PRESIDIO TRUST
REVISED FEASIBILITY STUDY REPORT
MAIN INSTALLATION SITES

PRESIDIO OF SAN FRANCISCO, CALIFORNIA

Volume I of II

Prepared for:

The Presidio Trust
34 Graham Street, P.O. Box 29052
San Francisco, California 94129-0052

Prepared by:

Erler & Kalinowski, Inc.
1870 Ogden Drive
Burlingame, California 94010

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Erler & Kalinowski, Inc.
Consulting Engineers and Scientists
1870 Ogden Drive
Burlingame, CA 94010
(650) 292-9100
Fax: (650) 552-9012

6 March 2003

Mr. Chris Nelson
Project Manager
The Presidio Trust
1750 Lincoln Blvd.
San Francisco, California 94129-0052

Subject: Revised Feasibility Study, Main Installation Sites
Presidio of San Francisco
San Francisco, California
(EKI A00003.04)

Dear Mr. Nelson:

Erler & Kalinowski, Inc. ("EKI") is pleased to submit the enclosed Presidio Trust Revised Feasibility Study for Main Installation sites ("Presidio Trust Revised FS Report"). This report was prepared by EKI in accordance with Contract No. PT-2000-002, Task Order TX005038, Purchase Order No. 785, dated 3 September 2002.

The purpose of the Presidio Trust Revised FS Report is to develop remedial actions that are protective of human health and the environment, cost-effective, and allow reuse of the Presidio of San Francisco as intended under the *General Management Plan Amendment*, dated July 1994, and the *Presidio Trust Management Plan*, dated May 2002.

Please call if you have any questions.

Very truly yours,
ERLER & KALINOWSKI, INC.

John T. DeWitt, P.E.
Project Engineer
CA Civil Engineer #C55468

REGISTERED PROFESSIONAL ENGINEER
JOHN THOMAS DE WITT
C055468
Exp. 12/31/2004
CIVIL
STATE OF CALIFORNIA

Michelle K. King, Ph.D.
Vice President

enc.

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LIST OF ACRONYMS/ABBREVIATIONS

§	Section
1,2-DCA	1,2-dichloroethane
2,4-D	2,4-dichlorophenoxyacetic acid
ACM	asbestos-containing material
Alternate Remedial Actions	*Alternate Remedial Actions for Presidio Main Installation Sites,* by EKI, May 1998
Antidegradation Policy	SWRCB Resolution No. 68-16
ARAR	Applicable or Relevant and Appropriate Requirement
Area A MOA	*Memorandum of Agreement for Environmental Remediation of Presidio of San Francisco "Area A" Property* between the Trust and NPS, dated 24 May 1999
Army	United States Department of Defense, Department of the Army
Army FS	*Final Feasibility Study Report, Presidio Main Installation, Presidio of San Francisco*, prepared by Dames & Moore, 1997
ARPA	Archeological Resources Protection Act
BaA	Benzo(a)anthracene
BbF	Benzo(b)fluoranthene
BAAQMD	Bay Area Air Quality Management District
BAT	Best Available Technology
BCDC	San Francisco Bay Conservation and Development Commission
bgs	below ground surface
BRAC	Base Realignment and Closure Act
bss	below sediment surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAA	Clean Air Act
Caltrans	California Department of Transportation
CAP	Corrective Action Plan
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations

LIST OF ACRONYMS/ABBREVIATIONS

Coast Guard	United States Coast Guard
COC	chemical of concern
contd	continued
Cr(VI)	hexavalent chromium
CT	carbon tetrachloride
CTC	Concurrent Technologies Corporation
CTR	California Toxics Rule
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DEH	Directorate of Engineering and Housing
DeSilva Gates	DeSilva Gates Construction
dicamba	3,6-dichloro-2-methoxybenzoic acid
DTSC	California Environmental Protection Agency, Department of Toxic Substances Control
EBEP	SWRCB *California Enclosed Bays and Estuaries Plan, Water Quality Control Plan for Enclosed Bays and Estuaries of California*, dated 11 April 1991
EE/CA	Engineering Evaluation/Cost Analysis
EIS	Environmental Impact Statement
EKI	Erler & Kalinowski, Inc.
EPC	exposure point concentration
ESA	Endangered Species Act
FDS	fuel distribution system
FPALDR	Montgomery Watson *Fuel Product Action Level Development Report*, dated October 1995
FS	Feasibility Study
GAC	granular activated carbon
GCL	geosynthetic clay liner
GGBHTD	Golden Gate Bridge Highway and Transportation District
GGNPA	Golden Gate National Parks Association
GGNRA	Golden Gate National Recreation Area
gm	gram
GMPA	NPS *General Management Plan Amendment*, dated July 1994

LIST OF ACRONYMS/ABBREVIATIONS

Golder	Golder Associates Inc.
GWRTAC	Ground-Water Remediation Technologies Analysis Center
H	horizontal
HDPE	high density polyethylene
HSWA	Hazardous and Solid Waste Amendments of 1984
ISWP	SWRCB *California Inland Surface Waters Plan, Water Quality Control Plan for Inland Surface Waters of California*, dated 11 April 1991
IT Corporation	International Technology Corporation
kg	kilogram
L	liter
LAMC	Letterman Army Medical Center
LBP	lead-based paint
LDR	Land Disposal Restriction
LLDPE	linear low density polyethylene
LTTD	low temperature thermal desorption
LUCMRR	Presidio-wide Land Use Controls Master Reference Report
MCE	Maximum Credible Earthquake
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MEK	methyl ethyl ketone
µg	microgram
µg/kg	microgram/kilogram
µg/L	microgram per liter
mg	milligram
mg/kg	milligram per kilogram
mg/L	milligram per liter
MNA	Monitored Natural Attenuation
MOA	Memorandum of Agreement
MtBE	methyl tertiary-butyl ether
NAGPRA	Native American Graves Protection and Repatriation Act

LIST OF ACRONYMS/ABBREVIATIONS

NAPL	non-aqueous phase liquid
National Register	National Register of Historical Places
NCEA	National Center for Environmental Assessment
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEIC	U.S. EPA National Enforcement Investigations Center
NESHAP	National Emission Standard for Hazardous Air Pollutant
NFA	no further action
NGVD29	National Geodetic Vertical Datum of 1929
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
NPS	United States Department of the Interior, National Park Service
NPS Archives	Park Archives and Records Center, Golden Gate National Recreation Area, maintained by the NPS
NTU	nephelometric turbidity unit
Order	Presidio-wide Site Cleanup Requirements as adopted in RWQCB Order No. 96–070
ORP	oxidation-reduction potential
OSWER	U.S. EPA Office of Solid Waste and Emergency Response
OU	Operable Unit
OVM	organic vapor meter
PA	Preliminary Assessment
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PCOC	potential chemical of concern
PHSH	Public Health Service Hospital
PID	photoionization detector
PLLW	Presidio Lower Low Water
Porter-Cologne	Porter-Cologne Water Quality Act
POTW	Publicly Owned Treatment Works
Presidio	Presidio of San Francisco

LIST OF ACRONYMS/ABBREVIATIONS

Presidio MOA	*Memorandum of Agreement Regarding Environmental Remediation at the Presidio of San Francisco* between the Trust, Army, and NPS, dated 24 May 1999
Presidio soil	serpentinite, Colma Formation, and beach/dune sand
Presidio-wide Cleanup Level Document	*Development of Presidio-wide Cleanup Levels for Soil, Sediment, Groundwater, and Surface Water, Presidio of San Francisco, California,* prepared by EKI, October 2002
PRG	Preliminary Remediation Goal
PRG_{high}	PRG based on high toxicity benchmark values
PRG_{low}	PRG based on low toxicity benchmark values
Proposition 65	Safe Drinking Water and Toxic Enforcement Act
PTMP	*Presidio Trust Management Plan,* dated May 2002
PX	Post Exchange
RAB	Restoration Advisory Board
RAO	Remedial Action Objective
RAP	Remedial Action Plan
RBSL	Risk-based Screening Level
RCRA	Resource Conservation and Recovery Act
Presidio Trust Revised FS Report	*Presidio Trust Revised Feasibility Study Report for Main Main Installation Sites*
RI	Remedial Investigation
RME	reasonable maximum exposure
ROD	Record of Decision
RWQCB	California Environmental Protection Agency, Regional Water Quality Control Board, San Francisco Bay Region
SARA	Superfund Amendments and Reauthorization Act of 1986
SDWA	Safe Drinking Water Act
SFDPW	City and County of San Francisco, Department of Public Works
SIP	State Implementation Plan
STLC	Soluble Threshold Limit Concentration
Superfund	collectively refers to CERCLA and SARA
SVE	soil vapor extraction

LIST OF ACRONYMS/ABBREVIATIONS

SVOC	semivolatile organic compound
SWRCB	California Environmental Protection Agency, State Water Resources Control Board
TBC	To-Be-Considered
TCE	trichloroethene
TDS	total dissolved solids
TIC	tentatively identified compound
TIN	Triangulated Irregular Network
TOG	Total Oil and Grease
TPH	total petroleum hydrocarbons
Trust	The Presidio Trust
TSCA	Toxic Substances Control Act
TTLC	Total Threshold Limit Concentration
UCB	University of California at Berkeley
U.S. EPA	United States Environmental Protection Agency
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
UST	underground storage tank
V	vertical
VOC	volatile organic compound
VMP	NPS and Trust *Vegetation Management Plan and Environmental Assessment for the Presidio of San Francisco*, dated May 2001
WET	Waste Extraction Test

1. EXECUTIVE SUMMARY

The Presidio Trust Revised Feasibility Study Report for Main Installation sites ("Presidio Trust Revised FS Report") has been completed consistent with applicable provisions of the National Oil and Hazardous Substances Pollution Contingency Plan, and in accordance with the Presidio Trust ("Trust") *Revised Final Feasibility Study Work Plan*, as approved by the California Environmental Protection Agency, Department of Toxic Substances Control in its letter, dated 18 April 2000. The purpose of the Presidio Trust Revised FS Report is to develop remedial actions that are protective of human health and the environment, cost-effective, and allow reuse of the Presidio of San Francisco ("Presidio") as intended under the *General Management Plan Amendment*, dated July 1994, and the *Presidio Trust Management Plan*, dated May 2002. Remedial actions in the Presidio Trust Revised FS Report have also been evaluated to confirm compliance with requirements for preparing a Remedial Action Plan under Section 25356.1 of the California Health and Safety Code.

1.1 REPORT OVERVIEW

Main Installation sites considered in the Presidio Trust Revised FS Report are divided into two groups that share similar characteristics. One group consists of eleven landfills. The other group consists of twenty-eight miscellaneous sites where the predominant chemicals of concern, if any, are likely to be metals or polycyclic aromatic hydrocarbons in soil. Chemical impacts of both the Main Installation landfills and miscellaneous sites appear to be restricted primarily to soil.

No definitive chemical impacts to water have been identified at any of the Main Installation sites at the Presidio. While the analytical results of surface water, seep, and groundwater samples often contain metals, the low concentrations at which they are detected, the spatial distribution, and the frequency of detection suggest that the presence of metals in water are naturally occurring rather than originating from releases at Main Installation sites. Besides metals, organic compounds have been detected in groundwater samples collected from certain Main Installation sites. The intermittent frequency or low concentrations at which these organic compounds are found in groundwater make it difficult to confirm that a source of contamination exists at these sites or that organic compounds have actually been released. Releases of organic compounds, if any, are minor and do not warrant implementation of active groundwater remedial actions.

Review of available analytical results collected at the Main Installation sites indicate that no further action is required at fifteen sites because generally either the Army previously completed cleanup of these sites or the concentrations of chemicals detected at the site are not greater than applicable cleanup levels. Graded Area 9 is the only landfill site

requiring no further action. The fourteen remaining no further action sites[1] are miscellaneous sites and include the following:

- Sewer Lift Station No. 2
- Former Building 609 Area
- Building 1245 Area
- Building 1369 Area
- Building 1388 Area
- Building 1057
- Building 1151/1153 Area
- Building 680 Area
- El Polin Spring
- Former Building 611 Area
- Former Building 302 Area
- Building 1450/1451 Area
- Building 1750 Area
- Lobos Creek

Preferred remedial alternatives identified by the Trust for the Main Installation sites are listed in Table 1-1. This table also summarizes the key environmental issues and total estimated present worth costs of the preferred remedial alternatives for each Main Installation site.

1.2 REPORT ORGANIZATION

This report consists of twelve sections and six appendices. Section 2 introduces the Presidio of San Francisco and its history. The discussion covers its use as an Army post and the process of converting the Presidio into a national park site. This report describes the transfer of responsibility for management and environmental cleanup associated with the conversion. The purpose of this Presidio Trust Revised Feasibility Study Report and the sites included in the report are also identified. The section concludes with a description of the feasibility study process, and outlines the components of the remainder of the report.

Section 3 provides an overview of the investigations and studies conducted at Main Installation sites to date by the Army and the Trust. Section 4 describes the approach used to screen the chemical data gathered during site investigations. Data quality issues are discussed, as well as a description of the steps used to screen unrepresentative data from queries of the Presidio-wide chemical database. A copy of the database is included as Appendix A, and tabulated data from site investigations and groundwater monitoring through July 2002 are included as Appendix B.

Section 5 identifies the Remedial Action Objectives ("RAOs") for the Main Installation sites. The RAOs consider the planned human and ecological uses of the Presidio, as well as planned water resource uses. Chemical-specific cleanup levels are identified for the different uses of the Presidio. These cleanup levels are derived in the *Development of Presidio-wide Cleanup Levels for Soil, Sediment, Groundwater, and Surface Water* ("Presidio-wide Cleanup Level Document") (EKI, 2002d). The Presidio-specific cleanup

[1] For purposes of this report, no further action alternatives may include decommissioning of existing groundwater monitoring wells at a site in accordance with state and local requirements.

levels are based on site-specific, risk-based preliminary remediation goals ("PRGs") calculated for the Presidio and chemical-specific Applicable or Relevant and Appropriate Requirements ("ARARs"). Chemical-specific ARARs and site-specific PRGs are compared to naturally occurring or background concentrations of metals in soil to establish cleanup levels for use throughout the Presidio. The cleanup levels applicable to individual Main Installation sites depend on the planned human use, presence of quality habitat and special status ecological receptors, site lithology, and potential uses of groundwater or surface water.

Section 6 identifies Potential Chemicals of Concern ("PCOCs") and Chemicals of Concern ("COCs") at each of the Main Installation sites. Site-specific history and the nature and extent of chemicals in soil and water are described for each Main Installation site. Figures of each Main Installation site identifying potential chemical impacts are presented in Section 6. In this section, PCOCs are screened against the cleanup levels presented in Section 5 to determine site-specific COCs. Through a series of meetings with Presidio stakeholders, the PCOCs and COCs were reviewed, and based on site-specific lithology, data, chemical distribution, and statistical evaluation, a consensus of retained COCs was determined for each site. Summary tables of PCOCs and COCs are presented in Section 6, which include chemicals detected, detection frequency, and maximum and minimum concentrations. Appendix C contains selected bivariate scatter plots identified in Section 6 that support the selection of retained COCs. Appendix D presents a figure showing the distribution of chromium in groundwater at the Presidio.

Section 7 presents a discussion of ARARs. This section identifies the legal rules, regulations, and requirements that are used to determine appropriate cleanup levels, remedial actions, and processes and procedures that require compliance or consideration in the selection of remedies. Table 7-1 summarizes these requirements.

Section 8 identifies and screens technologies that may be appropriate for achieving the remedial action objectives identified in Section 5. The universe of technologies is screened to a limited number that may potentially be used at the Presidio. In Section 9, these technologies are combined into alternatives. The alternatives may include multiple technologies for addressing cleanup goals for both soil and water, if appropriate. Table 9-3 summarizes each Main Installation site's remedial alternatives.

Section 10 presents a detailed analysis of the alternatives developed in Section 9 for each Main Installation site. The analysis is based upon specific state and federal criteria. Summary tables comparing the alternatives considered for each site are also included in Section 10. Preliminary estimated costs developed in Appendix E are used to evaluate estimated capital and annual costs for the potential remedial actions at each site. In addition, a total estimated present worth cost of each alternative is also calculated. Based on the detailed analysis of all of the state and federal criteria, a recommended alternative is identified for each site. The section describes the site-specific components of the recommended alternative.

Section 11 contains a table and figure that summarizes the preferred remedial alternatives and identifies sites requiring no further action. Section 12 provides references for the Presidio Trust Revised Feasibility Study Report.

Appendix F presents closure documentation for the former tanks at Building 662. Appendix G presents procedures to calculate representative concentrations from a non-parametric data set.

2. INTRODUCTION

The Presidio of San Francisco ("Presidio"), once the oldest military post in the nation, is located at the northern tip of the San Francisco peninsula as shown on Figure 2-1. The Presidio occupies approximately 1,491 acres and is bounded by the San Francisco Bay on the north and the Pacific Ocean on the south and east. The United States Department of the Defense, Department of the Army ("Army") operated the Presidio as a military post from 1848 to 1994. It served as a coastal defense fortification, a mobilization and embarkation point during several foreign defense conflicts, and a medical debarkation center.

2.1 CONVERSION OF PRESIDIO INTO A NATIONAL PARK

The Presidio is at the center of the Golden Gate National Recreation Area ("GGNRA"), which was created by Congress in 1972. The GGNRA legislation ensured that if the military could no longer use the Presidio, jurisdiction over it would be transferred to the United States Department of the Interior, National Park Service ("NPS"). In 1972, the Army transferred Baker Beach, part of Crissy field, and Fort Point National Historic Site to the NPS. In 1989, the Army announced that the Presidio would close as part of the Base Realignment and Closure Act ("BRAC"). On 1 October 1994, the Army transferred the remaining portion of the Presidio to NPS.

In 1996, Congress enacted the Presidio Trust Act (Section 103 of the Omnibus Parks and Public Lands Management Act of 1996, Public Law 104-333, 110 Stat. 4097) creating the Presidio Trust and giving the Trust jurisdiction over the 1,168-acre inland area of the Presidio known as Area B. The NPS continues to manage the shoreline area, or Area A (Figure 2-2). The Trust is a wholly-owned federal government corporation whose mission is to preserve the Presidio in perpetuity for the public benefit. Congress limited taxpayer support for the Presidio and required it to be financially self-sufficient by 2013. Congress gave the Trust authority to lease property and generate revenues to manage the leasing, maintenance, rehabilitation, and improvement of Area B. Once appropriations cease, the Trust must use the park's building assets to fund its rehabilitation and to pay for its ongoing operation. No other area of the national parks is managed in the same way or operates under the same financial requirement.

In 1990, in anticipation of the transfer by the Army, NPS began planning the conversion of the Presidio from a military post to a national park site. The planning effort culminated in the preparation of the *General Management Plan Amendment* ("GMPA") by the NPS (1994). The GMPA provides guidelines for the management and improvement of the Presidio, and is the governing plan for Area A. Once the Trust came into existence, the Trust prepared the *Presidio Trust Management Plan* ("PTMP") (Trust, 2002) setting forth the Trust's land use policies and general management framework for Area B of the Presidio. The Trust manages the Presidio in accordance with the PTMP, the general objectives of the GMPA, which are set forth in Trust Board Resolution 99-11,

and in such a way as to protect the Presidio from development and uses that would destroy the scenic beauty, historic and natural characteristics of the area, and cultural and recreational resources.

2.2 TRANSFER OF ENVIRONMENTAL CLEANUP RESPONSIBILITY

Subsequent to the transfer of the Presidio to NPS and the Trust, it was apparent that park preservation and reuse could be realized more quickly and efficiently and cleanup would be more effective if the Trust controlled and managed the environmental restoration of the Presidio. With certain exceptions identified in Section 2.4, the Trust assumed responsibility for remediation of both Areas A and B of the Presidio by signing the *Memorandum of Agreement Regarding Environmental Remediation at the Presidio of San Francisco* among the Trust, Army, and NPS ("Presidio MOA"), and the *Memorandum of Agreement for Environmental Remediation of Presidio of San Francisco "Area A" Property* between the Trust and NPS ("Area A MOA"). As part of its environmental remediation responsibility, the Trust retained Erler & Kalinowski, Inc. ("EKI") to prepare this Presidio Trust Revised FS Report for the Main Installation sites at the Presidio.

2.3 SITES INCLUDED IN THE PRESIDIO TRUST REVISED FS REPORT

The Trust entered into a Consent Agreement with the California Environmental Protection Agency, Department of Toxic Substances Control ("DTSC") and NPS on 30 August 1999. The Consent Agreement establishes responsibilities and procedures for cleanup of releases of hazardous substances and hazardous waste at the Presidio under the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA") and Resource Conservation and Recovery Act ("RCRA"). The Consent Agreement specifically governs cleanup of the following nine Operable Units ("OUs"):

OU 1 Public Health Service Hospital ("PHSH")

OU 2 Main Installation

OU 3 Firing Ranges

OU 4 Crissy Field Area

OU 5 Directorate of Engineering and Housing ("DEH") Area

OU 6 Miscellaneous Sites

OU 7 Basewide Cumulative Effects

OU 8 Golden Gate Bridge Highway and Transportation District ("GGBHTD") Site

OU 9 California Department of Transportation ("Caltrans") Site

Identified CERCLA sites within these OUs are depicted on Figure 2-3. Figure 2-4 is similar to Figure 2-3; the Presidio planning areas identified in the PTMP are shown, rather than those identified in the GMPA.[2] The RI and FS conducted by the Army included many more sites than are considered in the Presidio Trust Revised FS Report. Fewer sites are included in the Presidio Trust Revised FS Report because this report addresses only sites within the Main Installation OU, as defined under the Consent Agreement (DTSC, 1999a). Other sites included in the Army's RI and FS have already been remediated or will be cleaned up as part of different programs.

Remediated sites include those that the Army addressed under the DEH RAP (Army and DTSC, 1997b) and Crissy Field RAP (Army and DTSC, 1998). Expedited remedial actions at these sites were conducted to allow timely reuse contemplated under the GMPA. In addition, the Army addressed Landfills 8 and 10 and Building 1827 under the Record of Decision ("ROD") for the PHSH (Army, 1995).

It should be recognized that CERCLA governs only the cleanup of a release or threatened release of a hazardous substance into the environment, which incorporates substances, elements, compounds, solutions, or mixtures regulated under RCRA, Clean Water Act ("CWA"), Clean Air Act ("CAA"), or Toxic Substances Control Act ("TSCA"). The definition of hazardous substances excludes petroleum hydrocarbons. The National Oil and Hazardous Substances Pollution Contingency Plan ("NCP") at Title 40 of the Code of Federal Regulations ("CFR"), Part 300.5 states that the term hazardous substances:

> …does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance in the first sentence of this paragraph, and the term does not include natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas).

Accordingly, the Trust addresses releases of petroleum hydrocarbons at the Presidio under its petroleum program overseen by the California Environmental Protection Agency, Regional Water Quality Control Board, San Francisco Bay Region ("RWQCB").

Table 2-1 summarizes all of the sites considered in the Army's RI and FS and identifies the programs under which these sites have, or will be, remediated. Figure 2-5 depicts the locations of these sites at the Presidio.

[2] As this document was initiated prior to the release of the PTMP, the GMPA Planning areas are used to organize sites throughout this document (EKI, 2000e).

2.4 ENVIRONMENTAL CLEANUP RESPONSIBILITIES RETAINED BY ARMY AND OTHERS

Under the Presidio MOA, the Army agrees to retain responsibility for cleanup of the following sites or types of contaminants:

- Contamination caused by the Army's operations, if any, that remains unidentified as of the effective date of the Presidio MOA (i.e., unknown contamination).

- Radiological materials, chemical and biologic warfare agents, and unexploded ordnance, if any, that may be disposed of at the Presidio.

- Contamination present in off-shore sites, if any, due to use of the Crissy Field Skeet Range and Rifle Institute, or associated with any other activity attributable to the Army. Off-shore sites are defined in the Presidio MOA as being those locations "seaward of the Presidio's Mean Lower Low Water elevation line at zero (0) feet, equal to the National Geodetic Vertical Datum of 1929 (NGVD29) at minus two point eight four (-2.84) feet."

In addition, the Army retains responsibility for the cleanup of the following sites, to the extent that the responsible party does not remediate the site in accordance with applicable law:

- GGBHTD site

- Caltrans site

- Former Fort Point United States Coast Guard ("Coast Guard") site.

As lead state agency, DTSC acknowledges the Army's responsibility for remediation of the above sites and contaminants. GGBHTD, Caltrans, and the U.S. Coast Guard are participating in cleanup of contamination caused by their operations at OU 8, OU 9, and the former Coast Guard site, respectively. DTSC is overseeing remediation of OU 8 and OU 9 because these sites involve releases of hazardous substances. DTSC has entered into separate voluntary cleanup agreements with GGBHTD and Caltrans for cleanup of OU 8 and OU 9. DTSC has also been overseeing investigations of the former Coast Guard site, although the Coast Guard does not have a formal agreement with DTSC.

2.5 PURPOSE OF THE PRESIDIO TRUST REVISED FS REPORT

The purpose of the Presidio Trust Revised FS Report is to develop remedial alternatives that are protective of human health and the environment, cost-effective, and allow reuse of the Presidio as intended under the GMPA and PTMP. In 1997, the Army circulated the *Final Feasibility Study Report, Presidio Main Installation, Presidio of San Francisco*, which was prepared by Dames & Moore ("Army's FS"). More than 50 individuals and

organizations raised concerns about the remedial actions proposed in the Army's FS. As indicated in the *Responsiveness Summary to the Army's Final Feasibility Study, Main Installation Sites* (Presidio Trust, 2000b), concerns raised by the public and regulatory agencies have been taken into account in preparing the Presidio Trust Revised FS Report in an effort to improve upon remedial actions proposed in the Army's FS. Some of these concerns were associated with the Army's Remedial Investigation ("RI"). This Presidio Trust Revised FS Report attempts to address the major concerns with the RI (e.g., adequacy of characterization, protectiveness of cleanup levels). Remedial actions in the Presidio Trust Revised FS Report have also been evaluated to confirm compliance with requirements for preparing a Remedial Action Plan ("RAP") under Section 25356.1 of the California Health and Safety Code.

This Presidio Trust Revised FS Report includes more components than are commonly found in an FS because of the need to address concerns with the Army's RI. In particular, screening conducted to identify potential chemicals of concern and chemicals of concern that is often conducted in an RI is included in this document. In addition, this Presidio Trust Revised FS Report draws on a new set of cleanup levels, presented in the Presidio-wide Cleanup Level Document (EKI, 2002d). These factors may result in some repetition in the text; however, the intent is to provide a sequence of descriptions and derivations to allow the reader to follow the feasibility study process.

2.6 OVERVIEW OF FS PROCESS

In 1980, Congress enacted CERCLA in response to public concern over the dangers posed by abandoned hazardous waste sites, such as Love Canal in New York and Times Beach in Missouri. CERCLA was established to identify sites where hazardous substances have been released to the environment, to assess the risk of those releases, and to ensure that the parties responsible for the releases clean up the sites. The Superfund Amendments and Reauthorization Act ("SARA") of 1986 amended CERCLA. Because Congress established a trust fund to pay for CERCLA, which is primarily funded by taxes levied on certain petroleum products and chemicals, CERCLA and SARA are collectively referred to as "Superfund".

The Presidio Trust Revised FS Report for the Main Installation sites has been completed consistent with applicable provisions of the NCP. The NCP is required by Section 105 of CERCLA, as amended by SARA. The NCP, essentially the governing regulations of Superfund law, outlines the procedures that the federal government or lead agency shall follow in responding to releases of hazardous substances to the environment. The Trust became the lead federal agency when it assumed responsibility from the Army for environmental restoration of the Presidio in May 1999. The Trust has prepared the Presidio Trust Revised FS Report to ensure that appropriate remedial alternatives for permanently addressing releases at the Main Installation sites are developed and evaluated.

2.6.1 Report Preparation

As described in Section 2.2, the Trust retained EKI to prepare this Presidio Trust Revised FS Report for the Presidio. This report has been prepared consistent with the requirements of the NCP, and in accordance with the *Revised Final Feasibility Study Work Plan* (EKI, 2000e), as approved by DTSC in its letter, dated 18 April 2000.

Various subconsultants that provide expertise in geotechnical engineering, native plant restoration, and construction cost estimating, have assisted with preparation of the Presidio Trust Revised FS Report. These subconsultants are Golder Associates Inc. ("Golder"), Jonas & Associates, and DeSilva Gates Construction ("DeSilva Gates").

2.6.2 Report Organization

As discussed in Section 2.5, the objective of the Presidio Trust Revised FS Report is to address fundamental concerns with the Army's RI and FS raised by the public and regulatory agencies, and to develop appropriate remedial alternatives for the Main Installation sites.

2.6.2.1 Identification of the Need for Remedial Actions

Many of the Main Installation sites contain relatively low concentrations of metals in soil or sediment (collectively, "soil"), or surface water, seeps, or groundwater (collectively, "water"). The low metal concentrations are often difficult to distinguish from levels of metals that naturally occur in soil and water at the Presidio. Characterization of environmental conditions at Main Installation sites has been accomplished primarily through investigations conducted by the Army between 1989 and 1999, when the Army was responsible for environmental restoration of the Presidio. The analytical results of soil and water samples obtained from these investigations are of varying quality. In addition, as mentioned in Section 2.5, more than 50 individuals and organizations raised concerns about the manner in which background metal concentrations were assessed, the way in which cleanup levels were derived, and the appropriateness of remedial actions proposed by the Army in the FS it prepared in 1997. Subsequently, the Trust has performed additional characterization at several Main Installation sites and resumed a regular Groundwater Monitoring Program in 2001.

Sections 3 through 6 of the Presidio Trust Revised FS Report are devoted to reexamining available analytical results and determining those data that represent releases at Main Installation sites that may pose an unacceptable risk to human health and the environment from those data that are indicative of naturally occurring metal concentrations in soil and water, or artifacts introduced by sample collection and laboratory analyses. This reexamination is essential, not only to prevent needless expenditures, but also to avoid causing greater harm at Main Installation sites by implementing remedial actions that are not truly required, or which could destroy or substantially alter natural habitats or create physical public safety hazards at the sites.

Available data were reexamined by assessing the quality of analytical results in Section 4 and excluding from consideration those data that falsely describe environmental conditions at Main Installation sites. Remaining data were used to develop a list of PCOCs at each site. The next step in this process was to establish the concentrations at which PCOCs may pose an unacceptable risk to human health and the environment.

Under the NCP, there are two sources that can be used to establish cleanup levels that remedial actions must achieve under the RAP. These sources consist of chemical-specific ARARs and risk-based Preliminary Remediation Goals ("PRGs"). ARARs are laws, requirements, or other cleanup standards that pertain to the chemical release at a site. Chemical-specific ARARs for PCOCs identified at Main Installation sites are discussed in Section 7 and have been adopted as cleanup levels, when available and greater than naturally occurring or background concentrations of metals in soil and water. In the absence of such ARARs, risk-based PRGs derived in the Presidio-wide Cleanup Level Document (EKI, 2002d) are used as cleanup levels if the PRGs are greater than background concentrations of metals. Background concentrations of metals need to be considered in establishing cleanup levels because it is impracticable to remediate releases of metals to less than naturally occurring concentrations. Background concentrations of metals in soil and water are also developed in the Presidio-wide Cleanup Level Document (EKI, 2002d).

Chemical-specific ARARs, risk-based PRGs, and background metal concentrations are combined in the Presidio-wide Cleanup Level Document (EKI, 2002d) to develop cleanup levels that remedial actions are to achieve for COCs. These cleanup levels are summarized in Section 5, Remedial Action Objectives. PCOCs and COCs are screened on a site-by-site basis in Section 6 to assess which chemicals possibly pose a threat to human health and the environment, and to determine which chemicals are present due to releases as opposed to being naturally occurring, or artifacts of sample collection or laboratory analyses. Screening has been conducted by eliminating infrequently detected chemicals, comparing the maximum PCOC concentrations measured at a site to cleanup levels summarized in Section 5, and removing certain non-representative analytical results. Frequently detected chemicals measured at representative concentrations greater than background levels and relevant ARARs or PRGs have been retained as COCs that may warrant remedial actions. Section 7 includes a complete analysis of chemical-specific, action-specific, and location-specific ARARs.

2.6.2.2 Evaluation of Remedial Actions

Except for Section 12, which lists references consulted in preparing the Presidio Trust Revised FS Report, the remaining sections of this report describe the development and evaluation of remedial actions for Main Installation sites. Identifying and screening potentially suitable technologies is the initial step in assembling appropriate remedies. Technologies that pass the screening process are developed into remedial alternatives. The remedial alternatives are themselves screened and the alternatives that are retained undergo detailed analysis. The results of the detailed analysis determine the remedial alternatives that are recommended for implementation. Section 8 describes the

identification and screening of technologies. Section 9 summarizes the development and screening of remedial alternatives. Section 10 presents the detailed analysis of alternatives. Section 11 summarizes the preferred remedial alternatives for Main Installation sites identified through the development and evaluation of remedies performed in Sections 8 through 10.

3. OVERVIEW OF COMPLETED INVESTIGATIONS AND REMEDIAL ACTIONS

The use history, and nature and extent of chemicals in soil and water for each Main Installation site are based upon the results of numerous studies, sampling efforts, and remedial actions performed at the Presidio. Sections 3.1 through 3.4 summarize the work upon which the understanding of environmental conditions at the Main Installation sites is founded.

3.1 ARMY ENHANCED PRELIMINARY ASSESSMENT

The Army initiated evaluation of environmental conditions at the Main Installation sites by conducting an enhanced preliminary assessment ("PA") of the Presidio. The findings of the enhanced PA are presented in the report prepared by the Argonne National Laboratory, dated November 1989, and entitled *Enhanced Preliminary Assessment Report: Presidio of San Francisco Military Reservation, San Francisco, California*.

The PA involved conducting inspections, interviewing personnel who handled chemicals and hazardous materials, reviewing permits and records, examining aerial photographs, and studying geological and historical reports that pertain to the Presidio. The PA was intended to identify areas at the Presidio that required investigation and possible remedial action.

3.2 ARMY INVESTIGATIONS AND REMEDIAL ACTIONS

In response to the findings of the PA, the Army conducted several investigations of Main Installation sites. These investigations included the Initial RI conducted in 1990; Supplemental RI conducted in 1992; and Follow-on RI conducted in 1994 and 1995. In addition to investigations that were performed as part of the RI, the Army completed the following:

- Implemented Marine Ecological Sampling and Analysis Program (Dames & Moore, 1996).

- Evaluated 427 transformers for the presence of polychlorinated biphenyls ("PCBs"); (Watkins-Johnson Environmental, Inc. et al, 1993).

- Surveyed 483 residential buildings for lead-based paint ("LBP") and 808 residential and non-residential buildings for asbestos-containing material ("ACM"); (Versar, Inc., 1997).

- Investigated environmental conditions at small arms firing ranges at the Presidio (Montgomery Watson, 1997a).

- Conducted studies on the presence of hexavalent chromium ["Cr(VI)"] in groundwater due to serpentinite (Montgomery Watson, 1999c).

- Investigated naturally occurring concentrations of metals in chert and shale [International Technology Corporation ("IT Corporation"), 1999b].

- Performed additional review of historic records (IT Corporation, 1999d).

- Sampled monitoring wells throughout the Presidio on a quarterly basis.

The Army also completed extensive cleanup activities throughout the Presidio. Cleanup activities include:

- Removal or abandonment in-place of 263 aboveground and underground petroleum storage tanks (Montgomery Watson, 1999d), and approximately 45,000 linear feet of underground fuel distribution system ("FDS") lines (IT Corporation, 1999a).

- Excavation of PCB-containing soil at Building 680 Area and Building 1151/1153 Area (IT Corporation, 1999e).

- Removal of equipment, ACM, sludge containing LBP, and petroleum hydrocarbons floating on water in underground magazines at Nike Facility (IT Corporation, 1999c).

- Implementation of remedial actions at DEH (Army and DTSC, 1997b) and Crissy Field (Army and DTSC, 1998) to facilitate reuse of these areas.

- Implementation of remedial actions at the PHSH (e.g., confirmation sampling at Landfill 10, demolition and excavation at Building 1827) (Army, 1995).

The findings and data compiled as a result of the Army's investigative and cleanup activities have been combined with work performed by the Trust to describe the use histories, and distributions of chemicals at the Main Installation sites.

3.3 TRUST EVALUATION OF ALTERNATE REMEDIAL ACTIONS

Following the Army's Final FS in 1997 (Dames & Moore, 1997a), the Trust retained EKI to produce the *Alternate Remedial Actions for Presidio Main Installation Sites and Public Health Service Hospital Sites* ("Alternate Remedial Actions") report, dated May 1998. The Alternate Remedial Actions report was prepared to describe how remedial actions for the Main Installation sites should satisfy evaluation criteria under the NCP and to assist the Trust with its negotiations with the Army to assume responsibilities for environmental

restoration of the Presidio. As stated in the report, the alternate remedial actions were specifically developed to:

(1) Demonstrate the deficiencies in the Army's FS, particularly the Army's strong reliance on institutional controls and long-term monitoring as preferred cleanup measures.

(2) Illustrate the types of remedial actions that would be appropriate. The Alternate Remedial Actions report was not intended to be a FS, but to demonstrate that the remedies proposed in the Army's FS were not compatible with reuse of the Presidio under the GMPA.

The Alternate Remedial Actions report did not strictly adhere to the requirements for preparing a FS under the NCP. In addition, screening of COCs was not performed in accordance with U.S. EPA and DTSC guidance. Cleanup levels in the Alternate Remedial Actions report have been updated in the Presidio-wide Cleanup Level Document to incorporate new background metals concentrations, new toxicity values, and to conform to recent guidance (EKI, 2002d). These new cleanup levels are used in the chemical screening process. The Trust has also prepared the Presidio Trust Revised FS Report in an effort to improve upon remedial actions proposed in the Alternate Remedial Actions report. As part of this process, the remedial actions in the Alternate Remedial Actions report have been compared with other potentially viable alternatives.

Included in the Alternate Remedial Actions report are revised volume estimates of the Main Installation landfills. The volumes of landfills were estimated by comparing surface elevation changes recorded on topographical maps. Generally, filling and grading activities cannot be distinguished from disposal or landfilling using this approach. Historic and current topographical maps of the Presidio were evaluated in conjunction with information obtained from the Army's investigations, including lithologic logs of borings and test pits. The current ground surface elevations were obtained from an electronic version of a 1989 topographical map provided by NPS. Historic ground surface elevations were based upon contours digitized from topographical maps for the years 1921, 1936, 1938, 1939, 1942, 1945, 1946, 1954, 1958, 1969, 1972, and 1978. The historic topographical maps were obtained from the NPS Golden Gate National Recreation Area ("GGNRA") archives.

Softdesk Civil software was used to calculate the surface areas and volumes of soil and waste in each landfill. The Softdesk Earthworks module of the Softdesk Civil software created surfaces from the historic and current contours that were composed of Triangulated Irregular Networks ("TINs"). After generating historic and current surfaces, the two surfaces were joined at the edges to form a three-dimensional diagram of the landfill contents. The Softdesk Civil package established a grid across the landfill surface and calculated the thickness of each cell in the grid. The thickness was the distance between the current and historic surfaces. For example, if the current ground surface was at elevation 100 feet in cell A and the historic ground surface was at elevation 80 feet in cell A, the thickness of cell A was determined to be 20 feet. The

Softdesk Civil package calculated the volume of each cell by multiplying the surface area times the calculated thickness of the cell. The volume of the entire landfill was estimated by adding the volumes of all cells in the grid.

Revised volume estimates of landfills presented in the Alternate Remedial Actions report were subsequently confirmed by the Army's own comparison of current and historic topographical maps. Volume estimates in Montgomery Watson's *Landfill Design Summary Report, Presidio of San Francisco*, dated November 1999, generally approximates those in the Alternate Remedial Actions report. Consequently, landfill volumes in the Presidio Trust Revised FS Report necessitating remedial actions do not differ from those in the Alternate Remedial Actions report unless new information or data have been obtained. Landfill volumes were reconsidered at Battery Howe/Wagner, Fill Site 1, Fill Site 6, Landfill 4, and Baker Beach Disturbed Areas 2 and 3, based on additional information collected by the Trust.

3.4 TRUST SAMPLING AT MAIN INSTALLATION SITES

In connection with preparing the Presidio Trust Revised FS Report, the Trust has conducted investigations at several sites to address issues that remained questions after Army investigations or were not addressed by the Army. These investigations include:

- Sediment sample collection from Mountain Lake in October 1998 (EKI, 1998a);
- Soil, sediment, or water sample collection from Graded Area 9, Mountain Lake, and Lobos Creek in June and August 2000 (EKI, 2000a);
- Soil and groundwater sample collection from Battery Howe/Wagner, Fill Site 6, Fill Site 1, Landfill 4, Nike Swale, Fill Site 5, Baker Beach Disturbed Area 3, and Baker Beach Disturbed Area 4 in July and August 2000 (EKI, 2000b);
- Sediment sample collection from Mountain Lake in January 2001 (URS, 2001);
- Trenching and soil sampling from Fill Site 6 in February 2001 (EKI, 2001c);
- Trenching and soil sampling from Battery Howe/Wagner in April 2001 (EKI, 2001b);
- A passive soil gas survey near Battery Howe/Wagner in September and October 2001 (EKI, 2002f);
- Soil sample collection at Buildings 215, 1244, 1245, 1351, 1450/1451, and 1750 in November 2001 (EKI, 2002e);
- Soil and grab groundwater collection at the Commissary/PX area under the Trust's Petroleum Program in July 2002 which included samples near the Former

Building 609 Area and Building 633 Firing Range (Treadwell & Rollo, 2002a); and

- Soil, groundwater, and soil gas sampling, as well as geotechnical data collection, at Landfill E from November 2002 through January 2003 (EKI, 2002c; sampling results report in preparation).

The Army's groundwater monitoring program ended in the spring of 1999. The Trust has conducted regular groundwater monitoring since May 2001. No regular groundwater monitoring data were collected for approximately two years during this gap.

The scopes of most of these investigations were amended in response to comments from DTSC, RWQCB, and community members of the Restoration Advisory Board ("RAB").

Additional data for the sites listed above were needed to sufficiently narrow the range of potential remedies for these sites. Concerning the adequacy of data required to complete the FS, U.S. EPA (1988a) states the following:

> The available data should be evaluated to determine if they are sufficient to develop remedial alternatives. If they are not, additional data gathering will be required. When sufficient data are available, remedial response objectives with respect to the contaminants of concern, the areas and volumes of contaminated media, and existing and potential exposure routes and receptors of concern can be developed as part of the FS.

Data gaps at Main Installation sites that were not investigated by the Trust are not considered to be significant enough to fundamentally affect the evaluation and selection of remedial alternatives. For these sites, the Trust will conduct investigations to address data gaps as part of remedial design or remedial actions themselves. For sites where only limited removal of chemical-containing soil is likely to be required, verification sampling following removal may be the next and only additional sampling.

4. APPROACH TO CHEMICAL SCREENING

This section summarizes the process used by the Trust to evaluate site data and to identify PCOCs and COCs. The process was developed based on a series of meetings with the Trust, NPS, DTSC, RWQCB, and community members of the RAB (collectively "stakeholders").

To evaluate if chemical impacts to a site had occurred, the Trust used a multi-level screening approach to identify a list of site chemicals that were identified as PCOCs. Site-specific PCOCs included all organic compounds detected (as they were assumed to be anthropogenic) and inorganic compounds detected at concentrations above screening levels. The inorganic screening levels were based on the four main lithologies encountered at the Presidio: serpentinite, Colma Formation, beach/dune sand, and chert/shale (chert/shale is generally not naturally occurring at the Presidio). Once PCOCs were identified for each of the Main Installation sites, these PCOCs were evaluated to assess which chemicals possibly pose a threat to human health and the environment, and to determine which chemicals are present due to releases as opposed to being naturally occurring, or artifacts of sample collection or laboratory analyses.

The chemicals on the list of PCOCs were screened against Presidio-specific cleanup levels that took into account soil lithology, background metals concentrations, planned human health and ecological land uses, and regulatory requirements. The process for determining site-specific Presidio cleanup levels is described in detail in the Presidio-wide Cleanup Level Document (EKI, 2002d). An overview of the cleanup level document is presented in Section 5.1. Site-specific COCs were evaluated and agreed upon for each of the Main Installation Sites in a series of meetings with the stakeholders.

Prior to the screening to determine which PCOCs and COCs may be present at each Main Installation site, the integrity of the data being used to conduct the evaluation was scrutinized. The remainder of Section 4 discusses the assessment of the existing site data, and the process to screen the data.

Subsequent sections of this Presidio Trust Revised FS Report describe the steps that followed chemical screening. Section 5 describes the RAOs, including the human health and ecological parameters used to arrive at the cleanup levels identified for Main Installation sites. In Section 6, screening has been conducted to identify PCOCs and COCs. Frequently detected chemicals measured at representative concentrations greater than background concentrations and relevant ARARs or PRGs have been retained as COCs that may warrant remedial actions. Section 6 provides a site-by-site description of PCOCs and chemicals ultimately retained as COCs at each Main Installation site. Section 7 presents an ARARs analysis used to guide and support chemical-specific cleanup levels and remedial alternatives. Sections 8 through 11 present the development and analysis of remedial alternatives for Main Installation sites.

4.1 TRUST ASSESSMENT OF DATA QUALITY

A computerized database containing approximately 134,000 records of analytical results of soil and water samples collected primarily by the Army between 1989 and 1999 when the Army managed environmental cleanup of the Presidio was obtained from Montgomery Watson and was assessed for data quality by the Trust. It is the Trust's understanding that this database contains analytical results from the following sources:

- Environmental data from the Army's RI (Dames and Moore, 1997b);
- Groundwater monitoring data collected by Montgomery Watson from 1995 to 1999;
- Soil confirmation data from the PCB removals at the Building 1151/1153 and Building 680 Areas performed by IT Corporation (IT, 1999e);
- Additional background soil data collected by IT Corporation, Montgomery Watson, and U.S. EPA's National Enforcement Investigations Center ("NEIC") (IT Corporation, 1999b; Montgomery Watson, 1999c; U.S. EPA, 1997b);
- Additional soil and water data collected by NEIC (U.S. EPA, 2000b; U.S. EPA, 1999f; and U.S. EPA 1997i);
- Soil data collected near Doyle Drive by California Department of Transportation (1995);
- Data collected from the hydraulic tank removal and cleanup at the Nike Facility (IT Corporation, 1999c);
- Data collected from the removal of Tank 662.2 (IT Corporation, 1997);
- Environmental data from the Army's Landfill 10 Confirmation Report (Montgomery Watson, 1997b); and
- Soil confirmation data from the former Building 1827 remedy implementation (Montgomery Watson, 1997c).

In addition, data were added to the database by EKI from the following sources:

- Environmental data from the Army's RI for the PHSH (R.L. Stollar & Associates, 1993);
- Sediment sample data collected from Mountain Lake by the Trust in October 1998 and January 2001 (EKI, 1998a and URS, 2001).

- Soil and water data collected by the Trust at selected Main Installation sites in 2000, 2001, and 2002 (EKI, 2000a, 2000b, 2001b, 2001c, 2002e, 2002f; Treadwell & Rollo, 2002a, 2002b).

- Water data collected by Treadwell & Rollo on behalf of the Trust from May 2001 through July 2002 as part of the Trust's Groundwater Monitoring program (e.g., Treadwell & Rollo, 2002b).

- Soil data collected by the Army at the LTTD Area (near Building 633 Firing Range) (Montgomery Watson, 1999g).

Appendix A contains an electronic version of the analytical database on compact disc.

Consistent with U.S. EPA guidance (1998f, 1992c, 1989d), the Trust evaluated the quality of these data, and data collected by the Trust and others (e.g., U.S. EPA), to determine which analytical results inaccurately describe environmental conditions at Main Installation sites. Specifically, data were disregarded if the analytical results hindered answering the four basic questions that U.S. EPA (1992c) states should be addressed from data collected during the RI. These four basic questions are:

(1) What contamination is present and at what concentration?

(2) Are site concentrations sufficiently different from background?

(3) Are all exposure pathways and exposure areas identified and examined?

(4) Are all exposure areas fully characterized?

Database screening for Main Installation sites was conducted in two steps. The first database screening step (discussed in Section 4.2) entailed excluding analytical results for samples and analytes that are clearly not representative of environmental conditions caused by the potential release of chemicals at Main Installation sites. The second step (discussed in Section 4.3) also involved excluding non-representative analytical results but entailed additional data analysis and a greater degree of professional judgment in the removal of certain data. This database screening was performed prior to identifying site-specific PCOCs and COCs. In addition, background metals concentrations developed in the Presidio-wide Cleanup Level Document were compared to site date after the second database screening step.

To preserve the integrity of the database, analytical results excluded in these two screening steps were not actually removed from the database, but rather "flagged" so that queries of PCOCs and COCs would not include these analytical results. This flagging was accomplished with use of a field in the computerized database called "KILLFLAG" that was set to "Y" to identify non-representative data, and left blank if the data were to be included in queries of PCOCs and COCs at Main Installation sites.

4.2 DATA REMOVED IN FIRST SCREENING STEP

Data excluded in the first screening step consisted of analytical results for non-representative media, tentatively identified compounds ("TICs") and surrogates, soil that has been excavated, special methods that are not U.S. EPA methods, inorganic chemicals unrelated to potential releases, phthalates, grab groundwater samples from sites where more representative monitoring well groundwater results were available, and samples that are unreliable or have been rejected upon evaluation.

4.2.1 Non-Representative Media

Analytical results of wipe samples, soil gas samples, and samples obtained for classification and disposal of wastes were removed from the PCOC and COC database. None of these sample types were considered representative of soil and water conditions at Main Installation sites.

4.2.2 TICs and Surrogates

TICs are non-target analytes that are sometimes reported as part of analyses of samples for suites of organic compounds, but the actual identities and concentrations of which are uncertain. In addition, many TICs have not been studied extensively and lack toxicity values. Surrogates are unique compounds added during organic analyses for quality control purposes. To easily assess the biases that may be caused by testing, surrogates are organic compounds that are rarely found at chemical release sites. TICs and surrogates were excluded from the PCOC and COC database.

4.2.3 Soil That Has Been Excavated

Analytical results of soil that was subsequently excavated as part of remedial actions were excluded from the PCOC and COC database. Analytical results of residual chemical concentrations in soil after excavation, i.e., confirmation samples, were kept in the database.

4.2.4 Special Methods

Data that were generated by special methods not comparable to analytical results obtained from commonly accepted U.S. EPA methods were excluded from the PCOC and COC database. The Montgomery Watson leaching test analytical results from the hexavalent chromium study (Montgomery Watson, 1999c) and the U.S. EPA NEIC metal analytical results generated by sodium peroxide sintering are examples of special methods that do not produce data that are characteristic of environmental conditions at Main Installation sites. Montgomery Watson leaching tests were laboratory experiments intended to determine the conditions under which hexavalent chromium can be leached from serpentinite, irrespective of whether these conditions actually exist at the Presidio.

The sodium peroxide sintering procedure is an extreme method for completely dissolving soil samples prior to analysis for metals. U.S. EPA NEIC generated a small number of metal analytical results by the sodium peroxide sintering procedure for comparison to the results obtained by dissolving soil samples by the commonly accepted U.S. EPA digestion method 3050. For some metals, e.g., chromium and scandium, the sodium peroxide sintering procedure resulted in higher metal concentrations than those obtained by the U.S. EPA method 3050, indicating that these metals tended to occur in refractory minerals that resist acid attack. The sodium peroxide sinter results were of scientific interest, but were not comparable to the results produced by EPA method 3050, which has been approved by DTSC for testing soil samples collected at the Presidio.

4.2.5 Inorganic Chemicals Unrelated to Potential Releases

Inorganic chemicals are major components of the Earth's crust. Data on inorganic chemicals and trace elements present at normal crustal abundance levels, and common water quality parameters were excluded from the PCOC and COC database. These chemicals and parameters consisted of aluminum, boron, bismuth, calcium, iron, lanthanum, lithium, magnesium, manganese, phosphorous, potassium, scandium, silicon, sodium, strontium, tellurium, tin, titanium, tungsten, yttrium, zirconium, alkalinity, hardness, bromide, chloride, fluoride, carbonate, conductivity, ferrous iron, ignitability, nitrate, nitrite, dissolved and total solids, dissolved oxygen, phosphate, pH, salinity, sulfide, sulfate, temperature, total organic carbon, and turbidity.

4.2.6 Phthalates

All phthalate analytical results were excluded from the PCOC and COC database. Phthalates are associated with plastic materials and are recognized by U.S. EPA (1989d) to be common laboratory contaminants. In addition, there is no basis to expect releases of phthalates at the Presidio due to the historic uses of the facility.

4.2.7 Grab Groundwater Samples

Analytical results of grab groundwater samples were excluded if monitoring well data were available from the same site. Grab groundwater samples collected from borings generally contain high levels of suspended solids or turbidity that lead to measurement of non-representative concentrations of PCOCs in the samples. In particular, high turbidity interferes with the accurate quantification of metals because detected levels of metals may be associated with suspended solids that became entrained in groundwater during sampling rather than metals actually dissolved in groundwater.

Exceptions to this were analytical results of grab groundwater samples obtained from borings completed at Sewer Lift Station No. 1, Sewer Lift Station No. 2, and Building 662 Area, which were retained in the PCOC and COC database because these are the only available groundwater data for the sites. These data were retained despite the likelihood that metal concentrations in groundwater at Sewer Lift Station No. 1, Sewer

Lift Station No. 2, and Building 662 Area are overestimated by the analytical results of the grab groundwater samples.

4.2.8 Unreliable or Rejected Data

The Army evaluated data obtained by Dames & Moore and Montgomery Watson for their suitability in characterizing environmental conditions at chemical release sites at the Presidio. The Trust also conducted independent validation of the data obtained by EKI. Data determined to be unreliable or rejected by the either the Army or the Trust from its QA/QC evaluation were excluded from the database before screening for PCOCs.

4.3 DATA REMOVED IN SECOND SCREENING STEP

Certain analytical results remaining in the database after completing the first screening step were determined to be non-representative and were excluded from the PCOC and COC database. Exclusion of these analytical results was based upon more detailed data analysis and professional judgment. The reasons for excluding these results are discussed in Sections 4.3.1 through 4.3.6.

4.3.1 Anomalous Thallium and Antimony Concentrations in Soil

Thallium and antimony are prone to analytical problems. According to the RI (Dames & Moore, 1997b), "antimony and thallium displayed significant levels of QC failure with 30% and 11% of these data flagged "R", respectively." However, no corresponding data flags were found in the database supplied to the Trust. Hence, the Trust used a combination of information provided in the text of the RI (Dames & Moore, 1997b) and simple data analysis to identify and exclude suspect soil thallium and antimony data from the PCOC and COC database. The defining characteristics of these suspect data are as follows:

- Testing was performed by one laboratory that analyzed samples collected during a single sampling event and were often tested as a unique batch.

- No spatial patterns were apparent; samples with suspect results were collected from multiple sites, multiple depths, and multiple soil lithologies.

- Repeat sampling or testing did not confirm initial analytical results. Thallium and antimony concentrations that were typical of levels found in the earth's crust were often obtained after repeat sampling or testing.

In the case of thallium, Environmental Science and Engineering laboratory in Englewood, Colorado reported detections of thallium in 158 soil samples submitted by the Army to the laboratory for testing. Environmental Science and Engineering laboratory reported thallium concentrations in soil as high as 250 mg/kg. In contrast, splits of these soil samples analyzed by DTSC did not contain detectable amounts of

thallium and follow-up sampling at the DEH by NEIC could not find thallium at concentrations greater than ordinary crustal abundance levels.

The laboratory determined that the Army-certified analytical method followed was not appropriate for testing of thallium. The RI (Dames & Moore, 1997b) concluded the following:

> The thallium data from the Supplemental RI do not meet project quality requirements established from the PSF and are considered unusable for the RI process.

Despite this conclusion, the affected data were not identified as rejected in the database provided by the Army. The Trust has attached "R" flags to these entries in the database to signify that the analytical results are rejected. These data were not considered in the identification of PCOCs and COCs for Main Installation sites.

In the case of antimony, Environmental Science and Engineering laboratory in Englewood, Colorado, and Sequoia Analytical laboratory in Redwood City, California, reported anomalous data for soil samples. Antimony concentrations in soil samples tested by these laboratories exhibit marked differentiation from the antimony levels found in soil samples collected from Main Installation sites and tested by other laboratories. Environmental Science and Engineering laboratory consistently measured the highest concentrations of antimony in soil samples. During a single sampling event, this laboratory detected antimony in nineteen samples ranging from 51 to 295 mg/kg. Data analysis showed a near-perfect linear relationship between these suspect antimony results and their corresponding magnesium results. This relationship is indicative of an uncorrected spectral interference, rather than the actual presence of antimony in these samples.

Sequoia Analytical laboratory measured the next highest concentrations of antimony in soil samples. In a single sampling event, Sequoia Analytical laboratory detected antimony in sixteen samples ranging from 5.3 to 13 mg/kg. The results were produced during a single sampling event yet came from multiple sites, multiple depths, and multiple soil types.

It is extremely unlikely that this type of differentiation in analytical results is produced by variations of antimony in soil between sites. Although the RI stated that antimony displayed "significant" levels of QC failure (i.e., 30 percent of the data should be flagged "R"), no data were flagged in the database provided to the Trust. The Trust has attached "R" flags to antimony analytical results of soil samples reported by Environmental Science and Engineering laboratory and Sequoia Analytical laboratory. These data were not considered in the identification of PCOCs and COCs for Main Installation sites.

4.3.2 Anomalous Thallium and Antimony Concentrations in Water

As discussed in Section 4.3.1, certain thallium and antimony concentrations reported for soil were excluded during the second screening step because the data reported by specific laboratories appeared to be spurious. Similarly, review of water sample analytical results found that some of the thallium and antimony concentrations measured in water samples during specific monitoring events were laboratory artifacts and were excluded from the PCOC and COC database.

A strong dependence on the monitoring event and laboratory performing the analysis was displayed in the measurement of thallium in groundwater samples. Quality Assurance Laboratories of San Diego, California, and Applied Physics and Chemistry Laboratory of Chino, California reported thallium concentrations in groundwater samples as high as 6 µg/L. Quality Assurance Laboratories found thallium contamination in blank samples that suggests thallium analytical results of groundwater samples obtained from monitoring wells were compromised. Concentrations of thallium reported by Quality Assurance Laboratories and Applied Physics and Chemistry Laboratory to be present in groundwater samples did not agree with thallium levels found in groundwater samples collected from the same wells during different monitoring events. A total of 7 dissolved thallium analytical results were excluded. Thallium data were excluded for wells HWGW01 and HWGW05 for monitoring event QM9601 and wells LF1GW06, LF2GW02, LF2GW04, DAEGW03, and DAEGW06 for monitoring event QM9810.

A strong dependence on the laboratory performing the analyses of antimony in groundwater samples was also observed. Most of these anomalous antimony concentrations were reported for unfiltered groundwater samples that are excluded because the samples contained high turbidity levels that likely compromised data quality (see discussion in Section 4.5.2). Only two dissolved antimony groundwater sample analytical results were excluded, i.e., for the samples collected from well NKGW04 for monitoring event QM9510 and well LF1GW04 for monitoring event QM9601. Antimony concentrations in these groundwater samples results were not corroborated by data for groundwater samples collected from wells NKGW04 and LF1GW04 during other monitoring events.

4.3.3 Erroneous Duplicate Soil and Water Data

The database used to complete the Presidio Trust Revised FS Report contained many analytical results judged to be the result of data input or manipulation errors. Analytical results for 270 water and 932 soil samples labeled “FD” (i.e., field duplicate) were identical to the analytical results of the corresponding original samples. These results were highly unusual as testing of field duplicate samples almost never produce data that are identical to the original results. Review of analytical results for selected field duplicate samples presented in the RI (Dames & Moore, 1997b) confirmed that the identical data were not valid. Erroneous duplicate soil and water data were flagged in the database and excluded prior to identifying COCs.

The database also contained 2,133 duplicate analytical records for groundwater samples. Included in these duplicate records were U.S. EPA NEIC data and data compiled for monitoring events QM9801, QM9804, QM9901, and QM9904. Similarly, the database contained 96 analytical records for total metals in groundwater samples collected during monitoring event QM9901 that were determined to be incorrectly entered and were identical to analytical results for dissolved metals in groundwater samples for the same monitoring event. Both sets of erroneous duplicate data were flagged in the database and excluded prior to identifying COCs.

4.3.4 Landfill E Water Samples

Two water samples, DAEW05 and DAEW08, supposedly collected during August 1998 at Landfill E, were excluded from the PCOC and COC database. Analytical results of these samples were excluded because there was no record of their collection on a chain-of-custody form and no discussion of these samples in quarterly reports summarizing monitoring results at Landfill E prepared by the Army. The computerized database and quarterly reports were reviewed to determine if the samples were collected from groundwater monitoring wells DAEGW05 and DAEGW08 and the prefix "G" was inadvertently omitted from the sample identification. Review of the database and quarterly reports found that analytical results for samples collected from monitoring wells DAEGW05 and DAEGW08 on 17 August 1998 are included in the computerized database and quarterly reports. Comparison of the analytical results of the samples collected from wells DAEGW05 and DAEGW08 on 17 August 1998 with those of samples DAEW05 and DAEW08 indicate that the two sets of data are identical. The analytical results of samples DAEW05 and DAEW08 were excluded to prevent possible double counting of the data.

4.3.5 Nike Facility Water Samples

Analytical results of water inside the flooded magazines at the Nike Facility were excluded from the PCOC and COC database because the samples of standing water were collected before the Army conducted source removal actions. These samples have no relation to current groundwater or surface water conditions at the site. Source removal actions conducted by the Army are described in Section 6.7.3.3.

4.3.6 Anomalous Groundwater Analytical Results

Selected selenium, silver, cyanide, and 1,2-dichloroethane ("1,2-DCA") analytical results for groundwater samples were excluded from the PCOC and COC database because the occurrence of these chemicals appeared to be due to laboratory-related contamination or analytical difficulties. For these selected results, the detection of contaminants was sporadic, i.e., usually tied to a single sampling event and a single laboratory, and not supported by analyses of groundwater samples obtained from the monitoring wells during subsequent events.

For example, 1,2-DCA was detected in amounts ranging from 0.54 to 2.39 µg/L in 13 different monitoring wells at eight different sites. All the detections occurred in the same sampling event (the Follow-on RI sampling during 9 to 12 January 1995) and were analyzed by U.S. EPA Method 524.2 by Quality Assurance Laboratories of San Diego, California. Only one of the wells at any of the sites had a subsequent 1,2-DCA detection, a sample from Landfill E well DAEGW05 reportedly contained 0.6 µg/L in another event. The logical explanation for the 13 simultaneous detections is laboratory contamination. In fact, this problem was probably known to the Army, but not flagged in the database. In the RI, the following statement is made:

> Specific areas of concern in the Follow-on RI include: VOC data by method 524.2 …. With these exceptions, the data are usable for their intended purpose…. (Dames & Moore, 1997b, Vol. 1, page 3-59)

Cyanide provides another example. Quality Assurance Laboratories of San Diego, the same laboratory discussed above, reported 5.1 to 11.6 µg/L cyanide in eight different Follow-on RI groundwater samples collected in November and early December 1994. None of the Quality Assurance Laboratories cyanide detections are confirmed in previous or subsequent cyanide analyses from these wells, if available. Further, at the time these samples were collected, the laboratory was having trouble with cyanide affecting laboratory blanks for both soil and groundwater samples. For example, a groundwater sample from borehole 286SB06 was originally reported to have 7.3 µg/L cyanide, but this was flagged as a non-detect by data validators because of blank contamination. Because of these factors, selected cyanide data were excluded from the COC and PCOC databases.

The Trust detected these problems with simple data analysis tools, including time series plots, and excluded the data by adding killflags to the PCOC and COC database.

4.4 PROCEDURE TO IDENTIFY PCOCS

After the data screening process described above, PCOCs were identified at each site. PCOCs include the following:

- all organic chemicals detected at a site, because it is assumed these are all anthropogenic, and

- inorganic chemicals detected in soil samples above background screening levels identified in Table 4-1.

The background screening levels for inorganic compounds are based on a statistical analysis of background soil data collected from the four main soil types present at the Presidio (serpentinite, Colma Formation, beach/dune, and chert/shale). Their derivation is documented in the Presidio-wide Cleanup Level Document (EKI, 2002d).

The distribution and occurrence of PCOCs at each of the Main Installation sites is presented in Section 6.

4.5 PROCEDURE TO IDENTIFY COCS

COCs were identified by removing infrequently detected chemicals, unfiltered groundwater data, and concentrations of chemicals below cleanup levels. The rationale and approach to identify COCs is presented below and described on a site-by-site basis in Section 6.

4.5.1 Infrequently Detected Chemicals

Regarding the infrequent detection of chemicals, U.S. EPA (1989d) states that:

> Chemicals that are infrequently detected may be artifacts in the data due to sampling, analytical, or other problems, and therefore may not be related to site operations or disposal practices. Consider the chemical as a candidate for elimination from the quantitative risk assessment if: (1) it is detected infrequently in one or perhaps two environmental media, (2) it is not detected in any sampled media or at high concentrations, and (3) there is no reason to believe that the chemical may be present.

U.S. EPA risk assessment guidance was followed to establish the minimum frequency level for chemical detection. As suggested by U.S. EPA (1989d, 1989e), an infrequently detected chemical at Main Installation sites was determined to be a chemical that was detected in less than 5 percent of the samples for which it was analyzed.

Use of the 5 percent frequency level was complicated by the fact that only a few samples have been collected at most Main Installation sites. For soil data, the 5 percent frequency rule was strictly applied. However, for water data, the Trust also considered a chemical to be infrequently detected if it was detected at greater than 5 percent in the samples for which it was analyzed from a given monitoring well, but the number of samples analyzed was small (i.e., fewer than 20 samples) and the chemical is not anticipated to be present at the site based on recent or repeated monitoring events. If a PCOC was not detected above the applicable cleanup level for at least five of the most recent sampling rounds from a given well, the PCOC was not retained as a COC. For example, these decision criteria were followed in eliminating copper, nickel, selenium, 1,2-DCA, phenol, and petroleum hydrocarbons as motor oil in groundwater at Landfill E (see Section 6.5.1.3); copper, lead, phenol, and petroleum hydrocarbons as motor oil in groundwater at Fill Site 1 (see Section 6.5.2.3); bromodichloromethane in surface water at El Polin Spring (see Section 6.5.3.3); and arsenic, cadmium, copper, lead, selenium, and petroleum hydrocarbons as motor oil in groundwater at Landfill 2 (see Section 6.8.1.3).

4.5.2 Metal Analytical Results of Unfiltered Groundwater Samples

Analytical results of unfiltered groundwater samples were disregarded in determining the COCs in groundwater for those sites where more representative groundwater data have been obtained. Review of field notes in quarterly monitoring reports prepared by the Army indicates that the turbidity of groundwater in most of the monitoring wells at Main Installation sites is greater than 5 nephelometric turbidity units ("NTUs"). High levels of turbidity interfere with accurate quantification of metals in groundwater because detected concentrations of metals are often associated with suspended solids that became entrained in groundwater during sampling and are not present otherwise. Puls and Powell (1992) of U.S. EPA state:

> R.S. Kerr Environmental Research Laboratory ("RSKERL") personnel have evaluated sampling procedures for the collection of representative, accurate, and reproducible ground water quality samples for metals for the past four years. Intensive sampling research at three different field sites has shown that the method by which samples are collected has a greater impact on sample quality, accuracy, and reproducibility than whether the samples are filtered or not. In particular, sample collection practices that induce artificially high levels of turbidity have been shown to have the greatest negative impacts on sample quality.

U.S. EPA (1995c) recommends that groundwater samples be collected by low-flow sampling techniques to minimize turbidity levels. DTSC (2000e), in its comments on the Trust's *Revised Final Feasibility Study Work Plan*, stated that analytical results of unfiltered groundwater samples should be considered in identifying metals that are COCs in groundwater. In July 2000, the Trust evaluated the potential effect that filtering has on reproducibility of representative metal data by analyzing unfiltered and filtered groundwater samples collected from new and selected existing wells at Fill Site 6 and Fill Site 5 by low-flow sampling techniques. Review of these analytical results, which are included in the data tables in Appendix B, indicates that there are no significant differences in the concentrations of metals detected in unfiltered and filtered samples obtained from the wells in July 2000. In other words, if low-flow sampling techniques are employed such that low turbidity samples are obtained, metals concentrations in unfiltered samples can be representative of dissolved metals concentrations. Groundwater samples from the Army's RI and subsequent groundwater samples collected by the Army were not collected using low-flow techniques. Consequently, exclusion of metal data for excessively turbid samples is supported by U.S. EPA guidance and by the Trust's finding that similar metal concentrations were measured in filtered groundwater samples and unfiltered samples that had been collected using low-flow sampling techniques. Unfiltered groundwater data were retained only at sites where no filtered monitoring well data are available.

4.5.3 Chemicals Detected Below Cleanup Levels

Upon eliminating infrequently detected chemicals, the computerized database containing the analytical results of investigative and monitoring samples collected at the Presidio was screened against cleanup levels. Table 5-1 identifies which human health and ecological cleanup levels are applicable for soil and water, as well as the predominant lithologies, for each Main Installation site. Tables 5-2, 5-3, and 5-4 list human health and ecological cleanup levels for non-petroleum compounds in soil and freshwater and marine sediment. Table 5-5 lists human health and ecological cleanup levels for petroleum hydrocarbons and related constituents in soil. Table 5-6 lists cleanup levels for surface water, seeps, and groundwater. The derivation application of cleanup levels is summarized in Section 5.

Soil and sediment analytical results were screened by performing an initial computerized comparison of the data against human health and ecological cleanup levels for the predominant lithologies for each site. As discussed in Section 5.4.1, except for lead in soil at residential sites, VOCs in soil, PCBs in soil at commercial/industrial sites, and petroleum hydrocarbons in soil, cleanup levels for soil at the Presidio are calculated risk-based PRGs or, in the case of metals, background concentrations if naturally occurring levels of metals in soil are greater than PRGs. PCOCs were not retained as COCs in soil or sediment at a Main Installation site if the maximum concentrations of the PCOCs were below the applicable cleanup levels for the site-specific predominant lithologies.

For soil and sediment samples where the maximum concentrations of PCOCs consisting of metals were greater than the cleanup levels for the predominant lithologies, the lithology in the database assigned to the samples in question were reviewed to establish the actual soil types that comprised the samples. The metal analytical results of these samples were manually compared with the human health and ecological cleanup levels developed for the appropriate sample lithologies (i.e., serpentinite, Colma Formation, and beach/dune sand). In many cases, the assigned lithology was fill, which could be composed of a mixture of lithologies or imported soil, including chert and shale. Such samples required professional judgment to evaluate if the metal concentrations were similar to levels in other soil types at the Presidio. A metal was not retained as a COC at a Main Installation site if the maximum concentration of the metal was below the cleanup level for the appropriate sample lithology in the database or the metal appeared to be naturally occurring based on professional judgment. For metals that appeared to be naturally occurring, the stakeholders reviewed the initial screening, existing soil sample data posted on site figures, and bivariate scatter plots of the metals concentration data. Through a series of meetings with the stakeholders in the spring of 2001, COCs for most sites were determined based on a site-by-site evaluation of the data. A consensus of the site COCs was reached through this process.[3] Analytical results that were eliminated

[3] After these meetings in the spring 2001, additional data were collected and the cleanup levels for a few metals were lowered. Therefore, if new COCs were identified after these meetings, the same procedures for evaluating the new COCs were used as for the evaluation in the spring of 2001. The Trust prepared a technical memorandum that describes the scatter plot methodology and interpretation, and includes the scatter plots used to evaluate metal PCOCs that were reviewed by stakeholders (EKI, 2001a).

through this process are discussed in Section 6, and footnoted in the COC tables in Section 6.

The number of surface water, seep, and groundwater samples collected at Main Installation sites generally is less than the number of soil and sediment samples that have been obtained. Water analytical results were screened by performing a manual comparison of the data against the relevant cleanup levels specified for each Main Installation site in Table 5-1, and the corresponding cleanup level values listed in Table 5-6.

Hexavalent chromium was not retained as a COC at Battery Howe/Wagner, Landfill E, Fill Site 1, Nike Facility, Landfill 2, and Fill Site 5 where surface water or groundwater either contacts serpentinite or the site is immediately down gradient of the flow of groundwater through serpentinite. As discussed in the Presidio-wide Cleanup Level Document (EKI, 2002d), the findings of investigations and studies conducted by the Army, and supported by U.S. EPA data, clearly indicate that hexavalent chromium is naturally occurring in surface water and groundwater at these sites. DTSC agreed that hexavalent chromium is naturally occurring in areas where groundwater contains serpentinite (DTSC, 2000c). Hexavalent chromium in groundwater at the Building 215 Area and Fill Site 6 is also likely naturally occurring. These sites are located a significant distance from the upland areas with serpentinite. Figure D-1 in Appendix D depicts chromium concentrations detected in water samples throughout the Presidio. Groundwater containing hexavalent chromium appears to have migrated from the upland serpentinite-bearing areas, relatively unchanged, to the Fill Site 6/Building 215 Area. No known sources of hexavalent chromium have been identified in these areas and the chromium concentrations are consistent with this type of transport mechanism. Therefore, hexavalent chromium and dissolved chromium were not retained as COCs in groundwater at Fill Site 6 or Building 215 Area. The occurrence and distribution of hexavalent chromium at each of these sites is discussed further in Section 6. Other metals detected in water samples were not retained as COCs at a Main Installation site if the maximum concentration of the metal was below relevant cleanup levels for surface water, seeps, and groundwater.

5. REMEDIAL ACTION OBJECTIVES

CERCLA provides that remedial measures assure protection of human health and the environment. Consistent with this mandate, U.S. EPA (1995e, 1991g, 1989d) requires remedies to take into account future land use that is reasonable and that is associated with the most significant risk posed by exposure to COCs. Accordingly, RAOs for Main Installation sites consist of implementing remedies that are cost-effective, and prevent humans and ecological receptors from being exposed to unacceptable concentrations of COCs but still allow reuse described in the GMPA, PTMP, or other planned uses envisioned by the Trust. The Trust has prepared a Presidio-wide Cleanup Level Document (EKI, 2002d) to facilitate a streamlined, consistent approach to cleanup levels and RAOs throughout the Presidio. To determine the appropriate cleanup levels that should be applied to specific areas of the Presidio, a number of site-specific parameters, including the site lithology, future human and ecological land use, and planned water resource use, at each Main Installation site must be clearly defined.

This section summarizes relevant sections of the Presidio-wide Cleanup Level Document. Descriptions of specific parameters required to identify site-specific cleanup levels are excerpted for application to Main Installation sites. Summary tables and figures are included to facilitate the determination of site-specific cleanup levels. Individual sites and their site-specific PCOCs and COCs will be discussed in Section 6.

5.1 PRESIDIO-WIDE CLEANUP DOCUMENT

The Trust has prepared a Presidio-wide Cleanup Level Document (EKI, 2002d) to provide numerical cleanup levels for chemicals that may be encountered at Presidio sites. The Presidio-wide Cleanup Level Document presents proposed cleanup levels for PCOCs in soil, sediment, and water based on the protection of human health and ecological receptors.

The Presidio-specific cleanup levels are based on site-specific, risk-based PRGs calculated for the Presidio, and chemical-specific ARARs. Chemical-specific ARARs and site-specific PRGs are compared to naturally occurring or background concentrations of metals in soil to establish cleanup levels for use throughout the Presidio.

ARARs are laws, requirements, or other cleanup standards that pertain to the chemical release at a site. A more thorough discussion of ARARs, including chemical-, location-, and action-specific ARARs, is presented in Section 7. The complete ARARs analysis presented in Section 7 is used to guide the evaluation of remedial alternatives for the Main Installation sites. Chemical-specific ARARs have been adopted as cleanup levels, when available and greater than naturally occurring or background concentrations of metals in soil and water. In the absence of such ARARs, Presidio-specific risk-based PRGs were derived and used as cleanup levels if the PRGs are greater than background concentrations of metals. Naturally-occurring metal concentrations should be considered

when adopting chemical-specific ARARs and PRGs as cleanup levels for a site because it is not the intent of U.S. EPA (1992c, 1989d) nor DTSC (1999b) to have releases of COCs remediated to concentrations below background levels.

The key factors that are used to develop cleanup levels are background metal concentrations, human health exposure, and ecological exposure. Background metals concentrations are based on the predominant soil lithologies encountered within the Presidio. Figure 5-1 identifies surface lithologies at the Presidio. For any given site, the applicable cleanup level incorporates the planned human land use (residential, recreational, or institutional), the predominant soil or sediment lithology, and potential ecological species present (including the presence of special-status species). In addition, some cleanup levels, particularly for petroleum hydrocarbons and related constituents, are determined by Presidio-wide Site Cleanup Requirements as adopted in RWQCB Order No. 96–070 ("Order"). The Order allows varying cleanup levels depending on the existing and future use, depth to groundwater, and the Presidio drainage basin. Figure 5-2 shows groundwater basins and sub-areas within those basins at the Presidio.

The Presidio-wide Cleanup Level Document contains a series of tables and a process of steps to determine cleanup levels for specific sites at the Presidio. Table 5-1 identifies the specific parameters for determining cleanup levels for each of the Main Installation sites. The most stringent cleanup level from the applicable portions of Tables 5-2 through 5-6 is used to select cleanup levels for a specific chemical at a specific site.

5.2 PLANNED LAND USES

Figures 5-3 and 5-4 depict planned human and ecological land use at the Presidio. The land uses presented on Figures 5-3 and 5-4 are based primarily on descriptions from the GMPA and PTMP.

5.2.1 Human Land Use

Four broad categories of land use are defined in the GMPA for the Presidio (and are generally maintained in the PTMP). These categories consist of residential, recreational, institutional (education/conference), and industrial uses. The hatch type on Figure 5-3 signifies residential, recreational, institutional, and commercial/industrial areas on the Presidio and the color type depicts the corresponding cleanup levels that will protect people who reside, work, or visit these areas. Suitable cleanup levels are defined by the most sensitive population that is reasonably associated with the planned land use identified for different areas of the Presidio. These soil cleanup levels should be applied to a depth of 10 feet below ground surface, to account for soil disturbance during potential future construction.

5.2.1.1 Residential

Significant portions of the Presidio are designated as residential areas. Residential cleanup levels are applied to those Main Installation sites situated in areas that have the following uses:

- **Residential:** Residential use is designated for single-family housing and the grounds extending 150 feet from the structures in all directions, as well as playgrounds, and common areas near such housing. For example, it is reasonable to assume that children living in housing next to Fill Site 1 will use the open space at Fill Site 1 for a play area. Similarly, Julius Kahn playground is considered a "residential" area because adults and children who live adjacent to the Presidio spend considerable time at this playground and use it like a "backyard."

- **Institutional (Educational/Conference):** As described in the GMPA and PTMP, several areas of the Presidio will be used as educational/conference centers. Housing in these areas will provide permanent and temporary lodging for tenant employees and their families, visiting scholars, students, and researchers. While the land use for such areas generally may be described as institutional, the distinction between residential and institutional housing is inconsequential for purposes of selecting appropriate cleanup levels. The potential exposure scenarios for people living in such housing are comparable to those living in single-family residences. Accordingly, residential cleanup levels are applied to institutional housing. For example, the GMPA and PTMP indicate Fort Scott may be used for education, research, and training. The barracks will provide residential accommodations for people completing short- and long-term internships.

5.2.1.2 Recreational

Recreational cleanup levels are applied to those Main Installation sites situated in areas that have the following land uses:

Commercial/Recreational: Areas and the surrounding open spaces surrounding such places as museums, visitor centers, and park partner buildings will be frequented by recreational users, including children who likely will be picnicking and playing in the areas surrounding the buildings (e.g., the Main Post, the Cavalry Stables, and Crissy Field). At sites having such mixed or multiple uses, the population having the most significant risk (i.e., the most sensitive user) determines the applicable cleanup levels. For the Presidio, the most sensitive populations frequenting commercial/recreational areas will be recreational users.

Open Spaces: Areas of the Presidio not designated as residential, institutional, commercial/recreational, or industrial use areas are open spaces. Recreational users will frequent open spaces. Accordingly, recreational cleanup levels are applied in such areas.

5.2.1.3 Commercial/Industrial

As shown on Figure 5-3, only a small portion of the Presidio can be considered strictly commercial/industrial. These commercial/industrial areas consist of the water treatment plant area and the park maintenance facilities at Building 1750. Commercial/industrial cleanup levels are applied to these areas.

5.2.2 Ecological Land Use

The planned and existing ecological land use areas depicted on Figure 5-4 encompass most open spaces and recreational areas. Also included on Figure 5-4 are the saltwater and freshwater ecological protection zones defined in Order 96-070 issued by RWQCB. In this order, the Tennessee Hollow riparian corridor, the Crissy Field wetlands, and a 150-foot buffer zone along the shoreline at Crissy Field are identified as sensitive habitats requiring more stringent petroleum hydrocarbon cleanup levels than elsewhere on the Presidio. The area where more stringent petroleum cleanup levels apply to the Tennessee Hollow riparian corridor is designated as the freshwater ecological protection zone. The area where more stringent petroleum cleanup levels apply to the Crissy Field wetlands and shoreline area are designated as the saltwater ecological protection zone.

Figure 5-4 indicates the vegetation types to be preserved and rehabilitated at the Presidio. This figure is taken from the *Vegetation Management Plan and Environmental and Assessment for the Presidio of San Francisco* ("VMP") (NPS and Trust, 2001). Native plants, including threatened or endangered species, and historic plants are some of the vegetation types to be preserved and their growth enhanced in the future. Also to be preserved and enhanced under the VMP is the historic forest. The historic forest originates from the efforts of Army Major W.A. Jones. In 1883, Major Jones proposed a major tree-planting program to create windbreaks and to visually enhance the ridges, entrances, and perimeters of the Presidio. Planting of the historic forest began in 1886 and continued until the early 1900s.

Arguably, ecological cleanup levels should apply throughout the Presidio since activities at all locations may have some impact on the environment. However, review of the GMPA, VMP, and PTMP suggest that most ecologically sensitive areas and special status species[4] areas encompass land designated for open space and recreational use (e.g., Presidio Forest, Coastal Bluffs, Lobos Creek), and areas designated as ecological protection zones (i.e., Crissy Field wetlands, associated shoreline, and concomitant drainage area that includes the Tennessee Hollow riparian corridor). Figure 5-4 identifies areas where special status species are assumed to be present and ecological special status cleanup levels are applicable. These areas were established from the VMP and correspond to native plant habitat areas and forested areas. The remaining areas of the Presidio designated as ecological land use areas where special status species are not

[4] Special status species include those species that are listed or proposed for listing as threatened or endangered under federal or state Endangered Species Acts, the California Native Plant Protection Act, the Migratory Bird Treaty Act, California Species of Special Concern as defined by the California Department of Fish and Game, or protected by other laws.

likely to be present (e.g., the golf course in the Presidio Hills) are established as "buffer zone" ecological areas subject to the less-stringent buffer zone ecological cleanup levels (see Figure 5-4). Areas on Figure 5-4 where ecological cleanup levels are not applicable generally correspond to developed areas of the Presidio.

As described above, in areas where special status species are likely to be present, more stringent cleanup levels are applicable than in buffer zone ecological areas. However, the NPS (in Area A) and the Trust (in Area B), will have the option to assess and modify the applicability of special status cleanup levels on a site-by-site basis. In such cases, the Trust or NPS will coordinate with the State or Federal natural resource trustees, as appropriate, to determine if special status species are present at these sites. Such areas could include locations that are not currently identified as ecological land use on Figure 5-4. If an area demarcated as special status species on Figure 5-4 is modified to be a buffer zone ecological area or a non-ecological area (i.e., a less stringent cleanup level would become applicable), then the Trust must obtain approval from the DTSC to change the applicable cleanup level. Where ecological land uses overlap with human land uses, the more stringent cleanup level is the assigned cleanup level upon which remedial actions will be based. The identification of applicable cleanup levels at individual sites is described in more detail in Section 5.4.

5.3 PLANNED WATER RESOURCE USE

U.S. EPA has established in the NCP various expectations regarding the types of remedies that it has determined are consistent with (1) preferences and mandates set forth in Section 121 of CERCLA and (2) its practical experience in complying with such preferences and mandates (8 March 1990 *Federal Register*[5].). U.S. EPA expects, in part, to return usable groundwater to its beneficial use wherever practicable, within a reasonable time frame. When restoration of groundwater is not practicable, the NCP at 40 CFR §300.430(a)(1)(iii)(F) states that U.S. EPA expects that action will be taken to prevent continued migration of contamination, prevent exposure to the contaminated groundwater, and evaluate further risk reduction. Similar expectations are contained in California's laws, regulations, and policies (e.g., California Water Code §13304 and SWRCB Resolution No. 92-49).

Both the GMPA and RWQCB (1995) recognize that beneficial uses of groundwater at the Presidio include municipal or potable water supply and recharge to streams that enhance ecological and recreational uses. Surface water flow in Lobos Creek has provided most of the potable water at the Presidio. Planned future use of surface water and groundwater at the Presidio includes potable supply (NPS, 1994). As described in the GMPA, potable supply will continue to be provided by on-site sources but reliance on surface water will be reduced in favor of increased use of groundwater. The reasons for this change are that groundwater is less intensive to treat than surface water and that the Lobos Creek ecosystem might benefit if surface water is not diverted (NPS, 1994).

[5] Federal Register. 8 March 1990. Vol. 55, pp. 8666, 8702, 8710.

Besides potable supply, beneficial uses of surface water and groundwater that discharges to water bodies at the Presidio include ecological and recreational uses. Areas of the Presidio where ecological and recreational beneficial uses should be protected include, at a minimum, Lobos Creek drainage basin, Tennessee Hollow drainage basin, Nike Swale, Mountain Lake, Crissy Field wetlands, and coastal and shoreline areas.

5.4 PRESIDIO CLEANUP LEVELS APPLICABLE TO MAIN INSTALLATION SITES

Table 5-1 summarizes the types of cleanup levels applicable to each Main Installation site after considering the existing and planned land and water resource uses of the area where the site is located. Sections 5.4.1 through 5.4.4 discuss human health cleanup levels for soil, ecological cleanup levels for soil and sediment, and cleanup levels for surface water, seeps, and groundwater developed for the Presidio and referenced in Table 5-1.

As discussed previously, chemical-specific ARARs and PRGs were compared to naturally occurring concentrations of metals in soil to determine if the chemical-specific ARARs and PRGs are attainable cleanup levels. Background threshold concentrations of metals in serpentinite, Colma Formation, beach and dune sand, and chert and shale are summarized in Table 4-1. The background threshold concentration represents the Trust's best estimate of background levels of these metals based on currently available data for the primary soil types. Before, or as part of, implementing remedial actions, it may be necessary to collect additional soil and water samples to obtain more representative estimates of background concentrations to reduce uncertainty whether residual levels of metals in soil and water are caused by historic releases or are naturally occurring.

In addition, as stated in the Presidio-wide Cleanup Level Document (EKI, 2002d), it is possible that the background metals concentrations developed in the Presidio-wide Cleanup Level Document may not accurately reflect background conditions at all sites throughout the Presidio. If, for example, the Trust is having difficulty meeting cleanup levels during site remediation (when no other indicators for site contamination are present), the Trust may present supporting data to the DTSC and other stakeholders to determine if alternate background concentrations or lithologies may be appropriate for that site, or if other risk management measures should be considered. Similarly, the special status species PRGs developed in the Presidio-wide Cleanup Level Document were, in some cases, established as the method detection limit or other low concentration. As a practical matter, it may be difficult to achieve these cleanup levels during remediation. If such cases arise during remediation, the Trust may present the data to the DTSC and other stakeholders to determine alternate ecological cleanup levels at that time or other risk management measures.

It should also be recognized that chemical-specific ARARs and PRGs derived from toxicological data may be below the range of typical analytical method reporting limits for some PCOCs, such as semivolatile organic compounds ("SVOCs"), and PCBs, pesticides, and herbicides in water. The typical analytical method reporting limits range

from 0.1 to 10 µg/L for SVOCs by U.S. EPA Methods 8310 and 8270, and from 0.05 to 0.5 µg/L for PCBs, pesticides, and herbicides by U.S. EPA Methods 8081 and 8082 (U.S. EPA, 1997c). For those PCOCs in water, the Trust has selected the chemical-specific ARAR or PRG as the desirable cleanup level, but attainment can only be determined at the standard analytical method reporting limit. For SVOCs, PCBs, pesticides, herbicides and other classes of compounds that may have very low chemical-specific ARARs or PRGs in soil or water, the cleanup levels are established at the typical analytical method reporting limit ranges for these PCOCs assuming no matrix interference. In the event of matrix interference in soil or water samples, actual method reporting limits determining compliance with cleanup levels may be raised.

5.4.1 Human Health Cleanup Levels for Non-Petroleum Compounds in Soil

Chemical-specific ARARs for soil are available for only a limited number of contaminants. Human health cleanup levels for lead, PCBs, VOCs, and petroleum hydrocarbons in soil and water at the Presidio are derived from ARARs. Cleanup levels for remaining PCOCs in soil are risk-based PRGs or, in the case of metals, background concentrations if naturally occurring levels of metals in soil are greater than PRGs.

The residential cleanup level for lead is established as a not-to-exceed value of 400 mg/kg, with an average acceptable concentration of 370 mg/kg. A residential standard of 400 mg/kg is based on the bare residential soil standard promulgated in the 5 January 2001 *Federal Register*. A value of 370 mg/kg was calculated using Lead Spread Version 7.0 with site-specific data for lead in residential tap water.

Requirements governing cleanup of PCB-containing soil and wastes were broadened by amendments to TSCA in 1998. As part of these amendments, U.S. EPA added 40 CFR §761.61 to Subpart D of TSCA, which provides cleanup and disposal provisions for PCB-containing soil and other types of remediation wastes. This section of Subpart D sets cleanup levels for high occupancy areas (e.g., residence) at 1 mg/kg of PCBs in soil. However, the human health PRGs for PCBs were calculated in the Presidio-wide Cleanup Level Document (EKI, 2002d). For the residential and recreational land uses, the calculated site-specific PRGs for PCBs are less than 1 mg/kg. Therefore, the more stringent calculated values are proposed as the cleanup levels for those populations. For the commercial/industrial land use, a human health cleanup level of 1 mg/kg of PCBs is proposed to comply with TSCA because the site-specific PRG is less stringent than the TSCA value.

As discussed in the Presidio-wide Cleanup Level Document, human health PRGs for VOCs considered the direct contact pathways, vapor intrusion into indoor air, and groundwater protection via the leaching pathways. Values for vapor intrusion and groundwater protection were obtained from the RWQCB Risk Based-Screening Levels ("RBSLs") (RWQCB, 2001a and 2001b). In the absence of published RBSLs, values were calculated using the same methodology and assumptions used for the RBSLs. For most VOCs, the PRGs were established as the more stringent Groundwater Protection RBSL.

Table 5-2 lists human health cleanup levels for PCOCs in soil, other than petroleum hydrocarbons and related constituents. Naturally-occurring concentrations of metals in soil are also shown on this table to ensure that the cleanup level for a given PCOC and specific lithology is not less than background levels. Cleanup levels for petroleum hydrocarbons and related constituents are presented in Section 5.4.3.

5.4.2 Ecological Cleanup Levels for Non-Petroleum Compounds in Soil and Sediment

Figure 5-4 indicates primary areas of the Presidio where habitat suitable for ecological receptors exists or is planned.[6] Buffer zone and special status ecological cleanup levels pertain to the specific areas shown on Figure 5-4. Ecological cleanup levels generally do not apply to locations that are paved or dominated by designed landscapes (e.g., lawns or ornamental plantings). The identification of the potential presence of special status species or their habitat at the Main Installation sites was determined in the Army's RI, and updated by the Trust and NPS natural resource staff. Table 5-1 summarizes Main Installation sites situated in areas where special status species have been observed or are associated with habitat in the area of the site. Table 5-1 also identifies the sites that are classified as buffer zone ecological.

Table 5-2 lists ecological PRGs that are used for the development of ecological cleanup levels of non-petroleum compounds. The table identifies buffer zone and special status species cleanup levels, which can be compared to background metal and human health cleanup levels to identify the lowest appropriate cleanup level for a location.

Tables 5-3 and 5-4 list ecological cleanup level values for non-petroleum compounds in freshwater and marine sediment at the Presidio, respectively. The tables include cleanup levels for special status species, if available. In the absence of values for special status species, the regular ecological cleanup levels should be used. To account for naturally occurring concentrations of metals in the primary lithologies encountered at the Presidio, ecological cleanup levels for sediments have been developed separately for serpentinite, Colma Formation, beach/dune sand, and chert/shale lithologies.

5.4.3 Human Health and Ecological Cleanup Levels for Petroleum Hydrocarbons and Constituents in Soil and Sediment

Cleanup levels for petroleum hydrocarbons and related constituents developed in connection with Order No. 96-070 are being adopted for Main Installation sites and other areas of the Presidio where releases of petroleum hydrocarbons may have occurred with other types of chemicals.[7] Cleanup levels for petroleum hydrocarbons and related constituents were included in Order No. 96-070 or were developed from subsequent

[6] Limited additional areas, other than those indicated on Figure 5-4, with high quality habitat may exist at the Presidio.
[7] RWQCB Order No. 96-070 includes cleanup levels for TPH as fuel oil, which includes a carbon range of C_{24} to C_{36}. Reported values for TPH as fuel oil are based on a motor oil standard for carbon range C_{24} to C_{36}. The term for the compound reported from the laboratory in the database, whether motor oil or fuel oil, is typically used in the text, tables, and figures in this report.

studies required by the order. As discussed in Section 7.6.1.5, these studies consisted of performing bioassays and reviewing toxicological data published in scientific literature to develop cleanup levels for the saltwater ecological protection zone (IT Corporation, 1997) and freshwater protection zone (Montgomery Watson, 1999f).

Cleanup level values for petroleum hydrocarbons and related constituents in soil and sediment within the saltwater and freshwater ecological protection zone, and at other areas of the Presidio are summarized in Table 5-5. Figure 5-4 identifies the locations of the saltwater and freshwater ecological protection zones. For sites within these zones, cleanup levels for ecological protection must include not only the values for terrestrial receptors, but also the values for saltwater or freshwater aquatic organisms listed in Table 5-5.

5.4.4 Cleanup Levels for Surface Water, Seeps, and Groundwater

Chemical-specific ARARs were used to establish groundwater and surface cleanup levels for protection of human health and the environment. Promulgated Maximum Contaminant Levels ("MCLs") or published action levels have been adopted as cleanup levels to protect human health due to groundwater ingestion (U.S. EPA, Region IX, 2000e).

Promulgated water quality criteria were applied to existing and planned freshwater surface bodies, and groundwater that recharges surface water or emerges as seeps. Existing surface water bodies at the Presidio include Mountain Lake, Crissy Field wetlands, Tennessee Hollow riparian corridor, Dragonfly Creek at Fort Scott, and Lobos Creek. Water quality criteria adopted as cleanup levels for surface water and groundwater that recharges surface water at the Presidio are intended to protect freshwater aquatic organisms, and humans who may drink the water and consume fish or other organisms inhabiting the water bodies from chronic exposure to PCOCs. Water quality criteria adopted as cleanup levels for freshwater seeps at the Presidio are intended to protect freshwater aquatic organisms from chronic exposure to PCOCs. Seeps observed at the Presidio are not considered potential habitat that would support fish or other organisms that could be consumed by humans. Water quality criteria used to establish surface water, groundwater recharge to surface water, and seep cleanup levels were obtained from the following references:

- RWQCB *Water Quality Control Plan, San Francisco Bay Basin* or Basin Plan, dated 21 June 1995.

- Title 40 CFR §131.38, *Establishment of Numerical Criteria for Priority Toxic Pollutants for the State of California* or CTR.

Table 5-6 presents cleanup level values for PCOCs in surface water, seeps, and groundwater. Groundwater cleanup level values for PCOCs in Table 5-6 are established as drinking water standards (i.e., MCLs or action levels) unless the site is located near a surface water body (e.g., Mountain Lake, Tennessee Hollow riparian corridor, Lobos

Creek) or seep. For sites near surface water bodies, cleanup levels based on water quality criteria for protection of aquatic life or human health are applicable if they are more stringent than relevant MCL or action levels for the PCOC under consideration. For sites near seeps, cleanup levels are based on protection of aquatic life alone.

5.5 SELECTION OF SITE-SPECIFIC CLEANUP LEVELS

The process for selecting site-specific cleanup levels is described in detail in the Presidio-wide Cleanup Level Document (EKI, 2002d). Table 5-1 identifies site-specific parameters used to identify cleanup levels for each site. For soil, the cleanup level for each PCOC is the minimum (most stringent) cleanup level from the applicable columns of the applicable Tables 5-2 through 5-5. Any chemical that has been detected at a site at a concentration greater than this minimum cleanup level is identified as a COC for soil or sediment (after taking into account the frequency of detection). Similarly for water, the PCOCs should be screened against the lowest (most stringent) applicable water cleanup level. The cleanup level for each PCOC is the minimum cleanup level from the applicable columns of Table 5-6. Any chemical that has been detected at a site at a concentration greater than this minimum cleanup level is identified as a COC for water (after taking into account the frequency of detection).