Final

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard

Naval Station Treasure Island
San Francisco, California

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Prepared for:
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REVIEW AND APPROVAL

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TABLE OF CONTENTS

REVIEW AND APPROVAL i

ACRONYMS AND ABBREVIATIONS viii

EXECUTIVE SUMMARY ES-1

1.0 INTRODUCTION 1-1
- 1.1 PURPOSE AND SCOPE 1-1
- 1.2 REPORT ORGANIZATION 1-2

2.0 BACKGROUND INFORMATION 2-1
- 2.1 INSTALLATION RESTORATION PROGRAM 2-1
- 2.2 FEDERAL FACILITY SITE REMEDIATION AGREEMENT 2-1
- 2.3 SITE HISTORY, SETTING, AND LAND USE 2-2
  - 2.3.1 Site History 2-2
  - 2.3.2 Ecological Setting 2-4
  - 2.3.3 Land Use Designation 2-4
- 2.4 PREVIOUS INVESTIGATIONS AND REMOVAL ACTIONS 2-5
  - 2.4.1 Preliminary Assessment/Site Inspection 2-5
  - 2.4.2 Ambient Concentration of Metals in Soil at Treasure Island 2-5
  - 2.4.3 Ambient Concentrations of Metals in Groundwater at Treasure Island 2-6
  - 2.4.4 Tidal Influence Studies 2-6
  - 2.4.5 Former South Storage Yard Investigation 2-6
  - 2.4.6 Exploratory Trenching and Time-Critical Removal Action 2-7
  - 2.4.7 Groundwater Microwell Installation 2-9
- 2.5 GEOLOGY AND HYDROGEOLOGY 2-9
  - 2.5.1 Regional Geology 2-9
  - 2.5.2 Treasure Island and Installation Restoration Site 31 Geology 2-10
  - 2.5.3 Site Hydrogeology 2-10
- 2.6 CONCEPTUAL SITE MODEL FOR THE REMEDIAL INVESTIGATION REPORT 2-11
- 2.7 NATURE AND EXTENT OF CONTAMINATION 2-11
  - 2.7.1 Soil Results 2-12
  - 2.7.2 Groundwater Results 2-12
  - 2.7.3 Contaminant Fate and Transport Evaluation 2-13
- 2.8 HUMAN HEALTH RISK ASSESSMENT 2-14

2.9 ECOLOGICAL RISK ASSESSMENT 2-17
2.9.1 Screening Level Ecological Risk Assessment 2-17
2.10 REMEDIAL INVESTIGATION CONCLUSIONS AND RECOMMENDATIONS 2-17

3.0 REMEDIAL ACTION OBJECTIVES, APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, AND GENERAL RESPONSE ACTIONS 3-1
3.1 REMEDIAL ACTION OBJECTIVES EVALUATION 3-1
3.1.1 Determination of Remedial Action Triggers 3-1
3.1.2 Identification of Chemicals of Concern 3-2
3.1.3 Remedial Action Objectives 3-3
3.1.4 Remediation Goals 3-4
3.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS 3-5
3.2.1 Overview of Applicable or Relevant and Appropriate Requirements 3-5
3.2.2 Chemical-Specific Applicable or Relevant and Appropriate Requirements 3-6
3.2.3 Location-Specific Applicable or Relevant and Appropriate Requirements 3-7
3.2.4 Action-Specific Applicable or Relevant and Appropriate Requirements 3-8
3.3 GENERAL RESPONSE ACTIONS 3-9

4.0 SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS 4-1
4.1 SCREENING CRITERIA 4-1
4.1.1 Effectiveness 4-1
4.1.2 Implementability 4-2
4.1.3 Cost 4-2
4.2 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS 4-2
4.2.1 No Action 4-2
4.2.2 Engineering Controls 4-3
4.2.3 Institutional Controls 4-5
4.2.4 Active Remediation 4-7
4.3 SUMMARY OF RETAINED REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS 4-15

5.0 DEVELOPMENT AND ANALYSIS OF POTENTIAL REMEDIAL ALTERNATIVES 5-1

5.1 DEVELOPMENT OF POTENTIAL REMEDIAL ALTERNATIVES CONSIDERED FOR ANALYSIS 5-1

5.2 ANALYSIS OF POTENTIAL REMEDIAL ALTERNATIVES 5-3

6.0 DETAILED DEVELOPMENT OF RETAINED REMEDIAL ALTERNATIVES 6-1

6.1 ALTERNATIVE 1: NO ACTION 6-1

6.2 ALTERNATIVE 2: ENGINEERING CONTROLS COMBINED WITH INSTITUTIONAL CONTROLS 6-2

6.2.1 Engineering Controls 6-2

6.2.2 Institutional Controls 6-2

6.3 ALTERNATIVE 3: ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS, AND EXCAVATION (DEBRIS AREA E) AND OFF-SITE DISPOSAL SOIL 6-3

6.3.1 Engineering and Institutional Controls 6-4

6.3.2 Excavation (Debris Area E) 6-4

6.3.3 Off-Site Disposal of Soil 6-4

6.4 ALTERNATIVE 4: ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS, AND EXCAVATION (DEBRIS AREAS C AND D EXCLUDING STREET) AND OFF-SITE DISPOSAL OF SOIL 6-5

6.4.1 Excavation (Debris Area C) 6-5

6.4.2 Excavation (Debris Area D) 6-6

6.4.3 Off-Site Disposal 6-6

6.5 ALTERNATIVE 5: COMPLETE REMOVAL OF DEBRIS AREAS A, B, C, D, AND E, AND OFF-SITE DISPOSAL OF SOIL 6-6

6.5.1 Excavation (Debris Area A) 6-7

6.5.2 Excavation (Debris Area B) 6-7

6.5.3 Excavation (Debris Area C) 6-8

6.5.4 Excavation (Debris Area D) 6-8

6.5.5 Excavation (Debris Area E) 6-9

6.5.6 Off-Site Disposal 6-9

7.0 DETAILED ANALYSIS OF RETAINED REMEDIAL ALTERNATIVES 4-1

7.1 DETAILED ANALYSIS OF ALTERNATIVE 1: NO ACTION 4-2

7.1.1 Overall Protection of Human Health and the Environment 4-2

7.1.2 Compliance with Applicable or Relevant and Appropriate Requirements 7-3

7.1.3 Long-Term Effectiveness and Permanence 7-3
7.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment 7-3
7.1.5 Short-Term Effectiveness 7-3
7.1.6 Implementability 7-4
7.1.7 Cost 7-4
7.2 DETAILED ANALYSIS OF ALTERNATIVE 2: ENGINEERING CONTROLS COMBINED WITH INSTITUTIONAL CONTROLS 7-4
7.2.1 Overall Protection of Human Health and the Environment 7-4
7.2.2 Compliance with Applicable or Relevant and Appropriate Requirements 7-4
7.2.3 Long-Term Effectiveness and Permanence 7-5
7.2.4 Reduction of Mobility, Toxicity, or Volume through Treatment 7-5
7.2.5 Short-Term Effectiveness 7-5
7.2.6 Implementability 7-6
7.2.7 Cost 7-6
7.3 DETAILED ANALYSIS OF ALTERNATIVE 3: ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS, AND EXCAVATION (DEBRIS AREA E) AND OFF-SITE DISPOSAL OF SOIL 7-6
7.3.1 Overall Protection of Human Health and the Environment 7-6
7.3.2 Compliance with Applicable or Relevant and Appropriate Requirements 7-7
7.3.3 Long-Term Effectiveness and Permanence 7-7
7.3.4 Reduction of Mobility, Toxicity, or Volume through Treatment 7-8
7.3.5 Short-Term Effectiveness 7-8
7.3.6 Implementability 7-9
7.3.7 Cost 7-9
7.4 DETAILED ANALYSIS OF ALTERNATIVE 4: ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS, AND EXCAVATION (DEBRIS AREAS C AND D, EXCLUDING STREET) AND OFF-SITE DISPOSAL OF SOIL 7-9
7.4.1 Overall Protection of Human Health and the Environment 7-10
7.4.2 Compliance with Applicable or Relevant and Appropriate Requirements 7-10
7.4.3 Long-Term Effectiveness and Permanence 7-11
7.4.4 Reduction of Mobility, Toxicity, or Volume through Treatment 7-12
7.4.5 Short-Term Effectiveness 7-12
7.4.6 Implementability 7-12
7.4.7 Cost 7-13

7.5 DETAILED ANALYSIS OF ALTERNATIVE 5: COMPLETE REMOVAL OF DEBRIS AREAS A, B, C, D, AND E, AND OFF-SITE DISPOSAL OF SOIL 7-13
7.5.1 Overall Protection of Human Health and the Environment 7-13
7.5.2 Compliance with Applicable or Relevant and Appropriate Requirements 7-14
7.5.3 Long-Term Effectiveness and Permanence 7-14
7.5.4 Reduction of Mobility, Toxicity, or Volume through Treatment 7-14
7.5.5 Short-Term Effectiveness 7-15
7.5.6 Implementability 7-15
7.5.7 Cost 7-15

8.0 COMPARATIVE ANALYSIS OF RETAINED REMEDIAL ALTERNATIVES 8-1
8.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT 8-1
8.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS 8-2
8.3 LONG-TERM EFFECTIVENESS AND PERMANENCE 8-2
8.4 REDUCTION OF MOBILITY, TOXICITY, OR VOLUME THROUGH TREATMENT 8-3
8.5 SHORT-TERM EFFECTIVENESS 8-4
8.6 IMPLEMENTABILITY 8-5
8.7 COST 8-5
8.8 COMPARATIVE ANALYSIS SUMMARY 8-6
8.9 RECOMMENDATION 8-6

9.0 REFERENCES 9-1

Appendix

A Development of Contaminants of Concern and Screening of Potential Remedial Action Alternatives

B Evaluation of Applicable or Relevant and Appropriate Requirements

C Remedial Alternative Cost Summary and Assumptions

D Responses to Comments on the Draft Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

FIGURES

2-1 Installation Location Map
2-2 Aerial Photograph, Naval Station Treasure Island
2-3 Aerial Photograph, Site 31
2-4 Site 31 Features Map
2-5 Site 31 Soil Removal Locations

3-1 Location of Chemicals of Concern

TABLES

ES-1 Relative Ranking of Removal Alternatives

2-1 Field Screening Criteria for Soil
2-2 Chemicals in Soil Exceeding Field Screening Criteria

3-1 Chemicals of Concern and Remediation Goals

4-1 Initial Screening of Soil Treatment Technologies

5-1 Summary of Potential Remedial Action Alternatives

7-1 Summary of Costs for Soil and Groundwater Alternatives

8-1 Summary of Comparative Analysis of Alternatives
8-2 Relative Ranking of Removal Alternatives

§	Section
§§	Sections
µg/dL	Micrograms per deciliter
ARAR	Applicable or relevant and appropriate requirement
B(a)P	Benzo(a)pyrene
B(a)P EQ	Benzo(a)pyrene equivalent
Bay	San Francisco Bay
Bay Area	San Francisco Bay Area
BCT	BRAC Cleanup Team
BEC	BRAC Environmental Coordinator
bgs	Below ground surface
BRAC	Base Realignment and Closure
Cal. Code Regs.	*California Code of Regulations*
CCSF	City and County of San Francisco
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
COC	Chemical of concern
COPC	Chemical of potential concern
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethene
DDT	Dichlorodiphenyltrichloroethane
DoD	U.S. Department of Defense
DTSC	California Department of Toxic Substances Control
EC	Engineering control
ELCR	Excess lifetime cancer risk
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration
ERA	Ecological risk assessment
FFSRA	Federal Facility Site Remediation Agreement
FR	*Federal Register*
FRTR	Federal Remediation Technologies Roundtable
FS	Feasibility study
GRA	General response action

HHRA	Human health risk assessment
HI	Hazard index
IC	Institutional control
IR	Installation Restoration
LUC	Land use control
mg/kg	Milligram per kilogram
NAVSTA TI	Naval Station Treasure Island
Navy	U.S. Department of the Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ng/kg	Nanogram per kilogram
O&M	Operation and maintenance
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PRC	PRC Environmental Management, Inc.
PRG	Preliminary remediation goal
RAO	Remedial action objective
RAWP	Remedial action work plan
RCRA	Resource Conservation and Recovery Act
RI	Remedial investigation
RME	Reasonable maximum exposure
Reuse Plan	Draft Naval Station Treasure Island Reuse Plan
S/S	Solidification/stabilization
Shaw	Shaw Environmental & Infrastructure, Inc.
SLERA	Screening-level ecological risk assessment
SVOC	Semivolatile organic compound
TBC	To be considered
TCRA	Time-critical removal action
TEQ	Toxic equivalent quotient
Tetra Tech	Tetra Tech EM Inc.
TI	Treasure Island
tit.	Title
TPH	Total petroleum hydrocarbons

U.S.C.	*United States Code*
VOC	Volatile organic compound
Water Board	San Francisco Bay Regional Water Quality Control Board
YBI	Yerba Buena Island

EXECUTIVE SUMMARY

The U.S. Department of the Navy (Navy) has prepared this Feasibility Study (FS) Report for Installation Restoration (IR) Site 31, the Former South Storage Yard, at Naval Station Treasure Island (NAVSTA TI) in San Francisco, California. This FS Report specifically addresses remedial alternatives for contaminated soil at the NAVSTA TI Former South Storage Yard, IR Site 31 (hereafter referred to as IR Site 31).

This FS Report develops and carries out a comparative analysis of remedial alternatives to address concentrations of benzo(a)pyrene [B(a)P], lead, and dibenzo-*p*-dioxins and polychlorinated dibenzofurans (dioxins) that pose a potential risk to human health under alternative land use scenarios. Under current site conditions, IR Site 31 does not pose an unacceptable risk. The Final Remedial Investigation (RI) Report recommended an FS be conducted to evaluate remedial alternatives that would ensure protection of human health from exposure to these compounds in the event that 1) the school is reopened in the future with the schoolyard pavement removed or 2) the pavement is removed and the area is developed for residential or commercial/industrial use (SulTech 2006c).

SITE HISTORY AND LAND USE DESIGNATION

NAVSTA TI is located in San Francisco Bay (Bay), midway between San Francisco and Oakland, California. The naval station consists of two contiguous islands: Treasure Island (TI), which is 403 acres, and Yerba Buena Island (YBI), which is 147 acres. TI is manmade and was constructed of materials dredged from the Bay in 1936. The island was developed to be the site of the 1939 Golden Gate International Exposition. In response to a Navy request, the City and County of San Francisco (CCSF) leased TI to the Navy in 1941 for the duration of World War II. After the war, the CCSF agreed to transfer the deed for TI to the Navy in 1945 in exchange for government-owned land south of San Francisco, where the San Francisco International Airport was later built. In 1993, NAVSTA TI was designated for closure under the Base Closure and Realignment Act of 1990 (Public Law 101-510, Title XXIX, 10 United States Code [U.S.C.] Section (§) 2687 note). The base was closed on September 30, 1997, and is currently in the transfer process.

In 1995, the Navy conducted a basewide environmental baseline survey (EBS) to divide NAVSTA TI into EBS parcels based on like use, physical boundaries (such as roads, and so forth), or possible future use, and to update the environmental condition of property for each identified EBS parcel (ERM-West, Inc. 1995). Parcel boundaries are used in discussions about suitability for lease and transfer. IR Site 31 encompasses parts of EBS Parcels T089, T092, T094, and T095, which are divided by 11th Street and Avenue E. Before the area was developed as an elementary school in the late 1960s, the parcels were used for several purposes, beginning with exhibits for the 1939-40 Golden Gate International Exposition. Aerial photographs show that the exhibit structures were removed after the exposition ended in 1940 and the Navy took over the island. The open space was periodically used for storage, and later as a fenced storage yard before its current use as an asphalt-paved schoolyard. During the early 1970s, the southern portion of Parcel T095 was used as a storage yard (known as the South Storage Yard). The nature of operations at the South Storage Yard is unknown. In the late 1970s, the South Storage Yard was paved over and developed as an elementary schoolyard. The elementary school and

associated schoolyard are leased to the San Francisco Unified School District under a Finding of Suitability to Lease signed by the Navy on May 13, 1996 (PRC Environmental Management, Inc. and Uribe & Associates 1997).

In April 2002, a 1989 as-built drawing was discovered indicating that the Navy Public Works Center installed an 8-inch water line down the middle of 11th Street (SulTech 2006c). A note on the as-built drawings for the water line project identified an "old trash dump" within the western portion of the excavation along 11th Street between Avenues D and E (Shaw Environmental & Infrastructure, Inc. [Shaw] 2003). Subsequent soil investigations were conducted in 2002 and 2003 to evaluate the effect of previous activities at the South Storage Yard and to characterize the nature and extent of the buried debris. Based on the results of these soil investigations, the Navy established IR Site 31, the Former South Storage Yard, in September 2003 (Navy 2003). IR Site 31 was established to include the schoolyard, portions of 11th Street and Avenue E, associated sidewalks, and a portion of a parking lot near the intersection of 11th Street and Avenue E. IR Site 31 does not include the elementary school buildings or any other building structures.

According to the "Draft Naval Station Treasure Island Reuse Plan" (hereafter referred to as the "Reuse Plan") (CCSF 1996), the elementary school has been specifically identified for "Institutional Use." Although the elementary school is currently closed, projections for redevelopment of TI show that a kindergarten through 8th grade school could be supported by the population (Fancher 2006). Reuse of the existing school for this purpose is likely, given the cost associated with developing new educational and institutional facilities (CCSF 1996). The southeast quadrant of the site, north of 11th Street and east of Avenue E, is slated for recreational development.

REMEDIAL INVESTIGATION

The Final RI Report (SulTech 2006c) presents the analytical results of four field investigations completed at IR Site 31 including the South Storage Yard investigation (Tetra Tech EM Inc. 2002a), exploratory trenching and time-critical removal action (Shaw 2003), additional sampling at IR Site 31 (Shaw 2004), and temporary groundwater microwell installation and sampling (SulTech 2004). Results for soil from these investigations were compared with field screening criteria established in the associated sampling and analysis plans and were concurred upon by the Base Realignment and Closure Cleanup Team. These screening criteria included U.S. Environmental Protection Agency (EPA) preliminary remediation goals (PRG) for residential soils, B(a)P-equivalency factor for polycyclic aromatic hydrocarbons (PAH), and NAVSTA TI ambient levels for metals. These field screening criteria were used to identify areas for further investigation, as well as to evaluate the effectiveness of the removal action. Results for groundwater were compared with NAVSTA TI groundwater screening criteria. The NAVSTA TI groundwater screening criteria consist of values protective of ecological receptors in the Bay because groundwater at TI has the potential to migrate to the Bay. Data collected during these investigations were used to evaluate site conditions for the human health risk assessment (HHRA) and the ecological risk assessment ([ERA] SulTech 2006a).

REMEDIAL INVESTIGATION HUMAN HEALTH RISK ASSESSMENT

The quantitative HHRA for IR Site 31 at NAVSTA TI was presented in the Final IR Site 31 RI Report (SulTech 2006c). To satisfy federal (Navy and EPA) and state (Department of Toxic Substances Control [DTSC]) requirements, baseline risk estimates were prepared by two different methods in the HHRA, referred to as Method 1 (satisfying federal requirements) and Method 2 (satisfying state requirements). These two methods differed in the manner in which chemicals of potential concern (COPC) and toxicity criteria were selected.

Both elementary school children and adult staff were considered potential receptors to be evaluated under both current (paved) and altered (unpaved) site conditions. To account for potential variances in land use from the Reuse Plan, construction workers, adult/child residents, and commercial/industrial workers were also evaluated. The evaluation of construction workers also applies to current utility workers that may infrequently visit IR Site 31. Potential risk for these receptors was evaluated using soil and vapor exposure scenarios from 0 to 2 feet below ground surface (bgs) and 0 feet bgs to groundwater. The table below summarizes the potential cancer risks and noncancer hazard indices (HI) estimated for each of these receptors under reasonable maximum exposure (RME) conditions.

Receptor	RME Cancer Risk Estimates		RME Noncancer HI Estimates	
	Method 1	Method 2	Method 1	Method 2
Current Land Use				
Current Site Conditions				
Elementary School Child – Exposure to Soil (0 to 2 feet bgs, Unpaved Areas outside Fence Line)[1]	1×10^{-6}	2×10^{-6}	0.05	0.3
Elementary School Staff – Exposure to Soil (0 to 2 feet bgs, Unpaved Areas outside Fence Line)[1]	2×10^{-6}	5×10^{-6}	0.04	0.2
Altered Site Conditions				
Elementary School Child – Exposure to Soil (0 to 2 feet bgs, Inside Schoolyard Fence Line)[1,2]	1×10^{-5}	2×10^{-5}	0.2	0.2
Elementary School Staff – Exposure to Soil (0 to 2 feet bgs, Inside Schoolyard Fence Line)[1,2]	2×10^{-5}	4×10^{-5}	0.1	0.2
Alternative Land Use				
Construction Worker – Exposure to Soil (0 foot bgs to groundwater, Site-Wide)[3], Groundwater, and Vapors in Trench Air[4]	3×10^{-6}	5×10^{-6}	0.6	0.8
Resident – Exposure to Soil (0 to 2 feet bgs, Site-Wide)[3] and Vapors in Indoor Air[5]	7×10^{-5}	3×10^{-3}	24	25
Resident – Exposure to Soil (0 foot bgs to groundwater, Site-Wide)[3] and Vapors in Indoor Air[5]	6×10^{-5}	3×10^{-3}	24	25
Commercial/Industrial Worker – Exposure to Soil (0 to 2 feet bgs, Site-Wide)[3] and Vapors in Indoor Air[5]	3×10^{-5}	4×10^{-4}	2	2
Commercial/Industrial Worker – Exposure to Soil (0 foot bgs to groundwater, Site-Wide)[3] and Vapors in Indoor Air[5]	2×10^{-5}	4×10^{-4}	2	2

Notes:

1 Exposure to soil via incidental ingestion, dermal contact, and inhalation pathways presented in Section I.8.2 of Appendix I of the Site 31 RI Report.

2 Soil assumed to be unpaved for this assessment.

3 Exposure to soil via incidental ingestion, dermal contact, and inhalation of particulates or vapors in outdoor air.

4 In-trench air concentrations modeled from groundwater.

The San Francisco Bay Regional Water Quality Control Board has concurred that groundwater at NAVSTA TI meets the exemption criteria for drinking water use (Water Board 2001). Groundwater at NAVSTA TI is not presently used as a drinking water source, thus potential exposure to chemicals in groundwater is limited. Therefore, consumption of groundwater was not evaluated as a potential exposure pathway. However, the risk assessment evaluated the vapor intrusion pathway for chemicals in groundwater, as well as direct contact with groundwater under certain scenarios.

Estimated cancer risks for the elementary school child, elementary school staff, and construction worker were within the EPA risk management range (1×10^{-6} to 1×10^{-4}) for both methods. Estimated cancer risks for the hypothetical child/adult resident and commercial/industrial worker were within the cancer risk management range under Method 1, but above the risk management range under Method 2. The estimated HIs were less than the threshold of 1 for noncancer effects (EPA 1989) for all receptors except hypothetical residents and commercial/industrial workers. Site chemicals detected in groundwater did not contribute significantly to cumulative potential cancer risks or noncancer HIs.

To evaluate the potential for human health effects caused by lead in the elementary school child and the adult and child residents, LeadSpread modeling was performed (DTSC 1999). LeadSpread modeling resulted in 99th percentile concentrations below 10 micrograms per deciliter (µg/dL) for the elementary school child and adult residents, and for the child resident exposed to lead in surface soils (0 to 2 feet bgs). However, LeadSpread modeling resulted in 99th percentile concentrations above 10 µg/dL for child residents exposed to lead in combined surface and subsurface soils (0 foot bgs to groundwater). To evaluate potential harmful effects from exposure to lead in soil for elementary school staff, construction workers, and commercial/industrial workers, exposure point concentrations (EPC) were compared with the EPA Region 9 PRG for industrial soil, 800 milligrams per kilogram (mg/kg). The lead EPCs in the three surface soil data sets, ranging from 149 mg/kg to 346 mg/kg, were well below the 800 mg/kg benchmark, but the lead EPC in site-wide combined surface and subsurface soil, 858 mg/kg, exceeded this criterion.

Elevated concentrations of the cancer risk drivers B[a]P, dioxins, and other PAHs with B[a]P-like toxicity, as well as naphthalene and lead, were mostly limited to the identified debris areas. To account for potential utility worker exposure to combined surface and subsurface soil in the utility corridor beneath 11th Street (Debris Area E), a focused hotspot evaluation was performed and RME potential cancer risks and noncancer hazards were estimated using construction worker exposure parameters. Under both Method 1 and Method 2, the potential cancer risks were less than 1×10^{-6} and the HIs were less than 1. However, the estimated lead EPCs exceeded 800 mg/kg.

A separate, Tier 1 screening-level risk assessment protective of recreational visitors was also conducted to evaluate the potential redevelopment of the southeast quadrant of the site into a recreational area (Navy 2001). Potential cancer risks of 1×10^{-5} and 4×10^{-5} were estimated for exposure to surface soil (0 to 2 feet bgs) and combined surface and subsurface soil (0 foot bgs to groundwater), respectively, in the southeast quadrant. HIs estimated for exposure to surface soil

(0 to 2 feet bgs) and combined surface and subsurface soil (0 foot bgs to groundwater) were both equal to the threshold of 1. LeadSpread modeling using default exposure parameter values for residents as protective of recreational exposure resulted in 99th percentile concentrations above 10 µg/dL for child residents exposed to lead in combined surface and subsurface soils.

Finally, a separate evaluation was also conducted for receptors at the daycare center south of IR Site 31 (IR Site 30), accounting for the subsurface migration potential of VOCs detected at IR Site 31. The estimated Method 1 and Method 2 HIs for the daycare center receptors were less than 1. Using site-specific average vapor flow rate (Q_{soil}) values in the indoor air vapor intrusion model, the Method 1 potential cancer risks estimated for both daycare center children and daycare center staff, and the Method 2 potential cancer risks estimated for daycare center children were found to be below the EPA risk management range (10^{-6} to 10^{-4}). The Method 2 potential cancer risk estimated for the daycare center staff using site-specific Q_{soil} just exceeded 1×10^{-6}. This result was driven largely by four detected concentrations of naphthalene in Debris Area E.

Remedial Investigation Ecological Risk Assessment

The ERA focused on detected chemicals in groundwater at IR Site 31 and the potential risk to aquatic receptors associated with chemical groundwater migration to the offshore surface waters of the Bay. A step-wise approach for evaluating chemicals in groundwater was used to identify chemicals of potential ecological concern (COPEC) for the offshore point of exposure areas at NAVSTA TI. No COPECs were identified for IR Site 31 (SulTech 2006c).

Screening-Level Ecological Risk Assessment

A Tier 1 screening-level ERA was conducted to evaluate the potential for terrestrial receptors to be exposed to soil at IR Sites 6, 12, 21, 24, 30, 31, 32, and 33 at NAVSTA TI (SulTech 2006d). The draft screening-level ERA did not identify any ecological resources or processes at TI that needed to be protected or sustained. Based on the overall poor quality of the habitat on TI, the Navy does not recommend further evaluation of ecological risk in a Tier II assessment for Sites 6, 12, 21, 24, 30, 31, 33, and 33 (SulTech 2006d).

Remedial Investigation Conclusions and Recommendations

On the basis of the chemical characterization of current site conditions, the findings of the fate and transport evaluation, and the results of the baseline HHRA for the site, existing site conditions are considered protective of human health and the environment under current land use at the site as a paved elementary schoolyard (SulTech 2006c). Although future residential or commercial/industrial reuse of IR Site 31 is not planned, nor is the elementary schoolyard anticipated to be redeveloped as an unpaved play yard, the RI Report recommended an FS be conducted to evaluate remedial alternatives that would ensure protection of human health for such future reuse (SulTech 2006c).

CHEMICALS OF CONCERN

The Final RI Report concluded existing site conditions at IR Site 31 are considered protective of human health and the environment under current land use as a paved schoolyard (SulTech 2006c). However, risks to elementary school children and staff under altered site conditions (unpaved) and risks to construction workers, residents, commercial industrial workers, and recreational users under alternative land use were estimated to be within or above the risk management range.

Naphthalene was identified as the primary contributor to noncancer adverse health effects for residents and commercial/industrial workers and was the only COPC to contribute a chemical-specific hazard quotient greater than 1 (via inhalation of vapors in indoor air). However, all detected concentrations of naphthalene are commingled with elevated concentrations of the other chemicals of concern (COC) [B(a)P, dioxins, and lead] identified for IR Site 31. Remedial alternatives designed to address the elevated concentrations of B(a)P, dioxins, and lead in Debris Areas C, D, and E would coincidentally address the detected concentrations of naphthalene that may pose an unacceptable indoor air inhalation risk. As a result, naphthalene was excluded as an additional COC; however, it will be considered as a potential analyte during the confirmation sampling program for any future remedial action at the site.

The COCs identified for IR Site 31 are presented in the table below.

Receptor Scenario	COC
Current Land Use	
Elementary School Child and Staff (current site conditions)	No COCs Identified
Elementary School Child and Staff (altered site conditions)	B(a)P and Dioxins
Alternative Land Use	
Construction Worker	Lead
Resident	B(a)P, Dioxins, and Lead
Commercial/Industrial Worker	B(a)P, Dioxins, and Lead
Recreational Visitor	B(a)P and Dioxins

REMEDIAL ACTION OBJECTIVES

Based on the COCs identified for IR Site 31 and the additional site-specific risk refinement included in this FS Report, the following remedial action objectives (RAO) were developed for IR Site 31:

- For the elementary school child and staff receptor, to prevent direct contact with and ingestion of shallow soils containing B(a)P-equivalency quotient (EQ) concentrations exceeding 0.62 mg/kg and dioxin toxicity equivalent quotient (TEQ) concentrations exceeding the established NAVSTA TI ambient level of 12 nanograms per kilogram (ng/kg).

- For the construction worker, to prevent direct contact with and ingestion of soils that contain lead at concentrations exceeding 800 mg/kg.

- For the recreational visitor, to prevent direct contact with and ingestion of soils located in the southeastern quadrant that contain B(a)P-EQ concentrations exceeding 0.62 mg/kg and dioxin TEQ concentrations exceeding 12 ng/kg.

- For the commercial/industrial worker, to prevent direct contact with and ingestion of soils containing B(a)P-EQ concentrations exceeding 0.62 mg/kg, dioxin TEQ concentrations exceeding 12 ng/kg, and lead concentrations exceeding 800 mg/kg.

- For the residential receptor, to prevent direct contact with and ingestion of soil containing B(a)P-EQ concentrations exceeding 0.62 mg/kg, dioxin TEQ concentrations exceeding 12 ng/kg, and lead at concentrations exceeding 400 mg/kg.

The only designated COCs at IR Site 31 are B(a)P, dioxins, and lead. Because these COCs are not volatile, it is unnecessary to prevent exposure of receptors to vapors in indoor air. As a result, an RAO was not developed for vapor intrusion pathway.

REMEDIAL ALTERNATIVES

Seven potential remedial alternatives were selected for IR Site 31. From the initial screening of these seven potential remedial alternatives, five remedial alternatives were developed and evaluated for IR Site 31. Costs for alternatives that included excavation were estimated assuming the entire debris area would require excavation to a depth of 4 feet (restricted land use) or 6 feet (unrestricted land use). However, actual excavation areas will be limited to areas of contamination with concentrations above remediation goals (known as “hot spots”) and will be determined during implementation of the selected remedial alternative based on confirmation soil sampling results obtained in the field. The five remedial alternatives that were retained for IR Site 31 are listed below.

- **Alternative 1: No Action.** This alterative is required by the National Oil and Hazardous Substances Pollution and Contingency Plan (NCP) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and is used as a baseline to compare remedial alternatives. No costs are associated with Alternative 1.

- **Alternative 2: Engineering Controls Combined With Institutional Controls.** This alternative would use Engineering Controls (EC) and Institutional Controls (IC) to ensure the existing asphalt and concrete surfaces, consisting of sidewalks, roads (including curbs), parking lots, and paved schoolyard (hardscape) at IR Site 31 are monitored and maintained as an exposure prevention barrier. This alternative would include provisions for required repairs or improvements to subsurface utilities. The ICs would also restrict commercial/industrial or residential use of the property. Alternative 2 has a total present value cost (in 2006 dollars) of $788,000.

- **Alternative 3: Engineering Controls, Institutional Controls, and Excavation (Debris Area E) and Off-Site Disposal.** ECs and ICs are similar to Alternative 2. Debris Area E would be excavated to a maximum depth of 4 feet bgs. During removal, 11th Street would be closed and excavated, and utilities would be rerouted or reinstalled. Excavated soil would be disposed of at a licensed landfill. Hardscape would be restored. Alternative 3 has a total present value cost (in 2006 dollars) of $1,331,000.

- **Alternative 4: Engineering Controls, Institutional Controls, and Excavation (Debris Area C and D Excluding Street) and Off-Site Disposal of Soil.** ECs and ICs are similar to Alternative 2. Debris Areas C and D would be excavated to a maximum depth of 4 feet bgs. This remedial alternative would involve removal of Debris Areas C and D, except for the portion of Debris Area D that is beneath 11th Street. Excavated soil would be disposed of at a licensed landfill. Hardscape would be restored. Alternative 4 has a total present value cost (in 2006 dollars) of $1,950,000.

- **Alternative 5: Complete Removal of Debris Areas A, B, C, D, and E, and Off-Site Disposal of Soil.** Debris Areas A, B, C, D, and E would be excavated to a maximum depth of 6 feet bgs. During removal, 11th Street would be closed and excavated, and utilities would be rerouted or reinstalled. After excavation and backfilling are complete, excavated soil would be disposed of at a licensed landfill. The site would be returned to grade and to its present condition. Alternative 5 has a total present value cost (in 2006 dollars) of $2,308,000. Although Alternative 5 includes excavation of all of Debris Areas A, B, C, D, and E and off-site disposal of contaminated, the relative cost of Alternative 5 compared with Alternative 4 is only slightly higher because it does not include the costs associated with ECs and ICs.

COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

To select the most appropriate remedial action alternative for IR Site 31, the remedial alternatives above were evaluated with respect to the first seven of the nine NCP criteria. The NCP criteria consist of two threshold, five primary balancing, and two modifying criteria. The seven combined threshold and primary balancing criteria are considered the evaluation criteria, while the remaining two are considered modifying criteria.

- **Threshold criteria** relate directly to the statutory requirements each remedial alternative must meet: (1) overall protection of human health and the environment; and (2) compliance with applicable or relevant and appropriate requirements (ARAR).

- **Primary balancing criteria** are those that are used as the basis for preliminary selection of the remedy: (1) long-term effectiveness and permanence; (2) reduction of toxicity, mobility, and volume through treatment; (3) short-term effectiveness; (4) implementability; and (5) cost.

- **Modifying criteria** include agency and public comments on the proposed alternatives in the FS and will be addressed during development of the Proposed Plan: (1) state acceptance; and (2) community acceptance.

For the two threshold criteria, *Overall Protection to Human Health and the Environment* and *Compliance with ARARs,* Alternative 1, the No-Action Alternative, provides the least degree of protectiveness, but meets the threshold criteria for current land use—current site conditions for elementary school children and staff. Alternative 1 will not meet the threshold criteria for current land use under altered site conditions for elementary school children or staff or the alternative land use for construction workers, residents, commercial/industrial workers, or recreational visitors based on these land uses scenarios. Alternatives 2, 3, 4, and 5 each would protect human health and the environment for all land use scenarios and would comply with corresponding action-specific ARARs (Alternatives 2, 3, 4, and 5) or chemical-specific ARARs (Alternatives 3, 4, and 5). No ARARs apply to Alternative 1 since it does not involve any actions on site such as ECs, ICs, or remedial action.

The alternatives compared are assessed in two distinct groups under the primary balancing criteria. *Reduction of Toxicity, Mobility, or Volume through Treatment* and *Implementability* were indistinguishable in the comparative analysis of Alternatives 2, 3, 4, and 5 and only slightly different for Alternative 1. These two balancing criteria do not clearly identify preferred alternatives over each other. However, *Long-Term Effectiveness and Permanence*, *Short-Term Effectiveness,* and *Cost* each provided a clearer distinction between the alternatives. Table ES-1 summarizes the ranking Alternatives 1 through 5 for each of these three balancing criteria in order from most effective to least and least expensive to most expensive.

Based on the comparative analysis, Alternative 5 offers advantages compared with the other alternatives. Alternatives 3, 4, and 5 would reduce or prevent exposure by using active remediation by excavation and off-site disposal to reduce risks to human health under altered site conditions or alternative land uses. However, Alternative 5 would provide for the greatest risk reduction and achieve unrestricted land use at IR Site 31. Short-term effectiveness is less and the costs for implementation are correspondingly more expensive than the passive techniques (ECs and ICs) involved in Alternative 2, or partial excavation with ECs and ICs for Alternative 3 and Alternative 4. Alternative 5 offers a greater degree of overall protection of human health and the environment, long-term effectiveness, and reduction in toxicity of COCs at IR Site 31 as compared with the other alternatives.

Remedial Alternative	Total Present Value Cost in 2006 Dollars
Alternative 1	$0
Alternative 2	$788,000
Alternative 3	$1,331,000
Alternative 4	$1,950,000
Alternative 5	$2,308,000

Based on the results of the comparative analysis of remedial alternative, the site use, and the proximity to the daycare center, the Navy recommends Alternative 5 as the preferred alternative. The Navy will prepare a Proposed Plan for public comment, recommending Alternative 5 (complete removal of debris areas A, B, C, D, and E) be implemented at the site as the preferred alternative. After regulatory agency and community comments on the Proposed Plan have been considered, the Navy will issue a Record of Decision that sets forth the selected final remedy.

TABLE

TABLE ES-1: RELATIVE RANKING OF REMOVAL ALTERNATIVES

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, CA

Evaluation Criteria[a]	Alternative 1: No Action	Alternative 2: ECs Combined with ICs	Alternative 3: ECs, ICs, and Excavation (Debris Area E) and Off-Site Disposal of Soil	Alternative 4: ECs, ICs, and Excavation (Debris Areas C and D) and Off-Site Disposal of Soil	Alternative 5: Excavation (Debris Areas A, B, C, D, and E) and Off-Site Disposal of Soil
Overall Protection of Human Health and the Environment	5	3	3	2	1
Compliance with ARARs	5	1	1	1	1
Long-Term Effectiveness	5	4	3	2	1
Reduction of Toxicity, Mobility, Volume by Treatment[b]	5	5	3	2	1
Short-Term Effectiveness	1	2	2	3	4
Implementability	1	2	2	2	3
Cost	1	2	3	4	4[c]
Sum	**23**	**19**	**17**	**16**	**15**
Overall Rating	**5**	**4**	**3**	**2**	**1**

Ranking Scale:

1 Meets Criteria Best
5 Meets Criteria Least

Notes:

a Evaluation criteria does not include modifying criteria. State and community acceptance are modifying criteria, and include regulatory agency and public comments on the proposed alternatives in the Proposed Plan and will be addressed during development of the Record of Decision.

b Although this criterion is based on the reduction of toxicity, mobility, and volume by treatment, the scores for this category also consider reduction in toxicity, mobility and volume resulting from excavation of contaminated soil at IR Site 31.

c Although Alternative 5 is estimated to be more costly than Alternative 4, Alternative 5 does not include engineering controls and institutional controls (future costs) and is considered to have lower cost variability. Therefore Alternative 4 and Alternative 5 are considered to rate the same score for cost.

ARAR Applicable or relevant and appropriate requirement
EC Engineering control
IC Institutional controls

1.0 INTRODUCTION

This Feasibility Study (FS) Report summarizes the evaluation of remedial alternatives proposed for Installation Restoration (IR) Site 31, Former South Storage Yard, of the former Naval Station Treasure Island (NAVSTA TI) in San Francisco, California. This FS Report was prepared in accordance with Title 40 of the *Code of Federal Regulations* (CFR) Part 300 (40 CFR 300); the National Oil and Hazardous Substances Pollution and Contingency Plan (NCP) (U.S. Environmental Protection Agency [EPA] 1990); and "Guidance for Conducting Remedial Investigations and Feasibility Studies under the Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA]" (EPA 1988). The CERCLA remedial investigation (RI)/FS process (1) characterizes threats to human health and the environment posed by hazardous substances released at a site; and (2) evaluates potential remedial alternatives to mitigate those threats. U.S. Department of Defense (DoD) policy requires FSs that evaluate an alternative with a land use control (LUC) also consider an unrestricted use alternative (DoD 2001).

The current and planned use of IR Site 31 is Institutional Use as an elementary schoolyard (City and County of San Francisco [CCSF] 1996). The Final RI Report concluded existing site conditions are considered protective of human health and the environment under current paved land uses at IR Site 31 (SulTech 2006c).

The RI Report recommended an FS be conducted to evaluate remedial alternatives that would ensure protection of human health in the event the school is reopened in the future with the schoolyard pavement removed (altered site conditions), or the area is redeveloped. Alternative land use scenarios, including residential, commercial/industrial, construction (utility) workers, and recreational visitors, also were evaluated.

1.1 PURPOSE AND SCOPE

This FS Report develops and performs a comparative analysis of remedial alternatives to address concentrations of benzo(a)pyrene [B(a)P], lead, and polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans (collectively referred to as "dioxins") in soil that pose a potential risk to human health under altered site conditions or alternative land uses. The NCP indicates "appropriate remediation" is defined as a cost-effective remedial alternative that effectively minimizes threats to and provides adequate protection of human health, welfare, and the environment (EPA 1990). Remedial alternatives evaluated in this FS Report vary in cost and in the level of protection afforded to human health. Remedial alternatives were developed, screened, and evaluated in detail using the following steps:

- Develop remedial action objectives (RAO) that specify chemicals and media of concern, exposure pathways, and remediation goals. RAOs are developed based on the potential applicable or relevant and appropriate requirements (ARAR) identified for a site and the results of the human health risk assessment (HHRA) and ecological risk assessment (ERA).

- Develop general response actions (GRA) for each medium to address the RAOs. Containment, treatment, removal, or other actions singly or in combination are considered to develop GRAs.

- Quantify the volume of each contaminated medium of concern.

- Identify and screen available technologies and process options for each GRA to eliminate any that cannot be implemented based on technical considerations or that are not cost-effective.

- Assess compliance with DoD requirements by evaluating an alternative that would permit unrestricted use of the site if LUCs, including engineering controls (EC) and institutional controls (IC), are part of another alternative (DoD 2001).

- Assemble retained technologies and process options into potential remedial alternatives and screen these potential alternatives relative to basic threshold criteria and eliminate duplicative alternatives that exhibit outcomes similar to other potential alternatives.

- Perform detailed analysis of the retained remedial alternatives based on nine criteria identified in the NCP at 40 CFR § 300.430(e)(9).

1.2 REPORT ORGANIZATION

This FS Report is organized into nine sections. An outline of the general topics discussed in each section is presented below.

- **Section 1.0, Introduction** – summarizes the purpose and scope of the FS and the organization of the report.

- **Section 2.0, Background Information** – section provides information on the site history, regional and site geology and hydrogeology, and findings from previous investigations at IR Site 31.

- **Section 3.0, Remedial Action Objectives, Applicable or Relevant and Appropriate Requirements, and General Response Actions** – details the site-specific RAOs developed to address the chemicals of concern (COC), presents the ARARs, and identifies GRAs appropriate for IR Site 31.

- **Section 4.0, Screening of Remedial Action Technologies and Process Options –** identifies and describes the technologies and associated process options screened for further evaluation.

- **Section 5.0, Development and Screening of Potential Remedial Alternatives** – details the potential alternatives developed using the GRAs and screens them based on the results of the risk assessments. This screening process streamline the FS process, while ensuring the most promising remedial alternatives are evaluated.

- **Section 6.0, Detailed Development of Retained Remedial Alternatives** – provides a detailed description of the remedial alternatives retained for further analysis after the screening process of potential alternatives.

- **Section 7.0, Detailed Analysis of Retained Remedial Alternatives** – provides a detailed evaluation and analysis of each individual remedial alternative against the nine NCP criteria.

- **Section 8.0, Comparative Analysis of Retained Remedial Alternatives** – presents a comparative analysis of the remedial alternatives retained against the individual NCP criteria.

- **Section 9.0**, References – lists the references used in this report.

Figures and tables are provided at the end of the section in which they are first referenced. Appendices used to prepare this report are included after Section 9.0. Appendix A presents the development of COCs and screening of potential remedial alternatives. Appendix B is an evaluation of proposed ARARs. Appendix C includes the rationale, assumptions, and cost summary sheets for the remedial alternatives evaluated. Appendix D includes comments from the regulatory agencies pertaining to the Draft FS Report and the Navy responses to those comments.

2.0 BACKGROUND INFORMATION

This section summarizes the background information originally presented in the Final RI Report for IR Site 31 (SulTech 2006c). Information summarized includes a description of the IR Program; the Federal Facility Site Remediation Agreement (FFSRA); the site history, setting, and land use; previous site investigations and removal actions; and the site geology. The remainder of the section summarizes the conceptual site model, the nature and extent of contamination, and the results of the HHRA and ERA, as well as the conclusions and recommendations of the Final RI Report for IR Site 31.

2.1 INSTALLATION RESTORATION PROGRAM

In 1975, DoD initiated a program to identify and investigate potential hazardous waste sites at military installations. The program was the result of increasing public and government concern over the potential effects of past hazardous waste disposal methods. This program began on a pilot scale and expanded in 1980 as the DoD IR Program. Concurrent with the formation of the IR Program, the U.S. Congress directed EPA to develop a comprehensive national program to manage past disposal sites. The basis for this program is the CERCLA (or "Superfund"), as amended in 1986 by the Superfund Amendments and Reauthorization Act. In 1988, DoD adopted EPA's terminology for investigation and remediation of past hazardous waste disposal sites for use in its IR Program.

In compliance with the DoD IR Program, the Navy instituted a program to implement the DoD IR Program at naval facilities. The Navy IR Program is conducted in the following three phases:

- Preliminary Assessment/Site Investigation — identifies potential disposal or contaminated sites and evaluates these sites with respect to the potential threat to human health and the environment.

- RI/FS — verifies and characterizes the extent of contamination, defines potential migration pathways, calculates human health and ecological risk, and evaluates the feasibility of potential remedial actions.

- Remedial Design/Remedial Action — designs and implements the remedial actions required to minimize or eliminate confirmed problems.

2.2 FEDERAL FACILITY SITE REMEDIATION AGREEMENT

The FFSRA is an agreement between the State of California and the Navy, which stipulates the type, scope, and scheduling for each IR Program site at NAVSTA TI (Navy 1992). The FFRSA also coordinates activities at the site and identifies the regulatory agencies involved in the IR Program at NAVSTA TI. These agencies include the California Environmental Protection Agency's Department of Toxic Substances Control (DTSC) and San Francisco Bay Regional

Water Quality Control Board (Water Board). All CERCLA remediation efforts on NAVSTA TI are governed by this FFSRA.

A project team has been established at NAVSTA TI and is led by the Navy's Base Realignment and Closure (BRAC) Environmental Coordinator (BEC). The project team meets for periodic program reviews to reach consensus on decisions with federal and state regulatory agencies. The core team, which is the BRAC Cleanup Team (BCT), includes the BEC and representatives of EPA and DTSC. Other key participants on the project team include Navy remedial project managers, representatives from the Water Board and the CCSF, and technical consultants.

2.3 SITE HISTORY, SETTING, AND LAND USE

NAVSTA TI is located in the San Francisco Bay (Bay) in the CCSF, midway between San Francisco and Oakland, California (see Figure 2-1). The naval station consists of two contiguous islands connected by a causeway. The northern island, Treasure Island (TI), encompasses 403 acres; and the southern island, Yerba Buena Island (YBI), encompasses 147 acres (see Figure 2-2). The U.S. Coast Guard owns 30 of the 147 acres that make up YBI. TI is manmade and is constructed of materials dredged from the Bay; YBI is a natural island. All vehicular transportation to and from TI and YBI must use the San Francisco-Oakland Bay Bridge (Interstate 80), which passes through YBI by a tunnel. IR Site 31 is located in the central portion of NAVSTA TI (see Figures 2-2 and 2-3).

Beyond the waters of the Bay, the naval station is surrounded by the extensively developed, mixed-use lands of the San Francisco Bay Area (Bay Area). The Bay Area, with a population exceeding 6.6 million, is a major metropolitan center of business, industry, government, and residential development.

IR Site 31 is located within the southern half of Parcel T095 and the northernmost portion of Parcel T094; additionally, it is located southwest of Parcel T089 and northwest of Parcel T092 (see Figure 2-4). IR Site 31 is 87,950 square feet, or approximately 2 acres in size, and includes the asphalt-paved schoolyard of the recently closed Treasure Island Elementary School. This school has a capacity of up to a total of 1,000 students in kindergarten through 8th grade (Navy 2003). The schoolyard is fenced to the east, south, and west (see Figure 2-4). In addition to the schoolyard, IR Site 31 contains some landscaped areas outside the schoolyard, portions of 11th Street and Avenue E, associated sidewalks, and a portion of the paved parking lot near the intersection of 11th Street and Avenue E.

The remainder of this section discusses the history, ecological setting, and proposed land use of IR Site 31.

2.3.1 Site History

Military activities at the former NAVSTA TI date back to 1866, when the U.S. government took possession of YBI for defensive fortifications before TI was constructed. YBI was occupied by

the U.S. Department of the Army until 1896, when the Navy assumed operations. The Navy operated the first West Coast naval training station on YBI until 1923, when these activities were transferred to an alternative location in San Diego, California. YBI continued to function as a naval receiving station until World War II, after which naval operations were transferred to NAVSTA TI.

NAVSTA TI was built on Yerba Buena Shoals and a sand spit extending from the northwestern point of YBI. Dredging and construction of the island began in 1936 and were completed in 1937. According to an article researched from the Geologic and Engineering Aspects of San Francisco Bay Fill, "During February 1936 through August 1937, the Army Corps of Engineers conducted construction activities on the 402-acre man-made Treasure Island, which was to be the site of the 1939-1940 Golden Gate International Exposition. The Yerba Buena Shoals, a 735-acre reef extending north from Yerba Buena Island was used as the foundation for Treasure Island. To build the island, the Army Corps of Engineers constructed a perimeter of rock and filled it with millions of tons of silt dredged from San Francisco Bay and Delta" (Lee 1969). TI was developed to be the site of the 1939 Golden Gate International Exposition and then as San Francisco's proposed commercial airport.

In response to a Navy request, the CCSF leased TI to the Navy in 1941 for the duration of World War II. During World War II, the island became a major naval station, processing approximately 12,000 military personnel per day for service overseas and when they returned to the United States. NAVSTA TI was used primarily for training, administration, housing, and other support services to the U.S. Pacific Fleet. After World War II, the CCSF agreed to trade the deed for TI to the Navy in exchange for government-owned land south of San Francisco, where the San Francisco International Airport was eventually built (SulTech 2006a).

Parcel T095 was used for several purposes before it was developed as an elementary school in the late 1960s, beginning with exhibits for the 1939-1940 Golden Gate International Exposition. Historical aerial photographs show that the exhibit structures were removed after the exposition ended in 1940 and the Navy took over the island (SulTech 2006c). During the late 1960s, the northern portion of Parcel T095 was developed as an elementary school. The open space was periodically used for storage, and later a fenced storage yard before its current use as an asphalt-paved schoolyard. According to a review of historical aerial photographs, the southern portion of the parcel (IR Site 31) was used as a storage yard (known as the "South Storage Yard") during the early 1970s, while the northern portion of Parcel T095 was an elementary school (SulTech 2006c).

In the late 1970s, the South Storage Yard was paved over and developed to its current-day condition. The schoolyard is fenced to the east, south, and west. The elementary school and associated schoolyard were leased to the San Francisco Unified School District under a Finding of Suitability to Lease signed by the Navy on May 13, 1996 (PRC Environmental Management, Inc. [PRC] and Uribe & Associates 1997).

In 1993, the Defense BRAC Commission recommended closure of NAVSTA TI, pursuant to the Defense Base Closure and Realignment Act of 1990 (Public Law 101-510, Title XXIX, 10

United States Code [U.S.C.] Section (§) 2687 note). NAVSTA TI was subsequently closed on September 30, 1997. NAVSTA TI is currently in the process of being transferred to the CCSF.

In April 2002, a 1989 as-built drawing was discovered indicating that the Navy Public Works Center installed an 8-inch water line down the middle of 11th Street (SulTech 2006c). A note on the as-built drawing for the water line project identified an "old trash dump" in the western portion of the excavation for the water line along 11th Street, between Avenues D and E (Shaw Environmental & Infrastructure, Inc. [Shaw] 2003). Subsequently, a multi-phase investigation and removal action was conducted (beginning in May 2002) to determine the nature and extent of the buried debris (Shaw 2003, 2004).

IR Site 31 was established in September 2003 (Navy 2003), and the site boundaries were revised in April 2005 to include portions of 11th Street and Avenue E, associated sidewalks, and a portion of a parking lot near the intersection of 11th Street and Avenue E (Navy 2005). This FS Report incorporates the revised boundaries (see Figure 2-4). IR Site 31 does not include the elementary school buildings or any other building structures.

2.3.2 Ecological Setting

Generally, the terrestrial habitat of TI is of poor quality for wildlife species because the island is predominantly covered by urban development. To increase the understanding of the habitat and conditions found at IR sites on both TI and YBI, a group of Navy, federal and state regulatory agencies, and local representatives drove and walked through the IR sites on both TI and YBI. During the site tour conducted on June 3, 1994, the group characterized the habitat on TI as poor quality, with large areas of pavement, gravel, or buildings restricting use of the sites by ecological receptors of concern (EPA 1994; Navy 1994). Additionally, the vegetated parts of TI consist of lawns and landscaped areas. Lawns generally provide poor habitat and the landscaped areas are planted with predominantly non-native species. Disturbance from vehicular traffic and widespread human presence also reduces the quality of the habitat for wildlife species at TI. With higher quality habitat nearby at YBI, the group concluded receptor species' use of TI was infrequent and risk to terrestrial receptors was minimal (Tetra Tech EM Inc. [Tetra Tech] 1997).

IR Site 31 characteristics are similar to other sites on TI (EPA 1994). Approximately 90 percent of the site is paved, covered with the asphalt schoolyard, streets, and sidewalks. The remaining 10 percent of the site consists of narrow strips of landscaped areas between the schoolyard and the streets (see Figure 2-3). The future reuse of IR Site 31 is to remain an asphalt-paved schoolyard. The southeast quadrant of the site is slated for recreational development (CCSF 1996). Neither of these reuse scenarios would enhance or create sufficient quality habitat to sustain populations of wildlife.

2.3.3 Land Use Designation

According to Figure 17 of the "Draft Naval Station Treasure Island Reuse Plan" (Reuse Plan) (CCSF 1996), the reuse for the area that includes IR Site 31 is designated as "Residential/Open

Space/Publicly Oriented Uses." However, Table 7 of the Reuse Plan specifically identifies the elementary school for "Institutional Use" (CCSF 1996). Although the elementary school is currently closed, plans for the redevelopment of TI show a kindergarten through 8th grade school could be supported by the population (Fancher 2006). Reuse of the existing school for this purpose is likely, given the cost associated with developing new educational/institutional facilities (CCSF 1996). The southeast quadrant of IR Site 31 is slated for recreational development.

2.4 PREVIOUS INVESTIGATIONS AND REMOVAL ACTIONS

IR Site 31 has been the subject of several previous investigations and one removal action. In 1988, a Preliminary Assessment/Site Inspection was conducted at TI. Other investigations included a 1996 study of ambient metals in soil and a study of metals in groundwater, a 1995 tidal mixing zone study, and the 2002 investigation of the Former South Storage Yard. Subsequently, exploratory trenching and a time-critical removal action (TCRA) were completed in 2003 at IR Site 31, in addition to a 2004 groundwater investigation. The excavation associated with the TCRA was performed on both the north and south sides of 11th Street (see Figure 2-4). The area of this excavation did not include soil and debris beneath 11th Street or the associated sidewalks. These previous investigations and the removal action are briefly described below. A more thorough summary of the investigations is provided in the Final RI Report for IR Site 31 (SulTech 2006c).

2.4.1 Preliminary Assessment/Site Inspection

In April 1988, a Preliminary Assessment/Site Inspection was performed (Dames and Moore 1988). The report identified a total of 26 potentially contaminated sites at NAVSTA TI, which became the initial 26 IR sites. Each of the 26 sites was then evaluated with regard to contaminant characteristics, migration pathways, and potential receptors. The report concluded additional investigations were not warranted at four of the sites, remedial measures were recommended for two sites, and the remaining 20 sites were recommended for an RI (Dames and Moore 1988). IR Site 31 was not identified in the Preliminary Assessment/Site Inspection Report.

2.4.2 Ambient Concentration of Metals in Soil at Treasure Island

Ambient concentrations were established to assess if the presence of a chemical was the result of a site-specific release or if it was from naturally occurring or regional anthropogenic sources. The concentrations of inorganic chemicals present in soil altered by human activities, as is the case with land made of dredged fill, are referred to as "ambient," and this term is applied to conditions at NAVSTA TI. The concentrations of inorganic chemicals present in soil as part of the undisturbed natural conditions of the area are referred to as "background," and this term is applied to conditions at YBI. Both terms relate to concentrations of inorganic chemicals that are not site-related. Only ambient concentrations of metals are further discussed in this FS report because IR Site 31 is located on NAVSTA TI.

2.4.3 Ambient Concentrations of Metals in Groundwater at Treasure Island

In 2001, a study was performed to evaluate ambient concentrations of metals in groundwater at TI (Tetra Tech 2001a). Limited historical data were available to evaluate ambient concentrations of metals in groundwater (Tetra Tech 2001a). As a result, an additional four quarters of data were collected from the existing monitoring wells throughout TI. The number of monitoring wells and sampling frequency were selected using the data quality objective process developed for the study (Tetra Tech 1997). The number of samples required was estimated based on the coefficient of variation calculated using previous metals data. Additionally, statistical performance objectives were used to achieve a specified level of precision and confidence at a defined minimum detectable relative difference (EPA 1989a). Approximately 100 samples collected from 26 monitoring wells were found to be sufficient for meeting the goals to establish ambient concentrations of metals in groundwater.

2.4.4 Tidal Influence Studies

In 1995, a study was performed to assess the inland extent of tidal influence on nearshore groundwater levels at NAVSTA TI (PRC 1995). In 2001, a second study was performed to assess the degree of subsurface mixing of groundwater and surface water immediately inland of the shore at TI (Tetra Tech 2002b). The findings from these studies estimated that physical mixing of surface water and groundwater took place over distances ranging from 60 to 150 feet inland from the TI mean lowest low water shoreline (Tetra Tech 2002b). Significant temporal and spatial variations were observed in the degree of tidal mixing. IR Site 31 is located approximately 1,240 feet from the western shoreline, thus is not influenced by tidal fluctuations.

2.4.5 Former South Storage Yard Investigation

Based on a 2002 review of historical aerial photographs and historical activity, the Navy and the regulatory agencies identified a storage yard in the southern portion of Environmental Baseline Survey Parcel T095 (SulTech 2006c). This area was identified as the Former South Storage Yard. Between February and April 2002, an investigation was conducted to evaluate if historical operations at the Former South Storage Yard had contaminated soils. Forty-four soil samples were collected from depths up to 4 feet below ground surface (bgs) within IR Site 31. Five grab groundwater samples also were collected. These soil and grab groundwater samples were analyzed for metals, volatile organic compounds (VOC), semivolatile organic compounds (SVOC), organochlorine pesticides, polychlorinated biphenyls (PCB), and total petroleum hydrocarbons (TPH) as extractables and purgeables (Tetra Tech 2002a). Results of the investigation indicated elevated concentrations of lead, 4,4-dichlorodiphenyltrichloroethane (DDT), and PCBs were present in soil (Tetra Tech 2002a).

Results for these grab samples were not considered reflective of actual groundwater conditions, but merely an initial screen of possible groundwater contamination because residual soil particles were likely present in the grab groundwater samples. Therefore, results for grab groundwater samples were not used in the HHRA or ERA for IR Site 31. Results of the 2004 groundwater investigations performed at IR Site 31 are presented in Section 2.7.2.

2.4.6 Exploratory Trenching and Time-Critical Removal Action

Based on information from a 1989 as-built drawing, an investigation of the northern portion of Parcel T094 was conducted between May and August 2002 to explore the extent of the buried debris beneath the parcel (Shaw 2003). A part of this investigation area, which included the area beneath 11th Street and the sidewalks north and south of 11th Street, is located within the southernmost portion of IR Site 31. Based on results of the exploratory trenching investigation, a TCRA was initiated in July 2002. Activities conducted during the trenching investigation and TCRA, as well as additional sampling to further characterize debris, are discussed below.

2.4.6.1 Exploratory Trenching

Between May and August 2002, 47 trenches were excavated at Parcels T-094 and T-095. Of these, 14 trenches were located within the boundary of IR Site 31 (SulTech 2006c). Ten trenches (T094-1, T094-2, T094-3, T094-4, T094-5, T094-6, T094-7, T094-8, T094-10, and T094-12) at IR Site 31 were excavated beneath and on either side of 11th Street, within 30 feet of the water and gas pipeline alignment (see Figure 2-4). The remaining four trenches (T094-24, T094-25, T094-26, and T094–27) were located just inside the fenced schoolyard of the elementary school (see Figure 2-5).

All trenches were logged for debris. The common types of debris found included glass, porcelain, metal (such as utensils, rusted iron and copper pieces, metal plating, nails, bars, and wire), and burned lumber. Locations of debris spanned both sides of 11th Street (see Figure 2-5).

Samples were collected from the sidewalls of each trench (Shaw 2003). Soil sampling depths and analytical suites differed depending on the phase of sampling. The samples were analyzed for metals, polycyclic aromatic hydrocarbons (PAH), organochlorine pesticides, PCBs, TPH, and dioxins. Of these chemicals, only copper and lead were detected at concentrations exceeding field screening criteria (see Tables 2-1 and 2-2) (Shaw 2003).

2.4.6.2 Time-Critical Removal Action

In July 2002, a TCRA was conducted to excavate soil with chemicals (copper and lead) at concentrations exceeding the field screening criteria (Shaw 2003). The area of excavation did not include soil with elevated concentrations of chemicals of potential concern (COPC) and debris beneath 11th Street or the associated sidewalks. Confirmation samples were collected from both excavations as the excavation sidewalls and bottom were progressively exposed. Samples from the sidewalls were typically collected at 5-foot intervals horizontally and were targeted toward any burned debris that was encountered.

The excavation on the north side of 11th Street encompassed 3,200 square feet and ranged from 2 to 6 feet in depth (for a total volume of 450 cubic yards) (Shaw 2003). The deepest portion of the excavation was the western one-third, where burned debris was encountered near the water

table at a depth of approximately 5 to 7 feet bgs. A total of 81 sidewall samples, including 7 field duplicates, was collected. Samples from the bottom of the excavation were collected at a rate of 1 per every 200 square feet, for a total of 19 samples, including 2 field duplicates. Confirmation sample results indicated elevated concentrations of lead were still present along portions of the sidewalls of the excavation area adjacent to 11th Street (Shaw 2003). Lead concentrations in confirmation samples ranged from 410 milligrams per kilogram (mg/kg) to 9,100 mg/kg.

The excavation on the south side of 11th Street encompassed a total area of about 1,215 square feet and ranged in depth from 3 to 6 feet (Shaw 2003). A total of 42 sidewall samples, including 4 field duplicates, was collected. Samples from the bottom of the excavation were collected at a rate of 1 per every 200 square feet, for a total of seven samples, including one field duplicate. Soil sampling results for this southern excavation are discussed in the IR Site 30 RI Report (SulTech 2006a).

After review of the analytical results of the confirmation samples and the trench logs, the BCT concluded debris-contaminated soil that was not covered by asphalt or concrete in the northern and southern excavations had been adequately remediated and granted concurrence to backfill these excavations. Backfilling was completed in July and August 2002 (Shaw 2003).

2.4.6.3 Additional Sampling and Debris Characterization

Based on results of the TCRA and discussions with the regulatory agencies, the Navy decided further investigation of IR Site 31 was necessary to (1) evaluate if debris and associated concentrations of copper and lead in soils might be laterally continuous northward beneath the schoolyard; and (2) to further delineate areas of elevated concentrations of COPCs in soil (Shaw 2004).

Between August 18 and September 22, 2003, soil samples were collected from 43 trenches and 6 direct-push soil borings within IR Site 31. Samples were analyzed for metals, VOCs, SVOCs, organochlorine pesticides, PCBs, and total petroleum hydrocarbons (TPH) as extractables (TPH-e) and purgeables (TPH-p) (Tetra Tech 2002a). Analytical results indicated Debris Areas A, B, and E located along 11th Street (see Figure 2-5) and associated concentrations of copper and lead detected in soil during the Parcel T094 investigation and TCRA were unlikely to be laterally continuous beneath the elementary schoolyard. However, soil with localized debris and several chemicals exceeding field screening criteria were found within Debris Areas C and D (see Figure 2-5). Debris Area C is located in the northwestern quadrant of the site, and Debris Area D is in the southeastern quadrant of the site.

Soil from five trenches within the northwestern quadrant (Debris Area C) contained lead, PAHs, TPH as diesel, TPH as motor oil, and dioxins at concentrations exceeding field screening criteria (Shaw 2004). Additionally, soil in one trench (S031-26) contained primarily burned debris (up to 10 percent). Surrounding trenches contained only minor amounts of debris and chemicals at concentrations below the field screening criteria (Shaw 2004).

The area of contamination in the three trenches in the southeastern quadrant (Debris Area D) was smaller than in the northwestern quadrant. Concentrations of cadmium, lead, TPH as motor oil, and dioxins exceeded field screening criteria (Shaw 2004). Seven additional trenches were excavated to the north, east, and south of Debris Area D. Trench S031-03 was the only location with chemical concentrations exceeding the residential soil preliminary remediation goal (PRG) for B(a)P. However, concentrations of B(a)P were less than the B(a)P-equivalent (EQ) concentration used for field screening (0.62 mg/kg).

The Final Field Activity Report recommended the proposed IR Site 31 boundary be expanded east to encompass the additional area evaluated and to continue the CERCLA process at IR Site 31 (Shaw 2004).

2.4.7 Groundwater Microwell Installation

In 2004, eight direct-push borings were advanced and logged as part of an installation of temporary microwells to investigate groundwater at IR Sites 30 and 31 (SulTech 2004). These locations were selected based on previous analytical results for soil to evaluate the potential for groundwater contamination to migrate from identified subsurface debris areas. Water level measurements were recorded at each well and groundwater samples were collected using a low-flow peristaltic pump. Groundwater samples were analyzed for Title 22 metals, VOCs, SVOCs, organochlorine pesticides, PCBs, TPH, and dioxins (SulTech 2004). Results for samples from six of the eight temporary monitoring wells (30/31MW001 through 30/31MW005 and 30/31MW007) were used to evaluate the quality of groundwater at IR Site 31. Results of the groundwater investigations performed at IR Site 31 are presented in Section 2.7.2.

2.5 GEOLOGY AND HYDROGEOLOGY

This section briefly describes the regional and site-specific geological and hydrogeological setting of TI and IR Site 31.

2.5.1 Regional Geology

The Bay Area, which is along the contact between the North American and Pacific crustal plates, is a tectonically active region. This seismic regime is characterized by southeast-to-northwest trending faults that exhibit primarily right lateral strike-slip movement. The major active faults in the vicinity of TI are all part of the San Andreas fault system. These faults include the Hayward Fault, 3 miles to the east; the San Andreas Fault, 9 miles to the west; the San Gregorio-Seal Cove Fault, 25 miles to the west; and the Calaveras Fault, 16 miles to the east (Dames and Moore 1988).

Basement rocks in the Bay Area consist primarily of the fractured and sheared rocks of the Late Jurassic to Early Cretaceous Franciscan Assemblage. The Bay is a drowned river valley developed within a southeast-to-northwest-trending structural trough in the Franciscan Assemblage bedrock. Material eroded from the Berkeley/Oakland hills forms the broad, gently

sloping coastal plain that borders the eastern shoreline of the Bay. Extensive areas of fill material are found at locations along the western shoreline of the Bay, primarily along the San Francisco waterfront and in San Mateo County. This fill material generally consists of variable amounts of soil, gravel, broken concrete and asphalt, rock, Bay Muds, alluvial and estuarine sediments, and other solid material. Soil characteristics are highly variable because of the different kinds and amounts of fill material in the profile (Dames and Moore 1988).

2.5.2 Treasure Island and Installation Restoration Site 31 Geology

TI is a 403-acre flat, manmade island that consists primarily of sand dredged from the Bay and retained by a perimeter of rock and sand dikes. TI was constructed on the Yerba Buena Shoals, a sand spit that extends north and northwest of YBI. TI ranges in elevation from 9 to 12 feet above mean sea level, based on the National Geodetic Vertical Datum of 1929. Subsurface materials at TI can be divided into the following five units, listed from youngest to oldest: (1) Fill (Dredged Sand Fill), (2) Shoal Sands (Yerba Buena Shoal Sands), (3) Younger Bay Mud, (4) Older Bay Mud, and (5) Franciscan Assemblage.

Asphalt and concrete provide surface cover at IR Site 31 and are underlain by dredged fill and shoal deposits predominantly consisting of fine- to medium-grained sands, with varying proportions of shell fragments, silt, and clay. The dredged fill was emplaced on top of the shoal sands during construction of TI. Younger Bay Mud consisting of interbedded sand, silt, and clay underlie the shoal sands.

2.5.3 Site Hydrogeology

Based on the 2004 monitoring data, groundwater beneath IR Site 31 was encountered between 5 and 7 feet bgs (SulTech 2006c). Based on general NAVSTA TI hydrogeology and historical basewide groundwater monitoring data, groundwater at IR Site 31 flows in a northwest direction toward the shoreline. Historically, groundwater has generally flowed radially from the center of TI toward the shoreline at gradients from 0.0015 to 0.005 feet per feet. The Draft Final Onshore RI Report indicated that hydraulic testing using the Bouwer and Rice rising head test was performed on 13 wells located in select areas across NAVSTA TI (Tetra Tech 1997). Excluding an anomalous value from one well, an average hydraulic conductivity of 10.12 feet per day was reported.

Currently, groundwater at IR Site 31 is not used as a source of drinking water or as an agricultural, process, or industrial supply. The Water Board concurred in a letter dated January 23, 2001, that groundwater at NAVSTA TI meets the exemption criteria in State Water Resources Control Board Sources of Drinking Water Resolution 88-63, but retains its designation for potential agricultural, process, and industrial supply (Water Board 2001).

2.6 CONCEPTUAL SITE MODEL FOR THE REMEDIAL INVESTIGATION REPORT

Previously collected data and an understanding of the exposure setting and land use were used to develop a conceptual site model for the IR Site 31 RI Report (SulTech 2006c). A conceptual site model is an effective tool for defining site dynamics, streamlining any future risk evaluations, and for developing any further actions at a site. The conceptual site model aids in understanding and describing potential exposure pathways that may be present at a site. A more complete discussion of the conceptual site model is included in the Final IR Site 31 RI Report (SulTech 2006c).

The conceptual site model outlined potential exposure scenarios for elementary school children and staff at IR Site 31. Hypothetical residential and commercial/industrial redevelopment was also considered (1) based on EPA recommendations to consider alternative future land uses (EPA 1989b) and (2) to fulfill the DoD policy requirement to prepare alternative risk estimates for unrestricted reuse (DoD 2001). Construction workers involved in construction and excavation as part of implementing alternative land reuse could be exposed to chemicals at IR Site 31, thus they were evaluated for these exposures. Current utility workers that may visit the site on an infrequent basis to repair subsurface utility lines were also considered. Site-wide construction worker exposure is considered protective of site-wide utility worker exposure, but given the location of water and gas pipelines within 11th Street between Avenue D and Avenue E (see Figure 2-4), a focused hotspot evaluation was also considered for utility workers exposed to chemically affected soil beneath 11th Street (SulTech 2006c) Finally, potential exposure to recreational visitors within the southeastern quadrant north of 11th Street and east of Avenue E also was considered in the event this area is redeveloped for recreational use, as suggested in the Reuse Plan (CCSF 1996).

2.7 NATURE AND EXTENT OF CONTAMINATION

Four field investigations were completed at IR Site 31, including the investigation of the Former South Storage Yard (Tetra Tech 2002a), exploratory trenching and a TCRA (Shaw 2003), additional sampling at IR Site 31 (Shaw 2004), and the temporary groundwater microwell installation and sampling study (SulTech 2004). Results for soil from these investigations were compared with field screening criteria (see Table 2-2). These screening criteria included EPA PRGs for residential soils, the B(a)P-EQ soil action level for PAHs, and NAVSTA TI ambient levels for metals (see Table 2-1). These field screening criteria were used to identify areas for further investigation, characterize and delineate COPCs, and evaluate the effectiveness of the TCRA. Results for groundwater were compared with NAVSTA TI screening criteria for groundwater. The NAVSTA TI groundwater screening criteria consisted of values considered protective of ecological receptors in the Bay because groundwater at TI is not considered a suitable source of drinking water (Water Board 2001). Since groundwater is not a current or potential drinking water source at Site 31, the consumption of groundwater was not evaluated as a potential exposure pathway in the RI Report; however, potential pathways related to vapor intrusion from and direct contact with groundwater were evaluated (SulTech 2006c). Data collected during these investigations were used to evaluate site conditions for the HHRA and the ERA (SulTech 2006c).

2.7.1 Soil Results

The following chemicals were detected in IR Site 31 soil at concentrations exceeding field screening criteria:

- Metals: arsenic, cadmium, copper, iron, lead, and manganese
- SVOCs: bis(2-chloroetheyl)ether
- PAHs: benzo(a)anthracene, B(a)P, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene
- Pesticides: 4,4'-dichlorodiphenyldichloroethane (-DDD); 4,4'-dichlorodiphenyldichloroethene (-DDE); and 4,4'-DDT
- PCBs: Aroclor-1260
- TPH as motor oil
- Dioxins

Table 2-2 shows the chemicals detected throughout IR Site 31 that exceeded field screening criteria. Figure 2-5 illustrates the location of the delineated Debris Areas A, B, C, D, and E, sampling locations, and chemicals detected throughout IR Site 31 that exceeded field screening criteria. Although the concentrations of arsenic and manganese exceeded PRGs for residential soil, they are consistent with NAVSTA TI ambient levels (SulTech 2006c). This consistency suggests any release of arsenic or manganese that may have occurred has not resulted in concentrations significantly different than ambient levels. Most of the elevated concentrations occurred in samples collected within or adjacent to Debris Areas C and D, as well as the excavation sidewall samples bordering 11th Street (Debris Area E) (see Figure 2-5). A smaller number of elevated concentrations were scattered throughout the site (see Figure 2-5).

2.7.2 Groundwater Results

To determine whether impacts to groundwater pose an unacceptable risk to human health and the environment, 12 groundwater samples were collected at IR Site 31 (SulTech 2006c). Five grab groundwater samples were collected during the Former South Storage Yard investigation (Tetra Tech 2002a) and analyzed for SVOCs, VOCs, organochlorine pesticides, PCBs, TPH-e, TPH-p, and metals. The results from the grab samples were used for initial screening of the groundwater beneath the site. The results from grab groundwater samples were not used for ecological or human health risk assessments because they are considered screening criteria samples.

Seven temporary microwells were each sampled once during the groundwater investigation in May 2004 (SulTech 2004). Groundwater samples from temporary monitoring wells were

analyzed for metals, TPH-e, TPH-p, VOCs, SVOCs, pesticides, PCBs, and dioxins. The results from six temporary monitoring wells were used for the HHRA and ERA (SulTech 2006c).

Chemicals (such as pesticides, PCBs, and dioxins) detected in soil were not detected in groundwater at IR Site 31. Detections of site chemicals in groundwater did not contribute significantly to cumulative potential cancer risks or noncancer hazard index (HI) and are not considered to pose a threat to human health and the environment (SulTech 2006c).

2.7.3 Contaminant Fate and Transport Evaluation

The fate and transport of the chemicals in soil at IR Site 31 were evaluated in the Site 31 RI Report if they were found to exceed screening criteria and NAVSTA TI ambient levels: The chemicals evaluated included cadmium, copper, iron, and lead; bis(2-chloroethyl)ether; PAHs; Aroclor-1260; TPH; and dioxins. The assessment included an evaluation of (1) the physical features and activities on the site, (2) probable transport pathways for site chemicals, and (3) the physical and chemical characteristics that may influence the mobility and behavior of specific site chemicals (SulTech 2006c).

The potential exposure media at the site to human and ecological receptors are air and soil (where not covered by asphalt). Because groundwater is not considered to be potable, direct ingestion of groundwater at IR Site 31 was not considered to be a potential exposure pathway for humans in the RI Report route; however, potential pathways related to vapor intrusion from and direct contact with groundwater were evaluated (SulTech 2006c). Because of the distance between IR Site 31 and the Bay (approximately 1,200 feet), and the low concentration (and single detection) of mercury in groundwater, migration off site via groundwater is not expected. The primary migration pathways of chemicals off site are wind transport of particulates as dust and dissolution of chemicals by rainwater infiltration and groundwater transport. The nature of chemicals detected at concentrations exceeding screening criteria limits the possibility of volatilization of chemicals from soil or groundwater to the air. As a result, this pathway was not considered significant at IR Site 31 (SulTech 2006c).

The wind transport pathway consists of chemicals in exposed surface soil being entrained as dust in the air and being transported by wind. The rainwater infiltration and groundwater transport pathway consists of infiltration of rainwater into the subsurface of unpaved areas, dissolution of soil-bound chemicals into groundwater, and migration of chemicals through groundwater flow to the Bay. Transport of chemicals along the wind transport, rainwater infiltration, and groundwater pathways is considered to be unlikely (SulTech 2006c). Most of IR Site 31 is covered with asphalt and generation of dust and infiltration of rainwater through the surface is limited.

The assessment of fate and transport showed that none of the pathways identified transports chemicals to exposure points at concentrations exceeding screening criteria. Furthermore, based on the detected concentrations, chemical properties (their strong affinity to remain sorbed to soil), and lack of detections in groundwater, the expected fate of chemicals in soil at IR Site 31 is that they will likely continue to remain in place. In general, chemicals at concentrations

exceeding screening criteria are retained strongly by soil and are not expected to leach to groundwater in sufficient quantities to migrate off site to the Bay (SulTech 2006c).

2.8 HUMAN HEALTH RISK ASSESSMENT

The quantitative HHRA for IR Site 31 at NAVSTA TI was presented in the Final IR Site 31 RI Report (SulTech 2006c). To satisfy federal (Navy and EPA) and state (DTSC) requirements, baseline risk estimates were prepared by two different methods in the HHRA, referred to as Method 1 (satisfying federal requirements) and Method 2 (satisfying state requirements). These two methods differed in the manner in which COPCs and toxicity criteria were selected.

Both elementary school children and adult staff were considered potential receptors to evaluate under the current exposure setting in the event the elementary school is reopened. Two scenarios were evaluated for these receptors:

- Current site conditions, assuming direct contact exposures to soil were limited to surface soil (0 to 2 feet bgs) from the unpaved areas (between the schoolyard and Avenues D and E and 11th Street)
- Altered site conditions, assuming the schoolyard pavement is removed, thus exposing the underlying surface soil

In the latter case, direct contact exposures for the elementary school receptors were limited to surface soil (0 to 2 feet bgs) from inside the schoolyard fence line. Landscape workers that may frequent the unpaved areas also were considered, but it was determined the evaluation of exposure of elementary school staff would be protective of these potential workers.

Construction workers, residents, and commercial/industrial workers also were evaluated for alternative land use. Two scenarios were evaluated for residents and commercial/industrial workers following the hypothetical removal of all existing asphalt (including 11th Street) and other ground cover: (1) exposure to surface soils (0 to 2 feet bgs), and (2) exposure to combined surface and subsurface soils (0 foot bgs to the water tables), following more intrusive hypothetical redevelopment. The construction worker scenario was evaluated using exposure to combined surface and subsurface soils (0 foot bgs to the water tables). The evaluation of construction workers is considered representative of a utility worker who may infrequently visit the site.

Because the consumption of groundwater at IR Site 31 was not evaluated as a potential exposure pathway, potential exposure to chemicals in groundwater was limited to direct exposure to groundwater and inhalation of volatile chemicals that migrate upward into air (that is, subsurface vapor intrusion to indoor or outdoor air breathing zones). Exposure to vapors migrating from groundwater and soil into indoor air was not evaluated for elementary school receptors because IR Site 31 does not include any buildings, nor are any school buildings within 100 feet from sampling locations or wells where VOCs were detected. Residents and commercial/industrial

workers were assumed to be exposed to vapors migrating from groundwater and soil into hypothetical buildings. Finally, exposure to groundwater via dermal contact was evaluated for construction workers engaged in excavation during redevelopment or as utility workers, digging temporary trenches to repair subsurface utility lines.

The table below summarizes the potential cancer risks and noncancer HIs for each of these receptors under reasonable maximum exposure (RME) conditions.

Receptor	RME Cancer Risk Estimates		RME Noncancer HI Estimates	
	Method 1	Method 2	Method 1	Method 2
Current Land Use				
Current Site Conditions				
Elementary School Child – Exposure to Soil (0 to 2 feet bgs, Unpaved Areas outside Fence Line)[1]	1×10^{-6}	2×10^{-6}	0.05	0.3
Elementary School Staff – Exposure to Soil (0 to 2 feet bgs, Unpaved Areas outside Fence Line)[1]	2×10^{-6}	5×10^{-6}	0.04	0.2
Altered Site Conditions				
Elementary School Child – Exposure to Soil (0 to 2 feet bgs, Inside Schoolyard Fence Line)[1,2]	1×10^{-5}	2×10^{-5}	0.2	0.2
Elementary School Staff – Exposure to Soil (0 to 2 feet bgs, Inside Schoolyard Fence Line)[1,2]	2×10^{-5}	4×10^{-5}	0.1	0.2
Alternative Land Use				
Construction Worker – Exposure to Soil (0 foot bgs to groundwater, Site-Wide)[3], Groundwater, and Vapors in Trench Air[4]	3×10^{-6}	5×10^{-6}	0.6	0.8
Resident – Exposure to Soil (0 to 2 feet bgs, Site-Wide)[3] and Vapors in Indoor Air[5]	7×10^{-5}	3×10^{-3}	24	25
Resident – Exposure to Soil (0 foot bgs to groundwater, Site-Wide)[3] and Vapors in Indoor Air[5]	6×10^{-5}	3×10^{-3}	24	25
Commercial/Industrial Worker – Exposure to Soil (0 to 2 feet bgs, Site-Wide)[3] and Vapors in Indoor Air[5]	3×10^{-5}	4×10^{-4}	2	2
Commercial/Industrial Worker – Exposure to Soil (0 foot bgs to groundwater, Site-Wide)[3] and Vapors in Indoor Air[5]	2×10^{-5}	4×10^{-4}	2	2

Notes:

1 Exposure to soil via incidental ingestion, dermal contact, and inhalation pathways presented in Section I.8.2 of Appendix I of the Site 31 RI Report (SulTech 2006c).

2 Soil assumed to be unpaved for this assessment.

3 Exposure to soil via incidental ingestion, dermal contact, and inhalation of particulates or vapors in outdoor air.

4 In-trench air concentrations modeled from groundwater.

5 Indoor air concentrations modeled from groundwater and sitewide combined surface and subsurface soil (0 foot bgs to groundwater).

Estimated cancer risks for the elementary school child, elementary school staff, and construction worker were within the EPA risk management range (10^{-6} to 10^{-4}). Estimated cancer risks for the hypothetical child/adult resident and commercial/industrial worker were within the cancer risk management range under Method 1, but above the risk management range under Method 2. The estimated HIs were less than the threshold of 1 for noncancer effects (EPA 1989) for all receptors except hypothetical residents and commercial/industrial workers. Site chemicals detected in groundwater did not contribute significantly to cumulative potential cancer risks or noncancer HIs.

To evaluate the potential for human health effects caused by lead in the elementary school child and the adult and child residents, LeadSpread modeling was performed (DTSC 1999). LeadSpread modeling resulted in 99th percentile concentrations below 10 micrograms per deciliter (µg/dL) for the elementary school child and adult residents and for the child resident exposed to lead in surface soils. However, LeadSpread modeling resulted in 99th percentile concentrations above 10 µg/dL for child residents exposed to lead in combined surface and subsurface soils. To evaluate potential harmful effects from exposure to lead in soil for elementary school staff, construction workers and commercial/industrial workers, EPCs were compared with the EPA Region 9 PRG for industrial soil of 800 mg/kg (EPA 2004). The lead EPCs in the three surface soil data sets, ranging from 149 mg/kg to 346 mg/kg, were well below the 800 mg/kg benchmark, but the lead EPC in site-wide combined surface and subsurface soil, 858 mg/kg, exceeded the benchmark.

Elevated concentrations of the cancer risk drivers B[a]P, dioxins, and other PAHs with B[a]P-like toxicity, as well as naphthalene and lead, were mostly limited to the debris areas. To account for potential exposure of utility workers to combined surface and subsurface soil in the utility corridor beneath 11th Street (Debris Area E), a focused hotspot evaluation was performed and RME potential cancer risks and noncancer hazards were estimated using construction worker exposure parameters. Under both Method 1 and Method 2, the potential cancer risks were less than 1×10^{-6} and the HIs were less than 1. However, the estimated lead EPCs exceeded 800 mg/kg.

A separate Tier 1 screening-level risk assessment protective of recreational visitors also was conducted to evaluate the potential redevelopment of the southeast quadrant of IR Site 31 into a recreational area (Navy 2001). Potential cancer risks of 1×10^{-5} and 4×10^{-5} were estimated for exposure to surface soil (0 to 2 feet bgs) and combined surface and subsurface soil (0 foot bgs to groundwater), respectively, in the southeast quadrant. HIs estimated for exposure to surface soil (0 to 2 feet bgs) and combined surface and subsurface soil (0 foot bgs to groundwater) were both equal to the threshold of 1. LeadSpread modeling using default exposure parameter values for residents as protective of recreational exposure resulted in 99th percentile concentrations above 10 µg/dL for child residents exposed to lead in combined surface and subsurface soils.

Finally, a separate indoor air vapor intrusion evaluation was conducted for receptors at the daycare center south of IR Site 31 (IR Site 30) to determine the potential for subsurface migration of VOCs detected at IR Site 31. The estimated Method 1 and Method 2 HIs for the daycare center receptors were less than 1. Using site-specific average vapor flow rate (Q_{soil}) values in the vapor intrusion model, the Method 1 potential cancer risks estimated for both daycare center children and daycare center staff and the Method 2 potential cancer risks estimated for daycare center children were found to be below the EPA risk management range (10^{-6} to 10^{-4}). The Method 2 potential cancer risk estimated for the daycare center staff using site-specific Q_{soil} slightly exceeded 1×10^{-6}. This result was driven largely by concentrations of naphthalene in Debris Area E.

2.9 ECOLOGICAL RISK ASSESSMENT

The IR Site 31 ERA focused on detected chemicals in groundwater at IR Site 31 and the potential risk to aquatic receptors associated with migration of chemicals in groundwater to the offshore surface waters of the Bay (SulTech 2006c). A step-wise approach for evaluating chemicals in groundwater was used to identify chemicals of potential ecological concern for the offshore point of exposure areas at NAVSTA TI. Based on the ERA results, no chemicals of potential ecological concern were identified for IR Site 31 (SulTech 2006c).

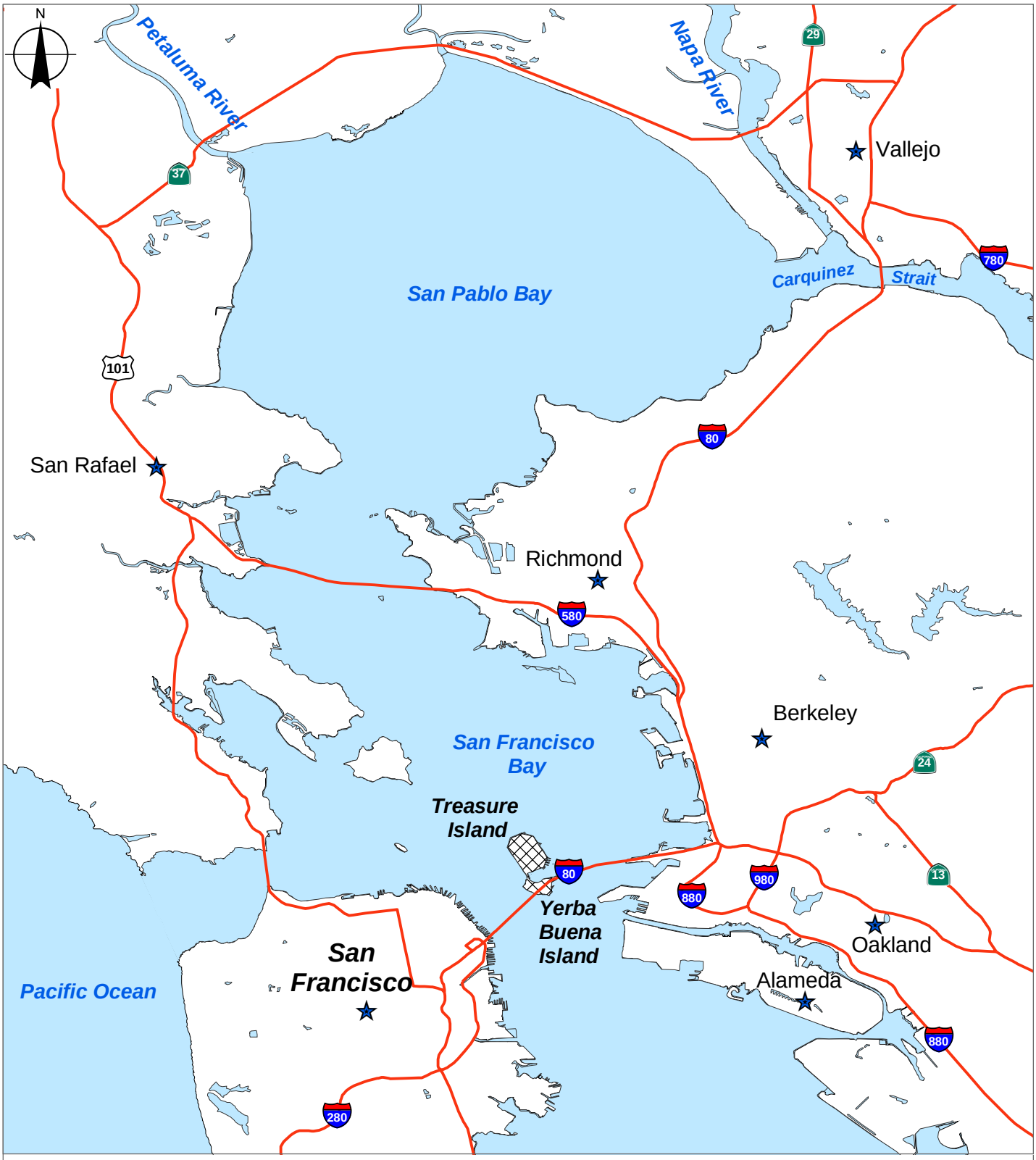
2.9.1 Screening Level Ecological Risk Assessment

A Tier 1 screening-level ERA was conducted to evaluate the potential for terrestrial receptors to be exposed to soil at IR Sites 6, 12, 21, 24, 30, 31, 32, and 33 at NAVSTA TI (SulTech 2006d). The draft screening-level ERA did not identify any ecological resources or processes at TI that needed to be protected or sustained. Based on the overall poor quality of the habitat on TI, the Navy does not recommend further evaluation of ecological risk in a Tier II assessment for Sites 6, 12, 21, 24, 30, 31, 33, and 33 (SulTech 2006d).

2.10 REMEDIAL INVESTIGATION CONCLUSIONS AND RECOMMENDATIONS

Based on the chemical characterization of current site conditions, the findings of the fate and transport evaluation, and the results of the HHRA for IR Site 31, existing site conditions are considered protective of human health and the environment under current land use at the site as a paved elementary schoolyard (SulTech 2006c). Although the future residential or commercial/industrial reuse of IR Site 31 is not planned, nor is the elementary schoolyard anticipated to be redeveloped as an unpaved play yard, the RI Report recommended an FS be conducted to evaluate remedial alternatives that would ensure protection of human health in the event such future reuse should occur (SulTech 2006c).

FIGURES



NAVAL STATION TREASURE ISLAND

2 0 2 4
Miles

SulTech

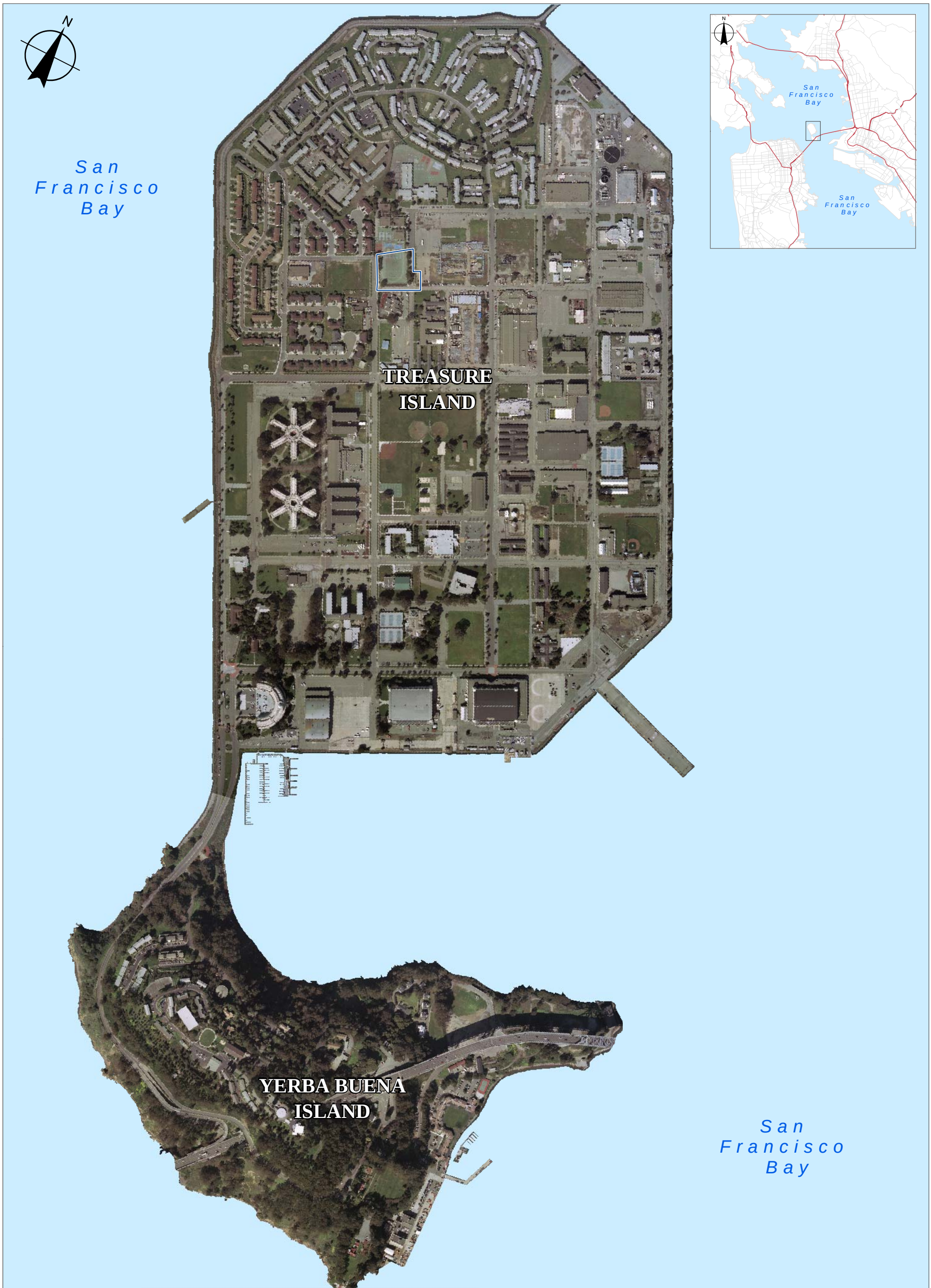
Naval Station Treasure Island
Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 2-1

INSTALLATION LOCATION MAP

Feasibility Study Report for
Installation Restoration Site 31

2006/05/12 V:\Projects\B171-TI\Site 31 FS\Figure 2-1.mxd SULLIVAN - SD L. Rizzo



IR SITE 31 BOUNDARY

350 0 350 700
Feet

Note:
Aerial photograph taken by HJW Geospatial Inc. on February 18, 2003; photograph georeferenced by Tetra Tech.

SulTech

Naval Station Treasure Island
Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 2-2

AERIAL PHOTOGRAPH
NAVAL STATION TREASURE ISLAND

Feasibility Study Report for
Installation Restoration Site 31

2006-05-13 V:\Projects\B171-TI\Site 31 FS\Figure 2-2.mxd SULLIVAN SD D. Wise

N

IR SITE 31 BOUNDARY

IR SITE 30 BOUNDARY

50 0 50 100

Feet

SulTech

Naval Station Treasure Island

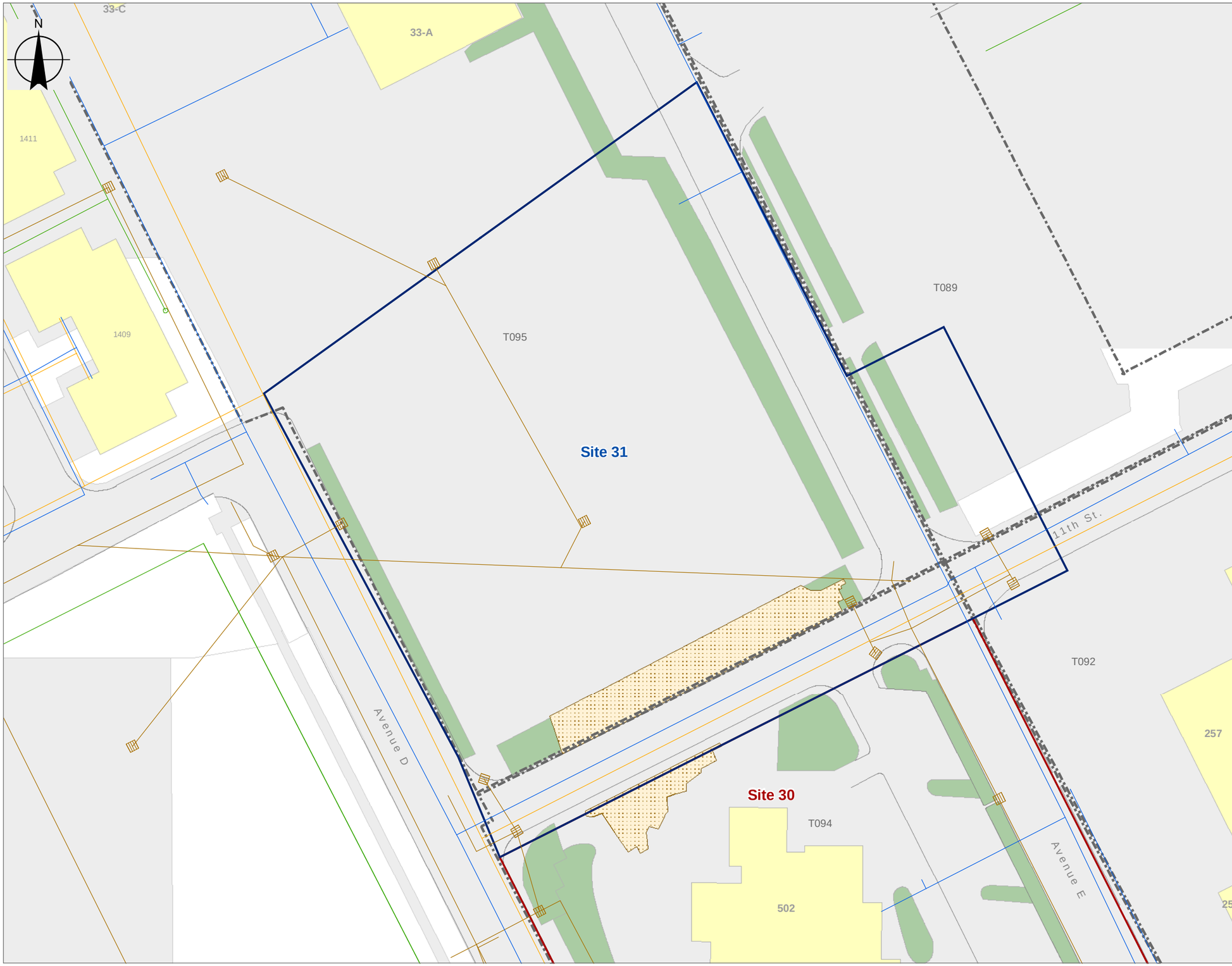
Department of the Navy, BRAC PMO West, San Diego, California

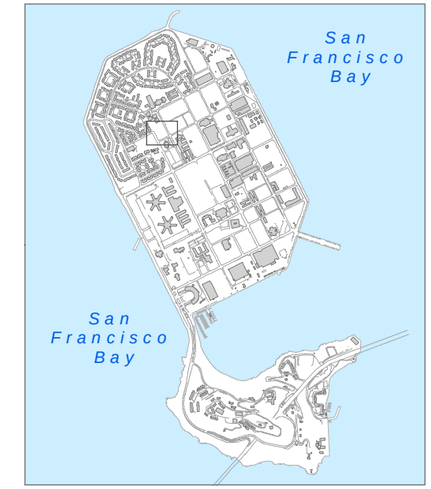
FIGURE 2-3

AERIAL PHOTOGRAPH
SITE 31

Feasibility Study Report for
Installation Restoration Site 31

2006/05/13 V:\Projects\B171-TI\Site 31 FS\Figure 2-3.mxd SULLIVAN SD D. Wise





- WATER PIPELINE
- GAS PIPELINE
- SANITARY SEWER PIPELINE
- STORM DRAIN LINE
- STORM DRAIN
- FENCE
- ROAD CURB
- ENVIRONMENTAL BASELINE SURVEY PARCEL BOUNDARY
- IR SITE 31 BOUNDARY
- IR SITE 30 BOUNDARY
- AREA WHERE DEBRIS HAS BEEN REMOVED
- VEGETATED AREA (INTERPRETED FROM 2003 AERIAL IMAGE)
- BUILDING
- PAVED AREA
- UNPAVED AREA

SulTech

25 0 25 50
Feet

Naval Station Treasure Island

Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 2-4

SITE 31 FEATURES MAP

Feasibility Study Report for
Installation Restoration Site 31

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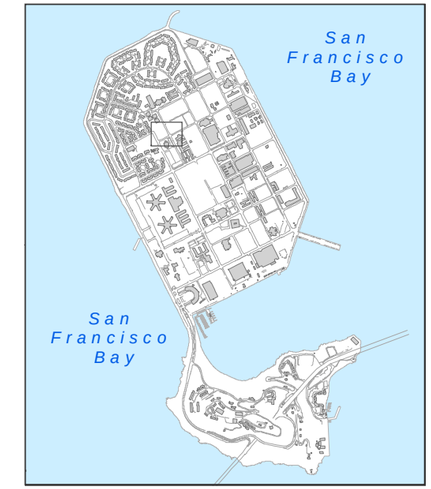


SAMPLE LOCATION

- LEAD SOIL EXCEEDING FIELD SCREENING LEVEL (400 MG/KG)
- DIOXIN IN SOIL EXCEEDS FIELD SCREENING LEVEL (12 NG/KG)
- BENZO(A)PYRENE IN SOIL EXCEEDS FIELD SCREENING LEVEL (0.62 MG/KG)
- EXCEEDS FIELD SCREENING LEVEL FOR LEAD, DIOXIN, AND B(A)P
- EXCEEDS FIELD SCREENING LEVEL FOR LEAD AND DIOXIN
- EXCEEDS FIELD SCREENING LEVEL FOR DIOXIN AND B(A)P
- IR SITE 30 BOUNDARY
- IR SITE 31 BOUNDARY
- AREA IMPACTED BY DEBRIS
- AREA WHERE DEBRIS HAS BEEN REMOVED
- VEGETATED AREA (INTERPRETED FROM 2003 AERIAL IMAGE)
- BUILDING
- ENVIRONMENTAL BASELINE SURVEY PARCEL BOUNDARY
- UNPAVED AREA
- ROAD CURB
- FENCE

SulTech

25 0 25 50
Feet

Naval Station Treasure Island

Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 2-5

SITE 31 SOIL REMOVAL LOCATIONS

Feasibility Study Report for
Installation Restoration Site 31

2006-05-16 V:\Projects\B171-TI\Site 31 FS\Figure 5.mxd SULLIVAN - SD L. Rizzo

TABLES

TABLE 2-1: FIELD SCREENING CRITERIA FOR SOIL

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Chemical	Field Screening Criteria	Criterion Source/Reference
Metals	Higher value of PRG or NAVSTA TI ambient level	PRC Environmental Management Inc. 1996. "Technical Memorandum Estimation of Background and Ambient Metal Concentrations in Soils, Naval Station Treasure Island, San Francisco, California." June 19. Sullivan Consulting Group and Tetra Tech EM Inc. 2004. "Facilitywide Groundwater Monitoring Program Health and Safety Plan, Naval Station Treasure Island, San Francisco, California." May. EPA. 2004b. "Region 9 Preliminary Remediation Goals." Available Online at: http://www.epa.gov/region9/waste/sfund/prg/index.html
Volatile organic compounds	PRGs	EPA. 2004b. "Region 9 Preliminary Remediation Goals." Available Online at: http://www.epa.gov/region9/waste/sfund/prg/index.html
Polycyclic aromatic hydrocarbons - B(a)P-EQ	0.62 mg/kg	Tetra Tech. 2000. "Field Sampling Plan for Focused Investigation of the Former Storage Yard, Naval Station Treasure Island, San Francisco, California." April 27. Tetra Tech EM Inc. 2001b. "Final Preliminary Remediation, Criteria for Petroleum and Petroleum Constituents, Technical Memorandum, Naval Station Treasure Island, San Francisco, California." November 13. Tetra Tech. 2002c. "Installation Restoration Site 12 Chemical- and Solid-Waste-Contaminated Soil Engineering Evaluation and Cost Analysis, Naval Station Treasure Island, San Francisco, California." Prepared for the Department of the Navy, Southwest Division, Naval Facilities Engineering Command, San Diego, California. September 18.
Pesticides/PCBs	PRGs	EPA. 2004b. "Region 9 Preliminary Remediation Goals." Available Online at: http://www.epa.gov/region9/waste/sfund/prg/index.html
TPH as diesel	1,380 mg/kg	Tetra Tech EM Inc. 2001b. "Final Preliminary Remediation, Criteria for Petroleum and Petroleum Constituents, Technical Memorandum, Naval Station Treasure Island, San Francisco, California." November 13.
TPH as gasoline	1,030 mg/kg	Tetra Tech EM Inc. 2001b. "Final Preliminary Remediation, Criteria for Petroleum and Petroleum Constituents, Technical Memorandum, Naval Station Treasure Island, San Francisco, California." November 13.
TPH as motor oil	1,900 mg/kg	Tetra Tech EM Inc. 2001b. "Final Preliminary Remediation, Criteria for Petroleum and Petroleum Constituents, Technical Memorandum, Naval Station Treasure Island, San Francisco, California." November 13.
Dioxins (TEQ)	12.0 ng/kg	DTSC. 2004. "Response Letter Regarding Ambient Soil Dioxin Level at the Former Naval Station Treasure Island, San Francisco, California. November 15.

Notes:

B(a)P-EQ	Benzo(a)pyrene-equivalent	PRG	Preliminary remediation goal	ng/kg	Nanogram per kilogram
TI	Treasure Island	mg/kg	Milligram per kilogram	TPH	Total petroleum hydrocarbons
EPA	U.S. Environmental Protection Agency	TEQ	Toxicity equivalency factor	NAVSTA	Naval Station

TABLE 2-2: CHEMICALS IN SOIL EXCEEDING FIELD SCREENING CRITERIA
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard
Naval Station Treasure Island, San Francisco, California

Analyte	Sample Location Identification Number	Sample Depth (feet bgs)	Field Screening Criterion (mg/kg)[a]	Concentration (mg/kg)
Metals				
Cadmium	S031-05-4	2.9	37	39.2
Copper	T094-NE-114	2.5	3,130	4,200
Copper	T094-SE-047	2.0	3,130	8,400
Copper	T094-NE-074	3.0	3,130	8,800
Copper	T094-2-3	1.5 to 2.0	3,130	9,650
Copper	T094-NE-071	3.0	3,130	57,000
Iron	SSYHP015	0 to 1.0	23,500	27,000
Lead	SSYHP015	0 to 1.0	400	690 J
Lead	SSYHP005	1.0 to 2.0	400	1,600 J
Lead	T094-NE-053	3.5	400	410
Lead	T094-NE-080	3.0	400	440
Lead	T094-NE-071	3.0	400	460
Lead	T094-NE-077	3.0	400	480
Lead	T094-SE-048	1.5 to 2.0	400	570
Lead	T094-NE-069	3.5	400	580
Lead	T094-3-3	1.5	400	611
Lead	T094-NE-056	3.5	400	690
Lead	T094-NE-120	2.8	400	700
Lead	T094-NE-109	0.83	400	720
Lead	T094-SE-030	2.5	400	770
Lead	T094-SE-037	2.5	400	800
Lead	T094-NE-112	2.5	400	800
Lead	T094-27-3	2.0	400	877
Lead	T094-SE-045	3.0	400	880
Lead	T094-NE-119	2.0	400	920
Lead	T094-SE-029	2.0	400	1,000
Lead	T094-NE-116	2.3	400	1,000
Lead	T094-SE-046	2.58	400	1,100
Lead	T094-NE-114	2.5	400	1,100
Lead	T094-SE-031	2.5	400	1,300
Lead	T094-NE-072	3.0	400	1,400
Lead	T094-SE-028	1.5	400	1,500
Lead	T094-NE-110	1.5	400	1,600
Lead	T094-NE-074	3.0	400	1,700
Lead	T094-SE-034	2.0	400	1,900
Lead	T094-NE-121	2.3	400	1,900

TABLE 2-2: CHEMICALS IN SOIL EXCEEDING FIELD SCREENING CRITERIA (CONTINUED)
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard
Naval Station Treasure Island, San Francisco, California

Analyte	Sample Location Identification Number	Sample Depth (feet bgs)	Field Screening Criterion (mg/kg)[a]	Concentration (mg/kg)
Metals (Continued)				
Lead	T094-2-3	1.5 to 2.0	400	1,950
Lead	T094-NE-117	2.5	400	2,200
Lead	T094-SE-036	2.0	400	3,900
Lead	T094-SE-047	2.0	400	5,200
Lead	T094-NE-118	2.3	400	5,200
Lead	T094-SE-033	2.5	400	7,600
Lead	T094-SE-032	2.5	400	9,100
Lead	S031-05-4	2.9	400	973
Lead	S031-26-4	3.5	400	2,240
Volatile Organic Compounds				
Bis(2-chloroethyl)ether	SSYHP009	0 to 1	0.22	0.47
Polycyclic Aromatic Hydrocarbons				
B(a)P-EQ	SSYHP012	0 to 1.0	0.62	0.88
B(a)P-EQ	S031-26	1.9	0.62	35.22
B(a)P-EQ	S031-03 (Debris Area D)	2.5	0.62	1.17
B(a)P-EQ	S031-43 (Debris Area D)	1.3	0.62	0.87
B(a)P-EQ	S031-04 (Debris Area D)	0.3 to 0.9	0.62	0.64
Benzo(a)anthracene	S031-40	0.8	0.62	1.3 J
Benzo(a)anthracene	S031-26	1.9	0.62	36 J
Benzo(a)pyrene	S031-03	2.5	0.062	0.13 J
Benzo(a)pyrene	S031-04	0.3 to 0.9	0.062	0.23 J
Benzo(a)pyrene	S031-26	1.9	0.062	25 J
Benzo(b)fluoranthene	S031-26	1.9	0.62	25 J
Benzo(k)fluoranthene	S031-26	1.9	6.2	29 J
Indeno(1,2,3-cd)pyrene	S031-26	1.9	0.62	9.4 J
Pesticides and Polychlorinated Biphenyls				
4,4'-DDD	SSYHP008	1.0 to 2.0	2.4	8.3
4,4'-DDE	SSYHP008	1.0 to 2.0	1.7	5.9
4,4'-DDT	SSYHP008	1.0 to 2.0	1.7	53
Aroclor-1260	SSYHP016	1.0 to 2.0	0.22	0.26

TABLE 2-2: CHEMICALS IN SOIL EXCEEDING FIELD SCREENING CRITERIA (CONTINUED)
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard
Naval Station Treasure Island, San Francisco, California

Analyte	Sample Location Identification Number	Sample Depth (feet bgs)	Field Screening Criterion (mg/kg)[a]	Concentration (mg/kg)
Petroleum Hydrocarbons				
TPH – diesel-range organics	S031-26-2	1.9	1,380	1,800
TPH – diesel-range organics	S031-26-4	3.5	1,380	5,100
TPH – motor oil-range compounds	S031-05-4	2.9	1,900	2,000
TPH – motor oil-range compounds	S031-26-2	1.9	1,900	3,400
TPH – motor oil-range compounds	S031-26-4	3.5	1,900	13,000
TPH – motor oil-range compounds	SSYHP014	0 to 1	1,900	2,300
Dioxins				
Dioxin	S031-31-5	2.5	0.000012[b]	0.0000121
Dioxin	S031-40-5	0.5	0.000012[b]	0.0000159
Dioxin	S031-05-5	2.9	0.000012[b]	0.000018
Dioxin	S031-43-5	1.3	0.000012[b]	0.0000242
Dioxin	S031-27-5	1.2	0.000012[b]	0.0000254
Dioxin	S031-03-5	2.5	0.000012[b]	0.0000546
Dioxin	S031-26-5	1.9	0.000012[b]	0.0000592
Dioxin	S031-37-5	1.2	0.000012[b]	0.0000608
Dioxin	T094-001	4.0	0.000012[b]	0.0000438
Dioxin	S031-31-5	2.5	0.000012[b]	0.0000121
Dioxin	S031-40-5	0.5	0.000012[b]	0.0000159

Notes:

a See Table 2-1 for field screening criteria source
b Treasure Island ambient level

bgs Below ground surface
DDD Dichlorodiphenyldichloroethane
DDE Dichlorodiphenyldichloroethene
DDT Dichlorodiphenyltrichloroethane
mg/kg Milligram per kilogram
TPH Total petroleum hydrocarbons

3.0 REMEDIAL ACTION OBJECTIVES, APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, AND GENERAL RESPONSE ACTIONS

This section identifies the RAOs for IR Site 31, summarizes the evaluation of potential ARARs, and presents the selected GRAs that will protect human health and the environment from altered site conditions and alternative land uses of the site. The RAOs were developed for the elementary school child and staff, the construction worker, the commercial/industrial worker, and resident receptors, as well as the recreational receptor for the southeast quadrant of IR Site 31.

3.1 REMEDIAL ACTION OBJECTIVES EVALUATION

An RAO is a medium-specific (soil, groundwater, or air) goal for protecting human health and the environment. According to EPA guidance, an RAO should specify (1) the COCs, (2) the exposure route and receptors, and (3) an acceptable chemical concentration or range of concentrations for each exposure route (such as remediation goals) (EPA 1989b). RAOs include both an exposure pathway and a chemical concentration in a given medium because protectiveness may be achieved in one of two ways: by limiting or eliminating the exposure pathway, or by reducing chemical concentrations. The remediation goals are usually chemical concentration limits that provide a quantitative means of (1) identifying areas for potential remedial action, (2) screening the types of appropriate technologies, and (3) assessing a remedial action's potential for achievement of the RAO. Remediation goals are the performance requirements and the main basis for measuring the success of the response actions.

The RAO evaluation for IR Site 31 is based on information from the previous site investigations, the RI Report, and the HHRA. The NCP details the expectations for remedy selection in Title 40 CFR § 300.430 (a)(1)(iii). These expectations were used to evaluate RAOs for IR Site 31. In addition, DoD integrates these expectations with the objectives of the DoD BRAC Program for expediting transfer of DoD property for reuse and development.

3.1.1 Determination of Remedial Action Triggers

The NCP has established an acceptable excess lifetime cancer risk (ELCR) range of 1×10^{-4} to 1×10^{-6} for exposure to carcinogens to trigger the need for action at a site (EPA 1990). (The ELCR referred to in the NCP is based on the RME assumptions.) As a result, site risks within an ELCR range of 1×10^{-4} to 1×10^{-6} may not require mitigation through remedial action. The NCP established a point-of-departure ELCR of 1×10^{-6} for selecting remedial actions at sites with risks outside of the 1×10^{-4} to 1×10^{-6} range; the point-of-departure ELCR is the lowest level at which action must be considered. In defining the point of departure, the NCP states that "the 10^{-6} risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARs are not available or are not sufficiently protective because of the presence of multiple chemicals at a site or multiple pathways of exposure... ." This FS Report follows the NCP by selecting remedial actions from an array of alternatives with cleanup goals based on the 1×10^{-6} point of departure.

The NCP specifies that "acceptable exposure levels shall represent concentration levels to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety..." for sites contaminated with noncarcinogens or systemic toxicants (EPA 1990). EPA has developed guidance that calculates noncancer site hazards as an HI (EPA 1989b). The guidance describes an HI of less than or equal to 1 as generally acceptable, but allows that an HI greater than 1 can still be protective within an adequate margin of safety. An important component in developing the RAOs is the identification of alternative land use. According to EPA's land use directive (EPA 1995), RAOs "should reflect the reasonably anticipated future land use or uses," thereby allowing for the development of "alternatives that would achieve cleanup levels associated with the reasonably anticipated future land use" of the site. The EPA land use directive lists a number of factors that may be considered in identifying a site's alternative land use, such as current or former site use, zoning laws and maps, and redevelopment plans. Based on these factors—many of which were evaluated during the HHRA process—remedial action triggers were evaluated for each alternative land use.

3.1.2 Identification of Chemicals of Concern

COCs were identified based on the evaluation of COPCs in the HHRA under RME scenarios that exceeded risk management thresholds. Appendix A presents a detailed description of the process and factors used to develop the COCs. In general, each COPC exceeding risk management thresholds was subjected to an objective analysis and risk management screening process. Factors considered during the risk management screening included relative risk to other COPCs, proximity of risk to the low end of the EPA risk management range (point of departure of 1×10^{-6}), collocation with other COPCs, and frequency of COPC detection.

4,4'-DDT, the only COPC exceeding risk management thresholds for elementary school staff under current site conditions, was excluded from the COC list. As discussed in the HHRA of the Final RI Report, the identification of 4,4'-DDT as a COPC exceeding risk management thresholds for elementary school staff is partly because of the use of a conservative outdoor soil-to-indoor dust transfer factor recommended by the Office of Environmental Health and Hazard Assessment for assessing on-site health risks at existing and proposed school sites (Office of Environmental Health Hazard Assessment 2004). The use of this transfer factor resulted in overestimated risks from exposure to indoor dust for the elementary school receptor scenarios evaluated for IR Site 31. Upon review of the data for 4,4'-DDT, 162 samples were analyzed and only one detected concentration exceeded the EPA Region 9 PRG for residential soil (1.7 mg/kg), used as the field screening criterion; the exceedance (53 mg/kg) was J-qualified (estimated between the detection limit and the reporting limit). The remaining detected concentrations were nearly three orders of magnitude lower, and were more than an order of magnitude below the residential soil PRG (SulTech 2006c). As a result, the EPC (12.4 mg/kg) for 4,4'-DDT was biased high. With only one detection exceeding the criterion, the conservative exposure risk assumptions, and the estimated risk close to the point of departure of 1×10^{-6}, risk management of 4,4'-DDT is not recommended and, therefore, was excluded from the COC list.

All detected concentrations of naphthalene are commingled with elevated concentrations of the other COCs [B(a)P, dioxins, and lead] identified for IR Site 31. Remedial alternatives designed to address the elevated concentrations of B(a)P, dioxins, and lead in Debris Areas C, D, and E would coincidentally address the detected concentrations of naphthalene that may pose an unacceptable indoor air inhalation hazard to hypothetical residential and commercial/industrial use. As a result, risk management of naphthalene is not recommended and, therefore, was excluded from the COC list.

The COCs identified for IR Site 31 include B(a)P, dioxins, and lead (see Figure 3-1 and Table A-4, Appendix A). B(a)P and dioxins were identified as COCs for (1) elementary school receptors under altered site conditions in which the schoolyard is redeveloped as an unpaved play yard; (2) site-wide residential and commercial/industrial worker exposure to soil; and (3) recreational visitor exposure to soil in the southeast quadrant. Lead was identified as a COC for all alternative land use scenarios involving exposure to site-wide combined surface and subsurface soil (0 foot bgs to groundwater) and for potential utility worker exposure to combined surface and subsurface soil beneath 11th Street. No COCs were identified for elementary school receptors under current site conditions.

3.1.3 Remedial Action Objectives

The following RAOs were developed for protection of human health based on the identified COCs and the affected media. The RAOs were developed for the potential reopening of the elementary school with the schoolyard pavement removed and for any future unrestricted residential or commercial/industrial use. Residential or commercial/industrial use of the property is not projected in the Reuse Plan and is therefore considered hypothetical. These alternative land use scenarios conservatively assume all hardscape, including streets and sidewalks, is no longer paved and that residential or commercial/industrial areas are developed in its place. The only medium that presents a concern at IR Site 31 is soil; therefore, RAOs were developed for soil only. The basis for selecting the remediation goals included in the RAOs is presented in Section 3.1.1. The following RAOs and remediation goals were developed for each human receptor at IR Site 31 based on the land use scenarios described above, the COCs, and the potential exposure routes developed for this site:

- Elementary school child and staff receptor: prevent direct contact with and ingestion of shallow soils containing B[a]P-EQ concentrations exceeding 0.62 mg/kg and dioxin toxic equivalent (TEQ) concentrations exceeding the NAVSTA TI ambient level of 12 nanograms per kilogram (ng/kg).

- Construction worker: prevent direct contact with and ingestion of soils containing lead at concentrations exceeding 800 mg/kg.

- Recreational visitor: prevent direct contact with and ingestion of soils located in the southeastern quadrant containing B(a)P-EQ concentrations exceeding 0.62 mg/kg and dioxin TEQ concentrations exceeding 12 ng/kg.

- Residential receptor: prevent direct contact with and ingestion of soil containing B(a)P-EQ concentrations exceeding 0.62 mg/kg, dioxin TEQ concentrations exceeding 12 ng/kg, and lead at concentrations exceeding 400 mg/kg.

- Commercial/industrial worker: prevent direct contact to and ingestion of soils containing B(a)P-EQ concentrations exceeding 0.62 mg/kg, dioxins TEQ concentrations exceeding 12 ng/kg, and lead at concentrations exceeding 800 mg/kg.

Risk was evaluated specific to a recreational visitor using the southeastern quadrant of IR Site 31, the only portion of the site planned for recreational use. This risk evaluation was used in developing the RAO for the recreational visitor.

The only designated COCs at Site 31 are B(a)P, dioxins, and lead. Because these COCs are not volatile, it is unnecessary to prevent exposure of receptors to vapors in indoor air. As a result, an RAO was not developed for vapor intrusion pathway. RAOs for the protection of aquatic and terrestrial ecological receptors from soil were not developed because pathways to ecological receptors are incomplete (SulTech 2006c). Most of IR Site 31 is covered with the paved areas of the schoolyard, creating an incomplete terrestrial pathway for COCs.

3.1.4 Remediation Goals

The remediation goal for B(a)P for the elementary school children and staff, recreational users, commercial/industrial worker, and residential child and adult is based on the B(a)P-EQ soil action level of 0.62 mg/kg. This action level has been applied for PAHs at other CERCLA and petroleum sites at NAVSTA TI (Tetra Tech 2000, 2001b, 2002c). The B(a)P-EQ concentration corresponds to a residential cancer risk of 4.2×10^{-6} using site-specific exposure parameters (Tetra Tech 2002c), or a cancer risk of 1×10^{-5} using the default exposure parameters used to derive the PRG for residential soil (EPA 2004).

The remediation goal for dioxins was set at a dioxin TEQ concentration of 12 ng/kg, which is the ambient level established for NAVSTA TI (DTSC 2004). In September 2004, the Navy submitted a letter to DTSC proposing an ambient TEQ value for dioxins of 12 ng/kg (Navy 2004). In a letter dated November 15, 2004, DTSC concurred with the proposed ambient dioxin TEQ level, with the understanding it would be used only as a screening criterion for soil (DTSC 2004). The use of 12 ng/kg for dioxin in soil was determined to be protective of residential reuse and will be used as the remediation goal for dioxins at IR Site 31 (DTSC 2004).

The remediation goal for lead for the hypothetical residential scenario is based on EPA's Region 9 PRG for residential soil of 400 mg/kg (EPA 2004). The remediation goal for lead for the commercial/industrial worker is based on the EPA's Region 9 commercial/industrial PRG of 800 mg/kg (EPA 2004). DTSC has recommended the current EPA Region 9 PRG for industrial soil, 800 mg/kg, be considered a benchmark for remedial-based decision-making for potential industrial sites (DTSC 2005). This remediation goal also is applied to elementary school staff and construction and utility workers.

All remediation goals are summarized in Table 3-1.

3.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Section 121(d) of CERCLA, as amended by Superfund Amendments and Reauthorization Act, indicates that on-site remedial actions must attain (or the decision document must justify a waiver of) any federal or more stringent state environmental standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate. As the lead federal agency, the Navy has primary responsibility for identifying federal ARARs for the remedial action at IR Site 31. State regulatory agencies are responsible for identifying state ARARs. On May 15, 2006, the Navy requested that state ARARs be identified for IR Site 31 (see Appendix B) On August 15, 2006, DTSC responded to the Navy's request stating that all ARARs developed for IR Site 30 should be considered ARARs for IR Site 31 (see Attachment B2). The ARAR identification process begins during the planning stages of the RI and continues as remedial action alternatives are developed. ARARs are then evaluated in the FS and subsequently finalized in the Record of Decision.

A detailed evaluation of potential ARARs and other criteria or guidelines to be considered for the IR Site 31 remedial action is presented in Appendix B. This section summarizes the conclusions of the ARARs evaluation. Three categories of ARARs have been established: chemical-specific requirements, location-specific requirements, and action-specific requirements. The following sections list the potential ARARs for each category.

3.2.1 Overview of Applicable or Relevant and Appropriate Requirements

The identification of ARARs is a site-specific determination and involves a two-part analysis:

- First, a determination of whether a requirement is applicable.
- Second, if the requirement is not applicable, a determination of whether it is relevant and appropriate.

A requirement is deemed applicable if the jurisdictional prerequisites of a standard show a direct correspondence when objectively compared with conditions at the site. If the jurisdictional prerequisites of the law or regulation are not met, the requirement may nonetheless be relevant and appropriate if the site's circumstances are sufficiently similar to circumstances when the law otherwise applies and it is well suited to the conditions of the site. An evaluation of the relevance and appropriateness of a requirement is site specific and must be based on best professional judgment. A requirement may be relevant, but not appropriate, for the specific site. The NCP lists factors in 40 CFR § 300.400(g)(2) to consider in evaluating relevance and appropriateness. Only requirements that are determined to be both relevant and appropriate must be followed. Portions of a requirement may be relevant and appropriate even if a requirement in its entirety is not. In addition, a requirement must be substantive to constitute an ARAR for activities conducted on site. Procedural or administrative requirements such as permits and reporting requirements are not ARARs.

In addition to ARARs, nonpromulgated agency advisories, criteria, or guidance issued by federal or state governments are not legally binding and do not have the status of ARARs. Such requirements may be useful and are to be considered (TBC). The preamble to the NCP states, however, that provisions in the TBC category "should not be required as cleanup standards because they are, by definition, generally neither promulgated nor enforceable, so they do not have the same status under CERCLA as do ARARs."

ARARs and TBC criteria are generally divided into three categories: chemical-specific, location-specific, and action-specific. Chemical-specific, location-specific, and action-specific ARARs that affect development of RAOs are summarized in Sections 3.2.2, 3.2.3, and 3.2.4, and are discussed in more detail in Appendix B.

3.2.2 Chemical-Specific Applicable or Relevant and Appropriate Requirements

Chemical-specific ARARs are health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical cleanup values. These values establish the acceptable amount or concentration of a chemical that may be found in or discharged to the ambient environment that is protective of human health and the environment. There are no potential ARARs that require a numerical cleanup level for soil at IR Site 31. The only potential chemical-specific ARARs define when a waste generated in the implementation of Alternatives 3, 4, and 5 is regulated. The excavation component of Alternatives 3, 4, and 5 will result in the generation of waste because soil will be excavated for off-site disposal. These chemical-specific requirements center around the federal Resource Conservation and Recovery Act (RCRA) and state non-RCRA definitions of hazardous waste and state definitions for designated waste and nonhazardous waste.

The applicability of RCRA requirements depends on whether the excavated soil contains listed or characteristic RCRA waste; whether the waste was initially treated, stored, or disposed of after the effective date of the particular RCRA requirement; and whether the activity at the site constitutes generation, treatment, storage, or disposal as defined by RCRA. Excavation of soil that contains RCRA hazardous waste constitutes generation of waste and so RCRA requirements apply. To the extent that the excavated soil contains RCRA hazardous wastes, the Navy will comply with RCRA.

The following RCRA requirements are potential ARARs, since they define RCRA hazardous wastes:

- *California Code of Regulations* (Cal. Code Regs.) Title (tit.) 22, § 66261.21
- Cal. Code Regs. tit. 22, § 66261.22(a)(1)
- Cal. Code Regs. tit. 22, § 66261.23
- Cal. Code Regs. tit. 22, § 66261.24(a)(1)
- Cal. Code Regs. tit. 22, § 66261.100

If the Navy determines a waste is a RCRA hazardous waste, the RCRA land disposal restrictions at Cal. Code Regs. tit. 22, § 66268.1(f) are potential ARARs for discharging that waste to land.

State RCRA requirements included within the EPA-authorized RCRA program for California are considered potential federal ARARs. When state regulations are either broader in scope or more stringent than their federal counterparts, they are considered potential state ARARs. The State of California regulates certain hazardous wastes under its RCRA program which fall outside the scope of the federal RCRA requirements. The following requirements define non-RCRA, state-regulated hazardous waste and are potential state ARARs:

- Cal. Code Regs. tit. 22, §§ 66261.22(a)(3) and (4)
- Cal. Code Regs. tit. 22, § 66261.24(a)(2)–(a)(8)
- Cal. Code Regs. tit. 22, § 66261.101
- Cal. Code Regs. tit. 22, § 66261.3(a)(2)(C) or § 66261.3(a)(2)(F)

Cal. Code Regs. tit. 27, §§ 20210 and 20220, are also potential state ARARs for characterizing any waste generated in implementing Alternatives 3, 4 and 5 for proper off-site disposal.

Table B-1 in Appendix B summarizes the chemical-specific ARARs for IR Site 31.

3.2.3 Location-Specific Applicable or Relevant and Appropriate Requirements

Location-specific ARARs are restrictions on the concentrations of hazardous substances or on the conduct of activities solely because of the specific qualities of some locations. Specific locations include flood plains, wetlands, historic places, and sensitive ecosystems or habitats. There are no location-specific ARARs for IR Site 31. The terrestrial habitat of NAVSTA TI is of poor quality for wildlife species because the island is predominantly covered with urbanized areas (SulTech 2006d). No receptors of concern use the area because of the low-quality habitat of IR Site 31. Disturbance from vehicular traffic and general human presence also reduce the quality of the habitat to wildlife species at this site. In addition, there are no floodplains, wetlands, or historic places on IR Site 31.

3.2.4 Action-Specific Applicable or Relevant and Appropriate Requirements

The following are potential ARARs for the remedial alternatives developed for IR Site 31. There is no need to identify action-specific ARARs for the no action alternative. ECs combined with ICs are evaluated as remedial alternative for IR Site 31. There are no potential federal or state ARARs for ECs and there are no federal ARARs for ICs. The substantive provisions of the following requirements are potential state action-specific ARARs for ICs that DTSC identified for Site 30, and DTSC has requested they be applied to IR Site 31:

- California Civil Code § 1471– which allows property owners to make a hazardous material covenant that runs with the land.
- California Health and Safety Code § 25202.5 – which allows DTSC to enter into agreements with property owners to restrict the use of the property.
- California Health and Safety Code § 25233(c) – which provides criteria for obtaining variances from land use restrictions.
- California Health and Safety Code § 25234 – which provides criteria for removing land use restrictions.
- California Health and Safety Code §§ 25222.1 and 25355.5(a)(1)(C) – which provides the authority for DTSC to enter into agreements with property owners to restrict the use of property.
- Cal. Code. Regs. tit. 22, § 67391.1(a) and (e)(1) – which requires DTSC and the federal government to execute an appropriate land use covenant, which is recorded in the county where the land is located.

Several potential remedial alternatives include the demolition of hardscape, excavation of contaminated soil, and off-site disposal of the waste at a permitted landfill. There are no potential federal or state ARARs for demolition of the existing paved surfaces and portions of 11th Street. Cal. Code Regs. tit. 22, §§66262.10(a) and 66262.11 are potential ARARs for excavation of soil requiring a generator of waste to determine if the waste is RCRA hazardous waste:

- The Navy may temporarily stage the hardscape waste and excavated soil in a waste pile before off-site disposal. The substantive provisions follow RCRA requirements, set forth in 40 CFR § 264.554(d)(1)(i-ii) and (d)(2), (e), (f), (h), (i), (j), and (k) are potential ARARs for this staging pile. These sections provide that a generator may accumulate solid remediation waste in a staging pile up to 2 years without triggering land disposal restrictions.

The following substantive provision of the Clean Air Act requirement is a potential ARAR for excavation:

- Substantive provisions of the Bay Area Air Quality Management District Regulation 6-302: the opacity limitation prohibits emissions for a period aggregating more than 3 minutes in any hour an emission equal to or greater than 20 percent opacity.

The following substantive provisions of sections of the Federal Hazardous Materials Transportation Law are potential ARARs for the on-site transportation of any hazardous waste:

- Title 49 U.S.C. 5101 through 5127, Title 49 CFR 171.2(f), 171.2(g), 172.300, 172.301, 172.302, 172.303, 172.304, 172.312, 172.400, and 172.504 (requirements for transporting hazardous wastes, including representations that containers are safe, prohibitions on altering labels, marking requirements, labeling requirements, and placarding requirements).

ARARs for characterization of the waste to identify waste for proper off-site disposal are discussed under the chemical-specific ARARs. Table B-2 in Appendix B summarizes the action-specific ARARs for IR Site 31.

3.3 GENERAL RESPONSE ACTIONS

GRAs are broad classes of responses or remedial actions intended to meet the RAOs. Similar to RAOs, GRAs are medium–specific; therefore, they are developed in relation to contamination of soil, groundwater, or air. GRAs may include treatment, containment, excavation, extraction, disposal, institutional actions, or a combination of these (EPA 1988). In some cases, response actions may stand alone as complete remedial alternatives, but in many cases combinations of response actions are necessary to effectively address soil contamination and meet the RAOs.

Four GRAs were identified to achieve the RAOs developed for IR Site 31:

- No Action: – Under the no action alternative, no remedial measures will be taken at the site. The NCP requires that the No-Action Alternative be carried through the detailed comparative analysis of the alternatives. No remedial action would take place under the No-Action Alternative; therefore, the soil would be left in place without implementing any ICs, ECs, containment, removal, treatment, or any other mitigating actions.

- Engineering Controls: ECs are measures, such as barriers or caps, that are used to reduce or eliminate the pathway for potential human exposure to contamination. Typically, ECs are used in conjunction with some form of ICs to ensure proper monitoring and maintenance of the EC.

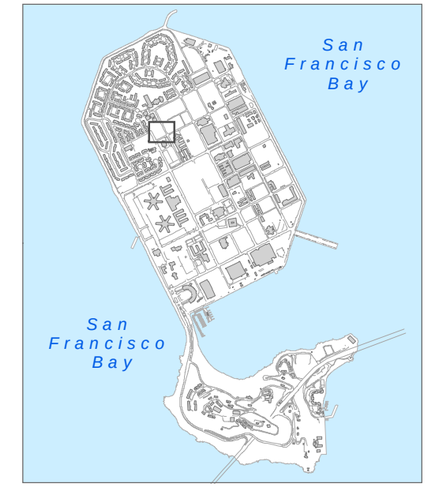
- Institutional Controls: ICs are legal and administrative mechanisms used to implement land use and access restrictions that limit the exposure of hypothetical landowners or users of the property to hazardous substances and to maintain the integrity of the remedial action until remediation is complete and remediation goals have been achieved. Monitoring and inspections are conducted to assure the land use restrictions are being followed. Legal mechanisms include restrictive covenants, negative easements, equitable servitudes, and deed restrictions. Administrative mechanisms include deed notices, adopted local land use plans and ordinances, construction permitting, or other existing land use management systems that may be used to ensure compliance with use restrictions.

- Active Remediation: Engineering instruments that minimize or eliminate the potential exposures of human and ecological receptors to contamination by reducing toxicity, volume, or mobility through treatment or containment. The active remediation alternative is intended for altered or alternative land use scenarios because IR Site 31 presents a risk within the risk management range for current paved conditions as an elementary schoolyard. Active remediation technologies can be categorized into three groups based on where the treatment occurs: *in situ* technologies, where the waste is treated on site where it is located (such as in the ground); *ex situ*, where the waste is treated on site but at a location other than where the waste was originally located; and off site, at a permitted facility.

These GRAs are further discussed in Section 4.0 to determine the remedial alternatives that should be evaluated for IR Site 31.

FIGURES

Alternative	Debris Area Excavated	Excavated Area (ft^2)	Estimated Depth of Excavation	Institutional Controls?
1	N/A	0	N/A	N/A
2	N/A	0	N/A	Yes
3	E	6,600	4'	Yes
4	C and D	14,500	4'	Yes
5	A, B, C, D, and E	21,900	6'	No



IR SITE 31 BOUNDARY
IR SITE 30 BOUNDARY
AREA IMPACTED BY DEBRIS
CHEMICAL NAME CHEMICAL OF CONCERN
AREA WHERE DEBRIS HAS BEEN REMOVED
VEGETATED AREA (INTERPRETED FROM 2003 AERIAL IMAGE)
BUILDING
PAVED AREA
UNPAVED AREA
FENCE
ROAD CURB

SulTech

20 0 20 40
Feet

Naval Station Treasure Island
Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 3-1
LOCATION OF CHEMICALS OF CONCERN
Feasibility Study Report for Installation Restoration Site 31

2005-03-03 C:\GIS\Site 31 FS Fig.mxd SULLIVAN SD D. Wise

TABLES

TABLE 3-1: CHEMICALS OF CONCERN AND REMEDIATION GOALS
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard
Naval Station Treasure Island, San Francisco, California

Chemical of Concern	Remediation Goal	Receptor	Location
B(a)P	0.62 mg/kg	Elementary School Child and Staff[1]	Debris Area C
		Resident	Debris Areas C and D
		Commercial/Industrial Worker	Debris Areas C and D
		Recreational User	Debris Area D
Dioxins	12 ng/kg	Elementary School Child and Staff[1]	Debris Area C
		Resident	Debris Areas C and D
		Commercial/Industrial Worker	Debris Areas C and D
		Recreational User	Debris Area D
Lead	400 mg/kg	Resident (Child)	Debris Areas A, B, and E
Lead	800 mg/kg	Elementary School Staff[1]	Debris Areas A, B, and E
		Construction Worker	Debris Area E
		Commercial/Industrial Worker	Debris Areas A, B, and E

Notes:

1 No chemicals of concern were identified for elementary school receptors under current site conditions. B(a)P, dioxins, and lead were identified as chemicals of concern for elementary school receptors for altered site conditions in which the schoolyard is redeveloped as an unpaved play yard.

B(a)P Benzo(a)pyrene
mg/kg Milligram per kilogram

4.0 SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

After the RAOs have been developed, the potential ARARs identified and reviewed, and the GRAs developed, the fourth step in development of remedial alternatives is the preliminary screening of remedial technologies and process options. Remedial technologies refer to general categories, such as active remediation, and process options refer to specific treatment trains. During screening, the range of remedial technologies and process options is reduced with respect to technical practicability, site conditions, waste characteristics, and contaminant properties, as well as the ability to meet the requirements of the NCP and the RAOs.

The remainder of this section discusses (1) the screening criteria used to evaluate remedial action technologies and process options, (2) the identification and screening of remedial action technologies and process options, and (3) the remedial action technologies and process options retained for development and analysis of potential remedial alternatives.

4.1 SCREENING CRITERIA

The screening process evaluates the various technologies that fall within each of the GRAs identified in Section 3.3 for effectiveness, implementability, and cost. This screening process eliminates the technologies that would not effectively address soil contamination at IR Site 31. Effectiveness, implementability, and cost are described below.

4.1.1 Effectiveness

Effectiveness is the ability of a remedial technology to protect the environment and to achieve the RAOs within a reasonable timeframe. When evaluating effectiveness, three primary factors are considered: (1) the ability to treat the estimated volume or area of contaminated media (in this case soil); (2) the protectiveness of the technology to the environment during implementation; and (3) the reliability of the technology to reduce the toxicity and mobility (movement) of contamination at the site and provide long-term protection. Technologies were identified for evaluation based on information provided in the screening matrix on remediation technologies compiled by the Federal Remediation Technologies Roundtable ([FRTR] 2005). Technologies were included in the initial screening evaluation if they were rated as “better” in treating the chemicals within the Federal Remediation Technologies Screening Matrix (FRTR 2005).

In terms of remediation timeframe, a technology is classified as short term (achieving the cleanup goals after less than 3 years of implementation), medium term (achieving the cleanup goals after 3 to 10 years of implementation), or long term (requiring more than 10 years of implementation to achieve the cleanup goals) (FRTR 2005).

4.1.2 Implementability

The evaluation of implementability includes both the technical and the administrative feasibility of implementing a treatment technology. Technical feasibility includes such factors as compatibility with site-specific conditions; the availability of equipment; the ease of constructing the remediation system; the labor intensiveness required by the system; and the availability of vendors that have the capability to design, construct, and maintain the system. Administrative feasibility includes such factors as the ease of obtaining concurrence from the regulatory agencies.

4.1.3 Cost

The purpose of evaluating cost is to eliminate remedial technologies with costs that greatly exceed other technologies that provide similar levels of protection. As a result, the relative cost for each remedial alternative is described as "low," "moderate," and "high." The low cost describes a unit cost for treatment that is less than $100 per ton of soil for low cost; moderate cost describes a unit cost for treatment that is less than $100 to $300 per ton of soil; and high cost describes a unit cost for treatment more than $300 per ton of soil (FRTR 2005). The cost ranges are based on a review of the literature, vendor quotations, and data prepared for other studies (see Appendix C). The evaluation of cost addresses direct and indirect capital costs and annual operation and maintenance (O&M) costs. Additionally, when the information was available, the cost range is presented quantitatively.

4.2 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

Remedial technologies and process options were evaluated against the three preliminary screening criteria described in Section 4.1. Sources of technology descriptions in this section include (1) the remediation technology screening matrix (FRTR 2005), (2) EPA's guides for noncombustion technologies and for implementing ICs (EPA 2005, 2003), and (3) DoD's policy on LUCs (DoD 2001). The following sections summarize the evaluation of each GRA identified for IR Site 31 (see Section 2.3).

4.2.1 No Action

As required in the NCP (40 CFR § 300.430(e), the no-action GRA is used as a baseline for comparison purposes only in this FS Report. Under the no-action GRA, the site is considered unchanged and no remedial activities would be implemented. As a result, this GRA is not effective in reducing potential risks to human health from contaminated soil that may result from hypothetical on-site industrial/commercial or residential unrestricted use. Additionally, because no action is taken implementability and cost does not apply to this option.

4.2.2 Engineering Controls

ECs are measures, such as engineered barriers or caps, used to reduce or eliminate the pathway for potential human exposure to contamination. The NCP indicates that, "EPA expects to use ECs, such as containment, for waste that poses a relatively low risk or where treatment is impractical" (40 CFR 300.430). The following sections describe the engineering control technologies that were screened for possible use at IR Site 31.

4.2.2.1 Containment

Containment strategies have been used to prevent human exposure when chemicals are to be buried or left in place at a site. Containment is often chosen when site conditions consist of extensive contamination and removal of wastes poses potential adverse health effects, prohibitive costs, or lack of adequate treatment technologies. The purpose of final covers (also known as caps) under RCRA and CERCLA is to control infiltration of moisture from the surface into closed facilities and to limit formation of leachate and its migration to groundwater. Typically, a RCRA or CERCLA cover consists of three basic layers: a low hydraulic conductivity layer; a drainage layer; and a vegetation/soil layer. Single-layer covers made of concrete or bituminous asphalt form a barrier between the waste and the surface environment, but typically do not meet regulatory requirements for containment of wastes, such as at landfills. Typically, the covers are designed to restrict contact with the underlying materials, as well as to minimize the infiltration of water to the underlying materials. Containment can also involve perimeter measures, such as subsurface walls (for example, sheet piles, cut-off walls, and interceptor trenches), to minimize the lateral movement of chemicals.

Benefits of containment include short installation times, no need to excavate the chemical-bearing materials, relatively low cost, minimum worker exposure, and prevention of water infiltration and subsequent migration of chemicals. Limitations are the requirements for periodic inspections, deed restrictions, and possible groundwater monitoring to verify that COCs are not transported to aquifers. Generally, long-term O&M programs are recommended to demonstrate containment structures are maintained in good condition. Long-term monitoring is often used at sites where containment is a selected remedial strategy to evaluate if chemicals are migrating to groundwater sources.

If used at IR Site 31, containment would require (1) demolishing existing hardscape, (2) excavating soil so a landfill-type cap several feet thick could be installed and existing grades maintained, or (3) raising the elevation of IR Site 31 to allow for proper installation of the cap, and (4) being inconsistent with the current and planned future use of IR Site 31 and limiting future uses of IR Site 31. Therefore, containment is not retained for further consideration.

4.2.2.2 Exposure Prevention Barriers

The purpose of an exposure prevention barrier is to prevent a complete exposure pathway to a human receptor. Exposure prevention barriers may also be used to contain contamination,

although containment is not the primary purpose of the barrier. Exposure prevention barriers can be applied to a site where the nature and extent of the contamination are such that a fully engineered and maintained containment system—such as required at landfills—is not warranted. The components of exposure prevention barriers may include existing or new building foundations and floors, parking lots, sidewalks, other paved areas, vapor barriers, subsurface vapor control systems, and landscaped areas. ICs would be required to maintain the exposure prevention barriers and allow for appropriate precautions to be taken should the need to penetrate the exposure prevention barrier be required, as might be encountered with utility repair. Exposure prevention barriers are most effective where there are low concentrations of chemicals and the chemicals are not highly mobile.

Exposure prevention barriers offer many benefits for low-risk sites. They can use existing site features, such as roadways, sidewalks, or other paved surfaces; are typically quick to construct and use readily available construction skills and materials; and are easy to integrate into site uses. Periodic maintenance may be required, depending on the sophistication of the exposure prevention barrier. Typically, exposure prevention barriers require periodic inspections and ICs to ensure they are maintained. Long-term O&M programs are recommended to assure exposure prevention barriers are maintained in good condition. Exposure prevention barriers could be effective, are readily implementable, and would be relatively inexpensive to implement. Exposure prevention barriers are a viable technology for IR Site 31, thus they are retained for further consideration.

4.2.2.3 Resource Conservation and Recovery Act Cover

Landfill capping is the most common form of remediation because it is generally less expensive than other technologies and effectively manages the human and ecological risks associated with a remediation site.

The design of landfill covers is site-specific and depends on the intended functions of the system. Landfill covers can range from a one-layer system of vegetated soil to a complex multilayer system of soils and geosynthetic liners. In general, less complex systems are required in dry climates, and more complex systems are required in wet climates. The material used in construction of landfill covers includes low-permeability and high-permeability soils and low-permeability geosynthetic products. The low-permeability materials divert water and prevent it from passing into the waste. The high-permeability materials carry water away that percolates into the cap. Other materials may be used to increase slope stability.

Landfilling does not reduce the toxicity, mobility, or volume of hazardous wastes but does reduce migration of these wastes. Landfill covers are most effective where the underlying waste is above the water table. A cap, by itself, cannot prevent the horizontal flow of groundwater through the waste; instead, it can prevent only the vertical entry of water into the waste. In many cases, landfill covers are used in conjunction with vertical walls to minimize horizontal flow and migration. The effective life of the components (including the cap) can be extended by long-term inspection and maintenance. Vegetation that has a tendency for deep root penetration must

be eliminated from the cap area. In addition, precautions must be taken to assure the integrity of the cap is not compromised by land use.

Landfill covers are generally the least expensive way to effectively manage human health and ecological risks at a site. Rough industry costs are $175,000 per acre for RCRA Subtitle D covers and $225,000 per acre for RCRA Subtitle C covers (FRTR 2005). However, this technology is not retained for further evaluation because of the inherent restrictions associated with future use for capped sites and the incompatibility of capping with current and planned use of the site.

4.2.3 Institutional Controls

ICs are legal and administrative mechanisms used to implement land use and access restrictions that limit the exposure of hypothetical landowners or users of the property to hazardous substances and to maintain the integrity of the remedial action until remediation is complete and remediation goals have been achieved. Monitoring and inspections are conducted to ensure that the land use restrictions are being followed.

ICs are often more effective if they are layered or implemented in series. Layering means using different categories of ICs concurrently to enhance the protectiveness of the remedy. ICs may be implemented in series to ensure both the short- and long-term effectiveness of the remedy. As a single remedy, ICs are typically implemented as a long-term approach. The following subsections describe and evaluate the ICs that could be applied at IR Site 31.

4.2.3.1 Legal Mechanisms

Legal mechanisms involve legal instruments included in the chain of title for the site property. Some legal mechanisms can be implemented without the intervention of any federal, state, or local regulatory agency. Legal mechanisms evaluated include negative easements and restrictive covenants.

When used as an IC, an easement typically provides access rights to a property so the facility owner or regulatory agency may inspect and monitor the effectiveness of a remediation system. An easement is retained for further evaluation because long-term monitoring is a critical component to assess the effectiveness of the IC approach. Its implementation would be layered with other ICs.

A covenant is an agreement between one landowner to another made in connection with a conveyance of property to use or refrain from using the property in a certain manner. A major benefit of a covenant is that it can be used to establish an IC where the unremediated property is being transferred from the current owner to another party. Implementation of a covenant is retained for further evaluation because of the possibility of property transfer in the future.

4.2.3.2 Administrative Mechanisms

Administrative mechanisms use the regulatory authority of a government entity to impose restrictions on citizens or property under its jurisdictions. Examples of government controls include restrictions on zoning, adopted local land use plans that may be used to ensure compliance with use restrictions, and deed notices.

Zoning is a common land use restriction that specifies allowed land uses for certain areas. Zoning can be used to prevent certain exposures that would not otherwise be prevented under a remedy. Examples of zoning restrictions include (1) prohibition of a site for residential development or (2) restriction of excavation at sites to specific depths where contamination is present. A local government typically issues the zoning restrictions. However, they are not necessarily permanent; instead, they can be repealed or local governments can grant exceptions after public hearings. Therefore, zoning restrictions are usually layered with other ICs for a long-term remedy. Zoning restrictions are readily implementable at low cost at IR Site 31; therefore, they are retained for further evaluation.

Groundwater use restrictions are typically directed at limiting or prohibiting certain uses of groundwater, which may include limitations or prohibitions on well drilling in a certain area or groundwater extraction from a certain aquifer. The effectiveness of the groundwater use restrictions depends on the willingness and ability of local governments to monitor compliance and take enforcement action. Similar to zoning, groundwater use restrictions are typically layered with other ICs. In a letter to the Navy, the Water Board concurred that groundwater at NAVSTA TI meets the exemption criteria under State Water Resources Control Board Sources of Drinking Water Resolution 88-63 but retains its designation for potential agricultural, process and industrial supply (Water Board 2001). Groundwater use restrictions are not retained for further evaluation at IR Site 31 because there are no impacts to groundwater from the site. For this reason, groundwater use restrictions are not presented in Table 4-1.

TI has a land use plan (the Draft NAVSTA TI Reuse Plan [CCSF 1996]); however, the plan does not contain enforcement components. As a result, the Reuse Plan is not retained for further evaluation as a component of a remedial alternative, but is still considered useful as a planning tool.

Informational tools provide information or notification that residual contamination may remain on site. Common examples include state registries of contaminated properties, deed notices, and advisories. The most commonly used are deed notices, which are non-enforceable, purely informational documents filed in public land records that alert persons searching the records. Informational tools are most likely to be used as a secondary layer to enhance the overall reliability of other ICs because they are nonenforceable. Therefore, deed notices will be retained for further evaluation.

4.2.4 Active Remediation

Active remediation involves removing COCs from the site, as opposed to either containing or preventing exposure to the COC. DoD policy requires that an alternative permitting unrestricted use be evaluated in any FS where LUCs (which include ECs and ICs) are evaluated as an alternative (DoD 2001). The purpose of the active remediation evaluation is, in part, to fulfill this requirement. A variety of technologies were screened, including technologies that treat the contamination in place (*in situ*), treat contamination on site but not in place (*ex situ*), and involve off-site treatment or disposal. The following *in situ* active remediation technologies and process options were considered:

- *In Situ* Bioremediation
- Phytoremediation
- *In Situ* Chemical Oxidation
- Solidification/Stabilization (S/S)
- *In Situ* Thermal Desorption
- Vitrification

Excavation is also evaluated as an active remediation technology to help develop *ex situ* and off-site treatment and disposal options. This technology is followed by the following *ex situ* active remediation technologies and process options:

- Low Temperature Thermal Desorption
- Soil Washing

The final group of technology and process options being considered to supplement excavation involves off-site treatment or disposal of soil, including:

- Incineration
- Off-Site Placement of Soil in a Permitted Landfill

Aside from effectiveness, implementability, and cost considerations, professional judgment and information from vendors also were used to screen the active remediation technologies.

4.2.4.1 In Situ Bioremediation

This option might require demolition of the existing hardscape to allow for access to contaminated soil. Bioremediation techniques have been successfully used to remediate chemicals in soil such as petroleum hydrocarbons, solvents, pesticides, wood preservatives, and other organic chemicals. However, there is little information available on the use of *in situ* bioremediation to treat PAHs, B(a)P, or dioxins at concentrations detected at IR Site 31. Additionally, *in situ* bioremediation is not considered to be a viable treatment technology for lead. Costs for *in situ* bioremediation are considered low to moderate.

Although *in situ* bioremediation has been successfully used to reduce VOC and SVOC concentrations in soil and groundwater, use of this technology at IR Site 31 would not effectively reduce other nonvolatile chemicals. Biodegradation rates are influenced by chemical type, soil type, oxygen supply, moisture content, nutrient supply, pH, and temperature. Based on available information, the effectiveness and implementability of *in situ* bioremediation to reduce dioxins concentrations are questionable and the costs are unknown. Therefore, *in situ* bioremediation is not retained for further consideration.

4.2.4.2 Phytoremediation

Phytoremediation is a process that uses plants to remove, transfer, stabilize, and destroy chemicals in soil and sediment. The mechanisms of phytoremediation include enhanced rhizosphere biodegradation, phytoextraction, phytodegradation, and phytostabilization. Phytoremediation may be applicable to reduce concentrations of metals, PAHs, pesticides, solvents, explosives, crude oil, and landfill leachates in soil.

Hyper-accumulator plants may be able to remove and store metals. Some plant species have the ability to store metals in their roots. They can be transplanted to sites to filter metals from wastewater. As the roots become saturated with metals, they can be harvested. Costs for phytoremediation are considered low to moderate.

Research is ongoing to evaluate if trees exhibit the ability to remove organic chemicals from groundwater, translocate and transpire, and possibly metabolize them either to carbon dioxide or plant tissue.

The following limitations were identified for phytoremediation in soil:

- The depth of the treatment zone is controlled by the plants used in phytoremediation, which in most cases is limited to shallow soils.
- High concentrations of hazardous materials can be toxic to plants.
- It involves the same mass transfer limitations as other biotreatments.

- It may be seasonal, depending on location.
- It might require demolition of the existing hardscape to allow for access to contaminated soil.
- It is not effective for strongly sorbed (such as PCBs and dioxins) and weakly sorbed chemicals.
- The toxicity and bioavailability of biodegradation products are not always known.
- Products may be mobilized into groundwater or bioaccumulated in animals.
- It is still in the preliminary evaluation stage.

Currently, the Superfund Innovative Technology Evaluation Program is attempting to demonstrate and evaluate the efficacy and cost of phytoremediation in the field at sites in Oregon, Utah, Texas, and Ohio. Although this technology is considered innovative, it is not retained for further evaluation based on its relative ineffectiveness in treating dioxins and the numerous limitations of the technology.

4.2.4.3 In Situ Chemical Oxidation

Chemical oxidants most commonly employed to date include peroxide, ozone, and permanganate. These oxidants have been able to cause the rapid and complete chemical destruction of many toxic organic chemicals; other organic chemicals are amenable to partial degradation as an aid to subsequent bioremediation. In general, the oxidants have been capable of achieving high treatment efficiencies (sometimes exceeding 90 percent) for unsaturated aliphatic (such as trichloroethene) and aromatic compounds (such as benzene), with very fast reaction rates (90 percent destruction in minutes). Field applications have clearly affirmed that matching the oxidant and *in situ* delivery system to the COCs and the site conditions is the key to successfully implementing and achieving performance goals.

In situ chemical oxidation is a viable remediation technology for mass reduction in source areas, as well as for plume treatment. The potential benefits of *in situ* oxidation include the rapid and extensive reactions with various COCs applicable to many biorecalcitrant organic compounds and subsurface environments. In addition, *in situ* chemical oxidation can be tailored to a site and implemented with relatively simple, readily available equipment. Some potential limitations include the requirement for handling large quantities of hazardous oxidizing chemicals because of the oxidant demand of the target organic chemicals and the unproductive oxidant consumption of the formation. Further research and development are under way to advance the science and engineering of *in situ* chemical oxidation and to increase its overall cost effectiveness. Still, *in situ* chemical oxidation is not retained for further evaluation because some COCs at IR Site 31 are resistant to oxidation and a potential exists for process-induced detrimental effects.

4.2.4.4 Solidification/Stabilization

S/S reduces the mobility of hazardous substances and chemicals in the environment through both physical and chemical means. Unlike other remedial technologies, S/S seeks to trap or immobilize chemicals within their host medium (such as soil, sand, or building materials that contain them) instead of removing them through chemical or physical treatment. Leachability testing is typically required to measure the immobilization of chemicals. S/S techniques can be used alone or combined with other treatment and disposal methods to yield a product or material suitable for land disposal or, in other cases, that can be applied to beneficial use. These techniques have been used as both final and interim remedial measures.

Seven distinct processes or groups of processes include (1) bituminization, (2) emulsified asphalt, (3) modified sulfur cement, (4) polyethylene extrusion, (5) pozzolan/Portland cement, (6) sludge stabilization, and (7) soluble phosphates. The target contaminant group for *in situ* S/S is generally inorganic chemicals (such as metals). S/S does not reduce the concentrations of inorganic chemicals but will reduce mobilization. *In situ* implementation of S/S leaves stabilized or solidified material in place and which could complicate future intrusive activities within treated areas. Based on planned reuse of IR Site 31, implementation of *in situ* S/S would likely complicate future intrusive activities. Implementation of S/S at IR Site 31 would therefore likely require off-site disposal at a permitted landfill. Shallow groundwater would complicate the use of *in situ* S/S at IR Site 31. In addition, this technology is not cost effective. As a result, this process is eliminated from further evaluation.

4.2.4.5 Thermal Desorption

Thermal desorption has been used in California to reduce dioxin concentrations from 3,200 to 60 ng/kg at a field scale (EPA 2005). However, no reports exist that document that thermal desorption has been used to treat dioxin or B(a)P at the low concentrations present in soil at IR Site 31. Although PAHs are considered to be a target chemical of thermal desorption remediation (FRTR 2005), lead would not be treated in the thermal desorption process. The presence of groundwater at a depth of approximately 6 feet limits the applicability of *in situ* thermal desorption. Where applicable, costs for this technology are moderate to high. As a result, *in situ* thermal desorption was not retained because it has not been proven effective to treat dioxins at the concentrations present in soil at IR Site 31. The *ex situ* variant of this technology has not been demonstrated to treat dioxin contamination at the low concentrations present at IR Site 31. In addition, some dewatering of excavated soils may be required before treatment. Furthermore, costs would be high because all costs associated with excavation would be included. Therefore, thermal desorption was not retained based on its inability to treat lead in soil, performance issues with low concentrations of dioxins, and the high cost.

Gas-phase chemical reaction, another method of thermal desorption, involves heating the soil to very high temperatures and then treating the chemicals in the resulting gaseous phase. This process has been used at a field scale on dioxins, but is currently not marketed by the vendor because its costs are prohibitive (EPA 2005). Therefore, gas-phase chemical reaction is not retained for further evaluation.

4.2.4.6 Vitrification

Vitrification is another S/S process that uses an electric current to melt soil or other earthen materials at extremely high temperatures (1,600 to 2,000 °C or 2,900 to 3,650 °F), thereby immobilizing most inorganic chemicals and destroying organic chemicals by pyrolysis. The process has been tested on a broad range of VOCs and SVOCs, as well as dioxins and PCBs, and on most priority pollutant metals and radionuclides. Inorganic chemicals are immobilized within the vitrified glass and crystalline mass. Water vapor and organic combustion products are captured in a hood, which draws the chemicals into an off-gas treatment system that removes particulates and other pollutants from the gas. The vitrification product is a chemically stable, leach-resistant, glass and crystalline material similar to obsidian or basalt rock. The process destroys or removes organic chemicals. Radionuclides and heavy metals are immobilized within the molten soil. The timeframe for the vitrification process is typically short term for *in situ* and short to medium term for *ex situ*.

Vitrification can be used as an off-site disposal option without creating any on-site permitting issues. This technology would likely require off-site disposal because of potential difficulties with the planned reuse of the site. Off-site treatment is typically combined with off-site disposal at an appropriately permitted landfill. Vitrification operation costs are considered high, although they vary with electricity costs, the quantity of water required, and the depth at which the process is implemented.

Shallow groundwater would complicate the use of *in situ* vitrification. *Ex situ* vitrification would entail permitting issues, but would likely destroy PAHs and destroy or contain dioxins, as well as stabilize or contain lead. However, the vitrified soil would need to be hauled to a landfill, and the process could generate low levels of airborne dioxins. This option is not retained for further evaluation because of the associated costs and additional handling of both treated and untreated waste.

4.2.4.7 Excavation

With excavation, contaminated material is removed and either treated on site or off site or is transported to permitted off-site treatment or disposal facilities. Some pretreatment of the contaminated media may be required to meet land disposal restrictions. Excavation and off-site disposal is applicable to the complete range of chemicals, with no particular target group.
The following factors may limit the applicability and effectiveness of excavation:

- Generation of fugitive emissions may be a problem during excavation.
- Distance from the contaminated site to the nearest disposal facility with the required permits will affect cost.
- Depth and composition of the media requiring excavation must be considered.
- Transportation of contaminated soil through populated areas may affect community acceptability.

- Disposal options for certain waste (such as mixed or transuranic waste) may be limited. Currently, only one licensed disposal facility for radioactive and mixed waste is present in the United States.
- Chemicals can migrate from the disposal facility through several pathways, including effluent discharge to surface water, surface runoff of rainfall, leaching into groundwater, and volatilization to the atmosphere.

Excavation and off-site disposal is a well proven and readily implementable technology. Until 1984, excavation and off-site disposal was the most common method for cleaning up hazardous waste sites. Excavation also is the initial component in all *ex situ* treatments.

The rate of excavation depends on a number of factors, including the number of loaders and trucks operating. The excavation of a standard remedial site of 18,200 metric tons (20,000 tons) of contaminated soil would typically require about 2 months (FRTR 2005). Disposal of the contaminated media depends on the availability of adequate containers to transport the hazardous waste to a permitted facility.

Excavation and off-site disposal is a relatively simple process, with proven procedures. It is a labor-intensive practice with little potential for further automation. Additional costs may include soil characterization and treatment to meet land disposal restriction requirements. Costs for excavation are considered moderate.

Any excavation option would involve demolition of hardscape to provide access to the contaminated soil, then excavation of the contaminated soils from beneath the hardscape and replacement of the hardscape. Contaminated soil was successfully excavated during a previous removal action at IR Site 31, demonstrating the viability of this approach. As a result, this option is retained for further evaluation.

4.2.4.8 Low Temperature Thermal Desorption

Low temperature thermal desorption is a physical separation process in which wastes are heated to volatilize water and organic chemicals. A carrier gas or vacuum system transports volatilized water and organic chemicals to the gas treatment system. The bed temperatures and residence times designed into these systems will volatilize selected chemicals but typically will not oxidize them.

In low temperature thermal desorption, wastes are heated to temperatures between 90 and 320 °C (or 200 to 600 °F). Low temperature thermal desorption is a full-scale technology that has been proven successful for remediating petroleum hydrocarbon contamination in all types of soil. Contaminant destruction efficiencies in the afterburners of these units exceed 95 percent. The same equipment could probably meet stricter requirements with minor modifications, if necessary. Decontaminated soil retains its physical properties. Unless they are heated to the higher end of the temperature range, organic components in the soil are not damaged, which enables treated soil to retain the ability to support future biological activity.

Thermal desorption systems have varying degrees of effectiveness against the full spectrum of organic chemicals. The target chemical groups for low temperature thermal desorption systems are nonhalogenated VOCs and fuels. The technology also can be used to treat SVOCs at reduced effectiveness.

Some dewatering of excavated soils may be required before treatment. Furthermore, costs would be high because all costs associated with excavation would be included. Therefore, low temperature thermal desorption was not retained based on its inability to treat lead in soil, performance issues with low concentrations of dioxins, and the high cost.

4.2.4.9 Soil Washing

Removal of chemicals by soil washing is a physical/chemical process for scrubbing soil *ex situ*. This technology would require demolition of the existing hardscape to allow for access to the contaminated soil. The process either dissolves or suspends material in a wash solution, or concentrates chemicals into a smaller volume of soil through particle size separation, gravity separation, and attrition scrubbing. It is applicable to heavy metals, radionuclides, and organic chemicals. Because chemicals tend to bind to clay, silt, and organic soil particles, washing separates these smaller particles from the coarser sand, thus concentrating chemicals into a smaller volume. The process removes chemicals from soils in one of the following two ways:

- By dissolving or suspending them in the wash solution (which can be sustained by chemical manipulation of pH for a period of time); or
- By concentrating them into a smaller volume of soil through particle size separation, gravity separation, and attrition scrubbing (similar to the techniques used in sand and gravel operations).

Soil washing systems that incorporate most of the removal techniques offer the greatest promise for application to soils contaminated with a wide variety of heavy metal, radionuclides, and organic chemicals. Commercialization of the process, however, is not yet extensive.

Complex mixtures of chemicals in the soil (such as a mixture of metals, nonvolatile organic chemicals, and SVOCs) and heterogeneous chemical compositions throughout the soil mixture make it difficult to formulate a single suitable washing solution that will consistently and reliably remove all of the different types of chemicals. The duration of soil washing is typically short to medium term.

The target chemical groups for soil washing are SVOCs, fuels, and heavy metals. The technology also can be used on selected VOCs and pesticides. The technology offers the ability to recover metals and can clean a wide range of organic and inorganic chemicals from coarse-grained soils. The average cost for this technology, including excavation, is approximately $170 per ton, depending on site-specific conditions and the quantity and concentration of the target waste.

Complex mixtures of chemicals can complicate formulation of a washing solution, and soil washing has not been proven with dioxins. Because of its questionable effectiveness and implementability, *ex situ* soil washing is not retained for further consideration.

4.2.4.10 Incineration

Incineration is used to remediate soils contaminated with explosives and hazardous wastes, particularly chlorinated hydrocarbons, PCBs, and dioxins. High temperatures, 870 to 1,200 °C (or 1,400 to 2,200 °F), are used to volatilize and combust (in the presence of oxygen) halogenated and other refractory organics in hazardous wastes in the incineration process. Often, auxiliary fuels are used to initiate and sustain combustion. The destruction and removal efficiency for properly operated incinerators exceeds the 99.99 percent requirement for hazardous waste and can be operated to meet the 99.9999 percent requirement for PCBs and dioxins.

Incinerator off-gas requires treatment by an air pollution-control system to remove particulates and neutralize and remove acid gases (such as hydrochloric acid, nitrogen oxide, and sulfur oxide). Baghouses, venturi scrubbers, and wet electrostatic precipitators remove particulates; packed-bed scrubbers and spray driers remove acid gases.

The duration of incineration technology ranges from short to long term.

This option would involve demolition of the existing hardscape to allow for access to the contaminated soils, followed by excavation and transportation of the contaminated soil to an existing, permitted commercial incinerator. Incineration has been successfully used to treat dioxin-contaminated soils with concentrations from the parts per million range (or mg/kg) to the parts per billion range (or micrograms per kilogram). Incineration has not been demonstrated to successfully reduce dioxins in soil when starting from the low concentrations detected at IR Site 31. (The maximum concentration of dioxin TEQ at IR Site 31 is 60.8 ng/kg.) Additionally, incineration is controversial, and incineration of any chlorinated compounds, including dioxins, can produce airborne dioxins if appropriate conditions are not maintained. Incineration is also expensive, with commercial incineration costs for soil exceeding $500 per ton, including pretreatment.

Because air emissions of dioxins could be generated during the incineration process, the effectiveness of treating dioxins is questionable. Additionally, incineration is not considered to be a viable treatment technology for lead. This technology is implementable but would be cost prohibitive because of the transportation and disposal costs. This technology is not retained for further analysis.

4.2.4.11 Off-Site Placement in a Permitted Landfill

Any excavation option would involve demolition of hardscape to provide access to the contaminated soil, excavation of the contaminated soils from beneath the demolished hardscape,

and transportation and disposal of the contaminated soil at an off-site landfill. Contaminated soil was excavated and disposed of at an off-site landfill during a previous removal action at IR Site 31, successfully demonstrating this approach. As a result, this option is retained for further evaluation.

4.3 SUMMARY OF RETAINED REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

All of the broad categories of remedial technologies were retained, but only a limited number of technologies were retained as viable process options. Table 4-1 summarizes the screening of remedial technologies and process options. Based on the screening, the following technologies were retained:

- ECs
- ICs
- Active Remediation

The retained process options include:

- Legal Mechanisms
- Administrative Mechanisms
- Exposure Prevention Barriers
- Excavation
- Off-Site Placement of Soil in a Permitted Landfill.

Aside from effectiveness, implementability, and cost considerations, professional judgment and information from vendors also were used to screen the active remediation technologies.

TABLES

TABLE 4-1: INITIAL SCREENING OF SOIL TREATMENT TECHNOLOGIES

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, CA

General Response Action	Technology Group	Treatment Technology	Description	Evaluation Criteria[a]			Evaluation Results
				Effectiveness	Implementability	Cost	
No Action	No Action	No Action	No remediation, institutional or engineering controls, or monitoring actions would be taken at the site. The site would remain in its current condition	Low effectiveness. Evaluation is required under the NCP and CERCLA as a baseline for comparison with other remedial alternatives.	Highly implementable. Evaluation is required under the NCP and CERCLA as a baseline for comparison with other remedial alternatives	No cost is associated with the No Action Alternative. Evaluation is required under the NCP and CERCLA as a baseline for comparison with other remedial alternatives.	Retained
Institutional Controls	Administrative Mechanisms	Zoning Restrictions	A common land use restriction specifying allowed land uses for certain areas. Zoning can be used to prohibit activities that could disturb a certain aspect of a remedy or to control certain exposures not otherwise protected under a remedy.	Highly effective in restricting future uses of land.	Zoning restrictions are highly implementable.	Low cost	Retained

TABLE 4-1: INITIAL SCREENING OF SOIL TREATMENT TECHNOLOGIES (CONTINUED)
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, CA

General Response Action	Technology Group	Treatment Technology	Description	Evaluation Criteria[a]			Evaluation Results
				Effectiveness	Implementability	Cost	
Institutional Controls (Continued)	Administrative Mechanisms (Continued)	Land Use Plans	A land use plan outlines potential future land uses. A land use plan, when adopted may or may not contain an enforcement mechanism (such as zoning restrictions).	Low effectiveness. Do not necessarily contain an enforcement mechanism for prevention of exposure to COCs.	The NAVSTA TI Reuse Plan has not been formally adopted; therefore, it is difficult to implement.	Low cost	Eliminated
		Deed Notice	Commonly refers to a non-enforceable, purely informational document filed in public land records, which alerts persons searching the records to important information about the property.	Moderately effective. Informs potential human receptors about the property.	Highly implementable and complements other IC components.	Low cost	Retained
	Legal Mechanisms	Easements	Easements typically provide access rights to a property.	Low effectiveness as a stand-alone technology. Can be moderately effective in combination with other ICs and engineering controls. Allows for access to a property for inspections of engineering controls.	Highly implementable and complements other IC components.	Low cost	Retained

TABLE 4-1: INITIAL SCREENING OF SOIL TREATMENT TECHNOLOGIES (CONTINUED)
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, CA

General Response Action	Technology Group	Treatment Technology	Description	Evaluation Criteria[a]			Evaluation Results
				Effectiveness	Implementability	Cost	
Institutional Controls (Continued)	Legal Mechanism (Continued)	Deed Restrictions	Deed restrictions are a clause or series of clauses in a deed which restricts the future use of the property.	Moderately effective. Future land use of the property would be restricted to designated use.	Highly implementable and complements other IC components.	Low cost	Retained
		Covenants	A covenant is an agreement between a landowner and another party made in connection with a conveyance of property to use or refrain from using a property in a certain manner. For example: a covenant not to dig on a certain portion of the property.	Will ensure the property would not be used in a manner which compromises the restrictions.	Highly implementable and complements other IC components.	Low cost	Retained
Engineering Controls	Exposure Prevention Barriers	Barriers	Barriers, such as building foundations, asphalt or concrete, or other hard surfaces are used to prevent direct contact with contaminated soil underneath.	Highly effective in eliminating exposure pathways. Prevents contact with contaminated soil.	Highly implementable. Existing exposure prevention barriers are in-place at Site 31.	Low cost	Retained
	Containment	Capping	Single layer caps composed of concrete or bituminous asphalt form a barrier between the contamination and the surface environment.	Highly effective in eliminating exposure pathways. Prevents contact with contaminated soil.	Low implementability. Would require modifications to the site that are inconsistent with planned reuse.	Moderate to high cost	Eliminated

TABLE 4-1: INITIAL SCREENING OF SOIL TREATMENT TECHNOLOGIES (CONTINUED)
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, CA

General Response Action	Technology Group	Treatment Technology	Description	Evaluation Criteria[a]			Evaluation Results
				Effectiveness	Implementability	Cost	
Engineering Controls (Continued)	Resource Conservation and Recovery Act Cap	Capping	Landfill caps can range from a one-layer system of vegetated soil to a complex multilayer system of soils and geosynthetic liners. Precautions must be taken to assure the integrity of the cap is not compromised by land use.	Highly effective in eliminating exposure pathways. Prevents contact with contaminated soil.	Low implementability. Would require modifications to the site that are inconsistent with planned reuse.	Moderate to high cost	Eliminated
Active Remediation	*In Situ* Treatment and On-Site Treatment	In Situ Bio–remediation	The existing hardscape may be demolished to allow for access to the remaining soils. Nutrients, chemicals, or microbes are added to the soil to remediate the dioxin. Soil is left in place.	Low effectiveness. These technologies have not been demonstrated to treat the already low levels of COCs to the remedial goals.	Low implementability. Too many uncertainties in the implementation process.	Low to moderate cost	Eliminated
		Phyto-remediation	Phytoremediation is a process that uses plants to remove, transfer, stabilize, and destroy chemicals in soil and sediment. Phytoremediation may be applicable for the remediation of metals, PAHs, pesticides, solvents, explosives, crude oil, and landfill leachates.	Low effectiveness. Numerous limitations and relatively ineffective for remediation of dioxins.	Low implementability. The depth of the treatment zone is controlled by the plants used in phytoremediation, which in most cases is limited to shallow soils.	Low to moderate	Eliminated

TABLE 4-1: INITIAL SCREENING OF SOIL TREATMENT TECHNOLOGIES (CONTINUED)
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, CA

General Response Action	Technology Group	Treatment Technology	Description	Evaluation Criteria[a]			Evaluation Results
				Effectiveness	Implementability	Cost	
Active Remediation (Continued)	*In Situ* Treatment and On-Site Treatment (Continued)	In Situ Chemical Oxidation	Application of oxidants has been able to cause the rapid and complete chemical destruction of many toxic organic chemicals; other organics are amenable to partial degradation as an aid to subsequent bioremediation.	Low effectiveness. Ineffective remediation of lead and dioxins.	Moderate implementability. Too many uncertainties in the implementation process.	Moderate to High	Eliminated
		Solidification/ Stabilization	Reduces the mobility of hazardous substances and chemicals in the environment through both physical and chemical means. Unlike other remedial technologies, S/S seeks to trap or immobilize chemicals within their host medium (such as the soil, sand, or building materials that contain them) instead of removing them through chemical or physical treatment.	Low to moderate effectiveness. Expected future reuse may require intrusive activities which would be complicated by the presence of solidified or stabilized material left in place. This process would likely require off-site disposal of soil at a permitted landfill, and the process could generate low levels of airborne dioxins.	Low implementability. Would require modifications to the site that are inconsistent with planned reuse.	Moderate to High	Eliminated

TABLE 4-1: INITIAL SCREENING OF SOIL TREATMENT TECHNOLOGIES (CONTINUED)
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, CA

General Response Action	Technology Group	Treatment Technology	Description	Evaluation Criteria[a]			Evaluation Results
				Effectiveness	Implementability	Cost	
Active Remediation (Continued)	*In Situ* Treatment and On-Site Treatment (Continued)	Thermal Desorption	A physical separation process and is not designed to destroy organic chemicals. Wastes are heated to volatilize water and organic chemicals. A carrier gas or vacuum system transports volatilized water and organic chemicals to the gas treatment system. The bed temperatures and residence times designed into these systems will volatilize selected chemicals but will typically not oxidize them.	Low effectiveness. Ineffective remediation of lead, performance issues with low concentrations of dioxins and B(a)P.	Low to moderate implementability. Would require modifications to the site that are inconsistent with planned reuse	Moderate to high	Eliminated
		Vitrification	Uses an electric current to melt soil or other earthen materials at extremely high temperatures (1,600 to 2,000 °C or 2,900 to 3,650 °F), thereby immobilizing most inorganic chemicals and destroying organic chemicals by pyrolysis. Inorganic chemicals are immobilized within the vitrified glass and crystalline mass.	Low to moderate effectiveness. The vitrified soil would still need to be hauled to a landfill, and the process could generate low levels of airborne dioxins.	Low implementability. Extensive and additional material handling of both treated and untreated waste.	High	Eliminated

TABLE 4-1: INITIAL SCREENING OF SOIL TREATMENT TECHNOLOGIES (CONTINUED)
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, CA

General Response Action	Technology Group	Treatment Technology	Description	Evaluation Criteria[a]			Evaluation Results
				Effectiveness	Implementability	Cost	
Active Remediation (Continued)	*Ex Situ* Treatment and Off-Site Treatment	Excavation	Contaminated material is removed and either treated on site or off site or transported to a permitted off-site treatment or disposal facility. Some pretreatment of the contaminated media may be required to meet land disposal restrictions.	Highly effective. This process was successfully used in a removal action at IR Site 31. Per DoD policy, an unrestricted use alternative must be evaluated.	Moderate to high implementability. Excavation equipment readily available and easily mobilized to Site 31.	Low to moderate	Retained
		Low-Temperature Thermal Desorption	A physical separation process not designed to destroy organic chemicals. Wastes are heated to volatilize water and organic chemicals.	Low effectiveness. Inability to treat lead in soil, performance issues with low concentrations of dioxins, and high cost.	Moderate to high implementability. Some dewatering of excavated soils may be required before treatment	High	Eliminated
		Soil Washing	The existing asphalt and concrete structures are demolished to allow for access to the contaminated soil. A physical/chemical process for scrubbing soil ex situ by dissolving/suspending material in a wash solution, or concentrating chemicals through particle size separation, gravity separation, and attrition scrubbing.	Low effectiveness. The process has not been successfully demonstrated when working with the already low concentrations of dioxin.	Moderate implementability. Difficult to formulate a single suitable washing solution that will consistently and reliably remove all of the different types of COCs	Moderate	Eliminated

TABLE 4-1: INITIAL SCREENING OF SOIL TREATMENT TECHNOLOGIES (CONTINUED)
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, CA

General Response Action	Technology Group	Treatment Technology	Description	Evaluation Criteria[a]			Evaluation Results
				Effectiveness	Implementability	Cost	
Active Remediation (Continued)	*Ex Situ* Treatment and Off-Site Treatment (Continued)	Incineration	The existing hardscape is demolished to allow for access to the remaining contaminated soils. Soils are excavated and sent to a permitted commercial incinerator for treatment.	Low effectiveness. Incineration has not been demonstrated to reduce dioxin concentrations from the already low starting concentrations found at IR Site 31. Incineration not considered a viable treatment technology for lead.	Moderate implementability. Substantial transportation requirements required.	High	Eliminated
		Disposal at Permitted Off-Site Landfill	The existing hardscape is demolished to allow for access to the remaining contaminated soils. Soils are excavated and sent to a permitted landfill for disposal.	Highly effective. This process has been successfully used in a removal action at the site.	Moderate implementability. Excavation and off-site disposal is a relatively simple process, with proven procedures.	Moderate cost	Retained

Notes: Soil treatment technologies retained for further evaluation are shaded.

a Cost:
Low < $100/ton
Moderate $100-$300/ton
High More than $300/ton

CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
DoD Department of Defense
IC Institutional control
NAVSTA Naval Station
NCP National Oil and Hazardous Substances Pollution Contingency Plan
RAO Remedial action objective
S/S Solidification/stabilization
TI Treasure Island

5.0 DEVELOPMENT AND ANALYSIS OF POTENTIAL REMEDIAL ALTERNATIVES

The development and analysis of potential remedial alternatives streamlines and focuses the evaluation of the most viable alternatives. Remedial alternatives were developed by combining the retained technologies and process options discussed in Section 4.0. The effectiveness, implementability, and cost of seven potential remedial alternatives are summarized below and presented in detail in Appendix A. Additionally, a risk refinement analysis was performed to support the analysis of potential remedial alternatives (Appendix A).

5.1 DEVELOPMENT OF POTENTIAL REMEDIAL ALTERNATIVES CONSIDERED FOR ANALYSIS

Existing site conditions are considered protective of human health and the environment under current land uses at IR Site 31 as a paved schoolyard. However, risks to human health may result from exposure to soil if current site conditions are altered (if the existing schoolyard pavement is removed) or if alternative land uses are implemented (if existing hardscape is removed for redevelopment of the site for residential or commercial/industrial use). The potential remedial alternatives were developed with respect to the RAOs to reduce potential risks. Alternative I would not meet the established RAOs because no remedial action, ECs, or ICs would be implemented. All other alternatives developed (Alternatives II through VII) meet the RAOs identified in Section 3.1.3 of this FS Report.

To differentiate between potential remedial alternatives and retained remedial alternatives, the seven potential remedial alternatives are identified using roman numerals (for example, I through VII). Remedial alternatives retained for detailed development, detailed analysis, and comparative analysis are identified using standard numbers (for example, 1 through 7).

The potential remedial action alternatives were developed with consideration to potential exposure to COCs in soil by receptors under the altered site use and alternative land use. These proposed remedial alternatives focus on the protection of the sensitive receptors (children) that frequent the schoolyard and the potential recreational receptors in the southeast quadrant. Additionally, Potential Remedial Alternative IV was developed to evaluate the risk reduction potential provided for construction or utility workers based on exposure to lead in soil beneath 11th Street.

The seven potential remedial alternatives include:

- **Potential Remedial Alternative I — No Action.** This alternative is required by the NCP and is used as a baseline to compare remedial alternatives.

- **Potential Remedial Alternative II — Engineering Controls Combined with Institutional Controls.** This alternative would use ECs and ICs to ensure the existing hardscape at IR Site 31 is maintained as an exposure prevention barrier and provide provisions for required repairs or improvements to subsurface utilities. The ICs would also limit the commercial/industrial or residential use of the property.

Monitoring, maintenance, annual reporting, and 5-year reviews also will be IC requirements.

- **Potential Remedial Alternative III — Engineering Controls, Institutional Controls, Excavation (Debris Area C), and Off-Site Disposal of Soil.** ECs and ICs are similar to Alternative II. Debris Area C would be excavated to a maximum depth of 4 feet bgs. Excavated soil would be disposed of at a licensed landfill. The area would be backfilled with a clean fill, and the hardscape would be restored.

- **Potential Remedial Alternative IV — Engineering Controls, Institutional Controls, Excavation (Debris Area E), and Off-Site Disposal of Soil.** ECs and ICs are similar to Alternative II. Debris Area E would be excavated to a maximum depth of 4 feet bgs. During removal, 11th Street would be closed and excavated and utilities would be rerouted or reinstalled. After excavation and backfilling have been completed, excavated soil would be disposed of at a licensed landfill. The area would be backfilled with a clean fill, and the hardscape would be restored.

- **Potential Remedial Alternative V — Engineering Controls, Institutional Controls, Excavation (Debris Areas C and D Excluding Street), and Off-Site Disposal of Soil.** ECs and ICs are similar to Alternative II. Debris Areas C and D would be excavated to a maximum depth of 4 feet bgs. This remedial alternative would involve removal of Debris Areas C and D, except for the portion of Debris Area D that is beneath 11th Street. Excavated soil would be disposed of at a licensed landfill. The area would be backfilled with a clean fill, and the hardscape would be restored.

- **Potential Remedial Alternative VI — Engineering Controls, Institutional Controls, Excavation (Debris Areas A, B, C, and D Excluding Street), and Off-Site Disposal of Soil.** ECs and ICs are similar to Alternative II. Areas of Debris Areas A, B, C, and D would be excavated to a maximum depth of 4 feet bgs. This remedial alternative would involve removal of Debris Areas A, B, C, and D, except for the portion of Debris Area D that is beneath 11th Street. Excavated soil would be disposed of at a licensed landfill. The area would be backfilled with a clean fill and the hardscape would be restored.

- **Potential Remedial Alternative VII — Complete Removal of Debris Areas A, B, C, D, and E and Off-Site Disposal of Soil.** Debris Areas A, B, C, D, and E would be excavated to a maximum depth of 6 feet bgs, including soils beneath 11th Street. This alternative does not include ICs. Soil would be removed to a maximum depth of 6 feet bgs to allow for removal of soil 1 foot below the known depth of COCs. During removal, 11th Street would be closed and excavated and utilities would be rerouted or reinstalled. After excavation and backfilling have been completed, excavated soil would be disposed of at a licensed landfill. The site would be returned to grade and to present condition with demolished roads, curbs, or parking lots rebuilt to current site conditions.

Potential Remedial Alternatives III through VII also would include short-term ECs to protect human health and the environment. These ECs would involve dust suppression, monitoring, and control measures and excavation shoring to protect remedial action workers. Storm water runoff measures using best management practices would be implemented to assure protection of the environment. ICs would be implemented for Potential Remedial Alternatives II through VI to include restrictions of commercial/industrial and residential reuse and provide provisions for protection of construction or utility workers for digging within the debris areas.

A potential remedial alternative for the excavation of Debris Areas C, D, and E only was not developed because of its similarity to Potential Remedial Alternative VII in cost and risk reduction. The additional cost associated with the removal of Debris Areas A and B included in Potential Remedial Alternative VII is minimal, considering Debris Areas A and B would require ICs if left in-place, making it unattractive compared with the minimal additional cost of Alternative VII.

5.2 ANALYSIS OF POTENTIAL REMEDIAL ALTERNATIVES

The screening criteria used to assess the Potential Remedial Alternatives I through VII were effectiveness, implementability, and cost (see Section 4.1). The effectiveness criterion incorporated a risk refinement as part of its evaluation (see Appendix A). Risk refinement was a key component of this evaluation because five of the seven potential remedial alternatives involved excavation of contaminated soil from the various debris areas. Therefore, it was possible to quantify the degree of risk reduction on numerical terms, allowing for a more substantive and less qualitative assessment. As a result, the effectiveness criterion was weighted more heavily than were implementability and cost, but all three were assessed and are presented.

No numerical risk refinement was required for Potential Remedial Alternatives I and II because the site-wide risk values apply (see Section 2.8). The numerical risk refinement for Potential Remedial Alternatives III, V, and VI is presented in Tables A-5, A-6, and A-7 of Appendix A, respectively. Risk refinement for Potential Remedial Alternative IV is limited to recalculation of blood-lead levels because lead is the only COC for Debris Area E (see Section A5.2.4 of Appendix A). No numerical risk refinement was required for Potential Remedial Alternative VII based on the assumption that removal of all COCs from IR Site 31 would remove risk to all human receptors.

Each of the seven potential remedial alternatives was evaluated to assess the risk reduction of exposure to receptors and the other components of effectiveness, as well as implementability and cost. This screening process is detailed for each potential alternative in Sections A5.2.1 through A5.2.7 (see Appendix A) and summarized in Table 5-1.

Based on the result of the screening process, the following five remedial alternatives were retained for detailed and comparative analysis:

- **Alternative 1**. No Action
- **Alternative 2**. Engineering Controls Combined With Institutional Controls
- **Alternative 3**. Engineering Controls, Institutional Controls, and Excavation (Debris Area E) and Off-Site Disposal of Soil
- **Alternative 4**. Engineering Controls, Institutional Controls, and Excavation (Debris Areas C and D Excluding Street) and Off-Site Disposal of Soil
- **Alternative 5**. Complete Removal of Debris Areas A, B, C, D, and E, and Off-Site Disposal of Soil

TABLES

TABLE 5-1: SUMMARY OF POTENTIAL REMEDIAL ACTION ALTERNATIVES

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Potential Remedial Action Alternative	Remedy Components			
	Engineering Controls	Institutional Controls	Excavation and Disposal of Soil	Rationale for Retaining for Further Evaluation
Alternative I (No Action)	No	No	No	Retained as Alternative 1 - Required for comparison against other alternatives.
Alternative II	Yes	Yes	No	Retained as Alternative 2 – Easily implementable and effective.
Alternative III	Yes	Yes	Yes – Debris Area C	Not retained – Level of overall risk reduction accomplished is not as great as Potential Remedial Alternative V.
Alternative IV	Yes	Yes	Yes – Debris Area E	Retained as Alternative 3 – Risk reduction is significant because of removal of lead in Debris Area E.
Alternative V	Yes	Yes	Yes – Debris Areas C and D	Retained as Alternative 4 – Provides order of magnitude reduction from the baseline cancer risk.
Alternative VI	Yes	Yes	Yes – Debris Areas A, B, C, and D	Not retained – Minimal difference in risk reduction in comparison with Potential Remedial Alternative V.
Alternative VII	No	No	Yes – Debris Areas A, B, C, D and E	Retained as Alternative 5 – Allows for unrestricted use assuming COCs are removed and overall site risk is reduced to below the risk management range.

6.0 DETAILED DEVELOPMENT OF RETAINED REMEDIAL ALTERNATIVES

Five remedial alternatives are retained to provide decision-makers with an appropriate range of options and information with which the alternatives can be evaluated and compared in Sections 7.0 and 8.0, respectively. This section presents the detailed development of the five remedial alternatives retained after screening.

The five retained remedial alternatives are:

- **Alternative 1**. No Action
- **Alternative 2**. Engineering Controls Combined With Institutional Controls
- **Alternative 3**. Engineering Controls, Institutional Controls, and Excavation (Debris Area E) and Off-Site Disposal of Soil
- **Alternative 4**. Engineering Controls, Institutional Controls, and Excavation (Debris Areas C and D Excluding Street) and Off-Site Disposal of Soil
- **Alternative 5**. Complete Removal of Debris Areas A, B, C, D, and E, and Off-Site Disposal of Soil

Detailed development of the retained remedial alternatives includes adequately describing each alternative to evaluate them in the comparative analysis. Costs for alternatives that include excavation were estimated assuming the entire area of the debris areas would require excavation. However, actual excavation areas will be determined during implementation of the selected remedial alternative and will be limited to areas of contamination with concentrations exceeding remediation goals (referred to as "hot spots") based on characterization and confirmation soil sampling results obtained in the field. Engineering cost estimates for each of the retained remedial alternatives are provided in Appendix C. Table 7-1 presents a summary of the detailed engineering cost estimates.

6.1 ALTERNATIVE 1: NO ACTION

Under this alternative, no remedial action would be performed at IR Site 31. No efforts would be made to contain, remove, monitor, or treat the contaminated soil at the site. No cost is associated with Alternative 1. This alternative would not meet the established RAOs because no remedial action, ECs, or ICs would be implemented. Still, an evaluation of the No-Action Alternative is required under the NCP to provide a baseline that can be used to measure other alternatives.

6.2 ALTERNATIVE 2: ENGINEERING CONTROLS COMBINED WITH INSTITUTIONAL CONTROLS

Remedial Alternative 2 uses a combination of ECs and ICs to reduce exposure to COCs identified in soils beneath hardscape at IR Site 31. This alternative would use ECs and ICs to ensure the existing asphalt and concrete hardscape at IR Site 31 is maintained as an exposure prevention barrier and provide for required repairs or improvements to subsurface utilities. The ICs would also limit commercial/industrial or residential use of the property.

The Final RI Report concluded existing site conditions are considered protective of human health and the environment under current land uses at IR Site 31 (SulTech 2006c). However, it would be necessary to reduce potential risk to human health from exposure to COCs in soil if the school is reopened in the future with the schoolyard pavement removed (altered site conditions), or the area is redeveloped and the existing asphalt and concrete hardscape at IR Site 31 is removed. Implementation of Remedial Alternative 2 would require maintenance of the existing asphalt and concrete hardscape as an exposure prevention barrier. Alternative 2 would provide the necessary legal provisions for a combination of ECs and ICs for any required repairs or improvements to subsurface utilities beneath the paved schoolyard area and 11th Street.

Alternative 2 would meet the RAOs listed in Section 3.1.3 by preventing exposure to COCs through the use of ECs and ICs that require monitoring, maintaining, and reporting on the effectiveness and integrity of existing exposure prevention barriers and/or by restricting land use. ECs and ICs would protect receptors from COC concentrations by preventing a complete exposure pathway. Alternative 2 is anticipated to take 9 months to complete. The cost for maintaining, monitoring, and reporting ECs and ICs was based on a 30-year lifecycle.

6.2.1 Engineering Controls

ECs considered for IR Site 31 include maintaining the asphalt and concrete hardscape as exposure prevention barriers. Review of lithologic and trench excavation data from previous reports indicated the schoolyard area is covered in asphalt, ranging typically from 4 to 6 inches thick with 0 to 4 inches of sub-base material. The parking lot appears to be of a similar construction, with a more consistent asphalt thickness and sub-base. The road and intersection consist of 6 inches of asphalt, 4 inches of sub-base, and 2 inches of sand. The thickness of the concrete was not documented, and various assumptions were made for the sidewalk and curbs. The existing hardscape is assumed not to require immediate repair to continue to function as an exposure prevention barrier; however, periodic inspections and routine maintenance would be required. RAOs for all receptors would be satisfied because the maintenance of existing exposure prevention barriers controls would prevent direct contact with contaminated soil.

6.2.2 Institutional Controls

Under Alternative 2, ICs would protect site occupants from exposure to contaminated soils by prohibiting site occupants from removing or penetrating surfaces that act as exposure prevention

barriers, except when specific guidelines are followed to prevent exposure from underlying contaminated soils. Since the elementary school and 11th Street may be used under the current site use plan, provisions would be made to allow for utility repair, such as water or sewer lines, as may be required with the general maintenance of the school and 11th Street. These measures would require that all subsurface work within the contaminated zone use detailed procedures designed to prevent exposure of the occupants and workers from exposure to COCs in soil.

The following ICs and measures would be required to implement Alternative 2:

- DTSC would enter into a land use covenant that requires maintenance of the existing exposure prevention barriers with provision for utility repairs, as necessary.
- A deed notice would be recorded to notify the public about the existence of the contamination.
- ECs and ICs would be implemented that would require the monitoring, maintenance, and annual reporting on the effectiveness of existing hardscape as an exposure prevention barrier.
- A remedial action work plan (RAWP) would be developed to specify the roles and responsibilities for implementing, monitoring, and enforcing the ICs (DoD 2004).
- Five-year reviews and reporting would be conducted to ensure the continued effectiveness of the ECs and ICs.
- Deed restrictions restricting commercial/industrial and residential reuse of the site.

6.3 ALTERNATIVE 3: ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS, AND EXCAVATION (DEBRIS AREA E) AND OFF-SITE DISPOSAL SOIL

Alternative 3 includes all components of Alternative 2, with the addition of limited active demolition of 11th Street, excavation to a maximum depth of 4 feet bgs, and disposal of soil containing elevated concentrations of lead associated with Debris Area E (see Figure 2-5) at an off-site, permitted hazardous waste landfill. Demolished concrete and pavement would be disposed of in a nonhazardous landfill. Lead is considered the principal COC in Debris Area E based on the results in the HHRA for evaluation of construction/utility worker exposure to lead in soil exceeding 800 mg/kg (SulTech 2006c). Alternative 3 would meet the RAOs for a construction or utility worker, as listed in Section 3.1.3.

Following active remediation of Debris Area E, ECs and ICs would be implemented to prevent exposure of residential receptors to lead at concentrations exceeding 400 mg/kg. Additionally, residential, commercial/industrial worker, and recreational exposure to B(a)P-EQ concentrations exceeding 0.62 mg/kg, dioxin-TEQ concentrations exceeding 12 ng/kg, and lead greater than 800 mg/kg would be prevented by implementing site-wide ECs and ICs. ECs and ICs would protect human receptors from COC concentrations in soil by preventing a complete exposure pathway.

ECs and ICs would require monitoring, maintaining, and reporting on the effectiveness and integrity of existing exposure prevention barriers. ICs would also restrict residential and commercial/industrial reuse of IR Site 31, thus it would meet the RAO for residential receptors and commercial/industrial workers. Alternative 3 is anticipated to take 16 months to complete.

6.3.1 Engineering and Institutional Controls

The relative scale of activities and; therefore, the associated costs are assumed to be the same as in Alternative 2 based on the small size of the site and the long-term duration of the ICs and ECs (30 years). Existing fencing is located at the perimeter of the schoolyard and the daycare center located across 11th street from IR Site 31. Additional security fencing will be installed at each end of 11th Street to limit public access and potential exposure during removal actions. The additional fencing would be removed once the road surface has been restored and all stockpiled material has been removed.

6.3.2 Excavation (Debris Area E)

Excavation of Debris Area E would involve the demolition of 11th Street and the adjacent sidewalks to excavate soil contaminated with lead to a maximum depth of 4 feet. The area was delineated based on previous sampling results and is estimated at 6,600 square feet (see Figure 2-5). Approximately 1,220 cubic yards (accounting for a 25 percent bulking factor once it is excavated) of lead-contaminated soils would be removed, and the excavation areas would be delineated by collecting confirmation soil samples. The excavation would be backfilled with clean soil, properly compacted in appropriate engineered lifts, and the excavated area of 11th Street and the adjacent sidewalks would be restored to current grade and conditions.

Excavation activities are anticipated to last for 1 week. The cost estimate for this alternative assumed that soil beneath the entire debris area would be removed to a depth of 4 feet bgs. An estimated 212 cubic yards of demolition debris (asphalt and concrete paved surface) from 11th Street would be disposed of as nonhazardous waste at a permitted landfill. Demolished asphalt and concrete from 11th Street would be segregated from targeted contaminated soils.

6.3.3 Off-Site Disposal of Soil

Asphalt and concrete from demolition of 11th Street would be segregated from stockpiled contaminated soils. Stockpiled soils would be properly characterized and transported by an approved waste hauler for proper disposal at a permitted landfill. Asphalt and concrete would be transported by a licensed transporter to a landfill for demolition debris.

It is assumed an estimated 1,220 cubic yards of contaminated soil would be excavated, characterized, and transported as a hazardous waste to a permitted hazardous waste landfill for disposal.

6.4 ALTERNATIVE 4: ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS, AND EXCAVATION (DEBRIS AREAS C AND D EXCLUDING STREET) AND OFF-SITE DISPOSAL OF SOIL

Alternative 4 involves the same ECs and ICs as Alternative 2, coupled with the proposed excavation of soils from areas with elevated COC concentrations within Debris Area C and Debris Area D. Debris Area C is located within the asphalt schoolyard (see Figure 2-5), and Debris Area D consists of a portion of the parking lot on the northeast corner of 11th Street and Avenue E.

Under Alternative 4, 11,500 square feet of asphalt on the surface of Debris Area C, as well as 3,000 square feet of asphalt on the surface of Debris Area D, would be demolished and soil would be removed to a maximum depth of 4 feet bgs. The cost estimate assumed that 2,685 cubic yards of contaminated soil (accounting for a 25 percent bulking factor once the soil is excavated) would be excavated and transported as hazardous waste to a permitted landfill for disposal. An estimated 707 cubic yards of asphalt and concrete would be disposed of as nonhazardous waste at a permitted landfill. The excavation would be backfilled with clean material and returned to approximately the existing grades and conditions.

Alternative 4 would meet the RAOs listed in Section 3.1.3 for elementary school children and staff and recreational visitors by active remediation of Debris Areas C and D. Alternative 4 would also restrict residential and commercial/industrial reuse of IR Site 31, thus it would meet the RAO for residential receptors and commercial/industrial workers. Excavation of Debris Areas C and D would prevent exposure to soils with B(a)P-EQ concentrations greater than 0.62 mg/kg and dioxin-TEQ concentrations greater than 12 ng/kg. Exposure of residents and construction workers to lead at concentrations exceeding 400 and 800 mg/kg, respectively, would be prevented by implementing ECs and ICs in Debris Areas A, B, and E following active remediation of soils in Debris Areas C and D. ECs and ICs would be required because Alternative 4 does not involve complete excavation of COCs in all debris areas and would not support unrestricted use of the site. Alternative 4 is anticipated to take 17 months to complete.

6.4.1 Excavation (Debris Area C)

Excavation of Debris Area C would remove areas of elevated concentrations of COCs in soil to a maximum depth of 4 feet. Demolition of 490 cubic yards of asphalt within Debris Area C would be required to complete excavation activities. The area was delineated based on previous sampling results and is estimated to be 11,500 square feet. Asphalt would be segregated from excavated soils and disposed of as nonhazardous waste. The contaminated soils would be removed and the excavation areas would be delineated by collecting confirmation soil samples. The estimated volume of soils that would be excavated within Debris Area C is 2,130 cubic yards (accounting for a 25 percent bulking factor once it is excavated). The excavation would be backfilled with clean soil, properly compacted in appropriate engineered lifts, and the excavated paved area of the Debris Area C schoolyard would be restored to current grade and conditions.

6.4.2 Excavation (Debris Area D)

Excavation of Debris Area D would be performed to a maximum depth of 4 feet in areas with elevated COC concentrations. Demolition of 127 cubic yards of asphalt within Debris Area D would be required to complete excavation activities. The area was delineated based on previous sampling results and is estimated to be 3,000 square feet. Removal of the area with elevated COC concentrations within Debris Area D would be limited to the parking area. Excavation would not include the area beneath 11th Street and Avenue E. The estimated volume of soils that would be excavated within Debris Area D is 555 cubic yards (accounting for a 25 percent bulking factor once it is excavated). The excavation would be backfilled with clean soil, properly compacted in appropriate engineered lifts, and the excavated paved area of Debris Area D would be restored to current grade and conditions. Excavation of Debris Areas C and D is anticipated to take 3 weeks to complete.

6.4.3 Off-Site Disposal

Demolished asphalt from demolition of the playground and parking lot would be segregated from targeted contaminated soils. Excavated soils would be properly characterized during excavation and transported by an approved waste hauler for proper disposal at a permitted hazardous waste landfill. Asphalt and concrete would be transported by licensed transporters to a nonhazardous landfill.

6.5 ALTERNATIVE 5: COMPLETE REMOVAL OF DEBRIS AREAS A, B, C, D, AND E, AND OFF-SITE DISPOSAL OF SOIL

Alternative 5 involves the removal of all soils with COCs greater than remediation goals within Debris Areas A, B, C, D, and E. This alternative is intended to meet the DoD requirement to evaluate an alternative that allows for unrestricted use of the site if other alternatives evaluated include EC and ICs.

Alternative 5 is the most extensive of the alternatives evaluated and involves complete excavation of Debris Areas A, B, C, D, and E to a depth of 6 feet bgs. An excavation depth of 6 feet bgs was conservatively selected to allow for over-excavation in areas of known contamination and assumes all contaminated soil would be removed. The intent of the removal of Debris Areas A, B, C, D, and E is to achieve unrestricted use of IR Site 31. It is assumed that following the completion of this alternative, the RAOs will have been achieved without the need for ICs. For the purpose of developing a cost estimate, the excavation depth of 6 feet bgs was chosen based on analytical results that indicate dioxin exceedances of the NAVSTA TI dioxin ambient level of 12.0 ng/kg extend to a maximum depth of 5 feet bgs. A temporary security fence would be installed around the site to prevent unauthorized access during remedial activities. Based on an excavation depth of 6 feet bgs, it is assumed a total of 21,900 square feet of soil beneath the entire Debris Areas A, B, C, D and E and an estimated 6,080 cubic yards of contaminated soil (accounting for a 25 percent bulking factor once the soil is excavated) would be excavated and transported as hazardous waste to a permitted landfill for disposal. Additionally, an estimated 930 cubic yards of asphalt and concrete hardscape (demolition debris)

from all debris sites would require disposal as nonhazardous waste at a permitted landfill. The excavation would be backfilled with clean material and returned to approximately the existing grade. Replacement of the street and the parking lot are included in this alternative.

The intent of the remedial action described in Alternative 5 is to achieve unrestricted use of the site. It is assumed that, following the completion of this alternative, the RAOs will have been achieved without the need for engineering controls and ICs. However, soils containing dioxin concentrations above the remediation goal may exist deeper than 6 feet bgs. For the purpose of developing a cost estimate, the depth of 6 feet bgs was chosen based on the analytical results indicating elevated dioxin concentrations are present to a maximum depth of 5 feet bgs.

ECs and ICs would not be required because Alternative 5 assumes complete excavation of Debris Areas A, B, C, D, and E, which would support unrestricted use of the site. The RAOs discussed in Section 3.1.3 would be met by removing COCs from Debris Areas A, B, C, D, and E, thereby eliminating risk to elementary school children and staff, residents, commercial/industrial workers, recreational visitors, and construction workers. Alternative 5 is anticipated to take 18 months to complete. Following completion of this alternative, the RAOs will have been achieved without the need for ICs. Details of the confirmation sampling program during excavation will be provided in the RAWP.

6.5.1 Excavation (Debris Area A)

Debris Area A is a crescent-shaped area just north of 11th Street within the schoolyard (see Figure 2-5). The asphalt area within Debris Area A would be demolished to excavate elevated concentrations of lead in soil to a depth of 6 feet. The area was delineated based on previous sampling results and is estimated to be 400 square feet in size (SulTech 2006c). Based on this area, the estimated volume of soils that would be excavated within Debris Area A is 111 cubic yards (accounting for a 25 percent bulking factor once it is excavated). Approximately 5 cubic yards of demolished hardscape would be segregated from excavated soils and disposed of as nonhazardous waste.

The contaminated soils would be removed, and adequate removal of lead would be verified by collecting confirmation soil samples. When data for confirmation soil samples demonstrate the RAOs defined in Section 3.1.3 have been achieved, the excavation would be backfilled with clean soil, properly compacted in appropriate engineered lifts, returned to grade, and the asphalt area of the schoolyard would be restored.

6.5.2 Excavation (Debris Area B)

Excavation of Debris Area B involves demolition of a crescent-shaped area of asphalt just north of 11th Street within the schoolyard (see Figure 2-5) to excavate elevated concentrations of lead in soil to a depth of 6 feet bgs. The area was delineated based on previous sampling results and is estimated to be 400 square feet in size (SulTech 2006c). Based on this area, the estimated volume of soils that would be excavated within Debris Area B is 111 cubic yards (accounting for

a 25 percent bulking factor once it is excavated). Approximately 5 cubic yards of demolished hardscape would be segregated from excavated soils and disposed of as nonhazardous waste.

The contaminated soils would be removed, and adequate removal of lead would be verified by collecting soil samples for analysis to confirm lead concentrations are below the remediation goal. When data for confirmation soil samples demonstrate the remediation goals defined in Section 3.1.4 have been met, the excavation would be backfilled with clean soil, properly compacted in appropriate engineered lifts, returned to grade, and the asphalt area of the schoolyard would be restored.

6.5.3 Excavation (Debris Area C)

Excavation of Debris Area C involves demolition of asphalt within the existing schoolyard in Debris Area C to excavate elevated concentrations of COCs in soil to a depth of 6 feet. The area was delineated based on previous sampling results and is estimated to be 11,500 square feet in size (SulTech 2006c). Based on this area, the estimated volume of soils that would be excavated within Debris Area C is 3,195 cubic yards (accounting for a 25 percent bulking factor once it is excavated). Approximately 490 cubic yards of demolished hardscape would be segregated from excavated soils and disposed of as nonhazardous waste.

The contaminated soils would be removed, and adequate removal of COCs would be verified by collecting soil samples for analysis of COCs. When data for confirmation soil samples demonstrate the remediation goals defined in Section 3.1.4 have been achieved, the excavation would be backfilled with clean soil, properly compacted in appropriate engineered lifts, and the excavated area would be returned to grade, and the asphalt area of the playground would be restored.

6.5.4 Excavation (Debris Area D)

Excavation of Debris Area D would involve demolition of both asphalt and concrete associated with the parking lot and extending into the street at the intersection of 11th Street and Avenue D. The area was delineated based on previous sampling results and is estimated to be 3,000 square feet (SulTech 2006c). Based on this area, the estimated volume of soils that would be excavated within Debris Area D is 833 cubic yards (accounting for a 25 percent bulking factor once it is excavated). Approximately 127 cubic yards of demolished hardscape would be segregated from excavated soils and disposed of as nonhazardous waste.

Soils with COCs in Debris Area D would be removed to a depth of 6 feet bgs, and adequate removal of COCs would be verified by collecting soil samples for analysis of COCs. When data for confirmation soil samples demonstrate the remediation goals defined in Section 3.1.4 have been achieved, the excavation would be backfilled with clean soil, properly compacted in appropriate engineered lifts, and returned to grade. The excavated area of Debris Area D would be replaced to grade, and repaved similar to current conditions.

6.5.5 Excavation (Debris Area E)

Excavation of Debris Area E involves demolition of 11th Street and the adjacent sidewalks within Debris Area E to excavate soil contaminated with lead beneath the street to a depth of 6 feet bgs. It is anticipated traffic would be temporarily rerouted during demolition of 11th Street and subsequent excavation. The area was delineated based on previous sampling results and is estimated to be 6,600 square feet (SulTech 2006c). Based on this area, the estimated volume of soils that would be excavated within Debris Area E is 1,833 cubic yards (accounting for a 25 percent bulking factor once it is excavated). Approximately 300 cubic yards of demolished hardscape would be segregated from excavated soils and disposed of as nonhazardous waste.

The lead-contaminated soils would be removed, and adequate removal of contaminated soil would be verified by collecting soil samples for analysis of COCs. When data for confirmation soil samples demonstrate the remediation goals defined in Section 3.1.4 have been achieved, the excavation would be backfilled with clean soil, properly compacted in appropriate engineered lifts, the excavated area would be replaced to grade, and the sidewalks and street replaced to current conditions.

6.5.6 Off-Site Disposal

Asphalt and concrete generated during excavation activities at the debris areas would be segregated from the targeted contaminated soils. Stockpiled soils would be properly characterized during excavation and transported by an approved waste hauler for proper disposal at a permitted landfill. Asphalt and concrete would be transported by licensed transporters to a nonhazardous debris landfill.

7.0 DETAILED ANALYSIS OF RETAINED REMEDIAL ALTERNATIVES

Each remedial alternative retained in Section 6.0 was evaluated against nine criteria that are based on the statutory requirements of CERCLA as amended by Superfund Amendments and Reauthorization Act, § 121; the NCP; and "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (EPA 1988). This information will be used to develop, define, and select a final remedy for IR Site 31. No significant risk to ecological receptors was identified in the RI Report (SulTech 2006c); therefore, the retained remedial alternatives will not be evaluated with respect to ecological risk. The nine criteria are discussed below and grouped by threshold, balancing, and modifying criteria.

Threshold Criteria. The two threshold criteria must be met by each alternative.

- **Overall Protection of Human Health and the Environment** - This criterion describes how each alternative, as a whole, protects human health and the environment and indicates how each hazardous substance source is to be eliminated, reduced, or controlled.
- **Compliance with ARARs** - This criterion evaluates each alternative's compliance with ARARs, or, if an ARAR waiver is required, how the waiver is justified. ARARs consider location-, chemical-, and cleanup action-specific concerns.

Balancing Criteria. The five balancing criteria represent the primary criteria used to evaluate the alternatives.

- **Long-Term Effectiveness and Permanence** - This criterion evaluates the long-term effectiveness of each alternative in protecting human health and the environment after the remedial action is complete. Factors considered for protection of the environment include magnitude of residual risks and adequacy and reliability of release controls.
- **Reduction of Toxicity, Mobility, or Volume Through Treatment** - This criterion evaluates the anticipated performance of each alternative's specific treatment technologies to reduce the toxicity, mobility, or volume of hazardous substances.
- **Short-Term Effectiveness** - This criterion examines the short-term effectiveness of each alternative in protecting human health and the environment during the construction and implementation period of the remedy. The factors considered in evaluating short-term effectiveness include protection of the community during remedial actions, protection of workers during remedial actions, environmental effects that would result from construction or implementation of the alterative, and time required to complete the remedial action.
- **Implementability** - This criterion evaluates the technical and administrative feasibility of each alternative and the availability of required resources.

- **Cost** - This criterion evaluates the capital and O&M cost of each alternative. Capital costs were identified for construction, equipment, land, buildings, engineering services, and project administration. O&M costs were identified for labor, spare parts, materials, and administration. The accuracy of costs developed for an FS typically ranges from -30 to + 50 percent, in accordance with EPA guidance (EPA 2000). The present worth of each alternative is calculated using a discount rate of 3.0 percent, which is listed as the "real" interest rate, with an implementation time of up to 30 years (Office of Management and Budget 2006). Costs are then compared on a common present-worth basis in terms of 2006 dollars. Costs presented in this FS Report are rounded to the nearest $1,000. The level of detail used to develop these estimates is considered appropriate for choosing among alternatives, but the estimates are not intended for use in detailed budgetary planning.

Modifying Criteria. The final two criteria will be evaluated following review of the FS Report and Proposed Plan and receipt of public comments on the Proposed Plan.

- **Community Acceptance** - This criterion evaluates the issues and concerns the public may have about each alternative.

- **Regulatory Agency Acceptance** - This criterion evaluates the technical and administrative issues and concerns the regulatory agencies may have about each alternative.

Sections 7.1 through 7.5 compare each of the five retained alternatives with seven (threshold and balancing) of the nine criteria listed above. The first two threshold criteria correlate directly to the statutory requirements; as such, each remedial alternative must meet each of the threshold criteria. The next five criteria are the primary balancing criteria and are the basis for the preliminary selection of the remedy. Together, these first seven criteria are considered the evaluation criteria. The remaining two criteria, state and community acceptance, are modifying criteria and include agency and public comments on the proposed alternatives in the Proposed Plan. These comments will be addressed in the Record of Decision.

7.1 DETAILED ANALYSIS OF ALTERNATIVE 1: NO ACTION

Under this alternative, no remedial action would occur at IR Site 31. No effort would be undertaken to contain, remove, monitor, or treat contaminated soil at the site. An evaluation of the No-Action Alternative is required under CERCLA to provide a baseline for comparison with other alternatives. A description of Alternative 1 is provided in Section 6.1. A detailed analysis of Alternative 1 against the first seven of the nine NCP criteria is provided below.

7.1.1 Overall Protection of Human Health and the Environment

Existing site conditions are considered protective of human health and the environment under current land uses at IR Site 31. However, unacceptable risks to human health may result from

exposure to soil if current site conditions are altered (if the existing schoolyard pavement is removed) or if alternative land uses are implemented (if existing hardscape is removed for redevelopment of the site for residential or commercial/industrial use).

Alternative 1 is not considered protective of human health for current land use under altered (unpaved) site conditions or the alternative land use scenarios (construction worker, commercial/industrial worker, resident, or recreational exposure [in the southeast quadrant]), since the No-Action Alternative does not contain any measure to prevent exposure.

7.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

No chemical-, action- or location-specific ARARs apply because Alternative 1 would not involve any actions on site, such as ECs, ICs, or remedial action.

7.1.3 Long-Term Effectiveness and Permanence

The factors evaluated for long-term effectiveness and permanence included the presence of COCs in soils at IR Site 31 and the potential magnitude of the risk to human health. Alternative 1 would be effective only so long as the use of the site as a paved elementary schoolyard remains. This alternative would not reduce risk under altered site conditions or alternative land use. Alternative 1 does not include an appropriate mechanism to ensure use of the site does not change, or that any change in site use is managed appropriately. Therefore, it cannot be considered effective in the long term or to add any level or degree of permanence. Long-term risk may be posed under altered site conditions or alternative land use. Alternative 1 is not considered to provide long-term effectiveness or permanence.

7.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

This alternative would not reduce the toxicity, mobility, or volume of chemicals at IR Site 31 because the chemicals would not be treated. The COCs identified for this site include B(a)P, dioxins, and lead. These COCs have been known to persist in soils and are not expected to degrade quickly in the subsurface soils. As a result, a reduction in toxicity, mobility, or volume is not expected by leaving these COCs in place under the No-Action Alternative.

7.1.5 Short-Term Effectiveness

This criterion examines the short-term effectiveness of the alternative during construction and implementation of the remedy until the RAO is met. No remedial action is involved under Alternative 1, so no new health risks would be posed to the community, current occupants, workers, or the environment in the short term. Existing site conditions are considered protective of human health and the environment under current land uses at IR Site 31; therefore, this alternative is considered highly effective in the short term.

7.1.6 Implementability

Implementability evaluates the technical and administrative feasibility and availability of required resources. Because the No-Action Alternative would not require resources, this alternative is highly implementable.

7.1.7 Cost

No capital or O&M costs are anticipated for Alternative 1 because no resources are required; no ECs, ICs, or remedial action is undertaken.

7.2 DETAILED ANALYSIS OF ALTERNATIVE 2: ENGINEERING CONTROLS COMBINED WITH INSTITUTIONAL CONTROLS

Alternative 2 uses a combination of ECs and ICs to mitigate exposure to COCs identified in soils at IR Site 31. Alternative 2 would require maintenance of existing asphalt and concrete hardscape as exposure prevention barriers and restrict commercial/industrial or residential reuse of the site. Alternative 2 would provide the necessary legal provisions for a combination of ECs and ICs for any required repairs or improvements to subsurface utilities beneath any of the asphalt or concrete hardscape, including the paved schoolyard, the paved parking lot, and 11th Street. A detailed analysis of Alternative 2 against the first seven of the nine NCP criteria is provided below.

7.2.1 Overall Protection of Human Health and the Environment

Alternative 2 would protect human health by preventing exposure to contaminated soil through ECs and ICs. Risk to human health would be prevented by (1) maintaining the existing hardscape as an exposure prevention barrier at IR Site 31; (2) providing a means for any utility maintenance under the existing hardscape to occur in a safe manner; (3) restricting residential or industrial/commercial reuse of the site; and (4) monitoring, maintenance, annual reporting, and 5-year reviews.

The risk posed by the migration pathway of wind transportation is considered to be incomplete because of the surface cover at the site. However, COCs would be left in-place and protection of human health relies upon ECs and ICs. Alternative 2 provides a moderate degree of overall protection of human health and the environment.

7.2.2 Compliance with Applicable or Relevant and Appropriate Requirements

No potential chemical-specific ARARs for soil that present a numerical cleanup goal were identified. The potential location-specific ARARs that were identified apply to alternatives that generate waste, such as the remediation of soil by excavation and off-site disposal. Because the

soil is not being remediated in Alternative 2, there are no potential chemical-specific ARARs for IR Site 31. No potential location-specific ARARs were identified for IR Site 31. This alternative would comply with the potential state action-specific ARARs for ICs identified in Table B-2 of Appendix B.

7.2.3 Long-Term Effectiveness and Permanence

Under Alternative 2, ICs would supplement the existing ECs to limit exposure of potentially contaminated soil beneath the asphalt and concrete hardscape of the schoolyard, parking lot, sidewalks, and 11th Street at IR Site 31 over the long term. Site conditions would be considered protective of human health and the environment over the long term because the existing exposure prevention barrier would be maintained. Provisions would be included to allow for subsurface repair of utilities. Users of the site must comply with each of the ICs for Alternative 2 to be effective. A RAWP would be prepared to guide implementation of the ICs and inspection for compliance, maintenance, reporting, and enforcement. In accordance with California law, the land use covenant would be recorded, and hypothetical future owners would be notified through a title search of the deed restrictions. Potential residential and commercial/industrial reuses would be prohibited by the ICs.

Because this alternative would not entail active mitigation of the existing risk (only passive techniques are associated with this alternative), the risk associated with altered land use conditions for school children and staff would not be reduced. Additionally, risk would not be reduced for the alternative land use scenarios for construction workers, residents, commercial/industrial workers, or recreational visitors. No degree or level of permanence is achieved. However, the passive techniques (ECs and ICs) incorporated into Alternative 2 would ensure this alternative meets all of the RAOs discussed in Section 3.1.3. Alternative 2 is only moderately effective and permanent over the long term because COCs remain in soil at IR Site 31.

7.2.4 Reduction of Mobility, Toxicity, or Volume through Treatment

Alternative 2 would not reduce the mobility, toxicity, or volume of hazardous substances over time at IR Site 31 because soil would not be treated.

7.2.5 Short-Term Effectiveness

Alternative 2 would not involve remedial construction because all of the ECs are in place. Therefore, no construction would be required and no short-term risks to construction workers or the public would be created by this alternative. This alternative would be highly effective in the short term.

7.2.6 Implementability

This alternative would be easy to implement technically because no active remediation is required. The implementation period for ICs would be in perpetuity, or until additional investigation or remediation demonstrates the ICs are no longer required. The cost estimate assumed a 30-year period to implement Alternative 2.

7.2.7 Cost

The estimated total present worth cost for Alternative 2 is $788,000. The detailed cost analysis for Alternative 2 includes an estimation of capital, O&M, and periodic costs. Capital costs of $313,000 include ECs and ICs. O&M costs include EC and IC monitoring and enforcement ($135,000). Periodic costs include 5-year reviews and exposure prevention barrier maintenance ($340,000). The costs were estimated for a 30-year period based on 2006 dollars. The capital costs primarily involve preparation and implementation of the RAWP and include regulatory review. The O&M costs involve periodic inspections and 5-year reviews pursuant to CERCLA. The cost estimate includes the cost for regulatory enforcement of the IC components. A 25 percent markup factor is included to account for Navy oversight. The total cost for ICs does include the cost for enforcing the components of the ICs. The basis for this cost estimate is summarized in Table 7-1 and detailed in Appendix C, Table C1-A.

7.3 Detailed Analysis of Alternative 3: Engineering Controls, Institutional Controls, and Excavation (Debris Area E) and Off-Site Disposal of Soil

Alternative 3 includes all components of Alternative 2, with the addition of limited active remediation of lead within Debris Area E. Alternative 3 involves ECs, ICs, active remediation of areas of elevated lead concentrations within Debris Area E, and off-site disposal of soil at a permitted landfill. Alternative 3 involves demolition of paved areas of 11th Street to excavate elevated concentrations of lead in soil. The contaminated soils would be removed, the excavation areas would be delineated by confirmation soil sampling, and the stockpiled soils would be properly characterized and transported by an approved waste hauler for proper disposal at a permitted landfill. The excavation would be backfilled with clean soil, properly compacted in appropriate engineered lifts, and the excavated paved area of 11th Street would be restored to current grade and conditions. A detailed analysis of Alternative 3 against the first seven of the nine NCP criteria is provided below.

7.3.1 Overall Protection of Human Health and the Environment

Alternative 3 would protect human health under the alternative land use for the construction worker by removing lead-contaminated soil in Debris Area E and disposing of it in a permitted landfill. Alternative 3 would also protect human health under the altered site conditions for elementary school children and staff, as well as the alternative land use for

commercial/industrial, residential, and recreational receptors by preventing exposure to contaminated soil through ECs and ICs.

Risk to human health would be prevented by (1) maintaining the existing hardscape at Debris Areas A, B, C, and D as an exposure prevention barrier at IR Site 31; (2) providing a means for any utility maintenance under the existing hardscape in Debris Areas C and D to occur in a safe manner; (3) excavating soil with lead concentrations exceeding 800 mg/kg at Debris Area E; (4) restricting residential or industrial/commercial reuse of the site; and (5) monitoring, maintenance, annual reporting, and 5-year reviews.

The risk posed by the migration pathway of wind transport would be actively controlled or reduced during implementation of this alternative because ECs would be identified in the RAWP. These measures would control dust generated from the site during excavation and other active remediation processes. These techniques may include, but are not limited to, suppression covers and fixation, water application, or other means to control. Debris Area E involves the smallest excavation area as compared with Alternatives 4 and 5. Therefore, the dust control techniques are anticipated to be highly effective. However, because COCs would be left in-place in Debris Areas A, B, C, and D, and protection of human health partly relies on ECs and ICs rather than complete removal of COCs, Alternative 3 provides a moderate degree of overall protection of human health and the environment.

7.3.2 Compliance with Applicable or Relevant and Appropriate Requirements

No potential chemical-specific ARARs for soil that present a numerical cleanup goal were identified. Because there are no chemical-specific ARARs for soil other than the waste characterization requirements, remediation goals for IR Site 31 are based on ambient levels, EPA Region 9 PRGs, and remediation goals.

No potential location-specific ARARs were identified for IR Site 31. This alternative would comply with the potential action-specific ARARs, such as the requirements for ICs, the requirement to characterize waste, and staging piles as identified in Table B-2 of Appendix B.

The soil would be characterized in accordance with state and federal ARARs before it could be disposed of in a landfill. If, as a result of this characterization, the Navy concludes that RCRA hazardous waste was generated as a result of the remedial action, the Navy will comply with all legally applicable RCRA requirements for off-site disposal. The Navy likewise will comply with the relevant and appropriate sections of the Federal Hazardous Materials Transportation Law, which have been identified in Appendix B.

7.3.3 Long-Term Effectiveness and Permanence

Under Alternative 3, ICs would supplement the ECs to limit exposure of potentially contaminated soil beneath the asphalt and concrete hardscape of the schoolyard, parking lot, and

sidewalks adjacent to the parking lot at IR Site 31 over the long term. Risks to human health from soils at IR Site 31 would be minimal over the long term because the existing exposure prevention barrier would be maintained and contaminated soils would be removed from Debris Area E (11th Street). Provisions would be included to allow for subsurface repair of utilities. Users of the site must comply with each of the ICs for Alternative 3 to be effective.

A RAWP would be prepared to guide implementation of ICs, inspection for compliance, maintenance, reporting, and enforcement. In accordance with California law, the land use covenant would be recorded and hypothetical owners would be notified through a title search of the deed restrictions. Potential alternative residential or commercial/industrial uses would be prohibited by the ICs.

Alternative 3 provides active remediation of the risk posed by lead associated with Debris Area E for construction and utility workers. This alternative does not actively reduce the risk associated with altered site conditions for school children and staff or alternative land use for residents, commercial/industrial workers, or recreational visitors. No degree or level of permanence would be achieved. However, the passive techniques incorporated into the alternative (ECs and ICs) ensure that Alternative 3 would meet all of the RAOs discussed in Section 3.1.3. Alternative 3 is only moderately effective and permanent over the long term.

7.3.4 Reduction of Mobility, Toxicity, or Volume through Treatment

When soils contaminated by lead in Debris Area E are removed, Alternative 3 would reduce the volume of hazardous substances within Debris Area E—not through treatment, but rather by relocating the contaminated soils to a permitted landfill. This alternative would not result in a reduction in mobility, toxicity, or volume in other areas of IR Site 31, including Debris Areas A, B, C, and D (corresponding to the asphalt schoolyard, parking lot, and associated curbs and sidewalks), because no remedial action would be initiated in those areas. Based on this assessment, Alternative 3 would not reduce the mobility, toxicity, or volume of hazardous substances through treatment (excavation and off-site disposal). However, Alternative 3 would reduce the mobility and volume of COCs identified at IR Site 31 by removing the COCs within Debris Area E and placing them in an approved landfill. As a result, Alternative 3 is considered only slightly effective in reducing the mobility, toxicity, or volume of soils through treatment.

7.3.5 Short-Term Effectiveness

Alternative 3 may require up to 16 months to complete because it involves preparing a RAWP, excavating Debris Area E within 11th Street, and replacing or rerouting utilities beneath the street and grading and paving the street. This schedule includes preparing the work plan, coordinating with the CCSF and private utilities (such as water and sewer), demolishing the street, excavating all of Debris Area E, confirmation sampling, backfilling with engineered lifts, restoring the site to current conditions, and preparing a Remedial Action Completion Report.

Alternative 3 would involve remedial construction, along with ECs and ICs. This alternative would create some potential short-term risks to remedial construction workers and the public. These activities are related to the physical hazards of construction because the risk assessment indicated the site poses a risk to construction workers based on the contamination (SulTech 2006c). Some risk to the public would be posed by construction-related traffic and potential exposure to COCs from airborne dust. This risk would be minimized by best control measures designed to reduce dust and designate routes for traffic. Potential environmental effects, such as generation of dust, also would be minimized through the ECs and best management practices. The RAWP for active remediation would address these issues to ensure short-term effectiveness. Because construction would be required and the short-term risks to construction workers or the public would be minimized, this alternative would be moderately effective in the short term.

7.3.6 Implementability

This alternative would be easy to implement technically because only limited active remediation, which has been successfully implemented at the site previously, is required. The implementation period for ECs and ICs would be in perpetuity, or until additional investigation or remediation demonstrates that the ICs are no longer required. Alternative 3 would take 16 months to be implemented.

7.3.7 Cost

The estimated total present value of Alternative 3 is $1,331,000. The cost estimate assumed a 30-year period for ECs and ICs for Alternative 3. The detailed cost analysis for Alternative 3 includes an estimation of capital, O&M, and periodic costs. Capital costs of $856,000 include ECs, ICs, excavation of Debris Area E, off-site disposal of soil, and restoration. O&M costs include EC and IC monitoring and enforcement ($135,000). Periodic costs include 5-year reviews and exposure prevention barrier maintenance ($340,000). The costs were estimated for a 30-year period based on 2006 dollars. The capital costs primarily involve preparation and implementation of the RAWP. The O&M costs involve periodic inspections and 5-year reviews pursuant to CERCLA. A 25 percent markup factor is included to account for Navy oversight. The total cost for ICs does include the cost for enforcing the IC components. The basis for this cost estimate is summarized in Table 7-1 and detailed in Appendix C, Table C1-B.

7.4 Detailed Analysis of Alternative 4: Engineering Controls, Institutional Controls, and Excavation (Debris Areas C and D, Excluding Street) and Off-Site Disposal of Soil

Alternative 4 involves ECs and ICs presented in Alternative 2, and active remediation by removal of COCs in soil at locations within Debris Areas C and D and off-site disposal of soil at a permitted landfill. Alternative 4 involves demolition of paved areas within the existing schoolyard as part of Debris Area C and the existing parking lot as part of Debris Area D to excavate areas with elevated concentrations of B(a)P and dioxins in soil.

The contaminated soils within Debris Areas C and D would be removed, the excavation areas would be delineated by confirmation soil sampling, and the stockpiled soils would be properly characterized and transported by an approved waste hauler for proper disposal at a permitted landfill. The excavation would be backfilled with clean soil, properly compacted in appropriate engineered lifts, and the excavated paved area of the paved playground and parking lot would be restored to current grade and conditions. A detailed analysis of Alternative 4 against the first seven of the nine NCP criteria is provided below.

7.4.1 Overall Protection of Human Health and the Environment

Alternative 4 would protect human health under altered site conditions for elementary school children and staff, as well as all alternative land use for the recreational scenario by removing soils contaminated with B(a)P and dioxins in Debris Areas C and D and disposing of them in a permitted landfill. Alternative 4 would prevent exposure to contaminated soil in Debris Areas A, B, and E through ECs and ICs.

Overall protection of human health and the environment would be provided by (1) maintaining the existing hardscape at Debris Areas A, B, and E as an exposure prevention barrier at IR Site 31; (2) providing a means for any utility maintenance under the existing Debris Area E hardscape to occur in a safe manner; (3) excavating COCs within Debris Areas C and D; (4) restricting residential or industrial/commercial reuse of the site; and (5) monitoring, maintenance, annual reporting, and 5-year reviews.

The risk posed by the migration pathway of wind transport during excavation activities would be actively controlled or reduced by this alternative. ECs would be identified in the RAWP to control dust generated from the site and during excavation and other active remediation processes. However, the combined excavation area of Debris Areas C and D is larger than in Alternative 3 (Debris Area E). As a result, dust suppression requirements are more extensive to address the increased risk from demolition, excavation, and transportation, but are anticipated to be highly effective. However, because COCs are left-in-place in Debris Areas A, B, and E, and protection of human health partly relies upon ECs and ICs rather than complete removal of COCs, Alternative 4 is considered to provide a moderate degree of overall protection of human health and the environment.

7.4.2 Compliance with Applicable or Relevant and Appropriate Requirements

No potential chemical-specific ARARs for soil that present a numerical cleanup goal were identified. Because there are no chemical-specific ARARs for soil other than the waste characterization requirements, remediation goals for IR Site 31 are based on ambient levels, EPA Region 9 PRGs, and remediation goals.

No potential location-specific ARARs were identified for IR Site 31. This alternative would comply with the action-specific state ARARs for ICs identified in Table B-2 of Appendix B, and

would be an integral part of implementing the ICs. The remedial action also would be designed to comply with the identified action-specific ARARs, such as the requirement to characterize waste and the temporary staging piles.

The soil would be characterized in accordance with state and federal ARARs before it could be disposed of in a landfill. If, as a result of this characterization, the Navy determines that RCRA hazardous waste was generated as a result of the remedial action, the Navy would comply with all legally applicable RCRA requirements for off-site disposal. The Navy also would comply with the relevant and appropriate sections of the Federal Hazardous Materials Transportation Law, which have been identified in Appendix B.

7.4.3 Long-Term Effectiveness and Permanence

Under Alternative 4, ICs would supplement the ECs to limit exposure of potentially contaminated soil beneath the asphalt at Debris Areas A and B and asphalt and concrete hardscape of 11th Street (Debris Area E) and corresponding curbs and sidewalk areas at IR Site 31 over the long term. Human health risks from soils at IR Site 31 would be minimal over the long term because the existing exposure prevention barrier would be maintained and COCs would be removed from Debris Areas C and D, the asphalt schoolyard, and the parking lot and associated curbs and sidewalk. Provisions would be included to allow for subsurface repair of utilities with Debris Area E. Users of the site must comply with each of the ICs for Alternative 4 to be effective.

A RAWP would be prepared to guide implementation of ICs and inspection for compliance, maintenance, reporting, and enforcement. In accordance with California law, the land use covenant would be recorded, and hypothetical future owners would be notified through a title search of the deed restrictions. Potential alternative residential or commercial/industrial uses would be prohibited by the ICs.

Alternative 4 provides active remediation of risk associated with the following land use scenarios:

- Altered land use of the schoolyard as an unpaved play field for school children and staff; and
- Alternative land use for recreational visitors in the southeast quadrant of IR Site 31.

This alternative would not actively reduce risk associated with the alternative land use for construction workers, and no degree or level of permanence would be achieved for those risks only. However, the passive techniques incorporated into the alternative (ECs and ICs) ensure that Alternative 2 meets all of the RAOs discussed in Section 3.1.3. Alternative 4 is only moderately effective and permanent over the long term.

7.4.4 Reduction of Mobility, Toxicity, or Volume through Treatment

When soils contaminated by the identified COCs [B(a)P and dioxins] have been successfully removed, Alternative 4 would reduce the volume of hazardous substances in Debris Areas C and D. However, the reduction would be achieved not through treatment, but rather by relocating the contaminated soils to a permitted landfill. This alternative would not result in a reduction in the mobility, toxicity, or volume of these COCs in other areas of IR Site 31, including Debris Areas A, B, and E, because no remedial action is being initiated in those debris areas. Based on this assessment, Alternative 4 would not reduce the mobility, toxicity, or volume of the COCs through treatment using the technologies selected (excavation and off-site disposal). As a result, Alternative 4 is only slightly effective in reducing the mobility, toxicity, or volume of soils through treatment.

7.4.5 Short-Term Effectiveness

Alternative 4 may take up to 17 months to complete. This schedule includes developing a RAWP; excavating Debris Areas C and D, consisting of the asphalt schoolyard and parking lot (along with curbs and sidewalks); and grading, regrading, and paving the demolished hardscape. The cost estimate and anticipated duration of the project includes preparing the work plan, demolishing the pavement, coordinating with CCSF and private utilities (such as water and sewer), excavating Debris Areas C and D, collecting confirmation samples, backfilling with engineered lifts, restoring the site to current site conditions, and preparing a Remedial Action Completion Report.

Alternative 4 involves remedial construction, along with ECs and ICs. This alternative poses potential short-term risks to remedial construction workers and the public. These risks are related to the physical hazards of construction because the risk assessment has concluded the site poses a risk to construction workers based on the contamination present. Some risk could be posed to the public by construction-related traffic and the potential exposure to COCs transported by airborne dust generated during excavation activities. This risk would be minimized through designated routes for traffic and best control measures designed to reduce the potential for dust migration. Potential environmental effects, such as generation of dust, would be minimized through ECs and best management practices. The RAWP for active remediation would address these issues to ensure short-term effectiveness. Because construction would be required and the short-term risks to construction workers or the public would be limited, this alternative would be moderately effective in the short term.

7.4.6 Implementability

This alternative is technically feasible and has been implemented previously at IR Site 31. This alternative would be easy to implement technically because only limited active remediation is required. The implementation period for ICs would be in perpetuity, or until additional investigation or remediation demonstrates that the ICs are no longer required. Alternative 4 would take 17 months to be implemented.

7.4.7 Cost

The estimated total present value of Alternative 4 is $1,950,000. The detailed cost analysis for Alternative 4 includes an estimation of capital, O&M, and periodic costs. Capital costs of $1,475,000 include ECs, ICs, excavation of Debris Areas C and D, off-site disposal of soil, and restoration. O&M costs include EC and IC monitoring and enforcement ($135,000). Periodic costs include 5-year reviews and exposure prevention barrier maintenance ($340,000). The costs were estimated for a 30-year period based on 2006 dollars. The capital costs primarily involve preparation and implementation of the RAWP. The O&M costs involve periodic inspections and 5-year reviews pursuant to CERCLA. A 25 percent markup factor is included to account for Navy oversight. The total cost for ICs, however, does not include the cost for enforcing the ICs. The basis for this cost estimate is summarized in Table 7-1 and detailed in Appendix C, Table C1-C.

7.5 Detailed Analysis of Alternative 5: Complete Removal of Debris Areas A, B, C, D, and E, and Off-Site Disposal of Soil

Alternative 5 is the most extensive remedial alternative because it involves complete excavation of Debris Areas A, B, C, D, and E. This alternative includes removal of Debris Area E soil beneath 11th Street and would involve demolishing the street, replacing or rerouting utilities, excavating three areas in the schoolyard at the elementary school, and excavating soil under the corner of the parking lot east of Avenue E.

Alternative 5 would protect human health under the altered use of the schoolyard and the alternative land use for commercial/industrial workers, residents, and construction workers because contaminated soil would be excavated and disposed of off site. The estimated risk to human health would be eliminated by removing the contaminated soil within Debris Areas A, B, C, D, and E. A detailed analysis of Alternative 5 against the first seven of the nine NCP criteria is provided below.

7.5.1 Overall Protection of Human Health and the Environment

Alternative 5 would protect human health under altered site conditions for elementary school children and staff, all alternative land uses, and construction workers by removing soils contaminated with B(a)P, dioxins, and lead from Debris Areas A, B, C, D, and E and disposing of them in a permitted landfill. The removal of contaminated soil from all debris areas would reduce potential risk below the risk management range for human health at IR Site 31.

The combined excavation area of Debris Areas A, B, C, D and E is larger than for Alternative 3 (Debris Area E) and Alternative 4 (Debris Areas C and D). As a result, there is increased risk from demolition, excavation, and transportation. While risk posed by Alternative 5 is anticipated to be slightly higher than for Alternative 4, dust control techniques are anticipated to be highly effective. As a result, Alternative 5 would provide a high degree of overall protection of human

health and the environment because all areas of elevated concentrations of COCs are assumed to be completely removed.

7.5.2 Compliance with Applicable or Relevant and Appropriate Requirements

No potential chemical-specific ARARs for soil that present a numerical cleanup goal were identified. Because there are no chemical-specific ARARs for soil other than the waste characterization requirements, remediation goals for IR Site 31 are based on ambient levels, EPA Region 9 PRGs, and remediation goals.

No potential location-specific ARARs were identified for IR Site 31. The alternative would comply with action-specific ARARs, such as requirements for excavation, characterization of waste, and temporary staging piles.

The soil would be characterized in accordance with state and federal ARARs before it could be disposed of in a landfill. If, as a result of this characterization, the Navy determines that RCRA hazardous waste was generated as a result of the remedial action, the Navy would comply with all legally applicable RCRA requirements for off-site disposal. The Navy likewise would comply with relevant and appropriate sections of the Federal Hazardous Materials Transportation Law, which have been identified in Appendix B.

7.5.3 Long-Term Effectiveness and Permanence

Under Alternative 5, human health risks from soils at IR Site 31 would be eliminated by the excavation and disposal of contaminated soil from all of the debris areas at a permitted landfill. As a result, the source areas would be eliminated over the long term, and Alternative 5 would be highly effective and permanent over the long term. Alternative 5 provides a permanent solution to the elevated concentrations of COCs at IR Site 31. After the remedial action is complete, the site would be available for unrestricted commercial/industrial or residential reuse because the RAOs will have been achieved without the need for engineering controls and ICs. Therefore, this alternative is highly effective at providing long-term effectiveness and permanence.

7.5.4 Reduction of Mobility, Toxicity, or Volume through Treatment

Alternative 5 would effectively reduce the volume of hazardous substances in all of the debris areas and at IR Site 31 by removing soils exhibiting elevated concentrations of COCs [specifically B(a)P, dioxins, and lead]. However, the reduction would not be achieved through treatment, but rather by relocating the contaminated soils to a permitted landfill. Based on this assessment, Alternative 5 would not reduce the mobility, toxicity, or volume of hazardous substances by treatment. However, Alternative 5 would reduce the mobility and volume of COCs identified at IR Site 31 by removing the COCs in Debris Areas A, B, C, D and E and transporting them to an approved landfill. As a result, Alternative 5 would be moderately effective at reducing the mobility, toxicity, or volume of soils through treatment.

7.5.5 Short-Term Effectiveness

Alternative 5 may take up to 18 months to complete. This schedule includes development of a RAWP; excavation of Debris Areas A, B, C, D, and E; replacing or rerouting utilities beneath the street; and subsequently grading and paving the street. This work includes preparing the RAWP; demolishing the associated hardscape, schoolyard, parking area; coordinating with CCSF and private utilities (such as water and sewer); excavating all debris areas; backfilling; performing confirmation sampling; and preparing a completion report.

This alternative poses some potential short-term risks to remedial construction workers because construction is involved. These activities are related to the physical hazards of construction because the risk assessment concluded the site poses a risk to construction workers based on the contamination present (SulTech 2006c). Some risk would be posed to the public because of construction-related traffic and potential generation of dust. This risk could be minimized through best control measures with designated routes for traffic and dust control measures. This alternative is would provide moderate short-term effectiveness.

7.5.6 Implementability

This alternative is technically feasible and has been implemented previously at IR Site 31. For this reason, Alternative 5 is of known high reliability. Development of the RAWP and coordination with regulatory agencies would be necessary to implement Alternative 5. Alternative 5 is expected to require 18 months to complete. Construction of a new paved schoolyard area and costs associated with reconstruction of 11th Street, the southeastern quadrant parking lot, and any related curbs and sidewalks are included as part of the remedial alternative.

7.5.7 Cost

The estimated total capital cost for Alternative 5 is $2,308,000; the basis for this cost estimate is summarized in Table 7-1 and detailed in Appendix C, Table C1-D. No long-term O&M costs are required or incurred because the alternative is comprehensive and permanent. Therefore, the present value is equal to the capital costs for the alternative.

TABLES

TABLE 7-1: SUMMARY OF COSTS FOR SOIL AND GROUNDWATER ALTERNATIVES

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Description	Alternative 1: No Action	Alternative 2: ECs Combined with ICs	Alternative 3: ECs, ICs, and Excavation (Debris Area E) and Off-Site Disposal of Soil	Alternative 4: ECs, ICs, and Excavation (Debris Areas C and D) and Off-Site Disposal of Soil	Alternative 5: Excavation (Debris Areas A, B, C, D, and E) and Off-Site Disposal of Soil
Total Project Duration (Yrs.)	$0	30	30	30	1
Capital Cost	$0	$313,000	$856,000	$1,475,000	$2,308,000
Annual O&M (ICs)	$0	$135,000	$135,000	$135,000	$0
Periodic Cost – 5-Year Reviews	$0	$328,000	$328,000	$328,000	$0
Periodic Cost (Maintenance)	$0	$12,000	$12,000	$12,000	$0
Subtotal of Periodic Costs	$0	$340,000	$340,000	$340,000	$0
Total Cost in 2006 Dollars	**$0**	**$788,000**	**$1,331,000**	**$1,950,000**	**$2,308,000**

Notes: Costs in this table are rounded to the nearest $1,000

EC Engineering control

IC Institutional control

O&M Operation and maintenance

8.0 COMPARATIVE ANALYSIS OF RETAINED REMEDIAL ALTERNATIVES

This section presents a comparative analysis of the remedial alternatives retained against the first seven of nine NCP criteria identified in Section 7.0. This comparative analysis identifies the advantages and disadvantages of each alternative, providing a sound basis for remedy selection consistent with the NCP (EPA 1990). The NCP states, "The national goal of the remedy selection process is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste" (EPA 1990). After the comparative analysis of remedial alternatives (see Sections 8.1 through 8.7), the summary based on the evaluation of each analysis is presented in Section 8.8 and in Table 8-1. Section 8.9 presents the recommendations based on the results of the comparative analysis of each alternative. No significant risk to ecological receptors was identified in the RI Report (SulTech 2006c); therefore, retained remedial alternatives were not evaluated with respect to ecological risk.

8.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Overall protection of human health and the environment is a threshold evaluation criterion and the alternatives must meet this criterion, as well as compliance with ARARs, to be eligible for selection. As a result, this criterion is not used to evaluate and compare alternatives; however, a brief summary of the alternatives is provided below.

Review of the results of the HHRA indicated the current site configuration and the paved area of the schoolyard, parking lot, 11th Street, and curbs and sidewalks act as a protective barrier to the exposure pathways (see Appendix A). However, COCs were identified in shallow soils at concentrations high enough to represent an unacceptable human health risk to school children and staff under altered site conditions (unpaved) and to construction workers, residents, commercial/industrial workers, and recreation visitors under the alternative land use, assuming the existing exposure prevention barrier is removed.

The use of ECs and ICs in Alternatives 2, 3, and 4 allows these alternatives to meet the RAOs for IR Site 31. Risk to human health would be prevented by (1) maintaining the existing asphalt and concrete hardscape as exposure prevention barriers at IR Site 31; (2) providing for any utility maintenance under the asphalt or concrete hardscape in a safe manner; (3) preventing residential or commercial/industrial reuse; and (4) monitoring, maintenance, annual reporting, and 5-year reviews.

Alternative 3 would directly protect human health under the alternative land use for the construction worker by removing soils contaminated by lead in Debris Area E. Alternative 4 would directly protect human health under altered site conditions for elementary school children and staff, as well as recreational visitors, by removing soils contaminated by B(a)P and dioxin in Debris Areas C and D. RAOs would be met for residents and commercial/industrial workers under the alternative land uses by the use of ECs and ICs.

Alternative 5 would directly protect human health under altered site conditions for elementary school children and staff, as well as alternative land uses for the construction worker, resident, commercial/industrial worker, and recreational visitor, by removing soils contaminated with B(a)P, dioxins, and lead in Debris Areas A, B, C, D, and E. Complete removal of Debris Areas A, B, C, D, and E would allow for unrestricted use of the site.

However, Alternative 1 is not considered protective of human health for alternative land use receptors (residents, commercial/industrial workers, construction workers, and recreational users [of the southeast quadrant]) under alternative land use conditions (unpaved). The No-Action Alternative does not provide measures to prevent exposure to COCs identified under the alternative land use scenarios.

8.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Compliance with ARARs is also a threshold evaluation criterion. An alternative must either comply with ARARs or provide grounds for a waiver. No potential chemical-specific ARARs for soil that present a numerical cleanup goal were identified. Because there are no chemical-specific ARARs for soil other than the waste characterization requirements, remediation goals for IR Site 31 are based on ambient levels, EPA Region 9 PRGs, and remediation goals.

No location-specific ARARs were identified for IR Site 31. No action-specific ARARs apply to Alternative 1 because it does not involve initiation of any action.

Alternative 2, as well as Alternatives 3 and 4, would comply with the potential action-specific state ARARs for ICs, as identified in Table B-2 of Appendix B.

Action-specific ARARs associated with on-site waste generation, waste characterization, waste piles and excavation would be addressed as part of the RAWP for Alternatives 3, 4, and 5 to ensure compliance with ARARs.

8.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

No remedial action would be undertaken or ICs implemented under Alternative 1; therefore, Alternative 1 would not provide long-term effectiveness and permanence for preventing exposure to contaminated soils at IR Site 31 beneath the existing asphalt and concrete hardscape.

The magnitude of residual risks remaining after implementation of Alternative 1 (No Action) and Alternative 2 (Engineering Controls Combined with ICs) would be the same because contamination would not be removed or treated. These risks are within the risk management range for human health based on the current (paved) and altered (unpaved) land use of the site as a schoolyard. However, potential risks may exist if the alternative land use scenarios are such that exposure exists from direct contact with, inhalation of, or ingestion of COCs in soil.

Alternative 2 would be slightly effective and permanent over the long term because there is no active remediation of the existing risk. The risk associated with altered site conditions is not reduced for school children and staff or under the alternative land use for construction workers, residents, commercial/industrial workers, or recreational visitors. Furthermore, no degree or level of permanence is achieved.

Alternative 3 would be moderately effective and permanent over the long term because only the risk associated with alternative land use for construction workers is actively reduced. This alternative does not reduce the risk associated with altered site conditions for school children and staff or under the alternative land use for residents, commercial/industrial workers, or recreational visitors. Furthermore, no degree or level of permanence is achieved.

Alternative 4 would be moderately effective and permanent over the long term because risk associated with altered site conditions is actively reduced for school children and staff and for recreational visitors. Risk also is reduced under the alternative land use for residents and commercial/industrial workers. This alternative would not reduce risk associated with alternative land use for construction workers, and no degree or level of permanence would be achieved for those risks.

Under Alternative 5, human health risks from soils at IR Site 31 would be eliminated over the long term by excavation and disposal of contaminated soil from all the debris areas at a permitted landfill. As a result, Alternative 5 would be highly effective and permanent over the long term. Alternative 5 provides a permanent solution to the COCs at IR Site 31. After the remedial action is complete, the site would be available for unrestricted use, including institutional (school), residential, recreational, and commercial/industrial. Therefore, this alternative provides the highest level of attainment associated with long-term effectiveness and permanence.

8.4 REDUCTION OF MOBILITY, TOXICITY, OR VOLUME THROUGH TREATMENT

None of the remedial alternatives would reduce the toxicity, mobility, or volume of chemicals at IR Site 31 through treatment because treatment technologies would not effectively reduce the COCs identified for this site. The COCs identified for IR Site 31 include B(a)P, dioxins, and lead. These COCs have been known to persist in soils and are not expected to degrade quickly in the surficial soils, so a reduction in the toxicity or volume is not expected by leaving these COC in place under any of the alternatives.

Alternatives 3, 4, and 5 would each require relocation of contaminated soil to a permitted landfill, which does not qualify as treatment. Alternatives 3, 4, and 5 do not treat the potential contamination or reduce its overall toxicity or volume. However, Alternatives 3, 4, and 5 reduce the overall mobility by removing contamination in Debris Areas A, B, C, D, or E and transporting and disposing of it in an approved landfill. Additionally, the site-specific toxicity, mobility, and volume of COCs at IR Site 31 is reduced by removal of the contamination in Debris Areas A, B, C, D, or E.

8.5 SHORT-TERM EFFECTIVENESS

This criterion examines the effectiveness of the alternative during construction and implementation of the remedy until the RAO is met. No remedial action is involved under Alternative 1, so no new health risks are posed to the community, current occupants, workers, or the environment in the short term. Existing site conditions are considered protective of human health and the environment under current land use as a paved schoolyard at IR Site 31; therefore, this alternative is considered highly effective in the short term.

Alternative 2 would not introduce a risk to the community or the environment in the short term because no active remedial action will be conducted. Alternative 2 would not involve remedial construction because all of the ECs are in place. Therefore, no construction would be required and no short-term risks to construction workers or the public would be created by this alternative. This alternative would be highly effective in the short term. Alternative 2 can quickly meet the RAO.

Alternatives 3, 4, and 5 would introduce a minimal degree of risk to the community during field activities from the potential generation of airborne dust during excavation and truck traffic associated with disposal and backfill; however, these risks could be minimized through best management practices such as traffic control and dust control measures. Dust control techniques and dust monitoring at the perimeter of the excavation areas are proven ECs and are anticipated to be highly effective.

For Alternative 3, the risk assessment indicated the cancer risk to the construction worker is below the risk management range from B(a)P and dioxins at the site (SulTech 2006c); however, any construction or demolition poses some risks to workers because of the presence of lead within Debris Area E. These construction-related risks can be minimized through best management safety practices. The RAWP for active remediation would address these issues to ensure short-term effectiveness. Similarly, Alternatives 4 and 5 would pose some risk to construction workers because of the presence of B(a)P and dioxins in Debris Areas C and D. Alternatives 3, 4, and 5 pose some potential short-term risks to remedial construction workers because construction is involved. These activities are related to the physical hazards of construction, as well as chemical hazards, since the risk assessment has concluded the site poses a risk to construction workers based on the contamination present.

8.6 IMPLEMENTABILITY

Implementability evaluates the technical and administrative feasibility of the alternative and the availability of required resources. All of the alternatives are technically feasible. Alternative 1 does not require any efforts to implement. From an administrative perspective and technical perspective, Alternatives 2, 3, 4, and 5 are proven methods, and it is unlikely that technical or administrative problems would delay any of these alternatives. The materials and services necessary to implement Alternatives 2, 3, 4, and 5 are readily available locally. All of the alternatives are considered equally implementable, and the expected durations are as follows:

- Alternative 1 can be implemented immediately.
- Alternative 2 would take 9 months to be implemented.
- Alternative 3 would take 16 months to be implemented
- Alternative 4 would take 17 months to be implemented
- Alternative 5 would take 18 months to be implemented

The implementation period for ICs related to Alternatives 2, 3, and 4 would be in perpetuity, or until additional investigation or remediation demonstrates that the ICs are no longer required. The cost estimate assumed a 30-year period for ICs for Alternatives 2, 3 and 4.

8.7 COST

Estimated total capital costs for each alternative are summarized in Table 8-1. These cost estimates were prepared based on commercially available cost estimating tools and previous estimates (published and unpublished) for similar projects. Actual costs will depend on current labor rates, productivity, the final project schedule, and other variable factors at the time the remedial action is implemented. No costs are associated with Alternative 1.

The estimated total present value of Alternative 2 is $788,000. The estimated total present value of Alternative 3 is $1,331,000. The estimated total present value of Alternative 4 is $1,950,000. The estimated total capital costs for Alternative 5 is $2,308,000. No required and no incurred long-term O&M costs are associated with Alternative 5 since the alternative would be comprehensive and permanent, so that no further actions are required. Therefore, the present value of Alternative 5 is equal to the capital costs and is equal to the total cost. Although Alternative 5 includes excavation of all Debris Areas A, B, C, D, and E and off-site disposal of contaminated soil, the relative cost of Alternative 5 compared with Alternative 4 is only slightly higher because it does not include the costs associated with ECs and ICs.

Costs also are incurred for Alternatives 2, 3, and 4 for annual O&M present value costs of $135,000 over 30 years. A present value cost of $340,000 also applies to Alternatives 2, 3, and 4 for periodic costs associated with ECs and ICs over 30 years.

8.8 COMPARATIVE ANALYSIS SUMMARY

For the two threshold criteria, *Overall Protection to Human Health and the Environment* and *Compliance with ARARs*, Alternative 1, the No-Action Alternative, provides the least degree of protectiveness, but meets the threshold criteria for current land use (current paved site conditions for elementary school children and staff). Alternative 1 would not meet the threshold criteria for altered site conditions for elementary school children or staff or alternative land use for the construction worker, utility worker, resident, commercial/industrial worker, or recreational visitor based on these land uses scenarios. Alternatives 2, 3, 4, and 5 each would protect human health and the environment for all land use scenarios and would comply with corresponding action-specific ARARs (Alternatives 2, 3, and 4). No ARARs apply to Alternative 1 because it would not involve any actions on site, such as ECs, ICs, or remedial action.

The balancing criteria, *Reduction of Toxicity, Mobility, or Volume through Treatment* and *Implementability*, were indistinguishable in the comparative analysis of Alternatives 2, 3, 4, and 5, and only slightly different for Alternative 1. These two balancing criteria do not clearly identify any preferred alternative over another. However, the remaining balancing criteria (*Long-Term Effectiveness and Permanence*, *Short-Term Effectiveness*, and *Cost*) more definitively identify more appropriate alternatives. Table 8-2 summarizes the ranking of Alternatives 1 through 5 for each of these three balancing criteria.

Alternative land uses, such as residential or commercial/industrial use, were found to pose cancer risks within the risk management range. Alternative 2 would allow for the elementary schoolyard to continue operating, and would use ICs to ensure that the existing exposure prevention barrier is maintained. Alternatives 3, 4, and 5 would require demolition of the pavement and excavation to remove various debris areas containing COCs.

Short-term effectiveness of Alternative 5 is less than Alternatives 2 and 3, but will be minimized, and the costs for implementation of Alternative 5 are correspondingly more expensive than the passive techniques involved in Alternatives 2 and 3. However, Alternative 5 offers a greater degree of overall protection of human health and the environment, long-term effectiveness, and reduction in toxicity, mobility, and volume of COCs at IR Site 31 as compared with the other alternatives.

8.9 RECOMMENDATION

Based on the comparative analysis described above and presented in Tables 8-1 and 8-2, Alternative 5 offers advantages compared with the other alternatives. Alternative 5 would limit or prevent exposure by using active remediation by excavation and off-site disposal to reduce risks for altered land uses for elementary school children and staff, and alternate land uses for construction workers, utility workers, residents, commercial/industrial workers, and recreational visitors. Additionally, Alternative 5 would provide for unrestricted land use at IR Site 31 (without the need for ECs and ICs) and is considered to provide the most conservative level of protection of human health and the environment. Based on the results of the comparative analysis of remedial alternatives, the site use, and the proximity to the daycare center, the Navy recommends Alternative 5 as the preferred alternative.

TABLES

TABLE 8-1: SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Effectiveness Criteria	Alternative 1: No Action	Alternative 2: ECs Combined with ICs	Alternative 3: ECs, ICs, and Excavation (Debris Area E) and Off-Site Disposal of Soil	Alternative 4: ECs, ICs, and Excavation (Debris Areas C and D) and Off-Site Disposal of Soil	Alternative 5: Excavation (Debris Areas A, B, C, D, and E) and Off-Site Disposal of Soil
	Comment	**Comment**	**Comment**	**Comment**	**Comment**
Threshold Criteria[a]					
1. Overall Protection of Human Health and the Environment	Threshold not achieved: No protection to human health and the environment would be provided.	Threshold achieved: Protection to human health and the environment would be provided.	Threshold achieved: Protection to human health and the environment would be provided.	Threshold achieved: Protection to human health and the environment would be provided.	Threshold achieved: Protection to human health and the environment would be provided.
2. Compliance with ARARs	Not applicable.	Threshold achieved: Meets ARARs.	Threshold achieved: Meets ARARs.	Threshold achieved: Meets ARARs.	Threshold achieved: Meets ARARs.
Primary Balancing Criteria[b]					
3. Long-Term Effectiveness and Permanence	Not effective and permanent because it does not address altered or alternative site uses.	Moderately effective in the long term by preventing exposure to soil beneath the asphalt and concrete hardscape.	Moderately effective in the long term by both removal of some source material and use of ECs and ICs to prevent exposure to soil beneath the asphalt and concrete hardscape.	Moderately effective in the long term by both removal of some source material and use of ECs and ICs to prevent exposure to soil beneath the asphalt and concrete hardscape.	Highly effective and permanent in the long term by eliminating the source by excavation and off-site disposal.
4. Reduction in Toxicity, Mobility, or Volume through Treatment	It would not reduce toxicity, mobility, or volume through treatment.	Would not reduce the toxicity, mobility, and volume through treatment, but would reduce or eliminate the exposure risk pathways.	Would not reduce the toxicity, mobility, and volume through treatment, but would reduce the volume of contamination at IR Site 31 by transporting the contaminated soil to a permitted landfill.	Would not reduce the toxicity, mobility, and volume through treatment, but would reduce the volume of contamination at IR Site 31 by transporting the contaminated soil to a permitted landfill.	Would not reduce the toxicity, mobility, and volume through treatment, but would reduce the volume of contamination at IR Site 31 by transporting the contaminated soil to a permitted landfill.

TABLE 8-1: SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES (CONTINUED)
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Effectiveness Criteria	Alternative 1: No Action	Alternative 2: ECs Combined with ICs	Alternative 3: ECs, ICs, and Excavation (Debris Area E) and Off-Site Disposal of Soil	Alternative 4: ECs, ICs, and Excavation (Debris Areas C and D) and Off-Site Disposal of Soil	Alternative 5: Excavation (Debris Areas A, B, C, D, and E) and Off-Site Disposal of Soil
	Comment	Comment	Comment	Comment	Comment
Primary Balancing Criteria[b] (Continued)					
5. Short-Term Effectiveness	No short-term risk because no active remediation activities are proposed.	No short-term risk because no active remediation activities are proposed. Quickly achieves RAOs.	Imposes slight short-term risks during the pavement demolition and excavation. Takes 16 months to achieve final RAOs.	Imposes modest short-term risks during the pavement demolition and excavation. Takes 17 months to achieve final RAOs.	Imposes moderate short-term risks during the pavement demolition and excavation. Takes 18 months to achieve final RAOs.
6. Technical and Administrative Implementability	Readily implementable.	Readily Implementable.	Readily Implementable.	Readily Implementable.	Readily Implementable.
7. Present Value (in 2006 $)	$0	$788,000	$1,331,000	$1,950,000	$2,308,000
Modifying Criteria[c]					
8. State Acceptance	*	*	*	*	*
9. Community Acceptance	*	*	*	*	*

Notes:

*	State and community acceptance are modifying criteria, and include regulatory agency and public comments on the proposed alternatives in the Proposed Plan and will be addressed during development of the Record of Decision.
a	The first two criteria are threshold criteria. The selected remedial alternatives must meet the threshold criteria.
b	These criteria are primary balancing criteria used to evaluate the alternative.
c	The last two criteria are modifying criteria that evaluate issues or concerns the state or public may have regarding each of the alternatives.

ARAR	Applicable or relevant and appropriate requirement	IR	Installation Restoration
EC	Engineering control	RAO	Remedial action objective
IC	Institutional control		

TABLE 8-2: RELATIVE RANKING OF REMOVAL ALTERNATIVES

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, CA

Evaluation Criteria[a]	Alternative 1: No Action	Alternative 2: ECs Combined with ICs	Alternative 3: ECs, ICs, and Excavation (Debris Area E) and Off-Site Disposal of Soil	Alternative 4: ECs, ICs, and Excavation (Debris Areas C and D) and Off-Site Disposal of Soil	Alternative 5: Excavation (Debris Areas A, B, C, D, and E) and Off-Site Disposal of Soil
Overall Protection of Human Health and the Environment	5	3	3	2	1
Compliance with ARARs	5	1	1	1	1
Long-Term Effectiveness	5	4	3	2	1
Reduction of Toxicity, Mobility, Volume by Treatment[b]	5	5	3	2	1
Short-Term Effectiveness	1	2	2	3	4
Implementability	1	2	2	2	3
Cost	1	2	3	4	4[c]
Sum	**23**	**19**	**17**	**16**	**15**
Overall Rating	**5**	**4**	**3**	**2**	**1**

Ranking Scale:

1 Meets Criteria Best

5 Meets Criteria Least

Notes:

a Evaluation criteria does not include modifying criteria. State and community acceptance are modifying criteria, and include regulatory agency and public comments on the proposed alternatives in the Proposed Plan and will be addressed during development of the Record of Decision.

b Although this criterion is based on the reduction of toxicity, mobility, and volume by treatment, the scores for this category also consider reduction in toxicity, mobility and volume resulting from excavation of contaminated soil at IR Site 31.

c Although Alternative 5 is estimated to be more costly than Alternative 4, Alternative 5 does not include engineering controls and institutional controls (future costs) and is considered to have lower cost variability. Therefore Alternative 4 and Alternative 5 are considered to rate the same score for cost.

ARAR Applicable or relevant and appropriate requirement

EC Engineering control

IC Institutional control

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APPENDIX A
DEVELOPMENT OF CONTAMINANTS OF CONCERN AND SCREENING OF POTENTIAL REMEDIAL ACTION ALTERNATIVES

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS ..... A-iii

A1.0 INTRODUCTION A-1

A2.0 FEASIBILITY STUDY TECHNICAL SCOPING MEETING A-1

A3.0 HUMAN HEALTH RISK ASSESSMENT A-2

A4.0 DEVELOPMENT OF CHEMICALS OF CONCERN A-4

A5.0 SCREENING OF POTENTIAL REMEDIAL ALTERNATIVES A-7

A5.1 SCREENING CRITERIA FOR POTENTIAL REMEDIAL ALTERNATIVES A-9

A5.1.1 Effectiveness A-9

A5.1.2 Implementability A-10

A5.1.3 Cost A-10

A5.2 ANALYSIS OF POTENTIAL REMEDIAL ALTERNATIVES A-11

A5.2.1 Analysis of Potential Remedial Alternative I – No Action A-11

A5.2.2 Analysis of Potential Remedial Alternative II – Engineering Controls Combined with Institutional Controls A-11

A5.2.3 Analysis of Potential Remedial Alternative III – Engineering Controls, Institutional Controls, and Excavation (Debris Area C) and Off-Site Disposal of Soil A-12

A5.2.4 Analysis of Potential Remedial Alternative IV – Engineering Controls, Institutional Controls, and Excavation (Debris Area E) and Off-Site Disposal of Soil A-13

A5.2.5 Analysis of Potential Remedial Alternative V – Engineering Controls, Institutional Controls, and Excavation (Debris Areas C and D Excluding Street) and Off-Site Disposal of Soil A-14

A5.2.6 Analysis of Potential Remedial Alternative VI – Engineering Controls, Institutional Controls, and Excavation (Debris Areas A, B, C, and D Excluding Street) and Off-Site Disposal of Soil A-15

A5.2.7 Analysis of Potential Remedial Action Alternative VII – Complete Removal of Debris Areas A, B, C, D, and E and Off-Site Disposal of Soil A-16

A6.0 SUMMARY OF RISK REDUCTION FOR RETAINED REMEDIAL ALTERNATIVES A-18

A7.0 REFERENCES A-20

TABLES

A-1 COPCs Exceeding Thresholds Using Default Q_{soil} Values

A-2 Changes to COPCs Exceeding Thresholds for Residents and Commercial/Industrial Workers Using Site-Specific Q_{soil} Values

A-3 COPCs Exceeding Thresholds, Recreational Exposures in Southeast Quadrant

A-4 Proposed Chemicals of Concern

A-5 Recalculated Cancer Risk and Noncancer HI Estimates, Adjusted for Removal of Soil from Debris Area C

A-6 Recalculated Cancer Risk and Noncancer HI Estimates, Adjusted for Removal of Soil from Debris Areas C and D

A-7 Recalculated Cancer Risk and Noncancer HI Estimates, Adjusted for Removal of Soil from Debris Areas A, B, C, and D

A-8 Summary of Screening of Potential Remedial Alternatives, Extent of Tier III Risk Assessment and Sample Points Excluded

ACRONYMS AND ABBREVIATIONS

µg/dL	Microgram per deciliter
B(a)P	Benzo(a)pyrene
BCT	BRAC Cleanup Team
bgs	Below ground surface
BRAC	Base Realignment and Closure
Cal/EPA	California Environmental Protection Agency
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CCSF	City and County of San Francisco
COC	Chemical of concern
COPC	Chemical of potential concern
DDT	Dichlorodiphenyltrichloroethane
DTSC	Department of Toxic Substances Control
EC	Engineering control
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration
FS	Feasibility study
GRA	General response action
HHRA	Human health risk assessment
HI	Hazard index
HQ	Hazard quotient
IC	Institutional control
IR	Installation Restoration
mg/kg	Milligram per kilogram
NAVSTA TI	Naval Station Treasure Island
Navy	U.S. Department of the Navy
ng/kg	Nanogram per kilogram
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
PAH	Polycyclic aromatic hydrocarbon
PRG	Preliminary remediation goal
RAO	Remedial action objective
RI	Remedial investigation
RME	Reasonable maximum exposure
TEQ	Toxicity equivalent

A1.0 INTRODUCTION

This appendix summarizes the results of the human health risk assessment (HHRA) conducted as part of the Final Remedial Investigation (RI) Report for Installation Restoration (IR) Site 31 (SulTech 2006b). This appendix also identifies the chemicals of concern (COC) used to develop the general response actions (GRA) and remedial action objectives (RAO), and then screens the potential remedial alternatives to identify the most applicable alternatives for the site. The retained alternatives are discussed further in the main body of the Feasibility Study (FS) Report. Lastly, this appendix presents an evaluation of the reduction of risk for the retained alternatives.

This appendix is organized into seven sections, including this introduction. An outline of the general topics discussed in the remaining sections is presented below.

- **Section A2.0, Feasibility Study Technical Scoping Meeting** – summarizes the technical scoping meeting for the FS Report.
- **Section A3.0, Human Health Risk Assessment** – provides information from the HHRA relevant for making risk management decisions.
- **Section A4.0, Development of Chemicals of Concern** – describes how the COCs were developed.
- **Section A5.0, Screening of Potential Remedial Alternatives** – presents and screens the potential alternatives using risk assessment results. This screening process helps streamline the FS process, while ensuring the most promising remedial alternatives are evaluated.
- **Section A6.0, Summary of Risk Reduction for Retained Remedial Alternatives** – summarizes the risk reduction of each retained remedial alternative.
- **Section A7.0**, References – lists the references used in this appendix.

Tables are provided at the end of the document following Section A7.0.

A2.0 FEASIBILITY STUDY TECHNICAL SCOPING MEETING

The potential remedial alternatives were developed during a technical scoping meeting on July 21, 2006, for the FS with the Base Realignment and Closure (BRAC) Cleanup Team (BCT) (SulTech 2006a). The following topics were discussed during the meeting:

- Site use
- Revised risk calculations
- COC tables

- RAOs developed for the FS
- Technologies associated with process options
- Innovative technologies considered in screening
- Alternatives
- Final remedial alternatives proposed for the FS
- Cost estimate approach
- Community relations schedule
- Milestone dates for the FS schedule

The BCT meets monthly for updates on the progress of environmental cleanup at Naval Station Treasure Island (NAVSTA TI) and to reach consensus on decisions with federal and state regulatory agencies. The BCT includes the U.S. Department of the Navy's (Navy) BRAC Environmental Coordinator and representatives from the U.S. Environmental Protection Agency (EPA) Region 9 and the California Environmental Protection Agency's (Cal/EPA) Department of Toxic Substances Control (DTSC). Other key participants on the BCT include Navy Remedial Project Managers, representatives from the Cal/EPA's San Francisco Bay Regional Water Quality Control Board and the City and County of San Francisco (CCSF), and technical consultants.

A3.0 HUMAN HEALTH RISK ASSESSMENT

This section summarizes the results of the quantitative HHRA for IR Site 31, presented in the Final IR Site 31 RI Report (SulTech 2006b), that were used to develop the COCs. The methodology used to prepare the HHRA was developed in consultation with the EPA Region 9 and the DTSC and in accordance with risk assessment guidelines from EPA (1989), DTSC (1992), and the Navy (2001a, 2001b). The HHRA methodology followed EPA's four-step process: (1) data evaluation and identification of chemicals of potential concern (COPC), (2) exposure assessment, (3) toxicity assessment, and (4) risk and hazard characterization.

COPCs identified in soil at IR Site 31 included (but were not limited to) Aroclor-1260, benzo(a)anthracene, benzo(a)pyrene [B(a)P], benzo(b)fluoranthene, benzo(k)fluoranthene, cadmium, copper, 4,4'-dichlorodiphenyldichloroethane, 4,4'-dichlorodiphenyldichloroethene, 4,4'-dichlorodiphenyltrichloroethane (-DDT), polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans (dioxins), indeno(1,2,3-cd)pyrene, iron, lead, and naphthalene. Complete lists of the COPCs identified in soil at IR Site 31 are provided in Section 6.1.2.1 of the Final RI Report. COPCs identified in groundwater at IR Site 31 included barium, benzene, methyl-tert-butyl ether, and toluene.

Table A-1 presents a list of the COPCs evaluated in the HHRA under reasonable maximum exposure (RME) scenarios that exceeded risk management thresholds identified by EPA (1989, 1991). Specifically, the table presents COPCs contributing chemical-specific cancer risks greater than 1×10^{-6} (the low end of the EPA risk management range [10^{-6} to 10^{-4}]); COPCs contributing chemical-specific, noncancer hazard quotients (HQ) greater than 1; and exceedances of lead thresholds identified in the HHRA (SulTech 2006b). All COPCs presented were based on exposure to soil; no COPCs in groundwater exceeded risk management thresholds. Most of the COPCs presented in Table A-1 contribute chemical-specific cancer risks within the EPA risk management range (10^{-6} to 10^{-4}) for the RME scenarios evaluated. Cases of COPCs contributing chemical-specific cancer risks greater than 1×10^{-4} are noted (marked in bold), as are all cases of COPCs contributing chemical-specific, noncancer HQs greater than 1 and all exceedances of lead thresholds. These cases were considered relevant for the identification of potential COCs. For elementary school children and hypothetical adult and child residents, the lead threshold used as a risk management benchmark was a 99th percentile blood-lead level of 10 micrograms per deciliter (µg/dL) calculated by DTSC's LeadSpread model (Version 7.0) (DTSC 1999). For all worker scenarios (elementary school staff, construction worker, and commercial industrial worker), the lead threshold used as a risk management benchmark was an exposure point concentration (EPC) greater than the EPA Region 9 preliminary remediation goal (PRG) of 800 milligrams per kilogram (mg/kg) for industrial soils (EPA 2004).

Risk estimates were prepared by two different methods in the HHRA, referred to as Method 1 and Method 2, to account for different federal and state requirements for selecting COPCs and toxicity criteria (see Table A-1). Method 1 risk estimates were prepared to satisfy federal (Navy and EPA) requirements, and Method 2 risk estimates were prepared to satisfy state (DTSC) requirements. In a few cases, employing the two methods resulted in different COPCs exceeding risk management thresholds for each. Two volatile COPCs, bis(2-chloroethyl)ether and naphthalene, contributed significantly elevated cancer risks using Method 2 for the resident and commercial/industrial worker (see Table A-1). Similarly, naphthalene contributed noncancer HQs for these receptors under both methods that were greater than 1. These chemical-specific cancer risks and HQs were elevated largely due to contributions from the inhalation of indoor air pathway. The cancer risks and HQs for volatile COPCs [bis(2-chloroethyl)ether, naphthalene, benzene, and methylene chloride] for this pathway were based on the use of default average vapor flow rate (referred to as Q_{soil} in the vapor intrusion model) values recommended by DTSC (2004b). As detailed in Appendix I, Section I.12.2.5 of the Final RI Report, default Q_{soil} values are based on coarse-grained soils (SulTech 2006b). However, the predominant soil type found at IR Site 31 is fine-grained loamy sand, as discussed in Attachment I2 of the Final RI Report (SulTech 2006b). As a result, use of the default Q_{soil} values is likely to have resulted in overly conservative vapor intrusion modeling results.

To analyze the effect of Q_{soil} on the cancer risks and noncancer hazards estimated for the vapor intrusion pathway, DTSC's 2003 Advanced Vapor Intrusion Model was used, with loamy sand as the site-specific soil type, to calculate alternative, site-specific Q_{soil} values (DTSC 2003). These alternative site-specific Q_{soil} values were then used to recalculate cancer risks and noncancer hazards for residents and commercial/industrial workers for the vapor intrusion pathway at IR Site 31, where indoor inhalation exposures were significant. Results of this evaluation are presented in Appendix I, Section I.12.2.5 of the Final RI Report (SulTech 2006b). Table A-2 lists the COPCs exceeding risk management thresholds for residents and commercial/industrial workers associated with the site-specific Q_{soil} evaluation. COPCs affected

by the shift in Q_{soil} values are italicized in Table A-2, along with the resulting change to their status as COPCs exceeding risk management thresholds and to their cancer risks and HQs. As presented, only volatile COPCs are sensitive to the Q_{soil} parameter and only the cancer risks and HQs contributed by these COPCs are affected by the shift from default to site-specific Q_{soil} values. The Q_{soil} values used in either evaluation simulate potential vapor flow into a hypothetical commercial/industrial or residential building on top of the site with no engineering controls or removal of the source or contaminated media.

Finally, Table A-3 lists the COPCs evaluated in the screening-level (Navy Tier 1) risk assessment for the southeast quadrant that exceeded risk management thresholds (Navy 2001a). The southeast quadrant, the southeast corner of the site extending east of the sidewalk of Avenue E, is likely to be redeveloped for recreational use as originally documented in the Reuse Plan (CCSF 1996). To conduct this screening-level assessment, EPCs of detected chemicals in soil, except for lead, were screened against EPA Region 9 PRGs for residential soil to be protective of potential recreational use of the area. Because the residential exposure parameters associated with the PRGs are considered overly protective for recreational use, the resulting cancer risks and HQs (estimated by proportional comparison of EPCs with PRGs) are considered conservative for the recreational visitor. This overestimation provides a margin of safety and eliminates uncertainty in using professional judgment to derive exposure parameters for recreational visitors or in justifying alternative PRGs for industrial soil as adequately protective for these receptors. As discussed in Section I.10.3 of Appendix I of the Final RI Report (SulTech 2006b), it would be inappropriate to include lead in an additive PRG-based approach based on its unique toxicological and pharmacological properties. Instead, DTSC's LeadSpread model (Version 7.0) was used to calculated blood-lead levels for hypothetical adult and child residents as protective of recreational visitors (DTSC 1999). Arsenic, B(a)P, dioxins, and lead were identified as COPCs exceeding risk management thresholds during evaluation of the southeast quadrant. Arsenic and lead were identified as COPCs exceeding risk management thresholds only when it is assumed that soil is brought to the surface from the subsurface during redevelopment of the area.

A4.0 DEVELOPMENT OF CHEMICALS OF CONCERN

COCs were developed from the COPCs presented in Tables A-1, A-2, and A-3. All COPCs presented exceeded risk management thresholds for exposure to soil; no COPCs in groundwater exceeded risk management thresholds. To develop COCs, each COPC exceeding risk management thresholds was subjected to an objective analysis and risk management screening process. Factors considered during the risk management screening included relative risk to other COPCs, proximity of risk to the low end of the EPA risk management range (point of departure of 1×10^{-6}), collocation with other COPCs, and frequency of COPC detection. The identification of COCs allows for an assessment of the potential for the remedial alternatives to reduce risk at IR Site 31 (see Section A5.0).

COCs developed from the COPCs presented in Tables A-1 and A-2 include B(a)P, dioxins, and lead. Aside from B(a)P, the remaining polycyclic aromatic hydrocarbons (PAH)–benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene–presented in Tables A-1 and A-2 were determined to be close enough to the point of departure of 1×10^{-6} for all evaluated scenarios to warrant exclusion from the COC list. Furthermore, any

active remediation of B(a)P would eliminate much of the contamination of the excluded PAHs because they are generally collocated with B(a)P.

4,4'-DDT, the only COPC exceeding risk management thresholds for elementary school staff under current site conditions, also was excluded from the COC list. As discussed in the HHRA of the Final RI Report, the identification of 4,4'-DDT as a COPC exceeding risk management thresholds for elementary school staff is partly due to the use of a conservative outdoor soil-to-indoor dust transfer factor recommended by the Office of Environmental Health and Hazard Assessment for assessing on-site health risks at existing and proposed school sites (Office of Environmental Health Hazard Assessment 2004). The use of this transfer factor resulted in overestimated risks from exposure to indoor dust for the elementary school receptor scenarios evaluated for IR Site 31. Furthermore, upon review of the data for 4,4'-DDT, only one detected concentration exceeded the EPA Region 9 PRG for residential soil, used as the field screening level; the exceedance (53 mg/kg) was J-qualified (estimated between the detection limit and the reporting limit). The remaining detected concentrations were nearly three orders of magnitude lower, and were more than an order of magnitude below the residential soil PRG (SulTech 2006b). As a result, the EPC (12.4 mg/kg) for 4,4'-DDT was biased high. With the estimated risk close to the point of departure of 1×10^{-6} and overestimated, 4,4'-DDT was excluded from the COC list.

B(a)P and dioxins were identified as COCs for elementary school receptors for altered site conditions in which the schoolyard is redeveloped as an unpaved play yard (for example, a sports field), and exposure is assumed to be complete to surface soil in this schoolyard area. Concentrations of these chemicals were elevated in the debris area identified in the Final RI Report as Debris Area C (SulTech 2006b). Remediation of B(a)P in this debris area will eliminate elevated concentrations of other PAHs identified as COPCs exceeding risk management thresholds [such as benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene]. All dioxin toxicity equivalent (TEQ) concentrations detected within Debris Area C exceeded the established ambient soil dioxin TEQ concentration for NAVSTA TI of 12 nanograms per kilogram ([ng/kg] DTSC 2004a).

B(a)P and dioxins also were identified as COCs for site-wide residential and commercial/industrial worker exposure, assuming the site is redeveloped for either alternative land use. Site-wide, B(a)P contamination is limited to Debris Area C and an additional debris area identified in the Final RI Report as Debris Area D (SulTech 2006b). B(a)P was only detected in 4 of 164 samples in site-wide combined surface and subsurface soil (0 foot below ground surface [bgs] to groundwater), and all four results were "J-qualified." Consequently, some degree of uncertainty resulting in a potential overestimate of risk is possible from the use of the EPC for B(a)P. However, concentrations (and corresponding risks) were significant enough and collocated with concentrations of other PAHs identified as COPCs exceeding risk management thresholds that B(a)P was retained as a COC for these alternative land use scenarios. Site-wide, estimates of dioxin TEQ concentrations exceeded the established ambient soil dioxin TEQ concentration for NAVSTA TI in all samples collected from Debris Areas C and D and in one sample from the debris area identified in the Final RI Report as Debris Area E.

Lead was identified as a COC for all alternative land use scenarios involving exposure to site-wide combined surface and subsurface soil (0 foot bgs to groundwater). Additionally, lead is considered a COC based on an evaluation of potential utility worker exposure to combined

surface and subsurface soil beneath 11th Street. Use of the site-specific Q_{soil} vapor intrusion modeling parameter resulted in a refined list of volatile COPCs exceeding risk management thresholds for residents and commercial/industrial workers (see Table A-2). Benzene and methylene chloride, identified as COPCs exceeding risk management thresholds using default Q_{soil} values, were not identified as COPCs using site-specific Q_{soil} values for most of these scenarios. For this reason, and considering the chemical-specific cancer risks using default Q_{soil} values were close to the point of departure of 1×10^{-6}, these benzene and methylene chloride were excluded from the COC list. The COPCs eliminated by use of site-specific Q_{soil} values are marked by strikeout in Table A-2.

Bis(2-chloroethyl)ether was identified as a Method 2 COPC contributing cancer risks above the EPA risk management range via inhalation of indoor air, but it is likely these potential cancer risks were overestimated because the compound was only detected once (in a sample from the unpaved area east of the schoolyard) in 147 site-wide samples and the one detected result was estimated (J-qualified). Because bis(2-chloroethyl)ether was only detected once and is not known to persist in the environment, it was not included as a COC for IR Site 31.

Use of site-specific Q_{soil} values also resulted in reduced HQs and Method 2 cancer risks for naphthalene. HQs remained above 1 for the residential exposure scenarios evaluated. As presented in the Final RI Report (SulTech 2006b), the estimated HQs and Method 2 cancer risks for residential exposure to naphthalene are protective of a hypothetical residence built over Debris Area C, but potentially biased because the maximum concentrations detected in two samples from Debris Area C were used as the source term for indoor air modeling. Excluding the two detected concentrations of naphthalene from Debris Area C, the remaining concentrations detected in six samples from Debris Areas D and E still contribute significantly to the HQs estimated for site-wide residential exposure to naphthalene in indoor air; the resulting HQ is above 1 using default Q_{soil} values (SulTech 2006b). However, all detected concentrations of naphthalene are commingled with elevated concentrations of the other COCs [B(a)P, dioxins, and lead] identified for IR Site 31. Remedial alternatives designed to address the elevated concentrations of B(a)P, dioxins, and lead in Debris Areas C, D, and E would coincidentally address the detected concentrations of naphthalene that may pose an unacceptable hazard to hypothetical residents. As a result, naphthalene was excluded as an additional COC.

COCs also were identified based on the list of COPCs evaluated in the Navy Tier 1 risk assessment (Navy 2001a) for the southeast quadrant that exceeded risk management thresholds (see Table A-3). As discussed in Section A3.0, B(a)P and dioxins were identified as COPCs exceeding risk management thresholds for exposure to surface soil (0 to 2 feet bgs) and exposure to combined surface and subsurface soil (0 foot bgs to groundwater). The risks associated with these chemicals can be largely attributed to the small sample size in the southeast quadrant, which required use of the maximum detected concentration as the EPC for both B(a)P and dioxins. B(a)P was detected in one of seven surface soil (0 to 2 feet bgs) samples and in one of six samples collected from subsurface soil (2 feet bgs to groundwater). Dioxins, on the other hand, were only analyzed for in one of the seven surface soil samples collected and in one of the additional six subsurface soil samples collected from the southeast quadrant. In both samples, the dioxin TEQ concentrations (24.2 and 54.6 ng/kg) exceeded the EPA Region 9 PRG for dioxins in residential soil of 3.9 ng/kg, as well as the established ambient soil dioxin TEQ concentration for NAVSTA TI of 12 ng/kg (DTSC 2004a). As a result, B(a)P and dioxins were identified as COCs.

Arsenic and lead were identified as additional COPCs exceeding risk management thresholds for the combined surface and subsurface soil exposure scenario. It should be noted, however, that arsenic exceeded ambient concentrations (and therefore was identified as a "site-related" chemical) in combined surface and subsurface soil on the basis of a single outlier (detected concentration of 16.3 mg/kg). Aside from this outlier, the range of arsenic concentrations in combined surface and subsurface soil (1.3 to 6.8 mg/kg) was comparable to the range of arsenic concentrations in surface soil (1.7 to 6.8 mg/kg), where arsenic was determined to be within ambient concentrations. Therefore, arsenic was not identified as a COC. In the case of lead, blood-lead modeling performed using the maximum detected concentration (354 mg/kg) in combined surface and subsurface soil resulted in a 99th percentile concentration (11.4 µg/dL) above 10 µg/dL for child residents (protective of child recreational visitors). However, this modeled concentration is below the EPA Region 9 PRG for residential soil of 400 mg/kg (EPA 2004). Therefore, lead was not identified as a COC for potential recreational exposure to combined surface and subsurface soil in the southeast quadrant.

Table A-4 summarizes the proposed COCs identified for each of the various exposure scenarios.

A5.0 SCREENING OF POTENTIAL REMEDIAL ALTERNATIVES

The location of COCs was used in the consideration of remedial alternatives for IR Site 31. The concentrations of COCs were elevated in Debris Areas C, D, and E. The exposure pathway to COCs in Debris Area C may be complete and significant for elementary school receptors if the school is reopened and the schoolyard redeveloped as an unpaved play yard. The exposure pathway to COCs in Debris Area C may also be complete under alternative land uses. Hence, Debris Area C should be evaluated in more than one alternative. The exposure pathway to COCs in Debris Area D may be complete under alternative land uses and if the debris area is redeveloped for recreational use, as suggested in the Reuse Plan (CCSF 1996). Therefore, Debris Area D should also be evaluated in more than one alternative. In addition to exposures under alternative land uses, the exposure pathway to COCs in Debris Area E may be complete for utility workers working near subsurface water and gas pipelines underneath 11th Street. Priority was set based on the most probable future use tied to the existing conditions of the debris areas and not due to concentrations of COCs being higher in one debris area versus another. Although the elementary school is currently closed, projections for the redevelopment of TI show that a grade school (kindergarten through 8th grades) could be supported by the population (Fancher 2006). Reuse of the existing school for this purpose is likely, given the cost associated with developing new educational/institutional facilities (CCSF 1996).

Three screening criteria – effectiveness, implementability, and cost – were used to assess Potential Remedial Action Alternatives I through VII (see Section A5.1). The risk reduction potential determined for Potential Remedial Action Alternatives III, V, and VI is presented in Table A-5 (adjusted for removal of soils from Debris Area C), Table A-6 (adjusted for removal of soils from Debris Areas C and D), and Table A-7 (adjusted for removal of soils from Debris Areas A, B, C, and D). The risks and hazards presented in these tables have been recalculated using default Q_{soil} values. The potential risk reduction for residential and commercial/industrial worker scenarios could be more significant with the use of alternative, site-specific Q_{soil} values.

Although all three screening criteria are considered important, risk reduction as a part of effectiveness was a key consideration during the screening of potential remedial action alternatives phase. The potential remedial action alternatives are listed below, and the comparison to all three screening criteria are detailed in the following sections.

The following seven potential remedial alternatives screened for IR Site 31:

- **Potential Remedial Alternative I – No Action.** This alternative is required by the National Oil and Hazardous Substances Pollution and Contingency Plan (NCP) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and is used as a baseline to compare remedial alternatives.

- **Potential Remedial Alternative II – Engineering Controls (EC) Combined with Institutional Controls (IC).** This alternative would use ECs and ICs to ensure the existing hardscape at IR Site 31 is maintained as an exposure prevention barrier and provide provisions for required repairs or improvements to subsurface utilities. The ICs would also limit the commercial/industrial or residential use of the property. Monitoring, maintenance, annual reporting, and 5 year reviews will also be IC requirements.

- **Potential Remedial Alternative III – Engineering Controls, Institutional Controls, Excavation (Debris Area C), and Off-Site Disposal of Soil.** ECs and ICs are similar to Alternative II. Areas of Debris Area C would be excavated to a maximum depth of 4 feet. Excavated soil would be disposed of at a licensed landfill. The area would be backfilled with a clean fill and the hardscape would be restored.

- **Potential Remedial Alternative IV – Engineering Controls, Institutional Controls, Excavation (Debris Area E), and Off-Site Disposal of Soil.** ECs and ICs are similar to Alternative II. Areas of Debris Area E would be excavated to a maximum depth of 4 feet. During removal, 11th Street would be closed and excavated and utilities would be rerouted or reinstalled. After excavation and backfilling have been completed, excavated soil would be disposed of at a licensed landfill. The area would be backfilled with a clean fill, and the hardscape would be restored.

- **Potential Remedial Alternative V – Engineering Controls, Institutional Controls, Excavation (Debris Areas C and D Excluding Street), and Off-Site Disposal of Soil.** ECs and ICs are similar to Alternative II. Areas of Debris Areas C and D would be excavated to a maximum depth of 4 feet. This remedial alternative would involve removal of Debris Areas C and D, except for the portion of Debris Area D that is beneath 11th Street. Excavated soil would be disposed of at a licensed landfill. The area would be backfilled with a clean fill, and the hardscape would be restored.

- **Potential Remedial Alternative VI – Engineering Controls, Institutional Controls, Excavation (Debris Areas A, B, C, and D Excluding Street), and Off-Site Disposal of Soil.** ECs and ICs are similar to Alternative II. Areas of Debris Areas A, B, C, and D would be excavated to a maximum depth of 4 feet. This remedial alternative would involve removal of Debris Areas A, B, C, and D, except for the portion of Debris Area D that is beneath 11th Street. Excavated soil would be disposed of at a licensed landfill. The area would be backfilled with a clean fill and the hardscape would be restored.

- **Potential Remedial Alternative VII – Complete Removal of Debris Areas A, B, C, D, and E and Off-Site Disposal of Soil.** Debris Areas A, B, C, D, and E would be excavated to a maximum depth of 6 feet, including soils beneath 11th Street. This alternative does not include ICs. Soil would be removed to a maximum depth of 6 feet to allow for removal of soil 1 foot below the known depth of COCs. During removal, 11th Street would be closed and excavated and utilities would be rerouted or reinstalled. After excavation and backfilling have been completed, excavated soil would be disposed of at a licensed landfill. The site would be returned to grade and to present condition with demolished roads, curbs, or parking lots rebuilt to current site conditions.

A5.1 SCREENING CRITERIA FOR POTENTIAL REMEDIAL ALTERNATIVES

The screening evaluation focuses on the effectiveness, implementability, and cost of each potential remedial action alternative.

A5.1.1 Effectiveness

The evaluation of the effectiveness of each potential remedial alternative considers the ability and reliability of the remedial technology to achieve the RAO within a reasonable timeframe. The ability of a remedial technology to address the COCs at IR Site 31 was evaluated based on its general applicability to treat COCs in soil and debris to concentrations that meet the RAOs.

Effectiveness contains those criteria that evaluate the state of development of the technology, the ability to protect human health and the environment, and identifies potential negative effects associated with the technology. These criteria include the following:

- Protectiveness: This evaluation considers the degree of protection each technology provides to human health and the environment; the extent to which reductions in risk (which is the key component of this evaluation), toxicity, and/or mobility are expected to be achieved; the time required to reduce risk and obtain cleanup standards; the off-site and on-site risks resulting from implementation of the alternative; and the degree of improvement of the overall environmental quality.

- Permanence: This evaluation considers the degree to which the alternative permanently reduces the toxicity, mobilization, or volume of the COCs. The evaluation considers the materials treated; quantity of material treated; degree of toxicity, mobility, and volume reduction; degree to which the treatment is irreversible; and residuals type and quantity.

- Long-Term Effectiveness: This evaluation considers the effectiveness of the process during the time when COC concentrations above remediation goals remain on site, the magnitude of risk with the alternative in place, and the adequacy and reliability of any site controls.

- Management of Short-Term Risks: This evaluation considers the effectiveness of the process in dealing with the potential effects to human health and the environment during the implementation phase.

- Risk Reduction: Quantitative risk calculations are performed for each alternative to evaluate the reduction of risks and hazards to the various receptor scenarios for current and alternative land use.

A5.1.2 Implementability

The evaluation of implementability includes both the technical and the administrative feasibility of implementing a treatment technology. Technical feasibility includes such factors as compatibility with site-specific conditions; the availability of equipment; the ease of constructing the remediation system; the labor intensiveness required by the system; and the availability of vendors that have the capability to design, construct, and maintain the system. Administrative feasibility includes such factors as the ease of obtaining concurrence from the regulatory agencies.

A5.1.3 Cost

The purpose of evaluating cost is to eliminate remedial technologies with costs that greatly exceed other technologies that provide similar levels of protection. As a result, the relative cost for each remedial alternative is described as "low," "moderate," and "high." The low cost describes a unit cost for treatment that is less than $100 per ton of soil for low cost; moderate cost describes a unit cost for treatment that is less than $100 to $300 per ton of soil; and high cost describes a unit cost for treatment more than $300 per ton of soil (Federal Remediation Technologies Roundtable 2005). The cost ranges are based on a review of the literature, vendor quotations, and data prepared for other studies (see Appendix C). The evaluation of cost addresses direct and indirect capital costs and annual operation and maintenance costs. Additionally, when the information was available, the cost range is presented quantitatively.

A5.2 ANALYSIS OF POTENTIAL REMEDIAL ALTERNATIVES

Each of the potential remedial alternatives was evaluated to determine the potential reduction of risks and hazards to the various receptor scenarios and the other components of effectiveness, as well as implementability and cost. Table A-8 summarizes the risk analyses performed and the sampling locations excluded during the recalculation of risk for each alternative.

A5.2.1 Analysis of Potential Remedial Alternative I – No Action

"No action" implies that no remedial action will be conducted on site. Under the no-action alternative, soil would be left as is without implementing any ICs, containment, removal, treatment, or other mitigating actions. The NCP requires the no-action alternative be evaluated in every FS because it provides a baseline for comparison with the other remedial alternatives (Title 40 *Code of Federal Regulations* Section 300.430[e][6]). Therefore, Alternative I, No Action, is retained for further evaluation. This alternative also has merit based on the current and planned land use scenario because no COCs were identified for school children or staff. This alternative is not protective to any of the receptors identified for altered site conditions or alternative land use. Results of the analysis against the three screening criteria are presented below.

- **Effectiveness.** Potential Remedial Alternative I does not address protectiveness, permanence, long-term effectiveness, or management of short-term risk and therefore has a poor level of effectiveness.
- **Implementability.** High because no action is required to implement this alternative.
- **Cost.** Low ($0) because no cost is associated with implementing this alternative.

Potential Remedial Alternative I is retained (as Remedial Alternative 1) based on the NCP under CERCLA as a baseline comparison for the other retained alternatives. The evaluation does not consider the reduced risk provided by excavation of elevated concentrations of COCs as active remediation is not conducted.

A5.2.2 Analysis of Potential Remedial Alternative II – Engineering Controls Combined with Institutional Controls

Potential Remedial Alternative II uses a combination of ECs and ICs to minimize exposure to COCs identified within soils beneath IR Site 31. This alternative would use ECs and ICs to ensure the existing asphalt and concrete hardscape at IR Site 31 is maintained as an exposure prevention barrier and will include provisions for required repairs or improvements to subsurface utilities. The ICs also would limit the commercial/industrial or residential use of the property to developments that maintain sufficient barriers to prevent exposure pathways.

Review of the risk assessment results indicated the site-related risk is within the risk management range for the current and planned land use of IR Site 31 as an elementary school playground (SulTech 2006b). Because COCs are present beneath the paved playground area and the potential exists for exposure from unanticipated alternative land use scenarios, it is necessary to minimize potential risk to human health from exposure to COCs in soil at IR Site 31. Implementation of Remedial Alternative II would require maintenance of the existing asphalt and concrete hardscape as an exposure prevention barrier. Remedial Alternative II would provide the necessary legal provisions for a combination of ECs and ICs to complete any required repairs or improvements to subsurface utilities. Costs associated with Remedial Alternative II include administrative land use controls, annual site inspections, recurring report generation, and routine barrier maintenance. Results of the analysis against the three screening criteria are presented below.

- **Effectiveness.** Provides a qualitative level of effectiveness associated with controlled but not unrestricted future use and can readily be modified as necessary to provide additional accommodations and protectiveness in the future. The ICs would restrict commercial/industrial and residential reuse of IR Site 31, thus protecting the associated receptors from inhalation of vapors in indoor air. ECs and ICs are limited with regard to effectiveness because implementation will never allow for unrestricted use. This assessment does not alter the risk presented for the COCs in Table A-4 because no soil would be removed from any of the debris areas.

- **Implementability.** Rated high with regard to implementability because these ECs and ICs have been used extensively at a wide range of sites.

- **Cost.** Cost is low to implement and maintain the ECs and ICs.

Potential Remedial Alternative II is retained (as Remedial Alternative 2) based on the overall evaluation of effectiveness, implementability and cost.

A5.2.3 Analysis of Potential Remedial Alternative III – Engineering Controls, Institutional Controls, and Excavation (Debris Area C) and Off-Site Disposal of Soil

The removal of Debris Area C is expected to reduce exposure to B(a)P, dioxins, and naphthalene but has a limited effect on lead. Potential Remedial Alternative III involves the demolition of asphalt playground and the adjacent sidewalks to excavate contaminated soil within Debris Area C to a maximum depth of 4 feet. The area was delineated based on results of previous investigations and is estimated to be 11,500 square feet in size. Soils containing B(a)P and dioxins would be removed, and the excavation areas would be delineated by analysis of confirmation soil samples. ECs and ICs would be relied upon to address the potential for exposure associated with the other debris areas and maintaining and improving existing exposure prevention barriers.

The removal of soils associated with Debris Area C is expected to reduce cancer risks and noncancer hazard indices (HI), as presented in Table A-5. Adjusted lead EPCs and blood-lead levels are also shown in Table A-5. Results of the analysis against the three screening criteria are presented below.

- **Effectiveness.** Considered moderate because it addresses B(a)P and dioxins resulting in the reduction of risk, as shown in Table A-5; however, this alternative does not address protectiveness, permanence, long-term effectiveness, or management of short-term risk for the other debris areas (specifically, potential recreational use of Debris Area D). The ECs and ICs would reduce (to a certain extent) the risk for exposure in the other debris areas to B(a)P, dioxins, and lead.

- **Implementability.** Rated high with regard to implementability because excavation and off-site disposal were used previously and effectively at this site and the corresponding ECs and ICs were extensively used at a wide range of sites.

- **Cost.** Moderate because it is more expensive than Alternatives I and II but cheaper than Alternatives IV through VII because it requires the least amount of excavation and off-site disposal of soil.

Potential Remedial Alternative III is not retained for further consideration based on the level of risk reduction accomplished compared with other potential remedial alternatives.

A5.2.4 Analysis of Potential Remedial Alternative IV – Engineering Controls, Institutional Controls, and Excavation (Debris Area E) and Off-Site Disposal of Soil

Potential Remedial Alternative IV involves the demolition of 11th Street and the adjacent sidewalks to excavate soil contaminated with lead to a maximum depth of 4 feet. The area was delineated based on results of previous investigations and is estimated to be 6,600 square feet in size. Soils containing lead would be removed, and the excavation areas would be delineated by analysis of confirmation samples. ECs and ICs would be relied upon to address the potential for exposure associated with the other debris areas (such as site-wide risk reduction) and maintaining and improving existing exposure prevention barriers.

Lead is considered the primary COC in Debris Area E, substantiated by the evaluation of construction/utility worker exposure to soil in Debris Area E presented in the HHRA of the Final RI Report (SulTech 2006b). Removal of soils containing lead from Debris Area E reduces risk to construction workers, and implementation of ECs and ICs reduces risk from the remaining debris areas. The ICs would restrict commercial/industrial and residential reuse of IR Site 31, thus protecting the associated receptors from inhalation of vapors in indoor air. Because lead was considered the primary COC addressed by this alternative, site-wide cancer risks and noncancer hazards were not recalculated assuming Potential Remedial Alternative IV was implemented.

If Potential Remedial Alternative IV were implemented, lead EPCs and blood-lead levels would be significantly reduced to below lead HHRA thresholds. The revised lead EPC for site-wide surface soil (0 to 2 feet bgs) would be 144 mg/kg, and the revised lead EPC for site-wide combined surface and subsurface soil (0 foot bgs to groundwater) would be 314 mg/kg. The resulting blood-lead levels for residential exposure would all be below 10 µg/dL, including the blood-lead level for a child resident exposed to lead in site-wide combined surface and subsurface soil (0 foot bgs to groundwater), reduced from 11.4 µg/dL to 9.7 µg/dL. Results of the analysis against the three screening criteria are presented below.

- **Effectiveness.** Effectiveness is low to moderate because the alternative is limited to reducing the risk associated with removal of soil containing lead from Debris Area E. The ECs and ICs would reduce (to a certain extent) the risk for exposure in the other debris areas to B(a)P and dioxins. The overall protectiveness, permanence, and long-term effectiveness are diminished by not actively reducing risk from B(a)P and dioxins. Protectiveness is mainly achieved by implementation of ICs.

- **Implementability.** Rated high with regard to implementability because excavation and off-site disposal soil were used previously and effectively at this site and the corresponding ECs and ICs were extensively used at a wide range of sites.

- **Cost.** Moderate to low because only Potential Remedial Alternatives I and II are less expensive. All other potential remedial alternatives involve excavation and subsequent off-site disposal of large volumes of soil and include subsequent ECs and ICs.

Potential Remedial Alternative IV is retained (as Remedial Alternative 3) for further evaluation because it is a potentially effective approach to reducing risk from lead in soils within Debris Area E.

A5.2.5 Analysis of Potential Remedial Alternative V – Engineering Controls, Institutional Controls, and Excavation (Debris Areas C and D Excluding Street) and Off-Site Disposal of Soil

Potential Remedial Alternative V involves the demolition of select asphalt within the existing playground area within Debris Area C, and excavation of soil to a maximum depth of 4 feet to remove elevated COCs within soil. The area was delineated based on results of previous investigations and is estimated to be 11,500 square feet in size. The asphalt would be segregated from any excavated soils to minimize the potential for generating additional waste requiring disposal as hazardous. Soils containing COCs would be removed, and the excavation areas would be delineated by analysis of confirmation soil samples.

Debris Area D would also be excavated in select locations and would involve demolition of both asphalt and concrete associated with the parking lot. The area was delineated based on results of previous investigations and is estimated to be 3,000 square feet size. Removal of areas with elevated concentrations of COCs within Debris Area D would not include areas beneath the northeast corner of the intersection of 11th Street and Avenue E. ECs and IC would be relied

upon to address the potential for exposure associated with the Debris Areas A, B, and E and maintaining and improving existing exposure prevention barriers.

The removal of soils associated with Debris Areas C and D is expected to reduce cancer risks and noncancer HIs by the amounts identified in Table A-6. Adjusted lead EPCs and blood-lead levels are also presented. Results of the analysis against the three screening criteria are presented below.

- **Effectiveness.** Effectiveness is moderate to high because it is expected to result in a significant reduction in cancer risks and noncancer HIs by the estimated amount identified in Table A-6; and it addresses protectiveness, permanence, long-term effectiveness, and management of short-term risk for the other debris areas (except construction worker exposure to lead in Debris Area E, which would be managed through incorporation of ECs and ICs). It reduces risks and hazards associated with exposure to B(a)P and dioxins in soil, but does little to address overall exposure to lead in soil.

- **Implementability.** Rated high with regard to implementability because excavation and off-site disposal of soil were previously and effectively used at this site and the corresponding ECs and ICs were extensively used at a wide range of sites.

- **Costs.** Relatively high because two large excavation areas would require extensive excavation and off-site disposal of soil, regrading and reconstruction, and subsequent ECs and ICs.

If Potential Remedial Alternative V were implemented cancer risks identified in the HHRA would decrease by approximately an order of magnitude. Additionally, removing Debris Area D eliminates the elevated concentrations of arsenic, B(a)P, dioxins, and lead that contributed significantly to the screening-level evaluation conducted for the southeast quadrant (see Table A-3). Consequently, no COPCs would exceed risk management thresholds for the southeast quadrant if Debris Area D were removed. Potential Remedial Alternative V is retained (as Remedial Alternative 4) because of the additional reduction in cancer risks compared with Potential Remedial Alternative III (see Tables A-5 and A-6).

A5.2.6 Analysis of Potential Remedial Alternative VI – Engineering Controls, Institutional Controls, and Excavation (Debris Areas A, B, C, and D Excluding Street) and Off-Site Disposal of Soil

Potential Remedial Alternative VI involves the demolition of the same areas as for Potential Remedial Alternative V and includes the removal of soil associated with Debris Areas A and B (the two small “half moon” debris areas to the north of 11th Street) to a maximum depth of 4 feet. The total area of Debris Areas A, B, C, and D was delineated based on results of previous investigations and is estimated to be 15,100 square feet in size. The contaminated soils would be removed, and the excavation areas would be delineated by analysis of confirmation soil samples.

ECs and IC would be relied upon to address the potential for exposure from lead remaining in Debris Area E and maintaining and improving existing exposure prevention barriers.

The removal of soils associated with Debris Areas A, B, C, and D is expected to reduce cancer risks and noncancer HIs by the amounts identified in Table A-7. Adjusted lead EPCs and blood-lead levels are also presented. Results of the analysis against the three screening criteria are presented below.

- **Effectiveness.** Effectiveness is moderate to high because it addresses B(a)P and dioxins; is expected to result in significant reductions in cancer risk and noncancer HIs, as shown in Table A-7; and address protectiveness, permanence, long-term effectiveness, and management of short-term risk for all debris areas (except construction worker exposure to lead in Debris Area E).

- **Implementability.** Rated high with regard to implementability because excavation and off-site disposal were previously and effectively used at this site and the corresponding ECs and ICs were extensively used and implemented at a wide range of sites.

- **Costs.** Potential Remedial Alternative VI is nominally more expensive compared with Potential Remedial Alternative V because of the increased cost of removing areas of elevated concentrations of COCs within Debris Areas A and B. This cost is not justified by the associated minimal reduction in risk calculated for Potential Remedial Alternative IV.

A comparison between Tables A-6 and A-7 demonstrates that there is little decrease in risk when Debris Areas A and B are included with Debris Areas C and D for removal. As a result, and based on increased cost, Potential Remedial Alternative VI is not retained for further evaluation in the FS Report.

A5.2.7 Analysis of Potential Remedial Action Alternative VII – Complete Removal of Debris Areas A, B, C, D, and E and Off-Site Disposal of Soil

Potential Remedial Alternative VII is proposed to address altered site conditions and all alternative land use scenarios and is the most extensive of the seven alternatives, with complete removal of soil from Debris Areas A, B, C, D, and E to a depth of 6 feet. Potential Remedial Alternative VII is protective of human health in the long-term because all soil from these debris areas would be removed to a depth of 6 feet. A conservative excavation depth of 6 feet was selected to allow for over-excavation in areas of known contamination. This alternative requires the removal of Debris Area E, which includes an excavation of portions of 11th Street, may include removal or rerouting of utilities beneath 11th Street, removal of the paved surface of the playground within Debris Area C, removal of the parking lot area within Debris Area D, and the removal of Debris Areas A and B adjacent to the north side of 11th Street.

Lead is the primary COC in Debris Area E. Removal of soils containing lead associated with Debris Areas A, B, C, D, and E is expected to reduce cancer risks and noncancer HIs by amounts comparable to those identified in Table A-7 (for the removal of soils associated with Debris Areas A, B, C, and D), with a notable exception. The HIs for residential exposures would be reduced to below 1 for removal of soils from Debris Area E and removal of soils from Debris Areas C and D would eliminate all detected concentrations of COCs that are the primary contributors to the HIs for residential exposure via the inhalation of vapors in indoor air pathway.

If Potential Remedial Alternative VII were implemented, lead EPCs and blood-lead levels would be significantly reduced to below lead thresholds in the HHRA (SulTech 2006b). The revised lead EPC for site-wide surface soil (0 to 2 feet bgs) would be 144 mg/kg, and the revised lead EPC for site-wide combined surface and subsurface soil (0 foot bgs to groundwater) would be 314 mg/kg. The resulting blood-lead levels for residential exposure would all be below 10 µg/dL, including the blood-lead level for a child resident exposed to lead in site-wide combined surface and subsurface soil (0 foot bgs to groundwater), which would be reduced from 11.4 µg/dL to 9.7 µg/dL. Results of the analysis against the three screening criteria are presented below.

- **Effectiveness.** Is considered very high for the long term because the COCs on the site are removed and relocated off site. The management of short-term risk is addressed through ECs implemented as part of the work plans, and protectiveness and permanence also are very high.

- **Implementability**. Rated high with regard to implementability because excavation and off-site disposal were previously and effectively used at this site and the corresponding ECs and ICs were extensively used at a wide range of sites.

- **Costs.** Considered prohibitively high to achieve unrestricted use in this manner. This is a significant consideration in further evaluation of this alternative.

Potential Remedial Alternative VII is retained (as Remedial Alternative 5) for further consideration because it allows for unrestricted use because the COCs would be removed and the overall high risk is reduced.

A6.0 SUMMARY OF RISK REDUCTION FOR RETAINED REMEDIAL ALTERNATIVES

A comparative evaluation of the risk reduction associated with the five retained alternatives was performed for IR Site 31. No RAOs were identified for current land use under current paved site conditions because no COCs were identified as exceeding risk management thresholds; therefore, no alternatives were evaluated against this receptor scenario. The results of the risk reduction evaluation are presented below for each retained remedial alternative.

Remedial Alternative 1. The no-action alternative would not reduce risk to elementary school children and staff for altered site conditions, or to construction workers, recreational visitors, commercial/industrial workers and residential receptors under alternative land use scenarios.

Remedial Alternative 2. This alternative would use a combination of ECs and ICs to minimize exposure to identified COCs within soils beneath IR Site 31. This alternative would eliminate exposure to elementary school children and staff for altered site conditions and construction workers, recreational visitors, commercial/industrial workers, and residential receptors under alternative land uses, provided the existing asphalt and concrete hardscape is maintained and the necessary legal provisions are upheld.

Remedial Alternative 3. This alternative includes removal of lead from areas within Debris Area E, beneath 11th Street. Assuming the elevated lead concentrations are removed from beneath 11th Street, the revised lead EPC for site-wide surface soil (0 to 2 feet bgs) would be 144 mg/kg, and the revised lead EPC for site-wide combined surface and subsurface soil (0 foot bgs to groundwater) would be 314 mg/kg. The resulting blood-lead levels for residential exposure would all be below 10 × g/dL, including the blood-lead level for a child resident exposed to lead in site-wide combined surface and subsurface soil (0 foot bgs to groundwater), reduced from 11.4 µg/dL to 9.7 µg/dL Control of risk associated with exposure to soil in the other debris areas is obtained through the use of ECs and ICs to the extent practical and necessary to meet the identified RAOs for elementary school children and staff, for the recreational visitor, for the commercial/industrial worker, and for the residential receptor. For altered site conditions based on potential removal of the protective exposure barrier in the paved playground, the RME risks were reported to be within the risk management range and below the HI of 1 for elementary school children and staff. Remedial Alternative 3 would reduce risk to a greater extent for a construction worker under alternative land use and reduces risk to the other receptors the same as for Remedial Alternative 2.

Remedial Alternative 4. This alternative includes ECs, ICs, and excavation and off-site disposal of soil from Debris Areas C and D. Removal of areas of elevated concentrations of COCs within Debris Area D would not include areas beneath the northeast corner of the intersection of 11th Street and Avenue E. The estimated cancer risk and noncancer HI estimates associated with this alternative are shown in Table A-6. Adjusted lead EPCs and blood-lead levels are also presented. For elementary school receptor exposure under altered site conditions (assuming the protective barrier in the paved playground is removed), RME cancer risks were estimated to be below the risk management range and RME HIs were estimated to be below 1.

For alternative land use scenarios, the RME cancer risk estimates were below the risk management range for the construction worker, and reduced to the low end of the risk management range for the resident and commercial/industrial worker. The RME HIs would be decreased to below the benchmark of 1 for construction workers and commercial/industrial workers. The RME HIs for residents would be decreased, but would remain above 1, due largely to contributions of naphthalene in Debris Area E to HQs estimated for the inhalation of indoor air pathway. Removing soil from Debris Area D also would eliminate the elevated concentrations of arsenic, B(a)P, dioxins, and lead that contributed significantly to the screening-level evaluation conducted for the southeast quadrant. ECs and IC would be relied upon to address potential exposure remaining from the other debris areas, notably Debris Area E, and maintaining and improving existing exposure prevention barriers.

Remedial Alternative 5. This alternative is proposed to meet the unrestricted land use scenario and is the most extensive of the five alternatives with complete removal of all of Debris Areas A, B, C, D, and E to 6 feet. Alternative 5 also is protective of human health in the short term and the long term because all of the debris areas will be removed. This alternative would require the removal of Debris Area E to include the excavation of a portion of 11th Street, removal and rerouting of utilities beneath 11th Street, removal of the paved surface of the playground within Debris Area C, removal of the parking lot area within Debris Area D, and the removal of Debris Areas A and B adjacent to the north side of 11th Street. This alternative provides the most comprehensive reduction in risk, addressing debris areas and risks and hazards associated with the identified COCs [B(a)P, dioxins, and lead].

A7.0 REFERENCES

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TABLES

TABLE A-1: COPCS EXCEEDING THRESHOLDS USING DEFAULT Q_{SOIL} VALUES

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Receptor Scenario	COPCs Exceeding Cancer, Noncancer, and Lead Thresholds[a]			
	Method 1		Method 2	
	COPC	Estimated RME Cancer Risk/HQ	COPC	Estimated RME Cancer Risk/HQ
Current Land Use				
Current Site Conditions				
Elementary School Child – Exposure to Soil (0 to 2 feet bgs, Unpaved Areas Outside Fence Line)[1]	No COPCs exceed thresholds		No COPCs exceed thresholds	
Elementary School Staff – Exposure to Soil (0 to 2 feet bgs, Unpaved Areas Outside Fence Line)[1]	4,4'-DDT	$2x10^{-6}$	4,4'-DDT	$2x10^{-6}$
Altered Site Conditions				
Elementary School Child – Exposure to Soil (0 to 2 feet bgs, Inside Schoolyard Fence Line)[1,2]	Benzo(a)pyrene Dioxins	$6x10^{-6}$ $2x10^{-6}$	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Dioxins	$1x10^{-6}$ $1x10^{-5}$ $1x10^{-6}$ $1x10^{-6}$ $1x10^{-6}$
Elementary School Staff – Exposure to Soil (0 to 2 feet bgs, Inside Schoolyard Fence Line)[1,2]	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Dioxins Indeno(1,2,3-cd)pyrene	$2x10^{-6}$ $2x10^{-5}$ $2x10^{-6}$ $4x10^{-6}$ $1x10^{-6}$	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Dioxins Indeno(1,2,3-cd)pyrene	$3x10^{-6}$ $3x10^{-5}$ $3x10^{-6}$ $3x10^{-6}$ $3x10^{-6}$ $2x10^{-6}$
Alternative Land Use				
Construction Worker – Exposure to Soil (0 foot bgs to groundwater, site-wide)[3], Groundwater, and Vapors in Trench Air[4]	Benzo(a)pyrene	$2x10^{-6}$	Benzo(a)pyrene	$3x10^{-6}$
	Lead EPC = 858 mg/kg, greater than EPA Region 9 PRG for industrial soils (800 mg/kg)			

TABLE A-1: COPCS EXCEEDING THRESHOLDS USING DEFAULT Q_{SOIL} VALUES (CONTINUED)
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

	COPCs Exceeding Cancer, Noncancer, and Lead Thresholds[a]			
	Method 1		Method 2	
Receptor Scenario	**COPC**	**Estimated RME Cancer Risk/HQ**	**COPC**	**Estimated RME Cancer Risk/HQ**
Alternative Land Use (Continued)				
Resident – Exposure to Soil (0 to 2 feet bgs, site-wide)[3] and Vapors in Indoor Air[5]	4,4'-DDT	$2x10^{-6}$	4,4'-DDT	$2x10^{-6}$
	Benzo(a)anthracene	$5x10^{-6}$	Benzene	$5x10^{-6}$
	Benzo(a)pyrene	$4x10^{-5}$	Benzo(a)anthracene	$8x10^{-6}$
	Benzo(b)fluoranthene	$4x10^{-6}$	Benzo(a)pyrene	$7x10^{-5}$
	Dioxins	$1x10^{-5}$	Benzo(b)fluoranthene	$7x10^{-6}$
	Indeno(1,2,3-cd)pyrene	$3x10^{-6}$	Benzo(k)fluoranthene	$7x10^{-6}$
	Methylene Chloride	$2x10^{-6}$	**Bis(2-chloroethyl)ether**	$2x10^{-3}$
	Naphthalene	**HQ=22**	Dioxins	$1x10^{-5}$
			Indeno(1,2,3-cd)pyrene	$5x10^{-6}$
			Methylene Chloride	$5x10^{-6}$
			Naphthalene	**$5x10^{-4}$/22[b]**
Resident – Exposure to Soil (0 foot bgs to groundwater, site-wide)[3] and Vapors in Indoor Air[5]	Benzo(a)anthracene	$3x10^{-6}$	Benzene	$5x10^{-6}$
	Benzo(a)pyrene	$3x10^{-5}$	Benzo(a)anthracene	$5x10^{-6}$
	Benzo(b)fluoranthene	$3x10^{-6}$	Benzo(a)pyrene	$5x10^{-5}$
	Dioxins	$2x10^{-5}$	Benzo(b)fluoranthene	$5x10^{-6}$
	Indeno(1,2,3-cd)pyrene	$2x10^{-6}$	Benzo(k)fluoranthene	$5x10^{-6}$
	Methylene Chloride	$2x10^{-6}$	**Bis(2-chloroethyl)ether**	$2x10^{-3}$
	Naphthalene	**HQ=22**	Dioxins	$1x10^{-5}$
			Indeno(1,2,3-cd)pyrene	$4x10^{-6}$
			Methylene Chloride	$5x10^{-6}$
			Naphthalene	**$5x10^{-4}$/22[b]**
	Blood-Lead Level for Child Resident = 21.2 µg/dL			

TABLE A-1: COPCS EXCEEDING THRESHOLDS USING DEFAULT Q_{SOIL} VALUES (CONTINUED)
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

	COPCs Exceeding Cancer, Noncancer, and Lead Thresholds[a]			
	Method 1		Method 2	
Receptor Scenario	**COPC**	**Estimated RME Cancer Risk/HQ**	**COPC**	**Estimated RME Cancer Risk/HQ**
Alternative Land Use (Continued)				
Commercial/Industrial Worker – Exposure to Soil (0 to 2 feet bgs, site-wide)[3] and Vapors in Indoor Air[5]	Benzo(a)anthracene	$2x10^{-6}$	Benzo(a)anthracene	$3x10^{-6}$
	Benzo(a)pyrene	$2x10^{-5}$	Benzo(a)pyrene	$3x10^{-5}$
	Benzo(b)fluoranthene	$2x10^{-6}$	Benzo(b)fluoranthene	$3x10^{-6}$
	Dioxins	$4x10^{-6}$	Benzo(k)fluoranthene	$3x10^{-6}$
	Indeno(1,2,3-cd)pyrene	$1x10^{-6}$	**Bis(2-chloroethyl)ether**	**$3x10^{-4}$**
	Naphthalene	**HQ=2**	Dioxins	$3x10^{-6}$
			Indeno(1,2,3-cd)pyrene	$2x10^{-6}$
			Naphthalene	**$7x10^{-5}$/2[c]**
Commercial/Industrial Worker – Exposure to Soil (0 foot bgs - groundwater, site-wide)[3] and Vapors in Indoor Air[5]	Benzo(a)anthracene	$1x10^{-6}$	Benzo(a)anthracene	$2x10^{-6}$
	Benzo(a)pyrene	$1x10^{-5}$	Benzo(a)pyrene	$2x10^{-5}$
	Benzo(b)fluoranthene	$1x10^{-6}$	Benzo(b)fluoranthene	$2x10^{-6}$
	Dioxins	$4x10^{-6}$	Benzo(k)fluoranthene	$2x10^{-6}$
	Naphthalene	**HQ=2**	**Bis(2-chloroethyl)ether**	**$3x10^{-4}$**
			Dioxins	$4x10^{-6}$
			Indeno(1,2,3-cd)pyrene	$2x10^{-6}$
			Naphthalene	**$7x10^{-5}$/2[c]**
	Lead EPC = 858 mg/kg, greater than EPA Region 9 PRG for industrial soils (800 mg/kg)			

TABLE A-1: COPCS EXCEEDING THRESHOLDS USING DEFAULT Q_{SOIL} VALUES (CONTINUED)

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Notes:

a	Any COPC contributing a chemical-specific cancer risk greater than $1x10^{-6}$ or a chemical-specific HQ greater than 1. Exceedances of lead thresholds are also presented. Cases of COPCs contributing chemical-specific cancer risks greater than $1x10^{-4}$ (the high end of the EPA risk management range) are marked in bold, as are all cases of COPCs contributing chemical-specific HQs greater than 1 and all exceedances of lead HHRA thresholds.
b	Naphthalene contributes a chemical-specific cancer risk of $5x10^{-4}$ and a chemical-specific HQ of 22.
c	Naphthalene contributes a chemical-specific cancer risk of $7x10^{-5}$ and a chemical-specific HQ of 2.
1	Exposure to soil via incidental ingestion, dermal contact, and inhalation pathways, as presented in Appendix I, Section I.8.2 of the Final RI Report, Installation Restoration Site 31 (SulTech 2006).
2	Soil assumed to be unpaved for this assessment
3	Exposure to soil via incidental ingestion, dermal contact, and inhalation of particulates or vapors in outdoor air
4	In-trench air concentrations modeled from groundwater
5	Indoor air concentrations modeled from groundwater and site-wide combined surface and subsurface soil (0 foot bgs to groundwater)
µg/dL	Microgram per deciliter
bgs	Below ground surface
COPC	Chemical of potential concern
4,4'-DDT	Dichlorodiphenyltrichloroethane
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration
HQ	Hazard quotient
mg/kg	Milligram per kilogram
PRG	Preliminary remediation goal
Q_{soil}	Average vapor flow rate
RME	Reasonable maximum exposure

References:

SulTech. 2006. "Final Remedial Investigation Report, Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California." July.

TABLE A-2: CHANGES TO COPCS EXCEEDING THRESHOLDS FOR RESIDENTS AND COMMERCIAL/INDUSTRIAL WORKERS USING SITE-SPECIFIC Q_{SOIL} VALUES

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

	COPCs Exceeding Cancer, Noncancer, and Lead Thresholds[a]			
	Method 1		Method 2	
Receptor Scenario	**COPC**	**Est. RME Cancer Risk/HQ**	**COPC**	**Est. RME Cancer Risk/HQ**
Alternative Land Use				
Resident – Exposure to Soil (0 to 2 feet bgs, site-wide)[1] and Vapors in Indoor Air[2]	4,4'-DDT	$2x10^{-6}$	4,4'-DDT	$2x10^{-6}$
	Benzo(a)anthracene	$5x10^{-6}$	~~*Benzene*~~	~~$5x10^{-6}$~~
	Benzo(a)pyrene	$4x10^{-5}$	Benzo(a)anthracene	$8x10^{-6}$
	Benzo(b)fluoranthene	$4x10^{-5}$	Benzo(a)pyrene	$7x10^{-5}$
	Dioxins	$1x10^{-5}$	Benzo(b)fluoranthene	$7x10^{-6}$
	Indeno(1,2,3-cd)pyrene	$3x10^{-6}$	Benzo(k)fluoranthene	$7x10^{-6}$
	~~*Methylene Chloride*~~	~~$2x10^{-6}$~~	***Bis(2-chloroethyl)ether***	***$4x10^{-4}$***
	Naphthalene	***HQ=4***	Dioxins	$1x10^{-5}$
			Indeno(1,2,3-cd)pyrene	$5x10^{-6}$
			~~*Methylene Chloride*~~	~~$5x10^{-6}$~~
			Naphthalene	***$1x10^{-4}/4$***[b]
Resident – Exposure to Soil (0 foot bgs to groundwater, site-wide)[1] and Vapors in Indoor Air[2]	Benzo(a)anthracene	$3x10^{-6}$	Benzene	$1x10^{-6}$
	Benzo(a)pyrene	$3x10^{-5}$	Benzo(a)anthracene	$5x10^{-6}$
	Benzo(b)fluoranthene	$3x10^{-6}$	Benzo(a)pyrene	$5x10^{-5}$
	Dioxins	$2x10^{-5}$	Benzo(b)fluoranthene	$5x10^{-6}$
	Indeno(1,2,3-cd)pyrene	$2x10^{-6}$	Benzo(k)fluoranthene	$5x10^{-6}$
	~~*Methylene Chloride*~~	~~$2x10^{-6}$~~	***Bis(2-chloroethyl)ether***	***$4x10^{-4}$***
	Naphthalene	***HQ=4***	Dioxins	$1x10^{-5}$
			Indeno(1,2,3-cd)pyrene	$4x10^{-6}$
			~~*Methylene Chloride*~~	~~$5x10^{-6}$~~
			Naphthalene	***$1x10^{-4}/4$***[b]
	Blood-Lead Level for Child Resident = 21.2 µg/dL			

TABLE A-2: CHANGES TO COPCS EXCEEDING THRESHOLDS FOR RESIDENTS AND COMMERCIAL/INDUSTRIAL WORKERS USING SITE-SPECIFIC Q_{SOIL} VALUES (CONTINUED)

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

	COPCs Exceeding Cancer, Noncancer, and Lead Thresholds[a]			
	Method 1		Method 2	
Receptor Scenario	**COPC**	**Est. RME Cancer Risk/HQ**	**COPC**	**Est. RME Cancer Risk/HQ**
Alternative Land Use (Continued)				
Commercial/Industrial Worker – Exposure to Soil (0 to 2 feet bgs, site-wide)[1] and Vapors in Indoor Air[2]	Benzo(a)anthracene	$2x10^{-6}$	Benzo(a)anthracene	$3x10^{-6}$
	Benzo(a)pyrene	$2x10^{-5}$	Benzo(a)pyrene	$3x10^{-5}$
	Benzo(b)fluoranthene	$2x10^{-6}$	Benzo(b)fluoranthene	$3x10^{-6}$
	Dioxins	$4x10^{-6}$	Benzo(k)fluoranthene	$3x10^{-6}$
	Indeno(1,2,3-cd)pyrene	$1x10^{-6}$	Bis(2-chloroethyl)ether	$4x10^{-5}$
	~~*Naphthalene*~~	~~*HQ=2*~~	Dioxins	$3x10^{-6}$
			Indeno(1,2,3-cd)pyrene	$2x10^{-6}$
			Naphthalene	$9x10^{-6}$~~/2~~
Commercial/Industrial Worker – Exposure to Soil (0 foot bgs - groundwater, site-wide)[1] and Vapors in Indoor Air[2]	Benzo(a)anthracene	$1x10^{-6}$	Benzo(a)anthracene	$2x10^{-6}$
	Benzo(a)pyrene	$1x10^{-5}$	Benzo(a)pyrene	$2x10^{-5}$
	Benzo(b)fluoranthene	$1x10^{-6}$	Benzo(b)fluoranthene	$2x10^{-6}$
	Dioxins	$4x10^{-6}$	Benzo(k)fluoranthene	$2x10^{-6}$
	~~*Naphthalene*~~	~~*HQ=2*~~	Bis(2-chloroethyl)ether	$4x10^{-5}$
			Dioxins	$4x10^{-6}$
			Indeno(1,2,3-cd)pyrene	$2x10^{-6}$
			Naphthalene	*$9x10^{-6}$*~~/2~~
	Lead EPC = 858 mg/kg, greater than EPA Region 9 PRG for industrial soils (800 mg/kg)			

TABLE A-2: CHANGES TO COPCS EXCEEDING THRESHOLDS FOR RESIDENTS AND COMMERCIAL/INDUSTRIAL WORKERS USING SITE-SPECIFIC Q_{SOIL} VALUES (CONTINUED)

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Notes:

COPCs impacted by use of site-specific Q_{soil} values are marked in italics. Strikeouts indicate use of site-specific Q_{soil} values resulted in chemical-specific cancer risks below $1x10^{-6}$ or chemical-specific HQs less than or equal to 1.

a Any COPC contributing a chemical-specific cancer risk greater than $1x10^{-6}$ or a chemical-specific HQ greater than 1. Exceedances of lead thresholds are also presented. Cases of COPCs contributing chemical-specific cancer risks greater than $1x10^{-4}$ (the high end of the EPA risk management range) are marked in bold, as are all cases of COPCs contributing chemical-specific HQs greater than 1 and all exceedances of lead HHRA thresholds.

b Naphthalene contributes a chemical-specific cancer risk of $1x10^{-4}$ and a chemical-specific HQ of 4.

1 Exposure to soil via incidental ingestion, dermal contact, and inhalation of particulates or vapors in outdoor air (SulTech 2006).

2 Indoor air concentrations modeled from groundwater and site-wide combined surface and subsurface soil (0 foot bgs to groundwater).

µg/dL Microgram per deciliter
4,4'-DDT Dichlorodiphenyltrichloroethane
bgs Below ground surface
COPC Chemical of potential concern
EPA U.S. Environmental Protection Agency
EPC Exposure point concentration
Est. Estimated
HQ Hazard quotient
mg/kg Milligram per kilogram
PRG Preliminary remediation goal
Q_{soil} Average vapor flow rate
RME Reasonable maximum exposure

References:

SulTech. 2006. "Final Remedial Investigation Report, Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California." July.

TABLE A-3: COPCS EXCEEDING THRESHOLDS, RECREATIONAL EXPOSURES IN SOUTHEAST QUADRANT

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Receptor Scenario	COPCs Exceeding Cancer, Noncancer, and Lead Thresholds[a]	
	COPC	**Estimated Cancer Risk/HQ**
Residential PRG Screen (protective of Recreational Visitors) – Exposure to Soil (0 to 2 feet bgs)[1]	Benzo(a)pyrene	$4x10^{-6}$
	Dioxins	$6x10^{-6}$
Residential PRG Screen (protective of Recreational Visitors) – Exposure to Soil (0 foot bgs to groundwater)[1]	Arsenic	$2x10^{-5}$
	Benzo(a)pyrene	$4x10^{-6}$
	Dioxins	$1x10^{-5}$
	Blood-Lead Level for Child Resident (protective of child recreational visitors) = 11.4 µg/dL	

Notes:

a Any COPC contributing a chemical-specific cancer risk greater than $1x10^{-6}$ or a chemical-specific HQ greater than 1. Exceedances of lead thresholds are also presented. Cases of COPCs contributing chemical-specific cancer risks greater than $1x10^{-4}$ (the high end of the EPA risk management range) are marked in bold, as are all cases of COPCs contributing chemical-specific HQs greater than 1 and all exceedances of lead HHRA thresholds.

1 Exposure to soil via incidental ingestion, dermal contact, and inhalation of particulates or vapors in outdoor air (SulTech 2006).

µg/dL Microgram per deciliter
bgs Below ground surface
COPC Chemical of potential concern
HQ Hazard quotient
PRG Preliminary remediation goal

References:

SulTech. 2006. "Final Remedial Investigation Report, Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California." July.

TABLE A-4: PROPOSED CHEMICALS OF CONCERN
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Receptor Scenario	Proposed COCs at IR Site 31	
	COC	**Rationale for Identification**
Current Land Use		
Current Site Conditions		
Elementary School Child – Exposure to Soil (0 to 2 feet bgs, Unpaved Areas Outside Fence Line)[1]	No COCs Identified	
Elementary School Staff – Exposure to Soil (0 to 2 feet bgs, Unpaved Areas Outside Fence Line)[1]	No COCs Identified	
Altered Site Conditions		
Elementary School Child – Exposure to Soil (0 to 2 feet bgs, Inside Schoolyard Fence Line)[1,2]	Benzo(a)pyrene Dioxins	Chemical-specific Method 1 CR = $6x10^{-6}$ Chemical-specific Method 1 CR = $2x10^{-6}$
Elementary School Staff – Exposure to Soil (0 to 2 feet bgs, Inside Schoolyard Fence Line)[1,2]	Benzo(a)pyrene Dioxins	Chemical-specific Method 1 CR = $2x10^{-5}$ Chemical-specific Method 1 CR = $4x10^{-6}$
Alternative Land Use		
Construction Worker – Exposure to Soil (0 foot bgs to groundwater, Site-Wide)[3], Groundwater, and Vapors in Trench Air[4]	Lead	Lead EPC = 858 mg/kg > 800 mg/kg
Resident – Exposure to Soil (0 to 2 feet bgs, Site-wide)[3] and Vapors in Indoor Air[5]	Benzo(a)pyrene Dioxins	Chemical-specific Method 1 CR = $4x10^{-5}$ Chemical-specific Method 1 CR = $1x10^{-5}$
Resident – Exposure to Soil (0 foot bgs to groundwater, Site-wide)[3] and Vapors in Indoor Air[5]	Benzo(a)pyrene Dioxins Lead	Chemical-specific Method 1 CR = $3x10^{-5}$ Chemical-specific Method 1 CR = $2x10^{-5}$ Blood-Lead Level for Child Resident = 21.2 µg/dL
Commercial/Industrial Worker – Exposure to Soil (0-2 feet bgs, Site-wide)[3] and Vapors in Indoor Air[5]	Benzo(a)pyrene Dioxins	Chemical-specific Method 1 CR = $2x10^{-5}$ Chemical-specific Method 1 CR = $4x10^{-6}$

TABLE A-4: PROPOSED CHEMICALS OF CONCERN (CONTINUED)

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Receptor Scenario	Proposed COCs at IR Site 31	
	COC	**Rationale for Identification**
Alternative Land Use (Continued)		
Commercial/Industrial Worker – Exposure to Soil (0 foot bgs – groundwater, Site-wide)[3] and Vapors in Indoor Air[5]	Benzo(a)pyrene Dioxins Lead	Chemical-specific Method 1 CR = $1x10^{-5}$ Chemical-specific Method 1 CR = $4x10^{-6}$ Lead EPC = 858 mg/kg > 800 mg/kg
Recreational Visitor – Exposure to Soil (0-2 feet bgs, Southeast Quadrant)[3]	Benzo(a)pyrene Dioxins	Chemical-specific CR = $4x10^{-6}$ Chemical-specific CR = $6x10^{-6}$
Recreational Visitor – Exposure to Soil (0 foot bgs – groundwater, Southeast Quadrant)[3]	Benzo(a)pyrene Dioxins	Chemical-specific CR = $4x10^{-6}$ Chemical-specific CR = $1x10^{-5}$

Notes:

1 Exposure to soil via incidental ingestion, dermal contact, and inhalation pathways presented in Appendix I, Section I.8.2 of the Final RI Report, Installation Restoration Site 31 (SulTech 2006).
2 Soil assumed to be unpaved for this assessment
3 Exposure to soil via incidental ingestion, dermal contact, and inhalation of particulates or vapors in outdoor air
4 In-trench air concentrations modeled from groundwater
5 Indoor air concentrations modeled from groundwater and site-wide combined surface and subsurface soil (0 foot bgs to groundwater)
6 Naphthalene was proposed as a COC based on HQs from site-specific Q_{soil}

bgs Below ground surface
COC Chemical of concern
CR Cancer risk
EPC Exposure point concentration
HQ Hazard quotient
mg/kg Milligram per kilogram
Pb Blood-lead
RME Reasonable maximum exposure

References:

SulTech. 2006. "Final Remedial Investigation Report, Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California." July.

TABLE A-5: RECALCULATED CANCER RISK AND NONCANCER HI ESTIMATES, ADJUSTED FOR REMOVAL OF SOIL FROM DEBRIS AREA C[A]

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Receptor	RME Cancer Risk Estimates		RME Noncancer HI Estimates	
	Method 1	Method 2	Method 1	Method 2
Current Land Use				
Altered Site Conditions				
Elementary School Child – Exposure to Soil (0 to 2 feet bgs, Inside Schoolyard Fence Line)[1,2]	$3x10^{-7}$ (down from $1x10^{-5}$)	$3x10^{-7}$ (down from $2x10^{-5}$)	0.1 (down from 0.2)	0.2 (no change)
Blood-lead level does not exceed 10 µg/dL				
Elementary School Staff – Exposure to Soil (0 to 2 feet bgs, Inside Schoolyard Fence Line)[1,2]	$6x10^{-7}$ (down from $2x10^{-5}$)	$1x10^{-6}$ (down from $4x10^{-5}$)	0.1 (no change)	0.1 (down from 0.2)
Lead EPC = 202 mg/kg (below the EPA Region 9 PRG for industrial soil, 800 mg/kg)				
Alternative Land Use				
Construction Worker – Exposure to Soil (0 foot bgs to groundwater, site-wide)[3], Groundwater, and Vapors in Trench Air[4]	$6x10^{-7}$ (down from $3x10^{-6}$)	$1x10^{-6}$ (down from $5x10^{-6}$)	0.5 (down from 0.6)	0.6 (down from 0.8)
Lead EPC = 894 mg/kg (greater than the EPA Region 9 PRG for industrial soil, 800 mg/kg)				
Resident – Exposure to Soil (0 to 2 feet bgs, site-wide)[3] and Vapors in Indoor Air[5]	$1x10^{-5}$ (down from $7x10^{-5}$)	$9x10^{-5}$ (down from $3x10^{-3}$)	4 (down from 24)	4 (down from 25)
Blood-lead levels for residents fall below 10 µg/dL				
Resident – Exposure to Soil (0 foot bgs to groundwater, site-wide)[3] and Vapors in Indoor Air[5]	$2x10^{-5}$ (down from $6x10^{-5}$)	$9x10^{-5}$ (down from $3x10^{-3}$)	4 (down from 24)	5 (down from 25)
Blood-lead levels for adult resident fall below 10 µg/dL, but blood-lead levels for child resident exceed 10 µg/dL				
Commercial/Industrial Worker – Exposure to Soil (0 to 2 feet bgs, site-wide)[3] and Vapors in Indoor Air[5]	$4x10^{-6}$ (down from $3x10^{-5}$)	$2x10^{-5}$ (down from $4x10^{-4}$)	0.3 (down from 2)	0.4 (down from 2)
Lead EPC = 296 mg/kg (below the EPA Region 9 PRG for industrial soil, 800 mg/kg)				

TABLE A-5: RECALCULATED CANCER RISK AND NONCANCER HI ESTIMATES, ADJUSTED FOR REMOVAL OF SOIL FROM DEBRIS AREA C[A] (CONTINUED)

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Receptor	RME Cancer Risk Estimates		RME Noncancer HI Estimates	
	Method 1	Method 2	Method 1	Method 2
Alternative Land Use (Continued)				
Commercial/Industrial Worker – Exposure to Soil (0 foot bgs to groundwater, site-wide)[3] and Vapors in Indoor Air[5]	$5x10^{-6}$ (down from $2x10^{-5}$)	$2x10^{-5}$ (down from $4x10^{-4}$)	0.3 (down from 2)	0.4 (down from 2)
Lead EPC = 894 mg/kg (greater than the EPA Region 9 PRG for industrial soil)				

Notes:

a EPCs for COPCs were recalculated assuming soil in Debris Area C from 0 foot bgs to 4 feet bgs was removed. The following samples were collected from Debris Area C from 0 foot bgs to 4 feet bgs and were therefore excluded from these EPC recalculations: 89S031-26-2, 89S031-26-4, 89S031-26-5, 89S031-27-2, 89S031-27-4, 89S031-27-5, 89S031-31-2, 89S031-31-4, 89S031-31-5, 89S031-37-2, 89S031-37-4, 89S031-37-5, 89S031-40-2, 89S031-40-4, 89S031-40-5, 314SSYHP347, 314SSYHP348, 314SSYHP349, 314SSYHP350, 314SSYHP351, 314SSYHP352, 314SSYHP353, 314SSYHP354, and 314SSYHP354. Contributions from bis(2-chloroethyl)ether were not factored into the Method 2 recalculations.

1 Exposure to soil via incidental ingestion, dermal contact, and inhalation pathways presented in Appendix I, Section I.8.2 of the Final RI Report, Installation Restoration Site 31 (SulTech 2006).

2 Soil assumed to be unpaved for this assessment.

3 Exposure to soil via incidental ingestion, dermal contact, and inhalation of particulates or vapors in outdoor air.

4 In-trench air concentrations modeled from groundwater.

5 Indoor air concentrations modeled from groundwater and site-wide combined surface and subsurface soil (0 foot bgs to groundwater).

µg/dL Microgram per deciliter
bgs Below ground surface
COPC Chemical of potential concern
EPA U.S. Environmental Protection Agency
EPC Exposure point concentration
HI Hazard index
PRG Preliminary remediation goal
RME Reasonable maximum exposure

References:

SulTech. 2006. "Final Remedial Investigation Report, Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California." July.

TABLE A-6: RECALCULATED CANCER RISK AND NONCANCER HI ESTIMATES, ADJUSTED FOR REMOVAL OF SOIL FROM DEBRIS AREAS C AND D[A]

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Receptor	RME Cancer Risk Estimates		RME Noncancer HI Estimates	
	Method 1	Method 2	Method 1	Method 2
Current Land Use				
Altered Site Conditions				
Elementary School Child – Exposure to Soil (0 to 2 feet bgs, Inside Schoolyard Fence Line)[1,2]	$3x10^{-7}$ (down from $1x10^{-5}$)	$6x10^{-7}$ (down from $2x10^{-5}$)	0.1 (down from 0.2)	0.2 (no change)
Blood-lead level does not exceed 10 µg/dL				
Elementary School Staff – Exposure to Soil (0 to 2 feet bgs, Inside Schoolyard Fence Line)[1,2]	$6x10^{-7}$ (down from $2x10^{-5}$)	$1x10^{-6}$ (down from $4x10^{-5}$)	0.1 (no change)	0.1 (down from 0.2)
Lead EPC = 202 mg/kg (below the EPA Region 9 PRG for industrial soil, 800 mg/kg)				
Alternative Land Use				
Construction Worker – Exposure to Soil (0 foot bgs to groundwater, site-wide)[3], Groundwater, and Vapors in Trench Air[4]	$3x10^{-7}$ (down from $3x10^{-6}$)	$6x10^{-7}$ (down from $5x10^{-6}$)	0.4 (down from 0.6)	0.6 (down from 0.8)
Lead EPC = 914 mg/kg (greater than the EPA Region 9 PRG for industrial soil, 800 mg/kg)				
Resident – Exposure to Soil (0 to 2 feet bgs, site-wide)[3] and Vapors in Indoor Air[5]	$9x10^{-6}$ (down from $7x10^{-5}$)	$8x10^{-5}$ (down from $3x10^{-3}$)	4 (down from 24)	4 (down from 25)
Blood-lead levels for residents fall below 10 µg/dL				
Resident – Exposure to Soil (0 foot bgs to groundwater, site-wide)[3] and Vapors in Indoor Air[5]	$1x10^{-5}$ (down from $6x10^{-5}$)	$8x10^{-5}$ (down from $3x10^{-3}$)	4 (down from 24)	5 (down from 25)
Blood-lead levels for adult resident fall below 10 µg/dL, but blood-lead levels for child resident exceed 10 µg/dL				
Commercial/Industrial Worker – Exposure to Soil (0 to 2 feet bgs, site-wide)[3] and Vapors in Indoor Air[5]	$2x10^{-6}$ (down from $3x10^{-5}$)	$1x10^{-5}$ (down from $4x10^{-4}$)	0.3 (down from 2)	0.4 (down from 2)
Lead EPC = 284 mg/kg (below the EPA Region 9 PRG for industrial soil, 800 mg/kg)				

TABLE A-6: RECALCULATED CANCER RISK AND NONCANCER HI ESTIMATES, ADJUSTED FOR REMOVAL OF SOIL FROM DEBRIS AREAS C AND D[A] (CONTINUED)

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Receptor	RME Cancer Risk Estimates		RME Noncancer HI Estimates	
	Method 1	Method 2	Method 1	Method 2
Alternative Land Use (Continued)				
Commercial/Industrial Worker – Exposure to Soil (0 foot bgs to groundwater, site-wide)[3] and Vapors in Indoor Air[5]	$3x10^{-6}$ (down from $2x10^{-5}$)	$1x10^{-5}$ (down from $4x10^{-4}$)	0.3 (down from 2)	0.4 (down from 2)
Lead EPC = 914 mg/kg (greater than the EPA Region 9 PRG for industrial soil)				

Notes:

a EPCs for COPCs were recalculated assuming soil in Debris Areas C and D from 0 foot bgs to 4 feet bgs was removed. The following samples were collected from Debris Area D from 0 foot bgs to 4 feet bgs and were therefore excluded from these EPC calculations, in addition to the samples identified in Table A-5 as collected from Debris Area C: 89S031-03-2, 89S031-03-4, 89S031-03-5, 89S031-04-2, 89S031-04-3, 89S031-04-4, 89S031-43-2, 89S031-43-4, and 89S031-43-5. Contributions from bis(2-chloroethyl)ether were not factored into the Method 2 recalculations.

1 Exposure to soil via incidental ingestion, dermal contact, and inhalation pathways presented in Appendix I, Section I.8.2 of the Final RI Report, Installation Restoration Site 31 (SulTech 2006).

2 Soil assumed to be unpaved for this assessment.

3 Exposure to soil via incidental ingestion, dermal contact, and inhalation of particulates or vapors in outdoor air.

4 In-trench air concentrations modeled from groundwater.

5 Indoor air concentrations modeled from groundwater and site-wide combined surface and subsurface soil (0 foot bgs to groundwater).

6 The chemical-specific risks from benzo(a)pyrene and dioxins for the recreational evaluation in the southeast quadrant, presented in Table 3 of the RI Final Report (SulTech 2006), would be eliminated with the removal of soil from Debris Area D. This removal also would eliminate the one arsenic outlier concentration that was responsible for concentrations exceeding ambient.

µg/dL Microgram per deciliter
bgs Below ground surface
COPC Chemical of potential concern
EPA U.S. Environmental Protection Agency
EPC Exposure point concentration
HI Hazard index
mg/kg Milligram per kilogram
PRG Preliminary remediation goal
RI Remedial investigation
RME Reasonable maximum exposure

References:

SulTech. 2006. "Final Remedial Investigation Report, Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California." July.

TABLE A-7: RECALCULATED CANCER RISK AND NONCANCER HI ESTIMATES, ADJUSTED FOR REMOVAL OF SOIL FROM DEBRIS AREAS A, B, C, AND D[A]

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Receptor	RME Cancer Risk Estimates		RME Noncancer HI Estimates	
	Method 1	Method 2	Method 1	Method 2
Current Land Use				
Altered Site Conditions				
Elementary School Child – Exposure to Soil (0 to 2 feet bgs, Inside Schoolyard Fence Line)[1,2]	$3x10^{-7}$ (down from $1x10^{-5}$)	$6x10^{-7}$ (down from $2x10^{-5}$)	0.1 (down from 0.2)	0.2 (no change)
Blood-lead level does not exceed 10 µg/dL				
Elementary School Staff – Exposure to Soil (0 to 2 feet bgs, Inside Schoolyard Fence Line)[1,2]	$6x10^{-7}$ (down from $2x10^{-5}$)	$1x10^{-6}$ (down from $4x10^{-5}$)	0.1 (no change)	0.1 (down from 0.2)
Lead EPC = 202 mg/kg (below the EPA Region 9 PRG for industrial soil, 800 mg/kg)				
Alternative Land Use				
Construction Worker – Exposure to Soil (0 foot bgs to groundwater, site-wide)[3], Groundwater, and Vapors in Trench Air[4]	$3x10^{-7}$ (down from $3x10^{-6}$)	$6x10^{-7}$ (down from $5x10^{-6}$)	0.3 (down from 0.6)	0.5 (down from 0.8)
Lead EPC = 955 mg/kg (greater than the EPA Region 9 PRG for industrial soil, 800 mg/kg)				
Resident – Exposure to Soil (0 to 2 feet bgs, site-wide)[3] and Vapors in Indoor Air[5]	$9x10^{-6}$ (down from $7x10^{-5}$)	$8x10^{-5}$ (down from $3x10^{-3}$)	4 (down from 24)	4 (down from 25)
Blood-lead levels for residents fall below 10 µg/dL				
Resident – Exposure to Soil (0 foot bgs to groundwater, site-wide)[3] and Vapors in Indoor Air[5]	$1x10^{-5}$ (down from $6x10^{-5}$)	$8x10^{-5}$ (down from $3x10^{-3}$)	4 (down from 24)	4 (down from 25)
Blood-lead levels for adult resident fall below 10 µg/dL, but blood-lead levels for child resident exceed 10 µg/dL				
Commercial/Industrial Worker – Exposure to Soil (0 to 2 feet bgs, site-wide)[3] and Vapors in Indoor Air[5]	$2x10^{-6}$ (down from $3x10^{-5}$)	$1x10^{-5}$ (down from $4x10^{-4}$)	0.3 (down from 2)	0.4 (down from 2)
Lead EPC = 284 mg/kg (below the EPA Region 9 PRG for industrial soil, 800 mg/kg)				

TABLE A-7: RECALCULATED CANCER RISK AND NONCANCER HI ESTIMATES, ADJUSTED FOR REMOVAL OF SOIL FROM DEBRIS AREAS A, B, C, AND D[A] (CONTINUED)

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Receptor	RME Cancer Risk Estimates		RME Noncancer HI Estimates	
	Method 1	Method 2	Method 1	Method 2
Alternative Land Use (Continued)				
Commercial/Industrial Worker – Exposure to Soil (0 foot bgs to groundwater, site-wide)[3] and Vapors in Indoor Air[5]	$3x10^{-6}$ (down from $2x10^{-5}$)	$1x10^{-5}$ (down from $4x10^{-4}$)	0.3 (down from 2)	0.4 (down from 2)
Lead EPC = 955 mg/kg (greater than the EPA Region 9 PRG for industrial soil)				

Notes:

a EPCs for COPCs were recalculated assuming soil in Debris Areas A, B, C, and D from 0 foot bgs to 4 feet bgs was removed. The following samples were collected from Debris Areas A and B from 0 foot bgs to 4 feet bgs and were therefore excluded from these EPC calculations, in addition to the samples identified in Tables A-5 and A-6 as collected from Debris Areas C and D, respectively: T094-27-3, T094-27-4, T094-NE-052, T094-NE-053, T094-NE-054, T094-NE-055, T094-NE-056, T094-NE-057, T094-NE-058, T094-NE-059, T094-NE-060, T094-NE-071, T094-NE-072, T094-NE-073, T094-NE-074, T094-NE-076, T094-NE-077, T094-NE-078, T094-NE-079, T094-NE-080, T094-NE-081, and T094-NE-082. Contributions from bis(2-chloroethyl)ether were not factored into the Method 2 recalculations.

1 Exposure to soil via incidental ingestion, dermal contact, and inhalation pathways presented in Appendix I, Section I.8.2 of the Final RI Report, Installation Restoration Site 31 (SulTech 2006).

2 Soil assumed to be unpaved for this assessment.

3 Exposure to soil via incidental ingestion, dermal contact, and inhalation of particulates or vapors in outdoor air.

4 In-trench air concentrations modeled from groundwater.

5 Indoor air concentrations modeled from groundwater and site-wide combined surface and subsurface soil (0 foot bgs to groundwater).

µg/dL Microgram per deciliter
bgs Below ground surface
COPC Chemical of potential concern
EPA U.S. Environmental Protection Agency
EPC Exposure point concentration
HI Hazard index
mg/kg Milligram per kilogram
PRG Preliminary remediation goal
RI Remedial investigation
RME Reasonable maximum exposure

References:

SulTech. 2006. "Final Remedial Investigation Report, Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California." July.

TABLE A-8: SUMMARY OF SCREENING OF POTENTIAL REMEDIAL ALTERNATIVES, EXTENT OF TIER III RISK ASSESSMENT AND SAMPLE POINTS EXCLUDED

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Potential Remedial Action Alternative	Analysis Performed	Sampling Location Excluded	Tables Where Detailed Analytical Results and Sampling locations ID Nos. Are Presented	Retained for Further Analysis?	Rationale
I – No Action	Not Available (HHRA Values Used)			Yes	Required for comparison against other alternatives
II – Engineering Controls Combined With Institutional Controls	Not Available (HHRA Values Used)			Yes	Anticipated future use of IR Site 31 is similar to current use. Easily implementable.
III – Engineering Controls, Institutional Controls, and Excavation (Debris Area C) and Off-Site Disposal of Soil	Recalculated site-wide cancer risk and noncancer HI risk values	All sampling locations within Debris Area C	Table A-5, Appendix A	No	Level of overall risk reduction accomplished is lower than that of other potential remedial alternatives.
IV – Engineering Controls, Institutional Controls, and Excavation (Debris Area E) and Off-Site Disposal of Soil	Blood-lead levels recalculated	All sampling locations within Debris Area E	Section A5.2.4	Yes	Risk reduction is significant due to removal of lead in Debris Area E.
V – Engineering Controls, Institutional Controls, and Excavation (Debris Areas C and D Excluding Street) and Off-Site Disposal of Soil	Recalculated site-wide cancer risk and noncancer HI risk values	All sampling locations within Debris Areas C and D	Table A-6, Appendix A	Yes	Provides order of magnitude reduction from the baseline cancer risk.
VI – Engineering Controls, Institutional Controls, and Excavation (Debris Areas A, B, C, and D Excluding Street) and Off-Site Disposal of Soil	Recalculated site-wide cancer risk and noncancer HI risk values	All sampling locations within Debris Areas A, B, C and D	Table A-7, Appendix A	No	Minimal difference in risk reduction in comparison to Potential Remedial Alternative V.
VII – Complete Removal of Debris Areas A, B, C, D, and E and Off-Site Disposal of Soil	NA (all risks are eliminated)		NA	Yes	Allows for unrestricted use because COCs are removed and overall site risk is mitigated.

Notes:

COC Chemical of concern HHRA Human health risk assessment HI Hazard index IR Installation Restoration

APPENDIX B
EVALUATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS ..... B-iii

B1.0 EVALUATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS B-1

B1.1 SUMMARY OF COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT AND NATIONAL OIL AND HAZARDOUS SUBSTANCES POLLUTION CONTINGENCY PLAN REQUIREMENTS B-1

B1.2 METHODOLOGY DESCRIPTION B-4

B1.2.1 General B-4

B1.2.2 Identifying and Evaluating Federal ARARs B-5

B1.2.3 Identifying and Evaluating State ARARs B-5

B1.3 OTHER GENERAL ISSUES B-6

B1.3.1 General Approach to Requirements of RCRA B-6

B1.4 WASTE CHARACTERIZATION B-7

B1.4.1 RCRA Hazardous Waste Determination B-7

B1.4.2 California-Regulated Non-RCRA Hazardous Waste B-9

B1.4.3 Other California Waste Classifications B-10

B2.0 POTENTIAL CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS B-10

B2.1 POTENTIAL FEDERAL CHEMICAL-SPECIFIC ARARS FOR SOIL B-10

B2.2 POTENTIAL STATE CHEMICAL-SPECIFIC ARARS B-11

B3.0 POTENTIAL LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS B-12

B4.0 POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS B-12

B4.1 NO ACTION ALTERNATIVE B-12

B4.2 ALTERNATIVE 2: ENGINEERING CONTROLS COMBINED WITH INSTITUTIONAL CONTROLS B-13

B4.2.1 Engineering Controls B-13

B4.2.2 Institutional Controls B-13

B4.3 ALTERNATIVE 3: ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS, AND EXCAVATION (DEBRIS AREA E) AND OFF-SITE DISPOSAL OF SOIL B-15

B4.3.1 Engineering Controls B-16

B4.3.2 Institutional Controls B-16

B4.3.3 Excavation and Off-Site Disposal of Soil B-16

B4.4 ALTERNATIVE 4: ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS, AND EXCAVATION (DEBRIS AREA C AND D, EXCLUDING THE STREET) AND OFF-SITE DISPOSAL OF SOIL B-17
B4.4.1 Engineering Controls B-18
B4.4.2 Institutional Controls B-18
B4.4.3 Excavation and Off-Site Disposal of Soil B-18
B4.5 ALTERNATIVE 5: COMPLETE REMOVAL OF DEBRIS AREAS A, B, C, D, AND E AND OFF-SITE DISPOSAL OF SOIL B-19
B4.5.1 Excavation and Off-Site Disposal of Soil B-19

B5.0 REFERENCES B-20

Attachment

B1 Letter Requesting Identification of State "Applicable" or "Relevant and Appropriate" Requirements for Installation Restoration Site 31 from Navy to Department of Toxic Substances Control

B2 DTSC Letter Requesting Installation Restoration Site 30 State "Applicable" or "Relevant and Appropriate" Requirements be Used for Installation Restoration Site 31

B3 Navy's Responses to ARARs Identified by the California Department of Fish and Game, California Department of Health Services, and the California Department of Toxic Substances Control

Table

B-1 Potential Chemical-Specific Applicable or Relevant and Appropriate Requirements

B-2 Potential Action-Specific Applicable or Relevant and Appropriate Requirements

ACRONYMS AND ABBREVIATIONS

§	Section
§§	Sections
ARAR	Applicable or relevant and appropriate requirement
BAAQMD	Bay Area Air Quality Management District
B(a)P-EQ	Benzo(a)pyrene-equivalent
Cal. Code Regs.	*California Code of Regulations*
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
ch.	Chapter
COC	Chemical of concern
div.	Division
DTSC	Department of Toxic Substances Control
EP	Extraction procedure
EPA	U.S. Environmental Protection Agency
FR	*Federal Register*
FS	Feasibility Study
IC	Institutional control
IR	Installation Restoration
mg/kg	Milligram per kilogram
NAVSTA TI	Naval Station Treasure Island
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ng/kg	Nanogram per kilogram
RAO	Remedial action objective
RCRA	Resource Conservation and Recovery Act
SWRCB	State Water Resources Control Board
TBC	To be considered
TCLP	Toxicity characteristic leaching procedure
TEQ	Toxic equivalent
tit.	Title
U.S.C.	*United States Code*

B1.0 EVALUATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

This appendix identifies and evaluates potential federal and State of California applicable or relevant and appropriate requirements (ARAR) from the universe of regulations, requirements, and guidance. This appendix also sets forth the U.S. Department of the Navy determinations regarding those potential ARARs for each remedial alternative retained for detailed analysis in the Feasibility Study (FS) Report for Installation Restoration (IR) Site 31, the Former South Storage Yard, at the former Naval Station Treasure Island (NAVSTA TI) in San Francisco, California.

This evaluation includes an initial determination of whether the potential ARARs actually qualify as ARARs and a comparison for stringency between the federal and state regulations to identify the controlling potential ARARs. The identification of potential ARARs is an iterative process. The final determination of ARARs will be made by the Navy in the Record of Decision, after public review, during selection of the response action for IR Site 31.

B1.1 SUMMARY OF COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT AND NATIONAL OIL AND HAZARDOUS SUBSTANCES POLLUTION CONTINGENCY PLAN REQUIREMENTS

Section (§) 121(d) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (42 *United States Code* [U.S.C.] § 9621[d]), as amended, 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 that are determined to be legally applicable or relevant and appropriate.

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 with 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 remedial action and are well suited to the conditions of the site (U.S. Environmental Protection Agency [EPA] 1988a). A requirement must be determined to be both relevant and appropriate in order to be considered a potential ARAR.

The criteria for determining relevance and appropriateness are listed in Title 40 *Code of Federal Regulations* (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
- The action or activities regulated by the requirement and the response action contemplated 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
- 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 (EPA 1988a), a requirement may be "applicable" or "relevant and appropriate," but not both. ARARs must be identified on a site-specific basis and involve a two-part analysis. First, a determination is made about whether a given requirement is applicable. Second, if the requirement is not applicable, a determination is made about 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 (EPA 1988a).

Tables B-1 and B-2 included in this appendix present each potential ARAR with a determination of ARAR status (that is, applicable, relevant, and appropriate, or to be considered [TBC]). For the determination of relevance and appropriateness, the pertinent criteria were examined to determine whether the requirements addressed problems or situations 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 potential ARAR under CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), a state requirement must be:

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

To constitute a potential ARAR, a requirement must be substantive. Only the substantive provisions of requirements identified as potential ARARs in the IR Site 31 FS Report are considered to be potential ARARs. Permits are considered to be procedural or administrative requirements. Provisions of generally relevant federal and state statutes and regulations that were determined to be procedural or nonenvironmental, including permit requirements, are not considered to be potential ARARs. CERCLA § 121(e)(1), 42 U.S.C. § 9621(e)(1), states that "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 CFR § 300.5).

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

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

As the lead federal agency, the Navy has primary responsibility for identifying potential federal ARARs at NAVSTA TI. The Department of Toxic Substances Control (DTSC) is responsible for identifying and advising the Navy of potential state ARARs relating to IR Site 31.

B1.2 METHODOLOGY DESCRIPTION

This section describes the process of identifying and evaluating potential federal and state ARARs.

B1.2.1 General

As the lead federal agency, the Navy has primary responsibility for identification of potential ARARs for IR Site 31. In preparing this ARARs analysis, the Navy undertook the following measures, consistent with CERCLA and the NCP:

- Identified federal ARARs for each remedial alternative addressed in the IR Site 31 FS Report, taking into account site-specific information for IR Site 31
- Reviewed potential state ARARs identified by the state to determine if they satisfy CERCLA and NCP criteria that must be met to constitute state ARARs
- Evaluated and compared federal ARARs and their state counterparts to determine if state ARARs are more stringent than federal ARARs or are in addition to the federally required actions
- Reached a conclusion about the federal and state ARARs that are the most stringent or "controlling" for each remedial alternative

As discussed in Section 3.0 of the IR Site 31 FS Report, the following remedial action objectives were developed for the site:

- Elementary school child and staff receptor: prevent direct contact with and ingestion of shallow soils containing B[a]P-EQ concentrations exceeding 0.62 mg/kg and dioxin TEQ concentrations exceeding the NAVSTA TI ambient level of 12 ng/kg.
- Construction worker: prevent direct contact with and ingestion of soils containing lead at concentrations exceeding 800 mg/kg.
- Recreational visitor: prevent direct contact with and ingestion of soils located in the southeastern quadrant containing B(a)P-EQ concentrations exceeding 0.62 mg/kg and dioxin TEQ concentrations exceeding 12 ng/kg.
- Residential receptor: prevent direct contact with and ingestion of soil containing B(a)P-EQ concentrations exceeding 0.62 mg/kg, dioxin TEQ concentrations exceeding 12 ng/kg, and lead at concentrations exceeding 400 mg/kg.
- Commercial/industrial worker: prevent direct contact to and ingestion of soils containing B(a)P-EQ concentrations exceeding 0.62 mg/kg, dioxins TEQ concentrations exceeding 12 ng/kg, and lead at concentrations exceeding 800 mg/kg.

The following remedial alternatives are considered in the detailed analysis in the IR Site 31 FS Report:

- **Alternative 1**. No Action
- **Alternative 2**. Engineering Controls Combined with Institutional Controls
- **Alternative 3**. Engineering Controls, Institutional Controls, and Excavation (Debris Area E) and Off-Site Disposal of Soil
- **Alternative 4**. Engineering Controls, Institutional Controls, and Excavation (Debris Areas C and D, excluding the street) and Off-Site Disposal of Soil
- **Alternative 5.** Complete Removal of Debris Areas A, B, C, D, and E and Off-Site Disposal of Soil

B1.2.2 Identifying and Evaluating Federal ARARs

The Navy is responsible for identifying federal ARARs as the lead federal agency under CERCLA and the NCP. The final determination of federal ARARs will be made when the Navy issues the Record of Decision. The Federal Government implements a number of federal environmental statutes that are the source of potential federal ARARs, either in the form of the statutes or regulations promulgated thereunder. Examples include the Resource Conservation and Recovery Act (RCRA), the Clean Water Act, the Safe Drinking Water Act, the Toxic Substances Control Act, and their implementing regulations. See the preamble to NCP at 55 *Federal Register* (FR) Sections (§§) 8764–8765 (1990) for a more complete listing.

The proposed remedial alternatives were reviewed against all potential federal ARARs, including but not limited to those set forth at 55 §§ FR 8764–8765 (1990), to determine if they were applicable or relevant and appropriate using the CERCLA and NCP criteria and procedures for ARAR identification by lead federal agencies.

B1.2.3 Identifying and Evaluating State ARARs

The state and the Navy identified and evaluated potential state ARARs for IR Site 31. This section describes the process followed by the state and the Navy, including the solicitation of state ARARs and the chronology of efforts by the Navy to identify state ARARs.

B1.2.3.1 Solicitation of State ARARs under NCP

EPA guidance recommends the lead federal agency consult with the state when identifying state ARARs for remedial actions (EPA 1988b). In essence, the CERCLA and NCP requirements at 40 CFR § 300.515 for remedial actions provide that the lead federal agency request the state to identify chemical-specific and location-specific state ARARs upon completion of site characterization. The requirements also provide that the lead federal agency request identification of all categories of state ARARs (chemical-specific, location-specific, and action-

specific) upon identification of the remedial alternatives for detailed analysis in an FS. The state must respond within 30 days of receipt of the lead federal agency requests. The Navy followed the procedures set forth in 40 CFR § 300.515 for remedial actions in seeking state assistance in identifying state ARARs.

B1.2.3.2 Chronology of Efforts to Identify State ARARs

In a letter to DTSC dated May 15, 2006, the Navy requested chemical-specific, location-specific, and action-specific ARARs for IR Site 31, and that DTSC coordinate responses from all California state agencies (see Attachment B1).

In response to the Navy's request for state ARARs, DTSC stated that the ARARs developed for IR Site 30 should be used for IR Site 31 (see letter from DTSC dated August 15, 2006, provided as Attachment B2). The Navy has reviewed all of the state requirements identified for IR Site 30 and has included the state requirements it determined to be ARARs for IR Site 31. The Navy has prepared a response to the requirements identified by the state (see Attachment B3).

Key correspondence between the Navy and the state agencies relating to this effort is included in the administrative record for the FS.

B1.3 OTHER GENERAL ISSUES

General issues were identified during the evaluation of ARARs for IR Site 31. These issues included the approach followed to identify RCRA requirements as potential ARARs and characterization of waste during the ARAR selection process.

B1.3.1 General Approach to Requirements of RCRA

RCRA is a federal statute enacted in 1976 to meet four goals: (1) the protection of human health and the environment; (2) the reduction of waste; (3) the conservation of energy and natural resources; and (4) wherever feasible, the reduction or elimination of the generation of hazardous waste as expeditiously as possible. The Hazardous and Solid Waste Amendments of 1984 significantly expanded 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 remedial 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 RCRA requirement; or
- The activity at the CERCLA site constitutes treatment, storage, or disposal, as defined by RCRA (EPA 1988a).

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 FR §§ 8666, 8742 [1990]). California received approval for its base RCRA hazardous waste management program on July 23, 1992 (57 FR § 32726 [1992]). The California "Environmental Health Standards for the Management of Hazardous Waste," set forth in Title 22 *California Code of Regulations* (Cal. Code Regs. tit. 22), Division (div.) 4.5, were approved by EPA as a component of the federally authorized California RCRA program. On September 26, 2001, California received final authorization of its revised State Hazardous Waste Management Program by the EPA (66 FR § 49118 [2001]). Therefore, Cal. Code Regs. tit. 22, div. 4.5 is a source of potential federal ARARs for CERCLA response actions. The exception is when a state regulation is "broader in scope" than the corresponding federal RCRA regulations. In that case, such regulations are not considered part of the federally authorized program or potential federal ARARs. Instead, they are purely state law requirements and potential state ARARs.

The EPA July 23, 1992, notice approving the State of California RCRA program (57 FR § 32726 [1992]) specifically indicated that state regulations addressed certain non-RCRA, state-regulated hazardous wastes that fell outside the scope of federal RCRA requirements. Cal. Code Regs. tit. 22, div. 4.5 requirements would be potential state ARARs for such non-RCRA, state-regulated wastes.

A key threshold question for the ARARs analysis is whether chemicals at IR Site 31 constitute federal hazardous waste as defined under RCRA and the state's authorized program or qualify as non-RCRA, state-regulated hazardous waste.

B1.4 WASTE CHARACTERIZATION

Selection of ARARs involves the characterization of wastes as described below.

B1.4.1 RCRA Hazardous Waste Determination

Characterization of hazardous wastes is necessary to determine if a waste is subject to RCRA requirements at Cal. Code Regs. tit. 22, div. 4.5 and other state requirements at Cal. Code Regs. tit. 22, div. 3, Chapter (ch.) 15. The first step in the characterization process is to evaluate contaminated media at the sites and determine if the chemicals identified at the site constitute a "listed" RCRA waste. The preamble to the NCP states that "… it is often necessary to know the origin of the waste to determine whether it is a listed waste and that, if such documentation is lacking, the lead agency may assume it is not a listed waste" (55 FR §§ 8666, 8758 [1990]).

This approach is confirmed in EPA guidance for CERCLA compliance with other laws (EPA 1988a), as follows:

> "To determine whether a waste is a listed waste under RCRA, it is often necessary to know the source. However, at many Superfund sites, no information exists on the source of wastes. The lead agency should use available site information, manifests, storage records, and vouchers in an effort to ascertain the nature of these contaminants. When this documentation is not available, the lead agency may assume that the wastes are not listed RCRA hazardous wastes, unless further analysis or information becomes available that allows the lead agency to determine that the wastes are listed RCRA hazardous wastes."

RCRA hazardous wastes that have been assigned EPA hazardous waste numbers (or codes) are listed in Cal. Code Regs. tit. 22, §§ 66261.30 through 66261.33. The lists include hazardous waste codes beginning with the letters "F," "K," "P," and "U."

The second step in the characterization process is to evaluate potential hazardous characteristics of the waste. The evaluation of waste characteristics is described in EPA guidance (EPA 1988a), as follows:

> "Under certain circumstances, although no historical information exists about the waste, it may be possible to identify the waste as RCRA characteristic waste. This is important in the event that (1) remedial alternatives under consideration at the site involve on-site treatment, storage, or disposal, in which case RCRA may be triggered as discussed in this section; or (2) a remedial alternative involves offsite shipment. Since the generator (in this case, the agency or responsible party conducting the Superfund action) is responsible for determining whether the wastes exhibit any of these characteristics (defined in 40 CFR Sections 261.21 through 261.24), testing may be required. The lead agency must use best professional judgment to determine, on a site-specific basis, if testing for hazardous characteristics is necessary.
>
> In determining whether to test for the toxicity characteristic using the extraction procedures (EP) toxicity test, it may be possible to assume that certain low concentrations of waste are not toxic. For example, if the total waste concentration in soil is 20 times or less the EP toxicity concentration, the waste cannot be characteristic hazardous waste. In such a case, RCRA requirements would not be applicable. In other instances, where it appears that the substances may be characteristic hazardous waste (ignitable, corrosive, reactive, or EP toxic), testing should be performed."

Hazardous waste characteristics, as defined in 40 CFR §§ 261.21 through 261.24, are commonly referred to as ignitability, corrosivity, reactivity, and toxicity. California environmental health standards for the management of hazardous waste set forth in Cal. Code Regs. tit. 22, div. 4.5

were approved by EPA as a component of the federally authorized California RCRA program. Therefore, the characterization of RCRA waste is based on the state requirements.

The characteristics of ignitability, corrosivity, reactivity, and toxicity are defined in Cal. Code Regs. tit. 22, §§ 66261.21 through 66261.24. According to Cal. Code Regs. tit. 22, § 66261.24(a)(1)(A), "A waste that exhibits the characteristic of toxicity pursuant to subsection (a)(1) of this section has the EPA Hazardous Waste Number specified in Table I of this section which corresponds to the toxic contaminant causing it to be hazardous." Table I assigns hazardous waste codes beginning with the letter "D" to wastes that exhibit the characteristic of toxicity; D waste codes are limited to "characteristic" hazardous wastes.

According to Cal. Code Regs. tit. 22, § 66261.10, waste characteristics can be measured by an available standardized test method or be reasonably classified by generators of waste based on their knowledge of the waste provided the waste has already been reliably tested or if there is documentation of chemicals used.

The requirements at Cal. Code Regs. tit. 22, § 66261.24 list the toxic chemical concentrations that determine the characteristic of toxicity. The concentration limits are in milligrams per liter. These units are directly comparable with total concentrations in waste groundwater and surface water. For waste soils, these concentrations apply to the extract or leachate produced by the toxicity characteristic leaching procedure (TCLP).

A waste is considered hazardous if chemicals in the wastewater or in the soil TCLP extract equal or exceed the TCLP limits. TCLP testing is required only if total chemical concentrations in soil equal or exceed 20 times the TCLP limits because TCLP uses a 20-to-1 dilution for the extract (EPA 1988a).

B1.4.2 California-Regulated Non-RCRA Hazardous Waste

A waste determined not to be a RCRA hazardous waste might still be considered a state-regulated non-RCRA hazardous waste. The state is broader in scope in its RCRA program in determining hazardous waste. Cal. Code Regs. tit. 22, § 66261.24(a)(2) lists the total threshold limit concentrations and the soluble threshold limit concentrations for non-RCRA hazardous waste. The state applies its own leaching procedure, the waste extraction test, which uses a different acid reagent and has a different dilution factor (tenfold). Other state requirements may be broader in scope than federal ARARs for identifying non-RCRA wastes regulated by the state. These requirements may be potential ARARs for wastes not covered under federal ARARs. See additional subsections of Cal. Code Regs. tit. 22, § 66261.24. A waste is considered hazardous if its total concentrations exceed the total threshold limit concentrations or if the extract concentrations from the waste extraction test exceed the soluble threshold limit concentration. A waste extraction test is required when the total concentrations exceed the soluble threshold limit concentration but are less than the total threshold limit concentration (Cal. Code Regs. tit. 22, div. 4.5, ch. 11, Appendix II [b]).

B1.4.3 Other California Waste Classifications

For waste discharged after July 18, 1997, solid waste classifications at Cal. Code Regs. tit. 27, §§ 20210, 20220, and 20230 are used to determine applicability of waste management requirements. These classifications are summarized below.

A "designated waste" under Cal. Code Regs. tit. 27, § 20210 is defined at *California Water Code* § 13173. Under *California Water Code* § 13173, designated waste is hazardous waste that has been granted a variance from hazardous waste management requirements or nonhazardous waste that consists of or contains pollutants that, under ambient environmental conditions at a waste management unit, could be released in concentrations exceeding applicable water quality objectives or that could reasonably be expected to affect beneficial uses of the waters of the state.

A nonhazardous solid waste under Cal. Code Regs. tit. 27, § 20220 is all putrescible and nonputrescible solid, semisolid, and liquid wastes, including garbage, trash, refuse, paper, rubbish, ashes, industrial wastes, demolition and construction wastes, abandoned vehicles and parts thereof, discarded home and industrial appliances, manure, vegetable or animal solid and semisolid wastes, and other discarded waste (whether of solid or semisolid consistency). These are considered nonhazardous solid waste provided that such wastes do not contain wastes that must be managed as hazardous wastes or wastes that contain soluble pollutants in concentrations that exceed applicable water quality objectives or could cause degradation of waters of the state.

B2.0 POTENTIAL CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Chemical-specific ARARs are generally health- or risk-based numerical values or methods applied to site-specific conditions that result in the establishment of a cleanup level. Many potential ARARs associated with particular remedial alternatives (such as closure or discharge) can be characterized as action-specific but include numerical values or methods to establish them so they fit in both categories (chemical- and action-specific).

The sections below present the proposed federal and state chemical-specific ARARs for soil at IR Site 31 (see Table B-1).

B2.1 POTENTIAL FEDERAL CHEMICAL-SPECIFIC ARARS FOR SOIL

The key threshold question for potential soil ARARs is whether the wastes located at IR Site 31 would be classified as hazardous waste. Soil may be classified as a federal hazardous waste as defined by RCRA and the state-authorized program, or as non-RCRA state-regulated hazardous waste. If soil is determined to be hazardous waste, the appropriate requirements will apply.

The federal RCRA requirements at 40 CFR Part 261 do not apply in California because the state RCRA program is authorized. The authorized state RCRA requirements are therefore considered potential federal ARARs. The applicability of RCRA requirements depends on (1) whether the

waste is a RCRA hazardous waste; (2) whether the waste was initially treated, stored, or disposed of after the effective date of the particular RCRA requirement; and (3) whether activity at the site constitutes treatment, storage, or disposal as defined by RCRA. RCRA requirements may, however, be relevant and appropriate even if they are not applicable. Examples include activities 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 with the definition of RCRA hazardous waste. The RCRA requirements at Cal. Code Regs. tit. 22, §§ 66261.21, 66261.22(a)(1), 66261.23, 66261.24(a)(1), and 66261.100 are potential ARARs because they define RCRA hazardous waste. 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 TCLP. The maximum concentrations allowable for the TCLP listed in Cal. Code Regs. tit. 22, § 66261.24(a)(1)(B) are potential federal ARARs for determining whether the site has hazardous waste. If the site waste has concentrations exceeding these values, it is determined to be a characteristic RCRA hazardous waste.

RCRA land disposal restrictions at Cal. Code Regs. tit. 22, § 66268.1(f) are potential federal ARARs for discharging waste to land. This section prohibits the disposal of hazardous waste to land unless (1) it is treated in accordance with the treatment standards of Cal. Code Regs. tit. 22, § 66268.40 and the underlying hazardous constituents meet the Universal Treatment Standards at Cal. Code Regs. tit. 22, § 66268.48; (2) it is treated to meet the alternative soil treatment standards of Cal. Code Regs. tit. 22, § 66268.49; or (3) a treatability variance is obtained under Cal. Code Regs. tit. 22, § 66268.44. These requirements are potentially applicable federal ARARs because they are part of the state-approved RCRA program. RCRA Treatment Standards for non-RCRA state-regulated waste are not potentially applicable federal ARARs but they may be potentially relevant and appropriate state ARARs.

As long as the excavated material remains inside the area of concern, it is not newly generated and will not be subject to RCRA generator, treatment, or other waste management requirements. Should excavated material be moved outside the area of concern, the substantive RCRA requirements managing hazardous waste, including land disposal restrictions, would be applicable.

B2.2 POTENTIAL STATE CHEMICAL-SPECIFIC ARARS

State RCRA requirements included within the EPA-authorized RCRA program for California are considered potential federal ARARs and are discussed above. When state regulations are either broader in scope or more stringent than their federal counterparts, they are considered potential state ARARs. State requirements such as the non-RCRA state-regulated hazardous waste requirements may be potential state ARARs because they are not within the scope of the federal ARARs (57 FR 60848). The requirements of Cal. Code Regs. tit. 22, div. 4.5 that are part of the state-approved RCRA program would be potential state ARARs for non-RCRA state-regulated hazardous wastes.

The site waste characteristics need to be compared with the definition of non-RCRA, state-regulated hazardous waste. The definition requirements for non-RCRA state-regulated waste at Cal. Code Regs. tit. 22, § 66261.24(a)(2) are potential state ARARs for determining whether other RCRA requirements are potential state ARARs. Section 66261.24(a)(2) lists the total threshold limit concentrations and soluble threshold limit concentrations. The site waste may be compared with these thresholds to determine whether it meets the characteristics for a non-RCRA state-regulated hazardous waste. Cal. Code Regs. tit. 22, §§ 66261.22(a)(3) and (4), 66261.24(a)(2)–(a)(8), 66261.101, 66261.3(a)(2)(C), or 66261.3(a)(2)(F) are also potential ARARs.

Cal. Code Regs. tit. 27, §§ 20210 and 20220 are state definitions for designated nonhazardous and inert waste. These sections may be potential ARARs for soil that meets the definitions. These soil classifications determine state classification and siting requirements for discharging waste to land.

B3.0 POTENTIAL LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Location-specific ARARs are restrictions on the concentrations of hazardous substances or the conduct of activities as a result of the characteristics of the site or its immediate environment. IR Site 31 does not encompass any historic properties included or eligible for inclusion on the National Register of Historic Places. No scientific, prehistoric, or archeological data have been identified at IR Site 31. No floodplains or wetlands are present at Site 31.

The terrestrial habitat of NAVSTA TI is of poor quality for wildlife species because the island is predominantly covered with urbanized areas. Because of the low-quality habitat of IR Site 31, no receptors of concern use the area. Disturbance from vehicular traffic and general human presence also reduces the quality of the habitat to wildlife species at this site. As a result, no location-specific ARARs were identified for IR Site 31.

B4.0 POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Action-specific ARARs are technology- or activity-based requirements or limitations for remedial actions. These requirements are triggered by the particular remedial actions conducted at a site and suggest how a selected remedial alternative should be achieved. These action-specific requirements do not in themselves determine the remedial alternative; rather, they indicate how a selected alternative must be conducted. As such, action-specific ARARs were identified and evaluated for each of the remedial alternatives for IR Site 31, as discussed below.

B4.1 NO ACTION ALTERNATIVE

There is no need to identify ARARs for the no action alternative because ARARs apply to “any removal or remedial action conducted entirely on-site” and “no action” is not a removal or

remedial action (CERCLA § 121[e], 42 U.S.C. § 9621[e]). CERCLA § 121 (42 U.S.C. § 9621) cleanup standards for selection of a Superfund remedy, including the requirement to meet ARARs, are not triggered by the no action alternative (EPA 1991). Therefore, a discussion of compliance with action-specific ARARs is not appropriate for this alternative.

B4.2 ALTERNATIVE 2: ENGINEERING CONTROLS COMBINED WITH INSTITUTIONAL CONTROLS

Alternative 2 consists of engineering controls combined with institutional controls. This alternative would use engineering controls and institutional controls to ensure the existing hardscape at IR Site 31 is maintained as an exposure prevention barrier and provide provisions for required repairs or improvements to subsurface utilities. The institutional controls also would require the commercial/industrial or residential use of the property maintain sufficient barriers to prevent exposure pathways and require construction activities, such as work into subsurface soil to repair utility lines, following procedures to protect against exposure to chemicals in soil.

B4.2.1 Engineering Controls

Engineering controls eliminate or reduce exposure to a chemical or physical hazard through the use or substitution of engineered machinery or equipment. Engineering controls considered for IR Site 31 include maintaining the hardscape surfaces as exposure prevention barriers.

B4.2.1.1 Federal

No potential ARARs were identified for the engineering controls evaluated in Alternative 2.

B4.2.1.2 State

No potential state ARARs were identified for the engineering controls evaluated in Alternative 2.

B4.2.2 Institutional Controls

Institutional controls would protect the site occupants from exposure to contaminated soils by restricting site occupants from removing or penetrating surfaces acting as exposure prevention barriers, except when following specific guidelines to prevent exposure from contaminated soils. Under the current site use plans the elementary school may be used; therefore, provisions would be made to allow for utility repair, such as water or sewer repairs, as may be required with general maintenance of the school.

B4.2.2.1 Federal

No potential federal ARARs were identified for the institutional controls evaluated in Alternative 2.

B4.2.2.2 State

State statutes identified by the Navy as potential ARARs for implementing institutional controls and entering into an environmental restrictive covenant and agreement with DTSC include substantive provisions of *California Civil Code* § 1471; *California Health and Safety Code* §§ 25202.5, 25222.1, 25233(c), 25234, and 25355.5(a)(1)(C); and Cal. Code Regs. tit. 22, § 67391.1(a) and (e)(1).

The substantive provisions of *California Civil Code* § 1471 are the following general narrative standard: "to do or refrain from doing some act on his or her own land … where…(c) Each such act relates to the use of land and each such act is reasonably necessary to protect present or future human health or safety or the environment as a result of the presence on the land of hazardous materials, as defined in Section 25260 of the Health and Safety Code." This narrative standard would be implemented through incorporation of restrictive environmental covenants in the deed at the time of transfer. These covenants would be recorded with the environmental restriction covenant and agreement and would run with the land.

The substantive provisions of *California Health and Safety Code* § 25202.5 are the general narrative standard to restrict "present and future uses of all or part of the land on which the facility is located." These substantive provisions would be implemented by incorporation of restrictive environmental covenants in the Environmental Restriction Covenant and Agreement at the time of transfer for purposes of protecting present and future public health and safety.

California Health and Safety Code §§ 25222.1 and 25355.5(a)(1)(C) provide the authority for the state to enter into voluntary agreements to establish land use covenants with the owner of property. The substantive requirements of the following *California Health and Safety Code* § 25222.1 provisions are relevant and appropriate: (1) the general narrative standard "restricting specified uses of the property,..." and (2) "…the agreement is irrevocable, and shall be recorded by the owner, …as a hazardous waste easement, covenant, restriction or servitude, or any combination thereof, as appropriate, upon the present and future uses of the land." The substantive requirements of the following provisions of *California Health and Safety Code* § 25355.5(a)(1)(C) are relevant and appropriate: "…execution and recording of a written instrument that imposes an easement, covenant, restriction, or servitude, or combination thereof, as appropriate, upon the present and future uses of the land."

The Navy will comply with the substantive requirements of *California Health and Safety Code* §§ 25222.1 and 25355.5(a)(1)(C) by incorporating the CERCLA use restrictions into the Navy's deed of conveyance in the form of restrictive covenants under the authority of *California Civil Code* § 1471 and into the environmental restriction covenant and agreement. The substantive

provisions of *California Health and Safety Code* §§ 25222.1 and 25355.5(a)(1)(C) may be interpreted in a manner consistent with the substantive provisions of *California Civil Code* § 1471. The covenants would be recorded with the deed and run with the land.

California Health and Safety Code § 25233(c) sets forth "relevant and appropriate" substantive criteria for granting variances from prohibited uses based on specified environmental and health criteria. *California Health and Safety Code* § 25234 sets forth the following "relevant and appropriate" substantive criteria for the removal of a land use restriction on the grounds that "…the waste no longer creates a significant existing or potential hazard to present or future public health or safety."

In addition to being implemented through the Environmental Restriction Covenant and Agreement between the Navy and DTSC, the appropriate and relevant portions of *California Health and Safety Code* §§ 25202.5, 25222.1, 25233(c), 25234, and 25355.5(a)(1)(C) and *California Civil Code* § 1471 would also be implemented through the deed between the Navy and the transferee.

Cal. Code Regs. tit. 22, § 67391.1 provides that DTSC will not approve or concur in a response action decision document that includes institutional controls unless the controls are clearly set forth and defined in the decision document. § 67391.1 also states, among other requirements, that DTSC shall not consider property owned by the Federal Government to be suitable for transfer to nonfederal entities where hazardous materials, hazardous wastes or constituents, or hazardous substances remain at the property at levels not suitable for unrestricted use without an institutional control. The Navy has identified the substantive provisions of §§ 67391.1(a) and (e)(1) as potential ARARs.

B4.3 ALTERNATIVE 3: ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS, AND EXCAVATION (DEBRIS AREA E) AND OFF-SITE DISPOSAL OF SOIL

The select hotspot removal is based on the identified chemicals of concern (COC) and the estimated potential human health risk to construction workers from exposure to lead concentrations exceeding the commercial/industrial preliminary remediation goal of 800 mg/kg. Alternative 3 involves the demolition of selected areas beneath 11th Street and the adjacent sidewalks to excavate soil contaminated with lead. The lead-contaminated soils would be removed, the excavation areas would be delineated and confirmation soil samples would be collected, and the stockpiled soils would be properly characterized and transported by an approved waste hauler for proper disposal at a permitted landfill. The excavation would be backfilled with clean soil and properly compacted in appropriate engineered lifts, and the excavated area of 11th street and the adjacent sidewalks would be replaced to current grade and conditions.

B4.3.1 Engineering Controls

Engineering controls eliminate or reduce exposure to a chemical or physical hazard through the use or substitution of engineered machinery or equipment. Engineering controls associated with Alternative 3 include maintaining the hardscape surfaces as exposure prevention barriers and implementation of dust control measures during excavation activities.

B4.3.1.1 Federal

No potential ARARs were identified for the engineering controls evaluated in Alternative 3.

B4.3.1.2 State

No potential state ARARs were identified for the engineering controls evaluated in Alternative 3.

B4.3.2 Institutional Controls

Institutional controls would protect the site occupants from exposure to contaminated soils by restricting site occupants from removing or penetrating surfaces acting as exposure prevention barriers, except when following specific guidelines to prevent exposure from contaminated soils. Under the current site use plans the elementary school may be used; therefore, provisions would be made to allow for utility repair, such as water or sewer repairs, as may be required with general maintenance of the school.

B.4.3.2.1 Federal

No potential federal ARARs were identified for the institutional controls evaluated in Alternative 3.

B4.3.2.2 State

The same state requirements identified as potential ARARs for institutional controls for Alternative 2 are potential ARARs for Alternative 3.

B4.3.3 Excavation and Off-Site Disposal of Soil

Federal and state ARARs for Alternative 3 are presented in the following subsections.

B4.3.3.1 Federal

Resource Conservation and Recovery Act

As discussed in Section B2.0, Chemical-Specific ARARs, RCRA is a potential ARAR for excavation and off-site disposal of soil. Any excavated waste would be characterized to determine if it is a hazardous waste (Cal. Code Regs. tit. 22, §§ 66262.10[a] and 66262.11). The excavated soil would be temporarily stockpiled prior to off-site disposal according to the requirements at 40 CFR § 264.554(d)(1)(i-ii) and (d)(2), (e),(f),(h),(i),(j), and (k). These requirements provide that a generator may accumulate solid remediation waste in a staging pile for storage for as long as 2 years during remedial actions without triggering land disposal restrictions.

Clean Air Act

The Bay Area Air Quality Management District (BAAQMD) by delegation of authority from the EPA implements the federal Clean Air Act. Therefore, BAAQMD regulations are described as Clean Air Act requirements. The following BAAQMD regulation is a potential ARAR for excavation of soil at IR Site 31:

- Regulation 6-302: Opacity Limitation (prohibiting emissions for a period aggregating more than 3 minutes in any hour an emission equal to or greater than 20 percent opacity)

Federal Hazardous Materials Transportation Law

The Federal Hazardous Materials Transportation Law (49 U.S.C. § 5101-5127), implemented at 49 CFR §§ 171.2(f), 171.2(g), 172.300, 172.301, 172.302, 172.303, 172.304, 172.312, 172.400, and 172.504, is a potential relevant and appropriate requirement for transporting hazardous waste on-site. These sections consist of requirements for transporting hazardous wastes, including representations that containers are safe, prohibitions on altering labels, marking requirements, labeling requirements, and placarding requirements.

B4.3.3.2 State

No state action-specific ARARs were identified for excavation and off-site disposal of soil under Alternative 3.

B4.4 ALTERNATIVE 4: ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS, AND EXCAVATION (DEBRIS AREA C AND D, EXCLUDING THE STREET) AND OFF-SITE DISPOSAL OF SOIL

Alternative 4 involves implementation of engineering controls, institutional controls, and active remediation of areas of elevated COC concentrations by removing soil at selected locations

within Debris Areas C and D, and off-site disposal of soil at a permitted landfill. Alternative 4 involves demolition of selected hardscape within the existing playground area, within Debris Area C, to excavate and remove soil containing elevated concentrations of COCs. Debris Area D also would be excavated in select locations and would involve demolition of hardscape within a parking lot. Excavation and removal of soil with elevated COC concentrations within Debris Area D would be limited to those areas not located beneath 11th Street.

B4.4.1 Engineering Controls

Engineering controls eliminate or reduce exposure to a chemical or physical hazard through the use or substitution of engineered machinery or equipment. Engineering controls associated with Alternative 4 include maintaining the hardscape surfaces as exposure prevention barriers and implementation of dust control measures during excavation activities.

B4.4.1.1 Federal

No potential ARARs were identified for the engineering controls evaluated in Alternative 4.

B4.4.1.2 State

No potential state ARARs were identified for the engineering controls evaluated in Alternative 4.

B4.4.2 Institutional Controls

Institutional controls would protect the site occupants from exposure to contaminated soils by restricting site occupants from removing or penetrating surfaces acting as exposure prevention barriers, except when following specific guidelines to prevent exposure from contaminated soils. Under the current site use plans the elementary school may be used; therefore, provisions would be made to allow for utility repair, such as water or sewer repairs, as may be required with general maintenance of the school.

B4.4.2.1 Federal

No potential federal ARARs were identified for the institutional controls evaluated in Alternative 4.

B4.4.2.2 State

The same state requirements identified as potential ARARs for institutional controls for Alternative 2 are potential ARARs for Alternative 4.

B4.4.3 Excavation and Off-Site Disposal of Soil

Federal and state ARARs for Alternative 4 are presented in the following subsections.

B4.4.3.1 Federal

The same requirements identified as potential ARARs for excavation and off-site disposal of soil for Alternative 3 are potential ARARs for Alternative 4.

B4.4.3.2 State

No state action-specific ARARs were identified for excavation and off-site disposal of soil under Alternative 4.

B4.5 ALTERNATIVE 5: COMPLETE REMOVAL OF DEBRIS AREAS A, B, C, D, AND E AND OFF-SITE DISPOSAL OF SOIL

Alternative 5 is the most extensive remedial alternative and would involve the complete excavation and removal of all of Debris Areas A, B, C, D, and E. This alternative also would involve removal of Debris Area E beneath 11th Street and demolition of the street, replacement and/or rerouting of utilities, and removal and excavation of hardscape to access and dispose of Debris Areas A, B, C, D, and E. The removal of all selected areas of elevated COC concentrations is intended to meet the U.S. Department of Defense (DoD) requirement of evaluating alternatives with respect to unrestricted use of the site. DoD policy requires FSs that evaluate an alternative with a land use control (LUC) also consider an unrestricted use alternative (DoD 2001).

B4.5.1 Excavation and Off-Site Disposal of Soil

Federal and state ARARs for Alternative 5 are presented in the following subsections.

B4.5.1.1 Federal

The same requirements identified as potential ARARs for excavation for Alternative 3 are potential ARARs for Alternative 5.

B4.5.1.2 State

No state action-specific ARARs were identified for excavation and off-site disposal under Alternative 5.

B5.0 REFERENCES

Department of Defense (DoD). 2001. "Policy on Land Use Controls Associated with Environmental Restoration Activities." From the Office of the Under Secretary of Defense. January 17.

U.S. Environmental Protection Agency (EPA). 1988a. "CERCLA Compliance with Other Laws Manual, Draft Guidance." EPA/540/G-89/006. Office of Emergency and Remedial Response. Washington, D.C. August.

EPA. 1988b. "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA." Office of Solid Waste and Emergency Response Directive 9355.3-01, -02. EPA/540/G-89/004.

EPA. 1991. "ARARs Q's and A's: General Policy, RCRA, CWA, SDWA, Post-ROD Information and Contingent Waivers." Office of Solid Waste and Emergency Response Publication 9234.2-01/FSA. Washington, D.C. July.

TABLES

TABLE B-1: POTENTIAL CHEMICAL-SPECIFIC[a] APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Requirement	Prerequisite	Citation[b]	Preliminary ARAR Determination	Comments
		Soil		
Federal Requirements				
Resource Conservation and Recovery Act (42 United States Code, Chapter 82, §§ 6901–6991[i])[c]				
Defines RCRA hazardous waste. A solid waste is characterized as toxic, based on the toxicity characteristic leaching procedure , if the waste exceeds the toxicity characteristic leaching procedure maximum concentrations.	Waste	Cal. Code Regs. tit. 22, §§ 66261.21, 66261.22(a)(1), 66261.23, 66261.24(a)(1), and 66261.100	Applicable	These requirements are applicable for determining whether waste is hazardous.
Land Disposal Restrictions prohibit disposal of hazardous waste unless treatment standards are met.	Hazardous waste land disposal	Cal. Code Regs. tit. 22 § 66268.1(f)	Applicable	This requirement is applicable if RCRA hazardous waste is to be disposed of on land.
State Requirements				
Department of Toxic Substances Control[c]				
Definition of “non-RCRA hazardous waste.”	Waste	Cal. Code Regs. tit. 22, §§ 66261.22(a)(3) and (4), 66261.24(a)(2)–(a)(8), 66261.101, 66261.3(a)(2)(C), or 66261.3(a)(2)(F)	Applicable	These requirements are applicable for determining whether a waste is a non-RCRA state regulated hazardous waste.
State and Regional Water Quality Control Boards [c]				
Definitions of designated waste and nonhazardous waste.	Waste	Cal. Code Regs. tit 27, §§ 20210 and 20220	Applicable	These requirements are potential ARARs for classifying waste.

Notes:

a Many potential action-specific ARARs contain chemical-specific limitations and are addressed in the action-specific ARAR tables.

b Only the substantive provisions of the requirements cited in this table are potential ARARs.

c Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader; listing the statutes and policies does not indicate that the Navy accepts the entire statutes or policies as potential ARARs; specific potential ARARs are addressed in the table below each general heading; only pertinent substantive requirements of specific citations are considered potential ARARs.

§	Section	Cal. Code Regs.	*California Code of Regulations*
§§	Sections	RCRA	Resource Conservation and Recovery Act
ARAR	Applicable or relevant and appropriate requirement	tit.	Title

TABLE B-2: POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Action	Requirement	Prerequisite	Citation	Preliminary ARAR Determination	Comments
			Institutional Controls		
State Requirements					
California Civil Code[a]					
Institutional controls	Provides conditions under which land use restrictions will apply to successive owners of land.	Transfer property from the Navy to a nonfederal agency.	*California Civil Code* §1471	Applicable	Substantive provisions are the following general narrative standard: "to do or refrain from doing some act on his or her own land…where (c) Each such act relates to the use of land and each such act is reasonably necessary to protect present or future human health or safety of the environment as a result of the presence of hazardous materials, as defined in Section 25260 of the California Health & Safety Code." This narrative standard would be implemented through incorporation of restrictive covenants in the deed at the time of transfer.
California Health & Safety Code[a]					
Institutional controls	Allows Department of Toxic Substances Control to enter into an agreement with the owner of a hazardous waste facility to restrict present and future land uses.	Transfer property from the Navy to a nonfederal agency.	*California Health & Safety Code* § 25202.5	Applicable	The substantive provisions of this section are the general narrative standards to restrict "present and future uses of all or part of the land on which the facility …is located."
	Provides a streamlined process to be used to enter into an agreement to restrict specific use of property in order to implement the substantive use restrictions of *California Health & Safety Code* § 25232(b)(1)(A)–(E).	Transfer property from the Navy to a nonfederal agency.	*California Health & Safety Code* § 25222.1 and 25355.5(a)(1)(C)	Applicable	This section is a potential ARAR when the Navy is transferring property to a nonfederal entity. *California Health & Safety Code* § 25222.1 provides the authority for the State to enter into voluntary agreements to establish land-use covenants with the owner of the property. The substantive provision of *California Health & Safety Code* § 25222.1 is the general narrative standard: "restricting specified uses of the property."

TABLE B-2: POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Action	Requirement	Prerequisite	Citation	Preliminary ARAR Determination	Comments
			Institutional Controls (Continued)		
State Requirements (Continued)					
California Health & Safety Code[a] (Continued)					
Institutional Controls (continued)	Provides a process for obtaining a written variance from a land use restriction.	Transfer property from the Navy to a nonfederal entity.	*California Health & Safety Code* §§ 25233(c) and 25234	Applicable	This section is a potential ARAR for institutional controls where the Navy is transferring property to a nonfederal entity. *California Health & Safety Code* § 25233(c) sets forth substantive criteria for granting variances from the uses prohibited in § 25232(b)(1)(A)-(E) based on specific environmental and health criteria.
California Code of Regulations Title 22					
Institutional controls	A land use covenant imposing appropriate limitations on land use shall be executed and recorded when Facility closure, corrective action, remedial or removal action, or other response actions are undertaken and hazardous materials, hazardous wastes or constituents, or hazardous substances will remain at the property at levels which are not suitable for unrestricted use of the land.	Property transfer by Federal Government to non-federal entity.	Cal. Code Regs. tit. 22, § 67391.1(a) and (e)(1)	Relevant and Appropriate	The substantive provisions of § 67391.1(a) and (e)(1) are potential ARARs.

TABLE B-2: POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Action	Requirement	Prerequisite	Citation	Preliminary ARAR Determination	Comments
Excavation and Off-Site Disposal of Waste					
Resource Conservation and Recovery Act (42 U.S.C., Chapter 82, §§ 6901-6991[i])[a]					
On-site waste generation	Definition of RCRA hazardous waste.	Waste.	Cal. Code Regs. tit. 22, §§ 66262.10(a), 66262.11	Applicable	The requirements of Cal. Code Regs. tit. 22, Division 4.5, Chapter 14 are potentially applicable for determining whether material generated contains hazardous waste. These requirements may be relevant and appropriate to material that is similar or identical to RCRA hazardous waste or non-RCRA hazardous waste.
Waste pile	A generator may accumulate solid remediation waste for storage for up to 2 years during remedial operations without triggering LDRs.	Hazardous remediation waste temporarily stored in piles.	40 CFR § 264.554(d)(1)(i-ii)and (d)(2), (e),(f),(h),(i), (j), and (k)	Applicable	These requirements are potentially applicable for temporary waste storage during remediation.
Clean Air Act (42 U.S.C. § 7401 et seq.)[ab]					
Excavation	Sets forth opacity limitations.	Excavation	BAAQMD Regulation 6-302	Applicable	This requirement is potentially applicable for excavation.
Federal Hazardous Materials Transportation Law (49 U.S.C. §§ 5101-5127)[a]					
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 substance by motor vehicle.	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	These requirements are potentially relevant and appropriate for transporting hazardous materials on site.

TABLE B-2: POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Notes:

a	Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that the Navy accepts the entire statutes or policies as potential ARARs. Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of specific citations are considered potential ARARs
b	The Clean Air Act ARARs apply only to the alternatives involving excavation.
§	Section
§§	Sections
ARAR	Applicable or relevant and appropriate requirement
BAAQMD	Bay Area Air Quality Management District
Cal. Code. Regs.	*California Code of Regulations*
CFR	*Code of Federal Regulations*
RCRA	Resource Conservation and Recovery Act
tit.	Title
U.S.C.	*United States Code*

ATTACHMENT B1
LETTER REQUESTING IDENTIFICATION OF STATE "APPLICABLE" OR "RELEVANT AND APPROPRIATE" REQUIREMENTS FOR INSTALLATION RESTORATION SITE 31 FROM NAVY TO DEPARTMENT OF TOXIC SUBSTANCES CONTROL

2 pages.

DEPARTMENT OF THE NAVY
BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
1455 FRAZEE RD, SUITE 900
SAN DIEGO, CA 92108-4310

5090
Ser BPMOW.Inl/0452
19 May 2006

VIA CERTIFIED MAIL

Mr. David Rist
California Environmental Protection Agency
Department of Toxic Substances Control
Office of Military Facilities
700 Heinz Avenue, Suite 200
Berkeley, California 94710

Dear Mr. Rist:

SUBJECT: IDENTIFICATION OF STATE "APPLICABLE" OR "REVELANT AND APPROPRIATE" REQUIREMENTS FOR THE FEASIBILITY STUDY FOR INSTALLATION RESTORATION SITE 31, FORMER SOUTH STORAGE YARD, AT FORMER NAVAL STATION TREASURE ISLAND

Pursuant to accomplishing the goals of the Naval Station Treasure Island (NAVSTA TI) Installation Restoration (IR) Program, the Department of the Navy (Navy) hereby request the California Environmental Protection Agency Department of Toxic Substances Control identify potential State chemical-specific, location-specific, and action-specific applicable or relevant and appropriate requirements (ARARs) for potential remedial actions for IR Site 31 at NAVSTA TI. State ARARs identified will be considered and evaluated during the preparation of the Feasibility Study (FS).

In addition, the Navy is requesting the State of California identify any other criteria, advisories, guidance, and proposed standards the State requests to be considered (TBCs) for IR Site 31. Please coordinate responses from all California state agencies.

Enclosure (1), the Executive Summary presented in the Draft Final Remedial Investigation Report for IR Site 31, dated May 2006, should allow you to begin to identify, with some specificity, State chemical-specific and location-specific ARARs. For action-specific ARARs, no action, institutional controls to maintain the hardscape as a protective barrier, and a combination of hot spot excavation and off-base disposal of soil are being evaluated as remedial alternatives. These remedial alternatives will be discussed in detail in the FS report.

The Navy is requesting timely identification of potential State ARARs consistent with the requirements under Section 121(d)(2)(A) of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and under the National Contingency Plan (NCP), 40 *Code of Federal Regulations* (CFR) 300.400(g) and 300.515(d) & (h). Experience to date around the country has shown that failure to identify ARARs with sufficient precision, early in the FS process, can cause severe disruptions in timely implementation of a remedial action. To ensure timely and complete ARARs identification for IR Site 31, please include the following information:

(1) A specific citation to the statutory or regulatory provisions for the potential State ARAR and the date of enactment or promulgation.

(2) A brief description of why the potential State ARAR is applicable or relevant and appropriate to IR Site 31.

(3) A description of how the potential State ARAR would apply to potential remedial action, including specific numeric discharge, effluent, or emission limitations; hazardous substance/constituent action or cleanup levels, etc.; if the State intends to take the position that the potential State ARAR includes such limitations, levels, etc.

(4) If the State believes its proposed ARAR is more stringent than the corresponding Federal ARAR, please provide the rationale and technical justification for this position.

(5) If the State determines that there is not enough information to fully respond to our request, please identify any additional information that would be required to support identification of State ARARs and their application.

Consistent with 40 CFR 300.515(h)(2), we are requesting that you send a response via first class mail to the address above, attention NAVSTA Treasure Island BRAC Environmental Coordinator and postmarked within 30 days of receipt of this request. Please direct any technical questions you may have concerning this request to Ms. La Rae Landers at (619) 532-0970 and any legal questions to Mr. Jan Whitacre, Environmental Counsel at (619) 532-0910.

JAMES B. SULLIVAN
BRAC Environmental Coordinator
By direction

Enclosure: 1. Executive Summary, Draft Final Remedial Investigation Report for IR Site 31, Former South Storage Yard, NAVSTA Treasure Island, May 2006

Copy to:
Mr. James Ricks
U.S. Environmental Protection Agency Region IX
75 Hawthorne Street, Code: SFD-8-1
San Francisco, CA 94105-3901

ATTACHMENT B2
DTSC LETTER REQUESTING INSTALLATION RESTORATION SITE 30 STATE "APPLICABLE" OR "RELEVANT AND APPROPRIATE" REQUIREMENTS BE USED FOR INSTALLATION RESTORATION SITE 31

2 pages.

Linda S. Adams
Secretary for
Environmental Protection

Department of Toxic Substances Control

Maureen F. Gorsen, Director
700 Heinz Avenue
Berkeley, California 94710-2721

Arnold Schwarzenegger
Governor

August 15, 2006

Ms. La Rae Landers
Lead Remedial Project Manager
Department of the Navy
Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, California 92108-4310

IDENTIFICATION OF STATE "APPLICABLE" OR "RELEVANT AND APPROPRIATE" REQUIREMENTS FOR THE FEASIBILITY STUDY FOR INSTALLATION RESTORATION SITE 31, FORMER SOUTH STORAGE YARD, NAVAL STATION TREASURE ISLAND, SAN FRANCISCO, CALIFORNIA

Dear Ms. Landers:

The Department of Toxic Substances Control (DTSC) received the Navy's letter, dated May 19, 2006, that formally requested that DTSC identify potential State chemical-specific, location-specific, and action-specific applicable or relevant and appropriate requirements (ARARs) for potential remedial actions for Installation Restoration Site 31 at Naval Station Treasure Island. All State ARARs identified would be considered and evaluated during the preparation of the Feasibility Study (FS).

After considering the Navy's request for State ARARs for the Site 31 FS, DTSC, acting as the lead regulatory agency for the State of California, has determined that it would be acceptable to apply the ARARS that were developed for the Site 30 FS to Site 31. DTSC made this determination based on the similarities between the two sites (i.e., contaminants of concern, site configuration, including paving and buildings, and the types of reuses) and with the understanding that the identification of ARARs by other

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State entities would likely result in the same list of ARARs previously identified for Site 30. Therefore, please consider the ARARs previously identified for Site 30 as potential ARARs for Site 31.

If you have any questions regarding this letter, please call me at (510) 540-3763.

Sincerely,

David Rist

David Rist
Hazardous Substances Scientist
Office of Military Facilities

cc: Mr. James Ricks (SFD-8-2)
U.S. Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, California 94105

Ms. Agnes Farres
California Regional Water Quality Control Board
1515 Clay Street, Suite 1400
Oakland, California 94612

Mr. Jack Sylvan
Mayor's Office of Base Reuse and Development
City Hall, Room 448
1 Dr. Carlton B. Goodlett Place
San Francisco, California 94102

Mr. Gary R. Foote
Geomatrix Consultants
2101 Webster Street, 12th Floor
Oakland, California 94612

Mr. Keith Sheets
CH2M HILL
155 Grand Avenue, Suite 1000
Oakland, California 94612

ATTACHMENT B3
NAVY'S RESPONSES TO ARARS IDENTIFIED BY THE CALIFORNIA DEPARTMENT OF FISH AND GAME, CALIFORNIA DEPARTMENT OF HEALTH SERVICES, AND THE CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

11 pages.

NAVY'S RESPONSES TO ARARS IDENTIFIED BY THE CALIFORNIA DEPARTMENT OF FISH AND GAME, CALIFORNIA DEPARTMENT OF HEALTH SERVICES, AND THE CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Location	Standard	Specific Citation	ARAR/TBC Explanation Provided by State on IR Site 30	Navy ARAR Determination as it applies to IR Site 31
California Department of Fish and Game				
Aquatic habitat/ Species	Action must be taken if toxic materials are placed where they can enter waters of the State. There can be no release that would have a deleterious effect on species or habitat.	Fish and Game Code § 5650 (a), (b) & (f)	This code section prohibits depositing or placing where it can pass into waters of the state any petroleum products (Section [§] 5650(a)(l)), factory refuse (§ 5650(a)(4)), sawdust, shaving, slabs or edgings (§ 5650(a)(3)), and any substance deleterious to fish, plant life or bird life (§ 5650(a)(6). These are substantive, promulgated environmental protection requirements. These requirements impose strict criminal liability on violators. (*People v. Chevron Chemical Company (1983) 143 Cal. App. 3d 50*). This imposition of strict criminal liability imposes a standard that is more stringent than federal law. The extent to which each subdivision of § 5650 is relevant and appropriate depends on the site characterization and the potential for contamination to be deposited near or within waters of the state.	The Navy does not expect to deposit any substance into the waters of the state as part of the remedial action for IR Site 31. The Navy has determined that this section is not a potential ARAR.
Wildlife Species	Action must be taken to prohibit the taking of birds and mammals, including the taking by poison.	Fish and Game Code § 3005 (Stats. 1957, c. 456, p. 1353 § 3005)	This code section prohibits the taking of birds and mammals, including, taking by poison. "Take" is defined by Fish and Game Code § 86 to include killing. "Poison" is not defined in the code. Although there is no state authority on this point, federal law recognizes that poison, such as Strychnine, may affect incidental taking. (Defenders of Wildlife v. Administrator, Environmental Protection Agency (1989) 882.F. 2d. 1295). This code section imposes a substantive, promulgated environmental protection requirement.	The terrestrial habitat of NAVSTA TI is of poor quality for wildlife species because the island is predominantly covered with urbanized areas. Because of the low-quality habitat of IR Site 31, no receptors of concern use the area. The Navy has determined that this section is not a potential ARAR.

Location	Standard	Specific Citation	ARAR/TBC Explanation Provided by State on IR Site 30	Navy ARAR Determination as it applies to IR Site 31
California Department of Fish and Game (Continued)				
Endangered Species	Action must be taken to conserve endangered species. There can be no releases and/or actions that would have a deleterious effect on species or habitat.	Fish and Game Code § 2080 (Added by Stats. 1984, c. 1240, § 2).	This section prohibits the taking, possession, purchase, or sell within the state, any species (including rare native plant species), or any product thereof that the commission determines to be an endangered or threatened species, or the attempt of any of these acts. This section is applicable to the extent that there are endangered or threatened species in the area which have the potential of being affected if actions are not taken to conserve the species. This section prohibits releases and/or actions that would have a deleterious effect on species or their habitat. This section and applicable Title 14 regulations should be considered as ARARs. Cal. Code Regs. tit. 14, § 670.2 provides a listing the plants of California declared to be endangered, threatened, or rare. Cal. Code Regs. tit. 14, § 670.5 provides a listing of Animals of California declared to be endangered or threatened. California Code of Regulations Title 14 section 783 et. seq., provides the implementation regulations for the California Endangered Species Act.	The terrestrial habitat of NAVSTA TI is of poor quality for wildlife species because the island is predominantly covered with urbanized areas. Because of the low-quality habitat of IR Site 31, no receptors of concern use the area. The Navy has determined that this section is not a potential ARAR.

Location	Standard	Specific Citation	ARAR/TBC Explanation Provided by State on IR Site 30	Navy ARAR Determination as it applies to IR Site 31
California Department of Fish and Game (Continued)				
Fully protected bird species/ habitat	Action must be taken to prevent the taking of fully protected birds.	Fish and Game Code § 3511 (Added by Stats. 1970, c. 1036, p. 1848 § 4)	This section provides that it is unlawful to take or possess any of the following fully protected birds: (a) American peregrine falcon (b) Brown Pelican (c) California black rail (d) California clapper rail (e) California condor (f) California least tern (g) Golden eagle (h) Greater sandhill crane (i) Light-footed clapper rail (j) Southern bald eagle (k) Trumpeter swan (l) White-tailed kite (m) Yuma clapper rail This should be considered Applicable and Relevant to the extent that such fully protected birds or their habitat are detected on or near the site. The Brown Pelican and California least tern are known to occur on or near this site.	The terrestrial habitat of NAVSTA TI is of poor quality for wildlife species because the island is predominantly covered with urbanized areas. Because of the low-quality habitat of IR Site 31, no receptors of concern use the area. The Navy has not observed the Brown Pelican or California least tern at IR Site 31. The Navy has determined that this section is not a potential ARAR.

Location	Standard	Specific Citation	ARAR/TBC Explanation Provided by State on IR Site 30	Navy ARAR Determination as it applies to IR Site 31
California Department of Fish and Game (Continued)				
Fully Protected Mammals	Actions must be taken to assure that no fully protected mammals are taken or possessed at any time.	Fish and Game Code § 4700 (Added by Stats. 1970, c. 1036, p. 1848 § 6)	This section prohibits the taking or possession of any of the fully protected mammals or their parts. The following are fully protected mammals: (a) Mono Bay kangaroo rat (b) Bighorn sheep, except Nelson bighorn sheep (c) Northern elephant seal (d) Guadalupe fur seal (e) Ring-tailed cat (f) Pacific right whale (6) Salt-marsh harvest mouse (h) Southern sea otter (i) Wolverine This section is applicable, relevant, and appropriate to the extent that such mammals and/or their habitat are located on or near the site.	The terrestrial habitat of NAVSTA TI is of poor quality for wildlife species because the island is predominantly covered with urbanized areas. Because of the low-quality habitat of IR Site 31, no receptors of concern use the area. The Navy has not observed any fully protected mammals at IR Site 31. The Navy has determined that this section is not a potential ARAR
Fully Protected Reptiles and Amphibians	Actions must be taken to prevent the taking or possession of any fully protected reptile or amphibian.	Fish Game Code § 5050 (Added by Stats. 1970, c. 1036, p. 1849 § 7)	This section prohibits the taking or possession of fully protected reptiles and amphibians or parts thereof. The following are fully protected reptiles and amphibians: (1) Blunt-nosed leopard lizard (2) San Francisco garter snake (3) Santa Cruz long-toed salamander (4) Limestone salamander (5) Black toad This section is applicable, relevant, and appropriate to the extent that such amphibians or reptiles and/or their habitat are located on or near the site.	The terrestrial habitat of NAVSTA TI is of poor quality for wildlife species because the island is predominantly covered with urbanized areas. Because of the low-quality habitat of IR Site 31, no receptors of concern use the area. The Navy has not observed any fully protected reptiles or amphibians at IR Site 31. The Navy has determined that this section is not a potential ARAR

NAVY'S RESPONSES TO ARARS IDENTIFIED BY THE CALIFORNIA DEPARTMENT OF FISH AND GAME, CALIFORNIA DEPARTMENT OF HEALTH SERVICES, AND THE CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL (CONTINUED)

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Location	Standard	Specific Citation	ARAR/TBC Explanation Provided by State on IR Site 30	Navy ARAR Determination as it applies to IR Site 31
California Department of Fish and Game (Continued)				
Birds	Actions must be taken to avoid the taking or destruction of the nest or eggs of any bird.	Fish Game Code § 3503	This section prohibits the taking, possession, or needless destruction of the nest or eggs of any bird, except otherwise provided by this code or any regulation made pursuant thereto.	The Navy has not observed any nests or eggs at IR Site 31. The Navy has determined that this section is not a potential ARAR.
Birds of Prey	Action must be taken to prevent the taking, possession, or destruction of any birds-of prey or their eggs.	Fish Game Code § 3503.5 (Added by Stats. 1985. c 1334. § 6)	This section prohibits the taking, possession, or destruction of any birds in the orders of Falconiformes or Strigiformes (birds of prey) or to take, possess, or destroy the nest or eggs of any such bird, except as otherwise provided by this code or any regulation adopted pursuant thereto. This section will be applicable and relevant to the extent that such species or their eggs are located on or near the site.	The terrestrial habitat of NAVSTA TI is of poor quality for wildlife species because the island is predominantly covered with urbanized areas. Because of the low-quality habitat of IR Site 31, no receptors of concern use the area. The Navy has not observed any birds in the orders of Falconiformes or Strigiformes at IR Site 31. The Navy has determined that this section is not a potential ARAR.
Non-game Birds	Action must be taken to prevent the taking of non-game birds.	Fish Game Code § 3800 (Added by Stats. 1971. c 1470, p 2906, § 13)	This section prohibits the taking of non-game birds, except in accordance with regulations of the commission, or when related to mining operations with a mitigation plan approved by the department. This section further provides requirements concerning mitigation plans related to mining. This section is applicable and relevant to the extent that non-game birds or their eggs are located on or near the site and such species have not been included in the fish and wildlife conservation plan filed pursuant to the Federal Fish and Wildlife Conservation Act. Species included in the plan will be protected at the federal standard making this section an ARAR to the extent that it is more stringent than the federal standard of protection.	The terrestrial habitat of NAVSTA TI is of poor quality for wildlife species because the island is predominantly covered with urbanized areas. Because of the low-quality habitat of IR Site 31, no receptors of concern use the area. Navy does not expect to take or impact any non-game birds as part of the remedial action. The Navy has determined that this section is not a potential ARAR.

Location	Standard	Specific Citation	ARAR/TBC Explanation Provided by State on IR Site 30	Navy ARAR Determination as it applies to IR Site 31
California Department of Fish and Game (Continued)				
Fur-Bearing Mammals	Provides manners under which fur-bearing mammals may be taken.	Fish Game Code § 4000 (Added by Stats. 1957. c. 456, p 1380, § 4000)	This section provides that a fur-bearing mammal may be taken only with a trap, a firearm, bow and arrow, poison under a proper permit, or with the use of dogs.	The terrestrial habitat of NAVSTA TI is of poor quality for wildlife species because the island is predominantly covered with urbanized areas. Because of the low-quality habitat of IR Site 31, no receptors of concern use the area. Navy does not expect to take or impact any fur-bearing mammals as part of the remedial action. The Navy has determined that this section is not a potential ARAR
Non-Game Mammals	Action must be taken to avoid the taking or possession of non-game mammals.	Fish Game Code § 4150 (Added by Stats. 1971 c. 1470, p 2907, § 21)	Non-game mammals are those occurring naturally in California which are not game mammals, fully protected mammals, or fur-bearing mammals. These mammals, or their parts, may not be taken or possessed, except as provided in this code or in accordance with regulations adopted by the commission.	The terrestrial habitat of NAVSTA TI is of poor quality for wildlife species because the island is predominantly covered with urbanized areas. Because of the low-quality habitat of IR Site 31, no receptors of concern use the area. Navy does not expect to take or impact any non-game mammals as part of the remedial action. The Navy has determined that this section is not a potential ARAR
White Shark	Action must be taken to avoid the taking of any white shark.	Fish Game Code § 5517 (Added by Stats. 1993. c 1174 (A.B. 522), § 2)	It is unlawful to take any white shark (Carcharodon carcharias), except under permit issued pursuant to § 1002 for scientific or educational purposes.	IR Site 31 is inland; there are no white sharks in the vicinity of IR Site 31. The Navy has determined that this section is not a potential ARAR.

NAVY'S RESPONSES TO ARARS IDENTIFIED BY THE CALIFORNIA DEPARTMENT OF FISH AND GAME, CALIFORNIA DEPARTMENT OF HEALTH SERVICES, AND THE CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL (CONTINUED)

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Location	Standard	Specific Citation	ARAR/TBC Explanation Provided by State on IR Site 30	Navy ARAR Determination as it applies to IR Site 31
California Department of Fish and Game (Continued)				
Tidal Invertebrates	Action must be taken to avoid the taking or possession of mollusk, crustaceans, or other invertebrates.	Fish Game Code § 8500 (Added by Stats. 1972. c 1248, p. 2436, § 2, effective 12/13/72)	It is unlawful to possess or take, unless otherwise expressly permitted in this chapter, mollusks, crustaceans, or other invertebrates, unless a valid tidal invertebrate permit has been issued. The taking, possessing, or landing of such invertebrates pursuant to this section shall be subject to regulations adopted by the commission.	IR Site 31 is inland there are no mollusks, crustaceans, or other invertebrates in the vicinity of IR Site 31. The Navy has determined that this section is not a potential ARAR.
White Shark	Action, must be taken to prevent the taking of any white shark.	Cal. Code Regs. tit. 14, § 28.06 (effective 03/07/94)	Regulation provides that white shark may not be taken, except under permit issued by the Department pursuant to § 1002 of the Fish and Game Code for scientific or educational purposes.	IR Site 31 is inland; there are no white sharks in the vicinity of IR Site 31. The Navy has determined that this section is not a potential ARAR.
Protected Amphibians	Action must be taken to avoid the taking or possession of protected amphibians.	Cal. Code Regs. tit. 14, § 40 (§ 40 designated effective 03/01/74)	This regulation makes it unlawful to capture, collect, intentionally kill or injure, possess, purchase, propagate, sell, transport, import, or export any native reptile or amphibian, or parts thereof unless special permit from the department issued pursuant to Cal. Code Regs. tit. 14, § 650, 670.7, or 783 of these regulations, or as otherwise provided in the Fish and Game Code or these regulations.	The terrestrial habitat of NAVSTA TI is of poor quality for wildlife species because the island is predominantly covered with urbanized areas. Because of the low-quality habitat of IR Site 31, no receptors of concern use the area. The Navy has determined that this section is not a potential ARAR.

NAVY'S RESPONSES TO ARARS IDENTIFIED BY THE CALIFORNIA DEPARTMENT OF FISH AND GAME, CALIFORNIA DEPARTMENT OF HEALTH SERVICES, AND THE CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL (CONTINUED)

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Standard	Specific Citation	ARAR/TBC Explanation
Radioactive materials	Title 10, Code of Federal Regulations, § 20.1001-2402 and Appendices A through F, as incorporated by reference to Cal. Code Regs. tit. 17, § 30253. A significant change in the regulations, as adopted by California, is that the federal term "licensee" is replaced by "user" as defined Cal. Code Regs. tit. 17, § 30100.	No radiological contamination exists on IR Site 31. The Navy has determined that this section is not a potential ARAR.
Radioactive materials	Title 10, Code of Federal Regulations, § 20.1402 through 20.1404, Radiological Criteria for License Termination, Final Rule.	No radiological contamination exists on IR Site 31. The Navy has determined that this section is not a potential ARAR.
Radioactive materials	Relevant guidance documents published by the Nuclear Regulatory Commission (NRC) (e.g., NUREG/CR - 5849).	No radiological contamination exists on IR Site 31. The Navy has determined that these guidance documents are not potential ARARs.

NAVY'S RESPONSES TO ARARS IDENTIFIED BY THE CALIFORNIA DEPARTMENT OF FISH AND GAME, CALIFORNIA DEPARTMENT OF HEALTH SERVICES, AND THE CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL (CONTINUED)

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Standard	Specific Citation	ARAR/TBC Explanation	Navy ARAR Determination
Determination of a Hazardous Waste	Cal. Code Regs. tit. 22, Division 4.5, Chapter 11.	Hazardous Waste Determination requirements are applicable for alternatives that will generate waste. The above identified sections include requirements for determining whether excavated material or extracted groundwater or other generated waste are either RCRA or non-RCRA hazardous waste (i.e., California only waste).	The Navy has evaluated the requirements identified and has included the substantive provisions of the following requirements as potential federal ARARs: Cal. Code Regs. tit. 22, §§ 66261.21, 66261.22(a)(1), 66261.23, 66261.24(a)(1), and 66261.100. The Navy has identified the substantive provisions of the following requirements as potential state ARARs: Cal. Code Regs. tit. 22, §§ 66261.22(a)(3) and (4), § 66261.24(a)(2)–(a)(8), § 66261.101, § 66261.3(a)(2)(C) or § 66261.3(a)(2)(F)
Land Disposal Restrictions	Cal. Code Regs. tit. 22, Chapter 18.	Land disposal restrictions prohibit disposal of hazardous waste unless treatment standards are met and are applicable for alternatives that will generate waste subject to land disposal restrictions.	The Navy has evaluated the requirements identified and has included the substantive provisions of the following requirement as potential ARARs: Cal. Code Regs. tit. 22 § 66268.1(f)
Hazardous Waste Generator Requirements	Cal. Code Regs. tit. 22, Chapter 12 and Chapters 15 and 18 as referenced in Chapter 12.	On-site hazardous waste accumulation requirements are applicable if hazardous waste is generated and accumulated on site before transport.	The Navy has evaluated the requirements identified and has included the substantive provisions of the following requirement as potential ARARs: Cal. Code Regs. tit. 22, §§ 66262.10(a), 66262.11
Drinking Water Primary Standards	Cal. Code Regs. tit. 22, Div. 4, Ch. 15, Article 4, § 64431 et seq., and Article 5.5, § 64444 et seq.	These requirements are considered relevant and appropriate where the aquifer is a potential drinking water source and the State MCLs are more stringent than Federal MCLs (Even though Treasure Island groundwater has been de-designated as a potential drinking water source, concentrations of contaminant at Site 30 should be compared to the State MCLs as a basis for the establishment of institutional controls to prohibit the use of groundwater).	Because groundwater is not a medium of concern at IR Site 30, MCLs are not potential ARARs.

NAVY'S RESPONSES TO ARARS IDENTIFIED BY THE CALIFORNIA DEPARTMENT OF FISH AND GAME, CALIFORNIA DEPARTMENT OF HEALTH SERVICES, AND THE CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL (CONTINUED)

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Standard	Specific Citation	ARAR/TBC Explanation	Navy ARAR Determination
Remediation Waste Staging and On-Site Storage	California Health and Safety Code, Chapter 6.5, Article 2, § 25123.3	This section provides definitions and requirements for on-site storage of non-RCRA hazardous waste soil prior to on-site treatment or off-site transportation and is applicable if non-RCRA hazardous waste soil is accumulated and stored on-site.	It is the Navy's position that this section is not an ARAR if 40 CFR § 264.554 is identified as an ARAR because it is more stringent. The Navy identified the substantive provisions of 40 CFR § 264.554(d)(1)(i-ii) and (d)(2), (e),(f),(h),(i),(j), and (k) as potential ARARs.
Transportation of Hazardous Waste	Cal. Code Regs. tit. 22, Chapter 13, §§ 66263.10 -.18	This regulation is applicable as these requirements must be fully complied with when transporting hazardous waste off-site. The following regulation is relevant and appropriate for remedial technology alternatives that involve the consolidation of waste and the installation of a protected cap. These regulations are relevant and appropriate because Site 30 is known to contain hazardous waste.	The Navy reviewed these sections and has determined that they are not potential ARARs, as they apply to off-site activities. These regulations do not apply to on-site transportation of hazardous waste. Cal. Code Regs. tit. 22, § 66263.10(b).
Construction of Landfill Cover Systems	Cal. Code Regs. tit. 22, Chapter 14, Article 14, Landfills, § 66264.303, Monitoring and Inspection	This section describes the requirements for inspections during construction or installation of cover systems. These systems shall be inspected for uniformity, damage, and imperfections.	The Navy reviewed this section and determined that it is not a potential ARAR because no cover is considered as part of any remedial alternative in the FS.
Landfill Closure and Post-Closure Care	Cal. Code Regs., 22. Chapter 14, Article 14, Landfills, § 66264.310.	This section describes the design and construction requirements for landfill cover as well as post-closure requirements. Also, describes requirements for gas recovery.	The Navy reviewed this section and determined that it is not a potential ARAR because no cover or gas recovery is considered as part of any remedial alternative in the FS Report.
Covenants to Restrict Use of Property - Environmental Restriction	California Civil Code § 1471	This section allows an owner of land to make a covenant to restrict use of land for the benefit of a covenantee. The covenant runs with the land to bind successive owners, and the restrictions must be reasonably necessary to protect present or future human health or safety or the environment as a result of the presence on the land of hazardous materials, as defined in section 25260 of the California Health and Safety Code. Requires recording of the covenant in the county where the land is located.	The Navy identified the substantive provisions of Civil Code § 1471 as a potential ARAR.

NAVY'S RESPONSES TO ARARS IDENTIFIED BY THE CALIFORNIA DEPARTMENT OF FISH AND GAME, CALIFORNIA DEPARTMENT OF HEALTH SERVICES, AND THE CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL (CONTINUED)

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

Standard	Specific Citation	ARAR/TBC Explanation	Navy ARAR Determination
Land use control	California Health & Safety Code § 25202.5	This section allows DTSC to enter into an agreement with the owners of a hazardous waste facility to restrict present and future land uses.	The Navy identified the substantive provisions of California Health and Safety Code § 25202.5 as a potential ARAR.
Land use control	California Health & Safety Code §§ 25221.1 and 25355.5(a)(1)(C)	This section allows DTSC to enter into voluntary agreements with land owners to restrict the use of property. The agreements run with the land restricting present and future uses of the land.	The Navy identified the substantive provisions of California Health & Safety Code §§ 25221.1 and 25355.5(a)(1)(C) as a potential ARARs.
Land use control	California Health & Safety Code §§ 25233(c) and 25234	This section provides the process and criteria for obtaining written variances from land use restrictions, and for termination of land use restrictions.	The Navy identified the substantive provisions of California Health & Safety Code §§ 25233(c) and 25234 as a potential ARARs.
Land use control	Cal. Code Regs. tit. 22, Division 4.5. Chapter 39, § 67391.1	This section defines requirements for establishing land use covenants for imposing limitations on land use when hazardous materials, hazardous waste or constituents, or hazardous substances will remain at the property at levels which are not suitable for unrestricted use of the land.	The Navy identified the substantive provisions of Cal. Code Regs. tit. 22, § 67391.1(a) and (e)(1) as potential ARARs.

Notes:

§	Section
A.B.	Assembly Bill
ARAR	Applicable or relevant and appropriate requirement
Cal. App.	California Appellate Court
Cal. Code Regs.	*California Code of Regulations*
CFR	Code of Federal Regulations
ch.	Chapter
div.	Division
DTSC	Dept. of Toxic Substances Ctrl.
et seq.	And the following
FS	Feasibility study
IR	Installation Restoration
MCL	Maximum contaminant level
NAVSTA	Naval Station
Navy	U.S. Dept. of the Navy
NRC	Nuclear Regulatory Commission
NUREG/CR	Nuclear Regulatory Commission publication
RCRA	Resource Conservation and Recovery Act
Stats.	Statutes
TBC	To be considered
TI	Treasure Island
tit.	Title

APPENDIX C
REMEDIAL ALTERNATIVE COST SUMMARY AND ASSUMPTIONS

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS ..... C-iii

C1.0 INTRODUCTION C-1

C2.0 PURPOSE OF ESTIMATES C-1

C3.0 TYPES OF COST ESTIMATING METHODS C-2

C4.0 METHODOLOGY C-2

C4.1 DESCRIPTION OF REMEDIAL ACTION COST ENGINEERING AND REQUIREMENTS C-2

C4.2 USER-DEFINED COSTS C-3

C5.0 COMPONENTS OF COST ESTIMATE C-3

C5.1 CAPITAL COSTS C-3

C5.2 ANNUAL OPERATION AND MAINTENANCE OR PERIODIC COSTS C-3

C5.3 PRESENT VALUE ANALYSIS C-4

C5.3.1 Discount Rate C-4

C5.3.2 Present Value C-4

C5.4 CONTINGENCY ALLOWANCES C-5

C5.5 ESCALATION COSTS C-5

C6.0 INDIVIDUAL COST ESTIMATE ASSUMPTIONS C-6

C6.1 COST AND ASSUMPTIONS ASSOCIATED ALTERNATIVE 2, ENGINEERING CONTROLS COMBINED WITH INSTITUTIONAL CONTROLS C-6

C6.1.1 General C-6

C6.1.2 Engineering Controls C-7

C6.1.3 Institutional Controls C-7

C6.1.4 Professional Labor Management C-7

C6.2 COST AND ASSUMPTIONS ASSOCIATED ALTERNATIVE 3: ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS, AND EXCAVATION (DEBRIS AREA E) AND OFF-SITE DISPOSAL OF SOIL C-8

C6.2.1 General C-8

C6.2.2 Engineering Controls and Institutional Controls C-8

C6.2.3 Pavement and Utility Demolition C-8

C6.2.4 Waste Characterization Sampling and Analysis C-9

C6.2.5 Excavation and Disposal of Contaminated Soils C-9

C6.2.6 Confirmation Sampling and Analysis C-10

C6.2.7 Site Restoration C-10
C6.2.8 Professional Labor Management C-10
C6.3 COST AND ASSUMPTIONS ASSOCIATED WITH ALTERNATIVE 4: ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS, AND EXCAVATION (DEBRIS AREAS C AND D, EXCLUDING THE STREET) AND OFF-SITE DISPOSAL OF SOIL C-11
C6.3.1 General C-11
C6.3.2 Engineering Controls and Institutional Controls C-11
C6.3.3 Pavement and Utility Demolition C-11
C6.3.4 Waste Characterization Sampling and Analysis C-12
C6.3.5 Excavation and Disposal of Contaminated Soils C-12
C6.3.6 Confirmation Sampling and Analysis C-13
C6.3.7 Site Restoration C-13
C6.3.8 Professional Labor Management C-14
C6.4 COST AND ASSUMPTIONS ASSOCIATED WITH ALTERNATIVE 5: EXCAVATION OF DEBRIS AREAS A, B, C, D, AND E AND OFF-SITE DISPOSAL OF SOIL C-14
C6.4.1 General C-14
C6.4.2 Pavement and Utility Demolition C-15
C6.4.3 Waste Characterization Sampling and Analysis C-15
C6.4.4 Excavation and Disposal of Contaminated Soils C-16
C6.4.5 Waste Confirmation Sampling and Analysis C-16
C6.4.6 Site Restoration C-17
C6.4.7 Professional Labor Management C-17

C7.0 REFERENCES C-18

TABLES

C-1 Total Remedial Cost Summary for Various Alternatives at Site 31

C-1A Site 31 Alternative 2: Engineering Controls Combined with Institutional Controls

C-1B Site 31 Alternative 3: Engineering Controls, Institutional Controls, Excavation (Debris Area E), and Off-Site Disposal of Soil

C-1C Site 31 Alternative 4: Engineering Controls, Institutional Controls, Excavation (Debris Areas C and D), and Off-Site Disposal of Soil

C-1D Site 31 Alternative 5: Complete Removal of Debris Areas A, B, C, D, and E, and Off-Site Disposal of Soil

ACRONYMS AND ABBREVIATIONS

EPA	U.S. Environmental Protection Agency
FS	Feasibility study
LUC	Land use control
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
O&M	Operation and maintenance
OMB	Office of Management and Budget
RACER	Remedial Action Cost Engineering and Requirements

C1.0 INTRODUCTION

This appendix describes each remedial alternative and the associated assumptions used to develop the cost estimate for Installation Restoration (IR) Site 31, Former South Storage Yard, at the former Naval Station Treasure Island in San Francisco, California.

The remaining sections of this appendix are organized as follows:

- Section C2.0 describes the purpose of the estimates.
- Section C3.0 presents the types of cost estimating methods used.
- Section C4.0 summarizes the cost estimate methodology.
- Section C5.0 describes the components of the cost estimate for each alternative.
- Section C6.0 provides assumptions used for each individual cost estimate.
- Section C7.0 lists the references used in preparing the cost estimates.

Cost estimate tables are included at the end of this appendix after Section C7.0.

C2.0 PURPOSE OF ESTIMATES

Cost estimates are developed as part of a Feasibility Study (FS) to compare remedial alternatives during the remedy selection process, and not to establish project budgets or to negotiate Superfund enforcement settlements. The cost estimate typically is carried over from the FS Report to the Proposed Plan for public comment during remedy selection. The cost estimate in the Record of Decision reflects any changes to the remedial alternative that occurred during the remedy selection process as a result of new information or public comment (U.S. Environmental Protection Agency [EPA] 2000).

Cost estimates developed during the detailed analysis phase are used to compare alternatives and to support remedy selection. The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) includes the following language in its description of the cost criteria for the detailed analysis and remedy selection.

> "The types of costs that shall be assessed include the following: (1) Capital costs, including both direct and indirect costs; (2) Annual operations and maintenance costs; and (3) Net present value of capital and O&M [operations and maintenance] costs (Title 40 *Code of Federal Regulations* 300.430 [e][9][iii][G])." (EPA 2000)

C3.0 TYPES OF COST ESTIMATING METHODS

The cost estimates presented in this appendix were developed using both detailed and parametric approaches; both are accepted by EPA, as described below.

The detailed approach estimates cost on an item-by-item basis. Detailed methods typically rely on compiled sources of unit cost data for each item, taken from either a built-in database (if part of a software package, for example) or from other sources (for example, cost estimating references). This method, also known as "bottom up" estimating, is used when design information is available.

The parametric approach relies on relationships between cost and design parameters. These relationships are usually statistically or model-based. Statistically based approaches rely on scaled-up or scaled-down versions of projects where historical cost data are available. Model-based approaches use a generic design linked to a cost database and adjusted for site-specific information. This method, also known as "top down" estimating, is used when design information is not available (EPA 2000).

C4.0 METHODOLOGY

Cost estimates for this FS Report were prepared in accordance with "A Guide to Developing and Documenting Cost Estimates during the Feasibility Study" (EPA 2000). The Remedial Action Cost Engineering and Requirements (RACER) System 2006 was the primary source of cost data (Earth Tech, Inc. 2006). Costs for unique line items that are not included in RACER were based on vendor quotes. Excel spreadsheets were used to tabulate costs and calculate net present values in 2006 dollars; RACER outputs also are presented in 2006 dollars.

C4.1 DESCRIPTION OF REMEDIAL ACTION COST ENGINEERING AND REQUIREMENTS

RACER is a computer modeling tool that estimates costs for all phases of remediation (Earth Tech, Inc. 2006). RACER can be used to evaluate costs for interim studies and measures, remedial and corrective measures design, remedial action and corrective action, O&M, long-term monitoring, and site closeout. The system was originally developed in 1991 under funding from the U.S. Department of the Air Force. Numerous revisions and updates have been incorporated through several releases since RACER was introduced.

RACER is a parametric cost modeling system that uses a patented methodology for estimating costs. The RACER cost database is a duplicate of the Environmental Cost Handling Options and Solutions, which was published by the R.S. Means Company, Inc. (2005). RACER cost estimates are based on generic engineering solutions for environmental projects, technologies, and processes. Historical project information, industry data, government laboratories, construction management agencies, vendors, contractors, and engineering analysis were used to develop generic solutions to engineering problems. Cost estimates in RACER are tailored specifically to each project by adding site-specific parameters to reflect project-specific

conditions and requirements. The tailored design is then translated into specific quantities of work, and the quantities of work are priced using current data.

C4.2 USER-DEFINED COSTS

It was not always possible to develop cost estimates using RACER because of the unique characteristics for some elements of the remedial alternatives. In these cases, the costs of the elements were estimated using vendor quotes, which were then evaluated and adjusted as necessary to account for inflation.

C5.0 COMPONENTS OF COST ESTIMATE

Cost estimates for the remedial alternatives include capital costs, annual O&M or periodic costs, present value costs, contingency allowances, and escalation costs. Each of these factors is discussed in further detail in the following sections.

C5.1 CAPITAL COSTS

Capital costs include direct and indirect costs. Costs incurred for equipment, material, labor, construction, development, and implementation of remedial technologies are included as direct costs. Indirect costs include health and safety, site supervision, engineering, overhead and profit, and startup. Indirect costs are included in the estimate as either a separate line item or as a percentage of the direct capital cost. Costs for alternatives that included excavation were estimated assuming the entire area of the debris areas would require excavation. However, actual excavation areas will be limited to areas of contamination with concentrations above remediation goals (known as “hot spots”) and will be determined during implementation of the selected remedial alternative based on characterization and collection and analysis of confirmation soil samples.

C5.2 ANNUAL OPERATION AND MAINTENANCE OR PERIODIC COSTS

Annual O&M costs are incurred after construction. These costs are necessary to assure the effectiveness of a remedial alternative. Annual O&M costs for active components of remediation systems typically include power, operating labor, consumable materials, purchased services (for example, laboratory analysis), equipment replacement, maintenance, sampling, permit fees, annual reports, and site reviews. O&M costs for remedial alternatives that involve land use controls (LUC) include inspections and preparation of reports to document the inspections and verify that the components of the LUC are functioning as intended, including engineering controls and institutional controls.

Periodic costs occur once every few years or once during the entire period of O&M. Examples include 5-year reviews, equipment replacement, site closeout, and remedy failure and replacement.

The capital costs primarily involve preparation and implementation of the RAWP. The O&M costs involve periodic inspections, annual reporting, and 5-year reviews pursuant to CERCLA. A 25 percent markup factor is included to account for the Navy's contractor oversight costs. The total cost for ICs does include the cost for enforcing the IC components.

C5.3 PRESENT VALUE ANALYSIS

Remedial action projects typically involve construction costs that are expended at the beginning of a project (capital costs) and costs in subsequent years (O&M or periodic costs). Present value analysis is a method to evaluate expenditures that occur over various periods. This standard methodology allows for cost comparisons of different remedial alternatives on the basis of a single cost figure for each alternative. This single value, referred to as the present value, is the amount that must be set aside at the initial point in time (the base year) to assure that funds would be available in the future as they are needed. Present value analysis uses a discount rate and period of analysis to calculate the present value of each expenditure. Both factors are discussed below.

C5.3.1 Discount Rate

A discount rate is similar to an interest rate and is used to account for the time value of money. A dollar is worth more today than in the future because the dollar would earn interest if invested in an alternative use today. If the capital were not employed in a specific use, it would have a productivity value in alternative uses. The choice of a discount rate is important because the rate chosen directly alters the present value of a cost estimate, which is then used in selecting a remedy.

EPA policy on the use of discount rates for remedial investigation and FS cost analysis is set forth in the preamble to the NCP (55 Federal Register 8722). As recommended in EPA's "A Guide to Developing and Documenting Cost Estimates during Feasibility Studies" (EPA 2000), real discount rates published in economic analysis by the federal government on August 11, 2005, in Office of Management and Budget (OMB) Circular A-94 (OMB 2006), have been used in the cost estimates. The current discount rate for a 30-year stream of payments is 3.0 percent.

C5.3.2 Present Value

The present value of a series of equal annual future payments, such as for annual O&M, is calculated using the following equation:

$$PV = \sum_{t=1}^{N} \frac{x_t}{(1+i)t} \qquad \text{(C-1)}$$

where:

PV	=	Present value
xt	=	Payment in year t (t = 0 for present or base year)
i	=	Discount factor
t	=	Number of years after construction that expenditures start
N	=	Number of years that the stream of equal annual future payments will run

The present value of a single periodic future payment is calculated using the following equation:

$$PV = \frac{x_t}{(1+i)^t} \qquad \text{(C-2)}$$

where:

PV	=	Present value
xt	=	Payment in year t (t = 0 for present or base year)
i	=	Discount factor
t	=	Number of years after construction that expenditures occur

The present value of a remedial alternative represents the sum of the present values of all future payments associated with the project. The present value for this cost estimate was calculated using 2006 dollars. (See Section C5.5, Escalation Costs, for adjustment of capital costs.)

C5.4 CONTINGENCY ALLOWANCES

Contingency is factored into a cost estimate to cover unknowns, unforeseen circumstances, or unanticipated conditions that are not possible to evaluate based on the data at hand when the estimate is prepared. The two main types of contingencies are scope and bid. Scope contingency covers unknown costs that would result from changes in scope that may occur during the design. Bid contingency covers unknown costs associated with constructing or implementing a project scope. Exhibit 5-6 of EPA's "A Guide to Developing and Documenting Cost Estimates during the Feasibility Study" lists some expected ranges in contingency fees for certain remedial technologies (EPA 2000).

C5.5 ESCALATION COSTS

Some RACER output costs are expressed in 2006 dollars (Earth Tech, Inc. 2006), and some vendor costs are expressed in 2006 dollars. Escalation costs reflect the increase in project costs over time as a result of inflation. Escalation costs were not required for this cost estimate because all capital costs are assumed to occur in 2006.

C6.0 INDIVIDUAL COST ESTIMATE ASSUMPTIONS

This section identifies the assumptions and parameters used in developing cost estimates for remediation of soil at IR Site 31. The tables listed below present the costs associated with each alternative. No cost table is presented for Alternative 1 (No Action) because no costs are associated with its implementation.

- Table C-1 presents the cost summary for all remedial alternatives for soil at IR Site 31.
- Table C-1A presents a cost summary of remedial costs associated with Alternative 2, Engineering Combined with Institutional Controls.
- Table C-1B presents a summary of costs associated with Alternative 3, Engineering Controls, Institutional Controls, and Excavation (Debris Area E) and Off-Site Disposal of Soil.
- Table C-1C presents a cost summary of remedial costs associated with Alternative 4, Engineering Controls, Institutional Controls, and Excavation (Debris Areas C and D, excluding the street) and Off-Site Disposal of Soil.
- Table C-1D presents a summary of costs associated with Alternative 5, Excavation of Debris Areas A, B, C, D, and E) and Off-Site Disposal of Soil.

C6.1 COST AND ASSUMPTIONS ASSOCIATED ALTERNATIVE 2, ENGINEERING CONTROLS COMBINED WITH INSTITUTIONAL CONTROLS

The major components of remediation under Alternative 2 are (1) maintain the existing asphalt and concrete surfaces as exposure prevention barriers; (2) perform routine inspections, and when necessary maintenance to prevent exposure to soils; (3) conduct yearly reporting and 5-year reviews; and (4) implement institutional controls. The capital costs primarily involve preparation and implementation of the Remedial Action Work Plan (RAWP).

The assumptions listed as follows were made for Alternative 2 at IR Site 31.

C6.1.1 General

- Various chemicals of concern are present in soil beneath the playground, parking lot, sidewalks, and 11th Street.
- Soil contaminated with lead is present beneath 11th Street (asphalt surface) between Avenue D and Avenue E.
- The cost estimate will cover costs over a 30-year period.

C6.1.2 Engineering Controls

- The existing asphalt and concrete hardscape will not require additional engineered improvements to continue to function as an exposure prevention barrier.
- The existing asphalt and concrete hardscape will require maintenance every 10 years to continue to function as an exposure prevention barrier over the 30-year duration.
- It is necessary to conduct yearly reporting and 5-year reviews for the period of this estimate to monitor, maintain, and report on the effectiveness of the existing asphalt and concrete hardscape as an exposure prevention barrier.

C6.1.3 Institutional Controls

- Institutional controls would include a RAWP, environmental restrictions in deed, annual inspections, and 5-year reviews. Regulatory review of the RAWP and Site Closeout Report capital costs include 20 hours of regulatory involvement. ICs would be in place indefinitely.
- Five-year reviews will be required. Five-year reviews will consist of document review, a site visit separate from the annual site visit, interviews, and a report per EPA guidelines. Costs also include 60 hours of regulatory review of the 5–year review reports.
- Annual site visits will be performed to ensure the site use has not changed and the existing asphalt and concrete hardscape has not been disturbed. Annual inspections will include a site visit (4 hours) and a letter report and will require one person to perform. O&M costs associated with implementation of ICs include 10 hours annually for site regulatory enforcement.
- The breakdown of support provided by the Navy and necessary for the regulatory agencies was included as a percentage for the overall annualized cost for each element. These costs are represented as a separate line item in the annual cost build-up.
- Project duration (to include a work plan, fieldwork, data validation, and closure report) is assumed to be 16 months.

C6.1.4 Professional Labor Management

- Professional labor percentages were calculated by RACER based on the total cost of the project.
- Project duration (including a work plan, fieldwork, data validation, and closure report) is assumed to be 8 months.

C6.2 COST AND ASSUMPTIONS ASSOCIATED ALTERNATIVE 3: ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS, AND EXCAVATION (DEBRIS AREA E) AND OFF-SITE DISPOSAL OF SOIL

Alternative 3 evaluates the remedy associated with risk to construction workers from lead in soil beneath 11th Street. The major components of Alternative 3 are similar to Alternative 2 except for the addition of (1) demolition of the existing asphalt surface and sidewalks along a portion of 11th Street to allow for waste characterization and excavation of soils beneath the street within Debris Area E; (2) excavation of soils in Debris Area E to a depth of 4 feet; and (3) transportation and disposal of contaminated soil in a permitted off-site landfill. Costs for Alternative 3 include demolition and replacement of underground utilities within Debris Area E. The O&M costs involve periodic inspections, annual reporting, and 5-year reviews pursuant to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The cost estimate includes the cost for regulatory enforcement of the IC components. A 25 percent markup factor is included to account for the Navy's contractor oversight costs.

The assumptions listed as follows were made for Alternative 3 at IR Site 31.

C6.2.1 General

- Modified Level D personal protective equipment will be required for all activities

C6.2.2 Engineering Controls and Institutional Controls

- The same engineering controls and institutional controls identified for Alternative 2 also will be implemented for Alternative 3. (The basis and assumptions are the same.)

C6.2.3 Pavement and Utility Demolition

- Additional perimeter construction fence will be installed to serve as a boundary for the excavation area (approximately 120 feet long) at Debris Area E.
- Existing asphalt surface on 11th Street is 4 inches thick.
- Approximately 180 linear feet of sidewalk and curb overlying Debris Area E will require demolition.
- 225 linear feet of a 10-inch-diameter water line beneath 11th Street will require demolition.
- Sidewalks and curbs are constructed of unreinforced concrete.
- Sidewalk is 48 inches wide and 4 inches thick.

- Load and haul of asphalt materials is assumed to be by highway truck and disposed of as nonhazardous waste at $19.31 per cubic yard.

- The distance to the nonhazardous landfill (Altamont Landfill and Resource Recovery Facility) is 50 miles or less (one way).

C6.2.4 Waste Characterization Sampling and Analysis

- Waste characterization samples will be collected during excavation by one field technician

- A differential global positioning system unit will be required.

- Waste characterization samples will be analyzed on a 24- to 72-hour turnaround time.

- Waste characterization samples will be collected to adequately characterize and profile excavated material sent off site for disposal.

- Fifteen samples will be collected for waste characterization analysis and analyzed for lead, including blanks and duplicates.

C6.2.5 Excavation and Disposal of Contaminated Soils

- Excavation will require 1 week to complete.

- Underground utilities will be removed during excavation activities and replaced as part of site restoration.

- The excavation area is approximately 6,585 square feet, which includes the area of Debris Area E.

- The excavation depth is 4 feet below ground surface.

- Soil type is sand-silt/sand-clay mixture.

- The volume for off-site disposal will be approximately 1,220 cubic yards, which includes a bulking factor of 25 percent.

- No drum removal is required.

- Ground-penetrating radar is not necessary.

- All excavated waste will be considered Resource Conservation and Recovery Act hazardous waste and will be disposed of at $115.86 per cubic yard.

- One-way haul distance for excavated hazardous waste is 200 miles or less (Kettleman Hills, California).

C6.2.6 Confirmation Sampling and Analysis

- Confirmation samples will be collected to demonstrate contamination has been removed.
- One mobilization for confirmation sampling will be required.
- Turnaround time for confirmation samples is 5 to 7 days.
- The area for confirmation sampling will be 6,585 square feet and will be sampled at the rate of one sample per 325 square feet (29 samples including blanks and duplicates).
- Confirmation samples will be analyzed for lead.
- Duplicate and rinsate samples will be required at the rate of 10 percent of the total confirmation samples collected.

C6.2.7 Site Restoration

- An estimated 1,220 cubic yards of imported, unclassified fill will be compacted in 6-inch lifts.
- A total of linear 180 feet of 11th Street will require restoration as a two-lane access road with 4-inch asphalt surfacing.
- The lane width of 11th Street is 12 feet.
- A total of 225 linear feet of 10-inch-diameter carbon steel water line beneath 11th Street will be replaced.
- Restoration of curbs and sidewalks will be performed following completion of excavation and backfill activities.

C6.2.8 Professional Labor Management

- Professional labor percentages were calculated by RACER based on the total cost of the project.
- Project management is approximately 2.5 percent of the total direct remedial action construction cost (total cost).
- Construction oversight is approximately 2.75 percent of the total cost.
- Reporting is approximately 0.35 percent of the total cost.
- As-built drawings are approximately 0.35 percent of the total cost.

- Public notice is approximately 0.08 percent of the total cost.
- Fieldwork duration is assumed to be 3 weeks.
- Project duration (including a work plan, fieldwork, data validation, and closure report) is assumed to be 16 months.

C6.3 Cost and Assumptions Associated with Alternative 4: Engineering Controls, Institutional Controls, and Excavation (Debris Areas C and D, excluding the street) and Off-Site Disposal of Soil

Alternative 4 evaluates a remedy associated with risk to elementary school children and staff and recreational users from chemicals of concern identified in soil beneath the paved playground and parking lot within Debris Areas C and D. The engineering and institutional controls of Alternative 4 are similar to Alternative 2. Additional capital costs include (1) demolition of the existing playground and portions of sidewalk and asphalt adjacent to Avenue E (the parking lot on the northeast corner of 11th Street and Avenue E) to allow for excavation of soils within Debris Areas C and D; (2) excavation of soils in Debris Areas C and D to a depth of 4 feet; and (3) transportation and disposal of debris and soil in an approved off-site landfill. Costs for Alternative 4 include replacement of underground utilities in Debris Areas C and D and the playground. Excavation within Debris Area D includes the portion of debris underlying the northeast corner of the intersection of 11th Street and Avenue E. The O&M costs involve periodic inspections, annual reporting, and 5-year reviews pursuant to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The cost estimate includes the cost for regulatory enforcement of the IC components. A 25 percent markup factor is included to account for the Navy's contractor oversight costs.

The assumptions listed as follows were made for Alternative 4 at IR Site 31.

C6.3.1 General

- Modified Level D personal protective equipment will be required for all activities

C6.3.2 Engineering Controls and Institutional Controls

- The same engineering and institutional controls identified for Alternative 2 also will be implemented for Alternative 4. (The basis and assumptions are the same.)

C6.3.3 Pavement and Utility Demolition

- Additional perimeter construction fence will be installed to serve as a boundary for the excavation areas (approximately 965 feet long) at Debris Areas C and D.
- The existing asphalt surface overlying Debris Areas C and D is 4 inches thick.

- Approximately 140 linear feet of sidewalk and curb overlying Debris Area D will require demolition.
- Sidewalks and curbs are constructed of unreinforced concrete.
- Sidewalks are 48 inches wide and 4 inches thick.
- A total of 140 linear feet of the 18-inch-diameter storm drain beneath the playground will require demolition.
- Load and haul of asphalt materials is assumed to be by highway truck and disposed of as nonhazardous waste at $19.31 per cubic yard.
- The distance to the nonhazardous landfill (Altamont Landfill and Resource Recovery Facility) is 50 miles or less (one way).

C6.3.4 Waste Characterization Sampling and Analysis

- Waste characterization samples will be collected during excavation by one field technician.
- A differential global positioning system unit will be required.
- Waste characterization samples will be analyzed for lead, benzo(a)pyrene-equivalent (B[a]P-EQ) chemicals, and dioxins.
- Waste characterization samples will be analyzed on a 24- to 72-hour turnaround time.
- Waste characterization samples will be collected to adequately characterize and profile excavated material sent off site for disposal.
- Waste characterization samples will be collected at a rate of approximately one sample per 100 cubic yards of excavated material.
- A total of 30 samples will be collected for characterization analysis and analyzed for lead, B(a)P-EQ chemicals, and dioxins, including blanks and duplicates.

C6.3.5 Excavation and Disposal of Contaminated Soils

- Excavation will take 3 weeks to complete.
- Underground utilities will be removed during excavation activities and replaced as part of site restoration.
- The excavation area is approximately 14,500 square feet, which includes the area of Debris Areas C and D.
- The excavation depth is 4 feet below ground surface.

- Soil type is sand-silt/sand-clay mixture.
- The volume for off-site disposal will be approximately 2,685 cubic yards, which includes a bulking factor of 25 percent.
- No drum removal is required.
- Ground-penetrating radar is not necessary.
- All excavated waste will be considered Resource Conservation and Recovery Act hazardous waste, and will be disposed of at $115.86 per cubic yards.
- One-way haul distance for excavated hazardous waste is 200 miles or less (Kettleman Hills, California).

C6.3.6 Confirmation Sampling and Analysis

- Confirmation samples will be collected to demonstrate that contamination has been removed.
- One mobilization for confirmation sampling will be required.
- Turnaround time for confirmation samples is 5 to 7 days.
- The confirmation sampling area will be 14,500 square feet and will be sampled at the rate of one sample per 325 square feet (50 samples including blanks and duplicates).
- Confirmation samples will be analyzed for lead, B(a)P-EQ chemicals, and dioxins.
- Duplicate and rinsate samples will be required at the rate of 10 percent of the total number of confirmation samples collected.

C6.3.7 Site Restoration

- An estimated 2,685 cubic yards of imported, unclassified fill will be compacted in 6-inch lifts.
- Asphalt surfacing to be replaced at a thickness of 4 inches.
- A total of 140 linear feet of sidewalk and curb adjacent to Avenue E will require replacement.
- A total of 140 feet of the 18-inch-diameter concrete storm drain will require replacement.
- Restoration of curbs and sidewalks will be performed following completion of excavation and backfill activities.

C6.3.8 Professional Labor Management

- Professional labor percentages were calculated by RACER based on the total cost of the project.
- Project management is approximately 2.5 percent of the total direct remedial action construction cost (total cost).
- Construction oversight is approximately 2.75 percent of the total cost.
- Reporting is approximately 0.35 percent of the total cost.
- As-built drawings are approximately 0.35 percent of the total cost.
- Public notice is approximately 0.08 percent of the total cost.
- Permitting requirements are 5 percent of the total cost
- The duration of fieldwork is assumed to be 4 weeks.
- Project duration (to include a work plan, fieldwork, data validation, and closure report) is assumed to be 17 months.

C6.4 COST AND ASSUMPTIONS ASSOCIATED WITH ALTERNATIVE 5: EXCAVATION OF DEBRIS AREAS A, B, C, D, AND E AND OFF-SITE DISPOSAL OF SOIL

Alternative 5 evaluates the remedy associated with the removal of all areas of elevated concentrations of chemicals of concern within Debris Areas A, B, C, D, and E, thereby providing unrestricted land use for IR Site 31. The major components of Alternative 5 include (1) demolition of the existing playground, parking lot, portions of 11th Street sidewalk and asphalt within the boundary of IR Site 31 to allow for excavation of soils within Debris Areas A, B, C, D, and E; (2) excavation of soils in Debris Areas A, B, C, D, and E to a depth of 6 feet; and (3) transportation and disposal of debris and soil to an approved off-site landfill. Costs for Alternative 5 include replacement of underground utilities within IR Site 31 and the playground, asphalt, and sidewalks that will be removed as part excavation of all debris areas. Costs for engineering controls and institutional controls are not included because all of the debris would be removed from IR Site 31 to allow for unrestricted use. Excavation within Debris Area D includes the portion of debris underlying the intersection of 11th Street

The assumptions listed as follows were made for Alternative 5 at IR Site 31.

C6.4.1 General

- Modified Level D personal protective equipment will be required for all activities.

C6.4.2 Pavement and Utility Demolition

- Additional perimeter construction fence will be installed to serve as a boundary for the entirety of IR Site 31 (approximately 1,252 feet long).
- Existing asphalt surface overlying Debris Areas A, B, C, D, and E is 4 inches thick.
- A total of 320 linear feet of sidewalk and curb overlying Debris Areas D and E will require demolition.
- Sidewalks and curbs are constructed of unreinforced concrete.
- Sidewalks are 48 inches wide and 4 inches thick.
- Load and haul of asphalt materials is assumed to be by highway truck and disposed of as nonhazardous waste at $19.31 per cubic yards.
- A total of 140 feet of the 18-inch-diameter storm drain beneath the playground will require demolition.
- A total of 225 feet of the 10-inch-diameter water line beneath 11th Street will require demolition.
- The distance to the nonhazardous landfill (Altamont Landfill and Resource Recovery Facility) is 50 miles or less (one way).

C6.4.3 Waste Characterization Sampling and Analysis

- Waste characterization samples will be collected during excavation by one field technician.
- A differential global positioning system unit will be required.
- Waste characterization samples will be analyzed for lead, B(a)P-EQ chemicals, and dioxins.
- Waste characterization samples to be analyzed on a 24- to 72-hour turnaround time.
- Waste characterization samples will be collected to adequately characterize and profile excavated material sent off site for disposal.
- Waste characterization samples will be collected at a rate of approximately one sample per 100 cubic yards of excavated material.
- A total of 67 samples will be collected for characterization analysis and analyzed for lead, B(a)P-EQ chemicals, and dioxins, including blanks and duplicates.

C6.4.4 Excavation and Disposal of Contaminated Soils

- Excavation will require 4 weeks to complete.
- Underground utilities will be removed during excavation activities and replaced as part of site restoration.
- The excavation area is approximately 21,855 square feet, which includes the area of Debris Areas A, B, C, D, and E.
- The deepest detection of a chemical of concern was 5 feet below ground surface. To ensure all chemicals of concern are excavated, the excavation depth is 6 feet below ground surface or to groundwater.
- Soil type is sand-silt/sand-clay mixture.
- The volume for off-site disposal will be approximately 6,070 cubic yards, which includes a bulking factor of 25 percent.
- No drum removal is required.
- Ground-penetrating radar is not necessary.
- The existing cover in the excavation areas is asphalt and concrete.
- All excavated waste will be considered Resource Conservation and Recovery Act hazardous waste and will be disposed of at $115.86 per cubic yards.
- The one-way haul distance for excavated hazardous waste is 200 miles or less (Kettleman Hills, California).

C6.4.5 Waste Confirmation Sampling and Analysis

- Waste confirmation samples will be collected to demonstrate that contamination has been removed.
- One mobilization for confirmation sampling will be required.
- Turnaround time for confirmation samples is 5 to 7 days.
- Waste confirmation sampling area will be 21,855 square feet and be sampled at the rate of one sample per 325 square feet.
- Waste confirmation samples will be analyzed for lead, B(a)P-EQ chemicals, and dioxins.
- Duplicate and rinsate samples will be required at the rate of 10 percent of the total number of confirmation samples collected.

C6.4.6 Site Restoration

- An estimated 6,070 cubic yards of imported, unclassified fill will be compacted in 6-inch lifts.
- Asphalt surfacing to be replaced at a thickness of 4 inches.
- A total of 225 linear feet of the 10-inch-diameter carbon steel water line beneath 11th Street will require replacement.
- A total of 140 linear feet of the 18-inch-diameter concrete storm drain will require replacement.
- Restoration of curbs and sidewalks will be performed following completion of excavation and backfill activities.

C6.4.7 Professional Labor Management

- Professional labor percentages were calculated by RACER based on the total cost of the project.
- Project management is approximately 2.5 percent of the total direct remedial action construction cost (total cost).
- Construction oversight is approximately 2.75 percent of the total cost.
- Reporting is approximately 0.35 percent of the total cost.
- As-built drawings are approximately 0.35 percent of the total cost.
- Public notice is approximately 0.08 percent of the total cost.
- Permitting requirements are 5 percent of the total cost
- The duration of fieldwork is assumed to be 6 weeks.
- Project duration (including include a work plan, fieldwork, data validation, and closure report) is assumed to be 18 months.

C7.0 REFERENCES

Earth Tech, Inc. 2006. "Remedial Action Cost Engineering and Requirements, Parametric Cost Estimating Software for Environmental Cleanup Projects." RACER Version 8.1.

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R.S. Means Company, Inc. 2005. "Environmental Cost Handling Options and Solutions, 2005."

U.S. Environmental Protection Agency. 2000. "A Guide to Developing and Documenting Cost Estimates during the Feasibility Study." EPA/540/R-00/002.

TABLES

TABLE C-1: TOTAL REMEDIAL COST SUMMARY FOR VARIOUS ALTERNATIVES AT SITE 31

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

TOTAL REMEDIAL COST SUMMARY FOR SOIL AT SITE 31

Site:	31	**Base Year:**	2006
Location:	Treasure Island, California	**Date:**	September 26, 2006
Phase:	Feasibility Study		

	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 4**	**Alternative 5**
Description	**No Action**	**Engineering Controls Combined with Institutional Controls**	**Engineering Controls, Institutional Controls, and Excavation (Debris Area E) and Off-Site Disposal of Soil**	**Engineering Controls, Institutional Controls, Excavation (Debris Areas C and D) and Off-Site Disposal of Soil**	**Complete Removal of Debris Areas A, B, C, D, and E and Off-Site Disposal of Soil**
Total Project Duration (Years)	0	30	30	30	1
Capital Cost	$0	$313,000	$856,000	$1,475,000	$2,308,000
Annual O&M (Institutional Controls)	$0	$135,000	$135,000	$135,000	$0
Periodic Cost - Maintenance	$0	$12,000	$12,000	$12,000	$0
Periodic Cost - 5-Year Reviews	$0	$328,000	$328,000	$328,000	$0
Total Cost in 2006 Dollars	**$0**	**$788,000**	**$1,331,000**	**$1,950,000**	**$2,308,000**

Note: Costs in this table are rounded to the nearest $1,000.

O&M Operation and maintenance

TABLE C-1A: SITE 31 ALTERNATIVE 2: ENGINEERING CONTROLS COMBINED WITH INSTITUTIONAL CONTROLS

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

COST ESTIMATE SUMMARY

Site:	31	**Description:**	To be protective of the site occupants under current use, this alternative
Location:	Treasure Island, California		Includes engineering controls to maintain hardscape
Phase:	Feasibility Study		and exposure prevention barriers installed during the removal action.
Base Year:	2006		Thirty years of ICs will begin when LUC RD is complete.
Date:	September 26, 2006		Capital costs occur in year 0.

CAPITAL COSTS: ENGINEERING CONTROLS COMBINED WITH INSTITUTIONAL CONTROLS

DESCRIPTION	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost
Work Plans and Reports						
Senior Project Manager	30	HR	0	250	0	$7,500
Project Manager	120	HR	0	230	0	$27,600
Senior Staff Engineer	400	HR	0	200	0	$80,000
Staff Scientist	160	HR	0	160	0	$25,600
Word Processing/Clerical	100	HR	0	100	0	$10,000
Draftsman/CADD	40	HR	0	130	0	$5,200
Regulatory Review	20	HR	0	185	0	$3,695
SUBTOTAL						**$159,595**
Institutional Controls - Implementation						
Overnight Delivery, 8 ounce Letter	8	EA	19	0	-	$148
Project Manager	60	HR	0	230		$13,800
Project Engineer	135	HR	0	210		$28,350
Staff Engineer	165	HR	0	180		$29,700
QA/QC Officer	39	HR	0	250		$9,750
Word Processing/Clerical	120	HR	0	100		$12,000
Draftsman/CADD	278	HR	0	130		$36,140
Computer Data Entry	150	HR	0	95		$14,250
Other Direct Costs	1	LS	1267	0		$1,267
Construction Signs	72	SF	18	0	-	$1,281
Surveying - 2-man Crew	3	DAY	0	1564	319.49	$5,651
Portable GPS Set with Mapping, 5 centimeters Accuracy	1	MO	968	0		$968
SUBTOTAL						**$153,305**
TOTAL CAPITAL COST IN 2006 DOLLARS						**$312,900**

OPERATIONS AND MAINTENANCE COSTS:

Institutional Controls - Monitoring & Enforcement							
Annual	Year	30	30				
Overnight Delivery, 8 ounce Letter			2	LB	23	0	-	$46
Project Manager			1	HR	0	230		$230
Project Engineer			3	HR	0	210		$630
Staff Engineer			8	HR	0	180		$1,440
Other Direct Costs			1	LS	1267	0		$1,267
Contingency				15%		-		$542
Navy Oversight				25%		-		$903
Regulatory Involvement			10			185		$1,847
SUBTOTAL								**$6,906**

PERIODIC COSTS

5-Year Reviews								
Five-Year Reviews	Year	5,10,15,20,25,30	6					
Project Manager			40	HR	0	230		$9,200
Project Engineer			120	HR	0	210		$25,200
Staff Engineer			60	HR	0	180		$10,800
Draftsman/CADD			40	HR	0	130		$5,200
Word Processing/Clerical			60	HR	0	100		$6,000
SUBTOTAL								$56,400
Contingency				15%				$8,460
Navy Oversight				25%				$14,100
Regulatory Involvement			60			185		$11,083
SUBTOTAL								**$90,043**
Barrier Maintenance								
Direct Cost Maintenance	Year	10, 20, 30	3	LS	$ 5,000	-	-	$15,000
Contingency				15%	$ 750			$2,250
Navy Oversight				25%	$ 1,250			$3,750
SUBTOTAL					$7,000			**$21,000**

TABLE C-1A: SITE 31 ALTERNATIVE 2: ENGINEERING CONTROLS COMBINED WITH INSTITUTIONAL CONTROLS (CONTINUED)

Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

COST ESTIMATE SUMMARY

Site:	31	**Description:**	To be protective of the site occupants under current use, this alternative
Location:	Treasure Island, California		Includes engineering controls to maintain hardscape
Phase:	Feasibility Study		and exposure prevention barriers installed during the removal action.
Base Year:	2006		Thirty years of ICs will begin when LUC RD is complete.
Date:	September 26, 2006		Capital costs occur in year 0.

PRESENT VALUE ANALYSES:

Cost Type	Year	Total Cost	Total Cost per Year	Discount Factor[b,c]	Present Value
Capital Cost	0	$312,900	$312,900	1.0	$312,900
Annual O&M	1-30	$207,187	$6,906	19.6	$135,365
Periodic Cost (Maintenance)	10, 20, 30	$21,000	$7,000	1.7	$11,761
Periodic Cost (5-Year Reviews)	30	$540,256	$90,043	3.6	$327,511
		$1,081,342			$787,536
TOTAL PRESENT VALUE OF ALTERNATIVE					**$787,536**

Notes:

a Cost obtained from RACER 2006.

b Discount factor = $\frac{1}{(1+i)^t}$ where i = 0.031 for a 30+ year technology and t = year (i.e., the present value of the dollar paid in year t at 3.0%)

c Multi-year discount factor = $\frac{(1+i)n - 1}{i(1+i)n}$ where i = 0.03 for a 30+ year technology and n = total number of years

CADD	Computer-Aided Design and Drafting
EA	Each
GPS	Global positioning system
HR	Hour
IC	Institutional control
LS	Lump sum
LUC	Land use control
MO	Month
O&M	Operation and maintenance
QA/QC	Quality assurance/quality control
RD	Remedial design

TABLE C-1B: SITE 31 ALTERNATIVE 3: ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS, EXCAVATION (DEBRIS AREA E), AND OFF-SITE DISPOSAL OF SOIL
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

COST ESTIMATE SUMMARY

Site: 31
Location: Treasure Island, California
Phase: Feasibility Study
Base Year: 2006
Date: September 26, 2006

Description: Incorporating the use of institutional and engineering controls as in alternative 2 and including the excavation (to a maximum of 4 feet) of soils of Debris Area E hot spot. Waste would be disposed of at a licensed landfill

CAPITAL COSTS: ENGINEERING AND INSTITUTIONAL CONCTROLS, HOT SPOT EXCAVATION, AND OFF-SITE DISPOSAL

DESCRIPTION	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost
Work Plans and Reports						
Senior Project Manager	30	HR	0	250	0	$7,500
Project Manager	120	HR	0	230	0	$27,600
Senior Staff Engineer	400	HR	0	200	0	$80,000
Staff Scientist	160	HR	0	160	0	$25,600
Word Processing/Clerical	100	HR	0	100	0	$10,000
Draftsman/CADD	40	HR	0	130	0	$5,200
Regulatory Review	20	HR	0	185	0	$3,695
SUBTOTAL						**$159,595**
Demolition and Disposal of Concrete & Pavement						
Demolish Unreinforced Concrete Sidewalk	9	CY	0	131	20	$1,337
Revove concrete curb	180	LF	0	7	0	$1,355
Demolish Rod Reinforced Concrete to 6" Thick with power Equipment	81	CY	0	132	28	$12,999
Demolish bituminous road with power equipment	122	CY	0	38	8	$5,653
Dump Charges	122	CY	19	0	0	$2,355
916, 1.5 CY, Wheel Loader	3	HR	0	101	44	$436
8 CY, Dump Truck	54	HR	0	84	65	$8,074
SUBTOTAL						**$32,210**
Demolition, Disposal, and Replacement of Underground Utilities (Debris Area E)						
Dump Charges	21.33	CY	19.31	0.00	0.00	$411.89
Minor site demolition, pipe, sewer/water, 10" diameter, remove, excludes excavation, hauling	225.00	LF	0.00	17.02	1.05	$4,066.81
910, 1.25 CY, Wheel Loader	1.00	HR	0.00	101.42	43.93	$145.35
Excavating, trench, medium soil, 6' to 10' deep, 1-1/2 C.Y. bucket, gradall, excludes sheeting or dewatering	87.50	BCY	0.00	1.06	0.34	$122.18
8 CY, Dump Truck	2.00	HR	0.00	84.49	65.03	$299.03
950, 3.00 CY, Backfill with Excavated Material	87.50	CY	0.00	1.43	1.07	$218.59
Backfill Trench, Borrow Material, Delivered & Dumped Only	18.87	CY	8.47	3.77	1.60	$261.03
Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	87.50	ECY	0.00	3.91	0.15	$354.83
Replacement of 10-inch diameter water main	225.00	LF	23.50	16.00	5.10	$10,035
SUBTOTAL						**$15,915**
Excavation of Contaminated Soils						
Temporary Fence	120	LF	23	35	7	$7,679
Site (Security) Signs	4	EA	47	49	0	$383
Excavate and load, bank measure, medium material, 2 cy bucket, hydraulic excavator	976	BCY	0	2	1	$2,547
Disposable materials per sample	29	EA	12	0	0	$358
Confirmation Sampling, soil and sediment metals (6010)	29	EA	17	0	0	$492
Synthetic covers over waste piles, plastic waste pile covers, plastic laminate waste pile cover, 130 lb. tear strength	10362	SF	0	0	0	$2,590
Spray washing, decontaminate heavy equipment	1	EA	0	907	0	$907
SUBTOTAL						**$14,956**
Load and Haul of Contaminated Soil						
Dump Charges	1220	CY	116	0	0	$141,349
926, 2.0 CY, Wheel Loader	17	HR	0	101	59	$2,724
20 CY, Semi Dump	797	HR	0	84	94	$142,033
SUBTOTAL						**$286,107**
Monitoring of Surface Soils						
Surface Soil Sampling Equipment	1	EA	549	0	0	$549
Testing, metals (1cp) (6010)	8	EA	34	0	0	$271
SUBTOTAL						**$820**
Monitoring of Sub-Surface Soils						
Screw augers, hand auger rental	1	Day	90	0	0	$90
Testing, metals (1cp) (6010)	7	EA	34	0	0	$237
SUBTOTAL						**$327**
General Monitoring						
Sample collection, vehicle milage charge, car or van	100	MI	0	0	0	$49
Project Scientist	77	HR	0	200	0	$15,400
Field Technician	11	HR	0	130	0	$1,430
SUBTOTAL						**$16,879**

TABLE C-1B: SITE 31 ALTERNATIVE 3: ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS, EXCAVATION (DEBRIS AREA E), AND OFF-SITE DISPOSAL OF SOIL (CONTINUED)
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

COST ESTIMATE SUMMARY

Site: 31
Location: Treasure Island, California
Phase: Feasibility Study
Base Year: 2006
Date: September 26, 2006

Description: Incorporating the use of institutional and engineering controls as in alternative 2 and including the excavation (to a maximum of 4 feet) of soils of Debris Area E hot spot. Waste would be disposed of at a licensed landfill

CAPITAL COSTS: ENGINEERING AND INSTITUTIONAL CONCTROLS, HOT SPOT EXCAVATION, AND OFF-SITE DISPOSAL

DESCRIPTION		Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost		Extended Cost
Resurfacing and Refurbishing of 11th Street								
Asphalt Pavement - 10" Subgrade, 9" Base, 1-1/2" Topping		732	SY	8	4	1		$9,538
Unclassified fill, 6-inch lifts, off-site, includes delivery, spreading, and compaction		1230	CY	9	4	3		$18,708
Site Maintenance, road maintenance, sweep roads with power vacuum		480	SY	0	0	0		$29
Intermediate Course Asphalt		78	TON	44	12	2		$4,540
Tack Coat		960	SY	0	0	0		$413
Asphalt Wearing Course		26	TON	46	14	3		$1,632
Center Stripe, White		180	LF	5	0	0		$871
SUBTOTAL								**$35,731**
Replacement of Sidewalks, Curb, and Gutter								
Replace Concrete Curb		180	LF	25	0	0		$4,500
Replace Unreinforced Concrete Sidewalk		180	LF	28	0	0		$5,040
Replace Gutter		180	LF	8	0	0		$1,440
SUBTOTAL								**$10,980**
Site Close-Out Documentation								
Sedan, Automobile, Rental		4	DAY	72	0	0		$288
Per Diem (per person)		4	DAY	194	0	0		$776
Project Manager		60	HR	0	230	0		$13,800
Staff Engineer		130	HR	0	180	0		$23,400
Word Processing/Clerical		36	HR	0	100	0		$3,600
Draftsman/CADD		24	HR	0	130	0		$3,120
Regulatory Review		20	HR	0	185	0		$3,695
SUBTOTAL								**$48,679**
Institutional Controls - Implementation								
Overnight Delivery, 8 ounce Letter		8	EA	19	0	0	0	$148
Project Manager		60	HR	0	230		0	$13,800
Project Engineer		135	HR	0	210		0	$28,350
Staff Engineer		165	HR	0	180		0	$29,700
QA/QC Officer		39	HR	0	250		0	$9,750
Word Processing/Clerical		120	HR	0	100		0	$12,000
Draftsman/CADD		278	HR	0	130		0	$36,140
Computer Data Entry		150	HR	0	95		0	$14,250
Other Direct Costs		1	LS	1267	0		0	$1,267
Construction Signs		72	SF	18	0	0		$1,281
Surveying - 2-man Crew		3	DAY	0	1587	325	345	$5,736
Portable GPS Set with Mapping, 5 centimeters Accuracy		1	MO	968	0		0	$968
SUBTOTAL								**$153,390**
Restoration Advisory Board								
Senior Project Manager		2	HR	0	250	0		$500
Project Manager		31	HR	0	230	0		$7,135
Senior Staff Engineer		5	HR	0	200	0		$1,000
Staff Scientist		7	HR	0	160	0		$1,120
Secretarial/Administrative		6	HR	0	80	0		$480
Word Processing/Clerical		8	HR	0	100	0		$800
Draftsman/CADD		16	HR	0	130	0		$2,079
Other Direct Costs		1	LS	117	0	0		$117
SUBTOTAL								**$13,230**
TOTAL WITHOUT PROFESSIONAL LABOR MANAGEMENT								**$788,818**
Professional Labor Management[a]								
Project Management Labor Cost			2.50%					$19,720
Planning Documents Labor Cost			2.50%					$19,720
Construction Oversight Labor Cost			2.75%					$21,692
Reporting Labor Cost			0.35%					$2,761
As-Built Drawings Labor Cost			0.35%					$2,761
Public Notice Labor Cost			0.08%					$631
Site Closure Activities Labor Cost			0.00%					$0
Permitting Labor Cost			0.00%					$0
SUBTOTAL								**$67,286**
TOTAL CAPITAL COST IN 2006 DOLLARS								**$856,104**
OPERATIONS AND MAINTENANCE COSTS:								
Institutional Controls - Monitoring & Enforcement								
Annual	Year 30	30						
Overnight Delivery, 8 ounce Letter		2	LB	23	0	-	0.00	$46
Project Manager		1	HR	0	230		0.00	$230
Project Engineer		3	HR	0	210		0.00	$630
Staff Engineer		8	HR	0	180		0.00	$1,440
Other Direct Costs		1	LS	1267	0		0.00	$1,267
Contingency			15%		-			$542
Navy Oversight			25%		-			$903
Regulatory Involvement		10			185			$1,847
SUBTOTAL								**$6,906**

TABLE C-1B: SITE 31 ALTERNATIVE 3: ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS, EXCAVATION (DEBRIS AREA E), AND OFF-SITE DISPOSAL OF SOIL (CONTINUED)
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

COST ESTIMATE SUMMARY

Site: 31
Location: Treasure Island, California
Phase: Feasibility Study
Base Year: 2006
Date: September 26, 2006

Description: Incorporating the use of institutional and engineering controls as in alternative 2 and including the excavation (to a maximum of 4 feet) of soils of Debris Area E hot spot. Waste would be disposed of at a licensed landfill

CAPITAL COSTS: ENGINEERING AND INSTITUTIONAL CONCTROLS, HOT SPOT EXCAVATION, AND OFF-SITE DISPOSAL

DESCRIPTION			Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost
PERIODIC COSTS								
5-Year Reviews								
Five-Year Reviews	Year	5,10,15,20,25,30	6					
Project Manager			40	HR	0	230	0.00	$9,200
Project Engineer			120	HR	0	210	0.00	$25,200
Staff Engineer			60	HR	0	180	0.00	$10,800
Draftsman/CADD			40	HR	0	130	0.00	$5,200
Word Processing/Clerical			60	HR	0	100	0.00	$6,000
SUBTOTAL								$56,400
Contingency				15%				$8,460
Navy Oversight				25%				$14,100
Regulatory Involvement			60		0	185	0.00	$11,083
SUBTOTAL								**$90,043**
Barrier Maintenance								
Direct Cost Maintenance	Year	10, 20, 30	*3*	LS	$ 5,000	-	-	$15,000
Contingency				15%	$ 750			$2,250
Navy Oversight				25%	$ 1,250			$3,750
SUBTOTAL					**$7,000**			**$21,000**

PRESENT VALUE ANALYSES:

Cost Type	Year	Total Cost	Total Cost per Year	Discount Factor[b,c]	Present Value
Capital Cost	0	$856,104	$856,104	1.0	$856,104
Annual O&M	1-30	$207,187	$6,906	19.6	$135,365
Periodic Cost (Maintenance)	10, 20, 30	$21,000	$7,000	1.7	$11,761
Periodic Cost (5-Year Review	5, 10, 15, 20, 25, 30	$540,256	$90,043	3.6	$327,511
		$1,624,547			$1,330,741

TOTAL CAPITAL COST IN 2006 DOLLARS **$1,330,741**

Notes:
Costs obtained from RACER™ 2006 (Remedial Action Cost Engineering and Requirements™). Some costs adjusted based on professional judgement.

b Discount factor = $\frac{1}{(1+i)^t}$ where i = 0.031 for a 30+ year technology and t = year (i.e., the present value of the dollar paid in year t at 3.0%)

c Multi-year discount factor = $\frac{(1+i)n - 1}{i(1+i)n}$ where i = 0.03 for a 30+ year technology and n = total number of years

ACR	Acre
BCY	Bulk cubic yard
CADD	Computer-Aided Design and Drafting
cy	Cubic yard
DOT	Department of Transportation
EA	Each
GPS	Global positioning system
HR	Hour
KGA	1,000-gallons
lb	Pound
LCY	Loose cubic yards
LF	Linear foot
MO	Month
PR	Pair
TAL	Target analyte list
SF	Square feet

TABLE C-1C: SITE 31 ALTERNATIVE 4: ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS, EXCAVATION (DEBRIS AREAS C AND D), AND OFF-SITE DISPOSAL OF SOIL
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

COST ESTIMATE SUMMARY

Site: 31
Location: Treasure Island, California
Phase: Feasibility Study
Base Year: 2006
Date: September 26, 2006

Description: Incorporating the use of institutional and engineering controls as in alternative 2 and including the excavation (to a maximum of 4 feet) of soils of Debris Area C & D hot spots. Waste would be disposed of at a licensed landfill

CAPITAL COSTS: INSTITUTIONAL & ENGINEERING CONTROLS, HOT SPOT EXCAVATION, & OFF-SITE DISPOSAL

DESCRIPTION	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost
Work Plans and Reports						
Senior Project Manager	30	HR	0	250	0	$7,500
Project Manager	120	HR	0	230	0	$27,600
Senior Staff Engineer	400	HR	0	200	0	$80,000
Staff Scientist	160	HR	0	160	0	$25,600
Word Processing/Clerical	100	HR	0	100	0	$10,000
Draftsman/CADD	40	HR	0	130	0	$5,200
Regulatory Review	20	HR	0	185	0	$3,695
SUBTOTAL						**$159,595**
Demolition and Disposal of Concrete & Pavement						
Demolish Un-reinforced Concrete Sidewalk	7	CY	0	129	20	$1,024
Revove concrete curb	140	LF	0	7	0	$1,039
Demolish bituminous road with power equipment	1340	CY	0	38	8	$61,184
Dump Charges	1340	CY	19	0	0	$25,875
916, 1.5 CY, Wheel Loader	7	HR	0	100	43	$1,002
8 CY Dump Truck	143	HR	0	83	64	$21,048
SUBTOTAL						**$111,173**
Demolition, Disposal, and Replacement of Underground Utilities (Debris Area C)						
Dump Charges	21.33	CY	19.31	0.00	0.00	$411.89
Minor site demolition, pipe, sewer/water, 18" diameter, remove, excludes excavation, hauling	140.00	LF	0.00	19.55	1.15	$2,898.00
910, 1.25 CY, Wheel Loader	1.00	HR	0.00	101.42	43.93	$145.35
Excavating, trench, medium soil, 6' to 10' deep, 1-1/2 C.Y. bucket, gradall, excludes sheeting or dewatering	87.50	BCY	0.00	1.06	0.34	$122.18
8 CY, Dump Truck	2.00	HR	0.00	84.49	65.03	$299.03
950, 3.00 CY, Backfill with Excavated Material	87.50	CY	0.00	1.43	1.07	$218.59
Backfill Trench, Borrow Material, Delivered & Dumped Only	18.87	CY	8.47	3.77	1.60	$261.03
Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	87.50	ECY	0.00	3.91	0.15	$354.83
Replacement of 18-inch diameter storm drain	140.00	LF	69.50	17.50	5.55	$12,957
SUBTOTAL						**$17,668**
Excavation of Contaminated Soils						
Temporary Fence	965	LF	8 23	34	6	$61,152
Site (Security) Signs	5	EA	47	48	0	$475
Excavate and load, bank measure, medium material, 2 cy bucket, hydraulic excavator	2148	BCY	0	1	1	$5,198
Disposable materials per sample	50	EA	12	0	0	$618
Confirmation Sampling, soil and sediment metals (6010)	50	EA	17	0	0	$848
Confirmation Sampling, semi-volatile organics (625, 8270)	50	EA	367	0	0	$18,360
Confirmation Sampling, dioxins & Benzofuran (8280)	50	EA	282	0	0	$14,089
Synthetic covers over waste piles, plastic waste pile covers, plastic laminate waste pile cover, 130 lb. tear strength	43987	SF	0	0	0	$10,997
Spray washing, decontaminate heavy equipment	1	EA	0	894	0	$894
SUBTOTAL						**$112,630**
Load and Haul of Contaminated Soil						
Dump Charges	2685	CY	116	0	0	$311,084
926, 2.0 CY, Wheel Loader	37	HR	0	100	58	$5,838
20 CY, Semi Dump	1741	HR	0	83	92	$305,337
SUBTOTAL						**$622,259**
Monitoring of Surface Soils						
Surface Soil Sampling Equipment	1	EA	549	0	0	$549
Testing, metals (1cp) (6010)	11	EA	34	0	0	$373
Testing, semi-volatile organics (625, 8270)	11	EA	734	0	0	$8,078
Testing, dioxins & dibenzofuran (8280)	11	EA	564	0	0	$6,199
SUBTOTAL						**$15,199**
Monitoring of Sub-Surface Soils						
Screw augers, hand auger rental	1	Day	90	0	0	$90
Testing, metals (1cp) (6010)	18	EA	34	0	0	$610
Testing, semi-volatile organics (625, 8270)	18	EA	734	0	0	$13,219
Testing, dioxins & dibenzofuran (8280)	18	EA	564	0	0	$10,144
SUBTOTAL						**$24,063**

TABLE C-1C: SITE 31 ALTERNATIVE 4: ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS, EXCAVATION (DEBRIS AREAS C AND D), AND OFF-SITE DISPOSAL OF SOIL (CONTINUED)
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

COST ESTIMATE SUMMARY

Site: 31
Location: Treasure Island, California
Phase: Feasibility Study
Base Year: 2006
Date: September 26, 2006

Description: Incorporating the use of institutional and engineering controls as in alternative 2 and including the excavation (to a maximum of 4 feet) of soils of Debris Area C & D hot spots. Waste would be disposed of at a licensed landfill

CAPITAL COSTS: INSTITUTIONAL & ENGINEERING CONTROLS, HOT SPOT EXCAVATION, & OFF-SITE DISPOSAL

DESCRIPTION	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost
General Monitoring						
Sample collection, vehicle milage charge, car or van	100	MI	0	0	0	$49
Project Scientist	102	HR	0	200	0	$20,400
Field Technician	18	HR	0	130	0	$2,340
SUBTOTAL						**$22,789**
Site Restoration						
Backfill w/stone, delivered and dumped	100	BCY	37	2	1	$3,957
Unclassified fill, 6-inch lifts, off-site, includes delivery, spreading, and compaction	2685	CY	9	4	3	$40,597
SUBTOTAL						**$44,554**
Resurfacing Roadways/Parking Lots - Debris Areas C and D						
Site maintenance, road & walk maintenance, sweep, drives & parking areas, with power vacuum	1,611.11	SY	0.00	0.06	0.00	$92.96
Asphalt, Intermediate Course (Line Item Includes 5% Waste)	131.76	TON	44.02	11.42	2.26	$7,602.32
Tack Coat	1,611.11	SY	0.18	0.20	0.04	$687.10
Asphalt Wearing Course, 1 Pass (Line Item Includes 5% Waste)	87.25	TON	45.92	13.48	3.11	$5,453.84
Lines on pavement, parking stall, paint, white, 4" wide	33.00	EA	4.49	10.55	1.19	$535.86
SUBTOTAL						**$14,372**
Replacement of Sidewalks, Curb, and Gutter						
Replace Concrete Curb	140	LF	25	0	0	$3,500
Replace Unreinforced Concrete Sidewalk	140	LF	28	0	0	$3,920
Replace Gutter	140	LF	8	0	0	$1,120
SUBTOTAL						**$8,540**
Site Close-Out Documentation						
Sedan, Automobile, Rental	4	DAY	72	0	0	$288
Per Diem (per person)	4	DAY	194	0	0	$776
Project Manager	60	HR	0	230	0	$13,800
Staff Engineer	130	HR	0	180	0	$23,400
Word Processing/Clerical	36	HR	0	100	0	$3,600
Draftsman/CADD	24	HR	0	130	0	$3,120
Regulatory Review	20	HR	0	185	0	$3,695
SUBTOTAL						**$48,679**
Institutional Controls - Implementation						
Overnight Delivery, 8 ounce Letter	8	EA	19	0	0	$148
Project Manager	60	HR	0	230		$13,800
Project Engineer	135	HR	0	210		$28,350
Staff Engineer	165	HR	0	180		$29,700
QA/QC Officer	39	HR	0	250		$9,750
Word Processing/Clerical	120	HR	0	100		$12,000
Draftsman/CADD	278	HR	0	130		$36,140
Computer Data Entry	150	HR	0	95		$14,250
Other Direct Costs	1	LS	1267	0		$1,267
Construction Signs	72	SF	18	0	0	$1,281
Surveying - 2-man Crew	3	DAY	0	1564	319	$5,651
Portable GPS Set with Mapping, 5 centimeters Accuracy	1	MO	968	0		$968
SUBTOTAL						**$153,305**
Restoration Advisory Board						
Senior Project Manager	2	HR	0	250	0	$500
Project Manager	31	HR	0	230	0	$7,135
Senior Staff Engineer	5	HR	0	200	0	$1,000
Staff Scientist	7	HR	0	160	0	$1,120
Secretarial/Administrative	6	HR	0	80	0	$480
Word Processing/Clerical	8	HR	0	100	0	$800
Draftsman/CADD	16	HR	0	130	0	$2,079
Other Direct Costs	1	LS	117	0	0	$117
SUBTOTAL						**$13,230**
TOTAL WITHOUT PROFESSIONAL LABOR MANAGEMENT						**$1,359,516**
Professional Labor Management[a]						
Project Management Labor Cost		2.50%				$33,988
Planning Documents Labor Cost		2.50%				$33,988
Construction Oversight Labor Cost		2.75%				$37,387
Reporting Labor Cost		0.35%				$4,758
As-Built Drawings Labor Cost		0.35%				$4,758
Public Notice Labor Cost		0.08%				$1,088
Site Closure Activities Labor Cost		0.00%				$0
Permitting Labor Cost		0.00%				$0
SUBTOTAL						**$115,967**
TOTAL CAPITAL COST IN 2006 DOLLARS						**$1,475,483**

TABLE C-1C: SITE 31 ALTERNATIVE 4: ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS, EXCAVATION (DEBRIS AREAS C AND D), AND OFF-SITE DISPOSAL OF SOIL (CONTINUED)
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

COST ESTIMATE SUMMARY

Site: 31
Location: Treasure Island, California
Phase: Feasibility Study
Base Year: 2006
Date: September 26, 2006

Description: Incorporating the use of institutional and engineering controls as in alternative 2 and including the excavation (to a maximum of 4 feet) of soils of Debris Area C & D hot spots. Waste would be disposed of at a licensed landfill

CAPITAL COSTS: INSTITUTIONAL & ENGINEERING CONTROLS, HOT SPOT EXCAVATION, & OFF-SITE DISPOSAL

DESCRIPTION			Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost
OPERATIONS AND MAINTENANCE COSTS:								
Institutional Controls - Monitoring & Enforcement								
Annual	Year	30	30					
Overnight Delivery, 8 ounce Letter			2	LB	23	0	-	$46
Project Manager			1	HR	0	230		$230
Project Engineer			3	HR	0	210		$630
Staff Engineer			8	HR	0	180		$1,440
Other Direct Costs			1	LS	1267	0		$1,267
Contingency				15%		0		$542
Navy Oversight				25%		0		$903
Regulatory Involvement			10			185		$1,847
SUBTOTAL								**$6,906**
PERIODIC COSTS								
5-Year Reviews								
Five-Year Reviews	Year	5,10,15,20,25,30	6					
Project Manager			40	HR	0	230		$9,200
Project Engineer			120	HR	0	210		$25,200
Staff Engineer			60	HR	0	180		$10,800
Draftsman/CADD			40	HR	0	130		$5,200
Word Processing/Clerical			60	HR	0	100		$6,000
SUBTOTAL								$56,400
Contingency				15%				$8,460
Navy Oversight				25%				$14,100
Regulatory Involvement			60		0	185		$11,083
SUBTOTAL								**$90,043**
Barrier Maintenance								
Direct Cost Maintenan	Year	10, 20, 30	*3*	LS	$ 5,000	-	-	$15,000
Contingency				15%	$ 750			$2,250
Navy Oversight				25%	$ 1,250			$3,750
SUBTOTAL					**$7,000**			**$21,000**

PRESENT VALUE ANALYSES:

Cost Type	Year	Total Cost	Total Cost per Year	Discount Factor[b,c]	Present Value
Capital Cost	0	$1,475,483	$1,475,483	1.0	$1,475,483
Annual O&M	1-30	$207,187	$6,906	19.6	$135,365
Periodic Cost (Maintenance)	10, 20, 30	$21,000	$7,000	1.7	$11,761
Periodic Cost (5-Year Reviews)	5, 10, 15, 20, 25, 30	$540,256	$90,043	3.6	$327,511
		$2,243,926			$1,950,120

TOTAL PRESENT VALUE OF ALTERNATIVE **$1,950,120**

Notes:
Costs obtained from RACER™ 2006 (Remedial Action Cost Engineering and Requirements™). Some costs adjusted based on professional judgement.

TABLE C-1D: SITE 31 ALTERNATIVE 5: COMPLETE REMOVAL OF DEBRIS AREAS A, B, C, D, AND E, AND OFF-SITE DISPOSAL OF SOIL
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

COST ESTIMATE SUMMARY

Site: 31
Location: Treasure Island, California
Phase: Feasibility Study
Base Year: 2006
Date: September 26, 2006

Description: Debris Areas A, B, C, D, & E hot spots would be excavated to a maximum depth of 6 feet. Waste would be disposed of at a licensed landfill.

CAPITAL COSTS: HOT SPOT EXCAVATION, AND OFF-SITE DISPOSAL

DESCRIPTION	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost
Work Plans and Reports						
Senior Project Manager	30	HR	0	250	0	$7,500
Project Manager	120	HR	0	230	0	$27,600
Senior Staff Engineer	400	HR	0	200	0	$80,000
Staff Scientist	160	HR	0	160	0	$25,600
Word Processing/Clerical	100	HR	0	100	0	$10,000
Draftsman/CADD	40	HR	0	130	0	$5,200
Regulatory Review	20	HR	0	185	0	$3,695
SUBTOTAL						**$159,595**
Demolition and Disposal of Concrete & Pavement						
Demolish bituminous road with power equipment	1650	CY	0	38	8	$75,339
Remove plain concrete curbs excludes hauling and disposal	320	LF	0	7	0	$2,374
Demolish un-reinforced concrete sidewalk	16	CY	0	129	20	$2,342
Dump Charges	1650	CY	19	0	0	$31,862
916, 1.5 CY, Wheel Loader	20	HR	0	100	43	$2,863
12 cy, Dump Truck	300	HR	0	83	64	$44,157
SUBTOTAL						**$158,937**
Demolition, Disposal, and Replacement of Underground Utilities (Debris Area E)						
Dump Charges	21.33	CY	19.31	0.00	0.00	$411.89
Minor site demolition, pipe, sewer/water, 10" diameter, remove, excludes excavation, hauling	225.00	LF	0.00	17.02	1.05	$4,066.81
910, 1.25 CY, Wheel Loader	1.00	HR	0.00	101.42	43.93	$145.35
Excavating, trench, medium soil, 6' to 10' deep, 1-1/2 C.Y. bucket, gradall, excludes sheeting or dewatering	87.50	BCY	0.00	1.06	0.34	$122.18
8 CY, Dump Truck	2.00	HR	0.00	84.49	65.03	$299.03
950, 3.00 CY, Backfill with Excavated Material	87.50	CY	0.00	1.43	1.07	$218.59
Backfill Trench, Borrow Material, Delivered & Dumped Only	18.87	CY	8.47	3.77	1.60	$261.03
Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	87.50	ECY	0.00	3.91	0.15	$354.83
Replacement of 10-inch diameter water main	225.00	LF	23.50	16.00	5.10	$10,035
SUBTOTAL						**$15,915**
Demolition, Disposal, and Replacement of Underground Utilities (Debris Area C)						
Dump Charges	21.33	CY	19.31	0.00	0.00	$411.89
Minor site demolition, pipe, sewer/water, 18" diameter, remove, excludes excavation, hauling	140.00	LF	0.00	19.55	1.15	$2,898.00
910, 1.25 CY, Wheel Loader	1.00	HR	0.00	101.42	43.93	$145.35
Excavating, trench, medium soil, 6' to 10' deep, 1-1/2 C.Y. bucket, gradall, excludes sheeting or dewatering	87.50	BCY	0.00	1.06	0.34	$122.18
8 CY, Dump Truck	2.00	HR	0.00	84.49	65.03	$299.03
950, 3.00 CY, Backfill with Excavated Material	87.50	CY	0.00	1.43	1.07	$218.59
Backfill Trench, Borrow Material, Delivered & Dumped Only	18.87	CY	8.47	3.77	1.60	$261.03
Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	87.50	ECY	0.00	3.91	0.15	$354.83
Replacement of 18-inch diameter storm drain	140.00	LF	69.50	17.50	5.55	$12,957
SUBTOTAL						**$17,668**
Excavation of Contaminated Soils						
Temporary Fence	630	LF	23	34	6	$39,923
Site (Security) Signs	7	EA	47	48	0	$665
Excavate and load, bank measure, medium material, 2 cy bucket, hydraulic excavator	4888	BCY	0	1	1	$11,829
Disposable materials per sample	67	EA	12	0	0	$827
Confirmation Sampling, soil and sediment metals (6010)	67	EA	17	0	0	$1,136
Confirmation Sampling, semi-volatile organics (625, 8270)	67	EA	367	0	0	$24,602
Confirmation Sampling, dioxins & Benzofuran (8280)	67	EA	282	0	0	$18,879
Synthetic covers over waste piles, plastic waste pile covers, plastic laminate waste pile cover, 130 lb. tear strength	51190	SF	0	0	0	$12,797
Spray washing, decontaminate heavy equipment	1	EA	0	894	0	$894
SUBTOTAL						**$111,554**

TABLE C-1D: SITE 31 ALTERNATIVE 5: COMPLETE REMOVAL OF DEBRIS AREAS A, B, C, D, AND E, AND OFF-SITE DISPOSAL OF SOIL (CONTINUED)
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

COST ESTIMATE SUMMARY

Site: 31
Location: Treasure Island, California
Phase: Feasibility Study
Base Year: 2006
Date: September 26, 2006

Description: Debris Areas A, B, C, D, & E hot spots would be excavated to a maximum depth of 6 feet. Waste would be disposed of at a licensed landfill.

CAPITAL COSTS: HOT SPOT EXCAVATION, AND OFF-SITE DISPOSAL

DESCRIPTION	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost
Load and Haul of Contaminated Soil						
Dump Charges	6070	CY	116	0	0	$703,270
966, 4.0 CY, Wheel Loader	31	HR	0	100	98	$6,150
26 cy, Semi Dump	2991	HR	0	83	93	$527,523
SUBTOTAL						**$1,236,943**
Monitoring of Surface Soils						
Surface Soil Sampling Equipment	1	EA	549	0	0	$549
Testing, metals (1cp) (6010)	11	EA	34	0	0	$373
Testing, semi-volatile organics (625, 8270)	11	EA	734	0	0	$8,078
Testing, dioxins & dibenzofuran (8280)	11	EA	564	0	0	$6,199
SUBTOTAL						**$15,199**
Monitoring of Sub-Surface Soils						
Screw augers, hand auger rental	3	Day	90	0	0	$270
Testing, metals (1cp) (6010)	63	EA	34	0	0	$2,136
Testing, semi-volatile organics (625, 8270)	63	EA	734	0	0	$46,267
Testing, dioxins & dibenzofuran (8280)	63	EA	564	0	0	$35,504
SUBTOTAL						**$84,176**
General Monitoring						
Sample collection, vehicle milage charge, car or van	200	MI	0	0	0	$98
Project Scientist	259	HR	0	200	0	$51,800
Field Technician	50	HR	0	130	0	$6,500
SUBTOTAL						**$58,398**
Site Restoration						
Backfill w/stone, delivered and dumped	404	BCY	37	2	1	$16,004
Unclassified fill, 6-inch lifts, off-site, includes delivery, spreading, and compaction	6070	CY	9	4	3	$91,778
SUBTOTAL						**$107,782**
Resurfacing Roadways/Parking Lots - Debris Areas C and D						
Site maintenance, road & walk maintenance, sweep, drives & parking areas, with power vacuum	1,611.11	SY	0.00	0.06	0.00	$92.96
Asphalt, Intermediate Course (Line Item Includes 5% Waste)	131.76	TON	44.02	11.42	2.26	$7,602.32
Tack Coat	1,611.11	SY	0.18	0.20	0.04	$687.10
Asphalt Wearing Course, 1 Pass (Line Item Includes 5% Waste)	87.25	TON	45.92	13.48	3.11	$5,453.84
Lines on pavement, parking stall, paint, white, 4" wide	33.00	EA	4.49	10.55	1.19	$535.86
SUBTOTAL						**$14,372**
Resurfacing and Refurbishing of 11th Street						
Asphalt Pavement - 10" Subgrade, 9" Base, 1-1/2" Topping	732	SY	8	4	1	$9,538
Unclassified fill, 6-inch lifts, off-site, includes delivery, spreading, and compaction	1230	CY	9	4	3	$18,708
Site Maintenance, road maintenance, sweep roads with power vacuum	480	SY	0	0	0	$29
Intermediate Course Asphalt	78	TON	44	12	2	$4,540
Tack Coat	960	SY	0	0	0	$413
Asphalt Wearing Course	26	TON	46	14	3	$1,632
Center Stripe, White	180	LF	5	0	0	$871
SUBTOTAL						**$35,731**
Replacement of Sidewalks, Curb, and Gutter						
Replace Concrete Curb	320	LF	25	0	0	$8,000
Replace Unreinforced Concrete Sidewalk	320	LF	28	0	0	$8,960
Replace Gutter	320	LF	8	0	0	$2,560
SUBTOTAL						**$19,520**
Site Close-Out Documentation						
Sedan, Automobile, Rental	4	DAY	72	0	0	$288
Per Diem (per person)	4	DAY	194	0	0	$776
Project Manager	80.00	HR	0	230	0	$18,400
Staff Engineer	240.00	HR	0	180	0	$43,200
Word Processing/Clerical	60.00	HR	0	100	0	$6,000
Draftsman/CADD	40.00	HR	0	130	0	$5,200
Regulatory Review	20.00	HR	0	185	0	$3,695
SUBTOTAL						**$77,559**

TABLE C-1D: SITE 31 ALTERNATIVE 5: COMPLETE REMOVAL OF DEBRIS AREAS A, B, C, D, AND E, AND OFF-SITE DISPOSAL OF SOIL (CONTINUED)
Feasibility Study Report for Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California

COST ESTIMATE SUMMARY

Site: 31
Location: Treasure Island, California
Phase: Feasibility Study
Base Year: 2006
Date: September 26, 2006

Description: Debris Areas A, B, C, D, & E hot spots would be excavated to a maximum depth of 6 feet. Waste would be disposed of at a licensed landfill.

CAPITAL COSTS: HOT SPOT EXCAVATION, AND OFF-SITE DISPOSAL

DESCRIPTION	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost
Restoration Advisory Board						
Senior Project Manager	2	HR	0	250	0	$500
Project Manager	31	HR	0	230	0	$7,135
Senior Staff Engineer	5	HR	0	200	0	$1,000
Staff Scientist	7	HR	0	160	0	$1,120
Secretarial/Administrative	6	HR	0	80	0	$480
Word Processing/Clerical	8	HR	0	100	0	$800
Draftsman/CADD	16	HR	0	130	0	$2,079
Other Direct Costs	1	LS	117	0	0	$117
SUBTOTAL						**$13,230**
TOTAL WITHOUT PROFESSIONAL LABOR MANAGEMENT						**$2,126,578**
Professional Labor Management[a]						
Project Management Labor Cost		2.50%				$53,164
Planning Documents Labor Cost		2.50%				$53,164
Construction Oversight Labor Cost		2.75%				$58,481
Reporting Labor Cost		0.35%				$7,443
As-Built Drawings Labor Cost		0.35%				$7,443
Public Notice Labor Cost		0.08%				$1,701
Site Closure Activities Labor Cost		0.00%				$0
Permitting Labor Cost		0.00%				$0
SUBTOTAL						**$181,397**
TOTAL CAPITAL COST IN 2006 DOLLARS						**$2,307,975**

Notes:
Costs obtained from RACER™ 2006 (Remedial Action Cost Engineering and Requirements™). Some costs adjusted based on professional judgement.

ACR	Acre
BCY	Bulk cubic yard
CADD	Computer-Aided Design and Drafting
cy	Cubic yard
DOT	Department of Transportation
EA	Each
GPS	Global positioning system
HR	Hour
KGA	1,000-gallons
lb	Pound
LCY	Loose cubic yards
LF	Linear foot
MO	Month
PR	Pair
TAL	Target analyte list
SF	Square feet

APPENDIX D
RESPONSES TO COMMENTS ON THE DRAFT FEASIBILITY STUDY REPORT FOR INSTALLATION RESTORATION SITE 31, FORMER SOUTH STORAGE YARD, NAVAL STATION TREASURE ISLAND, SAN FRANCISCO, CALIFORNIA

11 pages.

RESPONSES TO COMMENTS ON THE DRAFT FEASIBILITY STUDY REPORT FOR INSTALLATION RESTORATION SITE 31, FORMER SOUTH STORAGE YARD, NAVAL STATION TREASURE ISLAND, SAN FRANCISCO, CALIFORNIA

This document presents the U.S. Department of the Navy's (Navy) responses to comments from the regulatory agencies on the "Draft Feasibility Study [FS] Report for Installation Restoration [IR] Site 31, Former South Storage Yard, Naval Station Treasure Island [NAVSTA TI], San Francisco, California," dated September 2006. The Navy received one comment from the Department of Toxic Substances Control (DTSC) on October 24, 2006. The U.S. Environmental Protection Agency and the San Francisco Bay Regional Water Quality Control Board did not have any comments on the IR Site 31 FS Report.

Comments also were provided by the Treasure Island Development Authority (TIDA). These comments were received from Geomatrix Consultants, Inc. (on behalf of TIDA) on October 31, 2006, and (2) the NAVSTA TI Restoration Advisory Board (RAB) on October 17 and October 31, 2006. The Navy's responses to the comments received from DTSC, TIDA, and the NAVSTA TI RAB are presented below.

RESPONSES TO COMMENTS FROM DTSC, DAVID RIST, HAZARDOUS SUBSTANCES SCIENTIST, OFFICE OF MILITARY FACILITIES

1. Comment: On page ES-9, the first full-paragraph incorrectly identifies "Overall Protection of Human Health and the Environment and Compliance with ARARs" as balancing criteria instead of threshold criteria.

Response: The reference to balancing criteria will be revised to threshold criteria.

RESPONSES TO COMMENTS FROM TIDA, GARY R. FOOTE, P.G., GEOMATRIX CONSULTANTS, INC.

General Comments

1. Comment: The Human Health Risk Assessment (HHRA) in the Site 31 Remedial Investigation (RI) Report and information presented in Appendix A of the Draft Site 31 FS indicate that naphthalene is a significant risk driver for alternative land uses at Site 31. However, the Draft Site 31 FS states that naphthalene is not being considered as a chemical of concern (COC) for Site 31 because it is co-located with other COCs and will be addressed via the remedy that is addressing the other COCs. While this may be true for Alternative 5 (complete removal), it would not necessarily be true for other remedies that rely on institutional controls and engineering controls for soil that would remain in place. Because the exposure pathway of concern for naphthalene (i.e., vapor intrusion) is very different from the exposure pathway of concern for other COCs (i.e., direct contact), different

engineering controls would have to be used to address naphthalene (i.e., vapor barrier instead of a cap). Because Alternative 5 (complete removal) is the recommended alternative, we will not request any change to the document. However, if the final alternative is different from Alternative 5, this issue would need to be addressed. Additionally, we believe that the confirmation sampling program during excavation should consider naphthalene.

Response: Alternatives 2 through 4 restrict residential and industrial/commercial use. Therefore, indoor air vapor intrusion would not be an issue based on the reasonably foreseeable use of the site as an elementary school playground. The comment on confirmation sampling is noted. Analytes for confirmation sampling will be addressed during scoping of the Remedial Action Work Plan.

Specific Comments

Section 2.0 Background Information

1. Comment: ***Section 2.3, third paragraph.*** **The text indicate that Site 31 is located within Parcels T094 and T095. The text should also acknowledge that parts of Site 31 are within Parcels T089 and T092 and these additional parcel numbers should be shown on Figure 2-4 Also, see Executive Summary, page ES-1.**

Response: The text will be revised to indicate that Site 31 also is located within Parcels T089 and T092. Additionally, the labels for these parcels were added to Figure 2-4.

2. Comment: ***Section 2.4.6.1, first paragraph.*** **The text refers to a "pipeline alignment." Please specify what pipeline is in the alignment.**

Response: Section 2.4.6.1 will be revised to clarify that both water and gas pipelines are present within the pipeline alignment and to refer to Figure 2-4, which shows the pipeline alignment.

3. Comment: ***Section 2.7.3, second paragraph.*** **The text states, "Because groundwater is not considered to be potable, groundwater at IR Site 31 was not considered to be a potential exposure media to humans." Please clarify that direct ingestion of groundwater was not considered, however, other exposure pathways (direct contact and volatilization) were considered.**

Response: Section 2.7.3 will be revised to reflect that direct ingestion of groundwater was not considered as a direct exposure pathway; however, other exposure pathways (such as direct contact and volatilization) were considered.

4. Comment: ***Figure 2-2.*** **The site boundary shown on this figure is not correct.**

Response: The site boundary shown on Figure 2-2 will be revised to be consistent with Figure 2-3.

Section 3.0 Remedial Action Objectives, Applicable or Relevant and Appropriate Requirements, and General Response Actions

5. Comment: ***Section 3.1.3, Remedial Action Objectives (RAO).*** **We suggest that the second RAO specifically include a utility worker along with a construction worker. This comment also applies to the Executive Summary, page ES-7.**

Response: As stated in various locations within the main text (including page ES-3, the second paragraph of Section 2.6, and the fourth paragraph of Section 2.8) and Appendix A, the evaluation of construction workers is considered conservatively representative of a utility worker who may infrequently visit the site. Additionally, the remedial action objectives (RAO) have been approved by the regulatory agencies. As such, the second RAO will not be revised to include a utility worker.

6. Comment: ***Section 3.1.4, last sentence of the second paragraph.*** **The text states, "The use of 12 ng/kg for dioxin in soil was determined to be protective of residential reuse..." Please provide the reference where this determination was made.**

Response: Please note that the requested reference is included at the end of the first sentence of the second paragraph of Section 3.1.4. However, an additional reference to the DTSC response letter regarding the ambient soil dioxin level at NAVSTA TI will be added to the end of the last sentence of the second paragraph of Section 3.1.4.

7. Comment: ***Section 3.3, last bullet.*** **The text states that "...Site 31 presents a risk below the risk management range for current paved conditions as an elementary school." Actually, the calculated risk was within, but at the lower end of the risk management range.**

Response: Comment noted. The last bullet of Section 3.3 will be revised to indicate the calculated risk was within the risk management range.

Section 4.0 Screening of Remedial Technologies and Process Options

8. Comment: ***Section 4.2.3.2, last paragraph.*** **The text discusses deed notices but not deed restrictions, whereas Table 4-1 discusses deed restrictions but not deed notices. It appears that both deed notices and deed restrictions should be included in the text and in Table 4-1.**

Response: Section 4.2.3.2 and Table 4-1 will be revised to include both deed notices and deed restrictions.

9. Comment: ***Section 4.2.4.1 (In Situ Bioremediation) and Section 4.2.4.10 (Incineration).*** **The text and Table 4-1 should acknowledge that neither of these technologies will treat lead.**

Response: Comment noted. Sections 4.2.4.1 and 4.2.4.10 and Table 4-1 will be revised to reflect that in situ bioremediation and incineration are not effective treatment technologies for lead.

10. Comment: ***Section 4.3 (Summary of Retained Remedial Technologies and Process Options).*** **The text at the end of this section suggests that low temperature thermal desorption, soil washing, and incineration have been retained. However, previously they were eliminated. It is unclear why these three technologies are being discussed under the discussion of technologies that have been retained.**

Response: Comment noted. Discussion of low temperature thermal desorption, soil washing, and incineration will be removed from Section 4.3.

Section 5.0 Development and Analysis of Potential Remedial Alternatives

11. Comment: **The last sentence in the first paragraph of Section 5.1 states that all alternatives meet the RAOs identified in Section 3.1.3. However, Alternative I, No Action, does not meet the RAOs, as stated in Section 6.1. The text in Section 5.1 should be revised to be consistent with the text in Section 6.1.**

Response: Section 5.1 will be revised to be consistent with Section 6.1; the revised text states "Alternative I would not meet the established RAOs because no

remedial action, ECs, or institutional controls (IC) would be implemented."

Section 6.0 Detailed Development of Retained Remedial Alternatives

12. Comment: Section 6.4, Engineering Controls, Institutional Controls, and Excavation (Debris Areas C and D Excluding Street and Off-Site Disposal of Soil). It is unclear why this alternative excludes excavation of soil from Area D that is beneath the street. Please provide the rationale.

Response: Under Alternative 4, 11th Street and Avenue E are considered hardscape and have been evaluated as an adequate exposure prevention barrier. Institutional controls will ensure the hardscape is maintained appropriately.

Section 8.0 Comparative Analysis of Retained Remedial Alternatives

13. Comment: Throughout the discussion, the text should indicate that Alternative 5 would reduce risks to current utility workers. (See suggested revision to RAO in Section 3.1.3.)

Response: Please see the response to TIDA Specific Comment 5. As stated in various locations within the main text (including page ES-3, the second paragraph of Section 2.6, and the fourth paragraph of Section 2.8) and Appendix A, the evaluation of construction workers is considered conservatively representative of a utility worker who may infrequently visit the site. The text of Sections 8.8 and 8.9 will be revised to reiterate this statement.

Appendix C (Cost Estimate)

14. Comment: Demolition and Disposal of Concrete and Pavement—It is unclear why the costs under this heading are greater for Alternative 4 (approximately $83,000) than for Alternative 5 (approximately $70,000). The area requiring demolition is greater under Alternative 5.

Response: Costs for "Demolition and Disposal of Concrete and Pavement" under Alternative 4 erroneously contained a line item for the demolition of 6-inch-thick rod reinforced concrete. These costs have been removed.

Additionally, costs for the demolition of bituminous road with power equipment and associated dump charges were adjusted to accurately reflect the volume associated with Alternatives 4 and 5. As a result, costs for "Demolition and Disposal of Concrete and Pavement" are now estimated to be approximately $111,000 for Alternative 4 and approximately $158,000 for Alternative 5. The cost estimates for each alternative will be revised to reflect these changes.

15. Comment: **Excavation of Contaminated Soil—It is unclear why costs under this heading are greater for Alternative 4 (approximately $237,000) than for Alternative 5 (approximately $111,500) when the scope of excavation under Alternative 5 is greater than that under Alternative 4.**

Response: Costs for "Excavation of Contaminated Soil" for Alternative 4 erroneously contained duplicate costs for "Site Restoration" line items such as backfill and asphalt pavement. The erroneous duplicate costs have been removed from Alternative 4, resulting in a cost adjustment to approximately $112,000. The "Excavation of Contaminated Soil" costs for Alternative 4 and 5 are similar, despite the difference in soil volume, because Alternative 4 includes significantly more temporary fencing than Alternative 5, which would use more of the existing site perimeter fencing. The cost estimate for Alternative 4 will be revised to reflect these changes.

16. Comment: **Alternative 4 includes an item for capping which appears to be a RCRA-style cap over approximately 3,500 square yards of the site. This is significantly greater than the 14,500 square feet (1600 square yards) to be excavated under this option. There is no mention of such a cap in the description of alternatives in the text.**

Response: Costs for the Resource Conservation and Recovery Act-style cap were an erroneous remnant of previous cost analyses and have been removed from Alternative 4. Overall costs for Alternatives 4 and 5 have been adjusted in the text and tables of the main text.

RESPONSES TO COMMENTS FROM DALE SMITH, RAB MEMBER

Comments provided by Dale Smith in a letter dated October 31, 2006

1. Comment: **Pages ES-2 and 2-4: A false history of the cause of the investigation has been introduced by the consultants. The investigation is the result of surface rupture during the Loma Prieta earthquake causing the water main to fail. The document should so state this.**

Discussion of hypothetical future reuse is inappropriate, as remediation is based on the reuse plan developed in 1996.

Response: The discussion of site history and the cause of the investigation was obtained from the Remedial Investigation (RI) Report (SulTech 2006a). The Navy currently is not aware of any official report linking the Loma Prieta earthquake to the rupture of the water main. The Navy will conduct a record search and will correct the history if an official report verifying that the investigation was linked to the surface rupture caused by the earthquake is found.

Hypothetical future reuse scenarios were evaluated in the FS Report based on recommendations made in the Final RI Report for Site 31 (SulTech 2006a). After review of the RI Report, the regulatory agencies concurred with the recommendations made for the evaluation of hypothetical reuse scenarios. Additionally, hypothetical future reuse scenarios are evaluated for completeness as a component of the risk assessment; they are not based on the actual future land use plans presented in the Reuse Plan developed in 1996 (CCSF 1996).

2. Comment: **Page ES-3: The unnumbered chart uses a different nomenclature than has been used in the past and in other parts of this document. Would it not be best to be consistent within this document and with others in the series?**

Response: Nomenclature denoting risk will be revised to be consistent throughout the FS Report.

3. Comment: **Page ES-9: Use a chart similar to those used by NAS Alameda to indicate how different alternatives compare.**

Response: A numerically based comparison of the alternatives, such as Table ES-1, is considered adequate for the purposes of the FS and is traditionally used for FS Reports (EPA 1988).

4. Comment: **Page 2-4: The source of the fill used to build the island was discussed previously during Site 30 comments and was determined to not have**

come from the Delta. On 2-10 the soil is stated to be from Yerba Buena Shoals. Please confirm soil source and correct which ever statement is incorrect.

Response: Any reference to a "delta" being used as a source for fill is assumed to refer to the San Francisco Bay Area Delta. While the Sacramento River Delta was not used for fill material for Treasure Island, according to a report on Treasure Island fill (Lee 1969), Treasure Island fill consisted of fill from the San Francisco Bay and Delta. As such, reference to the Delta used as a source for fill refers to the San Francisco Bay Area Delta. Additionally, Page 2-10 states that Treasure Island was constructed on the Yerba Buena Shoals, not from its soils.

5. Comment: **Page 2-5: The ecological surveys performed have been of poor quality. It is not difficult to distinguish bromus species nor rubus species. It is recognized that the island is of poor quality habitat, but the same errors and lack of knowledge will color the assessment of Yerba Buena Island.**

Response: While the site tours performed in 1994 indicated that ecological habitat at Treasure Island is of poor quality, it is recognized that higher quality habitat exists nearby at Yerba Buena Island, as stated in Section 2.3.2. Additionally, the screening-level ecological risk assessment (SLERA) performed at Site 31 did not identify any ecological resources or processes at Treasure Island that needed to be protected or sustained (SulTech 2006b).

6. Comment: **Page 2-11: The use of quote marks around current is not warranted.**

Response: Comment noted. The quotation marks have been removed.

7. Comment: **Page 4-14: The document both states that incineration will and will not be considered. Which will it be? Incineration is not an acceptable alternative, either at the site, in the Bay Area or elsewhere.**

Response: Comment noted. Please see the response to TIDA Comment No. 10. Discussion of low temperature thermal desorption, soil washing, and incineration will be removed from Section 4.3. Incineration will be eliminated as a viable remedial alternative.

8. Comment: Page 6-6: It isn't clear that the sidewalls and base of the excavation will be sampled to ensure all contamination has been removed. This has been the case at other sites; will it be so here?

Response: Samples will be collected from the sidewalls and base of the excavation to confirm contaminated soils are adequately removed. Specific details on confirmation sampling locations will be included in the remedial action work plan documents to be developed after the FS Report is finalized.

9. Comment: Page 8-5: Please add a sentence that states that Alternative 5 would be a complete clean-up and not require any ICs.

Response: A statement will be added to Section 8.9 to indicate that Alternative 5 would provide for unrestricted land use at Site 31 (without the need for ECs and ICs). However, because excavation is limited to 6 feet below ground surface (bgs) under Alternative 5, text indicating this excavation would completely clean up soil will not be added. During implementation of Alternative 5, results of confirmation samples will be evaluated to determine if concentrations of chemicals of concern are present at depths below 6 feet bgs.

Comments provided by Dale Smith at Environmental RAB Meeting No. 126, held on October 17, 2006.

1. Comment: "I wanted to know why you chose, on ES 3 and elsewhere, to change the risk nomenclature from what had been used in previous documents."

Response: Nomenclature denoting risk will be revised to be consistent throughout the FS Report.

2. Comment: "We commented before about the vagueness of the source of the landfill material, meaning the dredged material, in a previous document. And it doesn't seem to have crept into this document clearly."

Response: Please see the response to the October 31 RAB Comment No. 4 and the response to comment #4 above. Treasure Island fill consisted of material obtained from the San Francisco Bay Area Delta. Reference to the delta used as a source for fill refers to the San Francisco Bay Area Delta. Additionally, Page 2-10 states that Treasure Island was constructed on the Yerba Buena Shoals, but not from its soils.

3. Comment: **"Does the lead spread take into consideration the fact that at-risk kids who are exposed to lead, say, in the schoolyard, like here, might also be exposed to lead in their home environment because they're not going to be in necessarily the most-pristine housing?"**

"So, it is just soil based? It doesn't have anything to do with your built environment, so to speak?"

Response: The DTSC LeadSpread Model Version 7, has the following input parameters (DTSC 1999):

1. Lead in air
2. Lead in drinking water
3. Lead in soil/dust
4. Lead from homegrown produce
5. Respirable dust

Other than the "lead in soil/dust" parameter, the other input parameters have recommended defaults, of which site-specific values may also be used. As stated in the FS Report, locally published levels for air and water were used for parameters 1 and 2. Parameter 4 was set to zero because Treasure Island does not support homegrown produce gardens. Parameter 5 was set to the model default. If the receptor (child or adult) never enters the school yard but resides on Treasure Island, the receptor would still be exposed to parameters 1, 2, 4, and 5 on a daily basis at Treasure Island. The Navy construes this is what the commentor refers to as a "built environment." What the model does not do is account for any additional lead exposure off site (that is, from the child's home, which may have lead-based paint contamination).

The model calculates the 99th percentile, so it is considered a conservative estimate of risk. Also, the model does present the "pica-child" exposure (child with a tendency to eat dirt/soil) to offer a high-end exposed receptor.

REFERENCES

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Lee, C. 1969. "Treasure Island Fill." *Geologic and Engineering Aspects of San Francisco Bay Fill, Special Report 97*. California Division of Mines and Geology, San Francisco. PP69-72.

SulTech. 2006a. "Final Remedial Investigation Report, Installation Restoration Site 31, Former South Storage Yard, Naval Station Treasure Island, San Francisco, California." Prepared for the Department of the Navy, BRAC PMO West. July.

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U.S. Environmental Protection Agency. 1988. "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA." Interim Final. October.