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San Bruno, California

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FEASIBILITY STUDY REPORT
SITE 29
NAVAL WEAPONS STATION SEAL BEACH
DETACHMENT CONCORD
CONCORD, CALIFORNIA

November 13, 2001

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ACRONYMS AND ABBREVIATIONS

ACM	Asbestos-containing materials
ALAD	aminolevulenic acid
AOC	Area of contamination
ARAR	Applicable or relevant and appropriate requirement
BAAQMD	Bay Area Air Quality Management District
BFI	Browning Ferris Industries
bgs	Below ground surface
C_{max}	Maximum detected concentrations
CAA	Clean Air Act
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
CLEAN	Comprehensive Long-term Environmental Action Navy
CNDDB	California Department of Fish and Game Natural Diversity Database
COC	Chemical of concern
COEC	Chemical of ecological concern
COPC	Chemical of potential concern
COPEC	Chemical of potential ecological concern
CSF	Cancer slope factor
CTO	Contract task order
cy	cubic yards
DNA	Deoxyribonucleic acid
DoD	Department of Defense
DoT	Department of Transportation
DTSC	Department of Toxic Substances Control
EC	Effective concentration
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
FETAX	Frog Embryo Teratogenesis Assay Xenopus Test
FFA	Federal Facilities Agreement
FS	Feasibility Study
GRA	General Response Action

ACRONYMS AND ABBREVIATIONS (continued)

HI	Hazard index
HQ	Hazard quotient
HSWA	Hazardous and Solid Waste Amendment
HHRA	Human Health Risk Assessment
IMP	Installation Master Plan
IRIS	Integrated Risk Information System
IRP	Installation restoration program
LC	Lethal concentration
LCL	Lower confidence limit
LDR	Land disposal restrictions
LFR	LFR Levine·Fricke
LOEC	Low observed effect concentration
LUCICP	Land Use Control Implementation and Certification Plan
µg/L	Micrograms per liter
µg/dL	Micrograms per deciliter
µg/kg	Micrograms per kilogram
mg/kg	Milligrams per kilogram
NACIP	Navy Assessment and Control of Installation Pollutants
Navy	U.S. Department of the Navy
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
NPL	National Priorities List
O&G	Oil and grease
O&M	Operation and Maintenance
ORNL	Oak Ridge National Laboratory
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
RA	Remedial alternative
RACM	Regulated Asbestos Containing Materials
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act

ACRONYMS AND ABBREVIATIONS (continued)

RfC	Reference concentrations
RfD	Reference dose
RFA	RCRA Facility Assessment
RFACS	RCRA Facility Assessment Confirmation Study
RI/FS	Remedial Investigation/Feasibility Study
RNA	Ribonucleic acid
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SARA	Superfund Amendment and Reauthorization Act
SBD	Seal Beach Detachment
SI	Site investigation
Site	Naval Weapons Station SBD Concord
SIP	State Implementation Plan
SLERA	Screening Level Ecological Risk Assessment
SRA	Screening-Level Risk Assessment
STLC	Soluble threshold limit concentration
SVOC	Semivolatile organic compounds
SWMU	Solid waste management unit
TBC	To be considered
TCE	Trichloroethene
TCLP	toxicity characteristic leaching procedure
TPH	Total petroleum hydrocarbon
TtEMI	Tetra Tech EM Inc.
TTLC	total threshold limit concentration
UCL_{95}	95 percent upper confidence limit on the arithmetic mean
URTD	Upper respiratory tract disease
USC	United States Code
USFWS	U.S. Fish & Wildlife Services
VOC	Volatile organic compound
WDR	Waste Discharge Requirements

EXECUTIVE SUMMARY

Tetra Tech EM Inc. (TtEMI) and its team firm LFR Levine Fricke (LFR) have prepared this focused feasibility study (FS) for Site 29, Naval Weapons Station Seal Beach Detachment Concord (Naval Weapons Station SBD Concord) located in Concord, California (the Site).

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. 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 (NCP) and with EPA guidance (EPA 1988) under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The remedial alternatives that are 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 Naval Weapons Station SBD Concord Site Investigation (SI) report (TtEMI 1999).

PREVIOUS INVESTIGATIONS

1988 – 1989 Building Crawlspace Surface Soils Sampling Event

Site investigations were conducted 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 spaces beneath Building IA-25. The soil samples were collected between the surface and 18 inches below grade. These 1988 and 1989 sampling events are collectively referred to as the "Building Crawlspace Surface Soils" sampling event throughout this report.

Based on sampling results, the Navy concluded (as documented in IT's report [IT 1990]) that shallow soils beneath the building contain metals and low-level detections of explosives, volatile organic compounds

(VOC), semivolatile organic compounds (SVOC), pesticides, polychlorinated biphenyls (PCB), polynuclear aromatic hydrocarbons (PAH), and chlorinated herbicides. However, a human health risk assessment (HHRA) (worker hazard assessment) performed for this sampling event concluded that no chronic exposure or long-term health effects to construction and maintenance workers were anticipated from compounds found 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 1990).

1999 Subsurface Soils Sampling Event

In January and February of 1999 LFR 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). Metals were detected from all soil samples collected. Arsenic, iron, manganese, and thallium were the only metals detected at concentrations exceeding Federal EPA Region IX residential preliminary remediation goals (PRG) (EPA 2000). However, of these four metals, only arsenic was detected at concentrations exceeding industrial PRGs and only manganese and thallium were detected at concentrations exceeding estimated ambient concentrations.

SCREENING-LEVEL RISK ASSESSMENT

A screening-level risk assessment (SRA) was completed for two areas at Site 29: (1) the Building IA-25 crawlspace and (2) "subsurface soils" east of Building IA-25. The SRA was conducted to identify chemicals detected in soil at Site 29 that could be associated with potential human health concerns. The data evaluated in the SRA included data collected during the Building Crawlspace Surface Soils sampling event and the Subsurface Soils sampling event, and were evaluated separately. 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 SRA 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 November 2000 PRGs. The SRA 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 and identification of areas for (1) elimination as an area of concern if all concentrations were below PRGs, total cancer risks were less than 10^{-6}, and HIs were less than 1 or (2) requiring additional investigation or more detailed risk evaluation.

Building Crawlspace Surface Soils Sampling Event

Total cancer risks posed by Building Crawlspace surface soil under both residential (2.1×10^{-5}) and industrial (6.5×10^{-6}) exposure scenarios exceeded 1×10^{-6}, but were within the EPA target risk range of 1×10^{-6} to 1×10^{-4}. The total non-cancer HI under the residential exposure scenario exceeded the threshold HI of 1 due to the combined concentrations of metal compounds detected. However, the segregated HIs were each below the threshold HI of 1, except for the central/peripheral nervous system, with a segregated HI of 1.2 due primarily to concentrations of manganese and aluminum. The non-cancer HI under the industrial exposure scenario was below the threshold HI of 1.

The maximum detected concentrations of manganese (1,440 milligrams per kilogram [mg/kg]) and aluminum (27,500 mg/kg) were slightly above ambient limits of 1,300 mg/kg and 21,000 mg/kg, respectively, but within the same order of magnitude. Furthermore, no contaminant source for manganese or aluminum concentrations can be identified based on historical uses of Site 29. Therefore, concentrations of manganese and aluminum in surface soils are consistent with ambient concentrations at Site 29.

Lead was identified as a chemical of concern (COC) in the Building Crawlspace surface soils. The maximum detected concentration of lead of 3,400 mg/kg exceeded the residential screening value of 400 mg/kg and the industrial screening value of 750 mg/kg. However, the 95 percent upper confidence limit on the arithmetic mean (UCL_{95}) for lead of 753 mg/kg is slightly, but not significantly, above the industrial screening value for lead.

Subsurface Soils Sampling Event

Total cancer risks posed by subsurface soils east of Building IA-25 under both residential (3.6×10^{-7}) and industrial (1.7×10^{-7}) exposure scenarios were less than the EPA target risk range of 1×10^{-6} to 1×10^{-4}. However, the total non-cancer HI under the residential exposure scenario exceeds the threshold HI of 1 due to the combined concentrations of metal compounds detected. The segregated HIs for the central/peripheral nervous system and the skin toxic endpoints also exceeded the threshold HI of 1 and were driven by concentrations of manganese and thallium. The total non-cancer HI under the industrial exposure scenario was below the threshold HI of 1.

Manganese was detected above the ambient concentrations of 1,300 mg/kg and the residential PRG of 1,800 mg/kg in two out of the nine samples both at a depth of approximately 5 feet bgs. Thallium was detected above the ambient concentration of 1.4 mg/kg and the residential PRG of 5.2 mg/kg in only one out of the nine samples at a depth of approximately 5 feet bgs. The maximum detected concentrations of manganese and thallium were from samples collected in undisturbed native materials at Site 29. Furthermore, no contaminant source for manganese or thallium has been identified based on historical use or other sample results at Site 29. Manganese and thallium detected therefore appears to be the result of ambient conditions at Site 29. In addition, elevated concentrations of manganese and thallium are present at depth in subsurface soils only and represent a limited volume of soil that potential receptors may be exposed to. For these reasons, manganese and thallium do not pose a significant risk to human health.

Results and Conclusions

The results of the SRA indicate that under a residential land-use scenario, potential adverse human health effects may occur due to exposure to lead in Building Crawlspace surface soils. The results of the SRA indicate that under the anticipated future industrial land-use scenario, chemicals detected at Site 29 do not pose an unacceptable risk, and thus remedial action is unnecessary for the protection of human health. However, this FS is intended to evaluate remedial actions for the higher standard of possible future unrestricted land uses.

SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

A Screening Level Ecological Risk Assessment (SLERA) was conducted to determine if chemicals and ecological receptors of concern are present at the Site. The data evaluated in this SLERA included data collected during the Building Crawlspace Surface Soils sampling event and the Subsurface Soils sampling event, and were evaluated separately. This SLERA was also performed because of the potential presence of the red-legged frog, a federally threatened species, and the tiger salamander, a state species of special concern, in the vicinity of the Site (CDFG-CNDDB 2000).

For the Building Crawlspace Surface Soils data set, barium, chromium, copper, lead, mercury, nickel, selenium, and zinc were identified as chemicals of ecological concern (COEC) based on exceedances when compared against background soil concentrations, and hazard quotient (HQ) exceedances when compared to ecological soil PRGs. These chemicals are likely to be associated with some ecological risk to receptors from Building Crawlspace surface samples. For the Subsurface Soils data set, chromium,

mercury, thallium and vanadium were identified as COECs based on a similar methodology as described above.

The results of the SLERA for the Building Crawlspace Surface Soils sampling event and the Subsurface Soils sampling event indicate that potential adverse ecological effects may occur due to exposure to barium, chromium, copper, lead, mercury, nickel, selenium, thallium, vanadium, and zinc. However, the SLERA incorporates several conservative assumptions as further explained in Section 2.2.7.2, and the overall effect of the use of conservative assumptions is likely to result in an over-estimation of potential risk.

SETTING REMEDIAL ACTION OBJECTIVES

The sole medium of concern at Site 29 is affected surface soils. Groundwater is not a medium of concern because the contaminants present in site soils have been found at depths much shallower (less than 1.0 foot bgs) than anticipated groundwater depths (estimated at 20 to 30 feet bgs). In addition, metallic compounds are likely immobile and have not been found at concentrations that would raise concerns about them leaching to groundwater. Under this same rationale, surface water runoff from the Site is also not a medium of concern. Surface water bodies are not present in the immediate vicinity of Site 29 and surface runoff from rainfall events is limited due to the presence of earthen berms and buildings constructed in the area.

To address the concern for both ecological and human health risks under an unrestricted land-use scenario (including residential use) remedial action objectives (RAOs) were set to identify, develop, and evaluate remedial alternatives. RAOs for the unrestricted land use scenario are to prevent exposure by human receptors via ingestion of, direct contact with, or inhalation of lead in soil from 0.0 to 1.0 foot bgs at concentrations greater than the established EPA Region IX residential level PRG for lead of 400 mg/kg. Ecological RAOs are to prevent ingestion of and direct contact of COECs by ecologic al receptors in soils from 0.0 to 1.0 foot bgs 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

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 to ensure the Site retains its current industrial use would be included under this alternative by appending the existing Installation Master Plan (IMP) for the Site until such time as the IMP would be formally updated. Potential future land use changes not compatible with an industrial use scenario would be identified and controlled through the Navy's "project review process," which considers proposed appending of the IMP.

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 (cy) 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. Table 5-1 provides a summary of the comparison of the remedial alternatives relative to the seven evaluation criteria. Table 5-2 summarizes the costs for each 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, and would comply with applicable or relevant and appropriate requirements (ARAR). 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, and thus it is not likely to receive community or regulatory agency acceptance. None of the three alternatives reduce the toxicity, mobility, or volume of contaminants at the Site. Alternative 3 is most effective in the long term and provides greater protection of human health and the environment as compared with Alternative 1 and 2. Overall, Alternative 3 was ranked higher than both Alternative 2 and Alternative 1.

1.0 INTRODUCTION

Tetra Tech EM Inc. (TtEMI), and its team firm LFR Levine·Fricke (LFR), under direction from the U.S. Department of the Navy (Navy), Naval Facilities Engineering Command Engineering Field Activity West (EFA West), have prepared this focused feasibility study (FS) report for Site 29 at the Naval Weapons Station Seal Beach Detachment (SBD) Concord in Concord, California (the Site). This work has been conducted as Contract Task Order (CTO) No. 325 pursuant to the Comprehensive Long-Term Environmental Action Navy (CLEAN II) Contract No. N62474-94-D-7609.

Earlier investigation activities conducted at Site 29 have found that several metals are present in soils at concentrations above ambient concentrations and U.S. Environmental Agency (EPA) Region IX preliminary remedial goals (PRGs). A screening-level risk assessment (SRA) was completed for two areas at Site 29: (1) the Building IA-25 crawlspace and (2) "subsurface soils" east of Building IA-25. The SRA was conducted to identify chemicals detected in soil at Site 29 that could be associated with potential human health concerns. The results of the SRA indicate that under a residential land-use scenario, potential adverse human health effects may occur due to exposure to lead in Building Crawlspace surface soils. Lead concentrations were not found to be a concern to human health under the anticipated future industrial land-use scenario. However, this FS has been developed to identify and evaluate a set of remedial alternatives to eliminate or reduce risks posed by lead should the future land uses change to residential use.

A Screening Level Ecological Risk Assessment (SLERA) was conducted to determine if chemicals and ecological receptors of concern are present at the Site. The results of the SLERA indicate that potential adverse ecological effects may occur due to exposure to barium, chromium, copper, lead, mercury, nickel, selenium, thallium, vanadium, and zinc. 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 the Site. As part of this program, the Department of Defense (DoD) is identifying, evaluating, and remediating past hazardous waste sites. This work is coordinated through a Federal Facilities Agreement (FFA) negotiated and signed on June 14, 2001. The Navy initiated environmental studies at the Site under a precursor to the current IRP entitled, "Navy Assessment and Control of

Installation Pollutants" (NACIP) in 1983. The EPA listed the Concord as a National Priorities List (NPL) site on December 16, 1994. Although the Inland Area of the Site is not active, the installation is not slated for closure in the foreseeable future. In addition to the Navy, other branches of the DoD reside within or partly occupy the Site including the United States Army.

PURPOSE AND ORGANIZATION OF REPORT

The purpose of this report is 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 and risk assessment results
- 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 Site history, and develops a site profile including a summary of past site investigation activities, site geology and hydrogeology, the nature and extent of contamination, and contaminant fate and transport. Section 2.0 also presents the updated human health SRA and SLERA. Section 3.0 develops the RAOs for Site 29, presents GRAs, and identifies three remedial alternatives to be further evaluated. Section 4.0 provides a detailed analysis of the remedial alternatives. Section 5.0

includes a comparative analysis of the remedial alternatives. Section 6.0 lists references cited in this report. Appendix A includes a summary of soil sample analytical results, Appendix B includes the human health risk assessment (HHRA) tables, and Appendix C includes detailed design and construction cost estimates for Alternatives 2 and 3.

2.0 BACKGROUND INFORMATION

Naval Weapons Station SBD Concord is the major munitions trans-shipment 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, which is near the southern boundary of the Inland Area of the Site (Figure 2-1). Site 29 is approximately 600 feet west of Seal Creek and 110 feet higher in elevation. It is located on the side of a hill sloping eastward toward Seal Creek. Building IA-25 within Site 29 is surrounded on three sides by man-made earthen berms approximately 8 feet high (Figure 2-3).

2.1 HISTORY

Facilities located in the greater Tidal Area of the Site 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 the Site, 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, a storm drain outfall, a sanitary sewer line, and a leach field northeast of the Building IA-25 (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 discuss the facility setting of the Site including (1) summary of site investigation activities, (2) geology, (3) hydrogeology, (4) nature and extent of contamination, (5) contaminant fate and transport, (6) screening-level human health risk assessment, (7) screening-level ecological risk assessment, and (8) applicable or relevant and appropriate requirements. A detailed description of the Site setting is presented in Section 3.0 of the Draft Naval Weapons Station SBD Concord SI report (TtEMI 1999).

2.2.1 Summary of Site Investigation Activities

2.2.1.1 Building Crawlspace Surface Soil Sampling

Initial site investigations were conducted from 1988 through 1989 to evaluate potential soil contamination beneath Building IA-25. In 1988, seven surface soil samples were collected in the crawl spaces beneath Building IA-25, and one 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 ten soil boring locations completed in 1989, soil samples were typically collected at 6-inches and 12-inches below grade. These two sampling events are collectively referred to as the "Building Crawlspace Surface Soils" sampling event throughout this report and are considered representative of the surface and near surface soils which exist below the building crawlspace.

During the Building Crawlspace Surface Soils sampling event, a total of 27 shallow soil samples were collected from the on-site soil borings whose locations are shown on Figure 2-3. 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. Several analytes, including PAHs and the metals cadmium, chromium, lead, and nickel were detected at concentrations exceeding EPA Region IX residential preliminary remediation goals (PRG) (EPA 2000) and estimated ambient levels as presented in Appendix A.

Based on sampling results, the Navy concluded that shallow soils beneath the building contain organic compounds, pesticides, and metals. However, a focused HHRA concluded that no long-term health effects to construction and maintenance workers were anticipated from compounds found in surface and shallow soil samples. The "Site Investigation at Building IA-25" report prepared by IT (IT 1990) presents

and discusses the results of the Building Crawlspace Surface Soil sampling event in more detail. Appendix A to this report presents a screening of maximum concentrations detected in the Building Crawlspace Surface Soils sampling event against estimated ambient concentrations, EPA Region IX Residential PRGs, and EPA Region IX Industrial PRGs.

2.2.1.2 RCRA Facility Assessment Confirmation Study

In June 1992, the California Department of Toxic Substances Control (DTSC) performed a Resource Conservation and Recovery Act (RCRA) facility assessment (RFA) at the Site. The RFA was performed to evaluate the potential for release of hazardous substances from 24 SWMUs at the Site. In 1996 the Navy performed a RCRA Facility Assessment Confirmation Study (RFACS) to further evaluate the state's RFA findings.

The septic tank, storm drain outfall, and leach field were investigated as SWMU 13 during the RFACS (PRC 1996). Two soil borings were advanced to a maximum depth of 16.5 feet bgs in the vicinity of the septic leach 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 one sample 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, and 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 1996). However, because samples from the septic tank were found to contain hazardous wastes, an interim RCRA corrective action was conducted to remove the septic tank contents for off-site disposal and thoroughly cleanse the tank.

Recommendations

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 sewage system pipeline for potential line breaks (PRC 1996).

2.2.1.3 Subsurface Soils Sampling

The recommended sampling was conducted in January and February of 1999. The 1999 sampling event is hereafter referred to as the "Subsurface Soils" sampling event throughout this report.

The Subsurface Soils sampling event at Site 29 was conducted according to the final Site Investigation (SI) Work Plan (TtEMI 1998) and in accordance with the data quality objectives for the Site. The Draft Site Investigation discusses the Subsurface Soils sampling event in detail (TtEMI 1999). Three soil borings (S29SB01, S292SB02 and S29SB03) were drilled at Site 29 to a maximum depth of 15 feet below ground surface (bgs) using standard hollow-stem auger drilling techniques (Figure 2-3). Boring S29SB01 was placed immediately adjacent to the sewage system pipeline 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 inorganics. The three samples collected from boring SB-1 were also 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 below and are summarized in Appendix A.

Metals were detected in all nine soil samples collected during the Subsurface Soils sampling event. The metals antimony, barium, beryllium, chromium, copper, manganese, mercury, molybdenum, selenium, thallium, 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 were detected at concentrations exceeding industrial PRGs except arsenic, which was detected at a concentration exceeding the industrial PRG in three samples. Although arsenic exceeded both residential and industrial PRGs, it did not exceed the estimated ambient concentration of 15 mg/kg in any sample. The ambient concentration for arsenic, however, is above both the residential and industrial PRGs. Iron concentrations were also within ambient screening levels.

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 one sample collected from boring S29SB01 at an estimated concentration of 2 micrograms per kilogram (µg/kg). This concentration is well below both the residential and industrial PRGs. TPH as gasoline was detected in one sample at a concentration of 0.7 mg/kg. There are no established PRGs for TPH in soil, and concentrations of gasoline detected at this low level do not appear to be of concern for further evaluation.

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 at the Site: the Concord and Clayton faults. The Concord Fault passes approximately 2 miles south of the Site 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 the Site. The Clayton Fault is classified as active or potentially active (PRC 1996). 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 the Site are clay-rich alluvium derived from nearby hills. They are well-sorted, pebbly alluviums from upstream areas of Mt. Diablo 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 byproducts 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 1996). Bedrock at the Inland Area is a Pliocene non-marine sedimentary rock formation.

These two geologic areas are separated by the approximate alignment of Seal Creek (PRC 1996). 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 the Site (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

The Site 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 through Clayton Valley and the Site to the outlet at Suisun Bay. Mt. Diablo Creek is known as Seal Creek where it enters the Site (PRC 1996).

Groundwater levels have never been recorded at Site 29. However, 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 1996). Based on local topography, the groundwater is estimated to flow generally to the northeast.

Several groundwater wells in the vicinity of the nearby Mallard Reservoir, approximately 0.75 mile west of the Site Inland Area, are used for firefighting at a nearby petroleum refinery. 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 due to man-made structures and natural variations in local surface and subsurface features.

2.2.4 Nature and Extent of Contamination

This report references both the results of the Building Crawlspace Surface Soils sampling event and the Subsurface Soils sampling event to quantify the nature and extent of the contamination at Site 29. Based on the results of the SRA discussed in Section 2.2.6 below, the chemicals of concern (COC) identified in soils at Site 29 (with associated health risks either above the EPA target risk range of 10^{-6} to 10^{-4}, threshold hazard index (HI) above 1, or blood lead levels above 10 micrograms per deciliter (µg/dL) are lead, manganese, and thallium. Based on the results of the SLERA discussed in Section 2.2.7 below, the chemicals of ecological concern (COECs) identified in soils at Site 29 are barium, chromium, copper, lead, mercury, nickel, selenium, thallium, vanadium, and zinc.

Barium was detected in all 29 surface soil samples, at an average soil concentration of 571 mg/kg, and a maximum detected soil concentration of 1,660 mg/kg, which is an order of magnitude higher than the average soil concentration. Barium was detected at high concentrations at 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. Barium was also detected in all 9 subsurface soil samples, at an average soil concentration of 326.7 mg/kg, and a maximum detected soil concentration of 439 mg/kg.

Chromium was detected in all 29 surface samples collected during the Building Crawlspace Surface Soils sampling event, 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 at 2,600 mg/kg, suggesting a possible hot spot. The average soil concentration excluding the sampling location IA25-1 is 68.04 mg/kg. Chromium was detected in all 9 sub-surface samples, at an average concentration of 38.7 mg/kg, and a maximum detected concentration of 75 mg/kg.

Copper was detected at an unusually high concentration at only one surface soil sampling location SS-02-1 at 1190 mg/kg. Interestingly, the average soil copper concentration excluding data from sampling location SS-02-1 is 63.11 mg/kg. Copper was also detected in all 9 subsurface soil samples, at an average soil concentration of 35.2mg/kg, and a maximum detected soil concentration of 62 mg/kg.

Lead was detected in all 29 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,

with an average soil concentration of 2.8 mg/kg and a maximum detected soil concentration of 6 mg/kg (below both residential and industrial PRG's). Lead concentrations above the residential PRG were found, however, in 5 of the 27 shallow soil samples taken during the Building Crawlspace Surface Soils sampling event.

Manganese was found in two of the nine Subsurface Soils sampling event samples at a concentration above the EPA residential PRG of 1,800 mg/kg manganese. These samples were taken at a depth of 4.5-5.0 feet and 5.0–5.5 feet and had a detection of 1,840 mg/kg and 6,560 mg/kg manganese, respectively. During the Building Crawlspace Surface Soils sampling event, manganese was not found at levels above the EPA residential PRG. Manganese was detected in 22 surface soil samples at a maximum detected soil concentration of 1440 mg/kg, and an average surface soil concentration of 1099.5 mg/kg.

Mercury was detected in 18 surface soil samples, with an average soil concentration of 0.4 mg/kg and a maximum detected concentration of 1.4 mg/kg. Mercury was also detected in sub-surface sampling events. It was detected in all 9 samples, with an average soil concentration of 0.1 mg/kg and a maximum detected concentration of 0.25 mg/kg.

Selenium was detected in 7 samples collected during the Building Crawlspace Surface Sampling event with an average concentration of 2.6 mg/kg and a maximum detected concentration of 4.4 mg/kg. No background selenium concentrations are available. Selenium was detected in only one subsurface soil sample at a concentration of 1.5 mg/kg.

Thallium was detected in one of the nine Subsurface Soils sampling event at a concentration of 7.0 mg/kg. This sample was taken at a depth of 5.0–5.5 feet and had a detection of 7.0 mg/kg thallium. During the Building Crawlspace Surface Soils sampling event, thallium was not found at levels above the EPA residential PRG.

Vanadium was detected in all 9 subsurface soil samples at an average concentration of 67.1 mg/kg, and a maximum detected concentration of 164 mg/kg. Vanadium was also detected in all 29 surface soil samples, at a maximum detected concentration of 110 mg/kg, and an average soil concentration of 65.95 mg/kg.

Zinc was detected in all 29 surface samples collected during the Building Crawlspace Surface Soil sampling event with an average concentration of 1,079.75 mg/kg and a maximum detected concentration

of 20,000 mg/kg. Zinc was also detected in all 9 subsurface soil samples, with an average soil zinc concentration of 64.6 mg/kg and a maximum detected soil concentration of 91.9 mg/kg.

No groundwater sampling has been conducted at Site 29. The previous SI report prepared for Site 29 (TtEMI 1999), as accepted 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. Additionally, the metal COCs and COECs at Site 29 are highly immobile in both soil and groundwater.

2.2.5 Contaminant Fate and Transport

The major migration pathway for chemical movement of metal COCs and COECs from Site 29 is by wind transport of dry surface soils potentially containing contaminants, or possibly by leachate migration. Surface water bodies are not present in the immediate vicinity of Site 29 and surface runoff from rainfall events is limited due to 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 because the contaminants present in site soils have been found at depths much shallower (less than 5.5 feet bgs) than anticipated groundwater depths at the Site (estimated at 20 to 30 feet bgs) and because metal contaminants in soil are likely immobile and have not been found 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 found 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 products on exterior surfaces of the Building or pilot-scale ammunition testing operations conducted with lead-containing ammunition.

2.2.6 Human Health Screening-Level Risk Assessment

A SRA was completed for two areas at Site 29: (1) the Building IA-25 crawlspace and (2) “subsurface soils” east of Building IA-25. The SRA was conducted to evaluate potential human health risks associated with the chemicals detected in soil at Site 29. The results of the SRA 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 November 2000 PRGs (EPA 2000). The SRA 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 and identification of areas for (1) elimination as an area of concern if all concentrations were below PRGs, total cancer risks were less than 10^{-6}, and HIs were less than 1 or (2) requiring additional investigation or more detailed risk evaluation. The methods applied in the SRA 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 the risk assessment paradigm consistent with EPA guidance (EPA 1989a), the SRA is composed of the five following components:

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

These components are detailed in sections 2.2.6.1 through 2.2.6.5. The results and conclusions of the SRA are summarized in Section 2.2.6.6. Appendix B presents tables including residential and industrial cancer risks and non-cancer hazard indexes HIs results, maximum detected concentrations and EPA Region IX residential and industrial soil PRGs.

2.2.6.1 Data Evaluation and Identification of COPCs

The data evaluated in this SRA included data collected from the Building IA-25 crawlspace referred to as the Building Crawlspace 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. Although the quality of the data collected during the Building Crawlspace Surface Soils sampling event cannot be verified because a complete data set is not available (only detected results are available), the data was included in the SRA. The Building Crawlspace 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 SRA as two separate areas. The chemical data collected during the 1996 RFACS site investigation for the septic tank system (SWMU 13) are not evaluated in this SRA because potential human health risk concerns were evaluated in the RFACS (PRC 1996).

COPCs were identified for evaluation in the SRA 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 one or more soil samples
(2) metals considered to be essential human nutrients (i.e. calcium, iron, magnesium, potassium, and sodium) were reviewed for possible elimination
(3) metals present at ambient levels (80 percent lower confidence limit [LCL] on the 95th percentile of the ambient data set, Appendix C of RFACS) were reviewed for possible elimination

Petroleum indicator results (e.g. gasoline) were not used in the SRA. However, the principal toxic constituents in petroleum products (i.e., certain metals, benzene, toluene, ethylbenzene, xylenes, and PAHs), if detected, were evaluated in the SRA.

The COPCs identified using the above three-step process are listed in Tables B-1 and B-3 of Appendix B for the Building Crawlspace Surface Soils sampling event and the Subsurface Soil sampling event chemical data sets, respectively. VOCs, SVOCs (including PAHs), organochlorine pesticides, PCBs, chlorinated herbicides, metals, and explosives byproducts were identified as COPCs based on the Building Crawlspace Surface Soils sampling event data set. VOCs and metals were identified as COPCs based on the Subsurface Soils sampling event data set.

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 land-use scenarios (residential).

The exposure pathways evaluated for potential receptors under both the residential and industrial land-use scenarios 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 exposure point concentrations (EPCs) for estimating potential health risks. EPCs and summary statistics for the two sampling event data sets are presented in Tables B-1 through B-4 in Appendix B.

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) that are 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. However, 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 2000).

For some carcinogens, separate PRGs are available to assess their carcinogenic effects and their non-cancer adverse health effects (EPA 2000). For these compounds, both the cancer risks and potential for non-cancer adverse health effects were evaluated. Additional issues related to PRGs, including the hierarchy of toxicity values, route-to-route extrapolation, chromium, and lead are discussed in detail below.

Hierarchy of Toxicity Values

Toxicity values (CSFs and RfDs) used by EPA Region 9 to develop PRGs were obtained from the following toxicological sources in order to preference:

- Integrated Risk Information Systems (EPA 2001)
- National Center for Environmental Assessment
- Health Effects Assessment Summary Table (EPA 1997).

Route-To-Route Extrapolation

Route-to-route extrapolations were used by EPA Region 9 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 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 RfD is dependent on the oxidation state of the metal (that is, whether chromium is present as trivalent chromium or 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 assume a one-to-six ratio in soils of hexavalent chromium to trivalent chromium.

Lead Assessment

Risks and HIs are not evaluated for lead in the same manner as other human health COPCs because EPA have developed physiologically based modeling approaches to evaluate the intake and subsequent blood lead levels of receptors, based on exposure to soil, groundwater, and other sources. EPA's Uptake Biokinetic Model estimates the percentage of children and adults whose blood lead levels would exceed acceptable limits if exposed to a specific concentration of lead.

The EPA screening values of 400 mg/kg for lead in residential soil and 750 mg/kg for lead in industrial soil were used for assessing lead exposures. If the maximum detected concentration of lead exceeded the industrial screening value, lead was screened further using the 95 percent upper confidence limit of the arithmetic mean (UCL_{95}) instead of the maximum detected concentration. The UCL_{95} was calculated in accordance with EPA guidance (EPA 1992a).

2.2.6.4 Risk Characterization

This section presents a quantitative analysis of the potential risk to human health from COPCs detected in soils.

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 EPA's acceptable target cancer risk range is 10^{-6} to 10^{-4}. The PRGs for carcinogenic chemicals correspond to the lower bound limit of the EPA acceptable target risk range. 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 the Site was estimated by summing together the cancer risk for each carcinogenic chemical.

Consideration of Noncarcinogenic Endpoints

Potential non-cancer 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 non-cancer hazard quotient (HQ) of 1 using current EPA RfDs discussed in Section 2.2.6.3) and regulatory default "standard" exposure factors in the intake equation (EPA 2000). The non-cancer 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 non-cancer HI for the Site was estimated by summing together the HQ for each COPC. If the HI is greater than 1, then the HI is recalculated for chemicals which have the same toxic manifestation, or which affect the same target organ. The total cancer risk and non-cancer HI for the Site are summarized in Section 2.2.6.6 below.

2.2.6.5 Uncertainty Analysis

There are varying degrees of uncertainty at each stage of the SRA, arising from assumptions made in therisk 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. A detailed discussion of the uncertainties associated with the SRA for Site 29 was presented in Section 5.4.5 of the Site 29 SI Report (TtEMI 1999) and is not presented in this report.

2.2.6.6 Summary and Conclusion of Screening Level Risk Assessment

The SRA results and conclusions for the Building Crawlspace Surface Soils sampling event and the Subsurface Soils sampling event are summarized in the sections below.

Building Crawlspace Surface Soils Data

Total cancer risks posed by Building Crawlspace surface soil under both residential (2.4×10^{-5}) and industrial (6.5×10^{-6}) exposure scenarios exceeded 10^{-6}, but were within the EPA target risk range of 10^{-6} to 10^{-4}. Individual cancer risk under the residential exposure scenario were below 10^{-6} except for benzo(a)pyrene, cadmium, chromium, and nickel. Individual cancer risk estimates under the industrial exposure scenario were below 10^{-6} except for chromium. However, the individual cancer risk estimates for all these chemicals were within the EPA target risk range of 10^{-6} to 10^{-4}. The total non-cancer HI under the residential exposure scenario exceeds the threshold HI of 1. However, both individual and the segregated non-cancer HIs were each below the threshold HI of 1, except for the central/peripheral nervous system with a segregated HI of 1 due primarily to concentrations of manganese and aluminum. The individual COPC and total non-cancer HI under the industrial exposure scenario was also below the threshold HI of 1.

The maximum detected concentrations of manganese (1,440 mg/kg) and aluminum (27,500 mg/kg) were slightly above ambient limits of 1,300 mg/kg and 21,000 mg/kg, respectively, but within the same order of magnitude. Furthermore, no contaminant source for manganese or aluminum concentrations can be identified based on historical uses of Site 29. Therefore, concentrations of manganese and aluminum in surface soils are consistent with ambient concentrations at Site 29. Summary of the risk and hazard results for the subsurface soils are presented in Tables B-5 and B-6.

Lead was identified as a COPC from the Building Crawlspace Surface Soils data set. The maximum

detected concentration of lead of 3,400 mg/kg exceeded the EPA residential screening value of 400 mg/kg, and the EPA industrial screening value of 750 mg/kg. The use of the maximum detected lead concentration for screening is highly conservative, therefore, 95 UCL value for lead of 753 mg/kg was used to perform the screen. The 753 mg/kg concentration is above the residential screening values, and slightly but not significantly above the industrial screening value.

Subsurface Soils Data

Total cancer risks posed by subsurface soils east of Building IA-25 under both residential (3.6×10^{-7}) and industrial (1.7×10^{-7}) exposure scenarios were less than the EPA target risk range of 10^{-6} to 10^{-4}. Individual cancer risk estimates for COPCs (i.e., VOCs and metals) under the residential and industrial exposure scenarios were below 10^{-6}. The non-cancer HI under the residential exposure scenario exceeds the threshold HI of 1. Individual non-cancer HI estimates for COPCs under the residential exposure scenario were below the threshold HI of 1 except for manganese and thallium. The segregated non-cancer HI for the central/peripheral nervous system was 2 (due primarily to manganese), and 1 for the skin (due primarily to thallium). The individual COPC and total non-cancer HI under the industrial exposure scenario were below the threshold HI of 1. Summary of the risk and hazard results for the subsurface soils are presented in Tables B-7 and B-8.

Manganese was detected at a depth of approximately 5 feet below ground surface (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 only one out of the nine samples at a depth of approximately 5 feet bgs (the highest thallium detection was in the same sample with manganese detection above ambient level). The maximum detected concentrations of manganese and thallium were from samples collected in undisturbed native materials at Site 29. Furthermore, the potential source for these contaminants is not known because operations previously conducted at the Site (pilot scale testing of ammunitions) are not typically associated with manganese and thallium. Therefore, concentrations of manganese and thallium are consistent with ambient concentrations at Site 29. In addition, elevated concentrations of manganese and thallium do not pose a significant potential risk to human health due to minimal exposure because (1) these concentrations are present at depth in subsurface soils and (2) represent only a limited volume of soil that potential receptors may be exposed to.

Results and Conclusions

The results of the SRA indicate that under a residential land-use scenario, potential adverse human health effects may occur due to exposure to lead in Building Crawlspace surface soils.

2.2.7 Screening Level Ecological Risk Assessment

The SLERA provides conservative assessments in that they provide a high level of confidence in determining a low probability of adverse effects, and they incorporate uncertainty in a precautionary manner. The purpose of SLERA is to assess the need, and if required, the level of effort necessary, to conduct a detailed or "baseline" risk assessment. The SLERA for Site 29 is based on the EPA guidance for Ecological Risk Assessment (ERA) (EPA 1997) and the supplemental ERA guidance put forth by the EPA (EPA, 2001). The components of a SLERA, although less detailed than a baseline ERA, still include the following components:

- Screening level Problem Formulation and Ecological Effects Characterization (Step 1)
  - identification of environmental setting and preliminary contaminants of concern
  - determination of contaminant fate and transport pathways
  - description of contaminant mechanisms of ecotoxicity and categories of receptors likely affected
  - identification of complete exposure pathways and selection of generic assessment endpoints
  - selection of screening ecotoxicity values
- Screening level Exposure Estimate and Risk Calculation (Step 2)
  - determination of screening-level exposure estimate
  - calculation of risk estimate
  - risk characterization and evaluation of uncertainties

2.2.7.1 Screening Level Problem Formulation and Ecological Effects

<u>Identification of Environmental Setting (site characterization) and COPECs</u>. To characterize the ecology of Site 29, existing surveys (Downard, 2000) combined with existing California Fish and Game's (CDFG) natural diversity database (CNDDB 2000) were reviewed. Site 29 is approximately 0.6 to 1.4 miles south of the junction of Bailey Road and Kinne Blvd.

Vegetation of the Inland area was mapped during the summer season of 1999 (Downard, 2000). 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 non-native/invasive grass species such as wild oat (*Avena fatua*), rigput grass (*Bromus diandrus*), Mediterranean barley (*Hordeum marinum*), and Italian rye grass (*Lolium multiflorum*). A non-native forb species, star thistle (*Cantaurea solstitialis*), is widely distributed within grasslands.

Amphibian and reptilian surveys were also conducted at the Site. Seven amphibian and fifteen reptile species were observed at the Site from July 1998 to September 1999. A single California whip snake was observed adjacent to Site 29 within the Tidal Area. The Site is also 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 currently a state Species of Special Concern (CDFG-CNDDB 2000). The California red-legged frogs primarily require nearby fresh water, and have been observed in ponds located approximately 0.5 to 2 miles radius from the junction of Bailey Road and Kinne Blvd. The U.S. Fish and Wildlife Service (USFWS) considers the red-legged frog habitat to include a 5-mile radius around known locations. California tiger salamanders have been known to occur in the freshwater ponds at the Site, and 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. The bunkers on Site 29 also provide a good habitat for California tiger salamanders. Other avian and mammalian receptors identified at the Site include raptors, coyotes and ground squirrels.

Preliminary list of chemicals of potential ecological concern (COPEC) were identified for evaluation in the SLERA to estimate total potential ecological risks associated with contaminants present in soils at Site 29 through a tiered process, as follows:

- Preliminary list of COPECs was developed that included all analytes detected in one or more soil samples.

- Chemicals considered to be essential nutrients (i.e., calcium, iron, magnesium, potassium and sodium) were reviewed for possible elimination.

- Chemicals present at background levels were reviewed for possible elimination, based on the Navy's Interim Final Policy on Use of Background Chemical levels (Navy 2000). Based on the Navy guidance, naturally occurring and anthropogenic chemicals that are present at levels below background concentrations are eliminated from consideration in the risk assessment

process. This is done by comparing the maximum detected chemical concentration at the Site to the background chemical concentration. If the maximum detected chemical concentration is greater than the background concentration, then the chemical is considered a COPEC.

Petroleum indicator results (i.e., gasoline) were not used in the SLERA. However, the results of the principal toxic constituents in petroleum products (i.e., certain metals, benzene, toluene, ethylbenzene, xylenes, and PAHs), if detected, were used in the SLERA.

COPECs were identified using the above three-step screening process and are listed in Tables 2-1 and 2-2 for the Building Crawlspace Surface Soils sampling event and the Subsurface Soils sampling event chemical data sets, respectively. VOCs, SVOCs (including PAHs), organochlorine pesticides, PCBs, chlorinated herbicides, metals, and explosives byproducts were identified as COPECs based on the Building Crawlspace Surface Soils sampling event data set. VOCs and metals were identified as COPECs based on the Subsurface Soils sampling event data set.

Fate and Transport Pathways. The major migration pathway for movement of inorganic and organic COPECs from Site 29 is by wind transport of dry surface soils potentially containing contaminants or by leachate migration. 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).

Ecotoxicity - Mechanism of Toxicity and Ecological Receptors Identification. EPA guidance requires the selection of assessment and measurement endpoints to focus the risk assessment process. Biota reported to use the habitats at Site 29 or observed during surveys were considered possible assessment endpoints. Protection of population of plant species and protection of upland birds and mammals are the assessment endpoints considered for the SLERA. Due to the presence of special status amphibians and reptiles near the Site, a qualitative evaluation of risk to amphibians and reptiles will be conducted. However, lack of amphibian and reptilian toxicity benchmarks precludes a more quantitative assessment. A qualitative evaluation of toxicity will be discussed based on current toxicity literature. The measurement endpoints used to evaluate chemical stressors found at Site 29 include chemical analyses conducted on soil samples with concentrations being compared with literature-based toxicity benchmarks.

Identification of Complete Exposure Pathways and Selection of Assessment Endpoints. Potentially complete exposure pathway for plants include root uptake. Potentially complete exposure pathways for

wildlife receptors residing in or in the vicinity of Site 29 include ingestion of inorganic and organic chemicals in soil, prey and other food items, and dermal contact with contaminated soil.

EPA guidance requires the selection of assessment and measurement endpoints to focus the risk assessment process. Biota reported to use the habitats at Site 29 or observed during surveys were considered possible assessment endpoints. Protection of individual and population of flora and fauna observed at Site 29 was used as the assessment endpoint. Additional research on the toxicity of the identified organic and inorganic COPECs was conducted for the California tiger salamander and California red-legged frog because of the federally listed and special status species.

Measurement endpoints used to evaluate chemical stressors found at Site 29 include chemical analyses conducted on soil samples.

Selection of Screening Ecotoxicity Values. For those COPECs that are present in site media at concentrations above the corresponding background values, maximum detected soil concentrations were compared with available ecological soil PRGs (Efroymson 1997). Soil PRGs are concentrations derived from exposure estimates and soil-to-biota contaminant uptake models intended to correspond to small effects on individual organisms that would be expected to cause minimal effects on populations and communities, and were developed for use in ecological risk assessment and decision-making at CERCLA sites. In the absence of relevant toxicological benchmarks, toxicologically-based ecological soil PRGs have been used as a second tier screening criteria as has been commonly done within other similar Navy ERA studies. The ecological soil PRGs however, are based on toxicity data relevant to specific categories of organisms- plants, earthworms, short-tailed shrew, American woodcock, red fox, white-tailed deer, white-footed mouse, and red-tailed hawk. However, these numbers are used to evaluate toxicity for all wildlife in general. Due to the lack of better comparison values, the ecological soil PRGs for the most sensitive receptor is used in determining COECs. These values represent the No Observed Adverse Effect Levels (NOAEL) for the wildlife organisms considered.

2.2.7.2 Screening Level Exposure Estimate and Risk Calculation

Determination of Screening-Level Exposure Estimate. The results of soil sampling data are presented in Tables 2-1 and 2-1. These concentrations represent the COPECs which were detected in the surface and sub-surface soil samples collected form various sampling locations at Site 29, and also the maximum

detected concentration of each organic and inorganic COPEC detected. They represent the concentration of COPECs identified that the receptors could be exposed to at the Site.

Chemicals present at background levels were reviewed for possible elimination, based on the Navy's Interim Final Policy on Use of Background Chemical levels (Navy 2000). This was done by comparing the maximum detected chemical concentration at the Site to the background chemical concentration. If the maximum detected chemical concentration is greater than the background concentration, then the chemical is considered a COPEC.

Calculation of Risk Estimate. Maximum detected soil concentrations for the COPECs were then qualitatively compared against available toxicological benchmark (ecological soil PRGs) for wildlife, as presented in Section 2.2.7.1. The chemical-specific ecological risk was conservatively calculated using the maximum detected concentration (C_{max}) and the ecological benchmark in the following equation:

$$HQ = C_{max} / \text{Ecological Soil PRG}$$

Chemical-specific HQs were also calculated using the mean detected concentration and the ecological soil PRG to qualitatively identify potential outliers or hot spots.

The magnitude of HQ values generally indicates the degree of exposure, with higher HQs indicating greater likelihood of adverse effects or more severe adverse effects. However, since HQs are a simple ratio between an observed concentration and a screening benchmark, the magnitude of the HQs must be interpreted in light of the degree of conservatism associated with the screening benchmark.

The following sections present the COPECs and also interpret HQs calculated for each COPEC for Building Crawlspace Surface Soils Data and Subsurface Soils Data. HQ calculations for these two data sets are also presented in Tables 2-1 and 2-2, respectively.

BUILDING CRAWLSPACE SURFACE SOILS DATA

For the Building Crawlspace Surface Soil data set, the following organic chemicals were selected as COPECs because they were detected in soils (no background soil concentrations were available): VOCs, SVOCs [including PAHs], organochlorine pesticides, PCBs, chlorinated herbicides, and explosives byproducts. The following inorganic chemicals were selected as COPECs because the maximum detected site-specific concentration exceeded the background soil concentrations: aluminum, barium,

beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, vanadium, and zinc. Table 2-1 lists the identified COPECs from this data set.

For these COPECs, soil concentrations were compared with available soil PRGs for ecological endpoints (Efroymson 1997). Tables 2-1 and 2-2 present a list of available ecological soil PRGs. Soil PRGs are concentrations derived from exposure estimates and soil-to-biota contaminant uptake models. They are intended to correspond to small effects on individual organisms that would be expected to cause minimal effects on populations and communities, and were developed for use in ERAs and decision-making at CERCLA sites. No ecological soil PRGs are available for aluminum, manganese, VOCs, SVOCs [including PAHs with the exception of acenaphthene], organochlorine pesticides, PCBs, chlorinated herbicides, and explosive byproducts. Acenaphthane was detected in only one sample at a concentration of 0.052 mg/kg. The HQ, calculated by comparing this concentration to the ecological soil PRG, is 2.6. 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 in Building Crawlspace surface soils.

The following sections present and interpret HQs calculated for each inorganic chemical.

Barium was detected in all 29 surface soil samples, and was detected at an order of magnitude higher at only 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), which suggests that these sampling locations are isolated hot spots and not representative of barium concentrations across Site 29. The HQ, calculated by comparing the maximum detected concentration to the ecological soil PRG for barium (283 mg/kg), based on the most sensitive receptor studied (the woodcock), is 5.87, indicating that barium is likely to be associated with some risk to ecological receptors at the Site. However, the ecological soil PRG for barium is less than the background barium soil concentration of 560 mg/kg.

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. The beryllium HQ calculated by comparing the maximum detected soil concentration of beryllium against the ecological PRG is 1.6. In general, beryllium concentrations in all the detected samples are less than the ecological soil PRGs of 10 mg/kg, based on the most sensitive biota studied (plants), with the exception of sampling station SS-02-2 where beryllium was detected at 16 mg/kg, indicating a very localized high concentration of beryllium and a potential hot spot.

Beryllium HQs do not exceed 1, compared to the ecological PRGs when the observation from sampling station SS-02-2 was excluded. This indicates that beryllium in surface soils is not likely to be associated with ecological risk except at sampling station 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. The HQ, calculated by comparing the maximum detected soil concentration against ecological soil PRG based on the most sensitive biota studied (plants and woodcock), is 8.0. 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), resulting in a HQ of 1.07. Based on the magnitude of HQ exceedance, cadmium in surface soils poses negligible risk to ecological receptors.

The chromium HQ, calculated by comparing the maximum detected concentration to the ecological soil PRG of 0.4 mg/kg, based on the most sensitive receptor-studied (earthworms), is 6,500. Chromium was detected in all 29 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 at 2,600 mg/kg. The maximum detected soil concentration excluding the observation at IA25-1 is 160.0 mg/kg, which is higher than ecological soil PRG. Based on the magnitude of HQ exceedance, chromium concentrations in the surface soils is likely to pose some risk to ecological receptors.

Cobalt was detected in all 29 surface soil samples, at a maximum detected concentration of 32.0 mg/kg. The cobalt HQ calculated by comparing the maximum detected concentration against the ecological soil PRG, based on the most sensitive biota studied, plants, is 1.6. Given the low magnitude of HQ exceedance and based on conservative use of the maximum detected concentrations, cobalt is likely to be associated with negligible ecological risk.

The copper HQ calculated by comparing the maximum detected concentration against the ecological soil PRG, based on the most sensitive receptor studied, the earthworm, is 19.8. Copper was detected in all 29 samples at an average concentration of 103 mg/kg, and a maximum detected concentration of 1,190 mg/kg. Copper was detected at an unusually high concentration at only one sampling location SS-02-1 at 1190 mg/kg. The average soil copper concentration excluding data from sampling location SS-02-1 is

63.11 mg/kg, which is less than the background copper soil concentration of 65 mg/kg. Based on the HQs calculated, copper is likely to be associated with some ecological risk.

Lead was detected in all 29 samples with an average soil concentration of 308 mg/kg and a maximum detected concentration of 3,400 mg/kg. The lead HQ, calculated by comparing the maximum detected concentration against the ecological soil PRG based on the most sensitive receptor studied (the woodcock), is 84.0. Based on the concentrations of lead observed at the different sampling locations and the magnitude of HQs calculated, lead is likely to be associated with some ecological risk in surface soils.

Mercury was detected in 18 samples, with an average soil concentration of 0.4 mg/kg and a maximum detected concentration of 1.4 mg/kg. The HQ, calculated by comparing the maximum detected concentration against the ecological PRG of 0.0005 mg/kg, is 2,800. However, the analytical detection limit for mercury is 0.02 mg/kg, which is higher than the ecological soil PRG based on the most sensitive receptor, the American woodcock. The ecological soil PRG based on the second most sensitive receptor, the short-tailed shrew, is 0.146 mg/kg, which results in a HQ of 9.6. Mercury is potentially toxic to wildlife and has no known biological function. Based on the known toxicity of mercury, and the presence of special status amphibian and reptile species observed, mercury is likely to be associated with some risk to ecological receptors in surface samples from the Building Crawlspace.

Nickel was detected in all 29 samples at an average concentration of 79.5 mg/kg and a maximum detected concentration of 160 mg/kg. The nickel HQ, calculated by comparing the maximum detected concentration against the ecological PRG, based on the most sensitive biota studied (plants), is 5.3. Nickel is not likely to pose an ecological risk at this location.

No background selenium concentrations are available. 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. Selenium HQs, calculated by comparing the maximum detected soil concentration against ecological PRG, based on the most sensitive receptor studied, the mouse, are 21.0. While selenium is an essential nutrient, it has a very narrow tolerance range. Selenium is both embryotoxic and teratogenic to wildlife. Based on the toxicity of selenium and presence of special status species on the Site, selenium is likely to be associated with some risk to ecological receptors on site.

Silver was detected at a maximum soil concentration of 0.3 mg/kg. The HQ calculated using the conservative maximum detected soil concentration against the ecological soil PRG, based on the most

sensitive biota studied (plants), is less than 1 (0.2). Therefore silver is not likely to be associated with any risk to ecological receptors at Site 29.

Vanadium was detected in all 29 samples at an average concentration of 66.02 mg/kg and a maximum detected concentration of 110 mg/kg. The vanadium HQ calculated by comparing the maximum detected concentration against the ecological PRG is 55.0. The background soil concentration of vanadium is 95 mg/kg, which is higher than the ecological soil PRG of 2 mg/kg. The ecological soil PRG is based on the most sensitive biota studied (plants). The ecological soil PRG for the most sensitive animal species studied (short-tailed shrew) is 55 mg/kg. The vanadium HQ, calculated by comparing the maximum detected vanadium concentration against the ecological soil PRG, based on the second most sensitive species, is 1.2. Given the low magnitude of HQ exceedance and based on conservative use of the maximum detected concentrations, vanadium is likely to be associated with negligible ecological risk at this location.

Zinc was also detected in all 29 samples, at an average concentration of 1,079.75 mg/kg and a maximum detected concentration of 20,000 mg/kg. The ecological soil PRG, based on the most sensitive receptor (the American woodcock), is 8.5, and the HQ calculated by comparing the maximum detected concentration to the ecological PRG is 2,353. Although zinc is essential for normal growth and reproduction, the primary toxic effect of zinc is on zinc-dependent enzymes that regulate ribonucleic acid (RNA) and deoxyribonucleic acid (DNA). Based on the magnitude of HQ exceedance, zinc is likely to be associated with ecological risk in surface samples from the Building Crawlspace.

SUBSURFACE SOILS DATA

For the Subsurface Soil data set, VOCs, and metals were identified as COPECs as listed in Table 2-2. TCE was the only VOC identified as a COPEC because TCE was detected in soils, and no background soil concentrations are available for comparison. The following inorganic chemicals were selected as COPECs because the maximum detected site-specific concentration exceeded the corresponding background soil concentrations: antimony, barium, beryllium, chromium, copper, manganese, mercury, molybdenum, selenium, thallium, and vanadium.

For these COPECs, soil concentrations were compared with available soil PRGs for ecological endpoints (Efroymson 1997). Soil PRGs are concentrations derived from exposure estimates and soil-to-biota contaminant uptake models intended to correspond to small effects on individual organisms that would be expected to cause minimal effects on populations and communities. The PRGs were developed for use in

ecological risk assessment and decision-making at CERCLA sites. For TCE, however, no background soil concentrations or ecological soil PRGs are available, and for manganese, no ecological soil PRGs are available. The following sections present and interpret HQs calculated for each chemical.

Antimony was detected in 4 samples at a maximum soil concentration of 1.9 mg/kg. The HQ calculated using the conservative maximum detected soil concentration against the ecological soil PRG, based on the most sensitive biota studied (plants) of 5 mg/kg, is less than 1 (0.38). Therefore, antimony is not likely to be associated with any risk to ecological receptors from subsurface soils at Site 29.

Barium HQ calculated by comparing the maximum detected soil concentration (1,240 mg/kg) against ecological PRG, based on the most sensitive receptor studied (the woodcock), is 4.38. Barium was detected in all 9 subsurface soil samples, and was detected at an order of magnitude higher at only one sampling depth (location 'S29SB02', 5.0 to 5.5 feet), at a concentration of 1,240 mg/kg. This suggests this sample location might be a hot spot. The maximum and average soil barium concentration excluding sampling station S29SB02, is 439.0 mg/kg and 326.6 mg/kg, respectively, which is less than the background barium soil concentration of 560 mg/kg. Barium is therefore not likely to pose any ecological risk except at sampling location 'S29SB02'.

Beryllium was detected in 5 subsurface soil samples, at an average soil concentration of 0.19 mg/kg and a maximum detected concentration of 0.35 mg/kg. The beryllium HQ, calculated by comparing the maximum detected site concentration against the ecological soil PRG, based on the most sensitive biota studied (plants), is 0.04, indicating that concentrations of beryllium observed in the subsurface soil samples are not associated with any ecological risk.

Chromium HQ calculated by comparing the maximum detected concentration to the ecological soil PRG of 0.4 mg/kg (based on toxicity to earthworms), is 187.5. Chromium was detected in all 9 samples, at an average concentration of 38.7 mg/kg, and a maximum detected concentration of 75 mg/kg. The background soil concentration of chromium is 62 mg/kg, which is higher than the ecological soil PRG of 0.4 mg/kg. The ecological soil PRG is based on the most sensitive biota studied (the earthworm), which ingests a lot of soil. The ecological soil PRG for the next most sensitive animal species studied (the American woodcock), is 16.1 mg/kg. The chromium HQ calculated by comparing the maximum detected chromium concentration against the ecological soil PRG, based on the second most sensitive species is

4.66. Based on the magnitude of HQ exceedance, chromium concentrations in the surface soils are likely to pose some risk to ecological receptors.

Copper HQ calculated by comparing the maximum detected concentration against the ecological PRG is 1.32. Copper was detected in all 9 samples at an average concentration of 43.7 mg/kg, and a maximum detected concentration of 79.1 mg/kg. The background soil concentration of copper is 65 mg/kg, which is higher than the ecological soil PRG of 60 mg/kg. The background soil concentration of copper is 65 mg/kg, which is higher than the ecological soil PRG of 60 mg/kg. The ecological soil PRG is based on the most sensitive biota studied (the earthworm), which ingests a lot of soil. The ecological soil PRG for the next most sensitive animal species studied (short-tailed shrew) is 370 mg/kg. The copper HQ calculated by comparing the maximum detected copper concentration against the ecological soil PRG based on the second most sensitive species is 0.2. Because the HQ is less than 1 (0.2) when comparing the maximum detected copper soil concentration against the ecological soil PRG, and because a low magnitude of HQ exceedance calculated using the conservative maximum detected concentration against the ecological PRG based on the most-sensitive receptor (1.32), copper is not likely to pose an ecological risk at this location.

Mercury was detected in all 9 samples, with an average soil concentration of 0.1 mg/kg and a maximum detected concentration of 0.25 mg/kg. The HQ, calculated by comparing the maximum detected concentration against the ecological PRG of 0.0005 mg/kg, is 490.2. However, the analytical detection limit for mercury is 0.02 mg/kg, which is higher than the ecological soil PRG based on the most sensitive receptor, the American woodcock. The ecological soil PRG based on the second most sensitive receptor, short-tailed shrew is 0.146 mg/kg, which results in a HQ of 1.7. Based on the HQs calculated, mercury is likely to be associated with some risk to ecological receptors from subsurface soil samples.

Molybdenum was detected in only 1 subsurface soil sample at a concentration of 0.48 mg/kg. No specific background soil concentrations are available for molybdenum. The molybdenum HQ, calculated by comparing the detected concentration against ecological PRG, based on the most sensitive biota studied (plants), is 0.24, indicating that molybdenum is not associated with any ecological risk.

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. The selenium HQ calculated by comparing the detected concentration against ecological PRG, based on the most sensitive

receptor studied (the mouse), is 7.14. The significance of the HQ exceedance based on an observation from only one data point is difficult to assess. However, it is likely that selenium at this sampling location might pose negligible risk to ecological receptors.

Thallium was also detected in only 1 subsurface soil sample at a concentration of 7.0 mg/kg. The thallium HQs, calculated by comparing the detected concentration against ecological PRG, based on the most sensitive biota studied (plants), is 7.0. The significance of the HQ exceedance based on an observation from only one data point is difficult to assess. However, it is likely that thallium at this sampling location might pose some risk to ecological receptors.

Vanadium HQ calculated by comparing the maximum detected concentration against the ecological PRG, based on the most sensitive biota studied (plants), is 82.0. Vanadium was detected in all 9 samples at an average concentration of 67.1 mg/kg, and a maximum detected concentration of 164 mg/kg. Based on the HQs calculated, vanadium is likely to be associated with some risk to ecological receptors from subsurface soil samples.

Qualitative Evaluation of Risk to Amphibians and Reptiles. As mentioned before, the Site is a known locale for the federally threatened California red-legged frog (Rana aurora draytonii) and the California tiger salamander (Ambystoma californiense), which is a candidate for federal listing and is currently a state Species of Special Concern (CDFG-CNDDB 2000). Because of the presence of special status amphibian and reptilian species, and the apparent lack of relevant toxicological criteria pertaining to these species, a qualitative evaluation of toxicological data pertinent to amphibians and reptiles have been reviewed.

Among the naturally occurring elements, the ones that have most frequently been associated with toxicity from environmental exposure include the heavy metals silver, cadmium, chromium, cobalt, copper, iron, mercury, molybdenum, nickel, lead, 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.

Amphibians

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. However, estimates of soil ingestion are not 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. Only a few of the metals with potential toxicity have been examined in amphibians. These include some of the COPECs identified earlier- 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, Linder and Bishop, 2000). Lethal concentrations causing 50%mortality in the test organisms studied (LC50) 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 1000 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 than urodeles. 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 1000 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 sub-lethal 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 et al. 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* (FETAX) test.

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 sub-lethal effects suggest that less variation may be present with Ni than with other metals, since the data appear to be an order of magnitude less for chronic estimators (e.g., Low Observed Effect Concentration [LOEC] and effective concentration [EC50] estimates). The data, however, are clearly insufficient to present an unequivocal summary of nickel's toxicity to amphibians, although, 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 (ASTM 1998). Despite their potential bias, selenium has survival estimates that range from 1,500 µg/L to greater than 11,000 µg/L, with non-lethal 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 et al. 1992), an NOEC of 800 µg/L is consistent with the survival estimates. However, 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 look only at acute toxicity endpoints.

Reptiles

There is a collective agreement that for reptiles little to no explicit information on the toxicological effect

potential is available for any metal (e.g., Hall 1980; Stoneburner and Kushlan 1984; Hebert et al. 1993; Aguirre et al. 1994; Meyers Schone and Walton 1994; Sparling and Lowe 1996). No reptile mortality due to metal intoxication has been reported. The only case of clinically severe toxicosis assigned to metal poisoning is known from a captive Cuban crocodile (*Crocodylus rhombifer*) suffering from anorexia, "depression", and weight loss. Symptoms were related to zinc intoxication due to 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 apparently healthy *Alligator mississipiensis* ranged from 0.18 to 3.48 parts per million (ppm). A few studies have been done to study 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 (ALAD) due to lead exposure.

Free-ranging desert tortoises (*Gopherus agassizii*) from various populations were reported to have died from upper respiratory tract disease (URTD) (Jacobson et al. 1991). In the course of a study to determine the cause of URTD in free-ranging desert tortoises, livers of ten clinically diseased and 4 clinically healthy desert tortoises were analyzed for residues of 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 levels correspond to hemosiderosis due to accelerated degradation of erythrocytes in mammals in which several metals are known to have hemolytic effects. But, hemolysis may also result from antibodies or physical or chemical injury other than that caused by metals (Woods 1996; Niesink et al. 1996).

In conclusion, the majority of observations on the toxicodynamics of metals in reptiles are rather anecdotal.

Risk Characterization

The SLERA results and conclusions for the Building Crawlspace Surface Soils sampling event and the Subsurface Soils sampling event are summarized in the sections below.

Building Crawlspace Surface Soils Data

For the Building Crawlspace Surface Soils data set, barium, chromium, copper, lead, mercury, nickel,

selenium, and zinc were identified as inorganic COECs based on a methodology described in section 2.2.7.1. These chemicals are likely to be associated with some ecological risk to receptors from Building Crawlspace surface samples. For all the COECs identified with the exception of lead and selenium, the ecological soil PRGs are more conservative than the background soil concentrations. As a result, most of the COPECs identified were also COECs. Lead however had a more conservative background soil concentration (32 mg/kg) as compared to the ecological soil PRG (84 mg/kg). No background soil concentrations are available for selenium. VOCs, SVOCs [including PAHs with the exception of acenaphthene], organochlorine pesticides, PCBs, chlorinated herbicides, and explosive byproducts were identified as COPECs because they were detected; however no screening values (background values or ecological PRGs) are available for comparison for these chemicals.

Subsurface Soils Data

For the Subsurface Soils data set, the following inorganic COECs were identified based on a methodology described in section 2.2.7.1. Inorganic COECs consist of chromium, mercury, thallium, and vanadium. These chemicals are likely to be associated with some ecological risk to receptors from Building Crawlspace surface samples. As a result, most of the COPECs identified were also COECs. Thallium however had a more conservative background soil concentration (1.4 mg/kg) as compared to the ecological soil PRG (1 mg/kg).

In summary, the results of the SLERA for the Building Crawlspace Surface Soils sampling event and the Subsurface Soils sampling event indicate that potential adverse ecological effects may occur due to exposure to barium, chromium, copper, lead, mercury, nickel, selenium, thallium, vanadium, and zinc.

Evaluation of Uncertainties

Inherent in all ERAs is uncertainty, and the following paragraphs discuss the uncertainties associated with the qualitative SLERA. The uncertainties can be broadly classified as uncertainty associated with the screening values and HQ, and uncertainty associated with sampling.

The maximum detected site concentration is used to determine COPECs and COECs, as opposed to the mean concentration or the 95 UCL. The maximum detected soil concentration is often times a very conservative value, since this value might not be representative of the overall site conditions. The mean is a more representative value of existing site-wide chemical concentrations. In order to determine

COPECs, the maximum detected site concentrations were first compared against background soil concentrations. Those chemicals that exceeded the background soil concentrations were identified as COPECs, and the maximum detected concentration was then compared against ecological soil PRGs. This was done because, based on the recent eco update (EPA 2000), it is recommended that contaminants of concern be refined to streamline the overall ERA process by comparing site media concentrations with conservative toxicologically based numbers. In the absence of relevant toxicological benchmarks, toxicologically-based ecological soil PRGs have been used as a second tier screening criteria as has been commonly done within other similar Navy ERA studies. The ecological soil PRGs however are based on toxicity data relevant to specific categories of organisms plants, earthworms, short-tailed shrew, American woodcock, red fox, white-tailed deer, white-footed mouse, and red-tailed hawk. However, these numbers are used to evaluate toxicity for all wildlife in general. Due to the lack of better comparison values, the ecological soil PRGs based on the most sensitive receptor is used of determining COECs. Also, while calculating HQs, it is intrinsically assumed that the chemicals are 100% bioavailable, which is a very conservative assumption.

There are uncertainties associated with sampling as well. 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.

There are varying degrees of uncertainty at each stage of the SLERA, arising from assumptions made in the risk assessment and limitations of the data used to calculate risk estimates.

2.2.8 Applicable or Relevant and Appropriate Requirements

This section identifies and evaluates potential federal and State of California applicant or relevant and appropriate requirements (ARAR) 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 Record of Decision (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 the CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA), 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 40 CFR § 300.400(g)(2) and include the following:

- the purpose of the requirement and the purpose of the CERCLA action;
- the medium regulated or affected by the requirement and the medium contaminated or affected at the CERCLA site;
- the substances regulated by the requirement and the substances found at the CERCLA site;
- any variances, waivers, or exemptions of the requirement and their availability for the circumstances at the CERCLA site;

- the type of place regulated and the type of place affected by the release or CERCLA action;
- the 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; and
- 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. Then, 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, if not applicable, may still be 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 2-3, 2-4 and 2-5 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 National Oil and Hazardous Substances Pollution Contingency Plan (NCP), a state requirement must be:

- 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, and
- 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" (40 Code of Federal Regulations [CFR] 300.5).

Non-promulgated 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 (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 the Site as a whole or to specific remedial alternatives and may require further technical evaluation. As the Remedial Investigation/Feasibility Study (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 the Site. 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 the Site. 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; and
- 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 (HSWA) 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 either:

- the waste was initially treated, stored, or disposed of after the effective date of the particular RCRA requirement; or
- 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 of the 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 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 U.S. 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

The California Environmental Quality Act (CEQA) is applicable to state actions and not actions of the federal government. Furthermore, U.S. 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, as amended by SARA. 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 above, 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 that 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 if 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. However, 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 22 CCCR § 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 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.

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 2-3.

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 (16 USC §§ 1531–1543) 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 meaning "... 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 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 species of special concern, the California tiger salamander (Ambystoma californiense) has been identified in the near vicinity of Site 29. These species were identified from a review of the CNDDB 2000 database and from a previous ecological survey conducted by the University of Arizona at the Site.

The federal ESA of 1973 (16 USC 1531 et seq, 50 CFR Part 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 species of special concern have been observed in the vicinity of Site 29. Remedial activities performed at the Site 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 (Pub. L. No.) 96-95 (16 USC § 470aa–470mm) was enacted in 1979 and amended in 1988 and 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 Act 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 (16 USC Section 470 aa 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 2-4. 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 (RA); 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. 22 CCR, Division 4.5, Chapter 11, Article 3, (22 CCR 66261.10 and 66261.24), set 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 RA involves excavation of soil that contains RCRA or non-RCRA hazardous waste, then the substantive requirements within 22 CCR, Division 4.5, Chapter 12, Articles 1 and 3 (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 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 FR 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 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 pre-transport regulations at 22 CCR §§ 66262.30 (packaging), 66262.31(labeling), 66262.32 (marking) and 66262.33 (placarding), and RCRA manifest requirements at 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 22 CCR §66268.7 are also ARARs. Prior to 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 22 CCR § 66268.7. In addition, the Department of Transportation (DOT) hazardous materials regulations at 49 CFR 171-172 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 if 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 U.S. EPA as part of the State Implementation Plan (SIP) and are thus implemented under the authority of Clean Air Act (CAA). 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. 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 1996) 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 2-5.

2.2.8.11 Other Requirements to be Followed

Resolutions adopted pursuant to Occupational Safety and Health Administration (OSHA) (29 CFR 1910.120) are additional, non-environmental 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 (29 CFR Part 1910.1101 and Part 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

3.1 INTRODUCTION

The objective of this focused FS is to develop and evaluate remedial alternatives for Site 29 that are consistent with CERCLA and the NCP and minimize the potential for human and ecological exposure to affected soils at the Site. 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.

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, 40 CFR Section 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 soil media has been addressed because groundwater and surface water is not a 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 screening level human health and ecological risk assessments performed for the SI report. The RAOs developed are consistent with NCP requirements for remedy selection as detailed in 40 CFR Section 300.430.

3.2.1 Remedial Action Objectives for Unrestricted Land Use

Although current and planned future uses of the Site are to remain industrial, with the potential for worker exposures to COCs at the Site, this FS conservatively develops a remedial action objective and remedial

alternatives that would allow for future unrestricted land use (i.e., residential land use scenario). The results of the SRA 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 SRA is lead found 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 from 0 to 1 foot bgs at concentrations greater than the established EPA Region IX residential level PRG for lead. The residential level PRG for lead is 400 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 metallic COECs 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 COECs identified from the SLERA include barium, chromium, copper, lead, mercury, nickel, selenium, and zinc, found in surface soils.

The RAO for protection of ecological receptors therefore consists of preventing ingestion of and direct contact with these COECs in soil from 0 to 1 feet bgs at concentrations above than the greater value of the background soil concentrations or established ecological soil PRGs for each of these compounds. The background soil concentrations for barium, chromium, copper, lead, mercury, nickel, and zinc are 560 mg/kg, 62 mg/kg, 65 mg/kg, 32 mg/kg, 0.17 mg/kg, 110 mg/kg, and 99 mg/kg, respectively. No selenium background soil concentration is available. The individual ecological soil PRGs for barium, chromium, copper, lead, mercury, nickel, selenium, and zinc are 283 mg/kg, 0.4 mg/kg, 60 mg/kg, 40.5 mg/kg, 0.0005 mg/kg, 30 mg/kg, 0.21 mg/kg, and 8.5 mg/kg, respectively.

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:

Contaminated Soil

- No Action
- Institutional Controls
- Containment
- Removal and Disposal

3.3.1 No Action

"No action" implies that no remedial action will be conducted at the Site. The Site is allowed to continue in its current state, and no actions are 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. No additional access restrictions would be put into place and no deed restrictions would be placed on the Site. The NCP requires that "No Action" be included among the general response actions evaluated in every FS (40 CFR Part 300, 430 [e][b]). The no action response provides a baseline for comparison to the other remedial alternatives.

3.3.2 Institutional Controls

Institutional controls are non-engineering measures, usually legal or physical means, of 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 asbestos-containing materials before building demolition begins, according to current State air-quality regulations.

3.4 DESCRIPTION OF REMEDIAL ALTERNATIVES

This section develops and describes potential remedial alternatives for contaminated soil. 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 and established background concentration levels. The remedial alternatives vary in degree of effectiveness, implementability, and cost, and represent a range of alternatives as required in the NCP (40 CFR Section 300.430[e]). This range (as required in the NCP) includes, (1) one or more alternatives that involve little or no treatment but protect human health and the environment primarily by preventing or controlling exposure; (2) an alternative that reduces the toxicity, mobility, or volume of COPCs and eliminates the need for long-term monitoring; and (3) a no action alternative.

3.4.1 Alternative 1: No Action

Under Alternative 1, no remedial action will be taken. Contaminated soil will be left at the Site "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 (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 non-engineering measures, usually legal or physical means, of 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 would be appended to the Installation Master Plan (IMP) for the Site to prohibit residential use of the Site and construction of hospitals, schools for children under 18 years of age, daycare centers for children, or any permanently occupied human habitation on the Site. Potential land use changes, including future construction activities, agricultural, commercial, or residential land use, would be evaluated through the Navy's "project review process" which considers appending the IMP.

In addition, the Navy will prepare a Land Use Control Implementation and Certification Plan (LUCICP) to ensure implementation of land-use restrictions imposed within the IMP. The LUCICP will include identification of responsible parties for carrying out periodic reviews of the Site's status for complying with the IMP restrictions, preparation of periodic LUCICP status memoranda, and procedures for notifying the Navy and other FFSRA signatories of a change in land use.

Access restrictions to the Site are currently in place because the Site 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 Site, 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 six inches) around the perimeter of the concrete cap to prevent and discourage burrowing of sensitive species such as the tiger salamander.

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 asbestos-containing materials 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 below, followed by a detailed evaluation of this alternative in Section 4.0.

Excavation and Backfill

This alternative involves the removal and clean backfill of an estimated 165 cy of contaminated soil from beneath Building IA-25 (one-foot depth of soil removed over an area of 4,400 square feet). Figure 2-4 presents the proposed areal 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 air borne 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 plans 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 the Site 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.

Building Demolition

Building IA-25 is a single story building of wood construction measuring approximately 40 feet wide by 150 feet long. The requirements of NESHAP as found in 40 CFR 61 Part M and as delegated to the State under BAAQMD Regulation 11, Rule 2, requires that all buildings be inspected for the presence of ACM prior to 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 crawlspace area beneath the building. The building will therefore be inspected and surveyed for Regulated Asbestos Containing Material (RACM). Should RACM be found, this material will be removed from the building before demolition activities begin. Any asbestos abatement activities performed will be done in strict compliance with federal and state NESHAP, EPA, and OSHA standards.

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 (RWQCB); 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 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 only be disposed of 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 CCRs 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 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 (BFI) in Pittsburg, California, has the following criteria for accepting designated waste:

- The waste must not exceed hazardous constituents in excess of 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
- Petroleum hydrocarbon concentrations that have no specific limits but the waste must meet 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 non-hazardous soil waste. Certain Class III landfills can also accept asbestos-containing materials 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: 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 Section 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
5. Short-term effectiveness
6. Implementability
7. Cost
8. State acceptance
9. Community acceptance

These nine criteria are discussed below.

1. 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.

2. 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 for the Site and identifies potential action-specific ARARs associated with the three remedial alternatives.

3. 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

4. Reduction in Toxicity, Mobility, or Volume

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

5. 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

6. 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

7. 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. Annual O&M costs for each alternative 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.

8 & 9. State and Community Acceptance

These two criteria evaluate the issues and concerns of the state and community regarding each alternative. These criteria cannot be fully evaluated until the state and community have reviewed the alternatives, which will occur after submittal of the proposed plan. For this reason, these criteria will not be further evaluated in this FS.

4.1 ALTERNATIVE 1: NO ACTION

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

Assuming the current and planned future uses of the Site remain industrial, risks to human health would remain within acceptable limits. However, the "no action" alternative is not protective of human health or the environment under the unrestricted land use scenario, because this alternative does nothing to prevent unrestricted use 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 the Site.

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 ecology will be unacceptable because of the presence of barium, chromium, copper, lead, mercury, nickel, selenium and zinc in soils. Thus, Alternative 1 does not assure long-term effectiveness and permanence.

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

The mobility, toxicity, and volume of hazardous substances at Site 29 will not be reduced 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. Each of these factors is assessed below for Alternative 1.

Because no action will be taken this alternative does nothing to address the unacceptable health risks to the community and current 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.

However, Alternative 1 will not achieve the RAO for soils under the unrestricted land use scenario or the ecological RAOs. The no action alternative is therefore not considered effective 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.

4.2 ALTERNATIVE 2: CAPPING WITH INSTITUTIONAL CONTROLS

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

The RAO for unrestricted land use is concerned primarily with preventing exposure to contaminated soil. Alternative 2 protects human health and the environment by restricting access to affected soils at the Site by ecological receptors identified, residents, children in school or day care centers, or other permanent occupants. Land use will be restricted through notations made within the Site IMP. 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 the Site 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.

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 below for Alternative 2.

Magnitude of Residual Risks

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

Adequacy and Reliability of Controls

Because contaminated soil will not be removed from the Site, 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 noted within the IMP or other land-use plan adopted by another owner and the ability of the Navy to maintain the integrity of the concrete cap. The Navy will prepare and follow the requirements of the proposed LUCICP to ensure implementation of land use restrictions imposed within the IMP (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 LUCICP 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 – Alternative 2

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

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 below for Alternative 2.

This alternative 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 the Site 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 potential sensitive habitat for species within the earthen berm habitat 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 therefore 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 needed 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 IMP is relatively low and future costs to monitor and enforce land use controls, through the LUCICP, are considered modest. Total estimated cost for this alternative is $40,300 as further detailed within Appendix C.

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 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 in 22 CCR, Division 4.5, Chapter 11 and 14, to determine whether soil exhibits state or federal hazardous waste characteristics. If the soil qualifies as a hazardous waste, it would be managed, stored, and transported in accordance with the substantive Federal requirements in 49 CFR Section 171, and 49 USC Sections 5101 through 5127 as well as the State requirements in 22 CCR, Sections 66262.20 through 66262.23 and Sections 66262.30 through 66262.34 (see also Table 2-5).

As appropriate, excavated soil would be handled and treated to comply with land disposal restrictions of 22 CCR 66268.7. In addition, if the soil is not hazardous waste, it would be characterized according to Title 27 requirements for solid and designated waste to determine if 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 asbestos construction materials, the requirements of BAAQMD Regulation 11, Rule 2 would be complied with including the survey, removal and off-site disposal of asbestos materials prior to building demolition.

The requirements of the Archeological Resources Protection Act, 16 USC Section 470aa through 470mm as location-specific ARARs, is 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 threatened and endangered species regulations found within 16 USC Section 1536(a)(h)(1)(B) and CDFG Codes, Sections 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 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 below for Alternative 3.

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.

Adequacy and Reliability of Controls

Excavation with off-site disposal is a proven and reliable technology that would effectively remove contaminated soils from the Site and thus permanently reduce the possibility of human or ecological exposure to affected materials at the Site. 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. Therefore, Alternative 3 is considered highly effective over the long term.

4.3.4 Reduction of Toxicity, Mobility, or Volume – 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 the Site because the affected soil would not be treated, or reduced in volume. Therefore, the CERCLA preference for treatment, as a principal element of the remedy, would not be satisfied by Alternative 3. Thus, 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.

Protection of the Community

The surrounding community is far removed from the Site and is not likely to face any short-term risks during building demolition, excavation, and removal activities. However, 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 which will 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.

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 hazards at the Site.

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.

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 at the Site.

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:

(1) the time required to characterize samples of the contaminated soil,
(2) additional volumes of contaminated soil encountered during excavation,
(3) the number of unanticipated obstructions during excavation
(4) suitable weather conditions.

Based on the 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 below.

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.

Administrative Feasibility

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

Availability of Required Resources

Off-site commercial disposal capacity will be adequate to handle the relatively small volume of contaminated soil generated from the Site (approximately 165 cy). Several Class II and III permitted

landfills are located fairly close to the Site. 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 since 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) distance between the Site and the landfill and (2) the volume of waste requiring disposal and (3) the soil characterization. Total estimated cost to complete this alternative is $119,300 (see Appendix C).

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 future 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:" overall protection of human health and the environment, and 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 comments by the community and the agencies on this 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. A summary of the comparative analyses is 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. However, according to the NCP, 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
- 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 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 the Site, to human or ecological receptors.

5.2.2 Reduction in Toxicity, Mobility, or Volume

None of the three alternatives provide for a reduction in toxicity, mobility or volume, 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. Alternatives 2 and 3 are considered to be equally effective in the short term as 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 $40,300, and the total costs for Alternative 3 are estimated at $119,300. 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. However, state and community acceptance cannot be fully evaluated 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.

6.0 REFERENCES

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TABLES

TABLE 2-1
SUMMARY OF ECOLOGICAL RISK AND HAZARD QUOTIENT RESULTS
(BUILDING CARWLSPACE SURFACE SOILS SAMPLING EVENT)
SITE 29 FEASIBILITY STUDY
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemicals	Number of Detections	Average of Detected Conc. (*)	Maximum Detected Conc.	Inland Area Background soil concentration (1)	Exceeded Background soil concentration	COPEC Flag	Rationale for COPEC Flag	ORNL Eco Soil PRGs	Exceeded Eco Soil PRGs	Eco PRG HQs
Volatiles (µg/kg)										
2-BUTANONE (MEK)	1	480	480	--	NA	Yes	DT			
1,1,1-TRICHLOROETHANE	1	13	13	--	NA	Yes	DT			
METHYLENE CHLORIDE	4	9.0	11	--	NA	Yes	DT			
XYLENES (total)	2	12	15	--	NA	Yes	DT			
Semivolatiles (µg/kg)										
BIS(2-ETHYLHEXYL)PHTHALATE	2	2,500	3,900	--	NA	Yes	DT			
Organochlorine Pesticides and PCB (µg/kg)										
4,4'-DDD	1	120	120	--	NA	Yes	DT			
4,4'-DDT	7	61	230	--	NA	Yes	DT			
beta-BHC	1	32	32	--	NA	Yes	DT			
Polynuclear Aromatic Hydrocarbons (µg/kg)										
ACENAPHTHENE	1	52	52	--	NA	Yes	DT	20	Yes	2.6
ANTHRACENE	1	7,000	7,000	--	NA	Yes	DT			
CHRYSENE	3	809	1,900	--	NA	Yes	DT			
BENZO(b/k)FLUORANTHENE	3	310	480	--	NA	Yes	DT			
BENZO(a)PYRENE	1	150	150	--	NA	Yes	DT			
FLUORANTHENE	6	2,210	6,400	--	NA	Yes	DT			
NAPHTHALENE	1	40	40	--	NA	Yes	DT			
PHENANTHRENE	1	3,500	3,500	--	NA	Yes	DT			
PYRENE	6	1,577	4,500	--	NA	Yes	DT			
Chlorinated Herbicides (µg/kg)										
2,3,5-TP (Silvex)	1	13	13	--	NA	Yes	DT			
2,4-DB	2	60	66	--	NA	Yes	DT			
DINOSEB	5	16	23	--	NA	Yes	DT			

TABLE 2-1
SUMMARY OF ECOLOGICAL RISK AND HAZARD QUOTIENT RESULTS
(BUILDING CARWLSPACE SURFACE SOILS SAMPLING EVENT)
SITE 29 FEASIBILITY STUDY
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemicals	Number of Detections	Average of Detected Conc. (*)	Maximum Detected Conc.	Inland Area Background soil concentration (1)	Exceeded Background soil concentration	COPEC Flag	Rationale for COPEC Flag	ORNL Eco Soil PRGs	Exceeded Eco Soil PRGs	Eco PRG HQs
CLP Metals (mg/kg)										
ALUMINUM	22	20,281	27,500	21,000	Yes	Yes	AAL			
BARIUM	29	571	1,660	560	Yes	Yes	AAL	283	Yes	5.9
BERYLLIUM	13	3.6	16	0.12	Yes	Yes	AAL	10	Yes	1.6
CADMIUM	12	6.8	32	0.28	Yes	Yes	AAL	4	Yes	8.0
CHROMIUM	29	156	2,600	62	Yes	Yes	AAL	0.4	Yes	6,500
COBALT	29	21.0	32	25	Yes	Yes	AAL	20	Yes	1.6
COPPER	29	103	1,190	65	Yes	Yes	AAL	60	Yes	19.8
LEAD	29	308	3,400	32	Yes	Yes	AAL	40.5	Yes	84.0
MANGANESE	22	1,108	1,440	1,300	Yes	Yes	AAL			
MERCURY	18	0.4	1.4	0.17	Yes	Yes	AAL	0.001	Yes	2,800
NICKEL	29	79.5	160	110	Yes	Yes	AAL	30	Yes	5.3
SELENIUM	7	2.6	4.4	DL	Yes	Yes	AAL	0.2	Yes	21.0
SILVER	3	0.22	0.3	DL	Yes	Yes	AAL	2	No	0.2
VANADIUM	29	66.02	110	95	Yes	Yes	AAL	2	Yes	55.0
ZINC	29	1079.75	20,000	99	Yes	Yes	AAL	8.5	Yes	2,353

Notes:

-- None Established
AAL Above ambient level.
BAL Below ambient level.
COPEC Chemical of Potential Ecological Concern
Conc. Concentrations
DL Detection limit.
DT Detected in soil; no ambient screening level.
HQ Hazard quotient
µg/kg microgram per kilogram
mg/kg milligram per kilogram
NA Not applicable
NUT Essential nutrient.
ORNL Oak Ridge National Lab
PRG Preliminary Remediation Goal (EPA 1998)

(*) Average based on a normal distribution.
(1) Naval Weapons Station Seal Beach Detachment Concord Inland Area ambient limits (Appendix C of RFACS).

TABLE 2-2
SUMMARY OF ECOLOGICAL RISK AND HAZARD QUOTIENT RESULTS
(SUBSURFACE SOILS SAMPLING EVENT)
SITE 29 FEASIBILITY STUDY
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemical	Number of Detections	Average of Detected Conc. (*)	Maximum Detected Conc.	Inland Area Background soil Concentrations (1)	Exceeded background soil concentrations	COPEC Flag	Rationale for COPEC Flag	ORNL's Eco Soil PRGs	Exceeded Eco Soil PRGs	Eco PRG HQs
Volatiles (µg/kg)										
TRICHLOROETHENE			2	--	NA	Yes	DT			
Petroleum Indicators (mg/kg)										
GASOLINE	1		0.7	--	NA	Yes	DT			
CLP Metals (mg/kg)										
ANTIMONY	4	1.6	1.9	0.9	Yes	Yes	AAL	5	No	0.38
BARIUM	9	428	1,240	560	Yes	Yes	AAL	283	Yes	4.38
BERYLLIUM	5	0.19	0.35	0.12	Yes	Yes	AAL	10	No	0.04
CHROMIUM	9	38.7	75	62	Yes	Yes	AAL	0.4	Yes	187.50
COPPER	9	43.7	79.1	65	Yes	Yes	AAL	60	Yes	1.32
MANGANESE	9	1,401	6,560	1,300	Yes	Yes	AAL			
MERCURY	9	0.1	0.25	0.17	Yes	Yes	AAL	0.0005	Yes	490.20
MOLYBDENUM	1	0.48	0.48	DL	Yes	Yes	AAL	2	No	0.24
SELENIUM	1	1.5	1.5	DL	Yes	Yes	AAL	0.21	Yes	7.14
THALLIUM	1	7	7	1.4	Yes	Yes	AAL	1	Yes	7.00
VANADIUM	9	67.1	164	95	Yes	Yes	AAL	2	Yes	82.00

Notes:

-- None Established
AAL Above ambient level.
BAL Below ambient level.
COPEC Chemical of Potential Ecological Concern
Conc. Concentrations
DL Detection limit.
DT Detected in soil; no ambient screening level.
HQ Hazard quotient
µg/kg microgram per kilogram
mg/kg milligram per kilogram
NA Not applicable
NUT Essential nutrient.
ORNL Oak Ridge National Lab
PRG Preliminary Remediation Goal (EPA 1998)
(*) Average based on a normal distribution.
(1) Naval Weapons Station Seal Beach Detachment Concord Inland Area ambient limits (Appendix C of RFACS).

TABLE 2-3
POTENTIAL CHEMICAL-SPECIFIC ARARS
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

Notes:

ARAR Applicable or relevant and appropriate requirement
CCR California Code of Regulations
CFR Code of Federal Regulations
RCRA Resource Conservation and Recovery Act
USC U.S. Code

TABLE 2-4
POTENTIAL LOCATION-SPECIFIC ARARs
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 unless such action is conduct pursuant to a permit.	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 2-4 (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:

ARAR	Applicable or Relevant and Appropriate Requirement
CFR	Code of Federal Regulations
FGC	Fish and Game Code
NHPA	National Historic Preservation Act
USC	United States Code

TABLE 2-5
POTENTIAL ACTION-SPECIFIC ARARs
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.
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

TABLE 2-5 (continued)
POTENTIAL ACTION-SPECIFIC ARARs
SITE 29 FEASIBILITY STUDY
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comments
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.
Excavation and handling of soil	Establishes requirements to limit the quantity of particulate matter.	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.

TABLE 2-5 (continued)
POTENTIAL ACTION-SPECIFIC ARARs
SITE 29 FEASIBILITY STUDY
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comments
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:

ARAR	Applicable or Relevant and Appropriate Requirement
BAAQMD	Bay Area Air Quality Management District
CAA	Clean Air Act
CCR	California Code of Regulations
CFR	Code of Federal Regulations
LDR	Land Disposal Restriction
RCRA	Resource Conservation and Recovery Act
SIP	State Implementation Plan
USC	United States Code

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

Evaluation Criteria	SITE 29		
	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
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	Annual O&M Cost (1)	Total NPV Cost (2)
1. No Action	- 0 -	- 0 -	- 0 -
2. Capping with Institutional Controls	$45,200	- 0 -	$45,200
3. Removal with Off-Site Disposal	$134,000	- 0 -	$134,000

Notes:

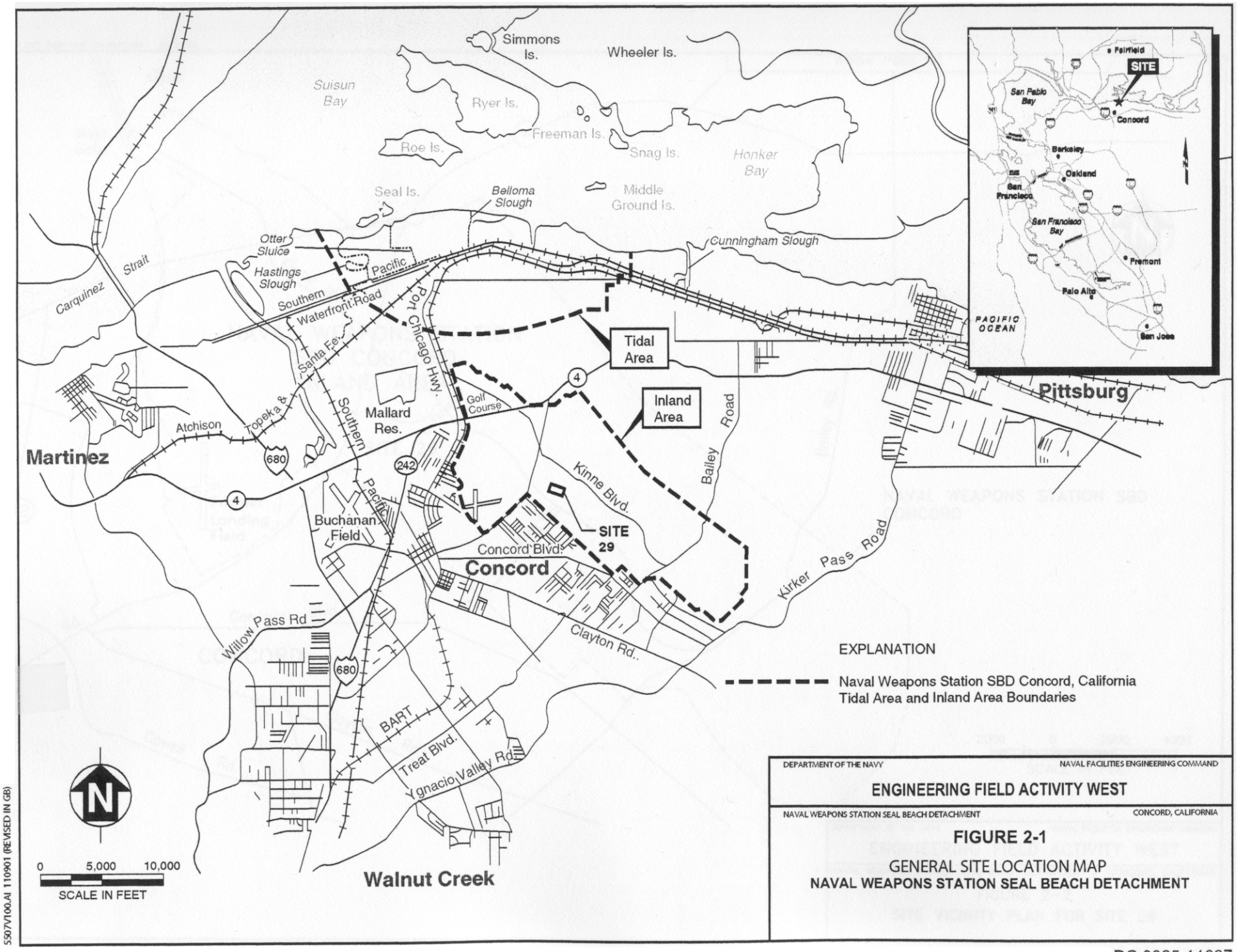
(1) Annual O&M cost during the first five years. Annual O&M cost assumes quarterly groundwater and gas monitoring for the first 5 years and annual monitoring for the next 25 years.

(2) Total NPV cost includes capital costs and NPV of annual O&M cost. Present value calculated based on a 7 percent discount rate.

NPV Net present value

O&M Operation and Maintenance

FIGURES



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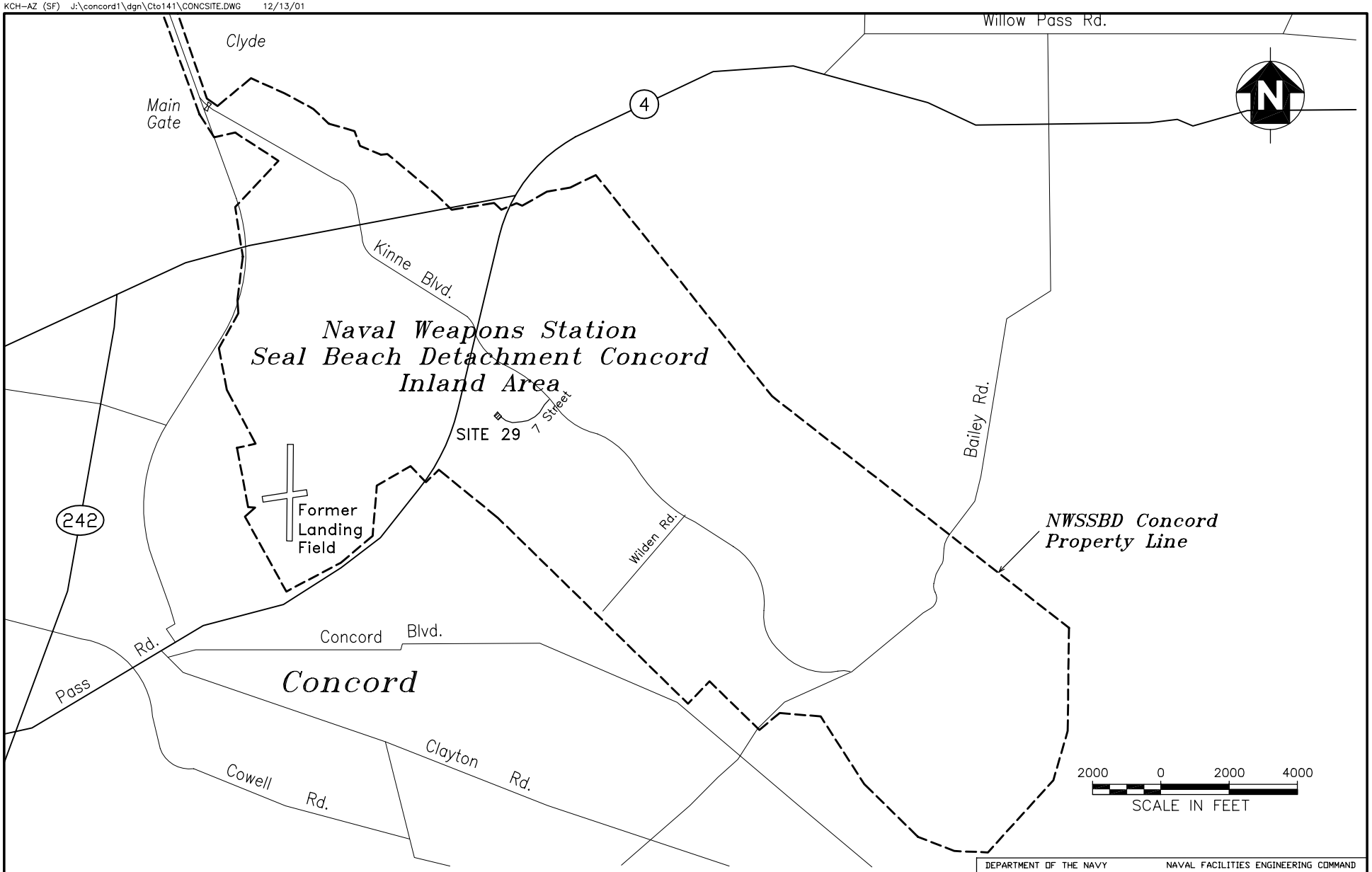

DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND

ENGINEERING FIELD ACTIVITY WEST

NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD, CALIFORNIA

FIGURE 2-2
SITE VICINITY PLAN FOR SITE 29

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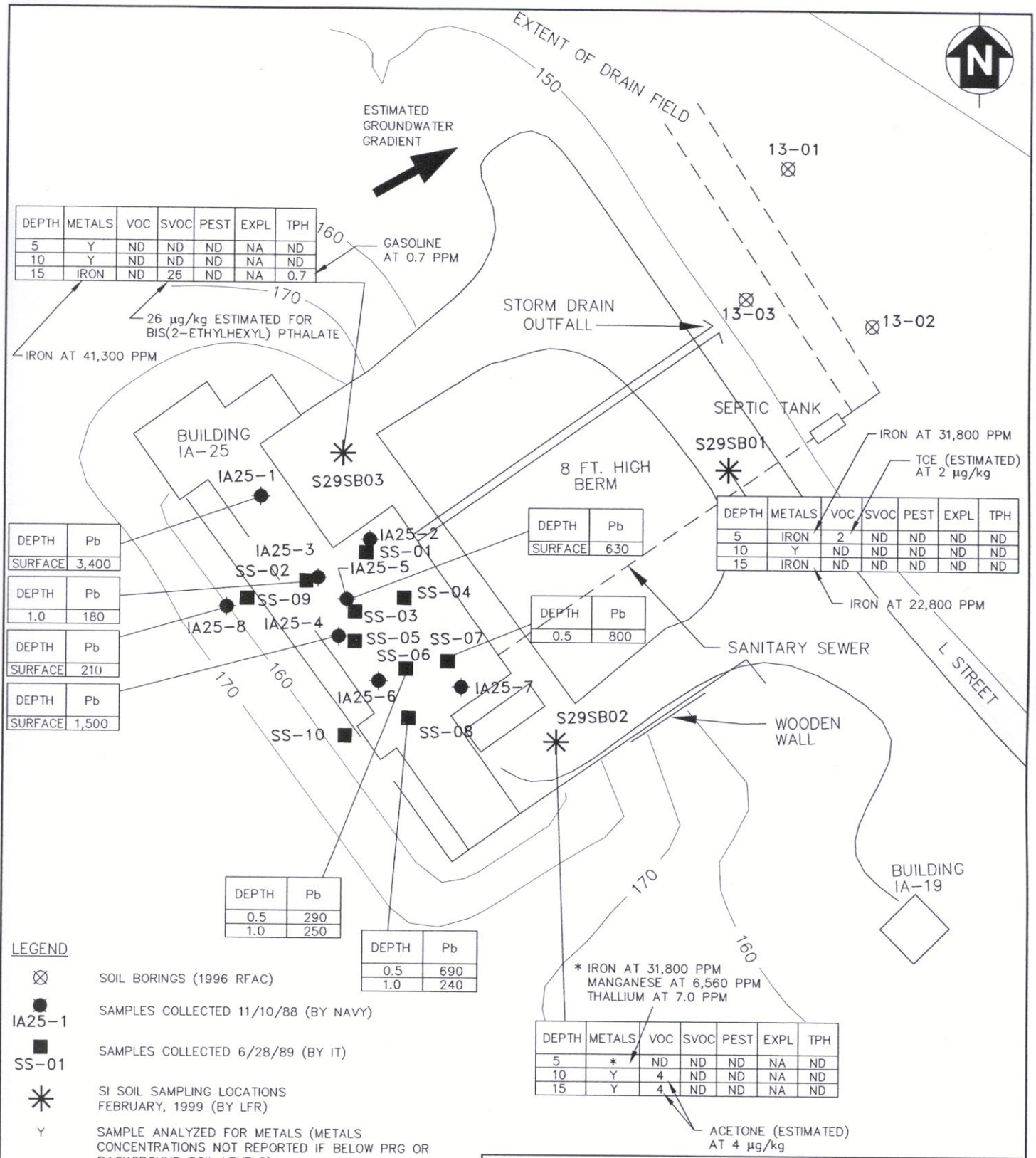

DEPTH	METALS	VOC	SVOC	PEST	EXPL	TPH
5	Y	ND	ND	ND	NA	ND
10	Y	ND	ND	ND	NA	ND
15	IRON	ND	26	ND	NA	0.7

DEPTH	Pb
SURFACE	3,400

DEPTH	Pb
1.0	180

DEPTH	Pb
SURFACE	210

DEPTH	Pb
SURFACE	1,500

DEPTH	Pb
SURFACE	630

DEPTH	Pb
0.5	800

DEPTH	Pb
0.5	290
1.0	250

DEPTH	Pb
0.5	690
1.0	240

DEPTH	METALS	VOC	SVOC	PEST	EXPL	TPH
5	IRON	2	ND	ND	ND	ND
10	Y	ND	ND	ND	ND	ND
15	IRON	ND	ND	ND	ND	ND

DEPTH	METALS	VOC	SVOC	PEST	EXPL	TPH
5	*	ND	ND	ND	NA	ND
10	Y	4	ND	ND	NA	ND
15	Y	4	ND	ND	NA	ND

LEGEND

⊗ SOIL BORINGS (1996 RFAC)

● IA25-1 SAMPLES COLLECTED 11/10/88 (BY NAVY)

■ SS-01 SAMPLES COLLECTED 6/28/89 (BY IT)

✳ SI SOIL SAMPLING LOCATIONS FEBRUARY, 1999 (BY LFR)

Y SAMPLE ANALYZED FOR METALS (METALS CONCENTRATIONS NOT REPORTED IF BELOW PRG OR BACKGROUND SOIL LEVELS)

NA NOT ANALYZED

ND NOT DETECTED

NOTES:

1. RESULTS REPORTED IN mg/kg IF NOT SHOWN OTHERWISE.
2. ONLY THE ANALYTICAL DATA FOR LEAD THAT WAS DETECTED ABOVE THE RESIDENTIAL PRG OF 130 mg/kg ARE SHOWN. ALL SAMPLES WERE ANALYZED FOR LEAD.

20' 0 20' 40'

SCALE: 1" = 40'

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

ENGINEERING FIELD ACTIVITY WEST

NAVAL WEAPONS STATION SEAL BEACH DETACHMENT — CONCORD, CALIFORNIA

FIGURE 2-3

SITE PLAN SHOWING SOIL ANALYTICAL RESULTS AT SITE 29

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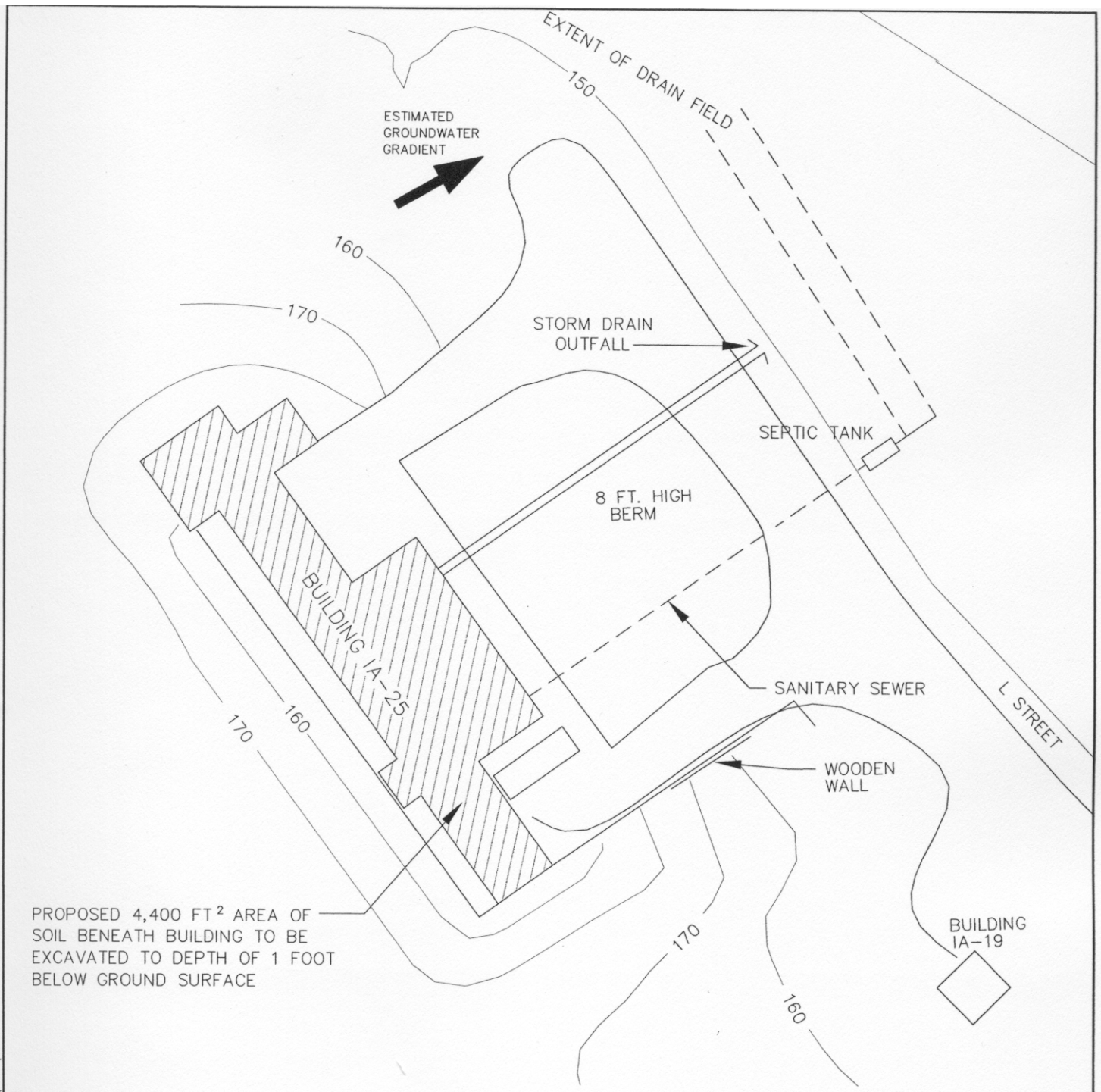

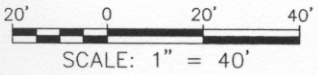

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

ENGINEERING FIELD ACTIVITY WEST

NAVAL WEAPONS STATION SEAL BEACH DETACHMENT — CONCORD, CALIFORNIA

FIGURE 2-4

SITE PLAN SHOWING SOIL EXCAVATION AREA

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APPENDIX A

SUMMARY OF SOIL SAMPLE ANALYTICAL RESULTS

APPENDIX A

LIST OF TABLES

Table No.	Title
A-1	MAXIMUM CONCENTRATIONS OF DETECTED CONSTITUENTS (BUILDING CRAWLSPACE SURFACE SOILS SAMPLING EVENT)
A-2	SUMMARY OF SITE 29 ANALYTICAL RESULTS (SUBSURFACE SOILS SAMPLING EVENT)

TABLE A-1
MAXIMUM CONCENTRATIONS OF DETECTED CONSTITUENTS
(BUILDING CRAWLSPACE SURFACE SOILS SAMPLING EVENT)
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemical	Maximum Detected Concentration	Inland Area Ambient Level[1]	Exceeded Ambient Level	COC
Volatiles (µg/kg)				
ACETONE		NA		
2-BUTANONE (MEK)	480	--	NA	No
1,1,1-TRICHLOROETHANE	13	--	NA	No
METHYLENE CHLORIDE	11	--	NA	No
TRICHLOROETHENE		--	NA	No
XYLENES (total)	15	--	NA	No
Semivolatiles (µg/kg)				
BIS(2-ETHYLHEXYL)PHTHALATE	3,900	--	NA	No
Organochlorine Pesticides and PCB (µg/kg)				
4,4'-DDD	120	--	NA	No
4,4'-DDT	230	--	NA	No
beta-BHC	32	--	NA	No
Polynuclear Aromatic Hydrocarbons (µg/kg)				
ACENAPHTHENE	52	--	NA	No
ANTHRACENE	7,000	--	NA	No
CHRYSENE	1,900	--	NA	No
BENZO(b/k)FLUORANTHENE	480	--	NA	No
BENZO(a)PYRENE	150	--	NA	No
FLUORANTHENE	6,400	--	NA	No
NAPHTHALENE	40	--	NA	No
PHENANTHRENE	3,500	--	NA	No
PYRENE	4,500	--	NA	No
Chlorinated Herbicides (µg/kg)				
2,3,5-TP (Silvex)	13	--	NA	No
2,4-DB	66	--	NA	No
DINOSEB	23	--	NA	No
CLP Metals (mg/kg)				
ALUMINUM	27,500	21,000	Yes	No
ANTIMONY		0.9		No
ARSENIC	10	15	No	No
BARIUM	1,660	560	Yes	No
BERYLLIUM	16	0.12	Yes	No
CADMIUM	32	0.28	Yes	No
CALCIUM	8,870	2541 to 45,577 [2] 100 to 320,000 [3]	No	No
CHROMIUM	2,600	62	Yes	No
COBALT	32	25	Yes	No
COPPER	1,190	65	Yes	No
IRON	42,400	10,000 to 87,000 [2] 7,000 to 550,000 [4]	No	No
LEAD	3,400	32	Yes	Yes

TABLE A-1
MAXIMUM CONCENTRATIONS OF DETECTED CONSTITUENTS
(BUILDING CRAWLSPACE SURFACE SOILS SAMPLING EVENT)
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemical	Maximum Detected Concentration	Inland Area Ambient Level[1]	Exceeded Ambient Level	COC
CLP Metals (mg/kg) (continued)				
MAGNESIUM	12,800	1,456 to 32,378 [2] 50 to >100,000 [3]	No	No
MANGANESE	1,440	1,300	Yes	No
MERCURY	1.4	0.17	Yes	No
MOLYBDENUM		DL		No
NICKEL	160	110	Yes	No
POTASSIUM	2270	2,100 to 30,000 [2] 50 to 63,000 [4]	No	No
SELENIUM	4.4	DL	Yes	No
SILVER	0.3	DL	Yes	No
SODIUM	3410	5,580 to 73,400 [2] <500 to 100,000 [3]	No	No
THALLIUM		1.4		No
VANADIUM	110	95	Yes	No
ZINC	20,000	99	Yes	No
Explosives and Explosive Byproducts (mg/kg)				
DIPHENYLAMINE	1.2	--	NA	No

Notes:

(1) Naval Weapons Station Seal Beach Detachment Concord, Inland Area ambient limits (Appendix C of RFACS).

(2) Values from Bradford and others (1996).

(3) Values from Shacklette and Boerngen (1984).

(4) Values from Lindsay (1979).

-- None Established

COC Chemical of Concern

NA Not applicable

TABLE A-2
SUMMARY OF SITE 29 ANALYTICAL RESULTS
(SUBSURFACE SOILS SAMPLING EVENT)
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Point ID	S29SB01	S29SB01	S29SB01	S29SB02	S29SB02	S29SB02	S29SB03	S29SB03	S29SB03	EPA Residential PRG	EPA Industrial PRG	Inland Area Ambient Levels
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			
Volatiles (µg/kg)												
TRICHLOROETHENE	2 J	11 U	11 U	11 U	12 U	12 U	12 U	12 U	11 U	2,700	6,100	N/A
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	N/A	N/A	N/A
CLP Metals (mg/kg)												
ALUMINUM	14,600	13,100	13,900	14,000	13,300	12,600	8,770	11,700	20,600	75,000	100,000	21,000
ANTIMONY	0.62 UR	0.74	1.3[A]	1.6[A]	0.77 UR	0.83 UR	0.67 UR	0.68 UR	1.9[A]	30	750	0.9
ARSENIC	3[R]	2.3[R]	1.6[R]	2.6[R]	1.6[R]	0.62 U	3[R]	1.7[R]	9.5[R,I]	0.38	3	15
BARIUM	438	274	379	1240[A]	223	250	256	354	439	5,200	100,000	560
BERYLLIUM	0.020 U	0.010 U	0.020 U	0.13[A]	0.35[A]	0.31[A]	0.09	0.020 U	0.08	150	3,400	0.12
CALCIUM	5,160	7,340	7,120	6,240	3,080	2,690	3,090	5,530	8,950	N/A	N/A	N/A
CHROMIUM	36.1	45.2	35.8	55.8	29.1	22.2	19.1	29.6	75[A]	210	450	62
COBALT	12.7	13.5	16.5	22.3	10.9	14.9	11.4	15.1	19.9	3,300	29,000	25
COPPER	61.9	29.5	37	35.8	26.2	25	66.8[A]	31.2	79.1[A]	2,800	70,000	65
IRON	31,800[R]	20,500	22,800[R]	31,800[R]	20,400	17,200	16,300	22,000	41,300[R]	22,000	100,000	N/A
LEAD	3.2	2.1	1.5	1.6	3.9	5.9	3.1	1.5	2.2	130	1,000	32
MAGNESIUM	10,700	8,800	9,950	10,700	7,760	7,900	5,050	9,060	12,200	N/A	N/A	N/A
MANGANESE	1840[A]	768	733	6560[A,R]	153	426	367	1,080	686	3,100	45,000	1,300
MERCURY	0.13	0.11	0.05	0.22[A]	0.21[A]	0.25[A]	0.12	0.1	0.09	22	560	0.17
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[A]	370	9,400	DL
NICKEL	101	64.9	55.6	91.2	51.7	55.1	39.3	71.4	58.1	150	37,000	110
POTASSIUM	458	552	500	682	1450	1560	801	390	832	N/A	N/A	N/A
SELENIUM	0.72 U	0.53 U	0.69 U	1.5[A]	0.71 U	0.77 U	0.78 U	0.79 U	0.83 U	370	9,400	DL
THALLIUM	3.4 U	1.8 U	2.8 U	7[A,R]	1.3 U	1.6 U	0.89 U	2.8 U	3.9 U	5.2[1]	130[1]	1.4
VANADIUM	63.1	51.8	58.5	99.7[A]	44.1	34.4	37.9	50.6	164[A]	520	13,000	95
ZINC	90.8	50.6	63.4	58.1	47.7	49.3	88	41.6	91.9	22,000	100,000	99

Notes:

Samples where no volatiles, semivolatiles, petroleum indicators, metals, pesticides, or PCBs were detected are not listed in this table. U = Not detected with detection limit indicated, J = Estimated value, R = Value rejected due to data quality issues

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 10 are reported to one significant figure and results greater than 10 are reported to two significant figures.

DL Detection Limit
N/A Not Available
PRG Preliminary Remediation Goal
R Exceeds EPA Residential PRG
I Exceeds EPA Industrial PRG
A Exceeds Ambient Level
1 PRG for thallium oxide used as surrogate for thallium

APPENDIX B

HUMAN HEALTH RISK ASSESSMENT TABLES

APPENDIX B

LIST OF TABLES

Table No.	Title
B-1	SUMMARY OF STATISTICAL ANALYSIS FOR INDUSTRIAL RISK AND HAZARD RESULTS (SUBSURFACE SOILS SAMPLING EVENT)
B-2	SUMMARY OF STATISTICAL ANALYSIS FOR RESIDENTIAL RISK AND HAZARD RESULTS (SUBSURFACE SOILS SAMPLING EVENT)
B-3	SUMMARY OF STATISTICAL ANALYSIS FOR INDUSTRIAL RISK AND HAZARD RESULTS (BUILDING CRAWLSPACE SURFACE SOILS SAMPLING EVENT)
B-4	SUMMARY OF STATISTICAL ANALYSIS FOR RESIDENTIAL RISK AND HAZARD RESULTS (BUILDING CRAWLSPACE SURFACE SOILS SAMPLING EVENT)
B-5	SUMMARY OF INDUSTRIAL RISK AND HAZARD RESULTS (BUILDING CRAWLSPACE SURFACE SOILS SAMPLING EVENT)
B-6	SUMMARY OF RESIDENTIAL RISK AND HAZARD RESULTS (BUILDING CRAWLSPACE SURFACE SOILS SAMPLING EVENT)
B-7	SUMMARY OF INDUSTRIAL RISK AND HAZARD RESULTS (SUBSURFACE SOILS SAMPLING EVENT)
B-8	SUMMARY OF RESIDENTIAL RISK AND HAZARD RESULTS (SUBSURFACE SOILS SAMPLING EVENT)

TABLE B-1
SUMMARY OF STATISTICAL ANALYSIS FOR INDUSTRIAL RISK AND HAZARD RESULTS
(SUBSURFACE SOILS SAMPLING EVENT)
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Analyte	Number of Detections/ Analysis	Maximum Detected Concentrations	Average of Detected Concentrations [1]	Number of Samples With Concentrations Greater Than Industrial PRG	Number of Samples With Concentrations Greater Than Industrial PRG and Ambient	EPA Industrial PRG	Ambient Value
Volatiles (μg/kg)							
TRICHLOROETHENE	1	2	2	0	0	6,100	N/A
CLP Metals (mg/kg)							
ALUMINUM	9	20,600	13,618	0	0	100,000	21,100
ANTIMONY	3	1.9	1.38	0	0	750	0.9
BARIUM	9	1,240	428	0	0	100,000	560
BERYLLIUM	3	0.35	0.192	0	0	3,400	0.12
CALCIUM	9	8,950	5,467	0	0	N/A	N/A
CHROMIUM	9	75	38.6	0	0	450	62
COPPER	9	79.1	43.6	0	0	70,000	65
MANGANESE	9	6,560	1,401	1	1	45,000	1,300
MERCURY	6	0.13	0.1	0	0	560	0.17
MOLYBDENUM	1	0.48	0.48	0	0	9,400	DL
SELENIUM	1	1.5	1.5	0	0	9,400	DL
THALLIUM	1	7	7	1	1	130	1.4
VANADIUM	9	164	67.1	0	0	13,000	95

Notes:

-- = None Established

PRG = Preliminary Remediation Goal (EPA 1998)

[1] Average based on a log normal distribution.

TABLE B-2
SUMMARY OF STATISTICAL ANALYSIS FOR RESIDENTIAL RISK AND HAZARD RESULTS
(SUBSURFACE SOILS SAMPLING EVENT)
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Analyte	Number of Detections/ Analysis	Maximum Detected Concentrations	Average of Detected Concentrations [1]	Number of Samples With Concentrations Greater Than Residential PRG	Number of Samples With Concentrations Greater Than Residential PRG and Ambient	EPA Residential PRG	Ambient Value
Volatiles (µg/kg)							
TRICHLOROETHENE	1	2	2	0	0	2,700	--
CLP Metals (mg/kg)							
ALUMINUM	9	20,600	13,618	0	0	75,000	21,000
ANTIMONY	3	1.9	1.38	0	0	30	0.9
BARIUM	9	1,240	428	0	0	5,200	560
BERYLLIUM	3	0.35	0.192	0	0	150	0.12
CALCIUM	9	8,950	5,467	0	0	N/A	N/A
CHROMIUM	9	75	38.6	0	0	210	62
COPPER	9	79.1	43.6	0	0	2,800	65
MANGANESE	9	6,560	1,401	1	1	3,100	1,300
MERCURY	6	0.13	0.1	0	0	22	0.17
MOLYBDENUM	1	0.48	0.48	0	0	370	DL
SELENIUM	1	1.5	1.5	0	0	370	DL
THALLIUM	1	7	7	1	1	5.2	1.4
VANADIUM	9	164	67.1	0	0	520	95

Notes:

-- = None Established

PRG = Preliminary Remediation Goal (EPA 1998)

[1] Average based on a log normal distribution.

TABLE B-3
SUMMARY OF STATISTICAL ANALYSIS FOR INDUSTRIAL RISK AND HAZARD RESULTS
(BUILDING CRAWLSPACE SURFACE SOILS SAMPLING EVENT)
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Analyte	Number of Detections	Maximum Detected Concentrations	Average of Detected Concentrations[1]	Number of Samples With Concentrations Greater Than Industrial PRG	Number of Discrete Locations With Sample Conc. Greater Than Industrial PRG and Ambient	EPA Industrial PRG Value	Ambient Value
Volatiles (μg/kg)							
2-BUTANONE (MEK)	1	480	480	0	0	27,000,000	--
1,1,1-TRICHLOROETHANE	1	13	13	0	0	1,400,000	--
METHYLENE CHLORIDE	4	11	9.4	0	0	20,000	--
XYLENES (total)	2	15	13	0	0	210,000	--
Semivolatiles (μg/kg)							
BIS(2-ETHYLHEXYL)PHTHALATE	2	3,900	2,966	0	0	210,000	--
Organochlorine Pesticides and PCB (μg/kg)							
4,4'-DDD	1	120	120	0	0	19,000	--
4,4'-DDT	7	230	82	0	0	13,000	--
beta-BHC	1	32	32	0	0	2,300	--
Polynuclear Aromatic Hydrocarbons (μg/kg)							
ACENAPHTHENE	1	52	52	0	0	28,000,000	--
ANTHRACENE	1	7,000	7,000	0	0	220,000,000	--
CHRYSENE	3	1,900	1,082	0	0	3,600	--
BENZO(b/k)FLUORANTHENE	3	480	352	0	0	3,600	--
BENZO(a)PYRENE	1	150	150	0	0	360	--
FLUORANTHENE	6	6,400	2,811	0	0	37,000,000	--
PHENANTHRENE	1	670	670	0	0	1,800,000[2]	--
NAPHTHALENE	1	40	40	0	0	190,000	--
PYRENE	6	4,500	1,994	0	0	26,000,000	--
Chlorinated Herbicides (μg/kg)							
2,3,5-TP (Silvex)	1	13	13	0	0	8,600,000	--
2,4-DB	2	66	62	0	0	8,600,000	--
DINOSEB	5	23	17	0	0	1,100,000	--

TABLE B-3
SUMMARY OF STATISTICAL ANALYSIS FOR INDUSTRIAL RISK AND HAZARD RESULTS
(BUILDING CRAWLSPACE SURFACE SOILS SAMPLING EVENT)
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Analyte	Number of Detections	Maximum Detected Concentrations	Average of Detected Concentrations[1]	Number of Samples With Concentrations Greater Than Industrial PRG	Number of Discrete Locations With Sample Conc. Greater Than Industrial PRG and Ambient	EPA Industrial PRG Value	Ambient Value
CLP Metals (mg/kg)							
ALUMINUM	22	27,500	20,595	0	0	100,000	21,000
BARIUM	28	1,660	607	0	0	100,000	560
BERYLLIUM	13	16	5	0	0	3,400	0.12
CADMIUM	12	32	9	0	0	930	0.28
CHROMIUM	29	2,600	237	0	0	450	62
COBALT	29	32	21	0	0	29,000	25
COPPER	29	1.190	139	0	0	70,000	65
LEAD	29	3,400	411	2	2	1,000	32
MANGANESE	22	1,440	1,123	0	0	45,000	1,300
MERCURY	18	1.4	0.43	0	0	560	0.17
NICKEL	29	160	83.9	0	0	37,000	110
SELENIUM	7	4.4	2.83	0	0	9,400	DL
SILVER	3	0.3	0.24	0	0	9,400	DL
VANADIUM	29	110	68	0	0	13,000	95
ZINC	29	20,000	1,710	0	0	100,000	99

Notes:

-- None Established

PRG = Preliminary Remediation Goal (EPA 1998)

[1] Average based on a normal distribution

[2] PRG for fluorene used as a surrogate for phenanthrene

TABLE B-4
SUMMARY OF STATISTICAL ANALYSIS FOR RESIDENTIAL RISK AND HAZARD RESULTS
(BUILDING CRAWLSPACE SURFACE SOILS SAMPLING EVENT)
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Analyte	Number of Detections	Maximum Detected Concentration	Average of Detected Concentration[1]	Number of Samples With Concentrations Greater Than Residential PRG	Number of Discrete Locations With Sample Conc. Greater Than Residential PRG and Ambient	EPA Residential PRG Value	Ambient Value
Volatiles (μg/kg)							
2-BUTANONE (MEK)	1	480	480	0	0	6,900,000	---
1,1,1-TRICHLOROETHANE	1	13	13	0	0	680,000	---
METHYLENE CHLORIDE	4	11	9.4	0	0	8,500	---
XYLENES (total)	2	15	13	0	0	210,000	---
Semivolatiles (μg/kg)							
BIS(2-ETHYLHEXYL)PHTHALATE	2	3,900	2,966	0	0	32,000	--
Organochlorine Pesticides and PCB (μg/kg)							
4,4'-DDD	1	120	120	0	0	2,400	--
4,4'-DDT	7	230	82	0	0	1,700	--
beta-BHC	1	32	32	0	0	300	--
Polynuclear Aromatic Hydrocarbons (μg/kg)							
ACENAPHTHENE	1	52	52	0	0	2,600,000	--
ANTHRACENE	1	7,000	7,000	0	0	14,000,000	--
CHRYSENE	3	1,900	1,082	1	0	560	--
BENZO(b/k)FLUORANTHENE	3	480	352	0	0	560	--
BENZO(a)PYRENE	1	150	150	1	0	56	--
FLUORANTHENE	6	6,400	2,811	0	0	2,000,000	--
PHENANTHRENE	1	670	670	0	0	1,800,000[2]	--
NAPHTHALENE	1	40	40	0	0	55,000	--
PYRENE	6	4,500	1,944	0	0	1,500,000	--
Chlorinated Herbicides (μg/kg)							
2,3,5-TP (Silvex)	1	13	13	0	0	440,000	--
2,4-DB	2	66	61	0	0	440,000	--
DINOSEB	5	23	16	0	0	55,000	--

TABLE B-4
SUMMARY OF STATISTICAL ANALYSIS FOR RESIDENTIAL RISK AND HAZARD RESULTS
(BUILDING CRAWLSPACE SURFACE SOILS SAMPLING EVENT)
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Analyte	Number of Detections	Maximum Detected Concentration	Average of Detected Concentration[1]	Number of Samples With Concentrations Greater Than Residential PRG	Number of Discrete Locations With Sample Conc. Greater Than Residential PRG and Ambient	EPA Residential PRG Value	Ambient Value
CLP Metals (mg/kg)							
ALUMINUM	22	27,500	20,595	0	0	75,000	21,000
BARIUM	28	1,660	607	0	0	5,200	560
BERYLLIUM	13	16	4.5	0	0	150	0.12
CADMIUM	12	32	8.7	3	3	9	0.28
CHROMIUM	29	2,600	237	1	1	210	62
COBALT	29	32	21.4	0	0	3,300	25
COPPER	29	1,190	138	0	0	2,800	65
LEAD	29	3,400	410	1	1	130	32
MANGANESE	22	1,440	1,123	0	0	3,100	1,300
MERCURY	18	1.4	0.43	0	0	22	0.17
NICKEL	29	160	83.9	1	1	150	110
SELENIUM	7	4.4	2.83	0	0	370	DL
SILVER	3	0.3	0.24	0	0	370	DL
VANADIUM	29	110	68	0	0	520	95
ZINC	29	20,000	1,710	0	0	22,000	99

Notes:

-- = None Established

PRG = Preliminary Remediation Goal (EPA 1998)

[1] Average based on a normal distribution

[2] PRG for fluorene used as a surrogate for phenanthrene

TABLE B-5
SUMMARY OF INDUSTRIAL RISK AND HAZARD RESULTS
(BUILDING CRAWLSPACE SURFACE SOILS SAMPLING EVENT)
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemical	Maximum Detected Concentration	EPA Industrial Cancer PRG	EPA Industrial Non-Cancer PRG	Exceeded Industrial PRG	Industrial Cancer Risk (1)	Industrial Non Cancer HQ (1)
Volatiles (µg/kg)						
2-BUTANONE (MEK)	480	NA	27,000,000	No		0.000018
1,1,1-TRICHLOROETHANE	13	NA	1,400,000	No		0.000009
METHYLENE CHLORIDE	11	20,000	9,100,000	No	5.5E-10	0.0000012
XYLENES (total)	15	NA	210,000	No		NA
Semivolatiles (µg/kg)						
BIS(2-ETHYLHEXYL)PHTHALATE	3,900	210,000	21,000,000	No	1.9E-08	0.00019
Organochlorine Pesticides and PCB (µg/kg)						
4,4'-DDD	120	19,000	800,000 (2)	No	6.3E-09	0.00002
4,4'-DDT	230	13,000	800,000	No	1.8E-08	0.00029
beta-BHC	32	2,300	450,000 (3)	No	1.4E-08	0.000071
Polynuclear Aromatic Hydrocarbons (µg/kg)						
ACENAPHTHENE	52	NA	28,000,000	No		0.0000019
ANTHRACENE	7,000	NA	220,000,000	No		0.000032
CHRYSENE	1,900	3,600	--	No	5.3E-07	
BENZO(b/k)FLUORANTHENE	480	3,600	--	No	1.3E-07	
BENZO(a)PYRENE	150	360	--	No	4.2E-07	
FLUORANTHENE	6,400	NA	37,000,000	No		0.00017
NAPHTHALENE	40	NA	190,000	No		0.00021
PHENANTHRENE	3,500	NA	22,000,000 (4)	No		0.00016
PYRENE	4,500	NA	26,000,000	No		0.00017
Chlorinated Herbicides (µg/kg)						
2,3,5-TP (Silvex)	13	NA	8,600,000	No		0.0000015
2,4-DB	66	NA	8,600,000	No		0.0000077
DINOSEB	23	NA	1,100,000	No		0.000021
CLP Metals (mg/kg)						
ALUMINUM	27,500	NA	100,000	No		NA
BARIUM	1,660	NA	100,000	No		NA
BERYLLIUM	16	NA	3,400	No		0.0047
CADMIUM	32	NA	930	No		0.034
CHROMIUM	2,600	450	--	Yes	5.8E-06	
COBALT	32	NA	29,000	No		0.0011
COPPER	1,190	NA	70,000	No		0.017
LEAD	3,400	NA	1,000	Yes		NA (5)
MANGANESE	1,440	NA	45,000	No		0.032
MERCURY	1.4	NA	560	No		0.0025
NICKEL	160	NA	37,000	No		0.0043
SELENIUM	4.4	NA	9,400	No		0.00047
SILVER	0.3	NA	9,400	No		0.000032
VANADIUM	110	NA	13,000	No		0.0085
ZINC	20,000	NA	100,000	No		NA

TABLE B-5
SUMMARY OF INDUSTRIAL RISK AND HAZARD RESULTS
(BUILDING CRAWLSPACE SURFACE SOILS SAMPLING EVENT)
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemical	Maximum Detected Concentration	EPA Industrial Cancer PRG	EPA Industrial Non-Cancer PRG	Exceeded Industrial PRG	Industrial Cancer Risk _(1)	Industrial Non Cancer HQ [1]
Explosives and Exp. Byproducts (mg/kg)						
DIPHENYLAMINE	1.2	NA	27,000	No		0.000044
Total Risk/Hazard						
TOTAL CANCER RISK					6.9E-06	
NON-CANCER HAZARD INDEX						0.11

Notes:

PRG = Preliminary Remediation Goal (EPA 1998)

HQ = Hazard Quotient

NA = Not Applicable

-- = None Established

(1) Cancer risk is presented for chemicals with cancer PRGs and non-cancer HQ is presented for chemicals with non-cancer PRGs.

(2) Non-cancer PRG for DDT used as a surrogate for DDD.

(3) Non-cancer PRG for gamma-BHC used as a surrogate for beta-BHC.

(4) PRG for fluorene used as a surrogate for phenanthrene.

(5) Lead is evaluated by estimating the blood lead levels in 99 percent of children and adults whose blood lead levels would exceed acceptable limits using the DTSC LeadSpread Model (DTSC 1992).

TABLE B-6
SUMMARY OF RESIDENTIAL RISK AND HAZARD RESULTS
(BUILDING CRAWLSPACE SURFACE SOILS SAMPLING EVENT)
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemical	Maximum Detected Conc.	EPA Residential Cancer PRG	EPA Residential Non-Cancer PRG	Exceeded Residential PRG	Non Cancer Toxic Endpoint	Residential Cancer Risk	Residential Non Cancer HQ (1)
Volatiles (µg/kg)							
2-BUTANONE (MEK)	480	NA	6,900,000	No	R		0.000070
1,1,1-TRICHLOROETHANE	13	NA	680,000	No	L		0.000019
METHYLENE CHLORIDE	11	8,500	1,600,000	No	L	1.3E-09	0.0000069
XYLENES (total)	15	NA	210,000	No			NA
Semivolatiles (µg/kg)							
BIS(2-ETHYLHEXYL)PHTHALATE	3,900	32,000	1,100,000	No	L	1.2E-07	0.0035
Organochlorine Pesticides and PCB (µg/kg)							
4,4'-DDD	120	2,400	35,000 (2)	No	--	5.0E-08	0.0034
4,4'-DDT	230	1,700	35,000	No	L	1.4E-07	0.0066
beta-BHC	32	300	20,000 (3)	No	--	1.1E-07	0.0016
Polynuclear Aromatic Hydrocarbons (µg/kg)							
ACENAPHTHENE	52	NA	2,600,000	No	L		0.000020
ANTHRACENE	7,000	NA	14,000,000	No	N		0.00050
CHRYSENE	1,900	560	--	Yes		3.4E-06	
BENZO(b/k)FLUORANTHENE	480	560	--	No		8.6E-07	
BENZO(a)PYRENE	150	56	--	Yes		2.7E-06	
FLUORANTHENE	6,400	NA	2,000,000	No	B, K, L		0.0032
NAPHTHALENE	40	NA	55,000	No	W, RP		0.00073
PHENANTHRENE	3,500	NA	1,800,000 (4)	No	--		0.0019
PYRENE	4,500	NA	1,500,000	No	K		0.0030
Chlorinated Herbicides (µg/kg)							
2,3,5-TP (Silverx)	13	NA	440,000	No	L		0.000030
2,4-DB	66	NA	440,000	No	N		0.00015
DINOSEB	23	NA	55,000	No	R		0.00042
CLP Metals (mg/kg)							
ALUMINUM	27,500	NA	75,000	No	C		0.37
BARIUM	1,660	NA	5,200	No	CV		0.32
BERYLLIUM	16	NA	150	No	N		0.11
CADMIUM	32	9	37	Yes	K	3.6E-06	0.8649
CHROMIUM	2,600	210	--	Yes		1.2E-05	
COBALT	32	NA	3,300	No	B, RP		0.0097
COPPER	1,190	NA	2,800	No	G		0.43
LEAD	3,400	NA	130	Yes	C		NA (5)
MANGANESE	1,440	NA	3,100	No	C		0.46
MERCURY	1.4	NA	22	No	C		0.064
NICKEL	160	150	1500	Yes	W	1.1E-06	0.11
SELENIUM	4.4	NA	370	No	C, L, S		0.012
SILVER	0.3	NA	370	No	S		0.00081
VANADIUM	110	NA	520	No	N		0.21
ZINC	20,000	NA	22,000	No	B		0.91
Explosives and Exp. Byproducts (mg/kg)							
DIPHENYLAMINE	1.2	NA	1,400	No	L, K, W		0.00086

TABLE B-6
SUMMARY OF RESIDENTIAL RISK AND HAZARD RESULTS
(BUILDING CRAWLSPACE SURFACE SOILS SAMPLING EVENT)
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemical	Maximum Detected Conc.	EPA Residential Cancer PRG	EPA Residential Non-Cancer PRG	Exceeded Residential PRG	Non Cancer Toxic Endpoint	Residential Cancer Risk	Residential Non Cancer HQ [1]
Total Risk/Hazard							
TOTAL CANCER RISK						2.4E-05	
NON-CANCER HAZARD INDEX							3.9
Target Organ-Specific Hazard Index							
Central/peripheral nervous system (C)							**1**
Liver (L)							0.014
Kidney (K)							0.87
Cardiovascular system (CV)							0.32
Blood (B)							0.92
Respiratory system (RP)							0.010
Skin including irritation or other effects (S)							0.013
Body weight alterations (W)							0.11
Reproductive system including teratogenic and developmental effects (R)							0.00049
Gastrointestinal system (G)							0.43
Other toxicological endpoints (O)							0.0
No observable toxicological endpoints (N)							0.32

Notes:

PRG = Preliminary Remediation Goal (EPA 1998)

HQ = Hazard Quotient

NA = Not Applicable

-- = None Established

[1] Cancer risk is presented for chemicals with cancer PRGs and non-cancer HQ is presented for chemicals with non-cancer PRGs.

[2] Non-cancer PRG for DDT used as a surrogate for DDD.

[3] Non-cancer PRG for gamma-BHC used as a surrogate for beta-BHC.

[4] PRG for fluorene used as a surrogate for phenanthrene.

[5] Lead is evaluated by estimating the blood lead levels in 99 percent of children and adults whose blood lead levels would exceed acceptable limits using the DTSC LeadSpread Model (DTSC 1992).

TABLE B-7
SUMMARY OF INDUSTRIAL RISK AND HAZARD RESULTS
(SUBSURFACE SOILS SAMPLING EVENT)
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemical	Maximum Detected Concentration	EPA Industrial Cancer PRG	EPA Industrial Non-Cancer PRG	Exceeded Industrial PRG	Industrial Cancer Risk [1]	Industrial Non-cancer HQ [1]
Volatiles (µg/kg)						
TRICHLOROETHENE	2	6,100	79,000	No	3.3E-10	0.000025
CLP Metals (mg/kg)						
ANTIMONY	1.9	NA	750	No		0.0025
BARIUM	1,240	NA	100,000	No		NA
BERYLLIUM	0.35	NA	3,400	No		0.00010
CHROMIUM	75	450	--	No	1.7E-07	
COPPER	79.1	NA	70,000	No		0.0011
MANGANESE	6,560	NA	45,000	No		0.15
MERCURY	0.25	NA	560	No		0.00045
MOLYBDENUM	0.48	NA	9,400	No		0.000051
SELENIUM	1.5	NA	9,400	No		0.00016
THALLIUM	7	NA	130	No		0.054
VANADIUM	164	NA	13,000	No		0.013
Total Risk/Hazard						
TOTAL CANCER RISK					1.7E-07	
NON-CANCER HAZARD INDEX						0.22

Notes:

PRG = Preliminary Remediation Goal (EPA 1998)

HQ = Hazard Quotient

NA = Not Applicable

-- = None Established

[1] Cancer risk is presented for chemicals with cancer PRGs and non-cancer HQ is presented for chemicals with non-cancer PRGs.

TABLE B-8
SUMMARY OF RESIDENTIAL RISK AND HAZARD RESULTS
(SUBSURFACE SOILS SAMPLING EVENT)
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

Chemical	Maximum Detected Concentrations	EPA Residential Cancer PRG	EPA Residential Non-Cancer PRG	Non-Cancer Toxic Endpoint	Exceeded Residential PRG	Residential Cancer Risk [1]	Residential Non-cancer HQ [1]
Volatiles (µg/kg)							
TRICHLOROETHENE	2	2,700	23,000	L	No	7.4E-10	0.000087
CLP Metals (mg/kg)							
ANTIMONY	1.9	NA	30	B, O	No		0.063
BARIUM	1,240	NA	5,200	CV	No		0.24
BERYLLIUM	0.35	NA	150	N	No		0.0023
CHROMIUM	75	210	--	RP, S	No	3.6E-07	
COPPER	79.1	NA	2,800	G	No		0.028
MANGANESE	6,560	NA	3,100	C	Yes		2.1
MERCURY	0.25	NA	22	C	No		0.011
MOLYBDENUM	0.48	NA	370	K	No		0.0013
SELENIUM	1.5	NA	370	C, L, S	No		0.0041
THALLIUM	7	NA	5.2	S	Yes		1.3
VANADIUM	164	NA	520	N	No		0.32
Total Risk/Hazard							
TOTAL CANCER RISK						3.6E-07	
NON-CANCER HAZARD INDEX							4
Target Organ-Specific Hazard Index							
Central/peripheral nervous system (C)							**2**
Liver (L)							0.0041
Kidney (K)							0.0013
Cardiovascular system (CV)							0.24
Blood (B)							0.063
Respiratory system (RP)							0.0
Skin including irritation or other effects (S)							**1**
Gastrointestinal system (G)							0.028
Other toxicological endpoints (O)							0.063
No observable toxicological endpoints (N)							0.32

Notes:

PRG = Preliminary Remediation Goal (EPA 1998)

HQ = Hazard Quotient

NA = Not Applicable

-- = None Established

[1] Cancer risk is presented for chemicals with cancer PRGs and non-cancer HQ is presented for chemicals with non-cancer PRGs.

APPENDIX C

COST ESTIMATES FOR PROPOSED REMEDIAL ALTERNATIVES

APPENDIX C
COST ASSUMPTIONS FOR REMEDIAL ALTERNATIVES AND MITIGATIVE MEASURES
SITE 29 FEASIBILITY STUDY
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD

The costs presented 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 approximately 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 (U.S. Navy 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.

Alternative 2

33.08.02.90 Cost of concrete cap based on contractors estimate.

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 CAM 17 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 volumes of soil less the 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 item 33.03.90.01.

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 area under building will be excavated to 1 ft. deep and that (4400 sq. ft. * 1 ft. = 165 cu. yd.).

33.03.90 Asbestos survey and removal costs are bases on estimates from contractors. Contractors estimates are based only on size of building.

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.

APPENDIX C
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:** Brian Keating, PE **FIRM:** LFR Levine Fricke	**DATE:** 11/13/01
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				**$26,600**		**$11,800**		**$6,900**		**$45,200**
Total Capital Costs				**$26,600**		**$11,800**		**$6,900**		**$45,200**
Total Direct Costs				$9,400		$9,500		$6,000		$24,900
Total Distributive Costs				$15,700		$800		$0		$16,500
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				**$15,700**		**$800**		**$0**		**$16,500**
33.99.01 Construction Supervision/Management				**$10,800**		**$800**		**$0**		**$11,600**
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 Implementation and Certification Plan (LUCICP)	1	ls	$10,000.00	$10,000	$0.00	$0	$0.00	$0	$10,000.00	$10,000
33.99.04 Engineering (Design, Permitting and Manifesting)				**$3,400**		**$0**		**$0**		**$3,400**
33.99.04.90 Engineering (Design, Permitting)	1	ls	$3,400.00	$3,400		$0		$0	$3,400.00	$3,400
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

APPENDIX C
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:** Brian Keating, PE **FIRM:** LFR Levine Fricke	**DATE:** 11/13/01
PROJECT TITLE: Site 29 Feasibility Study - Alternative 3	**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				**$82,700**		**$44,700**		**$7,300**		**$134,000**
Total Capital Costs				**$82,700**		**$44,700**		**$7,300**		**$134,000**
Total Direct Costs				$43,800		$36,400		$4,600		$84,200
Total Distributive Costs				$32,300		$2,800		$2,000		$37,100
Contingency (on Direct Costs Only - 15%)				$6,600		$5,500		$700		$12,700
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				**$4,300**		**$2,400**		**$2,000**		**$8,500**
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				**$3,450**		**$2,125**	**$80**	**$1,725**		**$7,300**
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
33.03 Site Work				**$23,400**		**$16,600**		**$2,200**		**$42,100**
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				**$1,800**		**$1,350**		**$0**		**$3,150**
33.03.03.02 Excavation	450	cy	$4.00	$1,800	$3.00	$1,350		$0	$7.00	$3,150
33.03.90 Asbestos Removal/Abatement				**$12,800**		**$6,380**		**$2,120**		**$21,300**
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
33.19 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