsenic, and selenium. Some of these metals have been identified as COPECs in the earlier section.

<u>Amphibians</u>

Amphibians frequent the transition zones between terrestrial and aquatic habitats and consequently face dramatically changing exposure conditions throughout their life histories. Based on the life stages of terrestrial dwelling amphibians, the predominant route of exposure will likely be dietary. Dietary sources of metals, as metal ions or as bound metals, include ingested food and intentionally or coincidentally ingested soil. Estimates of soil ingestion are not readily available for amphibians as they are for some birds and mammals; most of the toxicity studies on amphibians are not based on soil or soil ingestion as a route of exposure. Because of this, only a few of the metals with potential toxicity have been examined in amphibians. These include some of the COPECs identified previously: chromium, copper, lead, mercury, and zinc.

Chromium is relatively poorly characterized with respect to its toxicity in amphibians, with a much smaller set of toxicity data upon which to evaluate its potential effects (Sparling and others 2000). Lethal concentrations causing 50 percent mortality (LC50) in the test organisms studied vary widely, and the embryos of *Gastrophryne carolinensis* are the most sensitive species. Differences in chemical species tested (chromium trioxide versus potassium dichromate) and test methodologies likely confound the interpretation of survival data, and, with the exception of the work with *Gastrophryne carolinensis,* toxicity endpoints (LC50s and no adverse effect concentration [NOEC] primarily) exceed 1,000 micrograms per liter (µg/L).

Copper toxicity in amphibians is relatively well characterized; however, most data are focused on survival. Exposure periods varied from 48 hours to 8 days. Among the amphibians, more toxicity data for copper exist for anurans (an amphibians of the order Caudata, including the salamanders and newts, in which the larval tail persists in adult life) than urodeles (an amphibian of the order Salientia [formerly Anura or Batrachia], which includes the frogs and toads). LC50s for anurans and urodele amphibians consistently ranged from approximately 40 µg/L to slightly less than 800 µg/L, with *Bufo fowleri* presenting a uniquely characteristic LC50 greater than 25,000 µg/L. As with other metals, older larvae and tadpoles had higher LC50s than did embryos, generally greater than 650 µg/L, and often in excess of 1,000 µg/L. This trend in copper LC50 data, however, is less consistent than for other metals because some species have very similar tadpole and embryo/larval LC50s.

Information on the toxicity of lead to amphibians is relatively sparse and diverse. Although there are some sublethal endpoints reported, the majority of studies are related to survival as either LC50 or NOECs derived from work with anuran and urodele amphibians. As with other metals, *Gastrophryne carolinensis* appears to be the most sensitive to lead and has an LC50 of 40 µg/L (Birge 1978; Birge and Black 1979). Currently, data are insufficient to make comparisons among species and families on lead toxicity.

Mercury toxicity in amphibians has a very well developed literature. Toxicity endpoints in the literature are dominated by survival estimators, most often LC50s, derived from static or static-renewal tests. A range of LC50s for embryo/larval tests occurs between 10 µg/L and 100 µg/L. Inorganic and organic forms of mercury appear to have similar aquatic toxicities.

Much of the work reported for zinc has come from work on *Xenopus laevis*. Survival endpoints dominate the zinc data, as it has for most metals in amphibians. Median lethal concentrations for zinc vary from 1,300 µg/L to 34,500 µg/L in the same test, Frog Embryo Teratogenesis Assay-*Xenopus* Test (FETAX).

Nickel and selenium are some of the infrequently studied metals in amphibians. Given its presence in eco-regions characterized by serpentine formations, nickel may be critical to the characterization of metal toxicity to amphibians. Nickel presents a wide range of toxicity endpoints, most focused on survival, growth, or other chronic effects. Median lethal concentrations range from 50 µg/L in *Gastrophryne carolinensis* to greater than 21,000 µg/L in *Xenopus laevis*. Estimates of sublethal effects suggest that less variation may be present with nickel than with other metals, since the data appear to be an order of magnitude less for chronic estimators (for example, low observed effect concentration and effective concentration causing 50 percent mortality estimates). The data, however, are clearly insufficient to present an unequivocal summary of nickel's toxicity to amphibians. As noted for other metals, *Gastrophryne carolinensis* appears to be the most sensitive species.

As with nickel, selenium is also an infrequently studied metal. Nonetheless, its toxicity is potentially biased owing to a preponderance of data being derived from two studies using FETAX (American Society for Testing and Materials 1998). Despite their potential bias, selenium has survival estimates that range from 1,500 µg/L to greater than 11,000 µg/L, with nonlethal effects (largely developmental) falling in the range of 2,500 µg/L to nearly 3,800 µg/L. Although limited to a single study (Linder and others 1992), an NOEC of 800 µg/L is consistent with the survival estimates. The most sensitive species once again appears to be *Gastrophryne carolinensis*, which presents an LC50 of 90 µg/L.

In conclusion, the evidence of toxicity of metals in amphibians is unclear because most of the toxicity studies on amphibians are not based on soil or soil ingestion as a route of exposure and tend to include only an evaluation of acute toxicity endpoints. Because of the paucity of appropriate toxicity information for amphibians, representative mammalian and avian receptors are typically used in a FCM to evaluate potential risks at a site. This approach is particularly acceptable when there is poor habitat and no clear evidence that amphibians frequent Site 29 and more specifically, the crawl space underneath Building IA-25.

Reptiles

There is little to no information on the toxicological effects associated with exposure to metals by reptilian receptors (Hall 1980; Stoneburner and Kushlan 1984; Hebert and others 1993; Aguirre and others 1994; Meyers-Schone and Walton 1994; Sparling and Lowe 1996). No reptile mortality caused by metal intoxication has been reported. The only case of clinically severe toxicosis assigned to metal poisoning involved a captive Cuban crocodile (*Crocodylus rhombifer*) suffering from anorexia, "depression," and weight loss. Symptoms were related to zinc intoxication caused by ingested metallic objects after removal of the foreign objects (two dimes, two nickels, six pennies, and various watch parts along with multiple rocks). Plasma zinc levels reported for an apparently healthy alligator *Alligator mississipiensis* ranged from 0.18 to 3.48 parts per million (ppm). A few studies have shown the effect of lead on reptiles. In summary, only lead in test investigations has been studied for hematological alterations and enzyme activity. The results of these investigations correspond well to symptoms of lead intoxication known from other vertebrate classes like decreased aminolevulenic acid due to lead exposure.

Free-ranging desert tortoises (*Gopherus agassizii*) from various populations reportedly died from upper respiratory tract disease (URTD) (Jacobson and others 1991). During a study to determine the cause of URTD in free-ranging desert tortoises, livers of 10 clinically diseased and 4 clinically healthy desert tortoises were analyzed for residues of the following six metals: copper, cadmium, lead, selenium, mercury, and iron. While no differences between the two tortoise groups were apparent for concentrations of copper, cadmium, lead, and selenium, the livers of ill tortoises had higher concentrations of mercury (0.33 ppm and 0.03 ppm) respectively, and iron (1,526 ppm and 361 ppm, respectively). Elevated iron concentrations correspond to hemosiderosis associated with accelerated degradation of erythrocytes in mammals in which several metals are known to have hemolytic effects. Hemolysis may also result from antibodies or physical or chemical injury other than that caused by metals (Woods 1996; Niesink and others 1996).

In conclusion, the majority of observations on the toxicodynamics of metals in reptiles are rather anecdotal. Because of the paucity of appropriate toxicity information for reptiles, representative mammalian and avian receptors are typically used in a FCM to evaluate potential risks at a site. This approach is particularly acceptable when there is poor habitat and no clear evidence that reptiles frequent Site 29 and more specifically, the crawl space underneath Building IA-25.

2.2.7.4 Uncertainty Analysis

Uncertainty plays an important role in risk-based decision-making and is therefore incorporated explicitly into risk characterization. Identifying known sources of uncertainty is more useful than using conservative default assumptions because potential error is made more explicit in the risk management process (Suter 1993).

Three sources of uncertainty in ERAs are described by Suter (1993):

1. Mistakes in execution of assessment activities (errors such as incorrect measurements, data recording errors, and computational errors)
2. Imperfect knowledge of factors that could be known (ignorance about some aspect of the ecosystem that may be relevant, such as assumptions used in dose models, practical constraints on the ability to measure everything, and lack of knowledge on toxicological effects of all chemicals on all species)
3. Inherent randomness of the world (stochasticity in physical or biological processes that may affect assumptions or actual risk such as variation in population parameters or rainfall patterns)

As explained in previous text, the ERA process is based on using assumptions and extrapolations to evaluate potential risk to ecological receptors. The complexity of ecological systems tends to increase the level of uncertainty involved in ERAs compared with human health risk assessments. Many of the assumptions in the SLERA process are conservative and result in overestimates of site-specific parameters, but the assumptions are important to ensure that no COPECs are dismissed when they may potentially pose an adverse ecological risk. The use of realistic assumptions and multiple lines of evidence is the best approach to reducing the uncertainty associated with conclusions in an ERA. The following paragraphs discuss major uncertainties and conservative assumptions used in this SLERA.

Habitat

Site 29 includes areas of disturbed ruderal and annual grassland habitats. In addition, there are bare ground and paved areas. Building IA-25 is and elevated structure constructed over a barren soil and exposed gravel crawl space. The approximate location of the ruderal and grassland habitats, Building IA-15 (and crawl space), and surrounding paved areas are illustrated on Figure 2-5.

Most of the samples from Site 29 were collected from underneath Building IA-25 in the crawl space area. This area provides extremely poor habitat for ecological receptors. Use of the maximum concentration of metals in these areas to evaluate risk likely overestimates actual risk to ecological receptors that use other parts of the site and areas containing more suitable habitat. Average or the 95th percentile upper confidence limit on the arithmetic mean contaminant concentrations may better approximate actual exposures, especially when the relatively homogeneous nature of the crawl space area underneath Building IA-25.

Sampling Data and Analysis

Data collected from the site must be used to evaluate the conditions at the whole site; all measured parameters are therefore only estimates with associated error. Sampling data used to characterize risk at Site 29 included 27 surface soil samples and 9 subsurface soil samples collected from within the crawl space. The number of samples was adequate for the characterization of soil at the site.

The representativeness of samples collected to the true population is a critical part of sampling design. There is uncertainty associated with assuming that the samples collected are representative of the overall Site 29 conditions. Part of the uncertainty in sampling is attributable to the heterogeneity of soils at Site 29.

Data were validated and determined to be of high usability; data computations and summary tables were double checked. Data quality is not considered a significant source of uncertainty; rather, the uncertainties associated with the data reflect the analytical limitations of the data reduction tools, which capture those elements of uncertainty identified by Suter (1993).

Tissue Residue Data

For all chemicals and receptors, site-specific tissue residue data were not available and prey tissue concentrations had to be estimated based on literature-derived BAFs and other parameters. This approach is generally associated with much more uncertainty than the approach based on site-specific prey tissue concentrations. In particular, estimates of prey tissue concentration do not include accurate predictors of assimilation and depuration of chemicals in the same way that time-averaged tissue concentrations do.

Estimated Doses

Assumptions used in estimating ingested doses are identified in Section 2.2.7.2. These assumptions and model parameters are based mostly on scientific literature and may not accurately represent species or conditions at the site. Sources of uncertainty in dose estimates include inaccuracy in model parameters based on poor literature-derived data, population and individual variation in life history, and variation in dietary patterns of animals at the site. In addition, the lack of empirical data for each receptor necessitated using simple scaling equations to estimate receptor-specific ingestion rates; these estimates may not accurately represent actual ingestion rates and are a source of uncertainty in the dose calculation. An additional source of uncertainty is introduced in the estimation of food ingestion rates. Allometric regression models were used to estimate food consumption based on metabolic rate derived by Nagy (2001) for various groups of birds and mammals. Food ingestion rates estimated using these allometric equations are expressed as kilograms of dry weight per day. Wildlife do not generally consume dry food (unless maintained in the laboratory); therefore, some investigators suggest converting food consumption rates to kilograms of fresh weight by adding the water content of the food (Suter and others 2000). Because recommended literature-derived soil/deer mouse and soil/invertebrate BAFs (Sample and others 1996; EPA 1998, 1999a) were reported in wet weight, it was necessary to convert the tissue results to dry weight for mathematical consistency in the allometric equations used to estimate doses. Since plant/soil BAFs were provided in dry weight, this conversion was not performed for the plant/soil values provided in Table 2-11. Further reasoning behind the conversion from wet to dry weight is that the TRVs, which were used to calculate HQs and compare estimated doses to determine whether risk exists to higher-trophic-level receptors, are also reported on the basis of dry weight. This conversion from wet to dry weight may overestimate chemical concentrations in tissue, potentially resulting in higher calculated risk.

The use of dose models as estimates of exposure assumes that exposure to the animal through other routes (such as dermal exposure or drinking of surface water) is minimal. In general, it is common practice in ERAs to focus on ingestion of contaminated prey and soil (Pascoe and others 1996; EPA 1997b), although ignoring other sources may lead to underestimation of risk.

Site Use Factors

The SLERA assumed that all receptors lived and fed at Site 29 at all times (SUF of 1). This is clearly a conservative assumption and is certainly not true for upper-trophic-level receptors such as the red-tailed hawk, which has a large foraging range. Even for the American robin, with a significantly smaller foraging range, a SUF of 1 is a very conservative assumption. The actual ingestion of COPECs from the site would likely be much less than the values used in the risk calculations.

Dietary Composition

The American robin was assumed to have a diet that consisted of 45 percent plant material and 55 percent invertebrates; the red-tailed hawk's diet was assumed to be 100 percent small mammals; and the western harvest mouse's diet was assumed to be 100 percent plant materials. This is a conservative estimate of dietary composition because of the varied diet of the western harvest mouse.

Bioavailability

All COPECs were conservatively assumed to be 100 percent bioavailable to all assessment endpoints evaluated. Depending on the COPEC and receptor, bioavailability may be significantly less than 100 percent. Since only the bioavailable fraction of total metals concentrations poses a risk, consideration of the bioavailability and bioaccumulation potential of chemicals is important with regard to understanding risk implications and the potential ecotoxicological effects of total concentrations of chemicals detected in soil.

The bioavailability of chemicals in soil is dependent on numerous factors, including pH, organic matter content, soil moisture, soil texture, cation exchange capacity, electrical conductivity, and the concentrations of various inorganic and organic ligands and elements present in the soil. In this SLERA, parameters measured in the soil suitability study were used to discuss the potential effects of COPECs.

Body Weight and Ingestion Rates

The risk calculations used the average body weight and highest ingestion rate reported for each measurement endpoint receptor. The range of reported body weights and ingestion rates varies significantly in the literature (EPA 1993; Dunning 1993; Nagy 1987). These values may not reflect the true attributes of these receptors living at Site 29.

Development of Toxicity Reference Values

TRVs used in risk calculations were derived from studies reported in the literature. These studies were not conducted on the receptors used in this assessment; thus, TRVs were extrapolated using uncertainty factors to account for differences between species. The effect of this uncertainty cannot be estimated; however, uncertainty associated with the derivation and use of TRVs is described in "Development of Toxicity Reference Values for Conducting Ecological Risk Assessments at Naval Facilities in California"

(EFA West 1998). Allometric conversion was incorporated into the derivation of TRVs for site-specific receptors; extrapolation between taxa is a source of uncertainty. For example, the underlying assumption that a given effect on a small bird is the same as on a larger bird per unit body weight may not be true.

Toxicity Reference Values for Lead

The avian TRV for lead was derived from a study (Edens and Garlich 1983) in which a very soluble form of lead was used during the laboratory tests. Consequently, three overly conservative assumptions are incorporated into the TRVs. First, the form of lead received by receptors at the site is lead acetate, a very soluble and bioavailable form of lead. Second, receptors ingest lead at the site as lead acetate in drinking water as the primary route of exposure. Third, site-specific soil and chemical conditions at the sites affecting the bioavailability of the form of lead in soil are the same as controlled laboratory conditions used to generate the TRVs. Based on the history of site use at NWSSBD Concord, it is very unlikely that the form of lead in soils is a soluble organic form. Rather, it is likely to be a much less soluble form, bound within or strongly adsorbed to soil particles; therefore, the TRV for lead overestimates risk. Similar arguments can be made for cadmium (soluble cadmium chloride in drinking water), copper (administered as soluble cupric sulfate in drinking water), manganese (as manganese oxide in drinking water), nickel (as nickel chloride in water), selenium (as selenite and selenate in water), and zinc (as zinc carbonate in drinking water) (Webster 1988; Pocino and others 1991; Gray and Laskey 1980; Smith and others 1993; Harr and others 1996; Aughey and others 1977).

In addition, for some chemicals, uncertainty is associated with the TRV. For example, the avian low TRV for lead was not based on a no effects level dose, but rather on the lowest-known-effect-level dose, which was then increased by 10 percent to account for uncertainty. A similar uncertainty factor was applied to copper, manganese, and zinc.

Hazard Quotient Approach

The HQ approach used in comparing site chemicals with screening values and comparing ingested doses with TRVs is commonly employed in ERAs (EPA 1992; Tiebout and Brugger 1995). An HQ greater than 1.0 is generally considered to indicate a potential for risk; however, the HQ cannot be used to gauge either the probability or the magnitude of effects. The HQ approach has been criticized (Tiebout and Brugger 1995), and caution should be exercised in the interpretation of HQs.

Interspecies Extrapolation

The use of allometric conversions in interspecies extrapolations has already been discussed (see Section 2.2.7.2). The use of assessment endpoint species as surrogates for other related or ecologically similar taxa is supported by current guidance (EPA 1992, 1997b, 1999b); however, it should be recognized that differences among taxa are not accounted for in this type of analysis and that uncertainty exists with regard to assessments of risk to whole communities based on detailed analysis of relatively few taxa.

Individual and Population Variation

Individuals within a population vary in several life history and behavioral traits. The dose models incorporated some of this variability by estimating high, low, and typical values for most model parameters. The majority of these models, however, focus on adult individuals and may not accurately represent ingestion of chemicals by small juvenile stages that may feed in a different manner. Even among adults of the same population, there may be considerable individual variation in factors that affect exposure.

Potential Confounding Factors

Nonchemical stressors may confound the interpretation of the effects of chemical stressors that are the focus of the SLERA. Nonchemical stressors in soils include factors such as salinity, pH, nutrient deficiencies, and soil compaction and other physical disturbances. To the extent possible, these nonchemical factors were considered qualitatively in the evaluation of risk at Site 29.

2.2.7.5 Risk Characterization Summary and Risk Assessment Conclusions

The purpose of the SLERA was to identify potential exposure pathways and compare exposure point concentrations to established benchmarks. The SLERA consisted of the following two steps: (1) problem formulation and (2) exposure estimate and risk calculation. Upon completion of Steps 1 and 2, if the site passes the SLERA, it is considered to pose acceptable ecological risk, and no further work is required. If the site fails the SLERA because of the presence of complete exposure pathways and unacceptable or uncertain risk, however, the site must either be further evaluated in a Tier II (baseline) ERA, which corresponds to Step 3 of the EPA and Navy ERA processes, or undergo a cleanup action.

Building Crawl Space Surface Soils

Aluminum, barium, cadmium, chromium, copper, lead, manganese, mercury, nickel, selenium, vanadium, zinc, bis(2-ethylhexyl)phthalate, and DDT are likely to pose some level of risk to ecological receptors exposed to surface soils in the building crawl space area. The risk associated with a number of these COPECs is either driven by a hot spot (for example IA25-1) or shows very limited potential for risk (HQs slightly greater than 1). The primary risk drivers in surface soil are aluminum, lead, and zinc.

Subsurface Soils Data

In subsurface soils, barium, manganese, and vanadium likely pose a risk to ecological receptors exposed to subsurface soils in the building crawl space area at the site. Sampling location S29SB02 at the 5.0 to 5.5 feet sample depth clearly accounts for the calculated risk. The actual risk posed by soils from this sampling location is dependent upon (1) a complete exposure pathway and (2) the volume of material present (as well as uncertainty factors already discussed). Without this sample, the calculated ecological risk associated with exposure to subsurface soils would be minimal based on the results of the FCM.

California Red-legged Frog

Suitable habitat for the California Red-legged Frog is unlikely at Site 29. Typical breeding habitat includes coastal lagoons, marshes, springs, permanent and semipermanent natural ponds, ponded and backwater portions of streams as well as artificial impoundments such as stock ponds, irrigation ponds, and siltation ponds. Creeks and ponds where California red-legged frogs are found often have dense growths of woody riparian vegetation, especially willows (*Salix* spp.) (FWS 1997). Although red-legged frogs were sighted in standing water along Seal Creek in 1998 about 1,600 feet from Site 29, the habitat along this portion of the creek is not suitable for breeding, and these individual were believe to be migrating (Downard and others 1999). The closest known breeding location is over 7,000 feet from Site 29. In addition, Site 29 lacks a water source and riparian or wetland vegetation. It is unlikely that the California red-legged frog would be of concern at Site 29, particularly in the area adjacent to or in the crawl space of Building IA-25.

California Tiger Salamander

Suitable habitat for the California tiger salamander is also unlikely at Site 29. Tiger salamanders are most commonly associated with grasslands in rolling terrain or foothills that contain suitable underground retreats such as burrows (CDFG 2003). The nearest known breeding location is over 9,000 feet away, and tiger salamanders were not observed during survey at the fixed survey locations along Seal Creek near Site 29 (Downard and others 1999). In addition, no suitable ephemeral or perennial water sources exist at Site 29, and there are few California ground squirrel burrows on Site 29, particularly in the area near Building IA-25. It is unlikely that the California tiger salamander should be of concern at Site 29, particularly in the area adjacent to or in the crawl space of Building IA-25.

Conclusions

In summary, the results of the SLERA for the building crawl space surface soils and subsurface soils sampling events indicate that potential adverse ecological effects may occur because of exposure to a variety of metals and several organic compounds.

Although risk is predicted in the SLERA for the subsurface soils sampling event, the risk is driven by a single soil sample at a relatively deep depth in natural soils. There is no clear indication that the elevated metals concentrations detected in that soil sample are associated with environmental contamination and thus these elevated concentrations may be a naturally occurring anomaly in this sample.

For the crawl space surface soils sampling event, environmental contamination is evident, and the SLERA is adequate to indicate a potential for adverse ecological effects. At this point, a site-specific baseline ERA may be conducted to refine the risk estimate and reduce the uncertainty associated with the SLERA, or a remedial action based on the SLERA may be proposed. Because of the relatively small size of the site and limited material, the Navy prefers to pursue a remedial action at the site.

2.2.8 Applicable or Relevant and Appropriate Requirements

This section identifies and evaluates potential federal and State of California ARARs from the universe of regulations, requirements, and guidance and sets forth the Navy determinations regarding those potential ARARs for Site 29. This report will address potential chemical-, location-, and action-specific ARARs.

2.2.8.1 Introduction to ARARs

This evaluation includes an initial determination of whether the potential ARARs actually qualify as ARARs. The identification of ARARs is an iterative process. The Navy will make the final determination of ARARs in the ROD after public review, as part of the response action selection process.

2.2.8.2 CERCLA and NCP Requirements Summary

Section 121(d) of CERCLA states that remedial actions on CERCLA sites must attain (or the decision document must justify the waiver of) any federal or more stringent state environmental standards, requirements, criteria, or limitations determined to be legally applicable or relevant and appropriate to hazardous substances remaining on site.

Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address the situation at a CERCLA site. The requirement is applicable if the jurisdictional prerequisites of the standard show a direct correspondence when objectively compared to the conditions at the site. An applicable federal requirement is an ARAR. An applicable state requirement is an ARAR only if it is more stringent than federal ARARs.

If the requirement is not legally applicable, then the requirement is evaluated to determine whether it is relevant and appropriate. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not applicable, address problems or situations similar to the circumstances of the proposed response action and are well suited to the conditions of the site. A requirement must be determined to be both relevant and appropriate in order to be considered an ARAR.

The criteria for determining relevance and appropriateness are listed in Title 40 CFR 300.400(g)(2) and include the following:

- Purpose of the requirement and the purpose of the CERCLA action
- Medium regulated or affected by the requirement and the medium contaminated or affected at the CERCLA site
- Substances regulated by the requirement and the substances found at the CERCLA site
- Variances, waivers, or exemptions of the requirement and their availability for the circumstances at the CERCLA site
- Type of place regulated and the type of place affected by the release or CERCLA action
- Type and size of structure or facility regulated and the type and size of structure or facility affected by the release or contemplated by the CERCLA action
- Any consideration of use or potential use of affected resources in the requirement and the use or potential use of the affected resources at the CERCLA site

According to CERCLA ARARs guidance, a requirement may be “applicable” or “relevant and appropriate” but not both. Identification of ARARs must be done on a site-specific basis and involve a two-part analysis. First, a determination whether a given requirement is applicable. Second, if it is not applicable, a determination whether it is nevertheless both relevant and appropriate. It is important to explain that some regulations may be applicable or not applicable and still relevant and appropriate. When the analysis determines that a requirement is both relevant and appropriate, such a requirement must be complied with to the same degree as if it were applicable.

Tables 2-13, 2-14, and 2-15 present potential chemical-, location-, and action-specific ARARs with a determination of ARAR status (that is, applicable or relevant and appropriate or not an ARAR). For the determination of relevance and appropriateness, the pertinent criteria were examined in light of the criteria previously listed to determine whether the requirements addressed problems or situation sufficiently similar to the circumstances of the release or remedial action contemplated and whether the requirement was well suited to the site.

To qualify as a state ARAR under CERCLA and the NCP, the following descriptions must apply:

- A state law
- An environmental or facility siting law
- Promulgated (of general applicability and legally enforceable)
- Substantive (not procedural or administrative)
- More stringent that the federal requirement
- Identified in a timely manner
- Consistently applied

To constitute an ARAR, a requirement must be substantive; therefore, only the substantive provisions of requirements identified as ARAR in this analysis are considered to be ARARs. Permits are considered to be procedural or administrative requirements. Provisions of generally relevant federal and state statutes are regulations that were determined to be procedural or nonenvironmental, including permit requirements, are not considered to be ARARs. CERCLA 121(e)(1) states, “No Federal, State, or local permit shall be required for the portion of any removal or remedial action conducted entirely on-site, where such remedial action is selected and carried out in compliance with this section.” The term “on-site” is defined for purposes of this ARARs discussion as “the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action” (Title 40 CFR 300.5).

Nonpromulgated advisories or guidance issued by federal or state governments are not legally binding and do not have the status of ARARs. Such requirements may, however, be useful, and are “to be considered” (TBC). TBC (Title 40 CFR 300.400[g][3]) requirements complement ARARs but do not override them. They are useful for guiding decisions regarding cleanup levels or methodologies when regulatory standards are not available.

Pursuant to EPA guidance (EPA 1988), ARARs are generally divided into three categories: chemical-specific, location-specific, and action-specific requirements. This classification was developed to aid in this identification of ARARs; however, some ARARs do not fall precisely into one group or another. ARARs are identified on a site basis for potential remedial actions where CERCLA authority is the basis for cleanup.

Waivers from attaining specific ARARs may be obtained under certain conditions as presented in Section 121(d)(4) of CERCLA. These conditions are as follows:

- The remedial action selected is only part of a total remedial action that will attain the completed ARAR.
- Compliance with the ARAR will result in greater risk to human health and the environment.
- Compliance with the ARAR is technically impractical from an engineering perspective.
- The remedial action selected will attain a standard of performance equivalent to the ARAR through use of another method or approach.
- With respect to a state ARAR, the state has not consistently applied or demonstrated the intention to consistently apply the standard, requirement, criterion, or limitation in similar circumstances for other remedial actions within the state.

Several of these waivers may be relevant to Site 29 as a whole or to specific remedial alternatives and may require further technical evaluation. As the RI/FS and design phases progress, the applicability of these waivers will be assessed. A particular ARAR may be waived provided the remedial actions are protective of human health and the environment.

As the lead federal agency, the Navy has primary responsibility for identifying federal ARARs at Site 29. Identification of potential state ARARs was initiated through Navy requests that the DTSC identify potential state ARARs. At this time, the state has not provided a specific list of potential state ARARs. Nevertheless, the Navy has attempted to identify potential state ARARs for Site 29 as discussed in the following sections.

2.2.8.3 Methodology Description

The process of identifying and evaluating potential federal and state ARARs is described in this subsection.

2.2.8.4 General

As the lead federal agency, the Navy has primary responsibility for identification of potential ARARs for Site 29. In preparing this ARARs analysis, the Navy undertook the following measures, consistent with CERCLA and the NCP:

- Identified federal ARARs for Site 29 based on site-specific information
- Reviewed potential state ARARs identified by the state (no specific ARARs were identified) to determine whether they satisfy CERCLA and NCP criteria that must be met to constitute state ARARs

- As appropriate, evaluated and compared federal ARARs and their state counterparts to determine which state ARARs are more stringent than the federal ARARs or are in addition to the federally required actions
- Reached a conclusion as to which federal and state ARARs are the most stringent and/or "controlling" ARARs for each alternative

2.2.8.5 ARARs of General Applicability

General issues identified during the evaluation of ARARs for Site 29 are discussed in the following subsections.

2.2.8.6 General Approach to Requirements of the Federal Resource Conservation and Recovery Act

RCRA is a federal statute passed in 1976 to meet four goals: the protection of human health and the environment, the reduction of waste, the conservation of energy and natural resources, and the elimination of the generation of hazardous waste as expeditiously as possible. The Hazardous and Solid Waste Amendments significantly expands the scope of RCRA by adding new corrective action requirements, land-disposal restrictions, and technical requirements. RCRA, as amended, contains several provisions that are potential ARARs for CERCLA sites.

Substantive RCRA requirements are applicable to response actions on CERCLA sites if the waste is a RCRA hazardous waste and one of the following descriptions applies:

- The waste was initially treated, stored, or disposed of after the effective date of the particular RCRA requirement
- The activity at the CERCLA site constitutes generation, treatment, storage, or disposal, as defined by RCRA (EPA 1988)

The preamble to the NCP indicates that state regulations that are components of a federally authorized or delegated state program are generally considered federal requirements and potential federal ARARs for the purposes of ARARs analysis (55 Federal Register 8742). The State of California received approval of its base RCRA hazardous waste management program on 23 July 1992 (57 Federal Register 8742). The State of California "Environmental Health Standards for the Management of Hazardous Waste" set forth in Title 22 *California Code of Regulations* (CCR), Division 4.5, were approved by EPA as a component of the federally authorized State of California RCRA program.

The regulations of Title 22 CCR Division 4.5 are, therefore, a source of potential federal ARARs for CERCLA response actions. The exception is when a state regulation is "broader in scope" or more stringent than the corresponding federal RCRA regulation. In that case, the state regulation is not considered part of the federally authorized program or a potential federal ARAR. Instead, it is purely a state law requirement and a potential state ARAR.

The EPA notice of July 23, 1992, approving the State of California RCRA program specifically indicated that the state regulations addressed certain non-RCRA, state-regulated hazardous wastes that fell outside the scope of federal RCRA requirements. Division 4.5 requirements would be potential state ARARs for such non-RCRA, state-regulated wastes.

2.2.8.7 California Environmental Quality Act and National Environmental Policy Act

The California Environmental Quality Act (CEQA) is applicable to state actions and not actions of the federal government. Furthermore, EPA and the Navy have determined that the requirements of the National Environmental Policy Act (NEPA) and CEQA are no more stringent than the requirements for environmental review under CERCLA. Pursuant to the provisions of CERCLA, the NCP, and other federal environmental impact evaluation requirements, selecting a remedial action with feasible mitigation measures and provisions for public review is designed to ensure that the proposed action provides for short- and long-term protection of the environment and public health. Hence, CERCLA performs the same function as and is substantially parallel to the state requirements under CEQA.

For the reasons set forth previously, NEPA and CEQA are not ARARs for CERCLA actions.

2.2.8.8 Chemical-Specific ARARs

Chemical-specific ARARs are generally health- or risk-based numerical values or methodologies applied to site-specific conditions that result in the establishment of a cleanup level. If a chemical has more that one cleanup level, the most stringent level has been identified as an ARAR for this FS.

Soil

No federal or state action levels have been promulgated for chemical concentrations in soils. There are no chemical-specific ARARs for Alternatives 1 and 2. For Alternative 3, which includes excavation, the only chemical-specific ARARs are those requirements under RCRA relating to the identification of hazardous waste. Any waste generated as a result of the excavation activities will be analyzed to determine whether it is a hazardous waste. The applicability of RCRA hazardous waste management requirements depends on whether the activity generates a waste; whether the waste is a RCRA hazardous waste; whether the waste initially underwent treatment, storage, or disposal after the date of the particular RCRA requirement; and whether the activity at the site constitutes treatment, storage, or disposal as defined by RCRA. RCRA requirements may be relevant and appropriate even if they are not applicable. Examples include activities that are similar to the definition of RCRA treatment, storage, or disposal for waste that is similar to RCRA hazardous waste.

The determination of whether a waste is a RCRA hazardous waste can be made by comparing the site waste to the definition of RCRA hazardous waste. The RCRA requirements at Title 22 CCR 66261.21, 66261.22(a)(1), 66261.23, 66261.24(a)(1), and 66261.100 are ARARs because they define RCRA hazardous waste. In particular, a waste can meet the definition of hazardous waste if it has the toxicity characteristic of hazardous waste. This determination is made by using the toxicity characteristic leaching procedure (TCLP). The California regulation at Title 22 CCR 66261.24(a)(1)(Bb) lists the maximum concentrations allowable for the TCLP and is a federal ARAR for determining whether the site has hazardous waste. If the site has concentrations exceeding these values, it is determined to be a characteristic RCRA hazardous waste. If site waste is found to contain hazardous waste, it will be managed in accordance with EPA's contained-in policy.

EPA Region IX PRGs are TBC for Site 29 as indicated in Table 2-13.

Groundwater

No chemical-specific ARARs have been identified for groundwater at Site 29 because groundwater is not a media of concern at this site and will not be further addressed by any remedial alternatives evaluated under this FS.

Chemical-specific ARARs for Site 29 are identified and summarized in Table 2-13.

2.2.8.9 Location-Specific ARARs

Location-specific ARARs restrict actions or limit concentrations of contaminants in certain environmentally sensitive areas. These requirements may limit the type of remedial action that could be implemented, and may impose additional constraints on cleanup levels. Examples of environmentally sensitive locations include wetlands, coastal zones, and areas or buildings of archaeological or historical significance. The existence of endangered or threatened species within the area must also be considered. Federal and State of California regulations were reviewed for potential location-specific ARARs. Site 29 is not located within a recognized coastal zone or floodplain.

Endangered and Threatened Species Regulations

The Endangered Species Act (ESA) of 1973 (Title 16 *United States Code* [USC] 1531 through 1543) provides a means for conserving various species of fish, wildlife, and plants that are threatened with extinction. The ESA defines an endangered species and provides for the designation of critical habitats. Federal agencies may not jeopardize the continued existence of any listed species or cause the destruction or adverse modification of critical habitat. The statutory interpretation of the term "jeopardize the continued existence of" contained in Section 7 of the ESA of 1973 means "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species." The regulations define the term "destruction or adverse modification" as "a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. Such alterations include, but are not limited to, alterations adversely modifying any of those physical or biological features that were the basis for determining the habitat to be critical."

Under Section 7(a) of the ESA, federal agencies must carry out conservation programs for listed species. The Endangered Species Committee may grant an exemption for agency action if reasonable mitigation and enhancement measures such as propagation, transplantation, and habitat acquisition and improvement are implemented. Consultation regulations at Title 50 CFR 402 are administrative in nature and are therefore not ARARs; however, they may be TBCs to comply with the substantive provisions of the ESA.

As previously described in Section 2.2.7, sensitive habitat for one federally threatened species, the California red-legged frog (*Rana aurora draytonii*) and one State of California Species of Special Concern, the California tiger salamander (*Ambystoma californiense*), has been identified in the near vicinity of Site 29. These species were identified during a review of the CDFG (2000) database and a previous ecological survey conducted by the University of Arizona at NWSSBD Concord.

The federal ESA of 1973 (Title 16 USC 1531 et seq, Title 50 CFR 200 and 402) and CDFG Codes (Sections 2080, 3005[a], 3511, 3513 and 5650 [a][b]) are included as ARARs because threatened species and State of California Species of Special Concern have been observed in the vicinity of Site 29. Remedial activities performed at Site 29 including possible building demolition, soil excavation, and surface capping activities will be performed using engineering controls to limit impact to existing sensitive habitat.

Numerous sections within Divisions 3, 4, and 6 of the CDFG Codes (Sections 2080, 3005, 3511, 3513, and 5650) prohibit the taking of birds and mammals, including threatened and endangered species, through trapping, poisoning or other means. Although soil sampling in the vicinity of Site 29 has not detected poisonous substances, and trapping and taking activities are not proposed, these regulations are included as ARARs as they are protective of existing habitat and species.

Protection of Archaeological and Historic Artifacts

Public Law No. 96-95 (Title 16 USC 470aa through 470mm), enacted in 1979 and amended in 1988, applies to all lands to which the fee title is held by the United States. The purpose of this statute is to provide for the protection of archaeological resources on federal and Indian lands. The law prohibits unauthorized excavation, removal, damage, alteration, or defacement of archaeological resources located on public lands unless such activity is pursuant to a permit issued under Section 470cc. The requirements of the Archaeological Resources Protection Act (Title 16 USC 470aa et seq.) are considered applicable since excavation activities are included as a possible remedial measure. Should scientific, prehistoric, or historic artifacts be found at Site 29 during excavation, the requirements of these regulations will need to be met. Location-specific ARARs for Site 29 are identified and summarized in Table 2-14. A more detailed discussion of the location-specific ARARs and how they would be met under a particular remedial alternative is included within Section 4.0.

2.2.8.10 Action-Specific ARARs

Action-specific ARARs are technology- or activity-based requirements or limitations for remedial activities. These requirements are triggered by the particular remedial activities conducted at the site and indicate how a selected remedial alternative should be achieved. These action-specific requirements do not in themselves determine the remedial alternative; rather, they indicate how a selected alternative must be achieved.

RCRA provides comprehensive regulations for the transfer, treatment, storage, and disposal of RCRA-defined hazardous wastes. RCRA requirements are potentially applicable or relevant and appropriate to the excavation with off-site disposal remedial alternative evaluated within this FS. RCRA may be delegated to a state program if the state statutes and regulations are equivalent to or more stringent than the federal statutes and regulations.

The State of California's federally authorized hazardous waste program regulates RCRA as well as non-RCRA hazardous waste. Based on sampling of affected soils at Site 29, a determination of whether these materials meet the definition of RCRA or non-RCRA hazardous wastes will be made. Title 22 CCR Division 4.5, Chapter 11, Article 3 (Title 22 CCR 66261.10 and 66261.24) sets forth the criteria to determine whether excavated soils must be managed as RCRA or non-RCRA hazardous wastes (see discussion under Section 2.2.8.1).

If a remedial alternative involves excavation of soil that contains RCRA or non-RCRA hazardous waste, then the substantive requirements within Title 22 CCR, Division 4.5, Chapter 12, Articles 1 and 3 (Title 22 CCR 66262.10 and 66262.34) that apply to generators of hazardous waste are potential ARARs.

Any hazardous waste generated during excavation activities is subject to the RCRA requirements identified as chemical-specific ARARs to determine whether such waste would be classified as hazardous. Any hazardous waste accumulated on site must comply with the RCRA requirements set forth at Title 22 CCR 66262.32. This section permits on-site hazardous waste accumulation for up to 90 days as long as the waste is properly stored and labeled.

If hazardous waste is generated as a result of the excavation, the Navy will identify the removal site as an area of contamination (AOC) if the site meets the definition of an AOC as stated in the preamble to the NCP [55 Federal Register 8758]. With respect to activities conducted within the AOC, the Navy will examine the applicability of RCRA regulations in accordance with existing EPA rules and policies regarding the management of remediation wastes in AOCs. As long as the excavated material remains inside of the area of contamination, it is not newly generated and will not be subject to RCRA generator, treatment, or other waste management requirements. Should excavated soil or groundwater from dewatering operations be moved outside of the area of contamination, the substantive RCRA requirements of Title 22 CCR for managing hazardous waste would be applicable.

For hazardous waste sent off site for disposal at a disposal facility (such as excavated soil or dewatering water), the following RCRA requirements are ARARS: the RCRA pretransport regulations at Title 22 CCR 66262.30 (packaging), 66262.31(labeling), 66262.32 (marking) and 66262.33 (placarding) and RCRA manifest requirements at Title 22 CCR 66262.20, 66262.21, 66252.22, and 66262.23. The regulations implementing the RCRA land disposal restrictions (LDR), including applicable LDR treatment standards at Title 22 CCR 66268.7 are also ARARs. Before sending any waste off site, the Navy will determine whether the waste is subject to LDR and will provide the required notices and certifications of Title 22 CCR 66268.7. In addition, the U.S. Department of Transportation (DOT) hazardous materials regulations at Title 49 CFR 171 and 172 are also ARARS for transporting hazardous materials on site.

If no hazardous waste is generated as a result of the removal action, the Navy will analyze RCRA requirements to determine whether they are relevant and appropriate. The Navy may determine that certain RCRA regulations are relevant and appropriate because the excavated soil may be similar to a RCRA hazardous waste.

In addition to the above RCRA and DOT requirements, there are air ARARs relating to excavation activities. The Bay Area Air Quality Management District (BAAQMD) has promulgated regulations that have been approved by EPA as part of the state implementation plan and are thus implemented under the authority of Clean Air Act. BAAQMD Regulations 6-301, 6-302 and 6-305, which specify standards for particulates and visible emissions for excavations, are ARARs for the excavation alternative. BAAQMD Regulation 8, Rule 40 is also an ARAR and sets forth standards for maintaining, covering, and stockpiling soil. These limitations are applicable to the proposed remedial alternatives involving excavation and off-site disposal because excavation and disposal activities may release particulate matter, contaminants, or dust into the air.

Because Building IA-25 is known to contain asbestos-containing materials (ACM) (see PRC 1997) and building demolition may be required under the remedial alternative involving soil excavation, regulations regarding asbestos inspections and appropriate removal and disposal of ACM have been included as potential action-specific ARARs. BAAQMD is the local agency with delegated enforcement powers through the EPA to administer National Emission Standard for Hazardous Air Pollutants (NESHAP) regulations. BAAQMD Regulation 11, Rule 2, contains provisions regarding inspections, abatement work practices, administrative requirements, and transport and disposal of ACM before the proposed building demolition activities.

Action-specific ARARs are identified and summarized in Table 2-15.

2.2.8.11 Other Requirements to be Followed

Resolutions adopted pursuant to Occupational Safety and Health Administration (OSHA) (Title 29 CFR 1910.120) are additional, nonenvironmental related requirements to be followed. OSHA regulates exposure of workers to a variety of chemicals in the work place and specifies training programs, health and environmental monitoring, worker personal protection, and emergency procedures to be implemented. In addition, federal OSHA regulations (Title 29 CFR 1910.1101 and 1926.1101) regarding general asbestos industry and construction industry work practices and training requirements have been included.

3.0 IDENTIFICATION AND DEVELOPMENT OF REMEDIAL ALTERNATIVES

The objective of this focused FS is to develop and evaluate remedial alternatives for Site 29 consistent with CERCLA and the NCP and minimize the potential for human and ecological exposure to affected soils. This section identifies an RAO for contaminated media at Site 29 and presents two GRAs that will satisfy the goal for protecting human health and the environment. This section also identifies and describes three applicable remedial alternatives.

3.1 INTRODUCTION

This focused FS does not include a detailed development of GRAs or a detailed screening of remedial process options and remedial alternatives that are typically contained in an FS. This streamlining is consistent with EPA management principals defined in the NCP. The NCP, Title 40 CFR 300.430(a), provides that "site specific data needs, the evaluation of alternatives, and the documentation of the selected remedy should reflect the scope and complexity of the site problems."

3.2 REMEDIAL ACTION OBJECTIVES

RAOs are medium-specific goals for protecting human health and the environment. Each RAO should specify (1) the contaminant(s) of concern, (2) the exposure route and receptor(s), and (3) an acceptable contaminant concentration or range of concentrations for each exposure pathway. RAOs include both an exposure pathway and a contaminant concentration in a given media because protectiveness may be achieved in two ways: (1) limiting or eliminating the exposure pathway or (2) reducing contaminant concentrations. This FS evaluates remedial alternatives for both approaches. For this FS, only the soil medium has been addressed because groundwater and surface water are not media of concern (see Sections 2.2.4 and 2.2.5).

The RAOs developed for Site 29 are based on information from all previous investigations conducted at the site and the SLHHRA and SLERA performed for the site investigation report. The RAOs developed are consistent with NCP requirements for remedy selection as detailed in Title 40 CFR 300.430.

3.2.1 Remedial Action Objectives for Unrestricted Land Use

Current and planned future uses of Site 29 are to remain industrial; thus potential human exposure is limited to worker exposures to COCs. This FS conservatively develops a remedial action objective and remedial alternatives that would allow for future unrestricted land use (that is, residential land use scenario). The results of the SLHHRA showed that the principal threats to human health under an unrestricted land use scenario come from the ingestion, dermal contact, and inhalation of metallic compounds of concern in soils. As discussed in Section 3.2, RAOs can be achieved by eliminating the exposure pathway or reducing the concentration of or eliminating the contaminants of concern. The single COC identified from the SLHHRA is lead, detected in surface soils directly beneath Building IA-25.

The RAO for unrestricted land use therefore consists of preventing ingestion of, direct contact with, or inhalation of airborne particulates of lead in soil at concentrations greater than the established EPA Region IX residential level PRG for lead (EPA 2002a). The California-modified residential level PRG for lead is 150 mg/kg.

3.2.2 Ecological Remedial Objectives

The results of the SLERA showed that the principal threats to ecological receptors identified at Site 29 come from the ingestion and dermal contact of a number of constituents in soils. The constituents were identified based upon the results of the FCM calculated HQs exceeding a value of 1 for any of the ecological receptors considered.

As discussed in Section 3.2, RAOs can be achieved by eliminating the exposure pathway or reducing the concentration of or eliminating the contaminants of concern.

The RAO for protection of ecological receptors therefore consists of preventing ingestion of and direct contact with these COPECs in surface soils at concentrations above than the greater value of the background soil concentrations or established ecological soil PRGs for each of these compounds, as listed in the following table.

PROPOSED CLEANUP GOALS FOR CHEMICALS OF ECOLOGICAL CONCERN

Constituent	Estimated Ambient Concentration (mg/kg)	Ecological Preliminary Remediation Goal[a] (mg/kg)	Proposed Cleanup Goal (mg/kg)
Aluminum	21,000	None established	21,000
Barium	560	283	560
Cadmium	0.28		0.28
Chromium	62.0	0.4	62.0
Copper	65.0	60	65.0
Lead	32.0	40.5	40.5
Manganese	1,300	None established	1,300
Mercury	0.17	0.0005	0.20
Nickel	110	30	110
Selenium	Detection Limit	0.21	Detection Limit
Vanadium	95.0	2.0	95.0
Zinc	99.0	8.5	99.0
Bis(2-ethylhexyl)phthalate	Nondetect	None established	Detection Limit
Dichlorodiphenyltrichloroethane	Nondetect	None established	Detection Limit

Note:

a Values from Efroymson and others (1997).

3.3 GENERAL RESPONSE ACTIONS

GRAs are responses or remedies that may be implemented at a specific site or group of sites, intended to meet the RAOs. GRAs may be combined to attain the RAOs as necessary, depending on site conditions and waste characteristics. GRAs may be composed of one or more remedial technology types, for which one or more process options are available (Section 3.3). The GRAs identified for contaminated soil at Site 29 are as follows:

- No action
- Institutional controls
- Containment
- Removal and disposal

3.3.1 No Action

A GRA of "no action" means that no remedial actions would be conducted at Site 29. Under this scenario, Site 29 would continue in its current state, and no actions would be conducted to remove, isolate, or remediate soil contamination. Natural attenuation is not expected to significantly reduce metals contaminant concentrations over time, and monitoring would not be provided to assess changes in site conditions.

3.3.2 Institutional Controls

Institutional controls are nonengineering measures, usually legal or physical, for limiting potential exposures to a site or media of concern. Examples of institutional controls cited in the NCP include land and resource use and deed restriction, well drilling prohibitions, building permits, well use advisories, and deed notices. Institutional controls can also include access restrictions such as fencing and site monitoring. Land use and access restrictions would limit the potential for exposure to ingestion, dermal, and inhalation exposure pathways.

3.3.3 Containment

Containment actions refer to technologies that isolate soil contaminants, minimize disturbance to the affected soils, and reduce off-site surface contaminant migration. These actions are applicable for preventing human and ecological exposures to affected soils at Site 29. Containment technologies include surface controls (such as runoff controls) and capping.

3.3.4 Removal and Disposal

Removal and disposal involves excavating surface soils affected with COCs and COECs above specific cleanup criteria (EPA Region IX residential PRGs and established ambient levels, see Sections 3.2.1 and 3.2.2) and disposing of them off site at an appropriate permitted Class I, II, or III landfill. This response action would involve the demolition of existing Building IA-25 to gain access to affected surface soils beneath the building. Asbestos abatement activities may be required to remove ACMs before building demolition begins, according to current state air-quality regulations. Lead-based paint may be present on interior and exterior building surfaces. Disposal of building materials containing lead-based paint is required to comply with BAAQMD Regulation 11, Rule 1.

3.4 DESCRIPTION OF REMEDIAL ALTERNATIVES

This section develops and describes potential remedial alternatives for contaminated soil. The soil RAOs for Site 29 require that under an unrestricted land use scenario soil concentrations be reduced to meet EPA Region IX residential PRGs, established background concentration levels, and ecological PRGs. The remedial alternatives vary in degree of effectiveness, implementability, and cost, and represent a range of alternatives as required in the NCP (Title 40 CFR 300.430[e]). This range (as required in the NCP) includes (1) a no action alternative; (2) one or more alternatives that involve little or no treatment but protect human health and the environment primarily by preventing or controlling exposure; and (3) an alternative that reduces the toxicity, mobility, or volume of COPCs and eliminates the need for long-term monitoring.

3.4.1 Alternative 1: No Action

Under Alternative 1, no remedial action will be taken. Contaminated soil will be left at Site 29 as is, without implementation of any institutional control, containment, removal, treatment, or other remedial actions. The no action response is retained throughout the FS process as required by the NCP (Title 40 CFR 300.430[e][6]) to provide a comparative baseline against which other alternatives can be evaluated. This alternative is not effective for protecting human health under the unrestricted land use scenario, allowing potential future residents to be exposed to contaminated surface and near surface soils. The alternative is also not protective of ecological receptors because it does nothing to prevent the ingestion and direct contact with identified COECs.

3.4.2 Alternative 2: Capping with Institutional Controls

Institutional controls are nonengineering measures, usually legal or physical, for limiting potential exposures to a site or media of concern. Examples of institutional controls cited in the NCP include land and resource use and deed restriction, well drilling prohibitions, building permits, well use advisories, and deed notices. Institutional controls can also include access restrictions such as fencing and site monitoring. Land use and access restrictions would limit the potential for exposure by ingestion, dermal, and inhalation.

Land use restrictions at Site 29 under Alternative 2 will include development of a land use control remedial design (LUC RD) as part of the final remedial design for the site. The LUC RD will explain how institutional controls are established, documented, maintained and managed.

The LUC RD will also be identified in the Real Estate Summary/Base Mapping System of the Base Master Plan or other Navy Planning documents required for land/facility development. The LUC RD will describe the boundaries of the site, the objectives of the controls, the restrictions, the required frequency for inspections, the entities responsible for carrying out the monitoring and inspection, the methods for certifying compliance and procedures for notifying the state and EPA in the event of a failure to comply with the restriction.

The Navy will prepare the LUC RD as part of the final remedial design for the site, which will ensure implementation of land use restrictions as incorporated into the Real Estate Summary/Base Mapping

System of the Base Master Plan or other Navy Planning documents required for land/facility development. This includes noting the condition of the site annually for the next 30 years. Proper implementation of the LUC RD would adequately control exposure to contaminated soil and would be reliable over the long term.

Access restrictions to Site 29 are currently in place because the area is located on government property that is not accessible to the general public. These access restrictions reduce the potential that humans, other than personnel working on the property, are exposed to hazardous substances in soil.

Additionally, construction of a concrete cap over a 4,400-square-foot area of affected soils beneath Building IA-25 is proposed as part of this alternative to provide containment of affected soils and reduce the potential exposure pathways for both human and ecological receptors. Cap construction would include installation of a metal edge or skirt (to a depth of 6 inches) around the perimeter of the concrete cap to prevent and discourage animal burrowing.

3.4.3 Alternative 3: Removal with Off-Site Disposal

Alternative 3 consists of excavating affected soils with concentrations of hazardous compounds that are above specific cleanup criteria (either EPA Region IX residential PRGs or established background concentration levels, see Sections 3.2.1 and 3.2.2) with off-site landfill disposal. This alternative would include demolition of Building IA-25, the former military explosives manufacturing and testing facility. Risks from exposure to contaminated soil by ingestion, dermal contact, or inhalation will be eliminated under this alternative because all contaminated soil is removed.

The major components of this alternative are as follows:

- Mechanical excavation of contaminated soil, replacement with backfill, using imported material, and surface replacement
- Removal of any ACM in Building IA-25 and demolition of the building
- Off-site disposal of contaminated soil in appropriate landfill(s)

Each of these components is described in the following text, and Section 4.0 contains a detailed evaluation of this alternative.

3.4.3.1 Excavation and Backfill

This alternative involves the removal and clean backfill of an estimated 165 cubic yards of contaminated soil from beneath Building IA-25 (1-foot depth of soil removed over an area of 4,400 square feet). Figure 2-6 presents the proposed extent of excavation. Following building demolition, excavation will be performed with standard construction equipment such as bulldozers and front-end loaders. The types of equipment and removal techniques used will be developed during the final design phase if this alternative is selected. Engineering control measures will be implemented to prevent airborne dust emissions from the site and to control surface erosion.

Concurrent with the excavation activities, this alternative will also include soil characterization sampling and confirmation sampling of soils left in place to be developed as part of the sampling plan in the future remedial design. In addition, stringent air monitoring will be conducted to detect hazardous substance releases and implement appropriate health and safety measures.

Site-specific conditions that may affect the implementability of mechanical excavation are as follows: (1) physical characteristics of the soil being excavated, (2) depth of the excavation, (3) moisture content of the soil, and (4) physical obstructions.

The soil at Site 29 is predominantly native soil with limited areas of soil-fill materials that are relatively heterogeneous and variably compact. The physical characteristics and depth of the soil favor mechanical excavation over other excavation techniques. The potential removal of subsurface boulders and other obstructions is not expected to significantly impede the process. Physical obstructions such as storm and sanitary sewers could hamper or prevent excavation in some areas. The need to remove or replace any obstructions including overhead utilities and buried electrical lines will be evaluated during the design of the remedial alternative if it is selected.

3.4.3.2 Building Demolition

Building IA-25 is a single story building of wood construction measuring approximately 40 feet wide by 150 feet long. As found in Title 40 CFR 61M (NESHAP) and as delegated to the state under BAAQMD Regulation 11, Rule 2, all buildings must be inspected for the presence of ACM before demolition. Building IA-25 is assumed to contain asbestos-containing construction materials because of its age (pre-1978 construction) and because ACM was previously removed from the crawl space area beneath the building. Buildings IA-25 may also contain lead based-paint. The building will therefore be inspected and surveyed for Regulated Asbestos Containing Material (RACM) and lead based paint. If RACM or lead based paint is found, it will be removed from the building in accordance with RCRA requirements before demolition activities begin. Any asbestos or lead abatement activities performed will be done in strict compliance with federal and state NESHAP, EPA, and OSHA standards.

3.4.3.3 Off-Site Commercial Disposal

Depending on the characteristics of soil and debris, off-site commercial disposal would include disposal at permitted Class I, II, or III landfills. The actual wastes accepted at each landfill are specified by site-specific Waste Discharge Requirements (WDR) issued by the appropriate Regional Water Quality Control Board; however, waste acceptance is generally determined by the following criteria for the three classes of applicable landfills in the State of California.

Class I Landfill

Class I landfills generally accept hazardous waste as defined in Title 22 CCR Division 4.5, Chapter 11, which includes threshold criteria for classifying solid waste as hazardous based on the characteristics of ignitability, corrosivity, reactivity, and toxicity. The characteristic of toxicity for non-RCRA (California) hazardous waste is assessed by comparison to soluble threshold limit concentrations (STLC) and total threshold limit concentrations (TTLC). The characteristic of toxicity for RCRA hazardous waste is assessed by the TCLP. Under California law (Section 25157.8 of the Health and Safety Code), contaminated soils containing lead in excess of 350 mg/kg can be disposed of only at Class I disposal facilities whether designated as a hazardous waste or not. Excavated soil with these concentrations of lead will be sent to a Class I facility. A waste is considered hazardous if it exhibits any of the four characteristics. Therefore, samples collected from representative quantities of soil will be analyzed for ignitability, corrosivity, reactivity, and toxicity. For the initial characterization, all three toxicity tests (STLC, TTLC, and TCLP) will be performed.

The representative quantity of soil varies from landfill to landfill. Before land disposal, RCRA hazardous waste (Title 22 CCR for criteria) and selected California-only hazardous waste must be treated to achieve the appropriate treatment standard specified in 22 CCR Division 4.5, Chapter 18 (LDR). For purposes of this FS, the Navy assumes that hazardous waste being disposed of at the Class I facility will also be treated to universal treatment standards at the disposal facility. The Laidlaw facility in Buttonwillow, California, is a potential Class I disposal site.

Off-Site Class II Landfill

Class II landfills generally accept designated waste as defined in Title 23 CCR 2522, as specified in their WDRs. Acceptance criteria generally vary from landfill to landfill, depending on the provisions of their WDRs. Although numerical criteria for designated waste have not been promulgated, a Class II landfill, Browning Ferris Industries in Pittsburg, California, has the following criteria for accepting designated waste:

- The waste must not exceed hazardous constituents in excess of Title 22 CCR Division 4.5, Chapter 11 values (toxicity testing STLC, TTLC, and TCLP performed)
- Hazardous waste that has been granted a variance from the hazardous waste management requirements of Title 22 CCR
- Petroleum hydrocarbon concentrations that have no specific limits but that meets ignitability limits

Any designated waste excavated as part of Alternative 3 that meets the WDRs of selected Class II landfill facilities may be disposed of at that facility.

Off-Site Class III Landfill

Soils and miscellaneous debris that do not require disposal at a Class I or II landfill can be disposed at a Class III landfill as nonhazardous soil waste. Certain Class III landfills can also accept ACM for disposal, depending on their WDRs.

4.0 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

The alternatives identified and described in Section 3.0 are evaluated in this section in detail to provide sufficient information to adequately compare the alternatives, select an appropriate remedy, and demonstrate satisfaction of the CERCLA remedy selection requirements in the ROD. The following alternatives are evaluated in this section:

- Alternative 1: No Action
- Alternative 2: Capping with Institutional Controls
- Alternative 3: Removal with Off-Site Disposal

In this section, the three alternatives are evaluated based on the following nine criteria, as required by 40 CFR 300.430(e) of the NCP:

1. Overall protection of human health and the environment
2. Compliance with ARARs
3. Long-term effectiveness and permanence
4. Reduction in toxicity, mobility, or volume through treatment
5. Short-term effectiveness
6. Implementability
7. Cost
8. State acceptance
9. Community acceptance

These nine criteria are discussed below.

Overall Protection of Human Health and the Environment

This criterion assesses whether each alternative provides adequate protection of human health and the environment. The overall assessment of protection draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. The protectiveness evaluation focuses on how site risks are reduced or eliminated by each alternative. Risk reductions are associated with how effectively an alternative meets the RAOs. This criterion is considered a threshold criterion and must be met by the selected alternative.

Compliance with ARARs

This evaluation criterion is used to determine whether each alternative will meet all identified federal and state ARARs or whether justification exists for waiving one or more ARARs. The detailed analysis will describe how each alternative will meet ARAR requirements. This criterion is also a threshold criterion that must be met by the selected alternative. Section 2.2.8 summarizes location-specific ARARs and identifies potential action-specific ARARs associated with the three remedial alternatives.

Long-Term Effectiveness and Permanence

Each alternative is evaluated in terms of risk remaining at the site after RAOs have been met. The primary focus of this evaluation is the extent and effectiveness of remedial controls used to manage the risk posed by treatment residuals or untreated wastes. The following criteria were considered:

- Adequacy of remedial controls
- Reliability of remedial controls
- Magnitude of the residual risk

Reduction in Toxicity, Mobility, or Volume Through Treatment

This evaluation criterion addresses the statutory preference for treatment options that permanently and significantly reduce toxicity, mobility, or volume of the contaminants. This preference is satisfied when treatment reduces the principal threats through the following:

- Destruction of toxic contaminants
- Reduction in contaminant mobility
- Reduction of the total mass of toxic contaminants
- Reduction of total volume of contaminated media

Short-Term Effectiveness

This evaluation criterion addresses the effects of the alternative during the construction and implementation phase until RAOs are met. Under this criterion, alternatives are evaluated with respect to their effects on human health and the environment during implementation of the remedial action. The following factors were considered:

- Exposure of the community during implementation
- Exposure of workers during construction
- Environmental impacts
- Time to achieve RAOs

Implementability

This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. The following factors were considered:

- Ability to construct the technology
- Reliability of the technology
- Monitoring considerations
- Availability of equipment and specialists
- Ability to obtain concurrence from regulatory agencies

Cost

The cost analysis for each alternative is based on estimates of capital and operation and maintenance (O&M) costs. Capital costs consist of direct and indirect costs. Direct costs include the purchase of equipment, labor, and materials necessary to implement the alternative. Indirect costs include those for engineering, financial, and other services such as testing and monitoring. Where applicable, annual O&M costs include operating labor, maintenance materials and labor, auxiliary materials, and energy.

Per CERCLA guidance (EPA 1988), the accuracy of cost estimates for each alternative in this FS is expected to lie within the range of 50 percent above to 30 percent below the estimate.

State and Community Acceptance

State and community acceptance criteria are used for comparative analysis of remedial alternatives as CERCLA-recognized modifying criteria. This criterion evaluates state and community acceptance of the alternatives presented in the FS. Comments were received on the draft FS from the EPA and are presented in Appendix B. Written comments on the draft FS have not been received from SFRWQCB, DTSC, or the community.

4.1 ALTERNATIVE 1: NO ACTION

The no action response is retained throughout the FS process as required by the NCP (Title 40 CFR 300.430[e][6]) to provide a comparative baseline against which other alternatives can be evaluated. This alternative is not effective for protecting human health and ecological receptors.

4.1.1 Overall Protection of Human Health and the Environment – Alternative 1

Assuming the current and planned future uses of Site 29 remain industrial, risks to human health would remain within acceptable limits. The "no action" alternative is not protective of human health or the environment under the unrestricted land use scenario because this alternative does not restrict use of the site or address contaminants in soil posing a potential human health or ecological risk. Because no remedial action will be taken, contaminated soil is left as is. This alternative will not eliminate, reduce, or control the potential human health and ecological risk presented by contaminated soil at Site 29.

4.1.2 Compliance with ARARs – Alternative 1

No action- or location-specific ARARs apply to this alternative.

4.1.3 Long-Term Effectiveness and Permanence – Alternative 1

Assuming that the future use of Site 29 changes to unrestricted use, risks to human health and the environment will be unacceptable because of the presence of barium, chromium, copper, lead, mercury, nickel, selenium, and zinc in soils. Alternative 1 does not assure long-term effectiveness and permanence.

4.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment – Alternative 1

The mobility, toxicity, and volume of hazardous substances at Site 29 will not be reduced through treatment under Alternative 1 because the contaminated soil will not be treated.

4.1.5 Short-Term Effectiveness – Alternative 1

Four factors are considered when assessing the short-term effectiveness of an alternative: protection of the community during remedial actions, protection of workers during remedial actions, environmental impacts resulting from construction and implementation of the alternative, and time required to complete remedial action.

Because no action will be taken this alternative does nothing to address the unacceptable health risks to the community, NWSSBD Concord workers, and potential building occupants. This alternative will not pose any health risks to remedial action workers because no remedial action will be taken. No adverse environmental impacts will result from the construction and implementation of this alternative because no remedial action will be taken. This alternative does not require any time for remedial action because no remedial action will be conducted.

Alternative 1 will not achieve the RAO for soils under the unrestricted land use scenario or the ecological RAOs. Therefore, the no action alternative is considered to be ineffective in the short term.

4.1.6 Implementability – Alternative 1

Implementability includes the technical and administrative feasibility and availability of required resources. No construction or administrative activities will be required to implement this alternative; therefore, the alternative is technically feasible. This alternative is easily implemented because no action will be conducted and additional resources are not required.

4.1.7 Cost – Alternative 1

No capital or O&M costs are associated with this alternative.

4.1.8 State Acceptance – Alternative 1

Comments have not been received from the state. However, because Alternative 1 does not protect human health or the environment under an unrestricted use scenario, Alternative 1 is unacceptable to the state and EPA.

4.1.9 Community Acceptance – Alternative 1

Alternative 1 is unlikely to be acceptable to the community for the same reasons as specified by the state and EPA above.

4.2 ALTERNATIVE 2: CAPPING WITH INSTITUTIONAL CONTROLS

Alternative 2 includes implementation of land use restrictions at Site 29 to protect human health and construction of a concrete cap over a 4,400-square-foot area of affected soils beneath Building IA-25 to reduce the potential exposure pathways for ecological and human receptors. Cap construction would include installation of a metal edge or skirt (to a depth of 6 inches) around the perimeter of the concrete cap to discourage animal burrowing. This alternative also requires operation and maintenance activities to continue the implementation of institutional controls, monitoring of the site, and periodic inspection of the cap.

4.2.1 Overall Protection of Human Health and the Environment – Alternative 2

The RAO for unrestricted land use is to prevent exposure to contaminated soil. Alternative 2 protects human health and the environment by restricting access to affected soils at Site 29 by ecological receptors identified, residents, children in school or day care centers, or other permanent occupants. Under Alternative 2, the Navy will develop a LUC RD as part of the final remedial design for the site, to ensure implementation of land-use restrictions. The LUC RD will explain how institutional controls will be established, documented, maintained and managed. The LUC RD will be used to ensure implementation of land-use restrictions identified in the Real Estate Summary/Base Mapping System of the Base Master Plan or other Navy Planning documents required for land/facility development. The LUC RD will describe the boundaries of the site, the objectives of the controls, the restrictions, the required frequency for inspections, the entities responsible for carrying out the monitoring and inspection, the methods for certifying compliance and procedures for notifying the state and EPA in the event of a failure to comply with the restriction. Exposure pathways for both human and ecological receptors will be reduced through installation of a concrete surface cap. This alternative will reduce potential human or ecological health risks presented by contaminated soil at by limiting exposure to contaminants to acceptable levels. There are no short-term threats associated with the selected remedy.

4.2.2 Compliance with ARARs – Alternative 2

No chemical- or action-specific ARARs are considered applicable to this alternative since affected soils will not be disturbed or handled. Applicable location-specific ARARs include the federal and state threatened and endangered species regulations. Capping the surface soils will reduce potential exposure pathways for both human and ecological receptors. Capping activities will be scheduled so as not to interfere with typical migration seasons for the tiger salamander, and engineering controls will be implemented to avoid any impact to potential sensitive habitat in the earthen bunkers surrounding Building IA-25 through temporary fencing and worker communication.

4.2.3 Long-Term Effectiveness and Permanence – Alternative 2

The factors evaluated under long-term effectiveness and permanence include the magnitude of residual risks and adequacy and reliability of controls. Each of these factors is assessed in the following text for Alternative 2.

4.2.3.1 Magnitude of Residual Risks

Risks will be reduced to within acceptable risk ranges because the use of Site 29 will be restricted to industrial workers only, and exposure pathways to sensitive ecological receptors will be reduced through capping.

4.2.3.2 Adequacy and Reliability of Controls

Because contaminated soil will not be removed from Site 29, the long-term adequacy and reliability of controls will depend on the ability of the Navy (or other future owner) to enforce land-use restrictions detailed in the LUC RD and as noted within the Real Estate Summary/Base Mapping System of the Base Master Plan or other Navy Planning documents as well as the ability of the Navy to monitor and maintain the integrity of the concrete cap. The Navy will prepare and follow the requirements of the proposed LUC RD to ensure implementation of land use restrictions imposed (see also Section 3.4.2) and to note the condition and propose any required repair work for the concrete cap. Proper implementation of the LUC RD would adequately control exposure to contaminated soils and would be reliable over the long term.

Overall the long-term effectiveness of Alternative 2 is considered to be good.

4.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment – Alternative 2

Capping and institutional controls do not reduce the mobility, toxicity, or volume of hazardous substances through treatment.

4.2.5 Short-Term Effectiveness – Alternative 2

Four factors are considered when assessing the short-term effectiveness of an alternative: protection of the community during remedial actions, protection of workers during remedial actions, environmental impacts resulting from construction and implementation of the alternative, and time required to complete remedial action. Each of these factors is assessed in the following text for Alternative 2.

Alternative 2 will not present any new health risks to the community or current occupants because the current and future land use will remain the same. The surrounding community is far removed from Site 29 and is not likely to face any short-term risks during concrete cap construction activities. Measures will be taken during cap construction to reduce and control short-term risks to workers, including the use of dust suppression techniques and site access controls. Care will be taken to protect any potentially sensitive habitat for species within the earthen berm surrounding Building IA-25 during cap construction activities so as not impact these areas. The time required to complete capping activities (estimated at 2 weeks) is relatively short in duration, as is the time and effort associated with implementation of the administrative controls portion of this alternative.

The capping with institutional control alternative is considered highly effective in the short term.

4.2.6 Implementability – Alternative 2

Implementability includes the technical and administrative feasibility and availability of required resources. Common construction activities will be required to implement this alternative; therefore, the alternative is technically feasible. This alternative is also administrative in nature and will involve planning and organization to implement over the short and long term. Substantial coordination and cooperation will also be necessary between the Navy, as the landowner, and the regulatory agencies. Alternative 2 will require a modest amount of resources over the long term, and overall, it is considered moderately difficult to implement.

4.2.7 Cost – Alternative 2

This alternative is relatively inexpensive to implement. The cost to construct the concrete cap and modify the Real Estate Summary/Base Mapping System of the Base Master Plan is relatively low, and future costs to monitor and enforce land use controls, through the LUC RD, are considered modest. Annual O&M costs for Alternative 2 includes labor and materials for cap inspection and documentation.

The total net present value estimated cost for Alternative 2 is $83,200, as further detailed within Appendix D.

4.2.8 State Acceptance – Alternative 2

The state did not provide comments on the draft FS. Alternative 2 is acceptable to EPA if the Navy is able to demonstrate an effective method of controls to restrict access to soils below the building in the long term.

4.2.9 Community Acceptance – Alternative 2

The Navy has not received specific comments from the community on Alternative 2.

4.3 ALTERNATIVE 3: REMOVAL WITH OFF-SITE DISPOSAL

As discussed in Section 3.4.3, this alternative consists of excavating and disposing of all soil requiring remedial action at off-site landfills. It also consists of demolition of Building IA-25. This alternative would be implemented to address RAOs under the unrestricted land use scenario and to address the ecological RAOs. The major components of this alternative are as follows:

- Removal of the asbestos materials from the existing building
- Demolition of Building IA-25
- Excavation of contaminated soil
- Off-site disposal of contaminated soil in appropriate landfill(s)
- Confirmation soil sampling
- Backfill with clean imported materials

4.3.1 Overall Protection of Human Health and the Environment – Alternative 3

Alternative 3 will protect human health and the environment because it will involve excavation and removal of contaminated soil from affected areas, thereby eliminating the potential for direct contact with, ingestion of, or inhalation of contaminated soils by humans or ecological species. Moving quantities of affected soil will create some short term risks to the community, site workers and the environment; however, these will be minimized by compliance with ARARs during implementation of this alternative.

4.3.2 Compliance with ARARs – Alternative 3

Alternative 3 can be designed to meet all chemical-, action-, and location-specific ARARs. The Navy's excavation and disposal activities could potentially trigger a variety of hazardous waste requirements under the California Hazardous Waste Control Law. If the soil qualifies as a hazardous waste, it would be managed, stored, and transported in accordance with the substantive federal requirements in Title 49 CFR 171 and Title 49 USC 5101 through 5127 as well as the State of California requirements in Title 22 CCR 66262.20 through 66262.23 and 66262.30 through 66262.34 (see also Tables 2-13, 2-14, and 2-15).

As appropriate, excavated soil would be handled and treated to comply with land disposal restrictions of Title 22 CCR 66268.7. In addition, if the soil is not hazardous waste, it would be characterized according to Title 27 CCR requirements for solid and designated waste to determine whether the material must be disposed of at a permitted Class II or Class III landfill.

Further, the substantive requirements in BAAQMD Regulation 6 are considered applicable to Alternative 3. Specifically, Regulations 6-301, 6-302, and 6-305 that contain particulates and visible emissions standards would be applicable to limit dust and particulate emissions during excavation and removal activities as would the covering and stockpiling requirements found within BAAQMD Regulation 8, Rule 40. Dust control will likely include the judicious use of water, use of palliatives, properly covering stockpiled soils, modifying operations, or other engineering means acceptable to the Navy and regulatory agencies. Furthermore, if Building IA-25 is found to contain ACMs, BAAQMD Regulation 11, Rule 2 would require the survey, removal, and off-site disposal of ACM before the building demolition. If Building IA-25 is found to contain lead-based paint, the Navy will comply with the requirements of BAAQMD Regulation 11, Rule 1, which sets forth limitations on the amount of lead emitted to the atmosphere.

The requirements of the Archeological Resources Protection Act, Title 16 USC 470aa through 470mm as location-specific ARARs, are expected to be met because excavation activities will occur in very shallow soils only and will be monitored for the possible recovery and preservation of historical artifacts encountered. Other applicable location-specific ARARs include the federal and State of California threatened and endangered species regulations found within Title 16 USC Section 1536(a)(h)(1)(B) and CDFG Codes 2050 through 2116. Excavation and removal of affected soils will eliminate potential exposure pathways for both human and ecological receptors. These construction activities will be scheduled so as not to interfere with typical migration seasons for the tiger salamander, and engineering controls will be implemented, if necessary, to avoid any impact to potential sensitive habitat in the earthen bunkers surrounding Building IA-25 through temporary fencing and worker communication.

4.3.3 Long-Term Effectiveness and Permanence – Alternative 3

The factors evaluated under long-term effectiveness and permanence include the magnitude of residual risks and adequacy and reliability of controls. Each of these factors is assessed in the following text for Alternative 3.

4.3.3.1 Magnitude of Residual Risks

Residual risks will be permanently reduced to within acceptable levels that are protective of human health and the environment by removing all affected soils with concentrations exceeding the EPA Region IX residential PRG soil cleanup criteria and ambient levels.

4.3.3.2 Adequacy and Reliability of Controls

Excavation with off-site disposal is a proven and reliable technology that would effectively remove contaminated soils from Site 29 and thus permanently reduce the possibility of human or ecological exposure to affected materials. Technology performance specifications, long-term management, site monitoring, O&M requirements, and technical component replacement are not required under this alternative because contaminated soil will be removed and disposed of off site. Alternative 3 is considered highly effective over the long term.

4.3.4 Reduction of Toxicity, Mobility, or Volume Through Treatment– Alternative 3

This evaluation criterion addresses CERCLA's preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce the mobility, toxicity, or volume of hazardous substances. Alternative 3 will not reduce the toxicity, mobility or volume of hazardous substances removed from Site 29 because the affected soil would not be treated or reduced in volume. The CERCLA preference for treatment as a principal element of the remedy would not be satisfied by Alternative 3.

Under the NCP, 40 CFR Part 300.430(e)(9)(iii)(D)]), the reduction of toxicity, mobility, or volume through the use of treatment are not reduced if waste is simply hauled to a landfill, because the waste has not been altered (treated) to achieve these reductions. Although safe disposal of contaminants in an appropriately permitted landfill prevents exposure to the waste's toxicity and also prevents potential mobility, landfilling does not achieve the NCP criteria for reducing toxicity, mobility and volume through treatment. Therefore, excavation and disposal would have low effectiveness at satisfying this criterion.

4.3.5 Short-Term Effectiveness – Alternative 3

Four factors are considered when assessing the short-term effectiveness of an alternative: protection of the community during remedial actions, protection of workers during remedial actions, environmental impacts resulting from construction and implementation of the alternative, and time required to complete remedial actions. Each of these factors is assessed in the following paragraphs for Alternative 3.

4.3.5.1 Protection of the Community

The surrounding community is far removed from Site 29 and is not likely to face any short-term risks during building demolition, excavation, and removal activities. Measures will be taken during demolition, excavation, staging, and loading of contaminated soil (excavation activities) to reduce and control short-term risks.

For example, dust suppression measures will be used to reduce the generation of fugitive dusts. Furthermore, site access will be controlled to reduce the potential for direct contact with contaminated soils. A detailed air-monitoring plan will be developed to establish specific boundaries of work areas and traffic routes. Strategic locations along these boundaries will be monitored for airborne emissions to ensure short-term health levels are achieved throughout the remedial actions. The local community may also be faced with additional short-term impacts resulting from increased truck traffic during building demolition, excavation, and backfilling activities.

4.3.5.2 Protection of Workers

Worker safety considerations associated with implementation of Alternative 3 can be grouped in two categories: (1) general site hazards and (2) potential chemical hazards. General site hazards include the following:

- Heavy equipment hazards
- Occupational noise exposure
- Potential slip, trip, or fall hazards
- Potential for contact with underground or overhead mechanical and electrical hazards or utility lines
- Airborne dust hazards

Exposure to general site hazards can be reduced by providing (1) appropriate safety equipment to minimize noise and dust exposure and (2) awareness training to orient personnel with the physical site hazards.

Potential chemical hazards include inhalation of, absorption of, ingestion of, and contact with hazardous substances in building materials and contaminated soil. On-site remedial workers will wear Level D protection during soil excavation activities. Level C or greater levels of protection may be necessary to conduct asbestos abatement and will be supplemented with continuous baseline and personal air monitoring. The specific protection worn will be determined by the level of dermal and inhalation protection necessary. Air monitoring will be conducted to assist in determining the required level of protection. The level of protection will be upgraded if high contaminant concentrations are detected during excavation of soil at Site 29.

4.3.5.3 Environmental Impact

Excavation activities will not result in increased impact on the environment. Dust suppression measures and engineering controls will minimize any impacts. Air monitoring will assist in determining whether dust control measures are effective to limit environmental impacts. In addition, surface drainage controls and appropriate equipment decontamination procedures will be used to prevent transport of contaminated soil to uncontaminated areas.

4.3.5.4 Time Required for Remedial Action

Approximately 3 to 4 months will be required to complete all remedial activities associated with Alternative 3. The length of time required to excavate and remove contaminated soil may be affected by the following factors:

- Time required to characterize samples of the contaminated soil
- Additional volumes of contaminated soil encountered during excavation
- Number of unanticipated obstructions during excavation
- Suitable weather conditions.

Based on the previous four criteria above, Alternative 3 is considered to have an overall moderate level of short-term effectiveness.

4.3.6 Implementability – Alternative 3

The technical and administrative feasibility and availability of required resources to implement Alternative 3 are discussed in the following text.

4.3.6.1 Technical Feasibility

Alternative 3 is considered to have low technical complexity, primarily because both asbestos abatement and standard hazardous waste site excavation and disposal activities can be readily coordinated. This alternative will use standard construction methods and equipment modified for use at hazardous waste sites. Some technical difficulties and added regulatory constraints may be encountered with asbestos abatement activities. The shallow soil excavations do not pose a technical concern. After site restoration and backfilling, no long term O&M activities will be necessary.

4.3.6.2 Administrative Feasibility

The alternative is administratively feasible. Coordination with multiple regulatory agencies will be necessary to comply with action-specific ARARs.

4.3.6.3 Availability of Required Resources

Off-site commercial disposal capacity will be adequate to handle the relatively small volume of contaminated soil generated from Site 29 (approximately 165 cubic yards). Several Class II and III permitted landfills are located fairly close to NWSSBD Concord. The nearest Class I permitted landfill is located near Bakersfield, California. Many remediation firms have the equipment and specialists necessary to implement this alternative.

Overall, Alternative 3 is considered to be highly implementable. It is both technically and administratively feasible, and the required resources to complete associated remedial activities are readily available.

4.3.7 Cost – Alternative 3

The overall cost of this alternative is considered high because capital costs associated with asbestos abatement, building demolition, and soil excavation and disposal are included. No O&M costs are associated with this alternative. The cost of the off-site Class I, II, or III landfill disposal depends on several factors such as (1) the transportation distance to the landfill, (2) the volume of waste requiring disposal, and (3) the soil characterization. Total estimated cost to complete this alternative is $157,300 (see Appendix D).

4.3.8 State Acceptance – Alternative 3

The state did not provide comments on the draft FS. Alternative 3 is acceptable to the EPA.

4.3.9 Community Acceptance – Alternative 3

The Navy has not received specific comments from the community on Alternative 3.

5.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section analyzes the advantages and disadvantages of each of the three alternatives evaluated in Section 4.0. Identification of a preferred alternative will be made within the proposed plan to be developed following this FS.

For an alternative to be eligible for selection as a preferred alternative, it must meet two CERCLA-recognized “threshold criteria”: (1) overall protection of human health and the environment and (2) compliance with ARARs. After the comparison with threshold criteria, a comparative analysis of remedial alternatives is conducted based on five CERCLA-recognized “primary balancing criteria” that identify and weigh the major tradeoffs among alternatives. The last two criteria, state and community acceptance, will be addressed in the ROD following final comments received from the community and the agencies on the FS and the future proposed plan. The purpose of this comparative analysis is to identify the relative advantages and disadvantages of each alternative and thereby provide a sound basis for remedy selection that is consistent with the NCP. The comparative analyses are presented in Section 5.4 and summarized in Table 5-1.

5.1 THRESHOLD CRITERIA

Alternative 1 does not meet the threshold criteria of overall protection of human health and the environment and compliance with ARARs for the unrestricted land use scenario. The no-action alternative will result in site conditions that are controlled only by current land use practices. Without additional controls, land use could change giving rise to the unacceptable exposure of contaminants to human and ecological receptors. Alternative 1 does not address potential unacceptable exposures to ecological receptors.

Because Alternative 1 does not meet the threshold criteria for Site 29, this alternative is not eligible for selection. According to the NCP, however, the no-action alternative provides a basis for comparison against other alternatives.

As discussed in Section 4.0, alternatives 2 and 3 meet the threshold criteria. Both alternatives provide protection of human and ecological health; however, Alternative 3 provides for a more permanent solution since Alternative 2 is dependent on long-term maintenance activities to ensure remedial measures remain effective. Alternative 1 has no ARARs to meet. Alternatives 2 and 3 can be implemented to meet all ARARs.

5.2 BALANCING CRITERIA

The following five criteria are used for comparative analysis of remedial alternatives and are discussed in the following sections:

- Long-Term Effectiveness and Permanence
- Reduction in Toxicity, Mobility, and Volume Through Treatment
- Short-Term Effectiveness
- Implementability
- Cost

5.2.1 Long-Term Effectiveness and Permanence

Alternative 1 provides no long-term effectiveness since site conditions will be unpredictable and uncontrolled, and it could result in future exposure to human and ecological receptors. Alternative 2 presents some long-term residual risks since exposure to receptors is dependent on the stringency with which institutional controls are employed and long-term maintenance of the concrete cap is performed. Alternative 3 provides the best overall long-term effectiveness because it is a permanent solution that presents no residual risks at Site 29, to human or ecological receptors.

5.2.2 Reduction in Toxicity, Mobility, or Volume Through Treatment

None of the three alternatives provides for a reduction in toxicity, mobility, or volume, through treatment and as such, the alternatives are equally ineffective at meeting this criterion.

5.2.3 Short-Term Effectiveness

Alternative 1 is considered to be least effective in the short term because no remedial action will be taken and RAOs will not be met under this alternative. Alternative 2 can be implemented faster than Alternative 3, and Alternative 2 poses fewer risks to workers and the community because of its shorter duration. The differences in risk to workers and the community are slight, however, so Alternatives 2 and 3 are considered to be equally effective in the short term. Both alternatives can be implemented in a relatively short timeframe, both will achieve the RAOs in the short term, and both will have minimal risk of exposing the community or workers to risks during implementation.

5.2.4 Implementability

Because no action will be taken under Alternative 1, this alternative is the easiest to implement. Alternative 2 is slightly more difficult to implement than Alternative 3 because both construction activities and administrative action is necessary over the short and long term for Alternative 2. For Alternative 3, both technical and administrative effort will be required to implement the active remedial measures proposed.

5.2.5 Cost

Table 5-2 summarizes alternative costs. There are no costs associated with Alternative 1. The total costs for Alternative 2 have been estimated at $83,200, and the total costs for Alternative 3 are estimated at $157,300. Total net present value costs (including capital costs and O&M costs) are higher for Alternative 3 than for Alternative 2.

5.3 MODIFYING CRITERIA

State and community acceptance criteria are used for comparative analysis of remedial alternatives as CERCLA-recognized modifying criteria. Alternative 1 is not acceptable to the state or community. EPA has indicated that both Alternatives 2 and 3 are acceptable. The Navy has not received comments from the state and community regarding the acceptability of Alternatives 2 and 3. State and community acceptance cannot be fully evaluated, however, until after the public comment period.

5.4 RESULTS OF COMPARATIVE ANALYSIS

Results of the comparative analysis are summarized in Table 5-1 and indicate that Alternative 3 ranks the highest among the three alternatives considered. Alternative 3 is most effective in the long term and provides greater protection of human health and the environment as compared with Alternatives 1 and 2.

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TABLES

TABLE 2-1
ANALYTICAL RESULTS
BUILDING CRAWL SPACE SURFACE SOILS SAMPLING EVENT
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

SAMPLE ID	IA25-1	IA25-2	IA25-4	IA25-5	IA25-6	IA25-7	IA25-8	SS-01-1	SS-01-2	SS-02-01	SS-02-2	SS-03-1	SS-03-2	SS-04-1
SAMPLE DATE	11/10/88	11/10/88	11/10/88	11/10/88	11/10/88	11/10/88	11/10/88	6/28/89	6/28/89	6/28/89	6/28/89	6/28/89	6/28/89	6/28/89
CLP METALS (mg/kg)														
Aluminum	---	---	---	---	---	---	---	17,200	19,300	9,190	21,900	21,900	23,900	16,800
Arsenic	2.8	3.6	1.2	2.7	2.4	3.6	2.6	3	3	7	10	5	4	4
Barium	370	420	590	510	340	480	280	650	630	220	630	400	860	700
Berylium	1.3	0.34	0.7	0.78	0.22	0.3	0.45				16			
Cadmium	32	2	10	3.9	0.81	2	10				5			
Calcium	---	---	---	---	---	---	---	6,000	6,990	2,990	5,570	4,440	6,330	8,120
Chromium	2,600	46	150	160	49	84	32	64	67	21	87	46	67	63
Cobalt	30	16	20	22	18	19	13	22	30	14	27	16	22	29
Copper	320	62	99	160	31	87	28	55	57	46	1,190	29	44	36
Iron	---	---	---	---	---	---	---	32,500	41,600	16,200	3,880	28,300	35,600	39,400
Lead	3,400	63	1,500	630	53	89	210	32	11	99	180	45	32	32
Magnesium	---	---	---	---	---	---	---	8,900	11,200	4,540	12,800	6,890	9,890	11,800
Manganese	---	---	---	---	---	---	---	1,010	1,300	730	1,420	870	1,260	1,340
Mercury	0.21	0.14	1.4	1.1	0.21	0.16	0.08	0.3	0.5		0.4			
Nickle	65	70	57	95	82	89	53	98	140	37	80	56	84	160
Potassium	2,100	610	420	510	300	570	950	1,100				1,350	1,340	1,100
Selenium	4.4	2	1.1	3.4	2.6	2.5	2.3							
Silver	0.3	0.14				0.22								
Sodium	---	---	---	---	---	---	---							
Thallium														
Vanadium	47	43	6.6	47	43	52	38	70	93	28	92	68	85	85
Zinc	20,000	200	4,300	1,300	230	310	63	140	95	100	630	98	240	94
GENERAL CHEMISTRY (mg/kg)														
Cyanide	2.2		1					2			2		5	
Nitrate	530	250	120	330	2.8	220	49	31	15	18	7.4	3	120	12
pH (unitless)	6.7	8	8.9	8.7	6.9	10.2	7.5	7.8	7.4	5.4	7.3	6.8	8	7.3
Sulfate	---		---	---	---	---	---	130	94	41	17	49	21	320
EXPLOSIVES AND EXPLOSIVE BYPRODUCTS														
Tetryl														
Diphenylamine														
VOLATILE ORGANICS (GCMS) (mg/kg)														
Methylene Chloride										0.008	0.007			
2-Butanone (MEK)	0.48													
1,1,1-Trichloroethane						0.013								
Xylenes (total)										0.009	0.015			
SEMIVOLATILE ORGANICS (GCMS) (mg/kg)														
Benzo(b)fluoranthene										0.40				
Bis(2-ethylhexyl)phthalate										1.1				
Fluoranthene											0.37			
Phenanthrene														
Pyrene														
ORGANOCHLORINE PESTICIDES AND PCB's (GC) (mg/kg)														
4,4' -DDD			0.12											
4,4' -DDT			0.23					0.024				0.054		0.020
beta-BHC														
POLYNUCLEAR AROMATIC HYDROCARBONS (GC) (mg/kg)														
Acenaphthene										0.052				
Anthracene / Phenanthrene		7.0				3.5				0.31	0.075			
Benz(a)anthracene / Chrysene		1.9												
Benzo(b/k)fluoranthene										0.26	0.19			
Benzo(a)pyrene										0.15				
Fluoranthene		6.4				5.2				0.36	0.15			
Naphthalene														
Pyrene		4.5				3.7				0.24	0.11			
CHLORINATED HERBICIDES (GC) (mg/kg)														
2,4,5-TP (Silvex)														
2,4-DB														
Dinoseb														0.017

TABLE 2-1 (Continued)
ANALYTICAL RESULTS
BUILDING CRAWL SPACE SURFACE SOILS SAMPLING EVENT
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

SAMPLE ID	SS-04-2	SS-05-1	SS-05-2	SS-06-1	SS-06-2	SS-07-1	SS-07-2	SS-08-1	SS-08-2	SS-09-1	SS-09-2	SS-10-1	SS-10-2
SAMPLE DATE	6/28/89	6/28/89	6/28/89	6/28/89	6/28/89	6/28/89	6/28/89	6/28/89	6/28/89	6/28/89	6/28/89	6/28/89	6/28/89
CLP METALS (mg/kg)													
Aluminum	27,400	12,900	23,000	11,500	10,600	21,400	14,900	21,500	25,400	27,500	27,300	20,700	27,300
Arsenic	3	3	2	3		6	3	6	5	4	4	2	3
Barium	750	330	430	310	300	1,660	600	1,310	1,150	440	370	440	460
Berylium								6	6	5	5		
Cadmium				2	2			8	4				
Calcium	6,480	7,780	5,750	2,580	3,440	7,380	5,520	7,210	8,870	6,090	5,760	6,160	4,790
Chromium	75	42	47	71	38	85	58	160	100	54	54	50	57
Cobalt	20	15	22	18	15	32	22	27	28	22	19	19	18
Copper	37	28	31	86	30	110	31	110	76	39	33	31	31
Iron	37,300	17,700	35,500	18,000	26,200	41,400	32,300	42,300	42,400	34,300	31,700	31,500	33,500
Lead	15	72	23	290	250	800	11	690	240	20	18	12	10
Magnesium	10,300	10,500	10,900	12,500	10,600	10,800	9,420	9,400	11,000	9,280	8,640	8,480	7,970
Manganese	1,180	1,420	1,000	870	800	1,340	790	1,340	1,440	1,370	1,010	970	1,040
Mercury	0.2			0.4	0.4	0.2	0.2	0.3	0.2	0.4			
Nickle	100	94	69	46	64	130	79	98	100	75	75	63	68
Potassium	1,400		1,100			1,310		1,200	1,410	1,830	1,640	1,240	2,270
Selenium													
Silver													
Sodium				3,410	1,780	1,770							
Thallium													
Vanadium	89	39	88	32	75	84	70	87	110	85	78	74	76
Zinc	110	56	120	350	340	190	85	1,250	5,220	85	74	94	67
GENERAL CHEMISTRY (mg/kg)													
Cyanide				22	11			3	3				
Nitrate	11	0.8	3.5	180	97	43	180	20	15		1.7		1.1
pH (unitless)	7.3	6.4	6.7	8.2	9.5	7.8	8.2	7.8	7.5	7.1	8.1	5.9	7.6
Sulfate	220	22	22	160	72	160	160	46	22	11	6.2	10	2.3
EXPLOSIVES AND EXPLOSIVE BYPRODUCTS													
Tetryl													
Diphenylamine										Ta			
VOLATILE ORGANICS (GCMS) (mg/kg)													
Methylene Chloride						0.010	0.011						
2-Butanone (MEK)													
1,1,1-Trichloroethane													
Xylenes (total)													
SEMIVOLATILE ORGANICS (GCMS) (mg/kg)													
Benzo(b)fluoranthene													
Bis(2-ethylhexyl)phthalate						3.9							
Fluoranthene						0.89							
Phenanthrene						0.67							
Pyrene						0.63							
ORGANOCHLORINE PESTICIDES AND PCB's (GC) (mg/kg)													
4,4' -DDD													
4,4' -DDT	0.048			0.036		0.017							
beta-BHC							0.032						
POLYNUCLEAR AROMATIC HYDROCARBONS (GC) (mg/kg)													
Acenaphthene													
Anthracene / Phenanthrene						0.59	0.12						
Benz(a)anthracene / Chrysene						0.45	0.078						
Benzo(b/k)fluoranthene						0.48							
Benzo(a)pyrene													
Fluoranthene						0.98	0.19						
Naphthalene						0.040							
Pyrene						0.77	0.14						
CHLORINATED HERBICIDES (GC) (mg/kg)													
2,4,5-TP (Silvex)	0.013												
2,4-DB					0.053				0.066				
Dinoseb	0.023					0.012		0.014	0.012				

TABLE 2-1 (Continued)
ANALYTICAL RESULTS
BUILDING CRAWL SPACE SURFACE SOILS SAMPLING EVENT
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Notes:

Shaded cell	**Analysis not performed**
Blank cell	Analyte not detected (detection limits unknown) or not analyzed
---	Not Detected
BHC	Benzene Hexachloride
CLP	Contract Laboratory Program
DB	Dichlorophenoxy butanoic acid
DDD	Dichlorodiphenyldichloroethane
DDT	Dichlorodiphenyltrichloroethane
GC	Gas chromatography
GCMS	Gas chromatography/mass spectrometry
MEK	Methyl Ethyl Ketone
mg/kg	Milligrams per kilogram
PCB	Polychlorinated biphenyls
TP	Trichlorophenoxy propionic acid

TABLE 2-2
ANALYTICAL RESULTS SUMMARY
SUBSURFACE SOILS SAMPLING EVENT
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Point ID	S29SB01	S29SB01	S29SB01	S29SB02	S29SB02	S29SB02	S29SB03	S29SB03	S29SB03
Sample ID	265S29SB001	265S29SB002	265S29SB003	265S29SB032	265S29SB033	265S29SB034	265S29SB004	265S29SB005	265S29SB006
Matrix	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sample Date	1/25/1999	1/25/1999	1/25/1999	2/3/1999	2/3/1999	2/3/1999	1/25/1999	1/25/1999	1/25/1999
Sample Depth (in feet)	4.50 - 5.00	9.50 - 10.00	14.50 - 15.00	5.00 - 5.50	10.50 - 10.50	15.00 - 15.50	4.50 - 5.00	9.50 - 10.00	14.50 - 15.00
CLP Metals (mg/kg)									
ALUMINUM	14,600	13,100	13,900	14,000	13,300	12,600	8,770	11,700	20,600
ANTIMONY	0.62 UR	0.74	1.3	1.6	0.77 UR	0.83 UR	0.67 UR	0.68 UR	1.9
ARSENIC	3	2.3	1.6	2.6	1.6	0.62 U	3	1.7	9.5
BARIUM	438	274	379	1240	223	250	256	354	439
BERYLLIUM	0.020 U	0.010 U	0.020 U	0.13	0.35	0.31	0.09	0.020 U	0.08
CALCIUM	5,160	7,340	7,120	6,240	3,080	2,690	3,090	5,530	8,950
CHROMIUM	36.1	45.2	35.8	55.8	29.1	22.2	19.1	29.6	75
COBALT	12.7	13.5	16.5	22.3	10.9	14.9	11.4	15.1	19.9
COPPER	61.9	29.5	37	35.8	26.2	25	66.8	31.2	79.1
IRON	31,800	20,500	22,800	31,800	20,400	17,200	16,300	22,000	41,300
LEAD	3.2	2.1	1.5	1.6	3.9	5.9	3.1	1.5	2.2
MAGNESIUM	10,700	8,800	9,950	10,700	7,760	7,900	5,050	9,060	12,200
MANGANESE	1,840	768	733	6,560	153	426	367	1,080	686
MERCURY	0.13	0.11	0.05	0.22	0.21	0.25	0.12	0.1	0.09
MOLYBDENUM	0.28 U	0.21 U	0.27 U	0.19 U	0.22 U	0.23 U	0.30 U	0.31 U	0.48
NICKEL	101	64.9	55.6	91.2	51.7	55.1	39.3	71.4	58.1
POTASSIUM	458	552	500	682	1450	1560	801	390	832
SELENIUM	0.72 U	0.53 U	0.69 U	1.5	0.71 U	0.77 U	0.78 U	0.79 U	0.83 U
THALLIUM	3.4 U	1.8 U	2.8 U	7	1.3 U	1.6 U	0.89 U	2.8 U	3.9 U
VANADIUM	63.1	51.8	58.5	99.7	44.1	34.4	37.9	50.6	164
ZINC	90.8	50.6	63.4	58.1	47.7	49.3	88	41.6	91.9
Volatiles (mg/kg)									
TRICHLOROETHENE	0.002 J	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
Petroleum Indicators (mg/kg)									
GASOLINE	0.6 U	0.5 U	0.5 U	0.5 U	0.6 U	0.6 U	0.6 U	0.6 U	0.7

Notes: Only chemicals with detected concentrations are presented in this table.

CLP Contract Laboratory Program
ID Identification
J Estimated value
mg/kg Milligram per kilogram
R Value rejected due to data quality issues
U Not detected with detection limit indicated

TABLE 2-3
SELECTION OF CHEMICALS OF POTENTIAL CONCERN
BUILDING CRAWL SPACE SURFACE SOILS SAMPLING EVENT
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemical[1]	Maximum Detected Concentration	Inland Area Ambient Level[2]	Range of Background Concentrations in California[3] (mg/kg)	Exceed Ambient/Background Levels?	COPC	Residential Soil PRG[4] (mg/kg)	Industrial Soil PRG[4] (mg/kg)
CLP Metals (mg/kg)							
ALUMINUM	27,500	21,000	--	Yes	Yes	7.6E+04	9.2E+05
ARSENIC	10.0	15.0	--	No	No	3.9E-01	1.6E+00
BARIUM	1,660	560	--	Yes	Yes	5.4E+03	6.7E+04
BERYLLIUM	16.0	0.12	--	Yes	Yes	1.5E+02	1.9E+03
CADMIUM	32.0	0.28	--	Yes	Yes	3.7E+01	4.5E+02
CALCIUM	8,870	--	2,541 to 45,577	No	No	--	--
CHROMIUM[5]	2,600	62.0	--	Yes	Yes	2.1E+02	4.5E+02
COBALT	32.0	25.0	--	Yes	Yes	9.0E+02	1.9E+03
COPPER	1,190	65.0	--	Yes	Yes	3.1E+03	4.1E+04
IRON[6]	42,400	--	10,000 to 87,000	No	No	2.3E+04	3.1E+05
LEAD[7]	3,400	32.0	--	Yes	Yes	1.5E+02	7.5E+02
MAGNESIUM	12,800	--	1,456 to 32,378	No	No	--	--
MANGANESE	1,440	1,300	--	Yes	Yes	1.8E+03	1.9E+04
MERCURY	1.40	0.2	--	Yes	Yes	2.3E+01	3.1E+02
NICKEL	160	110	--	Yes	Yes	1.6E+03	2.0E+04
POTASSIUM	2,270	--	2,100 to 30,000	No	No	--	--
SELENIUM	4.40	--	--	Yes	Yes	3.9E+02	5.1E+03
SILVER	0.30	--	--	Yes	Yes	3.9E+02	5.1E+03
SODIUM	3,410	--	5,580 to 73,400	Yes	Yes	--	--
VANADIUM	110	95.0	--	Yes	Yes	5.5E+02	7.2E+03
ZINC	20,000	99.0	--	Yes	Yes	2.3E+04	3.1E+05
Volatiles (mg/kg)							
2-BUTANONE (MEK)	0.48	--	--	Yes	Yes	7.3E+03	2.7E+04
1,1,1-TRICHLOROETHANE	0.013	--	--	Yes	Yes	2.0E+03	6.9E+03
METHYLENE CHLORIDE	0.011	--	--	Yes	Yes	9.1E+00	2.1E+01
XYLENES (total)	0.015	--	--	Yes	Yes	2.7E+02	9.0E+02
Semivolatiles (mg/kg)							
BIS(2-ETHYLHEXYL)PHTHALATE	3.9	--	--	Yes	Yes	3.5E+01	1.2E+02
Polynuclear Aromatic Hydrocarbons (mg/kg)							
ACENAPHTHENE	0.052	--	--	Yes	Yes	3.7E+03	2.9E+04
ANTHRACENE	7.0	--	--	Yes	Yes	2.2E+04	2.4E+05
CHRYSENE[8]	1.9	--	--	Yes	Yes	3.8E+00	1.3E+01
BENZO(b/k)FLUORANTHENE[8,9]	0.48	--	--	Yes	Yes	3.8E-01	1.3E+00
BENZO(a)PYRENE	0.15	--	--	Yes	Yes	6.2E-02	2.1E-01
FLUORANTHENE	6.4	--	--	Yes	Yes	2.3E+03	2.2E+04
NAPHTHALENE	0.040	--	--	Yes	Yes	5.6E+01	1.9E+02
PHENANTHRENE[10]	3.5	--	--	Yes	Yes	2.2E+04	2.4E+05
PYRENE	0.45	--	--	Yes	Yes	2.3E+03	2.9E+04
Organochlorine Pesticides and PCB (mg/kg)							
4,4'-DDD	0.12	--	--	Yes	Yes	2.4E+00	1.0E+01

TABLE 2-3 (Continued)
SELECTION OF CHEMICALS OF POTENTIAL CONCERN
BUILDING CRAWL SPACE SURFACE SOILS SAMPLING EVENT
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemical[1]	Maximum Detected Concentration	Inland Area Ambient Level[2]	Range of Background Concentrations in California[3] (mg/kg)	Exceed Ambient/Background Levels?	COPC	Residential Soil PRG[4] (mg/kg)	Industrial Soil PRG[4] (mg/kg)
4,4'-DDT	0.23	--	--	Yes	Yes	1.7E+00	7.0E+00
beta-BHC	0.032	--	--	Yes	Yes	3.2E-01	1.3E+00
Chlorinated Herbicides (mg/kg)							
2,4,5-TP (Silvex)	0.013	--	--	Yes	Yes	4.9E+02	4.9E+03
2,4-DB	0.066	--	--	Yes	Yes	4.9E+02	4.9E+03
DINOSEB	0.023	--	--	Yes	Yes	6.1E+01	6.2E+02
General Chemistries (mg/kg)							
CYANIDE	0.022	--	--	Yes	Yes	1.2E+03	1.2E+04
NITRATE (as N)	0.53	--	--	Yes	Yes	--	--
SULFATE	0.32	--	--	Yes	Yes	--	--
Explosives and Explosive Byproducts (mg/kg)							
TETRYL	0.69	--	--	Yes	Yes	6.1E+02	6.2E+03
DIPHENYLAMINE	1.2	--	--	Yes	Yes	1.5E+03	1.5E+04

Notes:

1 Only chemicals with detected concentrations are presented in this table.
2 Ambient limits established for the Inland Area in the NWSSBD Concord. Values presented are the 80% LCL on the 95th percentile of the distribution calculated using nonparametric formula (Table 1 in Appendix C of "RCRA Facility Assessment Confirmation Study. PRC Environmental Management Inc., August 8, 1997).
3 Values from Bradford and others (1996).
4 Preliminary remediation goals established by U.S. Environmental Protection Agency (EPA) Region IX (October 1, 2002).
5 PRG is for total chromium (1:6 ratio Cr VI:Cr III).
6 Iron is not considered a COPC because detected concentrations are within background concentrations established in California (Bradford and others 1996). However, since the detected concentration for iron exceeds the residential soil PRG, a qualitative risk assessment from iron will be discussed in the text.
7 The residential PRG shown for lead is the Cal-modified PRG; the industrial PRG shown for lead is the EPA PRG.
8 Cal-modified PRG
9 PRG used is for benzo(k)fluoranthene.
10 PRG used is for anthracene.

-- None established
BHC Benzene Hexachloride
CLP Contract Laboratory Program
COPC Chemical of Potential Concern
Cr Chromium
DB Dichlorophenoxy butanoic acid
DDD Dichlorodiphenyldichloroethane
DDT Dichlorodiphenyltrichloroethane
LCL Lower confidende level
MEK Methyl Ethyl Ketone
mg/kg Milligram per kilogram
PCB Polychlorinated biphenyls
PRG Preliminary remediation goal
RCRA Resource Conservation and Recovery Act
TP Trichlorophenoxy propionic acid

TABLE 2-4
SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SUBSURFACE SOILS SAMPLING EVENT
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Point ID	S29SB01	S29SB01	S29SB02	S29SB03	S29SB03							
Sample ID	265S29SB001	265S29SB002	265S29SB032	265S29SB004	265S29SB005							
Matrix	SOIL	SOIL	SOIL	SOIL	SOIL							
Sample Date	1/25/1999	1/25/1999	2/3/1999	1/25/1999	1/25/1999							
Sample Depth (in feet)	4.50 - 5.00	9.50 - 10.00	5.00 - 5.50	4.50 - 5.00	9.50 - 10.00	**Maximum Detected Concentration**	**Inland Area Ambient Level[2]**	**Range of Background Concentrations in California[3] (mg/kg)**	**Exceed Ambient/ Background Levels?**	**COPC**	**Residential Soil PRG[4] (mg/kg)**	**Industrial Soil PRG[4] (mg/kg)**
CLP Metals[1] (mg/kg)												
ALUMINUM	14,600	13,100	14,000	8,770	11,700	14,600	21,000	--	No	No	7.6E+04	9.2E+05
ANTIMONY	0.62 UR	0.74	1.6	0.67 UR	0.68 UR	1.6	0.90	--	Yes	Yes	3.1E+01	4.1E+02
ARSENIC	3	2.3	2.6	3	1.7	3.0	15	--	No	No	3.9E-01	1.6E+00
BARIUM	438	274	1240	256	354	1,240	560	--	Yes	Yes	5.4E+03	6.7E+04
BERYLLIUM	0.020 U	0.010 U	0.13	0.09	0.020 U	0.13	0.12	--	Yes	Yes	1.5E+02	1.9E+03
CALCIUM	5,160	7,340	6,240	3,090	5,530	7,340	--	2,541 to 45,577	No	No	--	--
CHROMIUM[5]	36.1	45.2	55.8	19.1	29.6	55.8	62	--	No	No	2.1E+02	4.5E+02
COBALT	12.7	13.5	22.3	11.4	15.1	22.3	25	--	No	No	9.0E+02	1.9E+03
COPPER	61.9	29.5	35.8	66.8	31.2	66.8	65	--	Yes	Yes	3.1E+03	4.1E+04
IRON[6]	31,800	20,500	31,800	16,300	22,000	31,800	--	10,000 to 87,000	No	No	2.3E+04	3.1E+05
LEAD[7]	3.2	2.1	1.6	3.1	1.5	3.2	32	--	No	No	1.5E+02	7.5E+02
MAGNESIUM	10,700	8,800	10,700	5,050	9,060	10,700	--	1,456 to 32,378	No	No	--	--
MANGANESE	1,840	768	6,560	367	1,080	6,560	1,300	--	Yes	Yes	1.8E+03	1.9E+04
MERCURY	0.13	0.11	0.22	0.12	0.1	0.22	0.17	--	Yes	Yes	2.3E+01	3.1E+02
MOLYBDENUM	0.28 U	0.21 U	0.19 U	0.30 U	0.31 U	0.00	--	--	No	No	3.9E+02	5.1E+03
NICKEL	101	64.9	91.2	39.3	71.4	101	110	--	No	No	1.6E+03	2.0E+04
POTASSIUM	458	552	682	801	390	801	--	2,100 to 30,000	No	No	--	--
SELENIUM	0.72 U	0.53 U	1.5	0.78 U	0.79 U	1.5	--	--	Yes	Yes	3.9E+02	5.1E+03
THALLIUM	3.4 U	1.8 U	7	0.89 U	2.8 U	7.0	1.4	--	Yes	Yes	5.2E+00	6.7E+01
VANADIUM	63.1	51.8	99.7	37.9	50.6	100	95	--	Yes	Yes	5.5E+02	7.2E+03
ZINC	90.8	50.6	58.1	88	41.6	90.8	99	--	No	No	2.3E+04	3.1E+05
Volatiles[1] (mg/kg)												
TRICHLOROETHENE	0.002 J	0.011 U	0.011 U	0.012 U	0.012 U	0.002	--	--	Yes	Yes	5.3E-02	1.1E-01
Petroleum Indicators[1] (mg/kg)												
GASOLINE	0.6 U	0.5 U	0.5 U	0.6 U	0.6 U	0.00	--	--	No	No	--	--

TABLE 2-4 (Continued)
SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SUBSURFACE SOILS SAMPLING EVENT
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Notes:

1 Only chemicals with detected concentrations are presented in this table.
2 Ambient limits established for the Inland Area in the NWSSBD Concord. Values presented are the 80% LCL on the 95th percentile of the distribution calculated using nonparametric formula (Table 1 in Appendix C of "Final Report RCRA Facility Assessment Confirmation Study. PRC Environmental Management Inc., August 8, 1997).
3 Values from Bradford and others (1996).
4 Preliminary remediation goals established by U.S. Environmental Protection Agency (EPA) Region IX (October 1, 2002).
5 PRG is for total chromium (1:6 ratio Cr VI:Cr III).
6 Iron is not considered a COPC because detected concentrations are within background concentrations established in California (Bradford and others 1996). However, since the detected concentration for iron exceeds the residential soil PRG, a qualitative risk assessment from iron will be discussed in the text.
7 The residential PRG shown for lead is the Cal-modified PRG; the industrial PRG shown for lead is the EPA PRG.

--	None established
COPC	Chemical of Potential Concern
Cr	Chromium
J	Estimated value
LCL	Lower confidence level
mg/kg	Milligram per kilogram
PRG	Preliminary remediation goal
R	Value rejected due to data quality issues
U	Not detected with detection limit indicated,

TABLE 2-5
CANCER RISK AND HAZARD INDEX FROM EXPOSURE TO SOIL
RESIDENTIAL SCENARIO
BUILDING CRAWL SPACE SURFACE SOILS SAMPLING EVENT
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemical of Potential Concern	Exposure Point Concentration[1] (mg/kg)	Residential Soil PRG[2] (mg/kg)		Cancer Risk (unitless)	Hazard Index (unitless)
		Cancer	Noncancer		
CLP Metals					
ALUMINUM	27,500	--	7.6E+04	--	3.6E-01
BARIUM	1,660	--	5.4E+03	--	3.1E-01
BERYLLIUM	16	1.1E+03	1.5E+02	1.5E-08	1.0E-01
CADMIUM	32	1.4E+03	3.7E+01	2.3E-08	8.6E-01
CHROMIUM[3]	2,600	2.1E+02	--	1.2E-05	--
COBALT	32	9.0E+02	1.4E+03	3.5E-08	2.3E-02
COPPER	1,190	--	3.1E+03	--	3.8E-01
LEAD[4]	3,400	--	--	--	--
MANGANESE	1,440	--	1.8E+03	--	8.2E-01
MERCURY	1.4	--	2.3E+01	--	6.0E-02
NICKEL	160	--	1.6E+03	--	1.0E-01
SELENIUM	4.4	--	3.9E+02	--	1.1E-02
SILVER	0.3	--	3.9E+02	--	7.7E-04
VANADIUM	110	--	5.5E+02	--	2.0E-01
ZINC	20,000	--	2.3E+04	--	8.5E-01
Volatiles					
2-BUTANONE (MEK)	0.48	--	7.3E+03	--	6.6E-05
1,1,1-TRICHLOROETHANE	0.013	--	2.0E+03	--	6.6E-06
METHYLENE CHLORIDE	0.011	9.1E+00	2.0E+03	1.2E-09	5.6E-06
XYLENES (total)	0.015	--	2.7E+02	--	5.5E-05
Semivolatiles					
BIS(2-ETHYLHEXYL)PHTHALATE	3.9	3.5E+01	1.2E+03	1.1E-07	3.2E-03

TABLE 2-5 (Continued)
CANCER RISK AND HAZARD INDEX FROM EXPOSURE TO SOIL
RESIDENTIAL SCENARIO
BUILDING CRAWL SPACE SURFACE SOILS SAMPLING EVENT
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemical of Potential Concern	Exposure Point Concentration[1] (mg/kg)	Residential Soil PRG[2] (mg/kg)		Cancer Risk (unitless)	Hazard Index (unitless)
		Cancer	Noncancer		
Polynuclear Aromatic Hydrocarbons					
ACENAPHTHENE	0.052	--	3.7E+03	--	1.4E-05
ANTHRACENE	7.0	--	2.2E+04	--	3.2E-04
CHRYSENE[5]	1.9	3.8E+00	--	5.0E-07	--
BENZO(b/k)FLUORANTHENE[5,6]	0.48	3.8E-01	--	1.3E-06	--
BENZO(a)PYRENE	0.15	6.2E-02	--	2.4E-06	--
FLUORANTHENE	6.4	--	2.3E+03	--	2.8E-03
NAPHTHALENE	0.04	--	5.6E+01	--	7.2E-04
PHENANTHRENE[7]	3.5	--	2.2E+04	--	1.6E-04
PYRENE	4.5	--	2.3E+03	--	1.9E-03
Organochlorine Pesticides and Polychlorinated biphenyls (PCB)					
4,4'-DDD	0.12	2.4E+00	--	4.9E-08	--
4,4'-DDT	0.23	1.7E+00	3.6E+01	1.3E-07	6.4E-03
beta-BHC	0.032	3.2E-01	1.4E+01	1.0E-07	2.3E-03
Chlorinated Herbicides					
2,4,5-TP (Silvex)	0.013	--	4.9E+02	--	2.7E-05
2,4-DB	0.066	--	4.9E+02	--	1.4E-04
DINOSEB	0.023	--	6.1E+01	--	3.8E-04
General Chemistries					
CYANIDE	22	--	1.2E+03	--	1.8E-02
NITRATE (as Nitrogen)	530	--	--	--	--
SULFATE	320	--	--	--	--
Explosives and Explosive Byproducts					
TETRYL	0.69	--	6.1E+02	--	1.1E-03
DIPHENYLAMINE	1.2	--	1.5E+03	--	7.9E-04
TOTAL[8]				**2E-05**	**4E+00**

TABLE 2-5 (Continued)
CANCER RISK AND HAZARD INDEX FROM EXPOSURE TO SOIL
RESIDENTIAL SCENARIO
BUILDING CRAWL SPACE SURFACE SOILS SAMPLING EVENT
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Notes:

1 Exposure point concentration is the maximum detected concentration.
2 Preliminary remediation goals established by U.S. Environmental Protection Agency (EPA) Region IX (October 1, 2002).
3 PRG is for total chromium (1:6 ratio Cr VI:Cr III).
4 Lead is evaluated separately.
5 Cal-modified PRG
6 PRG used is for benzo(k)fluoranthene.
7 PRG used is for anthracene.
8 Some values in this table include more than one signficant figure to facilitate review of the calculations, not to reflect the precision of the analysis.

--	None established
BHC	Benzene Hexachloride
Cr	Chromium
DB	Dichlorophenoxy butanoic acid
DDD	Dichlorodiphenyldichloroethane
DDT	Dichlorodiphenyltrichloroethane
MEK	Methyl Ethyl Ketone
mg/kg	Milligrams per kilogram
PRG	Preliminary remediation goal
TP	Trichlorophenoxy propionic acid

Hazard Index Segregation	
Target Organ	**Hazard Index**
Central Nervous System	8.8E-01
Liver	1.4E-02
Kidney	8.7E-01
Respiratory	1.1E-02
Blood	8.6E-01
Skin	7.7E-04
Reproductive	2.3E-02
Gastrointestinal	3.8E-01
Non-specific	2.0E-01
No Observed Effects	1.2E-01
Body Weight	4.6E-01
Organ Weight	1.0E-01
Cardiovascular	3.3E-01
Developmental	3.8E-04
Nasal	7.2E-04
Spleen	1.1E-03
Not established	3.6E-03

TABLE 2-6
CANCER RISK AND HAZARD INDEX FROM EXPOSURE TO SOIL
INDUSTRIAL SCENARIO
BUILDING CRAWL SPACE SURFACE SOILS SAMPLING EVENT
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemical of Potential Concern	Exposure Point Concentration[1] (mg/kg)	Industrial Soil PRG[2] (mg/kg)		Cancer Risk (unitless)	Hazard Index (unitless)
		Cancer	Noncancer		
CLP Metals					
ALUMINUM	27,500	--	9.2E+05	--	3.0E-02
BARIUM	1,660	--	6.7E+04	--	2.5E-02
BERYLLIUM	16	2.2E+03	1.9E+03	7.1E-09	8.2E-03
CADMIUM	32	3.0E+03	4.5E+02	1.1E-08	7.1E-02
CHROMIUM[3]	2,600	4.5E+02	--	5.8E-06	--
COBALT	32	1.9E+03	1.3E+04	1.7E-08	2.4E-03
COPPER	1,190	--	4.1E+04	--	2.9E-02
LEAD[4]	3,400	--	--	--	--
MANGANESE	1,440	--	1.9E+04	--	7.4E-02
MERCURY	1	--	3.1E+02	--	4.6E-03
NICKEL	160	--	2.0E+04	--	7.8E-03
SELENIUM	4	--	5.1E+03	--	8.6E-04
SILVER	0	--	5.1E+03	--	5.9E-05
VANADIUM	110	--	7.2E+03	--	1.5E-02
ZINC	20,000	--	3.1E+05	--	6.5E-02
Volatiles					
2-BUTANONE (MEK)	0.48	--	2.7E+04	--	1.8E-05
1,1,1-TRICHLOROETHANE	0.013	--	6.9E+03	--	1.9E-06
METHYLENE CHLORIDE	0.011	2.1E+01	9.3E+03	5.4E-10	1.2E-06
XYLENES (total)	0.015	--	9.0E+02	--	1.7E-05
Semivolatiles					
BIS(2-ETHYLHEXYL)PHTHALATE	3.9	1.2E+02	1.2E+04	3.2E-08	3.2E-04
Polynuclear Aromatic Hydrocarbons					
ACENAPHTHENE	0.052	--	2.9E+04	--	1.8E-06
ANTHRACENE	7.0	--	2.4E+05	--	2.9E-05
CHRYSENE[5]	1.9	1.3E+01	--	1.5E-07	--
BENZO(b/k)FLUORANTHENE[5,6]	0.48	1.3E+00	--	3.7E-07	--
BENZO(a)PYRENE	0.15	2.1E-01	--	7.1E-07	--
FLUORANTHENE	6.4	--	2.2E+04	--	2.9E-04
NAPHTHALENE	0.04	--	1.9E+02	--	2.1E-04
PHENANTHRENE[7]	3.5	--	2.4E+05	--	1.5E-05
PYRENE	4.5	--	2.9E+04	--	1.5E-04

TABLE 2-6 (Continued)
CANCER RISK AND HAZARD INDEX FROM EXPOSURE TO SOIL
INDUSTRIAL SCENARIO
BUILDING CRAWL SPACE SURFACE SOILS SAMPLING EVENT
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemical of	Exposure Point Concentration[1]	Industrial Soil PRG[2] (mg/kg)		Cancer Risk	Hazard Index
Organochlorine Pesticides and Polychlorinated biphenyls (PCB)					
4,4'-DDD	0.12	1.0E+01	--	1.2E-08	--
4,4'-DDT	0.23	7.0E+00	4.3E+02	3.3E-08	5.4E-04
beta-BHC	0.032	1.3E+00	1.6E+02	2.5E-08	2.0E-04
Chlorinated Herbicides					
2,4,5-TP (Silvex)	0.013	--	4.9E+03	--	2.6E-06
2,4-DB	0.066	--	4.9E+03	--	1.3E-05
DINOSEB	0.023	--	6.2E+02	--	3.7E-05
General Chemistries					
CYANIDE	22	--	1.2E+04	--	1.8E-03
NITRATE (as Nitrogen)	530	--	--	--	--
SULFATE	320	--	--	--	--
Explosives and Explosive Byproducts					
TETRYL	0.69	--	6.2E+03	--	1.1E-04
DIPHENYLAMINE	1.2	--	1.5E+04	--	7.8E-05
TOTAL[8]				**7E-06**	**3E-01**

Notes:

1 Exposure point concentration is the maximum detected concentration.
2 Preliminary remediation goals established by U.S. Environmental Protection Agency (EPA) Region IX (October 1, 2002).
3 PRG is for total chromium (1:6 ratio Cr VI:Cr III).
4 Lead is evaluated separately.
5 Cal-modified PRG
6 PRG used is for benzo(k)fluoranthene.
7 PRG used is for anthracene.
8 Some values in this table include more than one signficant figure to facilitate review of the calculations, not to reflect the precision of the analysis.

--	None established	DDT	Dichlorodiphenyltrichloroethane
BHC	Benzene Hexachloride	MEK	Methyl Ethyl Ketone
Cr	Chromium	mg/kg	Milligrams per kilogram
DB	Dichlorophenoxy butanoic acid	PRG	Preliminary remediation goal
DDD	Dichlorodiphenyldichloroethane	TP	Trichlorophenoxy propionic acid

TABLE 2-7
CANCER RISK AND HAZARD INDEX FROM EXPOSURE TO SOIL
RESIDENTIAL SCENARIO
SUBSURFACE SOILS SAMPLING EVENT
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemical of Potential Concern	Exposure Point Concentration[1] (mg/kg)	Residential Soil PRG[2] (mg/kg)		Cancer Risk (unitless)	Hazard Index (unitless)
		Cancer	Noncancer		
CLP Metals					
ANTIMONY	1.60	--	3.1E+01	--	5.1E-02
BARIUM	1,240	--	5.4E+03	--	2.3E-01
BERYLLIUM	0.13	1.1E+03	1.5E+02	1.2E-10	8.4E-04
COPPER	66.8	--	3.1E+03	--	2.1E-02
MANGANESE	6,560	--	1.8E+03	--	3.7E+00
MERCURY	0.22	--	2.3E+01	--	9.4E-03
SELENIUM	1.50	--	3.9E+02	--	3.8E-03
THALLIUM	7.00	--	5.2E+00	--	1.4E+00
VANADIUM	99.7	--	5.5E+02	--	1.8E-01
Volatiles					
TRICHLOROETHENE	0.002	5.3E-02	1.6E+01	3.8E-08	1.2E-04
TOTAL[3]				**4E-08**	**6E+00**

Notes:

1 Exposure point concentration is the maximum detected concentration.
2 Preliminary remediation goals established by U.S. Environmental Protection Agency (EPA) Region IX (October 1, 2002).
3 Some values in this table include more than one signficant figure to facilitate review of the calculations, not to reflect the precision of the analysis.

-- None established
mg/kg Milligram per kilogram
PRG Preliminary remediation goal

Hazard Index Segregation	
Target Organ	**Hazard Index**
Central Nervous System	3.7E+00
Liver	1.4E+00
Blood	5.1E-02
Respiratory	3.8E-03
Gastrointestinal	2.1E-02
Non-specific	1.8E-01
No Observed Effects	8.4E-04

TABLE 2-8
CANCER RISK AND HAZARD INDEX FROM EXPOSURE TO SOIL
INDUSTRIAL SCENARIO
SUBSURFACE SOILS SAMPLING EVENT
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemical of Potential Concern	Exposure Point Concentration[1] (mg/kg)	Industrial Soil PRG[2] (mg/kg)		Cancer Risk (unitless)	Hazard Index (unitless)
		Cancer	Noncancer		
CLP Metals					
ANTIMONY	1.60	--	4.1E+02	--	3.9E-03
BARIUM	1,240	--	6.7E+04	--	1.9E-02
BERYLLIUM	0.13	2.2E+03	1.9E+03	5.8E-11	6.7E-05
COPPER	66.8	--	4.1E+04	--	1.6E-03
MANGANESE	6,560	--	1.9E+04	--	3.4E-01
MERCURY	0.22	--	3.1E+02	--	7.2E-04
SELENIUM	1.50	--	5.1E+03	--	2.9E-04
THALLIUM	7.00	--	6.7E+01	--	1.0E-01
VANADIUM	99.7	--	7.2E+03	--	1.4E-02
Volatiles					
TRICHLOROETHENE	0.000	1.1E-01	1.1E+02	1.7E-11	1.9E-08
TOTAL[3]				**8E-11**	**5E-01**

Notes:

1 Exposure point concentration is the maximum detected concentration.
2 Preliminary remediation goals established by U.S. Environmental Protection Agency (EPA) Region IX (October 1, 2002).
3 Some values in this table include more than one signficant figure to facilitate review of the calculations, not to reflect the precision of the analysis.

-- None established
mg/kg Milligram per kilogram
PRG Preliminary remediation goal

TABLE 2-9
SUMMARY OF CHEMICAL DATA AND A COMPARISON TO BACKGROUND AND ECOLOGICAL SOIL PRELIMINARY REMEDIATION GOALS
BUILDING CRAWL SPACE SURFACE SOILS
SITE 29 FEASIBILITY STUDY
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemical[1]	Detection Frequency	Maximum Detected Concentration	Inland Area Ambient Level[2]	Range of Background Concentrations in California[3] (mg/kg)	Exceed Ambient/Background Levels?	COPEC	Ecological Soil PRG (mg/kg)[4]	COEC
CLP Metals (mg/kg)								
ALUMINUM	20/27	27,500	21,000	--	Yes	Yes	--	Yes
ARSENIC	26/27	10	15	--	No	No	--	No
BARIUM	27/27	1,660	560	--	Yes	Yes	283	Yes
BERYLLIUM	12/27	16	0.12	--	Yes	Yes	10	Yes
CADMIUM	12/27	32	0.28	--	Yes	Yes	4	Yes
CALCIUM	20/27	8,870	--	2,541 to 45,577	No	No	--	No
CHROMIUM	27/27	2,600	62	--	Yes	Yes	0.4	Yes
COBALT	27/27	32	25	--	Yes	Yes	20	Yes
COPPER	27/27	1,190	65	--	Yes	Yes	60	Yes
IRON	20/27	42,400	--	10,000 to 87,000	No	No	--	No
LEAD	27/27	3,400	32	--	Yes	Yes	40.5	Yes
MAGNESIUM	20/27	12,800	--	1,456 to 32,378	No	No	--	No
MANGANESE	20/27	1,440	1,300	--	Yes	Yes	--	Yes
MERCURY	18/27	1.4	0.17	--	Yes	Yes	0.0005	Yes
NICKEL	27/27	160	110	--	Yes	Yes	30	Yes
POTASSIUM	20/27	2,270	--	2,100 to 30,000	No	No	--	No
SELENIUM	7/27	4.4	DL	--	Yes	Yes	0.21	Yes
SILVER	3/27	0.3	DL	--	Yes	Yes	2	No
SODIUM	3/27	3,410	--	5,580 to 73,400	No	No	--	No
VANADIUM	27/27	110	95	--	Yes	Yes	2	Yes
ZINC	27/27	20,000	99	--	Yes	Yes	8.5	Yes
Volatiles (mg/kg)								
2-BUTANONE (MEK)	1/11	0.48	--	--	NA	Yes	--	[5]
1,1,1-TRICHLOROETHANE	1/11	0.013	--	--	NA	Yes	--	[5]
METHYLENE CHLORIDE	4/11	0.011	--	--	NA	Yes	--	Yes
XYLENES (total)	2/11	0.015	--	--	NA	Yes	--	Yes
Semivolatiles (mg/kg)								
BIS(2-ETHYLHEXYL)PHTHALATE	2/11	3.9	--	--	NA	Yes	--	Yes
Polynuclear Aromatic Hydrocarbons (mg/kg)								
ACENAPHTHENE	1/11	0.052	--	--	NA	Yes	20	No
ANTHRACENE	6/11	7.0	--	--	NA	Yes	--	Yes
CHRYSENE	3/11	1.9	--	--	NA	Yes	--	Yes
BENZO(b/k)FLUORANTHENE	3/11	0.48	--	--	NA	Yes	--	Yes
BENZO(a)PYRENE	1/11	0.15	--	--	NA	Yes	--	[5]
FLUORANTHENE	6/11	6.4	--	--	NA	Yes	--	Yes
NAPHTHALENE	1/11	0.040	--	--	NA	Yes	--	[5]
PHENANTHRENE	1/11	3.5	--	--	NA	Yes	--	[5]
PYRENE	6/11	4.5	--	--	NA	Yes	--	Yes

TABLE 2-9 (Continued)
SUMMARY OF CHEMICAL DATA AND A COMPARISON TO BACKGROUND AND ECOLOGICAL SOIL PRELIMINARY REMEDIATION GOALS
BUILDING CRAWL SPACE SURFACE SOILS
SITE 29 FEASIBILITY STUDY
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemical[1]	Detection Frequency	Maximum Detected Concentration	Inland Area Ambient Level[2]	Range of Background Concentrations in California[3] (mg/kg)	Exceed Ambient/Background Levels?	COPEC	Ecological Soil PRG (mg/kg)[4]	COEC
Organochlorine Pesticides and PCB (mg/kg)								
4,4'-DDD	1/27	0.120	--	--	NA	Yes	--	[5]
4,4'-DDT	7/27	0.230	--	--	NA	Yes	--	Yes
beta-BHC	1/27	0.032	--	--	NA	Yes	--	[5]
Chlorinated Herbicides (mg/kg)								
2,4,5-TP (Silvex)	1/27	0.013	--	--	NA	Yes	--	[5]
2,4-DB	2/27	0.066	--	--	NA	Yes	--	[6]
DINOSEB	5/27	0.023	--	--	NA	Yes	--	[6]
General Chemistries (mg/kg)								
CYANIDE	9/27	22	--	--	NA	Yes	--	[6]
NITRATE (as N)	25/27	530	--	--	NA	Yes	--	[6]
SULFATE	20/27	320	--	--	NA	Yes	--	[6]
Explosives and Explosive Byproducts (mg/kg)								
TETRYL	1/27	0.69	--	--	NA	Yes	--	[5]
DIPHENYLAMINE	1/27	1.2	--	--	NA	Yes	--	[5]

Notes:

1 Only chemicals with detected concentrations are presented in this table.

2 Ambient limits established for the Inland Area in the NWS SBD Concord. Values presented are the 80% LCL on the 95th percentile of the distribution calculated using nonparametric formula (Table 1 in Appendix C of "RCRA Facility Assessment Confirmation Study. PRC Environmental Management Inc., August 8, 1997).

3 Values from Bradford and others (1996).

4 Values from Efroymson and others (1997).

5 Organic chemicals with one detection were not selected as COECs - see text for details.

6 Chemicals were evaluated qualitatively because no ecological information (for example, toxicity reference values) is available.

--	No established value
BHC	Benzene Hexachloride
CLP	Contract Laboratory Program
COEC	Chemical of Environmental Concern
COPEC	Chemical of Potential Ecological Concern
DB	Dichlorophenoxy butanoic acid
DDD	Dichlorodiphenyldichloroethane
DDT	Dichlorodiphenyltrichloroethane
DL	Detection Limit
MEK	Methyl Ethyl Ketone
mg/kg	Milligram per kilogram
NA	Not applicable
PCB	Polychlorinated biphenyls
PRG	Preliminary remediation goal
TP	Trichlorophenoxy propionic acid

TABLE 2-10
SUMMARY OF CHEMICAL DATA AND A COMPARISON TO BACKGROUND AND ECOLOGICAL SOIL PRELIMINARY REMEDIATION GOALS
SUBSURFACE SOILS
SITE 29 FEASIBILITY STUDY
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemical	Detection Frequency[2]	Maximum Detected Concentration	Inland Area Ambient Level[3]	Range of Background Concentrations in California[4] (mg/kg)	Exceed Ambient/ Background Levels?	COPEC	Ecological Soil PRG[5]	COEC
CLP Metals[1] (mg/kg)								
ALUMINUM	3/3	14,600	21,000	--	No	No	--	No
ANTIMONY	1/3	1.6	0.9	--	Yes	Yes	5	No
ARSENIC	3/3	3	15	--	No	No	--	No
BARIUM	3/3	1,240	560	--	Yes	Yes	283	Yes
BERYLLIUM	2/3	0.13	0.12	--	Yes	Yes	10	No
CALCIUM	3/3	6,240	--	2,541 to 45,577	No	No	--	No
CHROMIUM	3/3	55.8	62	--	No	No	0.4	No
COBALT	3/3	22.3	25	--	No	No	20	No
COPPER	3/3	66.8	65	--	Yes	Yes	60	Yes
IRON	3/3	31,800	--	10,000 to 87,000	No	No	--	No
LEAD	3/3	3.2	32	--	No	No	40.5	No
MAGNESIUM	3/3	10,700	--	1,456 to 32,378	No	No	--	No
MANGANESE	3/3	6,560	1,300	--	Yes	Yes	--	Yes
MERCURY	3/3	0.22	0.17	--	Yes	Yes	0.0005	Yes
NICKEL	3/3	101	110	--	No	No	30	No
POTASSIUM	3/3	801	--	2,100 to 30,000	No	No	--	No
SELENIUM	1/3	1.5	DL	--	Yes	Yes	0.21	Yes
THALLIUM	1/3	7	1.4	--	Yes	Yes	1	Yes
VANADIUM	3/3	99.7	95	--	Yes	Yes	2	Yes
ZINC	3/3	90.8	99	--	No	No	8.5	No
Volatiles[1] (mg/kg)								
TRICHLOROETHENE	1/3	0.002	--	--	NA	Yes	--	Yes

SUMMARY OF CHEMICAL DATA AND A COMPARISON TO BACKGROUND AND ECOLOGICAL SOIL PRELIMINARY REMEDIATION GOALS
SUBSURFACE SOILS
SITE 29 FEASIBILITY STUDY
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Notes:

1	Only chemicals with detected concentrations are presented in this table.
2	Only samples collected from 0 to 5.5 feet below ground surface are included in the data set used in this assessment. Chemicals with one detection remains as COPECs because of the small dataset for subsurface soils.
3	Ambient limits established for the Inland Area in the Naval Weapons Station Seal Beach Detachment Concord. Values presented are the 80% LCL on the 95th percentile of the distribution calculated using nonparametric formula (Table 1 in Appendix C of "RCRA Facility Assessment Confirmation Study. PRC Environmental Management Inc., August 8, 1997).
4	Values from Bradford and others (1996).
5	Values from Efroymson and others (1997)
--	No established value
COEC	Chemical of Environmental Concern
COPEC	Chemical of Potential Environmental Concern
LCL	Lower confidence level
mg/kg	Milligram per kilogram
PRG	Preliminary remediation goal

TABLE 2-11
SUMMARY OF LITERATURE-DERIVED BIOACCUMULATION FACTORS
NAVAL WEAPONS STATION SBD CONCORD, CALIFORNIA

Analyte	Soil/Plant BAF (mg dry tissue/ kg dry soil or sediment)[a]	Soil/Invertebrate BAF (mg wet tissue/ kg dry soil)[a]	Soil/Deer Mouse BAF (mg wet tissue/kg dry soil or sediment)[a,b]
Aluminum	0.004	0.22[c]	6.5×10^{-6} [c]
Barium	0.15	0.22[c]	2.16×10^{-7}
Beryllium	0.01	0.22[c]	1.44×10^{-6}
Cadmium	0.364	0.96	1.73×10^{-7}
Chromium	0.0075	0.01	7.91×10^{-6}[d]
Cobalt	0.12[e]	0.22[c]	6.5×10^{-6} [c]
Copper	0.40	0.04	6.5×10^{-6} [c]
Lead	0.045	0.03	4.32×10^{-7}
Manganese	0.12[e]	0.22[c]	6.5×10^{-6} [c]
Mercury	0.0375 ($MeCl_2$)	0.04 ($MeCl_2$)	7.52×10^{-6} ($MeCl_2$)
Nickel	0.032	0.02	8.63×10^{-6}
Silver	0.40	0.22[c]	4.32×10^{-6}
Thallium	0.004	0.22[c]	5.75×10^{-5}
Vanadium	0.12[e]	0.22[c]	6.5×10^{-6} [c]
Zinc	1.2×10^{-12}	0.56	1.29×10^{-7}
Anthracene	0.02 [f]	0.03 [f]	1.73×10^{-5} [f]
Benzo(b/k)fluoranthene	0.0101	0.07	5.75×10^{-5}
Bis(2-ethylhexyl)phthalate	0.038	1309	5.86×10^{-6}
Chrysene	0.0187	0.04	1.99×10^{-5}
DDT	0.009	1.26	6.52×10^{-5}
Fluoranthene	0.0111 [g]	0.07[g]	4.86×10^{-5}[g]
Methylene Chloride	52 [h]	0.05 [h]	2.17×10^{-11} [h]
Pyrene	0.0111 [g]	0.07[g]	4.86×10^{-5}[g]
Xylene	0.32 [i]	6.00 [i]	6.00 x 10 [i]
TCE	NA	NA	NA

Notes:

a BAFs obtained from EPA (1999b) unless otherwise noted.

b BAFs based on exposure of deer mouse to ingested soil from EPA (1999b).

c An empirical BAF for this compound was not available. As described in EPA (1999b), the recommended BAF is the arithmetic mean of the recommended values for those inorganics with empirical data available (arsenic, cadmium, chromium, copper, lead, inorganic mercury, nickel, and zinc).

d Based on recommended BAF for hexavalent chromium (EPA 1999b).

e An empirical BAF for this compound was not available. As described in EPA (1999b), the recommended BAF is the arithmetic mean of the recommended values for those inorganics with empirical data available (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, nickel, selenium, silver, thallium, and zinc).

f BAFs for benzo(a)anthracene were used as replacement BAFs for anthracene

g BAFs for HMW PAHs were based on the recommended BAF for benzo(a)pyrene (EPA 1999b).

h BAFs for acetone were used as replacement BAFs for methylene chloride

i BAFs for LMW PAHs for both invertebrates and small rodents were based on the recommended BAF for phenanthrene (EPA 1998). For plants, the BAF for LMW PAH was based on the following empirical equation used to calculate recommended BAFs for PAHs: $\log BAF = 1.588 – 0.578*\log K_{ow}$ (EPA 1999b), using the K_{ow} value for naphthalene.

TABLE 2-11 (Continued)
SUMMARY OF LITERATURE-DERIVED BIOACCUMULATION FACTORS
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT, CONCORD, CALIFORNIA

Notes: (cont'd)

BAF	Bioaccumulation factor
DDT	Dichlorodiphenyltrichloroethane
EPA	U.S. Environmental Protection Agency
HMW	High molecular weight
K_{ow}	Octanol-water partition coefficient
kg	Kilograms
LMW	Low molecular weight
$MeCl_2$	Methylene Chloride
mg	Milligrams
NA	Not available
PAH	Polynuclear aromatic hydrocarbon
TCE	Trichloroethene

TABLE 2-12
TOXICITY REFERENCE VALUES FOR BIRDS AND MAMMALS
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemical	Birds		Mammals	
	High TRV	Low TRV	High TRV	Low TRV
Inorganic Chemicals (mg/kg-day)				
Aluminum[a]	--	109.7	19.3	1.93
Barium[a]	41.7	20.8	19.8	5.1
Beryllium[a]	-	-	6.6	0.66
Cadmium[b]	10.43	0.08	2.64	0.06
Chromium III[a]	5.0	1.0	--	2737.0
Cobalt[b]	--	--	20.0	1.2
Copper[b]	52.26	2.3	631.58	2.67
Lead[b]	8.75	0.014	240.64	1.0
Manganese[b]	776	77.6	159.09	13.7
Mercury[b]	0.18	0.039	4.0 (rodents)	0.25 (rodents)
Nickel[b]	55.16	1.38	31.6	0.133
Selenium[b]	0.93	0.23	1.21	0.05
Vanadium[a]	--	11.4	2.1	0.21
Thallium[a]	--	--	1.43	0.48
Zinc[b]	172	17.2	411.43	9.608
Organic Chemicals (mg/kg-day)				
Anthracene[b]	--	--	32.79	1.31
Benzo(b/k)fluoranthene[b]	--	--	32.79	1.31
Bis(2-ethylhexylphthalate[a]	--	1.11	183.3	18.33
Chrysene[b]	--	--	32.79	1.31
DDT[b]	1.5	0.009	16.0	0.8
Fluoranthene[b]	--	--	32.79	1.31
Methylene chloride[a]	--	--	50	5.85
Pyrene[b]	--	--	32.79	1.31
Xylene[a]	--	--	2.6	2.1
TCE[a]	--	--	7	0.7

Notes: All TRVs are reported in mg/kg-day.

a TRVs are from *Toxicological Benchmarks for Wildlife* (Sample and others 1996).

b TRVs are from *Development of Toxicity Reference Values for Conducting Ecological Risk Assessments at Naval Facilities in California, Interim Final Technical Memorandum* (Naval Facilities Engineering Command, Engineering Field Activity West (EFA West) 1998).

-- Not enough data available to support the selection of a TRV.

DDT Dichlorodiphenyltrichloroethane

mg/kg-day Milligram of chemical per kilogram body weight per day

TRV Toxicity reference value

TCE Trichloroethylene

Sources:

Sample, B.E. and others. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision." Oak Ridge National Laboratory. June.

EFA West. Naval Facilities Engineering Command, U.S. Department of the Navy. 1998. "Development of Toxicity Reference Values for Conducting Ecological Risk Assessments at Naval Facilities in California, Interim Final Technical Memorandum." September.

TABLE 2-13
POTENTIAL CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE 29 FEASIBILITY STUDY
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Regulatory Requirement	Prerequisite	Citation	Preliminary ARAR Determination	Comments
Resource Conservation and Recovery Act (42 USC, Chapter 82, §§ 6901-699[I].)				
Definition of RCRA hazardous waste	Waste	22 CCR, Division 4.5, Chapter 14, §§§ 66261.21, 66261.22(a)(1), 66261.23, 66261.24(a)(1) and 66261.100	Applicable	The requirements of 22 CCR, Division 4.5, Chapter 14 are applicable for determining whether excavated material contains hazardous waste. These requirements may be relevant and appropriate to excavated material that is similar or identical to RCRA hazardous waste or non-RCRA hazardous waste
N/A	N/A	U.S. EPA Region IX residential PRGs	To be considered	This guidance may be useful for setting cleanup goals for protecting human health.

Notes:

§	Section
ARAR	Applicable or relevant and appropriate requirement
CCR	*California Code of Regulations*
EPA	U.S. Environmental Protection Agency
N/A	Not Applicable
PRG	Preliminary remediation goal
RCRA	Resource Conservation and Recovery Act
USC	*United States Code*

TABLE 2-14
POTENTIAL LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE 29 FEASIBILITY STUDY
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Archaeological Resources Protection Act of 1979, as Amended (16 USC § 470aa-470mm)					
Archaeological resources on federal land	Prohibits unauthorized excavation, removal, damage, alteration, or defacement of archaeological resources located on public lands.	Archaeological resources on federal land	Pub. L. No. 96-95 16 USC §470 aa-70mm	Applicable	Should scientific, prehistoric, or historic artifacts be found at the site during implementation of the selected remedial alternative, substantive provisions may be applicable.
Endangered Species Act of 1973 (16 USC §§ 1531-1543)					
Habitat upon which endangered species or threatened species depend	Federal agencies may not jeopardize the continued existence of any listed species or cause the destruction or adverse modification of critical habitat. The Endangered Species Committee may grant an exemption for agency action if reasonable mitigation and enhancement measures such as propagation, transplantation, and habitat acquisition and improvement are implemented.	Determination of effect upon endangered or threatened species or its habitat. Critical habitat upon which endangered species or threatened species depend.	16 USC § 1536(a), (h)(1)(B)	Applicable	Substantive provisions are potential ARARs for response actions at or near threatened or endangered species habitats.

TABLE 2-14 (Continued)
POTENTIAL LOCATION-SPECIFIC ARARs
SITE 29 FEASIBILITY STUDY
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comments
California Endangered Species Act (Cal. Fish & Game Code §§ 2050-2116)					
Protection of California Endangered Species	Prohibits the taking from the state of any endangered or threatened species.	Both threatened species and state species of special concern are known to reside within or near Site 29.	FGC Div. 3, Chapter 1.5, Article 3, Section 2080.	Applicable for Alternatives 2 and 3.	Substantive provisions are potential ARARs for response actions at or near threatened or endangered species habitats.
Protection of Wildlife Species	Prohibits the taking or possession of birds and mammals, including taking by trapping or with a poisonous substance.	Although the taking of such species is not anticipated during Site 29 remedies, this ARAR has been included to protect wildlife species in the vicinity of the site.	FGC Div. 6, Chapter 2, Section 3005(a); FGC Div. 4, Chapter 1, Sections 3511 and 3513	Applicable for Alternatives 2 and 3.	Substantive provisions are potential ARARs for response actions at or near threatened or endangered species habitats.

Notes:

§ Section
ARAR Applicable or Relevant and Appropriate Requirement
FGC Fish and Game Code
USC *United States Code*

TABLE 2-15
POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE 29 FEASIBILITY STUDY
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Activities relating to the handling of potentially hazardous soils or waters	Provides criteria for determining whether a solid or liquid waste is a RCRA or non-RCRA hazardous waste.	Generator of waste	Hazardous Waste Regulations, 22 CCR, Division 4.5, Chapter 11, Article 3, § 66261.24	Applicable	Applicable for determining whether excavated soils from Site 29 must be managed as a hazardous waste for Alternative 3.
Hazardous waste accumulation	On-site hazardous waste accumulation is allowed for up to 90 days as long as the waste is stored in containers or tanks, on drip pads, inside buildings, is labeled and dated, etc.	Accumulate hazardous waste.	Cal. Code Regs. tit. 22, Division 4.5, Chapter 12, Article 3, § 66262.34	Applicable	These requirements are applicable to Alternative 3 if hazardous waste is generated and accumulated on-site before transport.
Pretransport requirements	Hazardous waste must be packaged in accordance with DOT regulations prior to transporting.	Any operation where hazardous waste is generated.	Cal. Code Regs. tit. 22, § 66262.30	Applicable	These requirements are applicable to Alternative 3 if hazardous waste is to be transported.
	Hazardous waste must be labeled in accordance with DOT regulations prior to transporting.	Any operation where hazardous waste is generated.	Cal. Code Regs. tit. 22, § 66262.31	Applicable	These requirements are applicable to Alternative 3 if hazardous waste is to be transported.
	Provides requirements for marking hazardous waste prior to transporting.	Any operation where hazardous waste is generated.	Cal. Code Regs. tit. 22, § 66262.32	Applicable	These requirements are applicable to Alternative 3 if hazardous waste is to be transported.
	A generator must ensure that the transport vehicle is correctly placarded prior to transport of hazardous waste.	Any operation where hazardous waste is generated.	Cal. Code Regs. tit. 22, § 66262.33	Applicable	These requirements are applicable to Alternative 3 if hazardous waste is to be transported.

TABLE 2-15 (Continued)
POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE 29 FEASIBILITY STUDY
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Transportation of hazardous materials	Requires preparation of a manifest for transport of hazardous waste off-site.	Any operation where hazardous waste is transported	Cal.Code Regs, tit. 22, Division 4.5, Chapter 12 § 66262.20-66262.23	Applicable	These requirements are applicable to Alternative 3 if hazardous waste is to be transported
Placement of waste in land disposal units	Requires generators of hazardous waste to determine if waste has to be treated before it can be land disposed. Requires generators to notify treatment facility if a waste is subject to land disposal restrictions and does not meet applicable treatment standards. If the waste meets treatment standards, generators must sign a certification.	Any operation where waste is land disposed.	Cal.Code Regs, tit. 22, Division 4.5, Chapter 18 § 66268.7	Applicable	These requirements are applicable to Alternative 3 if hazardous waste is to be land disposed.
Transportation of hazardous material	Sets forth requirements for transporting hazardous waste including representations that containers are safe, prohibitions on altering labels, marking requirements, labeling requirements and placarding requirements.	Interstate carriers transporting hazardous waste and substances by motor vehicle. Transportation of hazardous material under contract with any department of the executive branch of the federal government.	49 USC §§ 5101-5127, 49 CFR § 171.2(f), 171.2(g), 172.300, 172.301, 172.302, 172.303 172.304, 172.312, 172.400, 172.504	Relevant and appropriate	Relevant and appropriate for transporting hazardous materials on-site.

TABLE 2-15 (Continued)
POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE 29 FEASIBILITY STUDY
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Excavation and handling of soil	Establishes requirements to limit the quantity of particulate matter emitted into the air.	Excavation	BAAQMD Regulations 6-301, 6-302, and 6-305.	Applicable	Applicable to Alternative 3 excavation activities. Excavation and handling of soils and debris must be conducted in compliance with these requirements.
	Provides requirements for maintaining, covering and stockpiling excavated soil.	Excavation	BAAQMD Regulation 8, Rule 40	Applicable	Applicable to Alternative 3 excavation activities. Excavation and handling of soils and debris must be conducted in compliance with these requirements.
Emission of Lead During Demolition	Establishes limitations on the emission of lead to the atmosphere.	Emission of lead.	BAAQMD Regulation 11, Rule 1	Applicable	Emission of lead during demolition
Asbestos Removal Prior to Building Demolition	Establishes asbestos abatement survey, work practices, administrative requirements and transportation and disposal requirements for buildings undergoing demolition or renovation.	Demolition or renovation of buildings containing asbestos	BAAQMD Regulation 11, Rule 2	Applicable	Applicable to Alternative 3. Building IA-25 is presumed to contain asbestos materials which must be removed before proposed building demolition and removal of metals affected soils from beneath the building.

Notes:

§	Section	CFR	*Code of Federal Regulations*
ARAR	Applicable or Relevant and Appropriate Requirement	DOT	Department of Transportation
BAAQMD	Bay Area Air Quality Management District	RCRA	Resource Conservation and Recovery Act
CCR	*California Code of Regulations*	USC	*United States Code*

TABLE 5-1
COMPARISON OF REMEDIAL ALTERNATIVES
SITE 29 FEASIBILITY STUDY
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

	SITE 29		
Evaluation Criteria	**Alternative 1 No Action**	**Alternative 2 Capping with Institutional Controls**	**Alternative 3 Removal with Off-site Disposal**
Overall Protection of Human Health and the Environment	5	2	1
Compliance with ARARs	1	1	1
Long-Term Effectiveness	5	3	1
Reduction of Toxicity, Mobility, Volume	5	5	5
Short-Term Effectiveness	5	1	1
Implementability	1	4	3
Cost	1	3	5
Sum	**23**	**19**	**17**
Overall Rating	**3**	**2**	**1**
Ranking Scale: 1 Meets Criteria Best 5 Meets Criteria Least			

Note:
ARAR Applicable or Relevant and Appropriate Requirement

TABLE 5-2
COST ESTIMATE SUMMARY FOR REMEDIAL ALTERNATIVES
SITE 29 FEASIBILITY STUDY
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Alternative	Capital Cost	NPV O&M Cost (1)	Total NPV Cost (2)
1. No Action	- 0 -	- 0 -	- 0 -
2. Capping with Institutional Controls	$70,200	$13000	$83,200
3. Removal with Off-Site Disposal	$157,300	- 0 -	$157,300

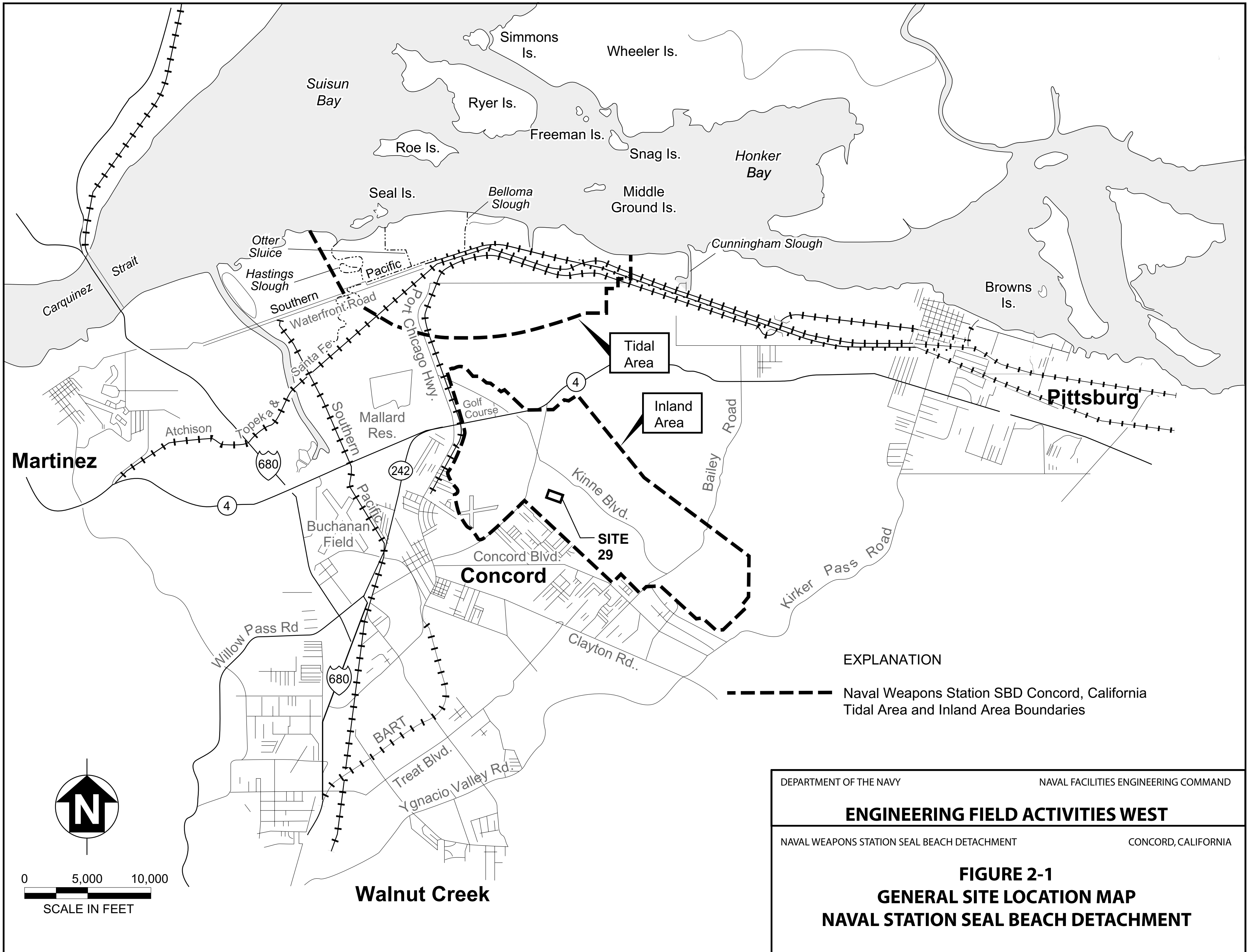
Notes:

1 NPV O&M cost assumes annual cap inspection and documentation activities with an annual cost of $750 and a 3.9 percent discount rate for 30 years.

2 Total NPV Cost equals Capitol Cost plus NPV O&M Cost.

NPV Net present value
O&M Operation and Maintenance

FIGURES



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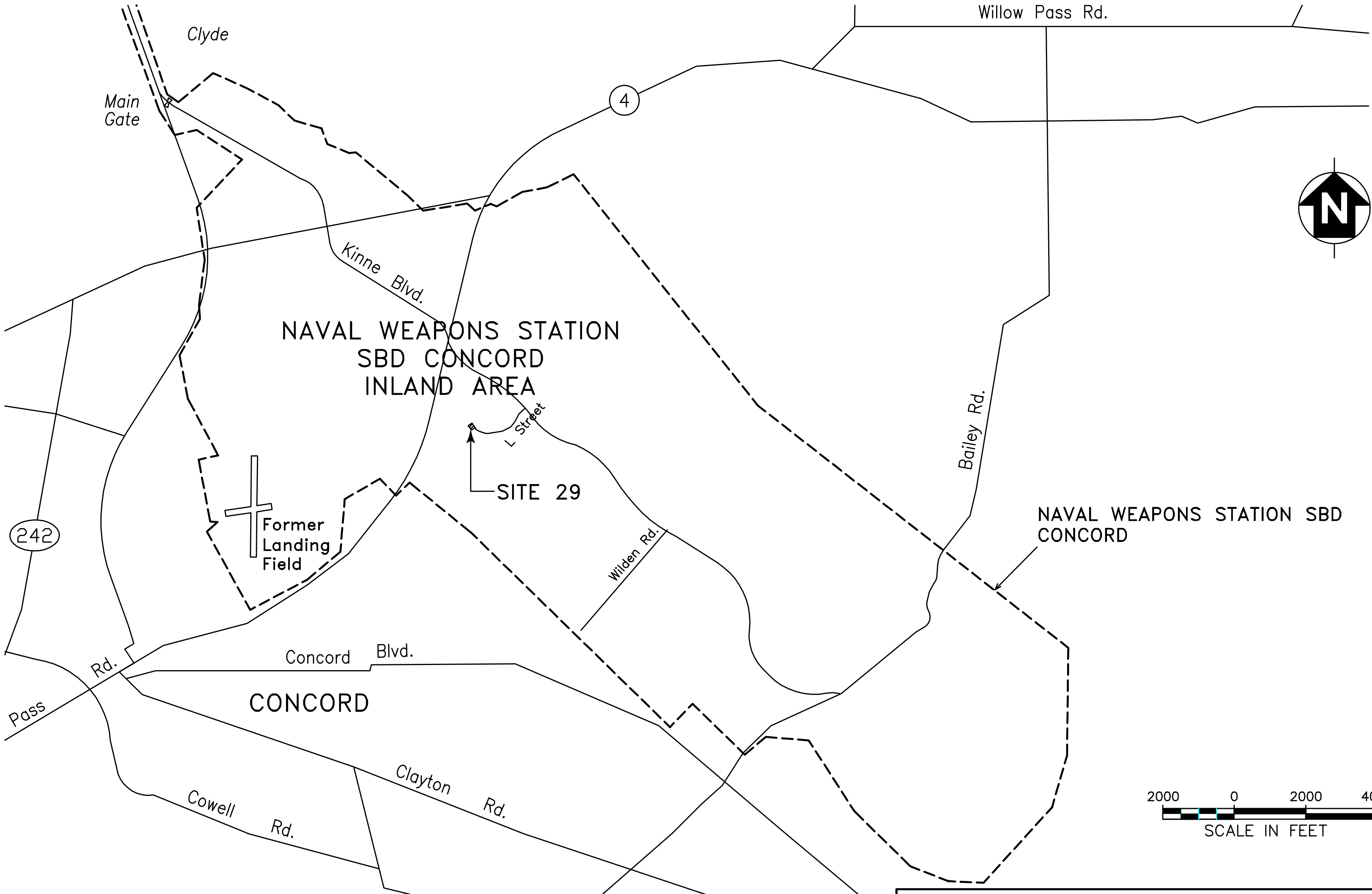
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT — CONCORD, CALIFORNIA

FIGURE 2-1
GENERAL SITE LOCATION MAP
NAVAL STATION SEAL BEACH DETACHMENT



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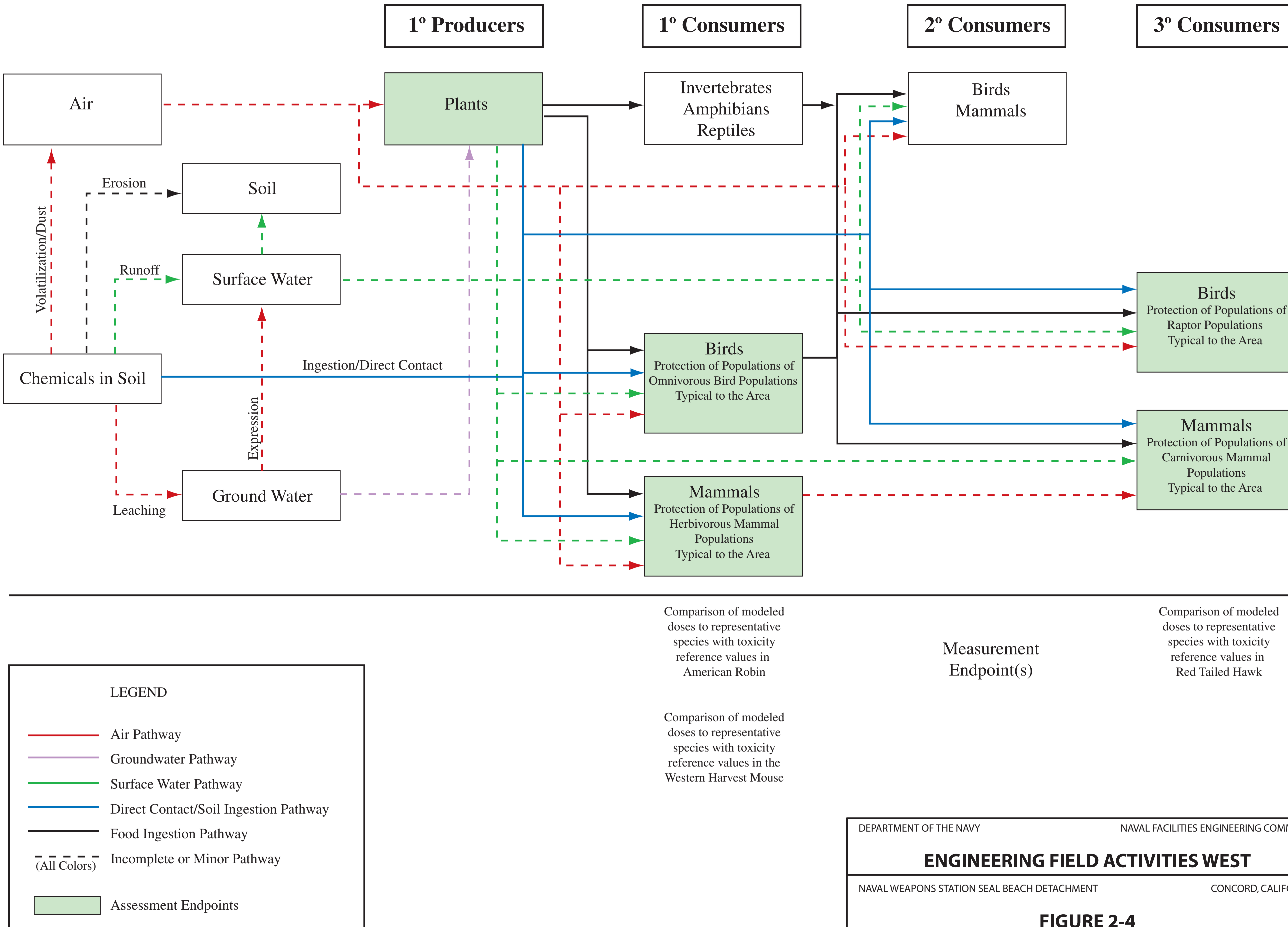
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT | CONCORD, CALIFORNIA

FIGURE 2-2
SITE VICINITY PLAN FOR SITE 29

Figure 2-3

This detailed station map has been deleted from the Internet-accessible version of this document as per Department of the Navy Internet security regulations.



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NAVAL WEAPONS STATION SEAL BEACH DETACHMENT | CONCORD, CALIFORNIA

FIGURE 2-4
ECOLOGICAL CONCEPTUAL SITE MODEL - SITE 29

Figures 2-5 & 2-6

These detailed station maps have been deleted from the Internet-accessible version of this document as per Department of the Navy Internet security regulations.

APPENDIX A

FULL ANALYTICAL RESULTS SUBSURFACE SOIL SAMPLING EVENT

APPENDIX A
FULL ANALYTICAL RESULTS
SUBSURFACE SOILS SAMPLING EVENT
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Point ID	S29SB01	S29SB01	S29SB01	S29SB02	S29SB02	S29SB02	S29SB03	S29SB03	S29SB03
Matrix	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sample Date	1/25/1999	1/25/1999	1/25/1999	2/3/1999	2/3/1999	2/3/1999	1/25/1999	1/25/1999	1/25/1999
Sample Depth (in feet)	4.50 - 5.00	9.50 - 10.00	14.50 - 15.00	5.00 - 5.50	10.00 - 10.50	15.00 - 15.50	4.50 - 5.00	9.50 - 10.00	14.50 - 15.00
Volatiles (mg/kg)									
1,1,1-TRICHLOROETHANE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
1,1,2,2-TETRACHLOROETHANE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
1,1,2-TRICHLOROETHANE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
1,1-DICHLOROETHANE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
1,1-DICHLOROETHENE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
1,2-DICHLOROETHANE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
1,2-DICHLOROETHENE (TOTAL)	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
1,2-DICHLOROPROPANE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
2-BUTANONE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
2-HEXANONE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
4-METHYL-2-PENTANONE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
ACETONE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 UJ	0.012 UJ	0.012 U	0.012 U	0.011 U
BENZENE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
BROMODICHLOROMETHANE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
BROMOFORM	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
BROMOMETHANE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
CARBON DISULFIDE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
CARBON TETRACHLORIDE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
CHLOROBENZENE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
CHLOROETHANE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
CHLOROFORM	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
CHLOROMETHANE	0.011 U	0.011 U	0.011 U	0.011 UJ	0.012 UJ	0.012 UJ	0.012 U	0.012 U	0.011 U
CIS-1,3-DICHLOROPROPENE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
DIBROMOCHLOROMETHANE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
ETHYLBENZENE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
METHYLENE CHLORIDE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
STYRENE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
TETRACHLOROETHENE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
TOLUENE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
TRANS-1,3-DICHLOROPROPENE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
TRICHLOROETHENE	0.002 J	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
VINYL CHLORIDE	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
XYLENE (TOTAL)	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
Semivolatiles (mg/kg)									
1,2,4-TRICHLOROBENZENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
1,2-DICHLOROBENZENE	0.20 U	0.18 U	0.18 U	0.18 U	0.19 U	0.20 U	0.19 U	0.19 U	0.19 U
1,3-DICHLOROBENZENE	0.20 U	0.18 U	0.18 U	0.18 U	0.19 U	0.20 U	0.19 U	0.19 U	0.19 U
1,4-DICHLOROBENZENE	0.20 U	0.18 U	0.18 U	0.18 U	0.19 U	0.20 U	0.19 U	0.19 U	0.19 U
2,2'-OXYBIS(1-CHLOROPROPANE)	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
2,4,5-TRICHLOROPHENOL	0.99 U	0.90 U	0.88 U	0.90 U	0.95 U	1.00 U	0.96 U	0.95 U	0.96 U
2,4,6-TRICHLOROPHENOL	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
2,4-DICHLOROPHENOL	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
2,4-DIMETHYLPHENOL	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
2,4-DINITROPHENOL	0.99 UJ	0.90 UJ	0.88 UJ	0.90 U	0.95 U	1.00 U	0.96 UJ	0.95 UJ	0.96 U
2,4-DINITROTOLUENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U

APPENDIX A
FULL ANALYTICAL RESULTS
SUBSURFACE SOILS SAMPLING EVENT
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Point ID	**S29SB01**	**S29SB01**	**S29SB01**	**S29SB02**	**S29SB02**	**S29SB02**	**S29SB03**	**S29SB03**	**S29SB03**
Matrix	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**
Sample Date	**1/25/1999**	**1/25/1999**	**1/25/1999**	**2/3/1999**	**2/3/1999**	**2/3/1999**	**1/25/1999**	**1/25/1999**	**1/25/1999**
Sample Depth (in feet)	**4.50 - 5.00**	**9.50 - 10.00**	**14.50 - 15.00**	**5.00 - 5.50**	**10.00 - 10.50**	**15.00 - 15.50**	**4.50 - 5.00**	**9.50 - 10.00**	**14.50 - 15.00**
Semivolatiles (mg/kg) (cont'd)									
2,6-DINITROTOLUENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
2-CHLORONAPHTHALENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
2-CHLOROPHENOL	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
2-METHYLNAPHTHALENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
2-METHYLPHENOL	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
2-NITROANILINE	0.99 U	0.90 U	0.88 U	0.90 U	0.95 U	1.00 U	0.96 U	0.95 U	0.96 U
2-NITROPHENOL	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
3,3'-DICHLOROBENZIDINE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
3-NITROANILINE	0.99 U	0.90 U	0.88 U	0.90 U	0.95 U	1.00 U	0.96 U	0.95 U	0.96 U
4,6-DINITRO-2-METHYLPHENOL	0.99 U	0.90 U	0.88 U	0.90 U	0.95 U	1.00 U	0.96 U	0.95 U	0.96 U
4-BROMOPHENYL-PHENYLETHER	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
4-CHLORO-3-METHYLPHENOL	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
4-CHLOROANILINE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
4-CHLOROPHENYL-PHENYLETHER	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
4-METHYLPHENOL	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
4-NITROANILINE	0.99 U	0.90 U	0.88 U	0.90 U	0.95 U	1.00 U	0.96 U	0.95 U	0.96 U
4-NITROPHENOL	0.99 UJ	0.90 UJ	0.88 UJ	0.90 U	0.95 U	1.00 U	0.96 UJ	0.95 UJ	0.96 U
ACENAPHTHENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
ACENAPHTHYLENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
ANTHRACENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
BENZO(A)ANTHRACENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
BENZO(A)PYRENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
BENZO(B)FLUORANTHENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
BENZO(G,H,I)PERYLENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
BENZO(K)FLUORANTHENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
BIS(2-CHLOROETHOXY)METHANE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
BIS(2-CHLOROETHYL)ETHER	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
BIS(2-ETHYLHEXYL)PHTHALATE	0.15 U	0.14 U	0.14 U	0.14 U	0.15 U	0.16 U	0.15 U	0.15 U	0.15 UJ
BUTYLBENZYLPHTHALATE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
CARBAZOLE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
CHRYSENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
DI-N-BUTYLPHTHALATE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
DI-N-OCTYLPHTHALATE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
DIBENZ(A,H)ANTHRACENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
DIBENZOFURAN	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
DIETHYLPHTHALATE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
DIMETHYLPHTHALATE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
FLUORANTHENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
FLUORENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
HEXACHLOROBENZENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
HEXACHLOROBUTADIENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
HEXACHLOROCYCLOPENTADIENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
HEXACHLOROETHANE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
INDENO(1,2,3-CD)PYRENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
ISOPHORONE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U

Point ID	**S29SB01**	**S29SB01**	**S29SB01**	**S29SB02**	**S29SB02**	**S29SB02**	**S29SB03**	**S29SB03**	**S29SB03**
Matrix	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**
Sample Date	**1/25/1999**	**1/25/1999**	**1/25/1999**	**2/3/1999**	**2/3/1999**	**2/3/1999**	**1/25/1999**	**1/25/1999**	**1/25/1999**
Sample Depth (in feet)	**4.50 - 5.00**	**9.50 - 10.00**	**14.50 - 15.00**	**5.00 - 5.50**	**10.00 - 10.50**	**15.00 - 15.50**	**4.50 - 5.00**	**9.50 - 10.00**	**14.50 - 15.00**
Semivolatiles (mg/kg) (cont'd)									
N-NITROSO-DI-N-PROPYLAMINE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
N-NITROSODIPHENYLAMINE (1)	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
NAPHTHALENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
NITROBENZENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
PENTACHLOROPHENOL	0.99 UJ	0.90 UJ	0.88 UJ	0.90 U	0.95 U	1.00 U	0.96 UJ	0.95 UJ	0.96 U
PHENANTHRENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
PHENOL	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
PYRENE	0.39 U	0.36 U	0.35 U	0.36 U	0.38 U	0.40 U	0.38 U	0.38 U	0.38 U
Pesticides and PCBs (mg/kg)									
4,4'-DDD	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
4,4'-DDE	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
4,4'-DDT	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
ALDRIN	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
ALPHA-BHC	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
ALPHA-CHLORDANE	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
AROCLOR-1016	0.020 U	0.018 U	0.018 U	0.018 U	0.019 U	0.020 U	0.019 U	0.019 U	0.019 U
AROCLOR-1221	0.040 U	0.036 U	0.035 U	0.036 U	0.038 U	0.041 U	0.039 U	0.038 U	0.039 U
AROCLOR-1232	0.020 U	0.018 U	0.018 U	0.018 U	0.019 U	0.020 U	0.019 U	0.019 U	0.019 U
AROCLOR-1242	0.020 U	0.018 U	0.018 U	0.018 U	0.019 U	0.020 U	0.019 U	0.019 U	0.019 U
AROCLOR-1248	0.020 U	0.018 U	0.018 U	0.018 U	0.019 U	0.020 U	0.019 U	0.019 U	0.019 U
AROCLOR-1254	0.020 U	0.018 U	0.018 U	0.018 U	0.019 U	0.020 U	0.019 U	0.019 U	0.019 U
AROCLOR-1260	0.020 U	0.018 U	0.018 U	0.018 U	0.019 U	0.020 U	0.019 U	0.019 U	0.019 U
BETA-BHC	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
DELTA-BHC	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
DIELDRIN	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
ENDOSULFAN I	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
ENDOSULFAN II	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
ENDOSULFAN SULFATE	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
ENDRIN	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
ENDRIN ALDEHYDE	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
ENDRIN KETONE	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
GAMMA-BHC (LINDANE)	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
GAMMA-CHLORDANE	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
HEPTACHLOR	0.0004 UJ	0.0004 UJ	0.0004 UJ	0.0004 UJ	0.0004 UJ	0.0004 UJ	0.0004 UJ	0.0004 UJ	0.0004 UJ
HEPTACHLOR EPOXIDE	0.0004 UJ	0.0004 UJ	0.0004 UJ	0.0004 U	0.0004 U	0.0004 U	0.0.004 UJ	0.0004 UJ	0.0004 UJ
METHOXYCHLOR	0.020 U	0.018 U	0.018 U	0.018 U	0.019 U	0.020 U	0.019 U	0.019 U	0.019 U
TOXAPHENE	0.12 U	0.11 U	0.11 U	0.11 U	0.11 U	0.12 U	0.12 U	0.11 U	0.12 U
1,3,5-TRINITROBENZENE	0.12 U	0.12 U	0.12 U	NA	NA	NA	NA	NA	NA
1,3-DINITROBENZENE	0.12 U	0.12 U	0.12 U	NA	NA	NA	NA	NA	NA
2,4,6-TRINITROTOLUENE	0.12 U	0.12 U	0.12 U	NA	NA	NA	NA	NA	NA
2,4-DINITROTOLUENE	0.12 U	0.12 U	0.12 U	NA	NA	NA	NA	NA	NA
2,6-DINITROTOLUENE	0.12 U	0.12 U	0.12 U	NA	NA	NA	NA	NA	NA
2-AMINO-4,6-DINITROTOLUENE	0.12 U	0.12 U	0.12 U	NA	NA	NA	NA	NA	NA
2-NITROTOLUENE	0.12 U	0.12 U	0.12 U	NA	NA	NA	NA	NA	NA
3-NITROTOLUENE	0.12 U	0.12 U	0.12 U	NA	NA	NA	NA	NA	NA

APPENDIX A
FULL ANALYTICAL RESULTS
SUBSURFACE SOILS SAMPLING EVENT
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Point ID	**S29SB01**	**S29SB01**	**S29SB01**	**S29SB02**	**S29SB02**	**S29SB02**	**S29SB03**	**S29SB03**	**S29SB03**
Matrix	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**
Sample Date	**1/25/1999**	**1/25/1999**	**1/25/1999**	**2/3/1999**	**2/3/1999**	**2/3/1999**	**1/25/1999**	**1/25/1999**	**1/25/1999**
Sample Depth (in feet)	**4.50 - 5.00**	**9.50 - 10.00**	**14.50 - 15.00**	**5.00 - 5.50**	**10.00 - 10.50**	**15.00 - 15.50**	**4.50 - 5.00**	**9.50 - 10.00**	**14.50 - 15.00**
Explosives (mg/kg)									
4-AMINO-2,6-DINITROTOLUENE	0.12 U	0.12 U	0.12 U	NA	NA	NA	NA	NA	NA
4-NITROTOLUENE	0.12 U	0.12 U	0.12 U	NA	NA	NA	NA	NA	NA
HMX	0.12 U	0.12 U	0.12 U	NA	NA	NA	NA	NA	NA
NITROBENZENE	0.12 U	0.12 U	0.12 U	NA	NA	NA	NA	NA	NA
RDX	0.12 U	0.12 U	0.12 U	NA	NA	NA	NA	NA	NA
TETRYL	0.12 U	0.12 U	0.12 U	NA	NA	NA	NA	NA	NA
Petroleum Indicators(mg/kg)									
DIESEL RANGE ORGANICS	8 U	7 U	7 U	7 U	8 U	8 U	8 U	8 U	8 U
GASOLINE RANGE ORGANICS	0.6 U	0.5 U	0.5 U	0.5 U	0.6 U	0.6 U	0.6 U	0.6 U	0.7 Y
MOTOR OIL RANGE ORGANICS	8 U	7 U	7 U	7 U	8 U	8 U	8 U	8 U	8 U
Metals (mg/kg)									
ALUMINUM	14,600 J	13,100 J	13,900 J	14000	13300	12600	8,770 J	11,700 J	20,600 J
ANTIMONY	NA	0.74 J	1.3 J	1.6 UJ	NA	NA	NA	NA	1.9 J
ARSENIC	3.0 UJ	2.3 UJ	1.6 UJ	2.6 J	1.6 J	0.62 U	3.0 UJ	1.7 UJ	9.5
BARIUM	438 J	274 J	379 J	1,240	223	250	256 J	354 J	439 J
BERYLLIUM	0.020 U	0.010 U	0.020 U	0.13 J	0.35 J	0.31 J	0.090 UJ	0.020 U	0.080 UJ
CADMIUM	0.040 UJ	0.030 UJ	0.040 UJ	0.080 UJ	0.10 U	0.11 U	0.040 UJ	0.040 UJ	0.050 UJ
CALCIUM	5,160 J	7,340 J	7,120 J	6,240	3,080	2,690	3,090 J	5,530 J	8,950 J
CHROMIUM	36.1 J	45.2 J	35.8 J	55.8	29.1	22.2	19.1 J	29.6 J	75.0 J
COBALT	12.7	13.5	16.5	22.3	10.9	14.9	11.4	15.1	19.9
COPPER	61.9 J	29.5 J	37.0 J	35.8	26.2	25	66.8 J	31.2 J	79.1 J
IRON	31,800 J	20,500 J	22,800 J	31,800	20,400	17,200	16,300 J	22,000 J	41,300 J
LEAD	3.2	2.1	1.5 J	1.6 J	3.9 J	5.9 J	3.1	1.5	2.2
MAGNESIUM	10,700 J	8,800 J	9,950 J	10,700	7,760	7,900	5,050 J	9,060 J	12,200 J
MANGANESE	1,840 J	768 J	733 J	6,560 J	153 J	426 J	367 J	1,080 J	686 J
MERCURY	0.13 J	0.11 J	0.050 J	0.22 UJ	0.21 UJ	0.25 UJ	0.12 J	0.10 J	0.090 J
MOLYBDENUM	0.28 UJ	0.21 UJ	0.27 UJ	0.19 UJ	0.22 U	0.23 U	0.30 UJ	0.31 UJ	0.48 J
NICKEL	101 J	64.9 J	55.6 J	91.2	51.7	55.1	39.3 J	71.4 J	58.1 J
POTASSIUM	458 J	552 J	500 J	682 J	1,450 J	1,560 J	801 J	390 J	832 J
SELENIUM	0.72 UJ	0.53 UJ	0.69 UJ	1.5 J	0.71 UJ	0.77 UJ	0.78 UJ	0.79 UJ	0.83 UJ
SILVER	0.20 U	0.15 U	0.19 U	0.17 U	0.20 U	0.21 U	0.22 U	0.22 U	0.23 U
SODIUM	52.3 UJ	38.6 UJ	50.6 UJ	44.4 U	51.6 U	55.7 U	56.9 UJ	57.4 UJ	60.6 UJ
THALLIUM	3.4 UJ	1.8 UJ	2.8 UJ	7	1.3 UJ	1.6 UJ	0.89 UJ	2.8 UJ	3.9 UJ
VANADIUM	63.1 J	51.8 J	58.5 J	99.7	44.1	34.4	37.9 J	50.6 J	164 J
ZINC	90.8 J	50.6 J	63.4 J	58.1 J	47.7 J	49.3 J	88.0 J	41.6 J	91.9 J

Notes: Inorganic results less than 10 are reported to two significant figures and results greater than 10 are reported to three significant figures.
Organic results less than 0.010 are reported to one significant figure and results greater than 0.010 are reported to two significant figures.

BHC	Benzene hexachloride	J	Estimated value
DDD	Dichlorodiphenyldichloroethane	mg/kg	Milligrams per kilogram
DDE	Dichlorodiphenyldichloroethene	NA	Not analyzed
DDT	Dichlorodiphenyltrichloroethane	PCB	Polychlorinated biphenyl
HMX	Cyclotetramethylene tetranitramine	RDX	Cyclotrimethylene trinitramine
ID	Identification	U	Not detected with detection limit indicated

APPENDIX B

AGENCY COMMENTS ON THE
DRAFT FEASIBILITY STUDY AND NAVY RESPONSES

RESPONSE TO AGENCY COMMENTS
DRAFT FEASIBILITY STUDY REPORT,
INSTALLATION RESTORATION SITE 29
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD
CONCORD, CALIFORNIA, DATED NOVEMBER 13, 2001

This document presents the Department of the Navy's (Navy) responses to comments from the U.S. Environmental Protection Agency (EPA) on the Draft Feasibility Study [FS] Report, Site 29, Naval Weapons Station (NWS) Seal Beach Detachment (SBD) Concord, California, dated November 13, 2001 (hereinafter referred to as the feasibility study [FS]).

In their e-mail of December 14, 2001, San Francisco Bay Region, Regional Water Quality Control Board (RWQCB) staff officially informed the Navy that RWQCB would not prepare comments pertaining to the Site 29 FS.

The comments addressed below were received from EPA on January 31, 2002.

EPA GENERAL COMMENTS:

EPA General Comment 1: **The Feasibility Study (FS) does not identify areas of the site or adjacent areas that may provide habitat for the two special status species (the red-legged frog and the tiger salamander) that the Navy believes are present. An evaluation of potential habitat relative to areas where remediation will occur is crucial to the overall ecological risk evaluation. Furthermore, U.S. EPA was copied on a March 14, 2001, letter from the Navy to the U.S. Fish and Wildlife Service requesting coordination regarding the special status amphibians at the site. An evaluation of potential habitat has been an important factor in making remedial decisions at the site and the Navy should state how this factor will be considered in the process. Please indicate if the Navy believes it has identified potential habitat at the site or if the Navy will assume there is habitat and apply the relevant requirements to protect the special status species.**

Response: Pages 2-17 and 2-18 of the draft FS discuss observations of red-legged frogs and California tiger salamanders at Naval Weapons Station Concord. These species have not been observed at Site 29 and the area does not appear to provide high quality habitat for them. There is a potential that the site will be used by the tiger salamander and the red-legged frog because of the marginal habitat that exists in the building crawlspace and the surrounding earthen berms. In lieu of embarking on a detailed study to determine whether these species use the site, the Navy decided to conservatively assume their presence on the property. Consequently, the Navy identified the Endangered Species Act as an applicable or relevant and appropriate requirement (ARAR). The area of the site providing potential habitat for these species is discussed in greater detail in the draft final FS.

EPA General Comment 2: **The FS does not contain a table listing the analytical results for surface soil samples collected in the building crawlspace. Appendix A contains a list with only the maximum detected concentrations in the building crawlspace and Figure 2-3 does not show all soil analytical results, whereas a table listing all *sub*surface sampling results is included in Appendix A. For completeness and to better evaluate the selected remedy, please include a table in the FS which lists all analytical results (including sample depth information) for samples collected in the building crawlspace.**

Response: The draft final FS has been updated to present all analytical results information currently available to the Navy. The crawlspace analytical results were obtained from samples collected and analyzed by International Technology (IT) Corporation in their 1990 risk assessment report prepared for the site (IT 1990). The IT Corporation data set includes only detected constituents, as described in the FS. It is uncertain whether these samples were subjected to data validation according to today's Navy protocol. For this reason, the 1990 IT Corporation sample results and qualifiers cannot be added to the NWSSBD Concord database. Please see Table 2-1 of the draft final FS for a data summary of the crawlspace analytical results and Appendix A for complete analytical results from the subsurface sampling event.

EPA General Comment 3: **The FS does not discuss the Solid Waste Disposal Act, the Toxic Substances Control Act and the Clean Air Act in the Applicable or Relevant and Appropriate Requirements (ARARs) section. In addition, the FS does not list ARARs for building demolition and lead-based paint removal and handling which would pertain to Alternative 3. Since these regulations appear to be ARARs please include them in the ARARs discussion.**

Response: The FS discusses the Resource Conservation and Recovery Act (RCRA) and includes RCRA as an ARAR. RCRA amended the Solid Waste Disposal Act (SWDA), so reference to the SWDA is unnecessary. The Navy did not include the Toxic Substances Control Act as an ARAR, because polychlorinated biphenyls (PCB) were not found at levels that present a risk to human health. The Navy discusses the Clean Air Act (CAA) in Section 2.2.8.10. The Navy identifies several Bay Area Air Quality Management District (BAAQMD) Regulations as ARARs and explains that these sections are regulations approved by EPA as part of the State Implementation Plan and are promulgated under the authority of the CAA. Demolition activities will be conducted in accordance with BAAQMD Regulations 6-301, 6-302, 6-3-5 and Regulation 8, Rule 40, which were identified as ARARs.

The Navy has added BAAQMD Regulation 11, Rule 1, which controls the emission of lead to the atmosphere. This regulation states that emissions of lead from any emission point may not exceed 6.75 kilograms (15 pounds) per day and sets ground-level concentration limits and monitoring requirements.

With regard to ARARs for lead-based paint (LBP), the FS states that lead concentrations in surface soil beneath Building IA-25 may be attributable to the use of LBP products on exterior surfaces of the building or pilot-scale ammunition testing operations conducted with lead-containing ammunition. It is not clear if there is LBP on the buildings. Any lead, whatever the source, will be removed in accordance with RCRA requirements, National Emission Standard for Hazardous Air Pollutants, and BAAQMD, Regulation 11, Rule 1.

EPA General Comment 4: **The FS does not accurately summarize the chemicals selected as Chemicals of Concern (COCs) for the protection of human health. For example, the FS (Page 3-2) identifies only lead as a COC in the building crawlspace; however, based on the discussion presented on Page 2-15, it appears that benzo(a)pyrene, cadmium, nickel and chromium should also be considered COCs for the building crawlspace. Section 2.2.6.6 states that for the building crawlspace, the individual cancer risk estimate for the industrial scenario for chromium exceeded 10-6. Individual cancer risk estimates for the residential scenario for benzo(a)pyrene, cadmium, chromium, and nickel also exceeded 10-6. Please revise the FS to include benzo(a)pyrene, cadmium, nickel and chromium in the list of COCs posing risks to human health in the building crawlspace.**

Similarly, Table A-1 indicates that the maximum detected concentrations of arsenic, cadmium, chromium, iron, lead, and nickel in samples collected from the building crawlspace exceed the respective residential Preliminary Remediation Goals (PRGs). It is unclear why arsenic and iron are not considered COCs for human health. Additionally, as indicated in Table B-4, chrysene was detected in three samples collected in the building crawlspace at an average concentration that exceeds the residential PRG. However, chrysene is not listed as a COC for the building crawlspace. Chrysene should be included as a COC for the building crawlspace, or the report should be revised to explain why chrysene is not a COC.

Response: The text of the FS correctly identifies lead as the only COC on the basis of the screening-level human health risk assessment (SHHRA).

Arsenic was not identified as a chemical of potential concern (COPC) for evaluation in the SHHRA, because the maximum detected concentration of arsenic (10 milligrams per kilogram [mg/kg]) did not exceed the ambient limit established for arsenic in Inland Area soils (10 mg/kg). The COPC selection process is shown in Tables 2-3 and 2-4.

Benzo(a)pyrene, benzo(b/k)fluoranthene, and chromium were identified as chemical risk drivers because the risks for each of these chemicals exceed 1×10^{-6}. However, these chemicals were not identified as COCs because the total estimated risk for building crawlspace soils is within the EPA risk management range of 1×10^{-4} and 1×10^{-6}, and the segregated noncancer HI does not exceed 1.

Although an ambient limit for iron has not been established for Inland Area soils, the maximum detected concentration of iron (42,400 mg/kg) is less than the ambient limit (58,000 mg/kg) established for the Tidal Area and is well within the background range of iron (10,000 to 87,000 mg/kg) reported in soils in California (Bradford and others 1996). In the absence of a site-specific ambient level for iron, however, a qualitative evaluation of risks from exposure to iron is included in the FS. This is consistent with the approach used to evaluate iron in the recent human health risk assessment (HHRA) for the 5-Year Periodic Review Assessment for the Litigation Area.

Segregated HIs for two target organs, the central nervous system and the liver, exceed the threshold HI of 1 for the residential exposure scenario, primarily due to manganese and thallium. However, manganese and thallium are not associated with historical site operations. In addition, these chemicals are unlikely to pose a health risk because measured concentrations exceeding PRGs are present at depth in subsurface soils, and represent a limited volume of soil at the site.

EPA General Comment 5: **In accordance with U.S. EPA guidance, risk and hazard estimates in the human health risk assessment should be presented to only one significant figure. The use of two of more significant figures implies a greater precision than is obtainable, which is not appropriate in a screening level risk assessment.**

The screening human health risk assessment (SRA) compares detected concentrations to Region 9 residential and industrial PRGs. The 2000 PRG table lists Cal-Modified PRGs for cadmium, chrysene, and nickel. However, the tables presented in Appendix B list only the EPA Region 9 values, and the California EPA's Office of Environmental Health Hazard Assessment (OEHHA) is not listed as a source of toxicity criteria in Section 2.2.6.3. Since Concord Naval Weapons Station is located in the State of California, sufficient justification is needed for the apparent decision not to consider Cal-Modified PRGs in the SRA. Please revise the report to include these values or explain why Cal-Modified PRGs were not considered.

Response: The text of the draft final FS has been revised to present the risk assessment results to one significant figure. Results are reported to two significant figures, as necessary to avoid confusion. If risks for several chemicals are reported to only one significant figure, then risk totals can be appear to be in error. As a simple example, if risks to compounds A and B are both 1.4E-06, then the text would report the risks associated with each compound as 1E-06. The total risk, however, would be reported as 3E-06, because the underlying risk calculations typically are implemented using two significant figures. Clearly, summing 1E-06 and 1E-06 and reporting a total of 3E-06 would lead to confusion.

In the draft final FS, the human health risk assessment tables are now presented in Tables 2-3 to 2-8. These tables present chemical-specific risk results to two significant figures to facilitate review of the risk calculations. Risk totals are presented to one significant figure. Footnotes have been added to the tables to indicate that the results are presented to two significant figures, not to reflect the accuracy of the results, but to facilitate checking of the risk calculations.

Tables 2-3 through 2-8 have been revised to include California-modified (Cal-modified) PRGs, where available, and associated revisions have been made to the text of the FS.

EPA General Comment 6:

a) **The problem formulation of the Screening-Level Ecological Risk Assessment (SLERA) is not clearly focused, particularly with regard to protection of the special status species of concern. First, the report does not provide sufficient detail regarding the habitats within the vicinity of Site 29, nor does it indicate how ecological receptors will specifically use the crawl space or other areas associated with the site. For example, the text states, "California tiger salamanders have been known to occur in the freshwater ponds at the Site", yet it is unclear whether the ponds may have been impacted by contamination. The report also indicates that "the bunkers at Site 29 also provide good habitat for California tiger salamanders", however, the bunkers and other site features have not been previously discussed or referenced. The report should provide figures which depict the site as well as the surrounding ecosystem, results of surveys conducted to identify the presence of special status species (as available), and possible impacted habitats.**

b) **Second, it is unclear whether the objective of the SLERA is to evaluate potential risk to all ecological receptors (however infrequently they use the site), or whether the assessment is to be focused on the noted special status amphibian species. For example, the SLERA discusses other species at the site as potential assessment endpoints, including raptors, coyotes, and ground squirrels. Since the site appears to contain limited habitat, a comprehensive ecological risk assessment does not appear to be warranted. Therefore, the selection of receptors of concern should be very specific. The assessment and measurement endpoints should focus on the protection of special status species on an individual level. In the absence of available receptor-specific toxicity information, the measurement endpoints for this evaluation should include consideration of a range of No Observed Adverse Effects Level (NOAELs) and Lowest Observed Adverse Effects Level (LOAELs) for plants and animals, and a detailed discussion of the life history of the special status species relative to the habitat types available on the site. For example, the SLERA should provide an estimate of the likelihood or possible duration of exposure and the life stage of the species that would use the contaminated habitat (i.e., whether amphibians/ reptiles would be likely to nest, reproduce, or feed in the crawl space or other adjacent contaminated areas).**

c) **The SLERA should be revised to define the areas associated with Site 29 that are of significance with regard to potential ecological risk. The report should discuss whether the locations of existing samples are adequate to characterize contamination that may have been the result of activities specific to Site 29 and that may impact the receptors of concern. The SLERA should be revised to clearly describe the assessment and measurement endpoints, and the SLERA should be revised to provide a more complete discussion of available information to evaluate risk to this receptor group.**

Response:

a) Please see response to EPA general comment No. 1. The ponds mentioned in the draft FS refer to ponds located at NWS SBD Concord and not at Site 29. This has been clarified in the draft final FS. The bunkers mentioned are actually earthen berms that surround Site 29. The location of berms and the crawlspace as well as potential habitat qualities offered by these areas has been clarified in the draft final FS.

The California red-legged frog is presumed to use the site because there have been sightings of this species at 10 of the 22 fixed amphibian and reptile survey locations sampled at NWS SBD Concord (Downard 2000). According to US Fish and Wildlife Service, the red-legged frog is known to have a range of up to 5 miles. California tiger salamanders were also observed within the Inland Area at 9 of the 22 fixed amphibian and reptile survey locations sampled. The area of Site 29 providing potential for red-legged frogs and tiger salamanders is of poor habitat quality, but is described in more detail in the draft final FS

b) Section 2.2.7.1 has been revised to more clearly state the objectives of the SLERA and the ecological receptors of interest. Assessment and measurement endpoints have been clarified in the draft final FS. A discussion of breeding habitat of the red-legged frog and tiger salamanders has been added to the draft final FS.

c) The existing data have been judged to be adequate to support the conclusion that unacceptable risk to assessment endpoints exists and that remedial action is required at the site. The FS has been revised to clarify the assessment and measurement endpoints.

EPA General Comment 7:

The risk characterization section of the SLERA includes a discussion of the magnitude of a hazard quotient (HQ) in order to determine whether the chemical is likely associated with ecological risk. This approach is not appropriate and does not aid in risk management decision-making. For example, page 2-22 states, "based on the low magnitude of HQ exceedance, and inadequate documentation of toxicity of acenaphthene to ecological receptors, it is unlikely that acenaphthene would be associated with ecological risk." The statement implies that it is possible to determine the potential for effect, or the level of effect, based on the magnitude of the HQ exceedance. This approach is not appropriate, particularly in a SLERA using benchmarks that may or may not be appropriate to the receptors at the site. The benchmark or PRG used in the SLERA is intended to represent the level at which a potential effect may occur; thus, once the level is exceeded (i.e., HQ equal to 1.0), it is assumed that the detected concentration is at the possible effect level. The discussion of the HQs should be revised to focus on the chemicals that exceed their respective benchmarks and should discuss whether the chemicals driving risk will be addressed in the proposed remedial alternatives.

Response: The FS has been revised to discuss all chemicals with HQs greater than 1. The primary ecological risk drivers at the site are metals, and the proposed remedial alternative is excavation and disposal of contaminated soils. Other constituents are generally collocated with metals-contaminated soils. The entire area of the site under consideration is proposed for contaminated soils excavation and thus all chemicals driving risk will be addressed.

EPA General Comment 8: **The FS limits the Remedial Action Objectives (RAOs) for human health and ecological receptors to soil from 0 to 1 foot below ground surface (bgs). However, based on Figure 2-3, the vertical extent of the lead contamination has not been determined (i.e., lead concentrations in excess of the residential soil PRG were detected in the deepest samples collected; the maximum depth where samples were collected was 1 foot). Therefore, additional characterization or confirmation samples are required to determine the total depth of the excavation that will be necessary. Since the vertical extent of the soil contamination has not been determined, please revise the RAOs to indicate that the soil cleanup will be to an acceptable level of human health risk and ecological risk to special status receptors. If the Navy wishes to specify the maximum depth of the excavation, the Navy should provide the rationale for this depth limitation. For example, normal human activity involving construction of another building would involve exposure to soil to a minimum depth of 5 feet (e.g., to install plumbing). The FS Report should also identify any feasibility, cost, or other contingencies associated with the possible need to excavate further than 1-foot below ground surface.**

Response: RAOs have been revised, as suggested, so that the remediation depth is not necessarily limited to a depth of 1 foot.

EPA General Comment 9: **The FS should be revised to include specific references to agency correspondence and a description of regulatory agency (State and Federal) involvement with the Site.**

Response: The agencies roles in reviewing the Site Investigation (SI) work plan and the SI report, have been described in the draft final FS. These agency comments and Navy responses are included in the draft final FS as part of the description of regulatory involvement in Site 29.

EPA General Comment 10: **CERCLA should be defined (on page ES-1 where it first appears) by inserting "as amended" after "Act of 1980", and then all future reference should just be to CERCLA (e.g. can delete the phrase "as amended by the Superfund Amendments and Reauthorization Act (SARA)" in Section 2.2.8.2. on page 2-34 and elsewhere).**

Response: The requested modifications have been made in the draft final FS.

EPA General Comment 11: **The FS should explain the status of the Remedial Investigation for Site 29.**

Response: By agreement with the agencies, no remedial investigation was conducted. This information has been added to the FS.

EPA General Comment 12: **The Navy should address the problem with data quality identified at Section 2.2.6.1 on page 2-10. How did this problem occur? How does the fact that only detected results are available affect the ability to evaluate the data? What method did (or will) the Navy use to evaluate this data in light of the data gaps?**

Response: The reason for the missing data is not clear in the IT Corporation report. Although the data set does not conform to Navy quality standards, the Navy believes that the data establish that there is a significant risk to human health and the environment. Further sampling could fill the data gaps now; however, such sampling is not required, because the Navy agrees to assume that significant contamination is present in the entire crawlspace area of the site.

Confirmation soil samples are a necessary part of the soil excavation process to verify appropriate removal of contaminated soils. Confirmation soil samples collected at the time of remediation will be subject to EPA Contract Laboratory Program protocol and the Navy's required quality assurance and quality control procedures for laboratory analysis. The Navy will ensure compliance with EPA and Navy requirements and successful implementation of the remedial action objectives through a variety of activities, including careful selection of remedial technologies, establishing data quality objectives as part of the remedial action work plan, use of Navy-approved laboratories, and use of proper data validation techniques.

EPA SPECIFIC COMMENTS

EPA Specific Comment 1: **Executive Summary: The Executive Summary contains several statements that should be explained or modified, including the following:**

a) ES - 3: first and fourth paragraphs – Please state the total non-cancer HI for residential exposure and explain the relevance of a "segregated" HI for purposes of remedy selection.

b) ES - 3: second paragraph – Has the Navy established a background concentration for manganese and aluminum? If so, please state these. In any event, delete the last sentence ("Therefore, concentrations of manganese and aluminum in surface soils are consistent with ambient concentrations at Site 29"), because the fact that the Navy has not been able to document a source of manganese or aluminum at Site 29 does not mean the detected levels are background. Please also revise the similar statements at the top of page ES-4 to reflect whether the risks posed to human health or ecological receptors from these contaminants, based on anticipated future use, exceed acceptable levels.

c) ES -3 third paragraph: please explain the last sentence ("However, the 95 percent upper confidence limit...")

d) ES- 6 first paragraph – explain "appending the existing Installation Master Plan (IMP)" and "the Navy's 'project review process'".

e) ES - 6 last paragraph – Alternative 2 arguably reduces mobility, and Alternative 3 certainly would reduce volume and possibly mobility of contaminants at the Site. Please note – comments on the Executive Summary should be taken to apply to the relevant sections in the body of the FS as well.

Response:

a) A brief description of the segregated HI has been added to the executive summary.

b) Background (ambient) numbers have been established for manganese and aluminum, as indicated in the first sentence of this paragraph. The Navy's statement has been clarified in response to this comment.

c) The Navy has deleted the last sentence of the paragraph.

d) References to the Installation Master Plan have been removed from the document and have been replaced with more complete descriptions of the Navy's means for implementing land use controls.

e) Under the National Oil and Hazardous Substances Contingency Plan (NCP), 40 CFR Part 300.430(e)(9)(iii)(D)]), the reduction of toxicity, mobility, or volume through the use of treatment applies to waste taken off site as well as waste remaining on site. Toxicity, mobility, and volume, are not reduced if waste is simply hauled to a landfill, because the waste has not been altered (treated) to achieve these reductions. Although safe disposal of contaminants in an appropriately permitted landfill prevents exposure to the waste's toxicity and also prevents potential mobility, landfilling does not achieve the NCP criteria for reducing toxicity, mobility and volume through treatment. Although land disposal restrictions might necessitate treatment of the waste, this will not be determined until the waste has been stockpiled and sampled. At this time it is assumed that the waste will not require treatment prior to direct placement in the landfill.

EPA Specific Comment 2: **Section 2.2.1.2, RCRA Facility Assessment Confirmation Study, Page 2-3: The FS states that the RCRA Facility Assessment Confirmation Study (RFACS) recommended that the sewage system pipeline be evaluated for potential line breaks. However, it is unclear whether the sewage system pipeline was evaluated for potential breaks. Please indicate whether the sewage system pipeline was further investigated and if so, summarize the results.**

Response: One of RWQCB's review comments from their review of the RFACS requested evaluation of soils in the area of the sewer line for contamination that may have resulted from potential sewer line breaks. Although the Navy considered the leachfield to be the only potential site of a significant release (because leachfields are designed to leak and are therefore much more likely to leak to the environment than a cracked or misaligned sewer that is not designed to leak), the Navy agreed to sample in the vicinity of the sewer line, in accordance with the RWQCB request. The Site 29 SI work plan proposed one soil boring to evaluate the area for potential subsurface spills. Boring S29SB01 was located adjacent to the sewer line and was sampled for that purpose in accordance with the EPA- and RWQCB-approved work plan. The Navy still considers the sewer in question to be an unlikely potential source of contamination at the site. The pipeline itself was not evaluated beyond the steps described in the approved work plan.

EPA Specific Comment 3: **Section 2.2.1.3, Subsurface Soils Sampling, Page 2-4 and Appendix A, Summary of Soil Sample Analytical Results, Table A-2, Summary of Site 29 Analytical Results (Subsurface Soils Sampling Event): The FS states that iron concentrations were within ambient screening levels. However, based on Table A-2, no Inland Area Ambient Levels were established for iron. Please resolve this discrepancy.**

Response: Ambient concentrations have not been developed for iron for the Inland Area Sites. However, background concentrations of iron have been established for the Tidal Area in NWS SBD Concord and in California soils as reported by Bradford and others (1996). The text now states that these concentrations are not site-specific, but represent background concentrations measured in soils in California. Please also see response to EPA general comment 4.

EPA Specific Comment 4: **Section 2.2.4, Nature and Extent of Contamination, Page 2-7, and Section 2.2.7.2, Screening Level Exposure Estimate and Risk Calculation, Page 2-25: The text does not include trichloroethene (TCE) as a Chemical of Potential Ecological Concern (COPEC). However, page 2-25 indicates that TCE was the only volatile organic compound identified as a COPEC because TCE was detected in soils, and no background soil concentrations are available for comparison. Section 2.2.4 should be revised to indicate that TCE was identified as a COPEC for Site 29.**

Response: Section 2.2.6.1 states that volatile organic compounds (VOC), semivolatile organic compounds, organochlorine pesticides, PCBs, chlorinated herbicides, and explosive by-products were selected as COPCs for the building crawlspace data set. Section 2.2.7.2 states that VOCs and TCE were identified as COPECs in the subsurface soils data set. Section 2.2.4 has been revised to also list these organic COPECs.

EPA Specific Comment 5: **Section 2.2.6, Human Health Screening Level Risk Assessment, Pages 2-9 to 2-10: The text states that the results of the SRA for Site 29 have been updated in the FS to incorporate the 2000 Region 9 PRGs. Based on a review of Appendix B, it does not appear that this is the case; the PRGs presented in the tables represent the 1998 PRGs. Please resolve this discrepancy and revise the text accordingly.**

Response: The SHHRA has been updated using the most current PRGs from EPA Region 9 (EPA 2002), and the corresponding text has been revised accordingly.

EPA Specific Comment 6: **Section 2.2.6.1, Data Evaluation and Identification of COPCs, Page 2-11: The FS states that chemical data collected during the 1996 RFACS site investigation for the septic tank system are not evaluated in the SRA because potential human health risk concerns were evaluated in the RFACS. To better evaluate the overall remedy for Site 29, please summarize the results of the risk assessment for Solid Waste Management Unit (SWMU) 13 which includes the septic tank system, the leach field and the outfall.**

Response: In the past, various areas of the site have been investigated for various reasons. IT Corporation investigated the crawlspace area to determine whether site soils posed a risk to workers conducting work in the building crawlspace for a specific job. The IT Corporation report concluded that the crawlspace soils would not pose a threat to these workers for the particular job in question.

The RFACS was conducted to investigate the septic tank and its leach field as well as surface drain outfall to determine whether these areas posed a risk to human health or the environment. Sampling of septic tank contents during the RFACS resulted in a cleanup action to remove septic tank contents. The tank was emptied of its contents and the tank walls were thoroughly cleaned. The leach field sampling and drain outfall sampling did not detect contamination that posed a risk to human health or the environment. No risk assessment was conducted for evaluation of soil samples collected in the vicinity of the septic tank leach field, because no constituents exceeded PRG concentrations. For additional details regarding the 1996 RFACS investigation, please refer to that report.

The RFACS also included a review of sampling results from the IT Corporation investigation of the building crawlspace below Building IA-25. Based on review of the data in the IT Corporation investigation, the crawlspace area of Building IA-25 was recommended for further study and the area was included in the Installation Restoration (IR) program as Site 29.

The septic tank and drain outfall focus of the RFACS investigation is different from the focus of the SI and FS at Site 29. Inclusion of the RFACS data into the Site 29 FS is inappropriate because that investigation covers a different area.

EPA Specific Comment 7: **Section 2.2.6.1, Data Evaluation and Identification of COPCs, Page 2-11: Please provide further explanation for the criteria used when metals are considered essential nutrients or present at ambient levels that "were reviewed for possible elimination."**

Response: The draft final FS has been revised to state: "metals considered to be essential human nutrients (that is, calcium, iron, magnesium, potassium, and sodium) were compared to the range of background concentrations of these nutrients in soil in California, as reported by Bradford and others (1996). Metals present at levels within the range of background concentrations were eliminated.

EPA Specific Comment 8: **Section 2.2.6.2, Exposure Assessment, page 2-12: Please include the potential for consuming food grown in contaminated soil.**

Response: The ingestion of homegrown produce pathway is now identified as a potentially complete exposure pathway in the draft final FS. However, this pathway is not evaluated in the risk assessment, which is considered to be a screening-level assessment.

EPA Specific Comment 9: **Section 2.2.6.3, Toxicity Assessment, Chromium Assessment, Page 2-13: For completeness, the text here should note that the oxidation state of chromium affects more than just the reference dose (i.e., hexavalent chromium is a known human carcinogen while trivalent chromium is not). Also, there is a typographical error in the last line on this page – "to" should be "of".**

Response: The text has been revised to note that the oxidation state of chromium affects selection of the appropriate reference dose and that hexavalent chromium, not trivalent chromium, is a carcinogen. The typographical error has been corrected.

EPA Specific Comment 10: **Section 2.2.6.3, Toxicity Assessment, Lead Assessment, Page 2-13: The text states that the health effects associated with lead are not evaluated "in the same manner as other human health COPCs because EPA have (sic) developed physiologically based modeling approaches to evaluate the intake and subsequent blood lead levels." This statement is not accurate as it implies that lead is evaluated differently from other COPCs because of the development of physiologically based pharmacokinetic (PBPK) models. In fact, the reverse is true. Because health effects associated with lead are correlated with measured blood lead levels rather than an external dose, PBPK models were developed to predict blood lead levels. Please revise the text here to correctly state that lead is evaluated differently because of the nature of the toxicological data and not because of the existence of PBPK models.**

In addition, the text here incorrectly states that the Integrated Exposure Uptake Biokenetic (IEUBK) model predicts the percentage of children and adults whose blood lead levels that would exceed acceptable levels. The IEUBK model predicts blood lead levels in adults, children, and fetuses, and the probability that fetal blood lead concentrations will exceed a specified target level. Please correct the text in this section.

Response: The text of the draft final FS has been revised to address this comment.

EPA Specific Comment 11: **Section 2.2.6.3, Toxicity Assessment, Lead Assessment, Page 2-13 and Section 2.2.6.6, Summary and Conclusion of Screening Level Risk Assessment, Page 2-16: The residential PRG for lead is cited in the text as 400 mg/kg. However, Figure 2-3, and Tables A-2 and B-4 list 130 mg/kg as the residential PRG. Please explain and resolve these discrepancies.**

Response: The draft final FS has been revised to address this discrepancy. In general, both EPA's PRG of 400 mg/kg and the Cal/EPA Modified PRG of 150 mg/kg developed using the California Department of Toxic Substances Control's Leadspread model (DTSC 1999) were used for comparative purposes.

EPA Specific Comment 12: **Section 2.2.6.4, Risk Characterization, Pages 2-14 to 2-16: Discussions presented here regarding the target risk range outlined in the National Contingency Plan (NCP) are inappropriate in the risk assessment and should be moved to the conclusion and recommendations sections of the FS.**

Response: The discussion of the target risk range is included to provide benchmarks for comparison to assist the reader in interpreting risk results. The text has been reviewed and revised, to ensure that no statements reflecting risk management decisions are included in this section.

EPA Specific Comment 13: **Section 2.2.6.4, Risk Characterization, Pages 2-14 to 2-16: The term "individual cancer risk" is misused in the discussions presented in these sections. U.S. EPA defines individual cancer risk as the incremental probability of an individual developing cancer over a lifetime. We recommend that the term "chemical-specific cancer risk" be used when discussing incremental risk posed specific COPCs. Further, we fail to see the relevance of the discussions of whether chemical-specific cancer risks are within a target risk range unless it can be demonstrated that concurrent exposure to more than one carcinogen is unlikely. Otherwise, the relevant indicator of site-related risks is the cumulative cancer risks from all carcinogenic contaminants.**

Response: The draft final FS has been revised to remove the term "individual cancer risk" and chemical specific risks are no longer discussed individually.

EPA Specific Comment 14: **Section 2.2.6.4, Risk Characterization, Pages 2-14 to 2-16: Some of the conclusions presented in these discussions are not supported by the information presented:**

The stated purpose of performing a PRG screen is to "provide an expedited but conservative evaluation" and identification of areas requiring additional investigation. As stated on page 2-10, this screening process uses the maximum detected concentration of each detected chemical as the exposure point concentration. Accordingly, the statement on page 2-16 that "the use of the maximum detected lead concentration for screening is highly conservative" is at odds with the stated purpose of the screening process and should be deleted.

The maximum detected lead concentration in the crawlspace surface soil data is 3,400 mg/kg, which is more than 100 times the established ambient level of 32 mg/kg. Provide additional justification for use of the 95 percent upper confidence limit of the arithmetic mean to perform the screen. A more careful evaluation of the data is warranted before concluding that overall lead concentrations are only "slightly but not significantly above the industrial screening value" of 750 mg/kg.

Response: The lead results have been reviewed to identify the appropriate exposure point concentration (EPC). The maximum concentrations have been used in the SHHRA and the text discusses the variability in lead results.

EPA Specific Comment 15: **Section 2.2.7.1, Screening Level Problem Formulation and Ecological Effects, Page 2-18: The FS indicates that Site 29 is a known locale for the federally threatened California red legged frog and the California tiger salamander. However, very limited information regarding these species has been presented. Please revise the report to provide a discussion of these species of concern (i.e., life history, preferred habitats, known use of the site).**

Response: The California red-legged frog and California tiger salamander were presumed to use the site because of sightings of these species in surrounding areas. The habitat qualities of the site are relatively poor for both of these species, as described in the draft final FS. The Navy has cited the Endangered Species Act as an ARAR because Site 29 is within the potential range of these animals. The FS has been revised to include basic life history information that relates to the potential for exposure to contaminants.

EPA Specific Comment 16: **Section 2.2.7.1, Screening Level Problem Formulation and Ecological Effects, Page 2-18: A three step process was used to identify a preliminary list of COPECs, which are subsequently presented on Tables 2-1 and 2-2. The second bullet indicates that chemicals considered to be essential nutrients were reviewed for possible elimination. The document should be revised to clarify the process used to perform this step.**

Response: The concentration of essential nutrients was reviewed to determine whether these constituents appear to be greatly elevated in concentration or have a particular distribution that would warrant concern. Because essential nutrients are not priority pollutants, they are very rarely included as COPEC in risk assessments. The FS has been revised to clarify which chemicals were eliminated as COPEC and to provide the rationale for their elimination.

EPA Specific Comment 17: **Section 2.2.7.1, Screening Level Problem Formulation and Ecological Effects, Page 2-19: Section 2.2.5, Contaminant Fate and Transport, indicates that the major migration pathway for movement of COPECs from Site 29 is by wind transport of dry surface soils or by leachate migration. The discussion here does not adequately describe the initial source of contamination or list all potential release mechanisms, nor does it discuss potential transport of COPECs from the site to the surrounding ecosystem through drainage and surface runoff. The SLERA should provide a site-specific conceptual site model to identify all potential migration pathways, especially pertaining to surrounding habitats or resources that may be used by special status species (e.g., low-lying areas where ponding could occur).**

Response: The original sources of the most significant contaminants are unknown; in the case of lead, the source is probably related to LBP or possibly from pilot-scale ammunition testing operations conducted with lead-containing ammunition. The primary drainage pathway from the site is located at the storm drain outfall. The only significant drainage pathway from the contaminated crawlspace area has been sampled. The draft final FS includes a conceptual site model.

EPA Specific Comment 18: **Section 2.2.7.1, Screening Level Problem Formulation and Ecological Effects, Page 2-19: The assessment endpoints are not clearly presented and evaluated. The SLERA should focus on the ecological receptors known or suspected to use the vicinity of the site, and the mechanisms of toxicity of the COPECs known to be present. For example, the pathways listed in the text, such as root uptake, ingestion of contaminated prey, and dermal contact, have not been evaluated in the SLERA, which only provides a comparison of soil concentrations to ecological benchmarks. The SLERA should be revised to describe only the specific exposure pathways that are to be considered complete, and the most likely exposed receptor groups.**

Response: Please see Navy responses to EPA general comment 6b and EPA specific comment 17. As stated in these earlier responses to comments, the FS revisions include (1) clearly stated objectives of the SLERA, (2) clearly defined assessment and measurement endpoints, and (3) a conceptual site model identifying exposure pathways. The work performed for the SLERA has been sufficient to demonstrate that a potential exists for significant ecological risk to special status species and other species. As such, the Navy developed RAOs to protect these species and plans to conduct remedial activities at the site to achieve the RAOs.

EPA Specific Comment 19: **Section 2.2.7.1, Screening Level Problem Formulation and Ecological Effects, Page 2-21: The *Selection of Screening Ecotoxicity Values* subsection indicates that maximum detected soil concentrations were compared to available ecological soil PRGs (Efroymson, 1997), which are based on toxicity data relevant to specific categories of organisms including plants, earthworms, short-tailed shrew, American woodcock, red fox, white-tailed deer, white-footed mouse, and the red-tailed hawk. Further, it is indicated that the screening values for the most sensitive receptor was selected. For completeness, please provide a table listing the PRGs for all receptors for the chemicals evaluated in the SLERA.**

Response: The draft final FS includes a table listing PRGs for terrestrial receptors.

EPA Specific Comment 20: **Section 2.2.7.2, Screening Level Exposure Estimate and Risk Calculation, Page 2-21: The text should indicate which locations are associated with habitats or other areas in the ecosystem that are used by receptors of concern. Additionally, Tables 2-1 and 2-2 should be revised to include the frequency of detection (i.e., add a column listing the total number of samples analyzed for each chemical).**

The text implies that the magnitude of the Hazard Quotient (HQ) generally indicates the degree of exposure, with the higher HQ indicating greater likelihood of adverse effects. This statement is inappropriate and misleading. An HQ exceeding 1 in a SLERA is the only threshold that is recommended for consideration in a screening level risk assessment. The discussion pertaining to the magnitude of HQs should be removed from the document. Instead, the exposure estimate should focus on chemicals considered risk drivers with respect to the location where the chemical was detected with respect to ecological exposures. Additionally, please indicate whether hot spots of chemicals that are considered risk drivers (e.g., for barium, beryllium and copper) are within the area planned for remediation.

Response: Tables 2-1 and 2-2 have been revised to indicate sample size and frequency of detection.

As currently stated in the FS, the RAO established for protection of ecological receptors applies to all chemicals of ecological concern (COEC) identified in the FS. The General Response Action for removal and disposal includes excavation of soils to PRGs or ambient levels.

EPA Specific Comment 21: **Section 2.2.7.2, Screening Level Exposure Estimate and Risk Calculation, Page 2-22: The text indicates that no PRGs are available for aluminum, manganese, VOCs, SVOCs (including PAHs), organochlorine pesticides, PCBs, chlorinated herbicides and explosive byproducts. It appears that any chemical without a PRG is eliminated and no further discussion is provided for these chemicals. It is recommended that toxicity reference values (TRVs) for these COPECs be obtained from the literature (i.e., other than Efroymson 1997) and used in the screening level risk assessment. Based on available TRVs, a range of PRGs may be calculated for use in determining possible remedial objectives, if HQs indicate the potential for adverse effects. Also, the statement that a HQ of**

2.6 is a "low magnitude of HQ exceedance" should be explained, in light of the requirement to take response action for any HQ above 1. In addition, the statement that inadequate documentation of toxicity of acenaphthene to ecological receptors means it is unlikely to be associated with ecological risk should be deleted unless it can be further explained.

Response: Toxicity reference values are only available for birds and mammals. TRVs are not available for frogs and salamanders. Please see responses to EPA general comment 7 and EPA specific comment 16.

EPA Specific Comment 22: **Section 2.2.7.2, Screening Level Exposure Estimate and Risk Calculation, Page 2-23: The FS states that the average chromium concentration at Site 29 (including a high hit of 2,600 mg/kg), is 156 mg/kg. However, the FS also states that without this high hit, the average chromium concentration is 160 mg/kg. Please address this discrepancy.**

Response: The text states that the ***maximum*** detected concentration (not the average, as stated in the comment), excluding the high hit of 2,600 mg/kg, is 160 mg/kg.

EPA Specific Comment 23: **Section 2.2.7.2, Screening Level Exposure Estimate and Risk Calculation, Page 2-27: The FS states that the soil background concentration for copper (65 mg/kg) exceeds the ecological soil PRG for copper (60 mg/kg); the maximum detected copper concentration was 79.1 mg/kg. Instead of concluding that copper is likely to pose an ecological risk, the FS proceeds to compare the maximum detected copper concentration to the ecological soil PRG based on the *second* most sensitive species and concludes that copper is not likely to pose an ecological risk. The rationale behind this evaluation process is unclear. Additionally, on Page 2-32 it is concluded for the crawlspace data that because in most cases the ecological soil PRGs are more conservative than the soil background levels, most of the COPECs are considered COECs. Therefore, for the crawlspace data, the rationale for selecting metals as COECs is the same rationale which is used for the subsurface data set to determine that copper is *not* a COEC. Please revise the FS to indicate that copper is likely to pose a risk to ecological receptors and add copper to the list of COECs for the subsurface soil data set on Page 2-32. Otherwise, please explain how the same rationale can be used to support the selection of metals as COECs in one data set and, at the same time, determine that copper is not a COEC in another data set.**

Response: The FS has been revised to correct the inconsistency noted by the reviewer. The screening process used to identify COPEC and COEC is clearly described in the revised document.

EPA Specific Comment 24: **Section 2.2.7.2, Screening Level Exposure Estimate and Risk Calculation, Page 2-29: The *Amphibians* subsection indicates that the primary route of exposure is likely through dietary ingestion. However, it is not evident that this is the case for amphibians. Dermal exposure could also be significant; in fact, the only ecotoxicological information presented in the SLERA is related to surface water exposures. The report should provide species-specific information to support exposure assumptions. In addition, if it is determined that the primary route of exposure is dietary exposure, then typical diets should be discussed relative to the selection of the most appropriate measurement endpoints (e.g., if the salamander's primary food resource is invertebrates, the report should discuss whether the receptor could obtain food resources from the contaminated area). Also, there appears to be a typographical error – in the 5th sentence under "Amphibians", the sentence states that "studies...are not based on soil or soil ingestion as a route of exposure" – it appears a word is missing after the first occurrence of "soil". (This comment also applies to the last sentence on page 2-30).**

Response: The SLERA has been revised in response to EPA comments and exposure pathways are more clearly described in the text and conceptual site model.

EPA Specific Comment 25:

a) Section 2.2.4, Nature and Extent of Contamination, Page 2-7, Section 2.2.7.2, Screening Level Exposure Estimate and Risk Calculation, Pages 2-24, and 2-32, Table 2-1, Summary of Ecological Risk and Hazard Quotient Results (Building Crawlspace Surface Soils Sampling Event), and Table 2-2, Summary of Ecological Risk and Hazard Quotient Results (Subsurface Soils Sampling Event): The FS states on Pages 2-7 and 2-32 that nickel is a COEC for the building crawlspace. However, based on Page 2-24, "Nickel is not likely to pose an ecological risk at this location [meaning the location where the maximum nickel concentration was detected]." Please resolve this discrepancy.

b) In addition, on Page 2-32, the FS states for the crawlspace data set that "For all the COECs identified with the exception of lead and selenium, the ecological soil PRGs are more conservative than the background soil concentrations." However, based on Table 2-1, the ecological soil PRGs identified for beryllium and cadmium are also less conservative (i.e., higher) than the background soil concentrations. Please revise the FS to include beryllium and cadmium in the list of chemicals for which the ecological soil PRGs are less conservative than the background soil concentrations.

c) Furthermore, it cannot be evaluated whether the ecological soil PRGs for selenium and silver are more or less conservative than the respective soil background levels for the crawlspace data set since Table 2-1 only indicates that the soil background levels equal the detection limits, but does not list the numeric values for the detection limits. Please list the detection limit for selenium and silver in Table 2-1.

d) **Additionally, based on previous comments regarding selenium and copper detected in the subsurface soil data set (discussed in the FS on Pages 2-27 and 2-28), please include copper and selenium in the list of COECs for the subsurface data set in the second paragraph on Page 2-32.**

e) **Furthermore, the text on page 2-32 states that the background soil concentration for thallium (1.4 mg/kg) is more conservative than the ecological soil PRG (1 mg/kg). Since a concentration of 1 mg/kg is more conservative than a concentration of 1.4 mg/kg, please delete this sentence from the FS.**

f) **Lastly, based on Table 2-2, the background soil concentrations for antimony and beryllium are more conservative than the respective ecological soil PRGs. Please revise the FS to state that the background soil concentrations for antimony and beryllium are more conservative than the respective ecological soil PRGs.**

Response: The detection limits for selenium and silver in the building crawlspace data set are not available because they were not included in the IT Corporation report.

With the exception of the above detection limits, the draft final FS has been revised to address all of the above concerns.

EPA Specific Comment 26: **Section 2.2.8.2 CERCLA and NCP Requirements Summary, Page 2-36: the fourth sentence on this page contains a typographical error – "are" should be "or".**

Response: The text has been revised, as requested.

EPA Specific Comment 27: **Section 2.2.8.7. California Environmental Quality Act, Page 2-39: The title of this section should also include NEPA, and NEPA should be referred to in the last sentence.**

Response: The text has been revised, as requested.

EPA Specific Comment 28: **Section 2.2.8.8, Chemical-Specific ARARs, Page 2-39: The FS states that there are no chemical-specific ARARs. However, the FS does not list PRGs as "To Be Considered". Since the RAOs indicate that PRGs are used as cleanup levels, please include human health and ecological PRGs as "To be Considered" in the ARARs discussion and table.**

Response: The text has been revised, as requested.

EPA Specific Comment 29: **Section 3.2.2, Ecological Remedial Objectives, Page 3-2: The FS does not list thallium, vanadium and TCE as COECs for subsurface soil, although these compounds were identified on Pages 2-25 and 2-32 as COECs for Site 29. It appears that the FS only discusses the COECs for the crawlspace under the building in this section. Please explain why thallium, vanadium and TCE are not included in the list of COECs for Site 29. Additionally, the FS lists nickel as a COEC, although nickel was not identified as a COEC in previous sections of the FS. Please explain why nickel is listed as COEC.**

In addition, the FS does not provide a list of cleanup levels for each COEC. The FS only lists the soil background concentrations and the ecological soil PRGs for each COEC and states that the greater value of these is the respective remediation goal. Please include a table listing the resulting cleanup level for each COEC.

Response: Section 3.2.2 has been revised to correct the list of COEC and further clarify the process of COEC selection. A table of cleanup levels for each surface soil COEC is included in the FS.

EPA Specific Comment 30: **Section 2.2.7.2, Screening Level Exposure Estimate and Risk Calculation, Page 2-28: The FS states that it is likely that selenium might pose negligible risk to ecological receptors because the calculated HQ was 7.14 at one location. In the next paragraph, the FS states that thallium might pose some risk to ecological receptors because the calculated HQ was 7.0. It is unclear why an HQ of 7.14 poses a negligible risk when an HQ of 7.0 poses some risk to ecological receptors. The FS should be revised to state that selenium might pose some risk to ecological receptors since it exceeds an HQ of 1. Similarly, any chemical present at a concentration greater than the PRG must be carried forward for a risk management decision.**

Response: The draft final FS has been revised to address this comment.

EPA Specific Comment 31: **Section 3.4, Description of Remedial Alternatives, Page 3-4 and Section 3.4.3, Alternative 3: Removal with Off-Site Disposal, Page 3-5: The FS states that the soil RAOs for the site require that under an unrestricted land use scenario, soil concentrations be reduced to meet EPA Region IX residential PRGs (for human health risk considerations) and established background concentrations (for ecological risk considerations). However, in the case of lead as a COEC, the cleanup level is not the established soil background concentration, but the ecological soil PRG (see Section 3.2.2). Therefore, please revise the FS to clearly describe the RAO for lead.**

Response: The FS states that the higher of the background concentration or the PRG has been used as the RAO. The draft final FS includes a table listing cleanup levels.

EPA Specific Comment 32: **Section 3.4.3, Alternative 3: Removal with Off-Site Disposal, Pages 3-6 and 3-7: The FS discusses the inspection of Building IA-25 for asbestos, but does not indicate that an inspection for the presence of lead-based paint will also be conducted. Since building demolition is part of this alternative, please revise the FS to state that the building will be inspected for the presence of lead-based paint, and that necessary precautions will be taken if present.**

Response: The text has been revised to indicate that disposal of lead-based paint is required to comply with waste disposal requirements and BAAQM Regulation 11, Rule 1. Please refer to EPA general comment No. 3.

EPA Specific Comment 33: **Section 4.0, Detailed Analysis of Remedial Alternatives, Page 4-1: The FS lists Alternative 2 as "Institutional Controls"; however, later in the FS (e.g., Page 4-5), Alternative 2 is described as "Capping and Institutional Controls". To avoid confusion, please revise the FS to consistently refer to Alternative 2 as "Capping and Institutional Controls".**

In addition, since the logistics of capping the soil underneath the building are unclear (e.g., it is unclear how a cap can be installed underneath the building without damaging the building, whether the crawlspace is large enough to install the cap, and what equipment would be used to install the cap), please provide more detail regarding the implementability of this alternative.

Response: The text has been revised to consistently describe Alternative 2 as "Capping with Institutional Controls." The cap, as described on page 3-5 consists of a 4,400-square-foot layer of concrete placed in the crawlspace of the existing building. The cap would be placed either as a layer of "shotcrete" or pumped concrete in the crawlspace area. Although placement of the material would require working in cramped quarters, the Navy is confident that such a cap could be constructed. Please note that the FS specifies Alternative 3, not Alternative 2, as the preferred alternative.

EPA Specific Comment 34: **Section 4.2.6, Implementability - Alternative 2, Page 4-7: The FS does not discuss Operation and Maintenance (O&M) requirements for this alternative (as is done in the respective section for Alternative 3). Since O&M activities would include 1) the inspection of the cap to ensure its continued integrity, and 2) monitoring of the proper implementation of the institutional control plan, please list these activities as part of the implementability discussion in this section.**

Also, for Section 4.2.2, Compliance with ARARs, please add the phrase "...through temporary fencing and worker communication." to the last sentence of this section on page 4-6 (consistent with text in Section 4.3.2).

Response: O&M of Alternative 2 is discussed under Section 4.2.3, "Long-term Effectiveness and Permanence." O&M is not an element of Alternative 3, because Alternative 3 calls for full remediation of the site.

The requested text has been added to Section 4.2.2.

EPA Specific Comment 35:	**Section 4.3.2, Compliance with ARARs - Alternative 3, Page 4-8: The FS states that "*If* there is a reasonable expectation that the excavated soil would be hazardous, the Navy *would* analyze samples of the excavated soils in accordance with hazardous waste identification regulations...to determine whether soil exhibits state or federal hazardous waste characteristics." It is unclear how the Navy will determine when there is a reasonable expectation that the excavated soil is hazardous, since testing is a requirement for offsite disposal. Please describe the process by which the Navy will determine when soil samples will be analyzed in accordance with hazardous waste identification regulations to determine whether the soil exhibits state or federal hazardous waste characteristics. It is recommended that the Navy perform this analysis on the excavated soil in any case to determine the appropriate landfill for disposal.**
Response:	This section of the FS has been revised to remove the sentence, "If there is a reasonable expectation that the excavated soil would be hazardous, the Navy would analyze samples of the excavated soils in accordance with hazardous waste identification regulations...to determine whether soil exhibits state or federal hazardous waste characteristics." All site wastes will be characterized and managed for disposal in accordance with state and federal regulatory requirements. Details regarding the characterization of wastes will be fully described in the remedial action plans and specifications to be developed following completion of the Record of Decision.
EPA Specific Comment 36:	**Section 5.2.3, Short-term Effectiveness, Page 5-2: It appears that Alternative 2 is more effective in the short-term than Alternative 3 since the implementation period is shorter, and fewer activities which could pose a risk to workers and the community during the implementation phase are involved under this alternative (e.g., no trucks will be used to haul off hazardous waste). The FS should be revised to state that the short-term effectiveness of Alternative 2 is better than for Alternative 3.**
Response:	The Navy considers the short-term effectiveness of Alternatives 2 and 3 to be generally similar although the EPA points out differences between these two alternatives. The Navy considers that the similarities in short-term effectiveness outweigh the differences in short-term effectiveness and thus the Navy prefers to rank these alternatives equally. The Navy has revised Section 5.2.3, to reflect the EPA's comments, but Table 5-1 has not been revised.
EPA Specific Comment 37:	**Section 5.2.5, Cost, Page 5-3 and Table 5-2, Cost Estimate Summary For Remedial Alternatives, Site 29 Feasibility Study: Based on the text, the cost for Alternative 3 is $119,300. However, based on the table, the cost for Alternative 3 is $134,000. Please resolve this discrepancy.**
Response:	The FS has been corrected to resolve the discrepancy.

EPA Specific Comment 38: **Figure 2-3, Site Plan Showing Soil Analytical Results at Site 29: The FS states that a paint spray booth was located in the southwest corner of Building IA-25. Please include the former location of the paint spray booth in the figure. In addition, since no sample locations are indicated at the southwest corner of Building IA-25, it is unclear whether soil samples were collected at the spray booth. Please indicate whether soil samples were collected at the paint spray booth. If no samples were collected, the lack of soil characterization at the paint spray booth suggests a data gap.**

Furthermore, the FS states that Site 29 encompasses Building IA-25, a septic tank, a sanitary sewer line, a storm drain with outfall, and a drain field. However, with the exception of the Building IA-25 and the sewer line samples, the sample locations in the vicinity of the other features are not shown in Figure 2-3. Please include the sample locations in the vicinity of all Site 29 features in Figure 2-3.

Response: The configuration and exact location of the spray paint booth is not clear from the previous reports, however the approximate location is indicated on Figure 2-3 (Weston Solutions 2003). The building is elevated above the ground surface, and the lowest portion of the crawlspace was sampled. The preferred alternative includes demolition of the entire building and comprehensive excavation of soils underneath the footprint of the structure. The job will encompass confirmation soil sampling of the area to verify removal of contaminated soils. Based on the scope of the removal, the lay of the land, and the confirmation soil sampling program, adequate sampling and analysis of the site will be performed. Additional sampling of the area before removal of the structure would be a time-consuming and expensive delay.

The septic tank, drainfield, and storm drain outfall were sampled previously as a part of the RFACS. To address EPA's concerns, a groundwater sample has been proposed for the area to analyze for volatile organic compounds. Conclusions regarding these areas are presented in the RFACS and are summarized in Section 2.2.1.2 of the FS. Other than the recommended (and completed) cleaning of the septic tank, the RFACS did not recommend remedial action at the septic tank, drainfield, and storm drain outfall. The FS is not intended to recreate the data presentation or evaluation of the RFACS investigation or consider remedial action for those portions of Site 29 that have already been determined not to require further action.

EPA Specific Comment 39: **Table 5-2, Cost Estimate Summary For Remedial Alternatives, Site 29 Feasibility Study: The table indicates that there are no O&M costs associated with Alternative 2; however, since the cap's integrity needs to be inspected and since the continued implementation of the Institutional Control Plan needs to be ensured, the cost for these activities should be taken into account. Table 5-2 should be revised to include the above-mentioned O&M costs for Alternative 2. This will also affect the cost table in Appendix C.**

In addition, footnote (1) states that annual O&M costs assume quarterly groundwater and gas monitoring for the first 5 years and annual monitoring for the next 25 years. These activities do not apply to any of the listed alternatives. Please revise the footnote to indicate the frequency of O&M activities for Alternative 2.

Response: The FS, including all tables and text have been revised to correctly account for O&M costs.

EPA Specific Comment 40: **Appendix A, Summary of Soil Sample Analytical Results, Table A-1, Maximum Concentrations of Detected Constituents (Building Crawlspace Surface Soils Sampling Event): To facilitate review, please expand this table to include the residential PRGs for the listed chemicals as was done in Table A-2.**

Response: The table in Appendix A has been revised in the draft final FS to present analytical results and not maximum concentrations. Please see the Tables 2-3 through 2-8 updated maximum concentrations and screening criteria such as EPA 2002 industrial and residential PRGs.

EPA Specific Comment 41: **Appendix A, Summary of Soil Sample Analytical Results, Table A-2, Summary of Site 29 Analytical Results (Subsurface Soils Sampling Event): With the exception of values listed for thallium, the industrial and residential PRGs are listed incorrectly. Please revise the table to include the 2000 PRGs in this table and indicate which values are Cal-modified PRGs.**

In addition, it is unclear why cadmium is not listed in the table. For completeness, please include the analytical results, Inland Area Ambient concentration, and PRGs for cadmium in the table.

Response: The table in Appendix A has been updated to present full analytical results. The human health risk assessment tables are presented in Tables 2-3 through 2-8 and these have been revised to include EPA 2002 PRGs and Cal-modified PRGs. Cal-modified PRGs are indicated with a footnote.

Because cadmium was not detected in any sample from the "subsurface soils sampling event," it was not included in the former table. The draft final FS has been revised to include a table in Appendix A which presents full analytical results, including detection limits for constituents not detected.

EPA Specific Comment 42: **Table A-1: The ambient levels listed for iron are from studies that are not site-specific, and the report does not provide information regarding the comparability of these soils to Site 29. The listed ambient iron concentrations are 10,000 to 87,000 mg/kg and 7,000 to 550,000 mg/kg. The range of these concentrations is wide, and it is not evident that these concentrations are applicable to Site 29. Therefore, either eliminate the reference to these concentrations from the table or discuss the applicability of the data from these other studies to Site 29. If no ambient level can be determined for iron, iron should be listed as COC for the building crawlspace, since the maximum detected iron concentration exceeds the**

residential PRG. Please explain why arsenic and iron are not considered COCs posing risks to human health for soils in the crawlspace underneath the building. Also, in Table A-2, the 'R' footnote is used for two different definitions and should be corrected.

Response: Although an ambient limit for iron has not been established for Inland Area soils, the maximum detected concentration of iron (42,400 mg/kg) is less than the ambient limit (58,000 mg/kg) established for the Tidal Area and is well within the background range of iron (10,000 to 87,000 mg/kg) reported in soils in California (Bradford and others 1996). In the absence of a site-specific ambient level for iron, however, a qualitative evaluation of risks from exposure to iron is included in the FS. This is consistent with the approach used to evaluate iron in the recent human health risk assessment (HHRA) for the 5-Year Periodic Review Assessment for the Litigation Area.

As previously discussed in the response to EPA general comment 4, arsenic was not identified as a COPC for evaluation in the risk assessment, because the maximum detected concentration of arsenic (10 mg/kg) did not exceed the ambient limit established for arsenic in Inland Area soils (10 mg/kg). New appendices have been added to the draft final FS and the COPC selection process is shown in Tables C-1 and C-2.

EPA Specific Comment 43: **Appendix B, Tables B-1 through B-8: It appears that several of the PRGs presented in these tables based on an arbitrary ceiling limit of 100,000 mg/kg were used in calculation of hazard. Non risk-based PRGs should not be used be used to calculate hazard quotients, and the actual risk-based PRG should be calculated using the information presented in the PRG technical support documentation.**

Response: The ceiling limits of 100,000 mg/kg have been removed from the draft final FS. The human health risk assessment tables are now presented in Tables 2-3 through 2-8 of the draft final FS.

EPA Specific Comment 44: **Appendix B, Human Health Risk Assessment Tables, Table B-2, Summary of Statistical Analysis for Residential Risk and Hazard Results (Subsurface Soils Sampling Event) and Table B-8, Summary of Residential Risk and Hazard Results (Subsurface Soils Sampling Event): The tables do not list results for arsenic, cobalt, iron, lead, magnesium, nickel and zinc, although these compounds are listed in Table A-2 which summarizes the analytical results for the subsurface soil sampling event (cadmium is not listed in either table). It is unclear why these compounds are missing from Tables B-2 and B-8. Please include these compounds in the table or explain why they will not be included.**

Response: Human Health risk assessment tables in the draft final FS have been revised to appear in Tables 2-3 through 2-8. These tables have been revised to include all detected analytes and not only COPCs. Nondetected analytes are not presented. The draft final FS has been revised to list a full data summary for the subsurface sampling event that includes all detected and nondetected analytes in Appendix A. Similar information cannot be presented for the data originating from the IT Corporation report because nondetected analyte information was not presented in the IT Corporation report.

EPA Specific Comment 45: **Appendix B, Human Health Risk Assessment Tables, Table B-4, Summary of Statistical Analysis for Residential Risk and Hazard Results (Building Crawlspace Surface Soils Sampling Event) and Table B-6, Summary of Residential Risk and Hazard Results (Building Crawlspace Surface Soils Sampling Event): The tables do not list results for arsenic, iron and magnesium, although these compounds are listed in Table A-1 which summarizes the analytical results for the building crawlspace surface soil sampling event. It is unclear why these compounds are missing from Table B-4. Please include these compounds in the table or explain why they will not be included.**

Response: Please see the response to EPA specific comment 44.

EPA Specific Comment 46: **Appendix C, Cost Estimates For Proposed Remedial Alternatives, Specific Assumptions, Alternative 3, Page C-2: The FS states that soil characterization and soil confirmation samples will be analyzed for CAM 17 Metals. However, it appears that chrysene and benzo(a)pyrene should also be considered COCs for Site 29. Please revise the FS to include the analysis of PAHs in the cost estimate for the soil characterization and soil confirmation samples.**

In addition, the FS states that one soil confirmation sample will be taken from 32 points in the excavated area. It is unclear whether the soil from 32 sample locations will be composited into one soil confirmation sample, and what rationale was used to determine the number of soil confirmation samples that should be taken in the excavated area. It is recommended that the Navy follow the 1989 EPA Guidance entitled: "Methods for Evaluating the Attainment of Cleanup Standards" to determine the number of confirmation samples necessary to confirm that cleanup levels have been achieved.

Response: The draft final FS has been revised to present the cost estimates in Appendix D. Although chrysene and benzo(a)pyrene exceed PRG concentrations, these compounds are collocated with the area proposed for metals remediation. The number of confirmation soil samples and proposed list of analytes have not been established and are only rough estimates at this time. The estimated number is sufficient to allow appropriate selection of the proposed remedial action. Confirmation soil samples will not be composited before analysis.

EPA Specific Comment 47: **Appendix C, Cost Estimates For Proposed Remedial Alternatives, Table: Costs for Proposed Remedial Alternatives, Alternative 3: The table shows that 450 cubic yards of soil will be excavated; however, on Page C-2, the FS states that 165 cubic yards of soil will be removed. Please resolve this discrepancy.**

Response: The discrepancy has been resolved in the draft final FS. The estimated volume of soil to be excavated is 165 cubic yards.

While reviewing the Site 29 FS, the EPA raised another comment regarding the site. The issue was raised in the Remedial Program Managers meeting of June 24, 2003. In the meeting, the EPA and the Navy agreed to append these Site 29 comments with the EPA's new comment. The EPA's comment is presented below with the Navy's response:

EPA RPM Meeting Comment 1	**Groundwater samples have not been collected to date in the vicinity of the septic tank leach field although the tank was previously known to have contained VOC-contaminated fluids and sludge.**
Response:	The Navy intends to collect one groundwater sample in the immediate vicinity of the septic tank leach field to address this data gap. The Navy is required to prepare a brief sampling and analysis plan for the work. Details regarding the sample collection methodology will be presented in the sampling and analysis plan. Based upon Navy and agency review of available data, analysis of metals in groundwater may be necessary.

REFERENCES

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Downard, G., P. Guertin, and M. Morrison. 2000. "Characterization of Wildlife and Plant Communities for Naval Weapons Station Seal Beach Detachment Concord, July 1998 to September 1999 Results." March.

International Technology Corporation (IT). 1990. “Site Investigation at Building IA-25, Naval Weapons Station Concord, California.”

U.S. Environmental Protection Agency (EPA). 2002. “Region IX Preliminary Remediation Goals.” October 1.

Weston Solutions, Incorporated. 2003. Sketch of estimated location of spray paint booth from Amado Andal. October.

APPENDIX C

SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT TABLES

APPENDIX C

LIST OF TABLES

Table No. **Title**

TABLE C-1
WESTERN HARVEST MOUSE DOSE CALCULATIONS AND HAZARD QUOTIENTS FOR SITE 29
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD, CONCORD, CALIFORNIA

Chemical	Total Ingestion Rate[1] (kg/day)	Plant Ingestion Rate[2] (mg/kg)	Plant BAF[3] (unitless)	Plant Concentration[4] (mg/kg dry weight)	Plant Daily Dose[5] (mg/day)	Soil Ingestion Rate[6] (kg/day)	Soil Concentration[7] (mg/kg)	Soil Daily Dose[8] (mg/day)	SUF	Receptor Body Weight[9] (kg)	Total Daily Dose[10] (mg/kg/day)	TRV[11] (mg/kg/day)	Test Species Body Weight[11] (kg)	Allometrically Adjusted TRV[12] (mg/kg/day)	HQ[13] (based on adjusted TRV)	Source of TRV
SURFACE SOILS																
Aluminum																
Dose/High TRV	2.40E-03	2.35E-03	0.004	110.00	0.26	4.80E-05	27500.00	1.32	1.00	0.01	121.44	19.30	0.03	20.29	5.98	Sample 1996
Dose/Low TRV	2.40E-03	2.35E-03	0.004	110.00	0.26	4.80E-05	27500.00	1.32	1.00	0.01	121.44	1.93	0.03	2.03	59.84	Sample 1996
Barium																
Dose/High TRV	2.40E-03	2.35E-03	0.15	249.00	0.59	4.80E-05	1660.00	0.08	1.00	0.01	51.18	19.80	0.35	24.13	2.12	Sample 1996
Dose/Low TRV	2.40E-03	2.35E-03	0.15	249.00	0.59	4.80E-05	1660.00	0.08	1.00	0.01	51.18	5.10	0.35	6.21	8.24	Sample 1996
Beryllium																
Dose/High TRV	2.40E-03	2.35E-03	0.01	0.16	3.76E-04	4.80E-05	16.00	7.68E-04	1.00	0.01	0.09	6.60	0.35	8.04	1.09E-02	Calculated[15]
Dose/Low TRV	2.40E-03	2.35E-03	0.01	0.16	3.76E-04	4.80E-05	16.00	7.68E-04	1.00	0.01	0.09	0.66	0.35	0.80	0.11	Sample 1996
Cadmium																
Dose/High TRV	2.40E-03	2.35E-03	0.364	11.65	0.03	4.80E-05	32.00	0.002	1.00	0.01	2.23	2.64	0.03	2.78	0.80	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.364	11.65	0.03	4.80E-05	32.00	0.002	1.00	0.01	2.23	0.06	0.03	0.06	35.28	EFA WEST 1998
Chromium																
Dose/High TRV	2.40E-03	2.35E-03	0.008	19.50	0.05	4.80E-05	2600.00	0.12	1.00	0.01	13.13	NA	NA	NA	No TRV[14]	No TRV[14]
Dose/Low TRV	2.40E-03	2.35E-03	0.008	19.50	0.05	4.80E-05	2600.00	0.12	1.00	0.01	13.13	2737.00	0.33	3324.35	0.004	Sample 1996
Cobalt																
Dose/High TRV	2.40E-03	2.35E-03	0.12	3.84	0.01	4.80E-05	32.00	0.002	1.00	0.01	0.81	20.00	0.35	24.37	0.03	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.12	3.84	0.01	4.80E-05	32.00	0.002	1.00	0.01	0.81	1.20	0.35	1.46	0.56	EFA WEST 1998
Copper																
Dose/High TRV	2.40E-03	2.35E-03	0.40	476.00	1.12	4.80E-05	1190.00	0.06	1.00	0.01	90.51	631.58	0.02	656.38	0.14	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.40	476.00	1.12	4.80E-05	1190.00	0.06	1.00	0.01	90.51	2.67	0.03	2.81	32.24	EFA WEST 1998
Lead																
Dose/High TRV	2.40E-03	2.35E-03	0.045	153.00	0.36	4.80E-05	3400.00	0.16	1.00	0.01	40.24	240.64	0.02	245.95	0.16	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.045	153.00	0.36	4.80E-05	3400.00	0.16	1.00	0.01	40.24	1.000	0.35	1.22E+00	33.02	HERD 2002
Manganese																
Dose/High TRV	2.40E-03	2.35E-03	0.12	172.80	0.41	4.80E-05	1440.00	0.07	1.00	0.01	36.58	159.09	0.02	163.26	0.22	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.12	172.80	0.41	4.80E-05	1440.00	0.07	1.00	0.01	36.58	13.70	0.33	16.64	2.20	EFA WEST 1998
Mercury																
Dose/High TRV	2.40E-03	2.35E-03	0.038	0.05	1.23E-04	4.80E-05	1.40	6.72E-05	1.00	0.01	0.01	4.00	0.43	4.93	2.97E-03	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.038	0.05	1.23E-04	4.80E-05	1.40	6.72E-05	1.00	0.01	0.01	0.25	0.19	0.29	0.05	EFA WEST 1998
Nickel																
Dose/High TRV	2.40E-03	2.35E-03	0.032	5.12	0.01	4.80E-05	160.00	0.01	1.00	0.01	1.52	31.60	0.25	37.72	0.04	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.032	5.12	0.01	4.80E-05	160.00	0.01	1.00	0.01	1.52	0.13	0.25	0.16	9.56	EFA WEST 1998
Selenium																
Dose/High TRV	2.40E-03	2.35E-03	0.016	0.07	0.0002	4.80E-05	4.40	0.00	1.00	0.01	0.03	1.21	0.02	1.26	0.02	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.016	0.07	0.0002	4.80E-05	4.40	0.00	1.00	0.01	0.03	0.05	0.02	0.05	0.56	EFA WEST 1998
Vanadium																
Dose/High TRV	2.40E-03	2.35E-03	0.12	13.20	0.03	4.80E-05	110.00	0.01	1.00	0.01	2.79	2.10	0.26	2.51	1.11	Sample 1996
Dose/Low TRV	2.40E-03	2.35E-03	0.12	13.20	0.03	4.80E-05	110.00	0.01	1.00	0.01	2.79	0.21	0.26	0.25	11.12	Sample 1996
Zinc																
Dose/High TRV	2.40E-03	2.35E-03	1.20E-12	2.40E-08	5.64E-11	4.80E-05	20000.00	0.96	1.00	0.01	73.85	411.43	0.18	480.89	0.15	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	1.20E-12	2.40E-08	5.64E-11	4.80E-05	20000.00	0.96	1.00	0.01	73.85	9.60	0.03	10.00	7.39	EFA WEST 1998
Anthracene*[16]																
Dose/High TRV	2.40E-03	2.35E-03	0.02	1.41E-01	3.33E-04	4.80E-05	7.00	3.36E-04	1.00	0.01	5.14E-02	32.79	0.03	34.51	1.49E-03	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.02	1.41E-01	3.33E-04	4.80E-05	7.00	3.36E-04	1.00	0.01	5.14E-02	1.31	0.03	1.38	3.73E-02	EFA WEST 1998
Benzo(b/k)fluoranthene*																
Dose/High TRV	2.40E-03	2.35E-03	0.01	4.85E-03	1.14E-05	4.80E-05	0.48	2.30E-05	1.00	0.01	2.65E-03	32.79	0.03	34.51	7.68E-05	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.01	4.85E-03	1.14E-05	4.80E-05	0.48	2.30E-05	1.00	0.01	2.65E-03	1.31	0.03	1.38	1.92E-03	EFA WEST 1998
Bis(2-ethylhexyl)phthalate																
Dose/High TRV	2.40E-03	2.35E-03	0.038	1.48E-01	3.49E-04	4.80E-05	3.90	1.87E-04	1.00	0.01	4.12E-02	183.30	0.03	192.73	2.14E-04	Sample 1996
Dose/Low TRV	2.40E-03	2.35E-03	0.038	1.48E-01	3.49E-04	4.80E-05	3.90	1.87E-04	1.00	0.01	4.12E-02	18.33	0.03	19.29	2.14E-03	Sample 1996

TABLE C-1
WESTERN HARVEST MOUSE DOSE CALCULATIONS AND HAZARD QUOTIENTS FOR SITE 29
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD, CONCORD, CALIFORNIA

Chemical	Total Ingestion Rate[1] (kg/day)	Plant Ingestion Rate[2] (mg/kg)	Plant BAF[3] (unitless)	Plant Concentration[4] (mg/kg dry weight)	Plant Daily Dose[5] (mg/day)	Soil Ingestion Rate[6] (kg/day)	Soil Concentration[7] (mg/kg)	Soil Daily Dose[8] (mg/day)	SUF	Receptor Body Weight[9] (kg)	Total Daily Dose[10] (mg/kg/day)	TRV[11] (mg/kg/day)	Test Species Body Weight[11] (kg)	Allometrically Adjusted TRV[12] (mg/kg/day)	HQ[13] (based on adjusted TRV)	Source of TRV
Chrysene*																
Dose/High TRV	2.40E-03	2.35E-03	0.019	3.55E-02	8.36E-05	4.80E-05	1.90	9.12E-05	1.00	0.01	1.34E-02	32.79	0.03	34.51	3.90E-04	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.019	3.55E-02	8.36E-05	4.80E-05	1.90	9.12E-05	1.00	0.01	1.34E-02	1.31	0.03	1.38	9.75E-03	EFA WEST 1998
DDT																
Dose/High TRV	2.40E-03	2.35E-03	0.009	2.16E-03	5.07E-06	4.80E-05	0.23	1.10E-05	1.00	0.01	1.24E-03	16.00	0.32	19.39	6.39E-05	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.009	2.16E-03	5.07E-06	4.80E-05	0.23	1.10E-05	1.00	0.01	1.24E-03	0.80	0.32	0.97	1.28E-03	EFA WEST 1998
Fluoranthene*																
Dose/High TRV	2.40E-03	2.35E-03	0.01	7.10E-02	1.67E-04	4.80E-05	6.40	3.07E-04	1.00	0.01	3.65E-02	32.79	0.03	34.51	1.06E-03	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.01	7.10E-02	1.67E-04	4.80E-05	6.40	3.07E-04	1.00	0.01	3.65E-02	1.31	0.03	1.38	2.65E-02	EFA WEST 1998
Methylene Chloride[17]																
Dose/High TRV	2.40E-03	2.35E-03	52.00	5.72E-01	1.35E-03	4.80E-05	0.011	5.28E-07	1.00	0.01	1.04E-01	50.00	0.35	60.92	1.70E-03	Sample 1996
Dose/Low TRV	2.40E-03	2.35E-03	52.00	5.72E-01	1.35E-03	4.80E-05	0.011	5.28E-07	1.00	0.01	1.04E-01	5.85	0.35	7.13	1.45E-02	Sample 1996
Pyrene*																
Dose/High TRV	2.40E-03	2.35E-03	0.01	5.00E-02	1.17E-04	4.80E-05	4.50	2.16E-04	1.00	0.01	2.57E-02	32.79	0.03	34.51	7.43E-04	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.01	5.00E-02	1.17E-04	4.80E-05	4.50	2.16E-04	1.00	0.01	2.57E-02	1.31	0.03	1.38	1.86E-02	EFA WEST 1998
Xylene[18]																
Dose/High TRV	2.40E-03	2.35E-03	0.32	4.80E-03	1.13E-05	4.80E-05	0.015	7.20E-07	1.00	0.01	9.24E-04	2.60	0.03	2.73	0.0003	Sample 1996
Dose/Low TRV	2.40E-03	2.35E-03	0.32	4.80E-03	1.13E-05	4.80E-05	0.015	7.20E-07	1.00	0.01	9.24E-04	2.10	0.03	2.21	0.0004	Sample 1996
SUBSURFACE SOIL																
Barium																
Dose/High TRV	2.40E-03	2.35E-03	0.15	186.00	0.44	4.80E-05	1240.00	0.06	1.00	0.01	38.23	19.80	0.35	24.13	1.58	Sample 1996
Dose/Low TRV	2.40E-03	2.35E-03	0.15	186.00	0.44	4.80E-05	1240.00	0.06	1.00	0.01	38.23	5.10	0.35	6.21	6.15	Sample 1996
Copper																
Dose/High TRV	2.40E-03	2.35E-03	0.40	26.72	0.06	4.80E-05	66.80	0.003	1.00	0.01	5.08	631.58	0.02	656.38	0.01	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.40	26.72	0.06	4.80E-05	66.80	0.003	1.00	0.01	5.08	2.67	0.03	2.81	1.81	EFA WEST 1998
Manganese																
Dose/High TRV	2.40E-03	2.35E-03	0.12	787.20	1.85	4.80E-05	6560.00	0.31	1.00	0.01	166.64	159.09	0.02	163.26	1.02	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.12	787.20	1.85	4.80E-05	6560.00	0.31	1.00	0.01	166.64	13.70	0.33	16.64	10.01	EFA WEST 1998
Mercury																
Dose/High TRV	2.40E-03	2.35E-03	0.04	0.01	1.94E-05	4.80E-05	0.22	1.06E-05	1.00	0.01	0.00	4.00	0.43	4.93	4.67E-04	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.04	0.01	1.94E-05	4.80E-05	0.22	1.06E-05	1.00	0.01	0.00	0.25	0.19	0.29	0.01	EFA WEST 1998
Selenium																
Dose/High TRV	2.40E-03	2.35E-03	0.016	0.02	0.00	4.80E-05	1.50	0.0001	1.00	0.01	0.01	1.21	0.02	1.24	0.01	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.016	0.02	0.00	4.80E-05	1.50	0.0001	1.00	0.01	0.01	0.05	0.02	0.05	0.19	EFA WEST 1998
Thallium																
Dose/High TRV	2.40E-03	2.35E-03	0.004	0.03	0.00	4.80E-05	7.00	0.0003	1.00	0.01	0.03	1.43	0.25	1.71	0.02	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.004	0.03	0.00	4.80E-05	7.00	0.0003	1.00	0.01	0.03	0.48	0.25	0.57	0.05	EFA WEST 1998
Vanadium																
Dose/High TRV	2.40E-03	2.35E-03	0.12	11.96	0.03	4.80E-05	99.70	0.005	1.00	0.01	2.53	2.10	0.26	2.51	1.01	Sample 1996
Dose/Low TRV	2.40E-03	2.35E-03	0.12	11.96	0.03	4.80E-05	99.70	0.005	1.00	0.01	2.53	0.21	0.26	0.25	10.08	Sample 1996
TCE																
Dose/High TRV	2.40E-03	2.35E-03	NA	NA	NA	4.80E-05	0.002	0.0000	1.00	0.01	NA	7.00	0.25	8.36	NA	Sample 1996
Dose/Low TRV	2.40E-03	2.35E-03	NA	NA	NA	4.80E-05	0.002	0.0000	1.00	0.01	NA	0.70	0.25	0.84	NA	Sample 1996

TABLE C-1
WESTERN HARVEST MOUSE DOSE CALCULATIONS AND HAZARD QUOTIENTS FOR SITE 29
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD, CONCORD, CALIFORNIA

Notes: Highlighted cells indicate HQs greater than 1.0.
* TRV based on TRV for Benzo(a)pyrene (EFA West 1998)

1 Total ingestion rate was calculated with average adult body weight of 13 grams using the Nagy (2001) dry matter intake food requirement equation for herbivorous mammals (a= 0.859; b= 0.628)
2 Plant ingestion rate equals 98 percent of the total ingestion rate, based on a sediment ingestion rate equal to 2 percent of the total ingestion rate.
3 Plant BAF sources are identified in Table 2-3.
4 The plant concentration was calculated by multiplying the sediment concentration by the BAF.
5 Plant daily dose was calculated by multiplying the plant ingestion rate by the plant concentration.
6 Sediment ingestion rate equals 2 percent of ingestion rate, based on white-footed mouse data from Beyer and others (1994).
7 The maximum concentration of all site-collected soil samples was used.
8 Soil daily dose was calculated by multiplying the sediment ingestion rate by the sediment concentration.
9 Average western harvest mouse body weight from Davis and Schmidly (1994).
10 Total daily dose is calculated using the following equation: total daily dose = ((sediment daily dose + plant daily dose)*SUF)/receptor species body weight.
11 The derivation of TRVs is described in EFA WEST (1998) and Sample (1996).
12 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-0.94)}$.
13 The HQ was calculated using total daily dose/allometrically adjusted TRV.
14 Sufficient data are not available to derive a TRV. This chemical was evaluated qualitatively.
15 "Calculated" indicates that a high TRV was not available in EFA WEST (1998) or Sample (1996); in those cases, an uncertainty factor of 10 was applied to the low TRV to derive a high TRV.
16 The BAF for benzo(a)anthracene was used as a surrogate for anthracene
17 The BAF for acetone was used as a surrogate for methylene chloride
18 The BAF for low molecular weight PAHs was used as a surrogate for xylene

BAF	Bioaccumulation factor	mg/day	Milligram per day
DDT	Dichlorodiphenyltrichloroethane	mg/kg	Milligram per kilogram
EFA West	Naval Facilities Engineering Command, Engineering Field Activity West	mg/kg/day	Milligram per kilogram per day
EPA	U.S. Environmental Protection Agency	NA	Not available
HQ	Hazard quotient	SUF	Site use factor
kg	Kilogram	TCE	Trichloroethene
kg/day	Kilogram per day	TRV	Toxicity reference value

Sources: Beyer and others. 1994. "Estimates of Soil Ingestion by Wildlife." *Journal of Wildlife Management*. Volume 58. Number 2. Pages 375 through 382.
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TABLE C-2
AMERICAN ROBIN DOSE CALCULATIONS AND HAZARD QUOTIENTS FOR SITE 29
NAVAL WEAPONS STATION, SEAL BEACH DETACHMENT CONCORD, CONCORD, CALIFORNIA

COPEC	Total Ingestion Rate[1] (kg/day)	Soil Ingestion Rate[2] (kg/day)	Soil Concentration[3] (mg/kg)	Soil Daily Dose[4] (mg/day)	Total Prey Ingestion Rate[1,5] (kg/day)	Plant Ingestion Rate[5,6] (kg/day)	Plant BAF[7] (unitless)	Plant Tissue Concentration in Dry Weight (mg/kg)[8]	Plant Daily Dose[9] (mg/kg)	Invertebrate Ingestion Rate[5,10] (kg/day)	Invertebrate BAF[7] (unitless)	Invertebrate Tissue Concentration in Wet Weight[11] (mg/kg)	Invertebrate Tissue Concentration in Dry Weight[12] (mg/kg)	Invertebrate Daily Dose[13] (mg/day)	SUF	Body Weight[14] (kg)	Total Daily Dose[15] (mg/kg/day)	TRV[16] (mg/kg/day)	Test Species Body Weight[17] (kg)	Allometrically Adjusted TRV[17] (mg/kg/day)	HQ[18] (based on adjusted TRV)	Source of TRV
SURFACE SOIL																						
Aluminum																						
Dose/High TRV	0.01	1.23E-06	27500.00	3.38E-02	0.01	0.01	0.004	110.00	0.607	0.01	0.22	6050.00	40333.33	272.24	1.00	0.08	3530.15	NA	NA	NA	No TRV[19]	No TRV[19]
Dose/Low TRV	0.01	1.23E-06	27500.00	3.38E-02	0.01	0.01	0.004	110.00	0.607	0.01	0.22	6050.00	40333.33	272.24	1.00	0.08	3530.15	109.70	0.16	95.450	36.984	Sample 1996
Barium																						
Dose/High TRV	0.01	1.23E-06	1660.00	2.04E-03	0.01	0.01	0.15	249.00	1.38	0.01	0.22	365.20	2434.67	16.43	1.00	0.08	230.41	41.70	0.12	38.125	6.043	Sample 1996
Dose/Low TRV	0.01	1.23E-06	1660.00	2.04E-03	0.01	0.01	0.15	249.00	1.38	0.01	0.22	365.20	2434.67	16.43	1.00	0.08	230.41	20.80	0.12	19.017	12.116	Sample 1996
Beryllium																						
Dose/High TRV	0.01	1.23E-06	16.00	1.96E-05	0.01	0.01	0.01	0.16	8.84E-04	0.01	0.22	3.52	23.47	0.16	1.00	0.08	2.06	NA	NA	NA	No TRV[19]	No TRV[19]
Dose/Low TRV	0.01	1.23E-06	16.00	1.96E-05	0.01	0.01	0.01	0.16	8.84E-04	0.01	0.22	3.52	23.47	0.16	1.00	0.08	2.06	NA	NA	NA	No TRV[19]	No TRV[19]
Cadmium																						
Dose/High TRV	0.01	1.23E-06	32.00	3.93E-05	0.01	0.01	0.36	11.65	0.06	0.01	0.96	30.72	204.80	1.38	1.00	0.08	18.72	10.43	0.08	10.359	1.807	EFA West 1998
Dose/Low TRV	0.01	1.23E-06	32.00	3.93E-05	0.01	0.01	0.36	11.65	0.06	0.01	0.96	30.72	204.80	1.38	1.00	0.08	18.72	0.08	0.78	0.050	371.445	EFA West 1998
Chromium																						
Dose/High TRV	0.01	1.23E-06	2600.00	3.19E-03	0.01	0.01	0.01	19.50	0.11	0.01	0.01	26.00	173.33	1.17	1.00	0.08	16.57	5.00	1.25	2.866	5.782	Sample 1996
Dose/Low TRV	0.01	1.23E-06	2600.00	3.19E-03	0.01	0.01	0.01	19.50	0.11	0.01	0.01	26.00	173.33	1.17	1.00	0.08	16.57	1.00	1.25	0.573	28.911	Sample 1996
Cobalt																						
Dose/High TRV	0.01	1.23E-06	32.00	3.93E-05	0.01	0.01	0.12	3.84	2.12E-02	0.01	0.22	7.04	46.93	0.32	1.00	0.08	4.37	NA	NA	NA	No TRV[19]	No TRV[19]
Dose/Low TRV	0.01	1.23E-06	32.00	3.93E-05	0.01	0.01	0.12	3.84	2.12E-02	0.01	0.22	7.04	46.93	0.32	1.00	0.08	4.37	NA	NA	NA	No TRV[19]	No TRV[19]
Copper																						
Dose/High TRV	0.01	1.23E-06	1190.00	1.46E-03	0.01	0.01	0.40	476.00	2.63	0.01	0.04	47.60	317.33	2.14	1.00	0.08	61.73	52.26	0.41	37.45	1.65	EFA West 1998
Dose/Low TRV	0.01	1.23E-06	1190.00	1.46E-03	0.01	0.01	0.40	476.00	2.63	0.01	0.04	47.60	317.33	2.14	1.00	0.08	61.73	2.30	0.64	1.51	40.95	EFA West 1998
Lead																						
Dose/High TRV	0.01	1.23E-06	3400.00	4.17E-03	0.01	0.01	0.05	153.00	0.84	0.01	0.03	102.00	680.00	4.59	1.00	0.08	70.36	8.75	0.80	5.48	12.83	EFA West 1998
Dose/Low TRV	0.01	1.23E-06	3400.00	4.17E-03	0.01	0.01	0.05	153.00	0.84	0.01	0.03	102.00	680.00	4.59	1.00	0.08	70.36	0.01	0.08	0.01	5110.06	EFA West 1998
Manganese																						
Dose/High TRV	0.01	1.23E-06	1440.00	1.77E-03	0.01	0.01	0.12	172.80	0.95	0.01	0.22	316.80	2112.00	14.26	1.00	0.08	196.79	776.00	0.08	770.69	0.26	EFA West 1998
Dose/Low TRV	0.01	1.23E-06	1440.00	1.77E-03	0.01	0.01	0.12	172.80	0.95	0.01	0.22	316.80	2112.00	14.26	1.00	0.08	196.79	77.60	0.08	76.32	2.58	EFA West 1998
Mercury																						
Dose/High TRV	0.01	1.23E-06	1.40	1.72E-06	0.01	0.01	0.04	0.05	2.90E-04	0.01	0.04	0.06	0.37	2.52E-03	1.00	0.08	0.04	0.18	1.00	0.11	0.34	EFA West 1998
Dose/Low TRV	0.01	1.23E-06	1.40	1.72E-06	0.01	0.01	0.04	0.05	2.90E-04	0.01	0.04	0.06	0.37	2.52E-03	1.00	0.08	0.04	0.04	1.00	0.02	1.56	EFA West 1998
Nickel																						
Dose/High TRV	0.01	1.23E-06	160.00	1.96E-04	0.01	0.01	0.03	5.12	0.03	0.01	0.02	3.20	21.33	0.14	1.00	0.08	2.23	55.16	0.78	34.72	0.06	EFA West 1998
Dose/Low TRV	0.01	1.23E-06	160.00	1.96E-04	0.01	0.01	0.03	5.12	0.03	0.01	0.02	3.20	21.33	0.14	1.00	0.08	2.23	1.38	0.78	0.87	2.57	EFA West 1998
Selenium																						
Dose/High TRV	0.01	1.23E-06	4.40	5.40E-06	0.01	0.01	0.016	0.07	0.00	0.01	0.22	0.97	6.45	0.04	1.00	0.08	0.57	0.93	1.00	0.56	1.02	EFA West 1998
Dose/Low TRV	0.01	1.23E-06	4.40	5.40E-06	0.01	0.01	0.016	0.07	0.00	0.01	0.22	0.97	6.45	0.04	1.00	0.08	0.57	0.23	1.00	0.14	4.13	EFA West 1998
Vanadium																						
Dose/High TRV	0.01	1.23E-06	110.00	1.35E-04	0.01	0.01	0.12	13.20	7.29E-02	0.01	0.22	24.20	161.33	1.09E+00	1.00	0.08	15.03	NA	NA	NA	No TRV[19]	No TRV[19]
Dose/Low TRV	0.01	1.23E-06	110.00	1.35E-04	0.01	0.01	0.12	13.20	7.29E-02	0.01	0.22	24.20	161.33	1.09E+00	1.00	0.08	15.03	11.40	1.17	6.62	2.27	Sample 1996
Zinc																						
Dose/High TRV	0.01	1.23E-06	20000.00	2.45E-02	0.01	0.01	1.20E-12	2.40E-08	1.33E-10	0.01	0.56	11200.00	74666.67	503.98	1.00	0.08	6520.11	172.00	0.96	104.03	62.67	EFA West 1998
Dose/Low TRV	0.01	1.23E-06	20000.00	2.45E-02	0.01	0.01	1.20E-12	2.40E-08	1.33E-10	0.01	0.56	11200.00	74666.67	503.98	1.00	0.08	6520.11	17.20	0.96	10.40	626.75	EFA West 1998
Anthracene[20]																						
Dose/High TRV	0.01	1.23E-06	7.00	8.59E-06	0.01	0.01	0.02	1.41E-01	7.81E-04	0.01	0.03	2.10E-01	1.40	9.45E-03	1.00	0.08	1.32E-01	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	7.00	8.59E-06	0.01	0.01	0.02	1.41E-01	7.81E-04	0.01	0.03	2.10E-01	1.40	9.45E-03	1.00	0.08	1.32E-01	NA	NA	NA	No TRV[12]	No TRV[12]
Benzo(b/k)fluoranthene																						
Dose/High TRV	0.01	1.23E-06	0.48	5.89E-07	0.01	0.01	0.01	4.80E-03	2.65E-05	0.01	0.07	3.36E-02	0.22	1.51E-03	1.00	0.08	1.99E-02	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	0.48	5.89E-07	0.01	0.01	0.01	4.80E-03	2.65E-05	0.01	0.07	3.36E-02	0.22	1.51E-03	1.00	0.08	1.99E-02	NA	NA	NA	No TRV[12]	No TRV[12]
Bis(2-ethylhexyl)phthalate																						
Dose/High TRV	0.01	1.23E-06	3.90	4.79E-06	0.01	0.01	0.038	1.48E-01	8.18E-04	0.01	1309.00	5.11E+03	3.40E+04	2.30E+02	1.00	0.08	2.97E+03	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	3.90	4.79E-06	0.01	0.01	0.038	1.48E-01	8.18E-04	0.01	1309.00	5.11E+03	3.40E+04	2.30E+02	1.00	0.08	2.97E+03	1.11	0.16	0.97	3077.01	Sample 1996
Chrysene																						
Dose/High TRV	0.01	1.23E-06	1.90	2.33E-06	0.01	0.01	0.02	3.55E-02	1.96E-04	0.01	0.04	7.60E-02	5.07E-01	3.42E-03	1.00	0.08	4.68E-02	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	1.90	2.33E-06	0.01	0.01	0.02	3.55E-02	1.96E-04	0.01	0.04	7.60E-02	5.07E-01	3.42E-03	1.00	0.08	4.68E-02	NA	NA	NA	No TRV[12]	No TRV[12]

TABLE C-2
AMERICAN ROBIN DOSE CALCULATIONS AND HAZARD QUOTIENTS FOR SITE 29
NAVAL WEAPONS STATION, SEAL BEACH DETACHMENT CONCORD, CONCORD, CALIFORNIA

COPEC	Total Ingestion Rate[1] (kg/day)	Soil Ingestion Rate[2] (kg/day)	Soil Concentration[3] (mg/kg)	Soil Daily Dose[4] (mg/day)	Total Prey Ingestion Rate[1,5] (kg/day)	Plant Ingestion Rate[5,6] (kg/day)	Plant BAF[7] (unitless)	Plant Tissue Concentration in Dry Weight (mg/kg)[8]	Plant Daily Dose[9] (mg/kg)	Invertebrate Ingestion Rate[5,10] (kg/day)	Invertebrate BAF[7] (unitless)	Invertebrate Tissue Concentration in Wet Weight[11] (mg/kg)	Invertebrate Tissue Concentration in Dry Weight[12] (mg/kg)	Invertebrate Daily Dose[13] (mg/day)	SUF	Body Weight[14] (kg)	Total Daily Dose[15] (mg/kg/day)	TRV[16] (mg/kg/day)	Test Species Body Weight[17] (kg)	Allometrically Adjusted TRV[17] (mg/kg/day)	HQ[18] (based on adjusted TRV)	Source of TRV
DDT																						
Dose/High TRV	0.01	1.23E-06	0.23	2.82E-07	0.01	0.01	0.009	2.16E-03	1.19E-05	0.01	1.26	2.90E-01	1.93E+00	1.30E-02	1.00	0.08	1.69E-01	1.50	3.00	0.72	0.23	EFA West 1998
Dose/Low TRV	0.01	1.23E-06	0.23	2.82E-07	0.01	0.01	0.009	2.16E-03	1.19E-05	0.01	1.26	2.90E-01	1.93E+00	1.30E-02	1.00	0.08	1.69E-01	0.009	1.00	0.01	31.31	EFA West 1998
Fluoranthene																						
Dose/High TRV	0.01	1.23E-06	6.40	7.86E-06	0.01	0.01	0.01	7.10E-02	3.92E-04	0.01	0.07	0.45	2.99	2.02E-02	1.00	0.08	0.27	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	6.40	7.86E-06	0.01	0.01	0.01	7.10E-02	3.92E-04	0.01	0.07	0.45	2.99	2.02E-02	1.00	0.08	0.27	NA	NA	NA	No TRV[12]	No TRV[12]
Methylene Chloride[21]																						
Dose/High TRV	0.01	1.23E-06	0.01	1.23E-08	0.01	0.01	52.00	5.20E-01	2.87E-03	0.01	0.05	0.00	0.00	2.25E-05	1.00	0.08	0.04	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	0.01	1.23E-08	0.01	0.01	52.00	5.20E-01	2.87E-03	0.01	0.05	0.00	0.00	2.25E-05	1.00	0.08	0.04	NA	NA	NA	No TRV[12]	No TRV[12]
Pyrene																						
Dose/High TRV	0.01	1.23E-06	4.50	5.52E-06	0.01	0.01	0.01	5.00E-02	2.76E-04	0.01	0.07	0.32	2.10	1.42E-02	1.00	0.08	0.19	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	4.50	5.52E-06	0.01	0.01	0.01	5.00E-02	2.76E-04	0.01	0.07	0.32	2.10	1.42E-02	1.00	0.08	0.19	NA	NA	NA	No TRV[12]	No TRV[12]
Xylene[22]																						
Dose/High TRV	0.01	1.23E-06	0.02	1.84E-08	0.01	0.01	0.32	4.80E-03	2.65E-05	0.01	6.00	0.09	0.60	4.05E-03	1.00	0.08	0.05	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	0.02	1.84E-08	0.01	0.01	0.32	4.80E-03	2.65E-05	0.01	6.00	0.09	0.60	4.05E-03	1.00	0.08	0.05	NA	NA	NA	No TRV[12]	No TRV[12]
SUBSURFACE SOIL																						
Barium																						
Dose/High TRV	0.01	1.23E-06	1240.00	1.52E-03	0.01	0.01	0.15	186.00	1.03	0.01	0.22	272.80	1818.67	12.28	1.00	0.08	172.11	41.70	0.12	38.125	4.514	Sample 1996
Dose/Low TRV	0.01	1.23E-06	1240.00	1.52E-03	0.01	0.01	0.15	186.00	1.03	0.01	0.22	272.80	1818.67	12.28	1.00	0.08	172.11	20.80	0.12	19.017	9.050	Sample 1996
Copper																						
Dose/High TRV	0.01	1.23E-06	66.80	8.20E-05	0.01	0.01	0.40	26.72	0.15	0.01	0.04	2.67	17.81	0.12	1.00	0.08	3.47	52.26	0.41	37.45	0.09	EFA West 1998
Dose/Low TRV	0.01	1.23E-06	66.80	8.20E-05	0.01	0.01	0.40	26.72	0.15	0.01	0.04	2.67	17.81	0.12	1.00	0.08	3.47	2.30	0.64	1.51	2.30	EFA West 1998
Manganese																						
Dose/High TRV	0.01	1.23E-06	6560.00	8.05E-03	0.01	0.01	0.12	787.20	4.35	0.01	0.22	1443.20	9621.33	64.94	1.00	0.08	896.47	776.00	0.08	770.69	1.16	EFA West 1998
Dose/Low TRV	0.01	1.23E-06	6560.00	8.05E-03	0.01	0.01	0.12	787.20	4.35	0.01	0.22	1443.20	9621.33	64.94	1.00	0.08	896.47	77.60	0.08	76.32	11.75	EFA West 1998
Mercury																						
Dose/High TRV	0.01	1.23E-06	0.22	2.70E-07	0.01	0.01	0.04	0.01	4.56E-05	0.01	0.04	0.01	0.06	3.96E-04	1.00	0.08	0.01	0.18	1.00	0.11	0.05	EFA West 1998
Dose/Low TRV	0.01	1.23E-06	0.22	2.70E-07	0.01	0.01	0.04	0.01	4.56E-05	0.01	0.04	0.01	0.06	3.96E-04	1.00	0.08	0.01	0.04	1.00	0.02	0.24	EFA West 1998
Selenium																						
Dose/High TRV	0.01	1.23E-06	1.50	1.84E-06	0.01	0.01	0.016	0.02	0.00	0.01	0.22	0.33	2.20	0.01	1.00	0.08	0.19	0.93	1.00	0.56	0.35	EFA West 1998
Dose/Low TRV	0.01	1.23E-06	1.50	1.84E-06	0.01	0.01	0.016	0.02	0.00	0.01	0.22	0.33	2.20	0.01	1.00	0.08	0.19	0.23	1.00	0.14	1.41	EFA West 1998
Thallium																						
Dose/High TRV	0.01	1.23E-06	7.00	8.59E-06	0.01	0.01	0.004	0.03	0.00	0.01	0.22	1.54	10.27	0.07	1.00	0.08	0.90	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	7.00	8.59E-06	0.01	0.01	0.004	0.03	0.00	0.01	0.22	1.54	10.27	0.07	1.00	0.08	0.90	NA	NA	NA	No TRV[12]	No TRV[12]
Vanadium																						
Dose/High TRV	0.01	1.23E-06	99.70	1.22E-04	0.01	0.01	0.12	11.96	6.61E-02	0.01	0.22	21.93	146.23	9.87E-01	1.00	0.08	13.62	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	99.70	1.22E-04	0.01	0.01	0.12	11.96	6.61E-02	0.01	0.22	21.93	146.23	9.87E-01	1.00	0.08	13.62	11.40	1.17	6.62	2.06	Sample 1996
TCE																						
Dose/High TRV	0.01	1.23E-06	0.002	2.45E-09	0.01	0.01	NA	NA	NA	0.01	NA	NA	6.67	0.04	1.00	0.08	NA	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	0.002	2.45E-09	0.01	0.01	NA	NA	NA	0.01	NA	NA	6.67	0.04	1.00	0.08	NA	NA	NA	NA	No TRV[12]	No TRV[12]

TABLE C-2
AMERICAN ROBIN DOSE CALCULATIONS AND HAZARD QUOTIENTS FOR SITE 29
NAVAL WEAPONS STATION, SEAL BEACH DETACHMENT CONCORD, CONCORD, CALIFORNIA

Notes: Highlighted cells indicate HQs greater than 1.0.
Numbers in **BOLD** are average values calculated from various studies

1 Total ingestion rate was calculated with body weight of 77.3 grams using the Nagy (2001) dry matter intake food requirement equation for passerine birds (a= 0.630; b= 0.683).
2 Soil ingestion rate based on Western Meadowlark soil ingestion rate in EPA (1999). The soil ingestion rate is expressed as a 0.01 percent of the total ingestion rate.
3 Soil concentration equals the maximum of all site-collected soil samples.
4 Soil daily dose was calculated by multiplying the soil ingestion rate (see note 2) by soil concentration (see note 3).
5 Total prey ingestion rate was 99.99 percent of the total ingestion rate, based on the soil ingestion rate (see note 2). The prey composition was assumed to consist of 44.75 percent plant and 55.25 percent invertebrates.
6 Plant ingestion rate was calculated by multiplying the total prey ingestion rate by 0.4475 (see note 5).
7 Plant and invertebrate BAF sources are identified in Table 2-3.
8 Plant tissue concentration was calculated by multiplying the soil concentration by the plant BAF. Concentrations are presented in dry weight.
9 Plant daily dose was calculated by multiplying plant ingestion rate (see note 6) by the plant BAF (see note 7).
10 Invertebrate ingestion rate was calculated by multiplying the total prey ingestion rate by 0.5525(see note 5).
11 Invertebrate tissue concentration was calculated by multiplying the soil concentration by the invertebrate BAF. Concentrations are presented in wet weight.
12 Invertebrate concentrations were converted to dry weight using the formula: dry weight concentration = (wet weight concentration)/(1-percent moisture in media). Average percent moisture for earthworm tissue equals 85 percent (EPA 1993).
13 Invertebrate daily dose was calculated by multiplying invertebrate ingestion rate (see note 10) by the maximum invertebrate concentration (see note 12).
14 Mean body weight of adults throughout the United States (Clench & Leberman, 1978, as cited in EPA 1993).
15 Total daily dose is calculated using the following equation: total daily dose = (plant daily dose + invertebrate daily dose + soil daily dose)*SUF)/receptor species body weight.
16 The derivation of TRVs is described in EFA WEST (1998). These TRVs are adjusted to incorporate uncertainty factors.
17 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight) $^{(1-1.2)}$.
18 The HQ was calculated using total daily dose / allometrically adjusted TRV.
19 Sufficient data are not available to derive a TRV. This chemical was evaluated qualitatively.
20 The BAF for benzo(a)anthracene was used as a surrogate for anthracene
21 The BAF for acetone was used as a surrogate for methylene chloride
22 The BAF for low molecular weight PAHs was used as a surrogate for xylene

BAF	Bioaccumulation factor
COPEC	Chemical of Potential Ecological Concern
DDT	Dichlorodiphenyltrichloroethane
EFA WEST	Naval Facilities Engineering Command, Engineering Field Activity West
EPA	U.S. Environmental Protection Agency
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Not available
SUF	Site use factor
TCE	Trichloroethene
TRV	Toxicity reference value

Nagy, K.A. 2001. "Food Requirements of Wild Animals: Predictive Equations for Free-Living Mammals, Reptiles, and Birds." *Nutrition Abstracts and Reviews, Series B: LivestockFeeds and Feeding* . Volume 71. Number 10. Pages 21R-31R.
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EPA. 1993. "Wildlife Exposure Factors Handbook; Volumes I and 2." EPA 600/R-93/187a. December.
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TABLE C-3
RED-TAILED HAWK DOSE CALCULATIONS AND HAZARD QUOTIENTS FOR SITE 29
NAVAL WEAPONS STATION, SEAL BEACH DETACHMENT CONCORD, CONCORD, CALIFORNIA

Chemical	Total Ingestion Rate[1] (kg/day)	Soil Ingestion Rate[2] (kg/day)	Soil Concentration[3] (mg/kg)	Soil Daily Dose[4] (mg/day)	Prey Ingestion Rate[5] (kg/day)	Soil to Mouse BAF (unitless)	Prey Concentration wet weight (mg/kg)	Prey Concentration dry weight (mg/kg)	Prey Daily Dose[6] (mg/day)	SUF	Body Weight[7] (kg)	Total Daily Dose[8] (mg/kg/day)	TRV[9] (mg/kg/day)	Test Species Body Weight[9] (kg)	Allometrically Adjusted TRV[10] (mg/kg/day)	HQ[11] (based on adjusted TRV)	Source of TRV
SURFACE SOIL																	
Aluminum																	
Dose/High TRV	0.08	5.63E-04	27,500.00	15.48	0.08	6.50E-06	1.79E-01	5.59E-01	4.46E-02	1.00	0.96	16.22	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.08	5.63E-04	27,500.00	15.48	0.08	6.50E-06	1.79E-01	5.59E-01	4.46E-02	1.00	0.96	16.22	109.70	0.16	156.88	0.10	Sample 1996
Barium																	
Dose/High TRV	0.08	5.63E-04	1,660.00	0.93	0.08	2.16E-07	3.59E-04	1.12E-03	8.95E-05	1.00	0.96	0.98	41.70	0.12	63.17	0.02	Sample 1996
Dose/Low TRV	0.08	5.63E-04	1,660.00	0.93	0.08	2.17E-07	3.60E-04	1.13E-03	8.99E-05	1.00	0.96	0.98	20.80	0.12	31.51	0.03	Sample 1996
Beryllium																	
Dose/High TRV	0.08	5.63E-04	16.00	9.00E-03	0.08	1.44E-06	2.30E-05	7.20E-05	5.75E-06	1.00	0.96	0.0094	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.08	5.63E-04	16.00	9.00E-03	0.08	1.44E-06	2.30E-05	7.20E-05	5.75E-06	1.00	0.96	0.01	NA	NA	NA	No TRV[12]	No TRV[12]
Cadmium																	
Dose/High TRV	0.08	5.63E-04	32.00	0.02	0.08	1.73E-07	5.54E-06	1.73E-05	1.38E-06	1.00	0.96	0.02	10.43	1.17	10.02	0.002	EFA West 1998
Dose/Low TRV	0.08	5.63E-04	32.00	0.02	0.08	1.73E-07	5.54E-06	1.73E-05	1.38E-06	1.00	0.96	0.02	0.08	1.17	0.08	0.24	EFA West 1998
Chromium																	
Dose/High TRV	0.08	5.63E-04	2,600.00	1.46	0.08	7.91E-06	2.06E-02	6.43E-02	5.13E-03	1.00	0.96	1.53	5.00	1.25	4.74	0.32	Sample 1996
Dose/Low TRV	0.08	5.63E-04	2,600.00	1.46	0.08	7.91E-06	2.06E-02	6.43E-02	5.13E-03	1.00	0.96	1.53	1.00	1.25	0.95	1.62	Sample 1996
Cobalt																	
Dose/High TRV	0.08	5.63E-04	32.00	1.80E-02	0.08	6.50E-06	2.08E-04	6.50E-04	5.19E-05	1.00	0.96	0.0189	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.08	5.63E-04	32.00	1.80E-02	0.08	6.50E-06	2.08E-04	6.50E-04	5.19E-05	1.00	0.96	0.02	NA	NA	NA	No TRV[12]	No TRV[12]
Copper																	
Dose/High TRV	0.08	5.63E-04	1,190.00	0.67	0.08	6.50E-06	7.74E-03	2.42E-02	1.93E-03	1.00	0.96	0.70	52.26	0.41	61.95	0.01	EFA West 1998
Dose/Low TRV	0.08	5.63E-04	1,190.00	0.67	0.08	6.50E-06	7.74E-03	2.42E-02	1.93E-03	1.00	0.96	0.70	2.30	0.64	2.49	0.28	EFA West 1998
Lead																	
Dose/High TRV	0.08	5.63E-04	3,400.00	1.91	0.08	4.32E-07	1.47E-03	4.59E-03	3.66E-04	1.00	0.96	2.00	8.75	0.80	9.07	0.22	EFA West 1998
Dose/Low TRV	0.08	5.63E-04	3,400.00	1.91	0.08	4.32E-07	1.47E-03	4.59E-03	3.66E-04	1.00	0.96	2.00	0.01	0.08	0.02	87.81	EFA West 1998
Manganese																	
Dose/High TRV	0.08	5.63E-04	1,440.00	0.81	0.08	6.50E-06	9.36E-03	2.93E-02	2.34E-03	1.00	0.96	0.85	776.00	0.08	1274.75	0.001	EFA West 1998
Dose/Low TRV	0.08	5.63E-04	1,440.00	0.81	0.08	6.50E-06	9.36E-03	2.93E-02	2.34E-03	1.00	0.96	0.85	77.60	0.08	126.24	0.01	EFA West 1998
Mercury																	
Dose/High TRV	0.08	5.63E-04	1.40	0.00	0.08	7.52E-06	1.05E-05	3.29E-05	2.63E-06	1.00	0.96	0.00	0.18	1.00	0.18	0.00	EFA West 1998
Dose/Low TRV	0.08	5.63E-04	1.40	0.00	0.08	7.52E-06	1.05E-05	3.29E-05	2.63E-06	1.00	0.96	0.00	0.04	1.00	0.04	0.02	EFA West 1998
Nickel																	
Dose/High TRV	0.08	5.63E-04	160.00	0.09	0.08	8.63E-06	1.38E-03	4.32E-03	3.44E-04	1.00	0.96	0.09	55.16	0.78	57.46	0.00	EFA West 1998
Dose/Low TRV	0.08	5.63E-04	160.00	0.09	0.08	8.63E-06	1.38E-03	4.32E-03	3.44E-04	1.00	0.96	0.09	1.38	0.78	1.44	0.07	EFA West 1998
Selenium																	
Dose/High TRV	0.08	5.63E-04	4.40	0.00	0.08	3.27E-06	1.44E-05	4.50E-05	3.59E-06	1.00	0.96	0.00	0.93	1.00	0.92	0.00	EFA West 1998
Dose/Low TRV	0.08	5.63E-04	4.40	0.00	0.08	3.27E-06	1.44E-05	4.50E-05	3.59E-06	1.00	0.96	0.00	0.23	1.00	0.23	0.01	EFA West 1998
Vanadium																	
Dose/High TRV	0.08	5.63E-04	110.00	0.06	0.08	6.50E-06	7.15E-04	2.23E-03	1.78E-04	1.00	0.96	0.06	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.08	5.63E-04	110.00	0.06	0.08	6.50E-06	7.15E-04	2.23E-03	1.78E-04	1.00	0.96	0.06	11.40	1.17	10.95	0.01	Sample 1996
Zinc																	
Dose/High TRV	0.08	5.63E-04	20,000.00	11.26	0.08	1.29E-07	2.58E-03	8.06E-03	6.44E-04	1.00	0.96	11.76	172.00	0.96	172.07	0.07	EFA West 1998
Dose/Low TRV	0.08	5.63E-04	20,000.00	11.26	0.08	1.29E-07	2.58E-03	8.06E-03	6.44E-04	1.00	0.96	11.76	17.20	0.96	17.21	0.68	EFA West 1998

TABLE C-3
RED-TAILED HAWK DOSE CALCULATIONS AND HAZARD QUOTIENTS FOR SITE 29
NAVAL WEAPONS STATION, SEAL BEACH DETACHMENT CONCORD, CONCORD, CALIFORNIA

Chemical	Total Ingestion Rate[1] (kg/day)	Soil Ingestion Rate[2] (kg/day)	Soil Concentration[3] (mg/kg)	Soil Daily Dose[4] (mg/day)	Prey Ingestion Rate[5] (kg/day)	Soil to Mouse BAF (unitless)	Prey Concentration wet weight (mg/kg)	Prey Concentration dry weight (mg/kg)	Prey Daily Dose[6] (mg/day)	SUF	Body Weight[7] (kg)	Total Daily Dose[8] (mg/kg/day)	TRV[9] (mg/kg/day)	Test Species Body Weight[9] (kg)	Allometrically Adjusted TRV[10] (mg/kg/day)	HQ[11] (based on adjusted TRV)	Source of TRV
Anthracene[13]																	
Dose/High TRV	0.08	5.63E-04	7.00	3.94E-03	0.08	1.73E-05	1.21E-04	3.78E-04	3.02E-05	1.00	0.96	4.15E-03	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.08	5.63E-04	7.00	3.94E-03	0.08	1.73E-05	1.21E-04	3.78E-04	3.02E-05	1.00	0.96	4.15E-03	NA	NA	NA	No TRV[12]	No TRV[12]
Benzo(b/k)fluoranthene																	
Dose/High TRV	0.08	5.63E-04	0.48	2.70E-04	0.08	5.75E-05	2.76E-05	8.63E-05	6.89E-06	1.00	0.96	2.89E-04	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.08	5.63E-04	0.48	2.70E-04	0.08	5.75E-05	2.76E-05	8.63E-05	6.89E-06	1.00	0.96	2.89E-04	NA	NA	NA	No TRV[12]	No TRV[12]
Bis(2-ethylhexyl)phthalate																	
Dose/High TRV	0.08	5.63E-04	3.90	2.19E-03	0.08	5.80E-06	2.26E-05	7.07E-05	5.64E-06	1.00	0.96	2.30E-03	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.08	5.63E-04	3.90	2.19E-03	0.08	5.80E-06	2.26E-05	7.07E-05	5.64E-06	1.00	0.96	2.30E-03	1.11	0.16	1.59	0.001	Sample 1996
Chrysene																	
Dose/High TRV	0.08	5.63E-04	1.90	1.07E-03	0.08	1.99E-05	3.78E-05	1.18E-04	9.43E-06	1.00	0.96	1.13E-03	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.08	5.63E-04	1.90	1.07E-03	0.08	1.99E-05	3.78E-05	1.18E-04	9.43E-06	1.00	0.96	1.13E-03	NA	NA	NA	No TRV[12]	No TRV[12]
DDT																	
Dose/High TRV	0.08	5.63E-04	0.23	1.29E-04	0.08	6.52E-05	1.50E-05	4.69E-05	3.74E-06	1.00	0.96	1.39E-04	1.50	3.00	1.19	0.00012	EFA West 1998
Dose/Low TRV	0.08	5.63E-04	0.23	1.29E-04	0.08	6.52E-05	1.50E-05	4.69E-05	3.74E-06	1.00	0.96	1.39E-04	0.009	1.00	0.01	0.0156	EFA West 1998
Fluoranthene																	
Dose/High TRV	0.08	5.63E-04	6.40	3.60E-03	0.08	4.86E-05	3.11E-04	9.72E-04	7.76E-05	1.00	0.96	3.84E-03	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.08	5.63E-04	6.40	3.60E-03	0.08	4.86E-05	3.11E-04	9.72E-04	7.76E-05	1.00	0.96	3.84E-03	NA	NA	NA	No TRV[12]	No TRV[12]
Methylene Chloride[14]																	
Dose/High TRV	0.08	5.63E-04	0.01	5.63E-06	0.08	2.17E-11	2.17E-13	6.78E-13	5.41E-14	1.00	0.96	5.88E-06	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.08	5.63E-04	0.01	5.63E-06	0.08	2.17E-11	2.17E-13	6.78E-13	5.41E-14	1.00	0.96	5.88E-06	NA	NA	NA	No TRV[12]	No TRV[12]
Pyrene																	
Dose/High TRV	0.08	5.63E-04	4.50	2.53E-03	0.08	4.86E-05	2.19E-04	6.83E-04	5.46E-05	1.00	0.96	2.70E-03	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.08	5.63E-04	4.50	2.53E-03	0.08	4.86E-05	2.19E-04	6.83E-04	5.46E-05	1.00	0.96	2.70E-03	NA	NA	NA	No TRV[12]	No TRV[12]
Xylene[15]																	
Dose/High TRV	0.08	5.63E-04	0.02	0.00	0.08	6.00E+00	1.20E-01	3.75E-01	2.99E-02	1.00	0.96	3.13E-02	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.08	5.63E-04	0.02	0.00	0.08	6.00E+00	1.20E-01	3.75E-01	2.99E-02	1.00	0.96	3.13E-02	NA	NA	NA	No TRV[12]	No TRV[12]
SUBSURFACE SOIL																	
Barium																	
Dose/High TRV	0.08	5.63E-04	1,240.00	0.70	0.08	2.16E-07	2.68E-04	8.37E-04	6.68E-05	1.00	0.96	0.73	41.70	0.12	63.17	0.01	Sample 1996
Dose/Low TRV	0.08	5.63E-04	1,240.00	0.70	0.08	2.16E-07	2.68E-04	8.37E-04	6.68E-05	1.00	0.96	0.73	20.80	0.12	31.51	0.02	Sample 1996
Copper																	
Dose/High TRV	0.08	5.63E-04	66.80	0.04	0.08	6.50E-06	4.34E-04	1.36E-03	1.08E-04	1.00	0.96	0.04	52.26	0.41	61.95	0.00	EFA West 1998
Dose/Low TRV	0.08	5.63E-04	66.80	0.04	0.08	6.50E-06	4.34E-04	1.36E-03	1.08E-04	1.00	0.96	0.04	2.30	0.64	2.49	0.02	EFA West 1998
Manganese																	
Dose/High TRV	0.08	5.63E-04	6,560.00	3.69	0.08	6.50E-06	4.26E-02	1.33E-01	1.06E-02	1.00	0.96	3.87	776.00	0.08	1274.75	0.003	EFA West 1998
Dose/Low TRV	0.08	5.63E-04	6,560.00	3.69	0.08	6.50E-06	4.26E-02	1.33E-01	1.06E-02	1.00	0.96	3.87	77.60	0.08	126.24	0.03	EFA West 1998
Mercury																	
Dose/High TRV	0.08	5.63E-04	0.22	0.00	0.08	7.52E-06	1.65E-06	5.17E-06	4.13E-07	1.00	0.96	0.00	0.18	1.00	0.18	0.001	EFA West 1998
Dose/Low TRV	0.08	5.63E-04	0.22	0.00	0.08	7.52E-06	1.65E-06	5.17E-06	4.13E-07	1.00	0.96	0.00	0.04	1.00	0.04	0.003	EFA West 1998

TABLE C-3
RED-TAILED HAWK DOSE CALCULATIONS AND HAZARD QUOTIENTS FOR SITE 29
NAVAL WEAPONS STATION, SEAL BEACH DETACHMENT CONCORD, CONCORD, CALIFORNIA

Chemical	Total Ingestion Rate[1] (kg/day)	Soil Ingestion Rate[2] (kg/day)	Soil Concentration[3] (mg/kg)	Soil Daily Dose[4] (mg/day)	Prey Ingestion Rate[5] (kg/day)	Soil to Mouse BAF (unitless)	Prey Concentration wet weight (mg/kg)	Prey Concentration dry weight (mg/kg)	Prey Daily Dose[6] (mg/day)	SUF	Body Weight[7] (kg)	Total Daily Dose[8] (mg/kg/day)	TRV[9] (mg/kg/day)	Test Species Body Weight[9] (kg)	Allometrically Adjusted TRV[10] (mg/kg/day)	HQ[11] (based on adjusted TRV)	Source of TRV
SUBSURFACE SOIL (Cont'd)																	
Selenium																	
Dose/High TRV	0.08	5.63E-04	1.50	0.00	0.08	3.27E-06	4.91E-06	1.53E-05	1.22E-06	1.00	0.96	0.00	0.93	1.00	0.92	0.001	EFA West 1998
Dose/Low TRV	0.08	5.63E-04	1.50	0.00	0.08	3.27E-06	4.91E-06	1.53E-05	1.22E-06	1.00	0.96	0.00	0.23	1.00	0.23	0.004	EFA West 1998
Thallium																	
Dose/High TRV	0.08	5.63E-04	7.00	0.00	0.08	5.75E-05	4.03E-04	1.26E-03	1.00E-04	1.00	0.96	0.00	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.08	5.63E-04	7.00	0.00	0.08	5.75E-05	4.03E-04	1.26E-03	1.00E-04	1.00	0.96	0.00	NA	NA	NA	No TRV[12]	No TRV[12]
Vanadium																	
Dose/High TRV	0.08	5.63E-04	99.70	0.06	0.08	6.50E-06	6.48E-04	2.03E-03	1.62E-04	1.00	0.96	0.06	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.08	5.63E-04	99.70	0.06	0.08	6.50E-06	6.48E-04	2.03E-03	1.62E-04	1.00	0.96	0.06	11.40	1.17	10.95	0.01	Sample 1996
TCE																	
Dose/High TRV	0.08	5.63E-04	0.002	0.00	0.08	NA	NA	NA	NA	1.00	0.96	NA	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.08	5.63E-04	0.002	0.00	0.08	NA	NA	NA	NA	1.00	0.96	NA	NA	NA	NA	No TRV[12]	No TRV[12]

Notes: Highlighted cells indicate HQs greater than 1.0.

1 Ingestion rate was calculated with body weight of 957 grams using the Nagy (2001) dry matter intake food requirement equation for carnivorous birds (a= 0.849; b= 0.663).
2 Rate for red-tailed hawk reported in EPA (1999); 0.7 percent of total ingestion rate.
3 The maximum concentration of all site-collected soil samples was used.
4 Soil daily dose was calculated by multiplying the soil ingestion rate (see note 2) by the habitat area maximum soil concentration (see note 3).
5 Prey ingestion rate is 99.3 percent of total ingestion rate. The remainder of the diet is incidentally ingested soil (see note 2).
6 Prey daily dose calculated by multiplying the maximum soil concentration by the rodent BAF (EPA 1999).
7 Average weight of adult males throughout the U.S. (Steenhof 1983, as cited in EPA 1993).
8 Total daily dose is calculated using the following equation: total daily dose = ((soil daily dose + prey daily dose)*SUF)/receptor species body weight.
9 The derivation of TRVs is described in EFA WEST (1998) and Sample (1996).
10 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2)}$.
11 The HQ was calculated using total daily dose/allometrically adjusted TRV.
12 Sufficient data are not available to derive a TRV. This chemical was evaluated qualitatively.
13 The BAF for benzo(a)anthracene was used as a surrogate for anthracene
14 The BAF for acetone was used as a surrogate for methylene chloride
15 The BAF for low molecular weight PAHs was used as a surrogate for xylene

BAF Bioaccumulation factor
DDT Dichlorodiphenyltrichloroethane
EFA WEST Naval Facilities Engineering Command, Engineering Field Activity West
EPA U.S. Environmental Protection Agency
HQ Hazard quotient
kg Kilogram
kg/day Kilogram per day
mg/day Milligram per day
mg/kg Milligram per kilogram
mg/kg/day Milligram per kilogram per day
NA Not available
SUF Site use factor
TCE Trichloroethene
TRV Toxicity reference value

Nagy, K.A. 2001. "Food Requirements of Wild Animals: Predictive Equations for Free-Living Mammals, Reptiles, and Birds." Nutrition Abstracts and Reviews, Series B: Livestock Feeds and Feeding. Volume 71. Number 10. Pages 21R through 31R.
Naval Facilities Engineering Command, Engineering Field Activity West. 1998. "Development of Toxicity Reference Values for Conducting Ecological Risk Assessments at Naval Facilities in California, Interim Final." San Bruno, California.
Sample, B.E., D.M. Opresko, G.W. Suter, II. 1996. "Toxicological Benchmarks for Wildlife: 1996 Revision." ES/ER/TM-86/R3. Oak Ridge National Laboratory. Oak Ridge, Tennessee.
EPA. 1993. "Wildlife Exposure Factors Handbook; Volumes I and 2." EPA 600/R-93/187a. December.
EPA. 1999. "Screening Level Ecological Risk Assessment Protocol." EPA Region 6, Office of Solid Waste, Center for Combustion Science and Engineering. August.

APPENDIX D

COST ESTIMATES FOR PROPOSED REMEDIAL ALTERNATIVES

APPENDIX D

LIST OF TABLES

APPENDIX D
COST ASSUMPTIONS FOR REMEDIAL ALTERNATIVES AND MITIGATIVE MEASURES
SITE 29 FEASIBILITY STUDY
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

The costs presented on Table D-1 for Alternative 2 and Table D-2 for Alternative 3 are for comparison purposes only and are intended to have an estimated accuracy of only +50 percent to -30 percent (Comprehensive Environmental Response, Compensation, and Liability Act of 1980 [CERCLA] Feasibility Study Criteria). Many design variables and permitting requirements have not been established. Construction cost estimates will be refined after system design is complete. A contingency of 15 percent of the direct costs is included in these estimates to reflect the uncertainty.

COMPONENTS OF COST ESTIMATE

Grand Total	Sum of capital costs (including direct costs, engineering costs, and contingency).
Total Capital Costs	Sum of the total direct costs, total engineering costs, and contingency (applied to direct costs only).
Total Direct Costs	Costs based on unit rates for remediation tasks.
Total Engineering Costs	Costs for engineering and management, report preparation, construction management, health and safety, permitting, and other costs based on a percentage of the direct costs. Engineering costs are proportional to direct costs, and range from 10 to 24 percent, depending on the complexity and cost.
Contingency	15% contingency applied to direct costs and annual O&M costs. Contingency was not applied to engineering costs.

GENERAL ASSUMPTIONS

- Estimated costs for all direct costs assume that the Navy will contract with the remedial action contractor (RAC) directly.
- Mobilization and demobilization costs are based on the length of time and amount of equipment required to implement the alternative.
- Engineering design and construction oversight, inspection, management, and testing cost estimates depend on technical complexity and the range of direct cost.
- Health and safety and monitoring depend on complexity and direct costs.

SPECIFIC ASSUMPTIONS

Specific assumptions follow work breakdown structure designations (i.e., 33.02.09) specified by the Department of the Navy's guidance document, "Hazardous, Toxic, and Radioactive Waste Removal Action" dated July 1993. Unless otherwise stated, the distribution of the total cost of an action between labor, equipment, and material costs is based on the estimator's general knowledge of the specified activity and not on specific cost breakdowns provided by vendors or subcontractors.

Table D-1, Alternative 2

33.08.02.90 Cost of concrete cap based on contractors estimate.

Table D-2, Alternative 3

33.02 Monitoring, Sampling, Testing and Analysis

33.02.06.02 Cost for sample collection for subsurface soil samples is $26 per sample, based on a 8 hour day of sampling for one person billing out at $80/hour, plus $5 of equipment (sample kits, vehicle, etc.) and $5 in materials (sample tubes, ice, etc.). All asbestos sampling will conducted by asbestos survey or asbestos removal subcontractors. Costs for asbestos sampling are included in costs for asbestos survey and asbestos removal.

33.02.09.90 Soil laboratory analysis costs are estimated at $165 per sample for the soil conformation and soil characterization samples. $165 is the price charged by a local laboratory for analysis of metals. One soil confirmation sample will be taken from 32 points in the excavated area. Each point will be fifty feet away from the nearest point in any direction.

33.02.09.91 Four soil characterization samples are required by landfills for soil volumes of less than 500 cubic yards. As two different landfills will be used for this project, eight soil characterization samples will be needed.

33.02.09.92 Approximately 25 samples will be required for the asbestos survey. This estimate is based only on the size of the building. Each sample will cost $20 for analysis and collection. Sampling costs associated with asbestos removal/abatement are included in items 33.03.90.90 and 33.03.90.91.

33.02.09.93 Approximately 20 samples will be required for the lead paint survey. This estimate is based only on the size of the building. Each sample will cost $50 for analysis and collection. Sampling costs associated with lead paint removal/abatement are included in items 33.03.90.92 and 33.03.90.93.

33.03 Site Work

33.03.01.90 Building demolition costs based on estimate from contractor. Contractor's estimate based on building size and construction.

33.03.03.90 Excavation costs based on estimate from contractor. Assumes that approximately 165 cubic yards (4,400 square feet by 1 foot deep) will be excavated under the building footprint.

33.03.90.90 Asbestos survey and removal costs are based on estimates from contractors. Contractors estimates are based only on the size of the building.

33.03.90.92 Lead survey and removal costs are based upon engineering experience with similar projects.

33.19 Disposal

Transportation and disposal costs are for Class II disposal at Keller Canyon landfill in Pittsburgh, CA and for Class III disposal at the Potrero Hills landfill in Suisun City, CA. Unit costs for transportation and disposal for the Keller Canyon (Class II) were obtained from Keller Canyon personnel. Unit costs for disposal at the Potrero Hills landfill (Class III) were obtained from Potrero Hills personnel.

33.20 Site Restoration

Unit costs for compaction, backfill and grading are based on contractors estimate. Revegetation will be accomplished with hydroseeding.

TABLE D-1
COSTS FOR PROPOSED REMEDIAL ALTERNATIVES
ALTERNATIVE 2
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

LOCATION: CONCORD NAVAL WEAPONS STATION- SITE 29 COUNTY OF CONTRA COSTA STATE OF CALIFORNIA	**SPEC NO:**		
	ORIGINATOR OF OPINION: P. Grow **FIRM:** LFR Levine Fricke	**CHECKED BY:** John Bosche, PE **FIRM:** TtEMI	**DATE:** 06/08/03
PROJECT TITLE: Site 29 Feasibility Study - Alternative 2	**SUBMITTAL STATUS:** Draft	**EFA WEST DELIVERY ORDER NO:** CTO No. 325	

Description	Quantity Amount	Quantity Unit	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Opinion Total Unit Cost	Opinion Total Cost
Grand Total				**$64,600**		**$11,800**		**$6,900**		**$83,200**
Net Present Value (NPV) O&M Costs 30 years (assume 3.9 percent interest)				**$13,000**		**$0**		**$0**		**$13,000**
Total annual O&M costs (includes annual site walk)				$750		$0		$0		$750
Total Capital Costs				**$51,600**		**$11,800**		**$6,900**		**$70,200**
Total Direct Costs				$9,400		$9,500		$6,000		$24,900
Total Distributive Costs				$40,700		$800		$0		$41,500
Contingency (on Direct Costs Only - 15%)				$1,500		$1,500		$900		$3,800
33 Hazardous Toxic, and Radioactive Waste										
33.01 Mobilization and Preparatory Work				**$200**		**$300**		**$0**		**$500**
33.01.01 Mobilization of Construction Equipment and Facilities				**$0**		**$300**		**$0**		**$300**
33.01.01.90 Mobilization of Construction Equipment	1	ls		$0	$300.00	$300		$0	$300.00	$300
33.01.02 Mobilization of Personnel				**$200**		**$0**		**$0**		**$200**
33.01.02.90 Mobilization of Personnel	1	ls	$200.00	$200		$0		$0	$200.00	$200
33.08 Solids Collection and Containment				**$9,000**		**$9,000**		**$6,000**		**$24,000**
33.08.02 Capping of Contaminated Area				**$9,000**		**$9,000**		**$6,000**		**$24,000**
33.08.90 Concrete Cap	6,000	sq. ft.	$1.50	$9,000	$1.50	$9,000	$1.00	$6,000	$3.00	$24,000
33.21 Demobilization				**$200**		**$200**		**$0**		**$400**
33.21.04 Demobilization of Construction Equipment				**$0**		**$200**		**$0**		**$200**
33.21.04.90 Construction Equipment				$0		$200		$0	$0.00	$200
33.21.05.90 Demobilization of Personnel				**$200**		**$0**		**$0**		**$200**
33.21.05.90 Demobilization of Personnel	1	ls	$0.00	$200		$0		$0		$200
33.99 Distributive Costs				**$40,700**		**$800**		**$0**		**$41,500**
33.99.01 Construction Supervision/Management				**$20,800**		**$800**		**$0**		**$21,600**
33.99.01.90 Construction Supervision/Management	8	hours	$100.00	$800	$100.00	$800		$0	$200.00	$1,600
33.99.01.91 Prepare Land Use Control Remedial Design (LUC RD) and Base Master Plan Notations	1	ls	$20,000.00	$20,000	$0.00	$0	$0.00	$0	$20,000.00	$20,000
33.99.04 Engineering				**$18,400**		**$0**		**$0**		**$18,400**
33.99.04.90 Engineering Design, Permitting, and Manifesting	1	ls	$3,400.00	$3,400		$0		$0	$3,400.00	$3,400
33.99.04.91 5-Year Review Report	1	ls	$15,000.00	$15,000		$0		$0	$15,000.00	$15,000
33.99.15 Health and Safety				**$1,500**		**$0**		**$0**		**$1,500**
33.99.15.17 Personal Protective Equipment	1	day		$0		$0		$0	$0.00	$0
33.99.15.90 Health and Safety Monitoring and Personnel	1	ls	$1,500.00	$1,500		$0		$0	$1,500.00	$1,500

TABLE D-2
COSTS FOR PROPOSED REMEDIAL ALTERNATIVES
ALTERNATIVE 3
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

LOCATION: CONCORD NAVAL WEAPONS STATION- SITE 29 COUNTY OF CONTRA COSTA STATE OF CALIFORNIA	**SPEC NO:**		
	ORIGINATOR OF OPINION: P. Grow **FIRM:** LFR Levine Fricke	**CHECKED BY:** John Bosche, P.E. **FIRM:** TtEMI	**DATE:** 06/08/03
PROJECT TITLE: Site 29 Feasibility Study - Alternative 3	**SUBMITTAL STATUS:** Draft		

Description	Quantity Amount	Quantity Unit	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Opinion Total Unit Cost	Opinion Total Cost
Grand Total				**$96,600**		**$51,600**		**$9,900**		**$157,300**
Total Capital Costs				**$96,600**		**$51,600**		**$9,900**		**$157,300**
Total Direct Costs				$55,900		$42,400		$6,800		$104,500
Total Distributive Costs				$32,300		$2,800		$2,000		$37,100
Contingency (on Direct Costs Only - 15%)				$8,400		$6,400		$1,100		$15,700
33 Hazardous Toxic, and Radioactive Waste										
33.01 Mobilization and Preparatory Work				**$200**		**$1,800**		**$0**		**$2,000**
33.01.01 Mobilization of Construction Equipment and Facilities				**$0**		**$1,800**		**$0**		**$1,800**
33.01.01.90 Mobilization of Construction Equipment	1	ls		$0	$1,800.00	$1,800		$0	$1,800.00	$1,800
33.01.02 Mobilization of Personnel				**$200**		**$0**		**$0**		**$200**
33.01.02.90 Mobilization of Personnel	1	ls	$200.00	$200		$0		$0	$200.00	$200
33.02 Monitoring, Sampling, Testing and Analysis				**$4,700**		**$2,900**		**$2,100**		**$9,500**
33.02.06 Sampling Soil and Sediment				**$800**		**$200**		**$200**		**$1,200**
33.02.06.02 Sub-surface Soil	40	samples	$20.00	$800	$5.00	$200	$5.00	$200	$30.00	$1,200
33.02.09 Laboratory Chemical Analysis				**$3,850**		**$2,625**	**$80**	**$1,825**		**$8,300**
33.02.09.90 Soil Confirmation Sampling	32	each	$80.00	$2,560	$50.00	$1,600	$40.00	$1,280	$170.00	$5,440
33.02.09.91 Soil Characterization	8	each	$80.00	$640	$50.00	$400	$40.00	$320	$170.00	$1,360
33.02.09.92 Asbestos Survey Sampling	25	each	$10.00	$250	$5.00	$125	$5.00	$125	$20.00	$500
33.02.09.93 Lead Paint Survey Sampling	20	each	$20.00	$400	$25.00	$500	$5.00	$100	$50.00	$1,000
33.03 Site Work				**$35,100**		**$22,100**		**$4,300**		**$61,400**
33.03.01 Building Demolition				**$8,800**		**$8,800**		**$0**		**$17,600**
33.03.01.90 Demolition of Wood Frame Building	4,400	sq. ft.	$2.00	$8,800	$2.00	$8,800	$0.00	$0	$4.00	$17,600
33.03.03 Earthwork				**$660**		**$495**		**$0**		**$1,155**
33.03.03.02 Excavation	165	cy	$4.00	$660	$3.00	$495		$0	$7.00	$1,155
33.03.90 Asbestos and Lead Paint Removal/Abatement				**$25,600**		**$12,760**		**$4,240**		**$42,600**
33.03.90.90 Asbestos Survey	1	ls	$800.00	$800	$380.00	$380	$120.00	$120	$1,300.00	$1,300
33.03.90.91 Asbestos Removal	1	ls	$12,000.00	$12,000	$6,000.00	$6,000	$2,000.00	$2,000	$20,000.00	$20,000
33.03.90.92 Lead Based Paint Survey	1	ls	$800.00	$800	$380.00	$380	$120.00	$120	$1,300.00	$1,300
33.03.90.93 Lead Based Paint Removal	1	ls	$12,000.00	$12,000	$6,000.00	$6,000	$2,000.00	$2,000	$20,000.00	$20,000
33.19 Disposal (Commercial)				**$7,100**		**$5,300**		**$0**		**$12,300**
33.19.02 Transportation to Storage/Disposal Facility				**$2,870**		**$1,070**		**$0**		**$3,940**
33.19.02.01 Loading/Hauling/Unloading of Solids (Class II)	170	cy	$7.00	$1,190	$3.00	$510		$0	$10.00	$1,700
33.19.02.01 Loading/Hauling/Unloading of Solids (Class III)	280	cy	$6.00	$1,680	$2.00	$560		$0	$8.00	$2,240
33.19.03 Disposal Fees and Taxes				**$4,140**		**$4,140**		**$0**		**$8,280**
33.19.03.01 Class II Landfill Disposal Fees	170	cy	$12.00	$2,040	$12.00	$2,040		$0	$24.00	$4,080
33.19.03.90 Class III Landfill Disposal Fees	280	cy	$7.50	$2,100	$7.50	$2,100		$0	$15.00	$4,200
33.20 Site Restoration				**$8,600**		**$8,500**		**$400**		**$17,300**
33.20.01 Earthwork				**$8,520**		**$8,415**		**$315**		**$17,250**
33.20.01.03 Backfill and Compaction	4,400	sq. ft.	$1.00	$4,400	$1.00	$4,400		$0	$2.00	$8,800
33.20.01.07 Grading	3,700	sq. ft.	$1.00	$3,700	$1.00	$3,700		$0	$2.00	$7,400
33.20.01.90 Revegetation	1	ls	$420.00	$420	$315.00	$315	$315.00	$315	$1,050.00	$1,050
33.21 Demobilization				**$200**		**$1,800**		**$0**		**$2,000**
33.21.04 Demobilization of Construction Equipment				**$0**		**$1,800**		**$0**		**$1,800**
33.21.04.90 Demobilization of Construction Equipment	1	ls		$0	$1,800.00	$1,800		$0	$1,800.00	$1,800
33.21.05.90 Demobilization of Personnel				**$200**		**$0**		**$0**		**$200**
33.21.05.90 Demobilization of Personnel	1	ls	$200.00	$200		$0		$0		$200
33.99 Distributive Costs				**$32,300**		**$2,800**		**$2,000**		**$37,100**
33.99.01 Construction Supervision/Management				**$25,600**		**$800**		**$0**		**$26,400**
33.99.01.90 Construction Supervision/Management	8	weeks	$3,200.00	$25,600	$100.00	$800		$0	$3,300.00	$26,400
33.99.04 Engineering (Design, Permitting and Manifesting)				**$4,200**		**$0**		**$0**		**$4,200**
33.99.04.90 Engineering (Design, Permitting)	1	ls	$4,200.00	$4,200		$0		$0	$4,200.00	$4,200
33.99.15 Health and Safety				**$2,500**		**$2,000**		**$2,000**		**$6,500**
33.99.15.17 Personal Protective Equipment	8	weeks		$0		$0	$250.00	$2,000	$250.00	$2,000
33.99.15.90 Health and Safety Monitoring and Personnel	1	ls	$2,500.00	$2,500	$2,000.00	$2,000		$0	$4,500.00	$4,500