Naval Facilities Engineering Systems Command Southwest
BRAC PMO West
San Diego, California

Draft

Fifth Five-Year Review Report

Hunters Point Naval Shipyard
San Francisco, California

November 2023

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Prepared for:

Department of the Navy
Naval Facilities Engineering Systems Command Southwest
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Fifth Five-Year Review Report

Hunters Point Naval Shipyard,
San Francisco, California

July 2024

This report documents the Fifth Five-Year Review for the Hunters Point Naval Shipyard that includes Installation Restoration (IR) Sites 7 and 18, and Parcels B-1, B-2, C, D-1, D-2, E, E-2, G, UC-1, UC-2, and UC-3 as required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in accordance with CERCLA § 121(c), as amended, and the National Oil and Hazardous Substances Pollution Contingency Plan, Part 300.430(f)(4)(ii) of the Code of Federal Regulations.

Approved by:

Michael Pound   Date
Base Realignment and Closure Program
Environmental Coordinator

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Contents

Appendixes

Tables

Figures

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Acronyms and Abbreviations

µg/L	microgram(s) per liter
AFFF	aqueous film-forming foam
Am-241	americium-241
AOMSR	Annual Operation and Maintenance Summary Report
ARAR	applicable or relevant and appropriate requirement
ARIC	area requiring institutional controls
ATC	active treatment criterion
BCT	BRAC Cleanup Team
BCY	bank cubic yard(s)
BERA	Baseline Ecological Risk Assessment
BGMP	Basewide Groundwater Monitoring Program
bgs	below ground surface
BRAC	Base Realignment and Closure
BTAG	Biological Technical Assistance Group
CDPH	California Department of Public Health
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cis-1,2-DCE	cis-1,2-dichloroethene
Co-60	cobalt-60
COC	chemical of concern
COEC	chemical of ecological concern
COPC	chemical of potential concern
Cs-137	cesium-137
CVOC	chlorinated volatile organic compound
1,2-DCE	1,2-dichloroethene
DBR	Design Basis Report
DTSC	California Department of Toxic Substances Control
EcoSSL	ecological soil screening level
ERA	ecological risk assessment
ERM	effects range median
ESD	Explanation of Significant Differences
F-WBZ	fractured water-bearing zone
FFA	Federal Facilities Agreement

FS	Feasibility Study
FSS	final status survey
GCCS	gas control and collection system
HGAL	Hunters Point groundwater ambient level
HHRA	human health risk assessment
HPNS	Hunters Point Naval Shipyard
HRA	Historical Radiological Assessment
IC	institutional control
IR	Installation Restoration
IRIS	Integrated Risk Information System
ISB	in situ biodegradation
ISS	in situ stabilization
K-40	potassium-40
LLRW	low-level radioactive waste
LNAPL	light nonaqueous phase liquid
LTM	long-term monitoring
LUC	land use control
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCL	maximum contaminant level
MLLW	mean lower low water
MNA	monitored natural attenuation
MNR	monitored natural recovery
msl	mean sea level
NAPL	nonaqueous phase liquid
NAVFAC	Naval Facilities Engineering Systems Command
Navy	Department of the Navy
NMOC	non-methane organic compound
NPL	National Priorities List
NRDL	Naval Radiological Defense Laboratory
NRWQC	National Recommended Water Quality Criteria
O&M	operations and maintenance
OCII	Office of Community Investment and Infrastructure
PA	preliminary assessment
PAH	polycyclic aromatic hydrocarbon

PAL	project action limit
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutane sulfonate
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
PMO	Program Management Office
PPRTV	Provisional Peer-reviewed Toxicity Values
PQL	practical quantitation limit
PRG	Preliminary Remediation Goal
Pu-239	plutonium-239
RA	remedial action
Ra-226	radium-226
RACR	Remedial Action Completion Report
RAMP	Remedial Action Monitoring Plan
RAMR	Remedial Action Monitoring Report
RAO	remedial action objective
RAWP	Remedial Action Work Plan
RD	remedial design
Regional Water Board	California Regional Water Quality Control Board, San Francisco Bay Region
RG	remediation goal
RI	Remedial Investigation
RMP	Risk Management Plan
RO	radiological object
ROC	radionuclide of concern
ROD	Record of Decision
RSL	Regional Screening Level
RSRS	Radiological Survey and Remedial Services
RU	remedial unit
SGAL	soil gas action level

SI	site inspection
SL	screening level
SLERA	screening-level ecological risk assessment
SLR	sea level rise
Sr-90	strontium-90
SVE	soil vapor extraction
SVOC	semivolatile organic compound
SWRCB	State Water Resources Control Board
TCE	trichloroethene
TCR	Toxicity Criteria Rule
TCRA	time-critical removal action
Th-232	thorium-232
TL	trigger level
TPH	total petroleum hydrocarbons
Triple A	Triple A Machine Shop, Inc.
TRV	toxicity reference value
U-235	uranium-235
UCL	upper confidence limit
UCSF	University of California San Francisco
USEPA	United States Environmental Protection Agency
UU/UE	unlimited use and unrestricted exposure
VC	vinyl chloride
VISL	vapor intrusion screening level
VOC	volatile organic compound
ZVI	zero-valent iron

Executive Summary

The Department of the Navy conducted this Five-Year Review for Hunters Point Naval Shipyard (HPNS) in San Francisco, California, as required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The Five-Year Review was conducted in accordance with CERCLA §121(c), as amended by the Superfund Amendments and Reauthorization Act, and the National Oil and Hazardous Substances Pollution Contingency Plan, Part 300.430(f)(4)(ii) of the Code of Federal Regulations. In addition, the Five-Year Review was conducted in accordance with the following documents:

- *Comprehensive Five-Year Review Guidance* (USEPA, 2001) and supplements (USEPA, 2012a, 2012b, 2016)
- *Navy/Marine Corps Policy for Conducting Comprehensive Environmental Response, Compensation, and Liability Act Five-Year Reviews* (Navy, 2011b)
- *Toolkit for Preparing Five-Year Reviews* (NAVFAC, 2013)
- *Defense Environmental Restoration Program (DERP) Management Manual Number 4715.20* (DoD, 2018)
- *Department of the Navy Environmental Restoration Program Manual* (Navy, 2018b)

This report summarizes the evaluation of remedies that resulted in hazardous substances, pollutants, or contaminants remaining at sites above levels that allow for unlimited use and unrestricted exposure (UU/UE), and for which there is a final Record of Decision (ROD). A ROD requiring a Five-Year Review has been finalized for the following HPNS parcels and sites:

- Former Parcel B (composed of Installation Restoration [IR] Sites 7 and 18 [IR-07/18] and Parcels B-1 and B-2)
- Former Parcel C (composed of Parcels C and UC-2)
- Former Parcel D (composed of Parcels D-1, D-2, UC-1, and G)
- Former Parcel E (composed of Parcels E, E-2, and UC-3)

This is the fifth Five-Year Review at HPNS. The objective of this Five-Year Review is to evaluate the selected remedies at these sites and parcels and determine whether the remedies remain protective of human health and the environment in accordance with the requirements set forth in each of the RODs. The principal method used to evaluate the protectiveness of the remedies was a review of documents pertaining to site activities, analytical data, and findings. The methods, findings, and conclusions from the document reviews are presented in this Five-Year Review Report. This report is intended to identify issues that may prevent a particular remedy from functioning as designed, which could affect the protection of human health and the environment should exposure occur. In addition, this report presents a screening level Climate Resilience Assessment to address potential future effects of climate change on the selected remedies. The overall evaluations of the effectiveness of each remedy are presented as protectiveness statements in the Five-Year Review Summary Form provided on the following page. Based on this Fifth Five-Year Review, the remedy at IR-07/18 is Protective, the remedies at Parcels B-1, B-2, C, UC-2, D-1, D-2, UC-1, G, and UC-3 are Short-Term Protective because there are no current uncontrolled exposures, and the remedies at Parcels E and E-2 Will be Protective upon completion of remedy construction.

The Five-Year Review Summary Form, which provides a summary of issues, recommendations, and protectiveness statements for each site evaluated in this Five-Year Review, is provided below. The period under review is December 1, 2018, to November 1, 2023.

Five-Year Review Summary Form

<table>
<tr><th colspan="3">SITE IDENTIFICATION</th></tr>
<tr><td colspan="3">Site name: Hunters Point Naval Shipyard</td></tr>
<tr><td colspan="3">USEPA ID: CA1170090087</td></tr>
<tr><td>Region: 9</td><td>State: California</td><td>City/County: San Francisco/San Francisco</td></tr>
<tr><th colspan="3">SITE STATUS</th></tr>
<tr><td colspan="3">NPL status: Final</td></tr>
<tr><td colspan="2">Multiple OUs?
Yes</td><td>Has the site achieved construction completion?
No</td></tr>
<tr><th colspan="3">REVIEW STATUS</th></tr>
<tr><td colspan="3">Lead agency: Other Federal Agency
If “Other Federal Agency” was selected above, enter Agency name: Department of the Navy</td></tr>
<tr><td colspan="3">Author name (Federal or State Project Manager): Naval Facilities Engineering Systems Command (NAVFAC), Base Realignment and Closure (BRAC) Program Management Office (PMO) West</td></tr>
<tr><td colspan="3">Review period [Time to complete the Five-Year Review]: October 1, 2022 – November 1, 2023</td></tr>
<tr><td colspan="3">Date of site inspection: February 9, 2023</td></tr>
<tr><td colspan="3">Type of review: Statutory</td></tr>
<tr><td colspan="3">Review number: 5</td></tr>
<tr><td colspan="3">Triggering action date: 7/31/2019 (signature date of Fourth Five-Year Review)</td></tr>
<tr><td colspan="3">Due date (5 years after triggering action date): 7/31/2024</td></tr>
</table>

The following pages summarize issues, recommendations, and protectiveness statements for each Five-Year Review site.

<table>
<tr><th colspan="5">ISSUES/RECOMMENDATIONS</th></tr>
<tr><td colspan="5">Sites without Issues/Recommendations Affecting Protectiveness Identified in the Five-Year Review:</td></tr>
<tr><td colspan="2">• IR-07/18
• Parcel E</td><td colspan="3">• Parcel E-2</td></tr>
<tr><td colspan="5">Issues and Recommendations Identified in the Five-Year Review:</td></tr>
<tr><td rowspan="3">Site:
Parcels B-1, B-2, C, D-1, D-2, UC-1, UC-2, UC-3, G</td><td colspan="4">Issue Category: Remedy Performance</td></tr>
<tr><td colspan="4">Issue: As identified in the Fourth Five-Year Review, there is uncertainty with a portion of the radiological survey and remediation work performed between 2004 and 2016 under the Basewide Radiological Removal Action, Action Memorandum (Navy, 2006). The Navy is in the process of implementing corrective actions to ensure the radiological remedies specified in the decision documents were implemented as intended; however, this work is ongoing.</td></tr>
<tr><td colspan="4">Recommendation: Complete radiological retesting at radiologically impacted sites, including current and former buildings and soil areas investigated under the Radiological Removal Action, Action Memorandum (Navy, 2006) and areas where evaluations determined previous data were unreliable.</td></tr>
<tr><td>Affect Current Protectiveness</td><td>Affect Future Protectiveness</td><td>Implementing Party</td><td>Oversight Party</td><td>Milestone Date</td></tr>
<tr><td>N</td><td>Y</td><td>Navy</td><td>USEPA</td><td>B-1 and B-2: 2/27/2025
C: 2/5/2025
D-1: 11/27/2026
D-2, UC-1, UC-2, UC-3: 3/2/2028
G: 10/2/2025</td></tr>
<tr><td rowspan="3">Site:
Parcel D-1</td><td colspan="4">Issue Category: Changed Site Conditions</td></tr>
<tr><td colspan="4">Issue: Radiological objects (ROs) were identified during excavation and remediation of soil in areas that were not considered radiologically impacted. There is a high degree of confidence that discrete ROs were removed to a depth of 2 feet below ground surface (bgs). However, there is a potential for ROs to be present in material below 2 feet bgs where shoreline expansion has occurred since 1946.</td></tr>
<tr><td colspan="4">Recommendation: Evaluate additional remedies to address the potential presence of ROs in material 2 feet bgs and prepare the appropriate post-ROD documentation.</td></tr>
<tr><td>Affect Current Protectiveness</td><td>Affect Future Protectiveness</td><td>Implementing Party</td><td>Oversight Party</td><td>Milestone Date</td></tr>
<tr><td>N</td><td>Y</td><td>Navy</td><td>USEPA</td><td>12/20/2024</td></tr>
<tr><td colspan="5">Other Findings</td></tr>
<tr><td colspan="5">The Navy recognizes climate change is occurring and based on a screening level Climate Resilience Assessment (CRA) (Appendix A), sea level rise (SLR) is the major variable of climate change that could affect the remedies at HPNS.

Based on the results of the CRA, the Navy will continue to monitor ongoing groundwater concentration and elevation data onsite through the Basewide Groundwater Monitoring Program (BGMP) and evaluate this data as it relates to the effectiveness of site remedies. The Navy will also regularly evaluate nearby tidal gauge data to verify SLR projections. Additional site-specific vulnerability assessments may be conducted in a timely manner to determine site-specific impacts and what remedy modification may be required.</td></tr>
</table>

<table>
<tr><th colspan="3">PROTECTIVENESS STATEMENT(S)</th></tr>
<tr><td colspan="3">Former Parcel B</td></tr>
<tr><td>Site:
IR Site 7/18</td><td>Protectiveness Determination:
Protective</td><td>Addendum Due Date (if applicable):
Not Applicable</td></tr>
<tr><td colspan="3">Protectiveness Statement: The remedy at IR-07/18 is protective of human health and the environment.
The Remedial Action Objectives (RAOs) for soil and soil gas have been met through excavation and removal of contaminated soil, durable covers, and ICs. Groundwater monitoring indicates that chemicals of concern (COCs) and radionuclides of potential concern (ROPCs) are less than trigger levels (TLs) during the majority of sampling events.</td></tr>
<tr><td>Site:
Parcel B-1</td><td>Protectiveness Determination:
Short-term Protective</td><td>Addendum Due Date (if applicable):
Not Applicable</td></tr>
<tr><td colspan="3">Protectiveness Statement: The remedy at Parcel B-1 is currently protective of human health and the environment. To determine whether the remedy can be considered protective in the long term, the radiological retesting work and the excavation of volatile organic compound (VOC)-impacted soil will be completed.
The RAOs for soil are met through hotspot excavation and offsite disposal, durable covers, and ICs. Excavation of VOC-impacted soil will permanently remove the source of VOCs to soil gas and groundwater. Groundwater long-term monitoring (LTM) and monitored natural attenuation (MNA) are ongoing. Exposure to groundwater is controlled through ICs.
Radiological retesting is ongoing to confirm that levels in soils and structures are protective of human health. Until retesting is complete, short-term protectiveness is met through Navy controls such as access to the parcel through fencing, locked gates, and ICs (restricting intrusive work and maintaining durable covers).</td></tr>
<tr><td>Site:
Parcel B-2</td><td>Protectiveness Determination:
Short-term Protective</td><td>Addendum Due Date (if applicable):
Not Applicable</td></tr>
<tr><td colspan="3">Protectiveness Statement: The remedy at Parcel B-2 is currently protective of human health and the environment. To determine whether the remedy can be considered protective in the long term, the radiological retesting work will be completed.
The RAOs for soil are met through durable covers and ICs. Groundwater LTM and MNA are ongoing. Exposure to groundwater is controlled through ICs.
Radiological retesting is ongoing to confirm that levels in soil and structures are protective of human health. Until retesting is complete, short-term protectiveness is met through Navy controls such as access to the parcel through fencing, locked gates, and ICs (restricting intrusive work and maintaining durable covers).</td></tr>
<tr><td colspan="3">Former Parcel C</td></tr>
<tr><td>Site:
Parcel C</td><td>Protectiveness Determination:
Short-term Protective</td><td>Addendum Due Date (if applicable):
Not Applicable</td></tr>
</table>

PROTECTIVENESS STATEMENT(S)

Protectiveness Statement: The remedy at Parcel C is currently protective of human health and the environment. In order to determine whether the remedy can be considered protective in the long term, the radiological retesting work and soil excavation and groundwater remediation will be completed.

The RAOs for soil are met through hotspot excavation and disposal, durable covers, and ICs. Groundwater remediation is ongoing and, once active treatment is complete, MNA will continue until COCs reach remediation goals (RGs). Until that time, ICs control exposure to groundwater.

Radiological retesting is ongoing to confirm that levels in soil and structures are protective of human health. Until retesting is complete, short-term protectiveness is met through Navy controls such as access to the parcel through fencing, locked gates, and ICs (restricting intrusive work and maintaining durable covers).

Site:	Protectiveness Determination:	Addendum Due Date (if applicable):
Parcel UC-2	Short-term Protective	Not Applicable

Protectiveness Statement: The remedy at Parcel UC-2 is currently protective of human health and the environment. In order to determine whether the remedy can be considered protective in the long term, the radiological retesting work will be completed.

The RAOs for soil are met through durable covers and ICs. Groundwater monitoring is ongoing. Radiological retesting is ongoing to confirm that levels in soil and structures are protective of human health. Until retesting is complete, short-term protectiveness is met through Navy controls such as access to the parcel through fencing, locked gates, and ICs (restricting intrusive work and maintaining durable covers).

Former Parcel D

Site:	Protectiveness Determination:	Addendum Due Date (if applicable):
Parcel D-1	Short-term Protective	Not Applicable

Protectiveness Statement: The remedy at Parcel D-1 is currently protective of human health and the environment. In order to determine whether the remedy can be considered protective in the long term, the radiological retesting work will be completed, and additional actions implemented to address the potential presence of ROs in subsurface soil.

The RAOs for soil are met through soil hotspot excavation and offsite disposal, durable covers, and ICs. Groundwater monitoring is ongoing and COCs have been consistently below RGs and TLs. Radiological retesting is ongoing to confirm that levels in soil and existing structures are protective of human health and post-ROD documentation is being prepared to address ROs in subsurface soil. Until retesting is complete, short-term protectiveness is met through Navy controls such as access to the parcel through fencing, locked gates, and ICs (restricting intrusive work and maintaining durable covers).

Site:	Protectiveness Determination:	Addendum Due Date (if applicable):
Parcel D-2	Short-term Protective	Not Applicable

Protectiveness Statement: The remedy at Parcel D-2 is currently protective of human health and the environment.

Parcel D-2 was acceptable for UU/UE upon completion of the radiological TCRA; however, in order to determine whether the parcel remains acceptable for UU/UE, the radiological retesting work will be completed. Until retesting is complete, exposure to radionuclides of concern in site media is being controlled through security features such as fencing, locked gates, and signage.

Site:	Protectiveness Determination:	Addendum Due Date (if applicable):
Parcel UC-1	Short-term Protective	Not Applicable

PROTECTIVENESS STATEMENT(S)		
Protectiveness Statement: The remedy at Parcel UC-1 is currently protective of human health and the environment. In order to determine whether the remedy can be considered protective in the long term, the radiological retesting work will be completed. The RAOs for soil are met through durable covers and ICs. Radiological retesting is ongoing to confirm that levels in soil and existing structures are protective of human health. Until retesting is complete, short-term protectiveness is met through Navy controls such as access to the parcel through fencing, locked gates, and ICs (restricting intrusive work and maintaining durable covers).		
Site: Parcel G	**Protectiveness Determination:** Short-term Protective	**Addendum Due Date (if applicable):** Not Applicable
Protectiveness Statement: The remedy at Parcel G is currently protective of human health and the environment. In order to determine whether the remedy can be considered protective in the long term, the radiological retesting work will be completed. The RAOs for soil are met through soil hotspot excavation and offsite disposal, durable covers, and ICs. Groundwater treatment is completed, and monitoring is ongoing. Radiological retesting is ongoing to confirm that levels in soil and existing structures are protective of human health. While retesting is ongoing, short-term protectiveness is met through Navy controls such as access to the parcel through fencing, locked gates, and ICs (restricting intrusive work and maintaining durable covers).		
Former Parcel E		
Site: Parcel E	**Protectiveness Determination:** Will be Protective	**Addendum Due Date (if applicable):** Not Applicable
Protectiveness Statement: The remedy at Parcel E Will Be Protective upon completion of remedy construction and completion of the radiological retesting. In the interim, exposures to COCs in soil, sediment, and groundwater are being controlled during construction using temporary sheet piles, erosion control measures, security fencing to prevent unauthorized access, and ICs. The RAOs for soil will be met through excavation and offsite disposal, closure of fuel and steam lines, durable covers, and ICs. The RAOs for soil gas will be met through soil vapor extraction (SVE) or excavation to address VOCs, and ICs. The RAOs for shoreline sediment will be met through excavation and offsite disposal, durable cover installation, shoreline protection, and a sea wall. The RAOs for groundwater will be met through in situ groundwater treatment, installation of a belowground barrier, monitoring, and ICs. The RAOs for radiologically impacted media will be met through radiological surveys, decontamination, and removal of radiologically impacted structures, soil, and sediment, and ICs. The RAOs for NAPL will be met through removal and treatment of NAPL source, in situ stabilization, and containment. Soil excavation to remove COC- and radiologically impacted soil has been completed. The following remedy components are under construction: installation of the shoreline armored revetment and the cement-bentonite slurry wall and belowground barrier, removal of sanitary sewer and storm drain lines, and excavation of NAPL followed by initiation of the in situ stabilization (ISS) treatment. Groundwater is currently being monitored through the Basewide Groundwater Monitoring Program (BGMP).		
Site: Parcel E-2	**Protectiveness Determination:** Will be Protective	**Addendum Due Date (if applicable):** Not Applicable

PROTECTIVENESS STATEMENT(S)		
Protectiveness Statement: The remedy at Parcel E-2 Will Be Protective upon completion of remedy construction. Soil and sediment hotspots have been removed and the final cover is currently under construction. Landfill gas venting and monitoring is ongoing during construction activities. Exposure to soil and groundwater is currently being controlled through security fencing to prevent unauthorized access, signage, and ICs. The RAOs for soil will be met through hotspot removal, soil cover and sea wall, and ICs. The radiological RAOs will be met through radiological screening and removal, installation of a soil cover with demarcation layer, and ICs. The RAOs for landfill gas will be met through landfill gas monitoring, removal, and treatment, landfill cover monitoring, and ICs. The RAOs for groundwater will be met through LTM and ICs. The RAOs for surface water will be met through installation of the protective soil cover, slurry walls, diversion to tidal and non-tidal constructed wetlands, and outfall monitoring. The following activities have been completed: soil excavation to remove COC- and low-level radiologically impacted soil, installation of soil layer of radiologically cleared soil and a soil cover, installation of the shoreline armored revetment, cement-bentonite slurry walls along the shoreline and in the upland portion of the parcel, and the installation of a portion of the landfill gas collection and treatment system. Groundwater is currently being monitored through the BGMP.		
Site: Parcel UC-3	**Protectiveness Determination:** Short-term Protective	**Addendum Due Date (if applicable):** Not Applicable
Protectiveness Statement: The remedy at Parcel UC-3 is currently protective of human health and the environment. In order to determine whether the remedy can be considered protective in the long term, the radiological retesting work must be completed. The RAOs for soil were met through hotspot excavation, durable covers, and ICs. Groundwater RGs have been met and groundwater meets the conditions for unlimited use/unrestricted exposure. Radiological retesting is planned to confirm that levels in soil are protective of human health. Until retesting is complete, short-term protectiveness is met through Navy controls such as access to the parcel through fencing, locked gates, and ICs (restricting intrusive work and maintaining durable covers.		

1.0 Introduction

This report details the Department of the Navy (Navy) Five-Year Review of Hunters Point Naval Shipyard (HPNS), San Francisco, California, as required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). HPNS (United States Environmental Protection Agency [USEPA] Identification: CA1170090087) was placed on the National Priorities List (NPL) in 1989. The Navy is the lead agency responsible for investigating and addressing the release of CERCLA hazardous substances at HPNS.

The Five-Year Review was conducted in accordance with CERCLA § 121(c), as amended by the Superfund Amendments and Reauthorization Act, and the National Oil and Hazardous Substances Pollution Contingency Plan, Part 300.430(f)(4)(ii) of the Code of Federal Regulations. The Five-Year Review was conducted in accordance with the following documents:

- *Comprehensive Five-Year Review Guidance* (USEPA, 2001) and supplements (USEPA, 2012a, 2012b, 2016)
- *Navy/Marine Corps Policy for Conducting Comprehensive Environmental Response, Compensation, and Liability Act Five-Year Reviews* (Navy, 2011)
- *Toolkit for Preparing Five-Year Reviews* (NAVFAC, 2013)
- *Defense Environmental Restoration Program (DERP) Management Manual Number 4715.20* (DoD, 2018)
- *Department of the Navy Environmental Restoration Program Manual* (Navy, 2018b)

This document has been prepared by the Naval Facilities Engineering Systems Command (NAVFAC), Base Realignment and Closure (BRAC) Program Management Office (PMO) West for submittal to USEPA Region 9, California Department of Toxic Substances Control (DTSC), and the California Regional Water Quality Control Board, San Francisco Bay Region (Regional Water Board).

1.1 Purpose and Approach

The purpose of the Five-Year Review is to evaluate the implementation and performance of site remedies to determine whether these remedies are, and will continue to be, protective of human health and the environment in accordance with the requirements set forth in each of the decision documents. The Five-Year Review included a document and data review, required visual site inspections, and interviews. The methods, findings, and conclusions identified during the review are presented in this Five-Year Review Report.

A statutory Five-Year Review is required for sites where: (1) concentrations of hazardous substances, pollutants, or contaminants remain at the sites at levels above those that allow for unlimited use and unrestricted exposure (UU/UE), and (2) the Records of Decision (RODs) for the sites were signed on or after October 17, 1986 (the effective date of the Superfund Amendments and Reauthorization Act). The triggering action for statutory Five-Year Reviews at HPNS was the date of mobilization for the remedial action (RA) activities at Parcel B, which was July 8, 1998. The triggering action for this Fifth Five-Year Review is the signature of the Fourth Five-Year Review, July 31, 2019 (Navy, 2019).

1.2 Environmental Restoration Program

Following inclusion of HPNS on the NPL in 1989, in 1992, the Navy, USEPA, and California Environmental Protection Agency signed a Federal Facilities Agreement (FFA). In the FFA, sites proposed for characterization during the confirmation study were reclassified within the Remedial Investigation (RI)/Feasibility Study (FS) framework of CERCLA into Operable Units because the Navy's intent was to maintain HPNS as an active facility. The focus of the FFA was subsequently changed to expedite transfer and public reuse of HPNS, so the Navy and regulatory agencies divided HPNS into geographic parcels (Parcels A through E) in 1992. In 1996, a sixth parcel was added (Parcel F, the offshore area), which encompasses areas immediately adjacent to San Francisco Bay. The parcels were further divided to expedite transfer as follows:

- In 2008, the Navy subdivided Parcel D into four separate parcels (D-1, D-2, G, and UC-1) and separated the western edge of Parcel C to create Parcel UC-2. The Navy also separated Installation Restoration (IR) Sites 07 and 18 (referred to as IR-07/18) from Parcel B to expedite remedy completion and transfer of the sites.
- In 2012, the Navy separated the Crisp Road roadway and adjacent areas of Parcel E to create Parcel UC-3. The UC-series parcels encompass mostly roadways and were created to facilitate the overall transfer and development of HPNS.
- In 2013, the Navy subdivided Parcel B, excluding IR-07/18, into two separate parcels (B-1 and B-2) to accommodate varying property transfer schedules for different portions of the original parcel. In 2015, the Navy transferred Parcels D-2, UC-1, and UC-2 to the City and County of San Francisco's Office of Community Investment and Infrastructure (OCII).

Figure 1-1 shows the current status and boundaries of the parcels.

Results of studies and initial response actions that were initiated before the FFA were incorporated, as appropriate, into additional investigations and studies in each major parcel. At each HPNS parcel, contaminated sites were designated as IR sites based on information developed during previous investigations. In most cases, IR sites were identified by a two-digit number (for example, IR-02). Site characterization activities and sampling data were mostly planned and organized by IR site. To assess risk, the BRAC Cleanup Team (BCT) agreed to divide all of HPNS into two different sized grids (residential and industrial) as a method of statistically calculating risk within an area for different future land use scenarios. RODs were prepared by parcel. **Figure 1-2** shows the parcel boundaries and locations of the IR sites across HPNS.

In general, remedies are applied by parcel with some exceptions for individual IR sites and remedial units (RUs), as discussed in their respective parcel sections of this Five-Year Review Report. The parcel sections are discussed by Former Parcels B, C, D, and E because all pre-ROD investigation work was completed before subdividing into smaller parcels to facilitate transfer. **Table 1-1** summarizes the major parcels or subdivided parcels, ROD signature date, basis for action, remedy components, Fourth Five-Year Review protectiveness determination, and inclusion in the Fifth Five-Year Review.

1.3 Installation Background and Setting

This section provides background information on HPNS and consists of location and physical setting, geography, topography, geology and hydrogeology, and land and resource use.

Information is summarized from the Fourth Five-Year Review (Navy, 2019) unless otherwise noted.

1.3.1 Location and Physical Setting

HPNS is located in the City and County of San Francisco, California (**Figure 1-1**). It encompasses 934 acres (491 acres on land and 443 acres under water in the San Francisco Bay) in southeastern San Francisco on a peninsula that extends east into San Francisco Bay. HPNS is currently divided into nine parcels (Parcels B-1, B-2, C, D-1, E, E-2, F, G, and UC-3) and two independent IR sites (IR-07/18) (**Figure 1-1**). HPNS formerly included Parcels A-1, A-2, D-2, UC-1, and UC-2, which since have been transferred out of federal ownership to the City and County of San Francisco OCII. Parcels A-1 and A-2 are acceptable for UU/UE and are not subject to the Five-Year Review. Issues affecting protectiveness were identified during the Fourth Five-Year Review for Parcels D-2, UC-1, and UC-2 and, although they are no longer under federal ownership, they are included in this Five-Year Review to document progress toward meeting the recommendations set forth in the Fourth Five-Year Review.

The Navy created most of the dry land portion of HPNS in the 1940s by excavating the hills surrounding the shipyard and using the resulting spoils to expand the shoreline into San Francisco Bay. Additional filling operations continued into the 1960s. The shoreline at HPNS is predominantly constructed seawalls, dry docks, engineered shoreline armoring and revetments, and seawalls. Shoreline and offshore areas at HPNS are considered environmentally sensitive areas, and effects to wildlife in environmentally sensitive areas were considered during the remedy selection and design process.

1.3.2 Topography

HPNS is characterized by a central hill (Former Parcel A) that slopes radially out to San Francisco Bay. Ground surface elevations of the parcels range from 30 to 60 feet above mean sea level (msl) near the landward edges and 0 feet above msl as they meet the bay. Large areas of HPNS are flat lowlands with elevations ranging from 10 to 15 feet above msl, where most of the Base roads, buildings, and operating areas were built.

1.3.3 Geology and Hydrogeology

The peninsula that forms HPNS is within a northwest-trending belt of Franciscan Complex Bedrock known as the Hunters Point Shear Zone. HPNS is underlain by five geologic units: the youngest being of Quaternary age and the oldest being the Franciscan Complex Bedrock of Jurassic-Cretaceous age. In general, the stratigraphic sequence of these geologic units, from youngest (shallowest) to oldest (deepest), is as follows: Artificial Fill, Undifferentiated Upper Sand Deposits, Bay Mud Deposits, Undifferentiated Sedimentary Deposits, and Franciscan Complex Bedrock. The Franciscan Complex contains a variety of rock types, including basalt, chert, sandstone, shale, and serpentinite. Some of these rock types contain wide-ranging concentrations of naturally occurring metals; serpentinite also contains naturally occurring asbestos minerals. Artificial Fill covers the entire surface, except for colluvium and alluvium on the hillside at the southern edge (Navy, 2009).

There are three hydrostratigraphic units that are relevant to environmental investigations at HPNS: (1) the A-aquifer, (2) the B-aquifer, and (3) the bedrock water-bearing zone. An aquitard composed of Bay Mud separates the A-aquifer and B-aquifer. The following is a summary of each unit (Navy, 2019):

- The **A-aquifer** is present throughout most of HPNS and primarily consists of heterogeneous Artificial Fill but may also consist of the following underlying layers: Undifferentiated Upper Sand Deposits, sandy units within the uppermost Bay Mud, and upper weathered bedrock zone. The A-aquifer is generally unconfined, but semiconfined conditions may exist where fine-grained sediments overlie more permeable materials. The aquifer ranges in thickness from a few feet to greater than 50 feet. Groundwater elevations range from about -1 to +7 feet relative to msl (TRBW, 2022). Primary sources of recharge for the A-aquifer are infiltration of precipitation and runoff, leakage from utilities, intrusion of bay water, horizontal flow of groundwater from upgradient areas, and vertical flow of water from the B-aquifer.
- **Bay Mud** acts as an aquitard that typically separates the A-aquifer from the underlying B--aquifer. The Bay Mud Deposits consist of highly plastic clay to sandy clay and generally thicken from 0 feet near the historical shoreline to more than 50 feet thick near the bay margin. The Bay Mud aquitard is absent in several locations across HPNS and in areas of bedrock highs. In most areas where the Bay Mud is absent, a Sandy Lean Clay layer is present which also acts as an aquitard.
- The **B-aquifer** consists of Undifferentiated Sedimentary Deposits in a sequence of relatively thick (about 30 to 40 feet), laterally continuous layers of sand and silty and clayey sand, which are separated by laterally continuous layers of silt and clay. The upper portions of the B-aquifer contain layers of less permeable silts and clay that impede downward migration, making the B-aquifer less likely to be affected by contamination from site activities. The uppermost B-aquifer generally corresponds to the upper 20- to 40-foot-thick layer of sand and silty sand of Undifferentiated Sedimentary Deposits. The B-aquifer is generally confined by the Bay Mud aquitard. In areas where the aquitard is absent, the A- and B-aquifers are in hydraulic communication and behave as a single aquifer. The primary sources of recharge for the B-aquifer include infiltration of precipitation and runoff and horizontal groundwater flow from upgradient areas.
- The **fractured water-bearing zone** consists of the deeper portions of saturated fractured bedrock that are not in direct contact with the A- or B-aquifers. The fractured, unweathered bedrock is not considered an aquifer because of its limited flow capability and low storage capacity. The bedrock water-bearing zone likely discharges into the B-aquifer at upgradient contacts and is recharged by infiltration of precipitation at landward outcrop areas.

1.3.4 Land and Resource Use

1.3.4.1 Past and Present Land Uses

Various industrial activities at HPNS, including shipbuilding and repair, metal working, degreasing, painting, foundry operations, radiological research, and other industrial operations, have resulted in a broad distribution of chemicals in soil, soil gas, sediment, groundwater, and structures. These chemicals include metals, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs) (including polycyclic aromatic hydrocarbons [PAHs]), pesticides, polychlorinated biphenyls (PCBs), total petroleum hydrocarbons (TPH), and radionuclides.

Bethlehem Steel owned and operated a commercial dry dock facility in the HPNS area until 1939 when the Navy purchased the property. Quays, docks, and support buildings were built on an expedited wartime schedule to support the shipyard’s mission of fleet repair and maintenance. After the end of World War II, the Navy used the berthing facilities at HPNS for ships returning from the Pacific. By 1951, HPNS shifted from a general repair facility to specializing in submarine maintenance and repair but continued to operate Pacific Fleet carrier overhaul and ship maintenance repair facilities through the 1960s. During the 1950s and 1960s, until 1969, the Naval Radiological Defense Laboratory (NRDL) occupied buildings at HPNS to conduct practical and applied research on radiological decontamination methods and on the effects of radiation on living organisms and natural and synthetic materials. HPNS was disestablished as an active Naval facility in 1974 (NAVSEA, 2004).

From July 1, 1976, to June 30, 1986, the Navy leased 98 percent of HPNS to a private ship repair company, Triple A Machine Shop, Inc. (Triple A). Triple A used dry docks, berths, machine shops, power plants, various offices, and warehouses to repair commercial and Navy vessels. Triple A also subleased portions of the property to various other businesses. In 1986, the Navy resumed occupancy of HPNS. Triple A vacated the property in March 1987.

Currently, the San Francisco Police Department occupies a portion of Parcel E, and an artist colony occupies a portion of Parcel B-1. There are no other current land uses on Navy-owned property with the exception of environmental remediation activities.

1.3.4.2 Future Land Uses

The City and County of San Francisco OCII's HPNS Redevelopment Plan, developed in 1997 and amended in 2010 (SFRA, 2010) and 2018 (OCII, 2018), described the anticipated future use of HPNS. The Redevelopment Plan delineates "land use districts" in the subdivision of HPNS and describes the allowable uses within each land use district. **Figure 1-3** shows land use districts used at the time of the RODs, or ROD amendments, which were used for exposure scenario assumptions in human health risk assessments (HHRAs). The following is a summary of land use districts and associated HHRA exposure scenarios:

Human Health Risk Assessment Exposure Scenario	Land Use District
Industrial Use	Education/Cultural (museums, cultural centers, civic, arts, and entertainment facilities)
	Industrial and Maritime-Industrial (light industrial use)
Residential Use	Research and Development (including some residential use)
	Mixed Use (including mixed density residential, commercial/retail)
Recreational Use	Open Space (parks and recreational areas)

The HPNS Redevelopment Plan was updated in 2018 (OCII, 2018). The Navy will coordinate with the City of San Francisco to address any post-ROD changes needed for consistency with updated development plans and prepare appropriate post-ROD change documentation. Additionally, future land use will be required to comply with any environmental restrictions recorded in the Quitclaim Deed and Covenant to Restrict Use of Property developed during property transfer (OCII, 2018).

Implementation of Institutional Controls

The remedies for each parcel were selected and designed to be protective of human health and the environment for planned future land use. One component of the remedy is institutional controls (ICs), which are legal and administrative mechanisms used to implement land use restrictions that limit the exposure of future landowners or users of the property to hazardous substances present on the property and to ensure the integrity of the RA. ICs are required on a property where the selected remedial cleanup levels result in contamination remaining at the property greater than levels that allow for UU/UE. ICs will be maintained until the concentrations of hazardous substances in soil and groundwater are at such levels to allow for UU/UE. Implementation of ICs includes requirements for monitoring and inspections and reporting to ensure compliance with land use or activity restrictions.

Although ICs are implemented on a parcel-by-parcel basis, the ICs are consistently implemented across all parcels designated as areas requiring institutional controls (ARICs). **Table 1-2** presents a summary of each IC and respective performance objective and applicability by parcel. The land use and activity restrictions will be met by controlling access to each parcel until the time of transfer. The land use and activity restrictions are described in the Land Use Control (LUC) RD Reports referenced in each respective section and will be incorporated into the Quitclaim Deed and Covenant to Restrict Use of Property and will take effect upon transfer to the City and County of San Francisco's OCII and issuance of those documents. **Figure 1-4** presents the current proposed ARIC boundaries and ICs.

1.3.4.3 Surface Water and Groundwater Use

With the exception of Parcel F (sediments in the San Francisco Bay surrounding HPNS) and constructed wetlands at Parcel E, no permanent surface water features exist at HPNS. Surface water runoff flows to nearby San Francisco Bay or infiltrates into the ground. Groundwater beneath HPNS is not currently used for drinking water, irrigation, or industrial supply. The City and County of San Francisco supplies drinking water to HPNS through its municipal supply from the Hetch Hetchy watershed in the Sierra Nevada.

On September 25, 2003, Regional Water Board staff concurred with the Navy that A-aquifer groundwater at HPNS meets the exception criteria in the State Water Resources Control Board (SWRCB) Resolution No. 88-63, "Sources of Drinking Water"; therefore, groundwater in the A-aquifer is not suitable as a potential source of drinking water. Likewise, on July 29, 2008, Regional Water Board staff concurred with the Navy that B-aquifer groundwater in the central and southern area of Parcel C meets the exception criteria in SWRCB Resolution No. 88-63, "Sources of Drinking Water"; therefore, groundwater in the B-aquifer at those locations is not suitable as a potential source of drinking water.

Similar to the evaluation for SWRCB Resolution No. 88-63, the Navy concluded that maximum contaminant levels (MCLs) were not applicable or relevant and appropriate requirements (ARARs) for CERCLA cleanups at HPNS for the A-aquifer based on an evaluation of site-specific- factors (ChaduxTt, 2007; SulTech, 2007, 2008; Barajas & Associates, Inc., 2008; and ERRG and Shaw, 2011). Results of the evaluation of site-specific factors are as follows:

- There is no historical or current use of groundwater as a water supply.
- The City and County of San Francisco will not allow the use of groundwater for drinking water because the City of San Francisco prohibits installation of domestic wells within city boundaries.
- Arsenic and other metals occur in A-aquifer groundwater at ambient levels that exceed MCLs, and the cost to reduce concentrations of these chemicals to concentrations less than MCLs would likely be prohibitive, and it may be technically impracticable to do so.
- The proximity of saline groundwater and surface water from San Francisco Bay creates a high potential for saltwater intrusion if significant quantities are produced from the aquifer.

Future drinking water is expected to continue to be supplied by the city's municipal system. The RODs for the various parcels that require RAs all require ICs to prohibit the use of groundwater, and, consequently, future use of groundwater is expected to be prohibited, except for uses allowed by the RODs (for example, maintenance of groundwater monitoring wells). However, the potential use of groundwater in the B-aquifer, although unlikely, is considered in the risk evaluation and basis for action for each parcel, where applicable.

1.4 Basewide Considerations Relevant to the Five-Year Review Process

Basewide evaluations are being conducted to address per- and polyfluoroalkyl substances (PFAS), climate change, and radiological aspects that are relevant to evaluation of the remedies in this Five-Year Review. The status of these Basewide efforts are summarized in the following sections.

1.4.1 Per- and Polyfluoroalkyl Substances

The Navy and USEPA have identified certain PFAS compounds as emerging chemicals of environmental concern. PFAS have been used in a variety of industrial and military applications. Potential releases of PFAS resulting from historical activities conducted at Navy installations, such as use of aqueous film-forming foam (AFFF) during fire and emergency response, testing, and training activities or chromium plating operations, has prompted the Navy to develop and implement a PFAS preliminary assessment (PA)/site inspection (SI) process to identify and prioritize the investigation of sites with known or potential PFAS releases. The Department of Defense (DoD) released guidance related to the use of USEPA-issued Regional Screening Levels (RSLs) in PFAS investigations (ASD, 2023).

A Basewide PA for PFAS was completed in June 2022, which identified areas for further investigation based on historical site use or data collected during previous investigations (Multi-MAC JV, 2022). To provide for a more comprehensive and installation-wide assessment for the potential presence of PFAS at HPNS, groundwater in the A-aquifer zone within all parcels where industrial activities occurred (Parcels B-1, B-2, C, D-1, G, E, and E-2) was further investigated in a PFAS SI (Multi-MAC JV, 2022; Liberty JV, 2023a, 2023b). Because investigation of PFAS is ongoing and it has not yet been determined whether PFAS pose unacceptable risk that requires RA, and because a remedy for PFAS has not yet been determined, a protectiveness determination cannot be made. Rather, parcel-specific discussions as Other Findings in **Sections 3** through **6** present individual areas that were identified for further investigation under the SI, based on historical site use or data collected during previous investigations.

Current exposure pathways for PFAS are potentially incomplete at HPNS. As presented in **Section 1.3.4.3,** groundwater within the A-aquifer (and portions of the B-aquifer within Parcel C) is unsuitable for drinking water. Additionally, the City and County of San Francisco prohibits installation of domestic wells within city and county limits.

For soil, the Navy maintains durable covers and implements ICs to restrict exposure to soil throughout all parcels at HPNS.

1.4.2 Climate Resilience Assessment

The Navy recognizes climate change is occurring and based on a screening level evaluation (**Appendix A**), sea level rise (SLR) is the major variable of climate change that could affect the remedies at HPNS. The screening level climate resilience assessment (CRA) was conducted for HPNS by NAVFAC Expeditionary Warfare Center to assess how climate change-related hazards could potentially affect IR sites at HPNS. The CRA was conducted consistent with guidance provided in the *DoD Climate Assessment Tool (DCAT)* (DoD, 2020), USEPA's *Guidance on Climate Resilience in Superfund Planning* (USEPA, 2021), and the *Draft Sea Level Rise Guidance to DTSC Project Managers for Cleanup Activities* (DTSC, 2023). The CRA identified the coastal flooding caused by SLR as being the primary climate-related hazard for HPNS. Both permanent effects (seawater inundation and groundwater emergence) and transient effects (flooding from storm events) of SLR were assessed. SLR projections from the *DoD Regional Sea Level Database* (DoD, 2021) for the years 2035 and 2065 were used, with 1992 serving as the baseline year. The Navy has extensive groundwater elevation data collected annually from over 100 monitoring wells since 2002. The evaluation of this data shows groundwater level has a significant amount of variability from year to year and there is no consistent upward trend.

The initial evaluation identified the potential for permanent groundwater emergence impacts in approximately 2035 at D-1 and IR-07/18 and in approximately 2065 at B-1, B-2, C, D-1, E, and G. Parcels D-2, E-2, G, UC-1, UC-2, and UC-3 are not anticipated to be affected by SLR by 2065. No permanent seawater inundation is projected through 2065 in any of the parcels, but storm surges could lead to transient flooding in all parcels, except D-2 and UC-3, in approximately 2035 and 2065. Further study to validate these projections is needed to assess actual effects of SLR so that the Navy can evaluate, plan, and implement strategies to mitigate the impacts of SLR and groundwater emergence on its CERCLA remedies.

As recommended in Section 6.1 of the CRA (**Appendix A**), the Navy will continue to monitor ongoing groundwater concentration and elevation data onsite through the Basewide Groundwater Monitoring Program (BGMP) and evaluate this data as it relates to the effectiveness of site remedies. The Navy will also regularly evaluate nearby tidal gauge data to verify SLR projections. Additional site-specific vulnerability assessments may be conducted in a timely manner to determine site-specific impacts and what remedy modification may be required. The results of the CRA for each parcel are discussed in the Other Findings section for each respective parcel.

1.4.3 Radiological Retesting and Remediation Goal Evaluation

Radiological surveys and remediation were previously conducted at HPNS as part of a Basewide time-critical removal action (TCRA; Navy, 2006). The radiologically impacted sites evaluated under the TCRA were identified in the Historical Radiological Assessment (NAVSEA, 2004) and included soil and building structures located within Parcels B-1, B-2, C, D-1, D-2, E, G, UC-1, UC-2, and UC-3 (**Figure 1-5**). An independent third-party evaluation identified potential manipulation, falsification, and data quality issues with the TCRA data, (Navy, 2017a, 2017b, 2017c, 2017d, 2018a, 2018c). Radiological retesting, including sampling and surveys of soils previously investigated during sanitary sewer line and storm drain removal and resurvey of impacted buildings and former building sites conducted under the Basewide TCRA (Navy, 2006) is planned or ongoing at all affected parcels.

The Fourth Five-Year Review (Navy, 2019) identified this as an Issue and Recommendation as follows:

Issue: *The Navy has determined that a significant portion of the radiological survey and remediation work completed to date was not reliable because of manipulation and/or falsification of data by one of its radiological contractors. A long-term protectiveness evaluation of the radiological RGs has not yet been completed for this Fourth Five-Year Review, and it is* *currently not known if the RAOs for radionuclides have been achieved in Parcels B-1, B-2, C, D-1, D-2, G, E, UC-1, UC-2, and UC-3.*

Recommendation: *The Navy is in the process of implementing corrective actions to ensure that the radiological remedies specified in the decision documents are implemented as intended. In addition, the Navy is in the process of conducting a long-term protectiveness evaluation of the ROD radiological RGs. After finalization of the Five-Year Review, the Navy will issue a draft addendum evaluating the long-term protectiveness of the RGs for soil using RESRAD and the USEPA's Preliminary Remediation Goal (PRG) Calculator for radiation risk to human health. Another draft addendum evaluating the long-term protectiveness of the RGs for buildings (for both residential and commercial/industrial scenarios) will also be issued. The draft addenda will include explanations of the proposed site-specific inputs and will be issued to the public and regulatory agencies for a 30-day review and comment period. The Navy will prepare responses to regulatory agency comments and a responsiveness summary to comments from the public. The results of the final evaluations will inform the retesting sensitivity and cleanup thresholds. These risk evaluations may also inform future risk management decisions and the potential for post-ROD changes, if appropriate. It is anticipated that the radiological rework will be completed prior to the next Five-Year Review.*

1.4.3.1 Progress Since the Fourth Five-Year Review

The Navy is currently in the process of implementing corrective actions, which includes the radiological retesting of the impacted areas evaluated under the TCRA. Progress for each parcel is discussed in their respective sections. Additionally, the Navy evaluated the radiological remediation goals (RGs) to ensure the radiological remedies will be protective in the long term, with human health risk within the risk range as described in the National Oil and Hazardous Substances Pollution Contingency Plan. Following the recommendation from the Fourth Five-Year Review, the Navy issued addendums evaluating the long-term protectiveness of the RGs for soil and building structures, which concluded that the current RGs are protective for all future land users (Navy, 2020a, 2020b). Radiological retesting is planned and/or currently underway to verify that the RGs, which were determined to be protective and remain valid, have been met for each parcel that was identified in the Fourth Five-Year Review.

1.5 Report Organization

The Five-Year Review for HPNS consists of seven sections, organized as follows:

- **Section 1.0** — Introduces the Five-Year Review and its purpose and provides the background of HPNS.
- **Section 2.0** — Describes the Five-Year Review process.
- **Sections 3.0 through 7.0** — Evaluates each of the parcels included in the Fifth Five-Year Review. Discussion elements for each parcel include the site history and background, site chronology, and site characterization; description of RAs (remedy implementation and remedy operations and maintenance [O&M]); progress since the Fourth Five-Year Review; technical assessment; issues, recommendations, and follow-up actions; and statement of protectiveness. References, figures, and tables are provided at the end of each section.

Appendixes are provided at the end of the document.

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Table 1-1. Summary of Hunters Point Naval Shipyard Parcels for Five-Year Review

Parcel		ROD Signature Date	Basis for Action	Remedy Components	Fourth Five-Year Review Protectiveness Determination	Inclusion in the Fifth Five-Year Review	Fifth Five-Year Review Protectiveness Determination
A		11/16/1995	None	Not Applicable	Not Applicable	No	Not Applicable
B	IR-07/18	ROD: 10/7/1997 ESD: 8/24/1998 ESD: 5/4/2000 Amended ROD: 1/14/2009	Human Health Risks - exposure to chemicals in soil, soil gas, groundwater Ecological Risks - exposure to chemicals in sediment and groundwater to surface water pathway Radiologically Impacted Media	Soil excavation and offsite disposal Durable covers to prevent exposure to COCs and ROCs Monitoring for methane in soil gas Monitoring for COCs and ROCs in groundwater Radiological scanning and excavation and disposal of anomalies ICs	Protective	Yes	Protective
	B-1			Soil excavation and offsite disposal Durable covers to prevent exposure to COCs SVE In situ biological treatment for VOCs in groundwater Monitoring for COCs in groundwater Excavation and disposal of radiologically impacted soil and structures Radiological scanning and unrestricted release of buildings, former building sites, and radiologically impacted areas ICs	Will be protective	Yes	Short-term Protective
	B-2			Soil excavation and offsite disposal Durable covers to prevent exposure to COCs In situ stabilization of metals in groundwater Monitoring for COCs in groundwater Excavation and disposal of radiologically impacted soil and structures Radiological scanning and unrestricted release of buildings, former building sites, and radiologically impacted areas ICs	Will be protective	Yes	Short-term Protective

Table 1-1. Summary of Hunters Point Naval Shipyard Parcels for Five-Year Review

Parcel		ROD Signature Date	Basis for Action	Remedy Components	Fourth Five-Year Review Protectiveness Determination	Inclusion in the Fifth Five-Year Review	Fifth Five-Year Review Protectiveness Determination
C	C	ROD: 9/30/2010 ESD: 10/2014	Human Health Risks - exposure to chemicals in soil, soil gas, groundwater Ecological Risks - groundwater to surface water pathway only Radiologically Impacted Media	Soil excavation and offsite disposal Durable covers to prevent exposure to COCs In situ remediation (ZVI, biological treatment) and performance monitoring for COCs in groundwater MNA for COCs in groundwater SVE Excavation and disposal of radiologically impacted soil and structures Radiological scanning and unrestricted release of buildings, former building sites, and radiologically impacted areas ICs	Will be protective	Yes	Short-term Protective
C	UC-2	12/17/2009	Human Health Risks - exposure to chemicals in soil, soil gas, groundwater Radiologically Impacted Media	Durable covers to prevent exposure to COCs Monitoring for COCs in groundwater Decontamination or dismantling and offsite disposal of radiologically impacted structures Excavation and disposal of radiologically impacted storm drain and sanitary sewer lines and associated soil Radiological scanning unrestricted release ICs	Short-term protective	Yes	Short-term Protective
D	D-1	12/17/2009	Human Health Risks - exposure to chemicals in soil, soil gas, groundwater Ecological Risks - groundwater to surface water pathway only Radiologically Impacted Media	Soil excavation and offsite disposal Durable covers to prevent exposure to COCs In situ remediation for groundwater (not necessary after completion of pre-ROD pilot study) MNA for COCs in groundwater Excavation and disposal of radiologically impacted soil and structures Radiological scanning and unrestricted release of buildings, former building sites, and radiologically impacted areas ICs	Short-term protective	Yes	Short-term Protective

Table 1-1. Summary of Hunters Point Naval Shipyard Parcels for Five-Year Review

Parcel		ROD Signature Date	Basis for Action	Remedy Components	Fourth Five-Year Review Protectiveness Determination	Inclusion in the Fifth Five-Year Review	Fifth Five-Year Review Protectiveness Determination
D	UC-1	12/17/2009	Human Health Risks - exposure to chemicals in soil and soil gas Radiologically Impacted Media	Durable covers to prevent exposure to COCs Decontamination or dismantling and offsite disposal of radiologically impacted structures Excavation and disposal of radiologically impacted storm drain and sanitary sewer lines and associated soil Radiological survey and unrestricted release ICs	Short-term protective	Yes	Short-term Protective
D	D-2	8/9/2010	None	No Further Action - At the time of the ROD, the basewide radiological TCRA had addressed all potential risks associated with radionuclides; included in Fourth Five-Year Review because of ongoing radiological re-scan	Short-term protective	Yes	Short-term Protective
D	G	ROD: 2/18/2009 ESD: 4/18/2017	Human Health Risks - exposure to chemicals in soil, soil gas, groundwater Ecological Risks - groundwater to surface water pathway only Radiologically Impacted Media	Soil excavation and offsite disposal Durable covers to prevent exposure to COCs In situ remediation for groundwater (not necessary after completion of pre-ROD pilot study) MNA for COCs in groundwater Excavation and disposal of radiologically impacted soil and structures Radiological scanning and unrestricted release of buildings, former building sites, and radiologically impacted areas ICs	Short-term protective	Yes	Short-term Protective

Table 1-1. Summary of Hunters Point Naval Shipyard Parcels for Five-Year Review

Parcel		ROD Signature Date	Basis for Action	Remedy Components	Fourth Five-Year Review Protectiveness Determination	Inclusion in the Fifth Five-Year Review	Fifth Five-Year Review Protectiveness Determination
E	E	12/1/2013	Human Health Risks - exposure to chemicals in soil, soil gas, groundwater Ecological Risks - exposure to chemicals in shoreline sediments, groundwater to surface water pathway Presence of NAPL Radiologically Impacted Media	Excavation and offsite disposal of soil and sediment Closure of steam and fuel line systems potentially acting as an ongoing source of contamination Durable covers to prevent exposure to COCs and ROCs SVE In situ treatment of groundwater In situ treatment and removal of NAPL Below-grade barriers (slurry wall) to limit COC migration in groundwater and NAPL migration Monitoring of groundwater COCs Excavation and disposal of radiologically impacted structures and soil Radiological scanning and unrestricted release of buildings and former building sites ICs	Will be protective	Yes	Will Be Protective
	E-2	11/1/2012	Human Health Risks - exposure to chemicals in soil, landfill gas, groundwater Ecological Risks - exposure to chemicals in shoreline sediments, groundwater to surface water pathway Presence of Waste Radiologically Impacted Media	Excavation and offsite disposal of soil and sediment Durable covers to prevent exposure to COCs Landfill cap to prevent exposure to COCs and landfill material Collection, treatment, and monitoring of landfill gas In situ treatment of groundwater COCs Below-grade barriers to limit groundwater migration into and out of landfill material Monitoring of groundwater COCs and landfill compliance monitoring Radiological scanning and treatment of radiologically impacted materials during remedy implementation Radiological survey of final cover ICs	Will be protective	Yes	Will Be Protective

Table 1-1. Summary of Hunters Point Naval Shipyard Parcels for Five-Year Review

Parcel		ROD Signature Date	Basis for Action	Remedy Components	Fourth Five-Year Review Protectiveness Determination	Inclusion in the Fifth Five-Year Review	Fifth Five-Year Review Protectiveness Determination
E	UC-3	1/1/2014	Human Health Risks - exposure to chemicals in soil, soil gas, groundwater Radiologically Impacted Media	Durable covers to prevent exposure to COCs In situ treatment of VOCs in groundwater Monitoring for COCs in groundwater Excavation and disposal of radiologically impacted storm drain and sanitary sewer lines and associated soil Radiological scanning unrestricted release ICs	Short-term protective	Yes	Short-term Protective
F	F	PENDING	Human Health Risks - consumption of seafood Ecological Risks - exposure to chemicals in sediment	Focused removal of sediment and backfill with clean fill Capping to prevent exposure to COCs in sediment Monitored natural recovery ICs	Not Applicable (ROD was not signed)	No	Not Applicable

COC = chemical of concern
ESD = Explanation of Significant Differences
IC = institutional control
MNA = monitored natural attenuation
NAPL = nonaqueous phase liquid
ROC = radionuclide of concern
ROD = Record of Decision
SVE = soil vapor extraction
TCRA = time-critical removal action
VOC = volatile organic compound
ZVI = zero-valent iron

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Table 1-2. Institutional Controls Summary

Institutional Control	Performance Objectives	Parcels										
		IR-07/18	B-1	B-2	C	UC-2	D-1	UC-1	G	E	E-2	UC-3
ARIC for Soil and Groundwater Use: General	Restricted activities must be conducted in accordance with the Covenant(s) to Restrict Use of Property, Quitclaim Deed(s), O&M Plan(s), LUC RD Report, Parcel-specific RMP(s), and, if required, any other work plan or document approved in accordance with these referenced documents: a. “Land disturbing activity” includes, but is not limited to, the following: (1) excavation of soil, (2) construction of roads, utilities, facilities, structures, and appurtenances of any kind, (3) demolition or removal of “hardscape” (for example, concrete roadways, parking lots, foundations, and sidewalks), (4) any activity that involves movement of soil to the surface from below the surface of the land, and (5) any other activity that causes or facilitates the movement of known contaminated groundwater. b. Alteration, disturbance, or removal of any component of a response or cleanup action (including but not limited to pump-and-treat facilities, revetment walls and shoreline protection, and soil cap/containment systems); groundwater extraction, injection, and monitoring wells and associated piping and equipment; or associated utilities. c. Extraction of groundwater and installation of new groundwater wells. d. Removal of or damage to security features (for example, locks on monitoring wells, survey monuments, fencing, signs, or monitoring equipment and associated pipelines and appurtenances). Prohibited Activities: a. Growing vegetables, fruits, or any edible items in native soil for human consumption.[a] b. Use of groundwater.	●	●	●	●	●	●	●	●	●	●	●
Restrictions Related to VOC Vapors	Any proposed construction of enclosed structures must be approved in accordance with the Covenant(s) to Restrict Use of the Property, Quitclaim Deed(s), LUC RD, and RMPs before conducting such activity within the ARIC for VOC vapors to ensure that the risks of potential exposures to VOC (and SVOC, as applicable) vapors are reduced to acceptable levels that are adequately protective of human health. The reduction in potential risk can be achieved through engineering controls or other design alternatives that meet the specifications set forth in the Amended ROD, RD Reports, LUC RD Report, and RMPs. The ARIC for VOC (and SVOC, as applicable) vapors may be modified by the FFA signatories (and CDPH as applicable), as the soil contamination areas and groundwater contaminant plumes that are producing unacceptable vapor inhalation risks are reduced over time or in response to further soil, vapor, and groundwater sampling and analysis for VOCs that establishes that areas now included in the ARIC for VOC vapors do not pose an unacceptable potential exposure risk to VOC vapors.	◐	◐	◐	●	◐	◐	◐	◐	◐		◐
ARIC for Soil and Groundwater Use: Within Areas Designated for Open Space, Educational/ Cultural, and/or Industrial Reuse (**Figure 1-3**)	Use restricted unless prior written approval for other uses is granted by the FFA signatories and CDPH (as applicable). In addition, the following land uses are specifically prohibited within the ARIC for radionuclides unless prior written approval for these uses is granted by the FFA signatories and CDPH (as applicable): a. A residence, including any mobile home or factory-built housing, constructed or installed for use as residential human habitation b. A hospital for humans c. A school for persons under 21 years of age d. A daycare facility for children	◐			◐	◐	●	◐	◐	◐	●	◐
	e. Any permanently occupied human habitation, including those used for commercial or industrial purposes.										●	

Table 1-2. Institutional Controls Summary

Institutional Control	Performance Objectives	Parcels IR-07/18	B-1	B-2	C	UC-2	D-1	UC-1	G	E	E-2	UC-3
Radiologically Impacted Soil and Structures	For land-disturbing activities, as defined previously and including installation of water lines, storm drains, or sanitary sewers, above the demarcation layer, the LUC RD Report, O&M Plan, RMP, or a project-specific work plan, if applicable, will list the procedures for ensuring that the cap is not disturbed or breeched. The specific design of the cap and clean soil cover will be agreed to in the RD.											
	The installation of water or sewer lines below the demarcation layer will be prohibited unless written approval is granted by the FFA signatories and CDPH.	◐								◐		
	Excavation into site soils within the ARIC for radionuclides beneath the demarcation layer is strictly prohibited unless approved in writing by the FFA signatories and CDPH (as applicable). Any proposed excavation will be required to be described in a work plan that will include, but not be limited to, a radiological work plan, the identification of a radiological safety specialist, a soil management plan, soil sampling and analysis requirements, and a plan for offsite disposal of any excavated radionuclides by the transferee in accordance with federal and state law. The integrity of the cover/cap must be restored upon completion of excavation as provided in the O&M Plan(s), LUC RD Report(s), or similar document.										●	
Landfill Gas	Any proposed construction of enclosed structures must be approved in accordance with the Covenant to Restrict Use of the Property, Quitclaim Deed(s), LUC RD Report, and, if deemed necessary, the Parcel E-2 RMP before conducting such activities within the ARIC to ensure compliance with the substantive provisions of Cal. Code Regs. tit. 27 § 21190(a), (b), (d), (e), (f), and (g), which require that post-closure land uses be designed and maintained to protect health and safety in areas affected by landfill gas migration. In particular, Cal. Code Regs. tit. 27 § 21190(g) specifies design and construction standards for “all on site construction within 1,000 feet of the boundary of any disposal area.”										●	

[a] For Parcel E: Plants for human consumption may be grown if they are planted in raised beds (above the CERCLA-approved cover) containing non-native soil. Trees producing edible fruit (including trees producing edible nuts) may also be planted provided they are grown in containers with a bottom that prevents the roots from penetrating the native soil.

● = Applies to entire parcel
◐ = Applies to a portion of the parcel
ARIC = area requiring institutional control
Cal. Code Regs. = California Code of Regulations
CDPH = California Department of Public Health
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
FFA = Federal Facilities Agreement
LUC RD = Land Use Control Remedial Design
O&M = operations and maintenance
RD = Remedial Design
ROD = Record of Decision
RMP = Risk Management Plan
SVOC = semivolatile organic compound
VOC = volatile organic compound

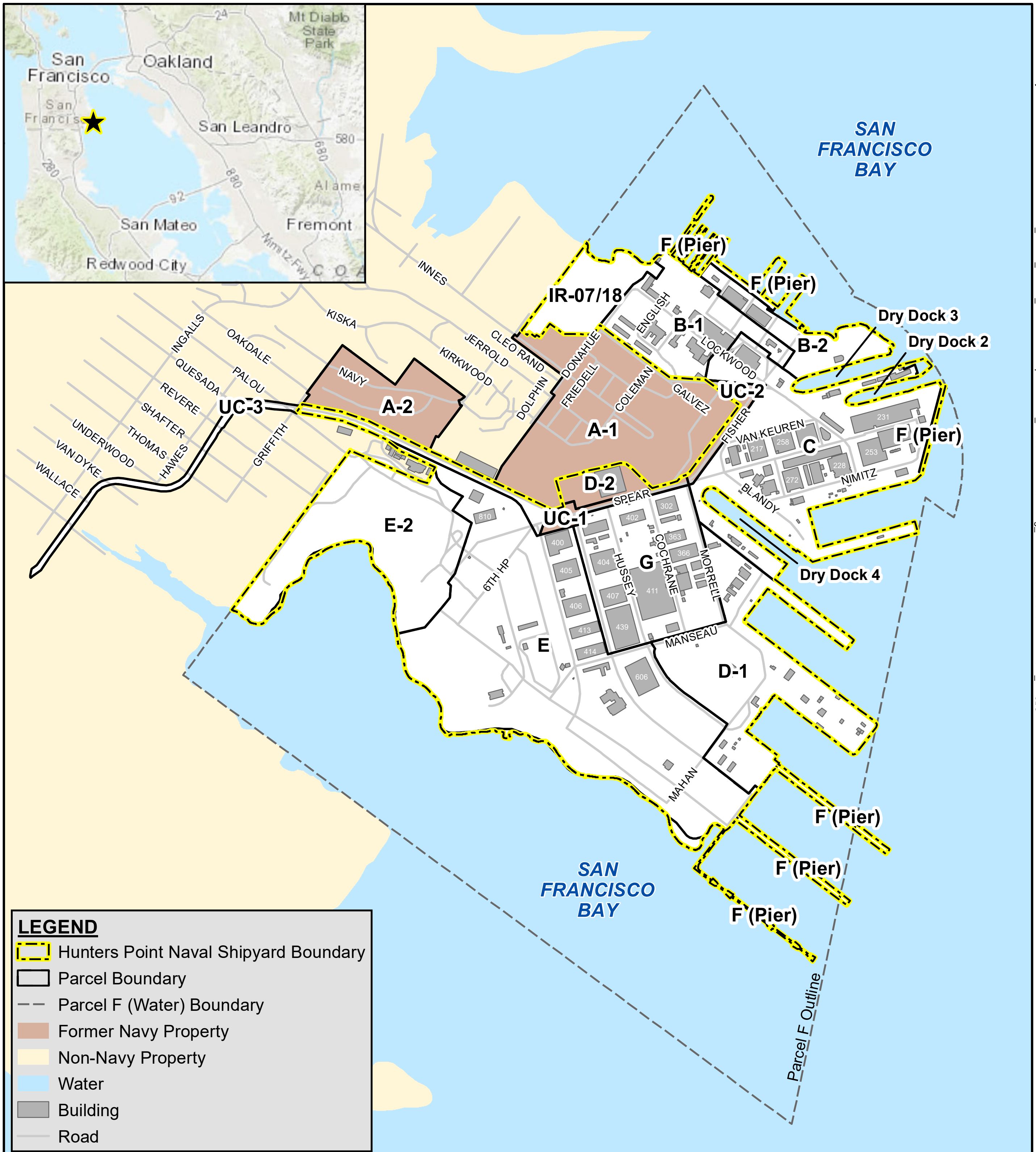

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Figure 1-1
Base Overview Figure/Parcel Map
Fifth Five-Year Review Report
Hunters Point Naval Shipyard, San Francisco, California

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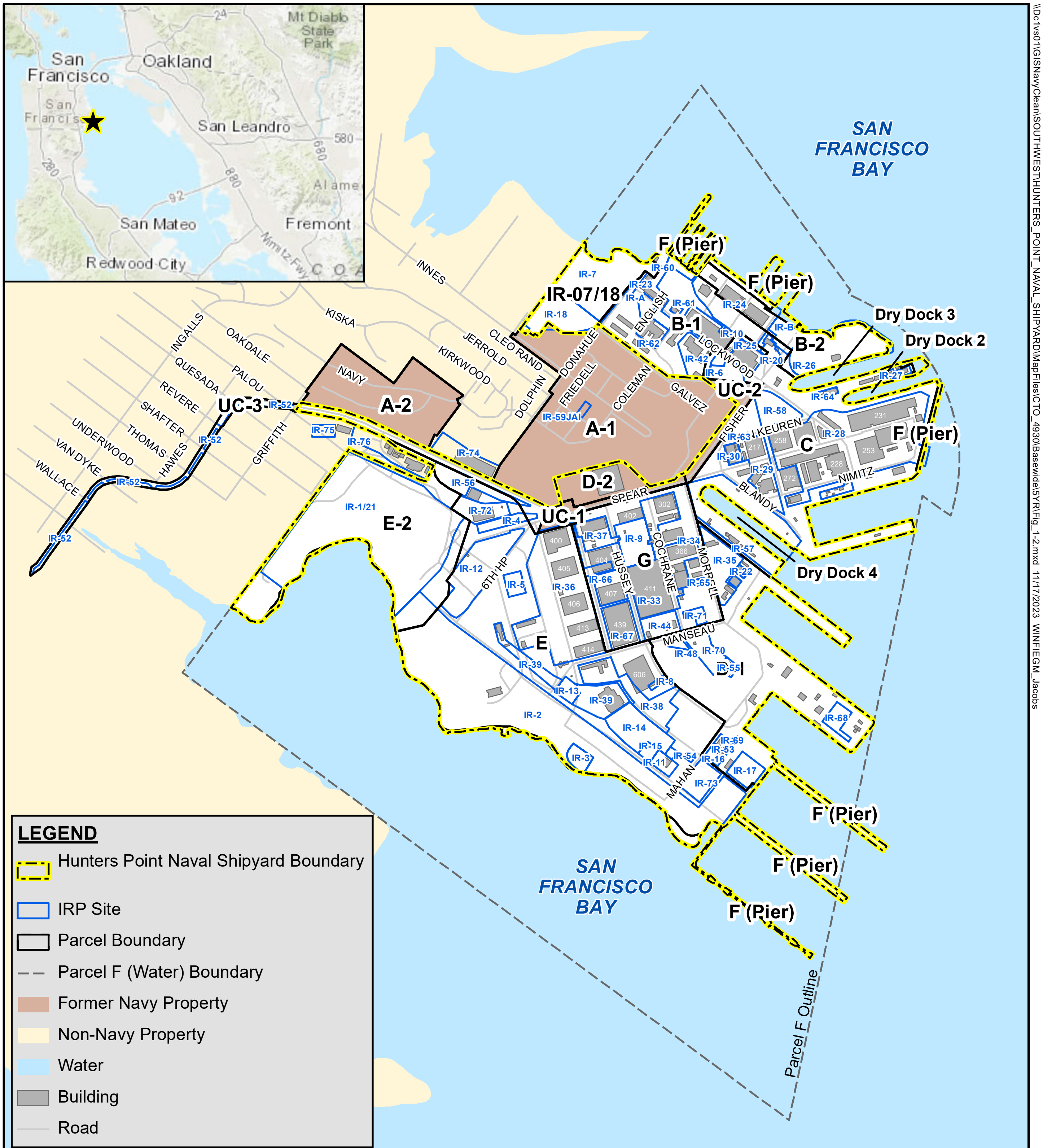

Figure 1-2
Installation Restoration Sites
Fifth Five-Year Review Report
Hunters Point Naval Shipyard, San Francisco, California

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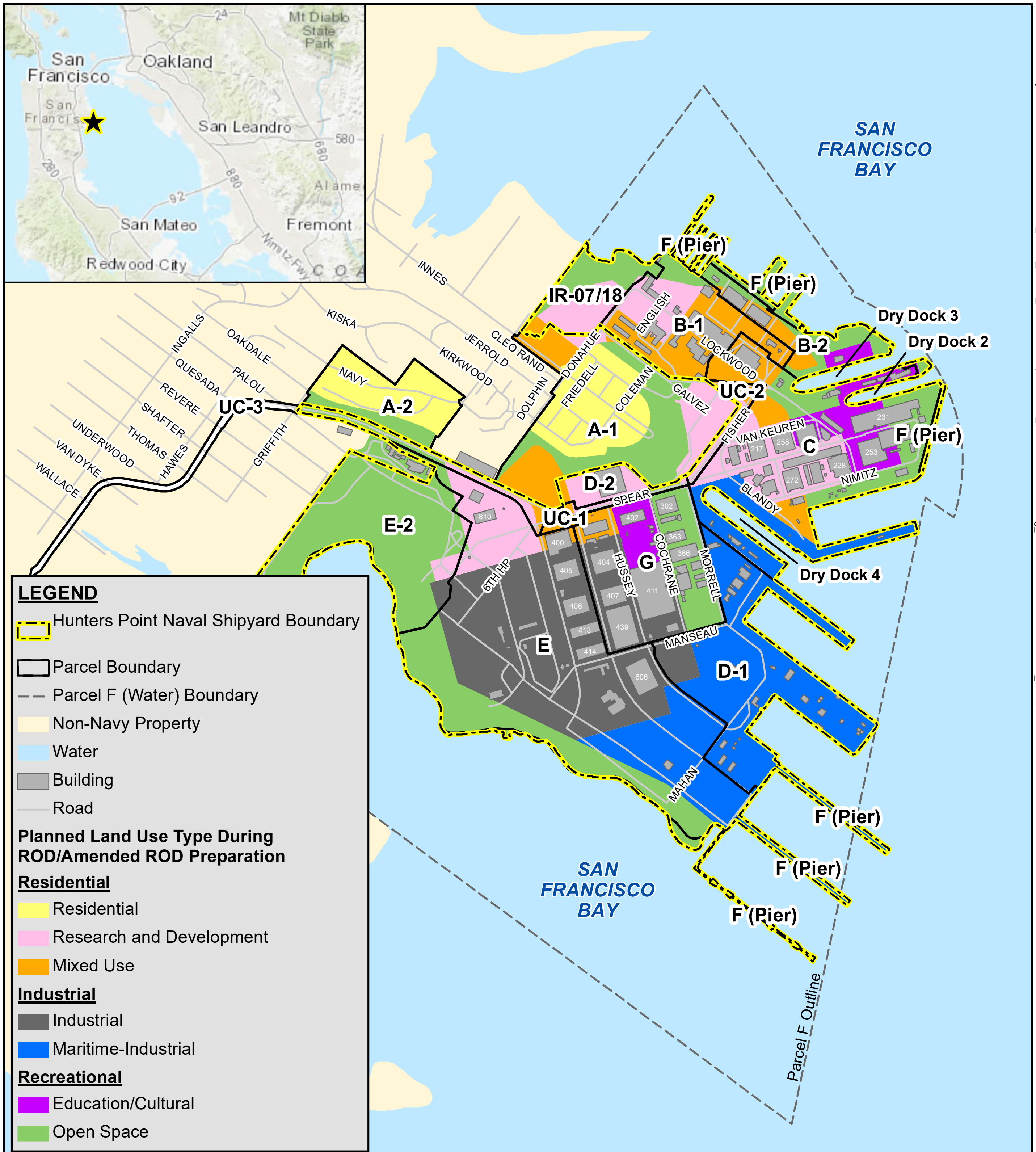

The Redevelopment Plan was updated in 2018.
The Land Use Districts shown on this figure were applicable at the time risk evaluations and development of institutional controls for future use were completed.

Figure 1-3
Land Use Districts
Fifth Five-Year Review Report
Hunters Point Naval Shipyard, San Francisco, California

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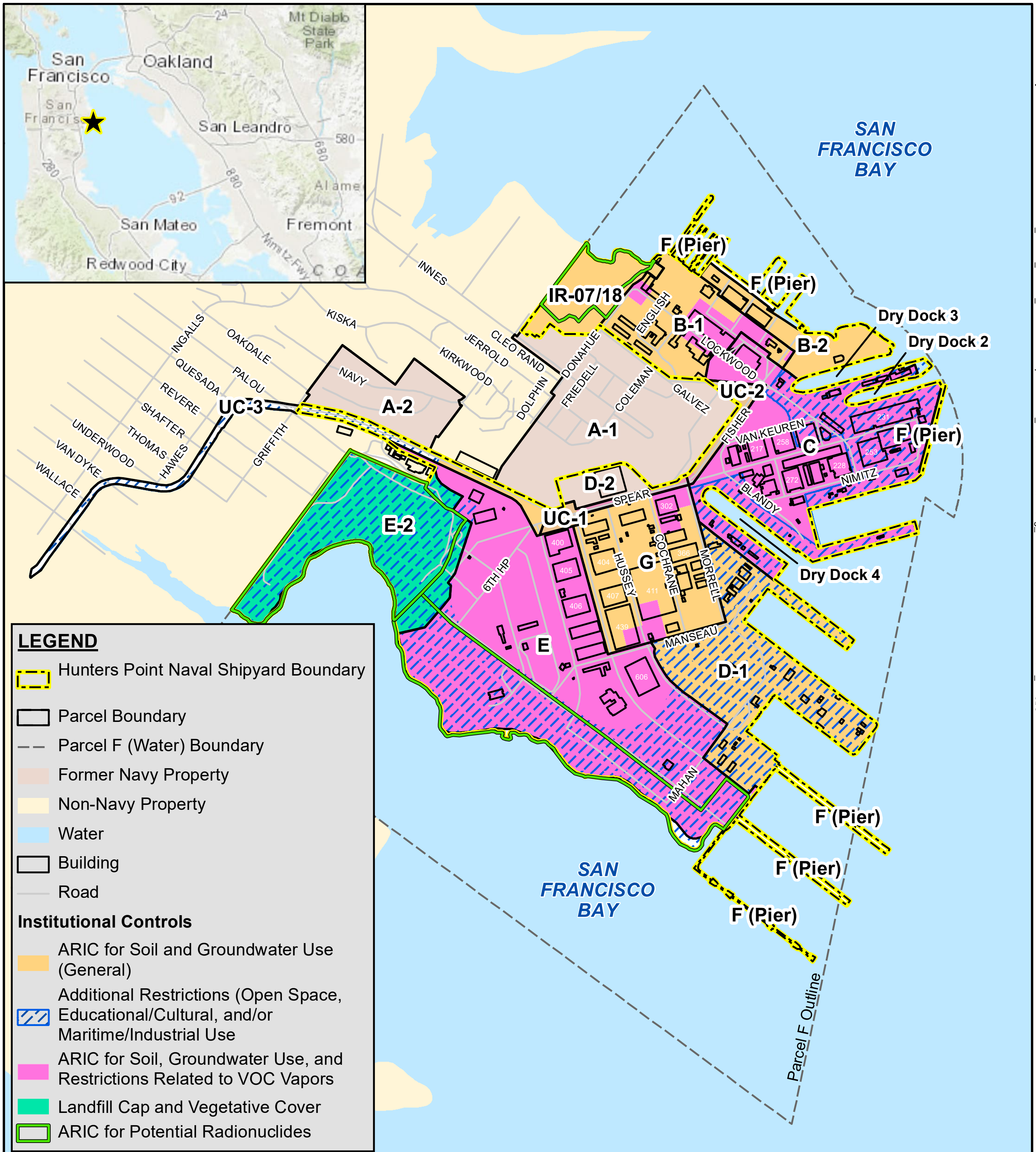

ARIC = area requiring institutional controls
VOC = volatile organic compound

General ARICs apply to all areas and allow residential uses with restrictions. Additional Restrictions apply to areas designate as Open Space, Educational/Cultural, and/or Maritime/Industrial Use and prohibit residential uses.

ARIC performance objectives are provided in Table 1-2.

All ARICs shown are proposed and/or recommended boundaries, actual boundaries will be surveyed and included in the Quitclaim Deed(s) upon property transfer.

Figure 1-4
Institutional Controls
Fifth Five-Year Review Report
Hunters Point Naval Shipyard, San Francisco, California

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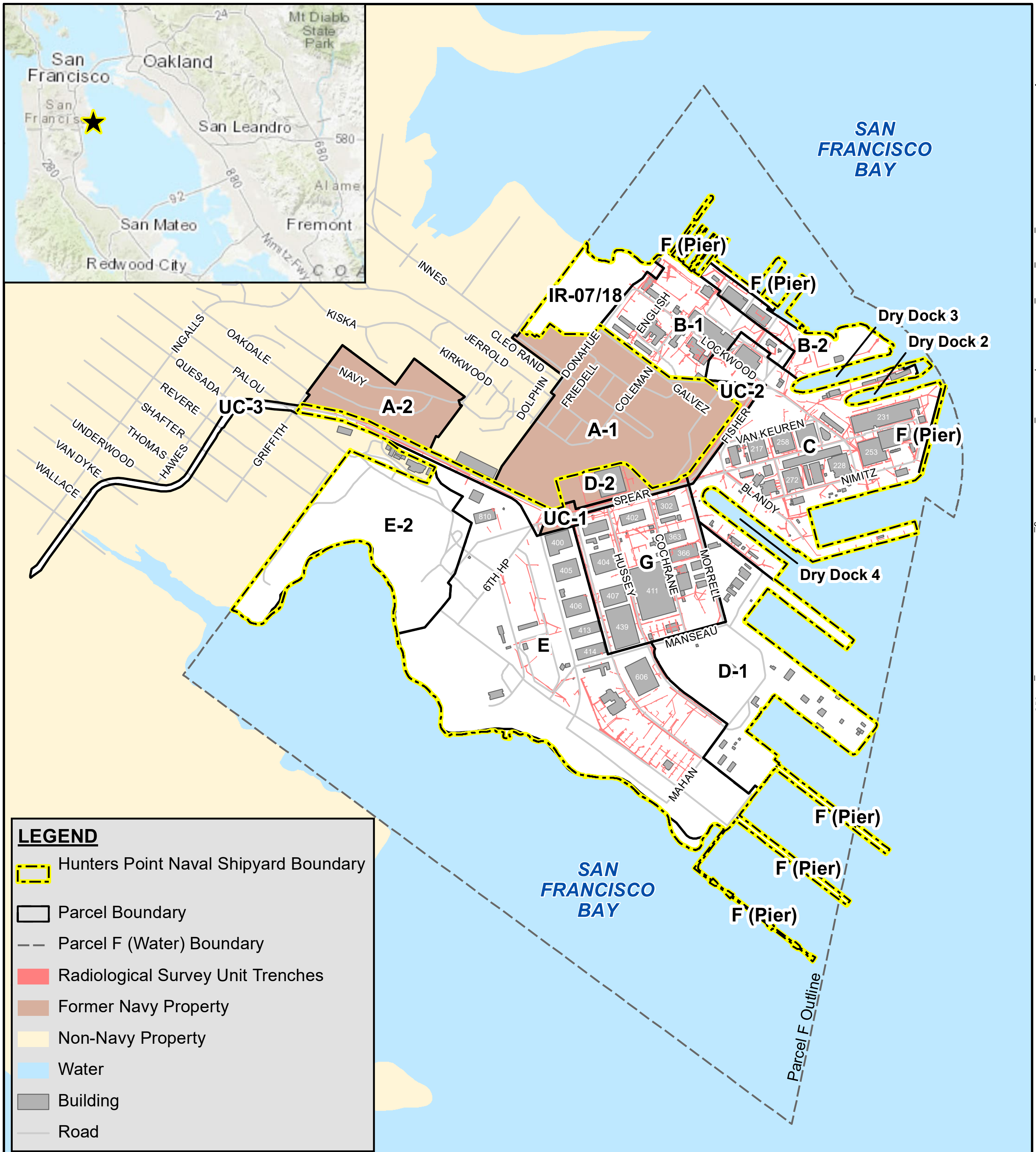

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Figure 1-5
Basewide Radiological Time-Critical
Removal Action Survey Trenches
Fifth Five-Year Review Report
Hunters Point Naval Shipyard, San Francisco, California

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2.0 Five-Year Review Process

This section describes the Five-Year Review process for the sites at HPNS. This process includes conducting interviews and visual site inspections, reviewing all relevant documents, and notifying and presenting the findings to the community to keep the public informed of the progress to evaluate remedy effectiveness.

2.1 Site Interviews

The following individuals were interviewed via email in February 2023:

- Project Manager, KEMRON – Parcel E-2 Construction Contractor
- Project Manager, GES-AIS – Parcels B-1, B-2, C, D-1, D-2, UC-1, UC-2, and UC-3 Radiological Rework Contractor, Parcel E Construction Contractor
- Caretaker Site Office Facility/Compliance Project Manager

Appendix B provides the survey and consolidated responses. Overall, there were no issues identified.

2.2 Site Inspections

The Five-Year Review inspection was conducted on February 9, 2023. Applicable site sections summarize specific findings, and **Appendix C** provides inspection forms and photograph logs. Overall, the remedies were in good condition. Active work is being conducted at Parcels B-1, B-2, C, D-1, G, E, and E-2.

2.3 Document and Data Review

The Five-Year Review included a review of site-specific documentation for each site. First, the ROD, or post-ROD decision document if applicable, for each site was reviewed to identify the potential risks to human health and the environment that are the basis for taking RA, Remedial Action Objectives (RAOs), selected remedies, and ARARs. Additional review of relevant documents, including O&M records, monitoring data, and other pertinent documents and data, was also completed to assess remedy performance and continued protection of human health and the environment. Documents reviewed for each site are listed in their respective reference section.

Copies of Administrative Record documents are available by searching the online Administrative Record located on the HPNS public website at:

https://www.bracpmo.navy.mil/BRAC-Bases/California/Former-Naval-Shipyard-Hunters-Point/.

2.4 Technical Assessment

Information from the document and data review was used to answer three technical assessment questions from USEPA guidance. The type of information used for each question is discussed in this section.

Question A: Is the remedy functioning as intended by the decision documents?

The following information was used to address this question: decision documents, remedy performance monitoring data, long-term monitoring (LTM) or monitored natural attenuation (MNA) data, O&M reports, and IC inspection findings in comparison with the RAOs.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

The following information was used to address this question:

Exposure Assumptions: Reviewed chemicals of emerging concern, new pathways of concern, and changes in land use.

Toxicity Data: Reviewed the toxicity information and values for chemicals of concern (COCs) and radionuclides of concern (ROCs) to evaluate whether the conclusions from the previous HHRAs and ecological risk assessments (ERAs) are still valid.

Cleanup Levels: Reviewed current ARARs and standards on which the ROD cleanup levels are based.

RAOs: Reviewed existing RAOs in context with the other components of Question B to determine whether the remedy will meet the existing RAOs.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Information used to answer this question includes external factors that were not apparent during remedy selection and were not covered under Questions A and B, such as resilience to climate change.

2.5 Community Notification and Involvement

Members of the community were notified of the initiation of the Fifth Five-Year Review on February 15, 2023, via an announcement in the *San Francisco Chronicle* (**Appendix D**). When the Five-Year Review has been finalized, a notice will be sent to the newspaper indicating the results and that the final report is available to the public.

The Navy conducts outreach to members of the community with the objective to reach stakeholders, share program information, and receive community input. The Navy published an update to the Community Involvement Plan in November 2022 (Navy, 2022) that describes the surrounding community demographics and key stakeholders, current and planned outreach methods, and metrics for measuring outreach efforts. The outreach program consists of community meetings, presentations to local groups, updates to elected officials, small group site tours and stakeholder meetings, guided bus tours, local community events, and community technical assistance where experts in the field answer health and safety questions at meetings and events by phone or by email. Newsletters are provided to individuals and groups who subscribe, are posted to the HPNS public website (www.bracpmo.navy.mil/hpns), and key documents are maintained at the following local information repository:

San Francisco Main Public Library
Government Information Center, 5th Floor
100 Larkin Street
San Francisco, CA 94102
(415) 557-4500

2.6 Next Five-Year Review

The next Five-Year Review is due to be finalized 5 years from the signature of this Five-Year Review, which is anticipated to be in 2029.

2.7 References

Department of the Navy (Navy). 2022. *Community Involvement Plan, Hunters Point Naval Shipyard, San Francisco, California.* Department of the Navy Base Realignment and Closure Program Management Office West. November.

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3.0 Former Parcel B (Installation Restoration Sites 07 and 18, Parcels B-1 and B-2)

3.1 Site History and Background

Former Parcel B was formerly part of the industrial support area at HPNS and was used for shipping, ship repair, training, barracks, and offices. Activities supporting these uses, such as painting, metalworking, and storing, using, and disposing of liquids and fuels, are potential sources of chemicals (Navy, 2009).

Former Parcel B is bounded by Parcels A and C to the south, the City of San Francisco Bayview-Hunters Point District to the west, and Parcel F and San Francisco Bay to the north and east. The boundary between Parcel B and Parcel F is considered the mean lower low water line. Any base infrastructure at Parcel B that is considered to be “hanging” off seawalls and quay walls into the bay, such as piers, wharves, and dry dock sidewalls, is considered to be part of Parcel F.

Former Parcel B covers approximately 63 acres, which has been subdivided into two independent IR sites, IR-07 and IR-18 (referred to as IR-07/18) (14 acres) and Parcels B-1 (27 acres) and B-2 (22 acres) (**Figure 3-1**). IR-07/18 was split from Parcel B in 2008 to expedite remedy completion and transfer of the sites (Navy, 2019). In 2013, following the issuance of the Third Five-Year Review Report, the Navy subdivided Parcel B, excluding IR-07/18, into two separate parcels (Parcels B-1 and B-2) to accommodate varying property transfer schedules for different portions of the original parcel (ERRG, 2017).

The following IR sites are located in Former Parcel B:

- IR-07/18
- Parcel B-1: IR-A, IR-10, IR-20, IR-23, IR-24, IR-42, IR-60, IR-61, and IR-62
- Parcel B-2: IR-B, portions of IR-24, and IR-26

Facility-wide sites IR-50 and IR-51 also traverse the parcels. Active remediation is ongoing at IR-10 and IR-26. Investigations and actions began in 1994, as shown in the following chronology.

Parcel B Chronology

Date	Investigation/Action
1994	SI
1996	RI and FS
1996	Removal Actions at IR-23, IR-26, and IR-50 (Sediment in Parcel B Storm Drains)
10/7/1997	ROD
1998	Explanation of Significant Differences (ESD)
1998–1999	RA (Phase 1)
2000	ESD (Second)
2000–2001	RA (Phase 2)
2001	Quarterly Groundwater Monitoring

Parcel B Chronology	
Date	**Investigation/Action**
2000–2002	Soil Vapor Extraction (SVE) Treatability Study at IR-10
2003	Investigation of Chromium VI in IR-10 Groundwater Characterization and Sampling of Shoreline at IR-07 and IR-26 First Five-Year Review
2004	Historical Radiological Assessment (HRA)
2003–2004	Waste Consolidation and Removal Activities Groundwater Treatability Study at IR-10
2004–Ongoing	Groundwater LTM
2005	Soil Gas Survey at IR-07/18
2006	Phase III SVE Treatability Study at IR-10
2007	Technical Memorandum in Support of a ROD Amendment
2006–2010	Radiological Removal Actions
2008	TCRA for Methane at IR-07 TCRA for Mercury at IR-26 Second Five-Year Review
1/26/2009	Amended ROD
2010	LUC RD – IR-07/18
2010–2012	RD and Amendments
2010–2011	Construction of IR-07/18 Remedy Hotspot Removal (Parcels B-1 and B-2)
2011	LUC RD Parcel B, Excluding IR-07/18 Remedial Action Completion Report (RACR) for Hotspot Excavation at Parcel B (B-1 and B-2)
2011–Ongoing	O&M of Durable Covers and ICs (IR-07/18)
2012	RACR for IR-07/18
2012–2015	Durable Cover Installation (Parcels B-1 and B-2)
2013	Biological Amendment Injection at IR-10 Third Five-Year Review
2013–2020	SVE at IR-10 (Parcel B-1)
2015–Ongoing	O&M of Durable Covers and ICs (Parcels B-1 and B-2)
2017	In Situ Stabilization (ISS) Using Organo-sulfur Injections at IR-26 (Parcel B-2) RACR for Durable Covers at Parcel B-1
2018	RACR for Durable Covers at Parcel B-2
2019	Fourth Five-Year Review for HPNS

3.2 Site Characterization

This section summarizes the findings from various investigations at Former Parcel B that are pertinent to the Five-Year Review.

3.2.1 Physical Characteristics

3.2.1.1 Surface Features

Parcel B is located in the lowlands portion of HPNS, and ground surface elevations range from 0 to 18 feet above msl (Navy, 1997). The elevation at IR-07/18 ranges from approximately 14 to 50 feet above msl. About 75 percent of the ground surface at Parcel B is covered by pavement and buildings; the western portion (IR-07/18) is unpaved and without structures. There is no surface water on Parcel B. Stormwater at Parcel B is currently handled via surface swales and storm sewers. The shoreline at Parcel B includes a mix of sandy beach and riprap, concrete and wooden seawalls, and riprap and concrete seawalls (Navy, 2009). The shoreline at IR-07 and portions of Parcels B-1 and B-2 are also covered by shoreline protection materials consisting of engineered riprap (ERRG, 2012a, 2017; Innovex-ERRG Joint Venture, 2018b).

3.2.1.2 Geology and Hydrogeology

Parcel B was constructed in the 1940s by placing borrowed fill material from various sources, including crushed serpentinite bedrock from the adjacent highlands and dredged sediments (ChaduxTt, 2011a).

The following is a summary of hydrostratigraphic units at Parcel B:

- A-Aquifer: The A-aquifer generally thickens from about 15 feet in the southwest to as much as 80 feet in the northeast, but averages about 25 feet thick over most of Parcel B. In general, groundwater flows north/northeast, toward San Francisco Bay, approximately perpendicular to the shoreline (Navy, 2009). The tidal influence zone extends inland up to about 300 feet from the shoreline (PRC et al., 1996; PRC, 1996). Tidal influence may also mix groundwater with San Francisco Bay water; however, mixing usually does not occur as far inland as the fluctuations in groundwater elevation do (Navy, 2009). Depth to groundwater averages at approximately 8 feet below ground surface (bgs) (KMJV, 2021).
- Bay Mud: The Bay Mud is present over most of Parcel B; however, the Bay Mud is absent in some areas in the western and central portions of the parcel, and the A- and B-aquifers directly contact each other in those areas. Hydraulic communication is restricted, although not prevented, in areas where Bay Mud Deposits are present, and the potential for communication between the A- and B-aquifers is greater where the Bay Mud Deposits are absent. However, previous investigations (Tetra Tech, 2001) concluded that, although lithologic data suggest the potential for communication, chemical results do not indicate communication exists. The eastern portion of Parcel B that includes the peninsula called Point Avisadero is characterized by a thin layer of Artificial Fill over bedrock (Navy, 2009). The Bay Mud Deposits generally thicken from where they pinch out against the historical shoreline in the southwest to 40 feet near the bay margin in the northeast. Dredging has removed the Bay Mud and B-aquifer at various locations across Parcel B (Insight-ESI, 2023).
- B-Aquifer: The B-aquifer is not continuous across Parcel B but exists primarily in two separate areas, along the western parcel boundary and in a portion of the central area of the parcel. The semiconfined B-aquifer includes interbedded sands and clayey silts and ranges in thickness from about 5 to 15 feet where it is present and averages 10 feet thick (Insight-

ESI, 2023). In general, groundwater flows north/northeast toward San Francisco Bay. The groundwater elevation averages at approximately 6 feet above msl (TRWB, 2022).

3.2.2 Land Use

3.2.2.1 Current Land Use

Parcel B is owned by the federal government and is under the jurisdiction of the Navy. Most of the buildings at Parcel B are vacant, although a small number are used for commercial enterprises such as artist studios (Building 103, 104, 116, 117, and 125). Except for the few occupied buildings, Parcel B is unoccupied and unused. Most of Parcel B is fenced, and access is limited (Navy, 2009).

3.2.2.2 Future Land Use

Parcel B is currently planned to be transferred to the City and County of San Francisco. Based on the City and County of San Francisco's reuse plan as currently amended (SFRA, 1997; 2010), Parcel B is expected to be zoned to accommodate mixed uses, including a mixed residential/retail area, a research and development area, a cultural and educational area, and open space.

3.2.3 Basis for Taking Action

This section describes the results of site investigations and risk assessments that provide the basis for taking action at Parcel B. Details are provided in the RI (PRC et al., 1996), FS (PRC, 1996), ROD (Navy, 1997), and Amended ROD (Navy, 2009).

3.2.3.1 Site Investigations and Removal Actions

Previous investigations at Parcel B identified the presence of metals, VOCs, SVOCs, pesticides, PCBs, and radionuclides in soil, groundwater, structures, and sediment.

After the initial ROD was signed, potential sources of mercury (IR-26, Parcel B-2) and methane (IR-07) were identified and subsequently removed via TCRAs in 2008 (Insight, 2009; SES-TECH, 2009). Post-removal action monitoring for mercury in groundwater and methane in soil gas was incorporated into the remedy as documented in the Amended ROD (Navy, 2009).

3.2.3.2 Human Health Risk

The most current HHRA for Parcel B was performed in support of the Amended ROD using data collected from previous investigations. Human health risks were characterized separately for COCs and ROCs. The following unacceptable risks to potential receptors from COCs were identified (**Table 3-1**):

- Future industrial workers from exposure to metals and SVOCs in subsurface soil (no unacceptable risks were identified for surface soil) and VOCs in groundwater (in A-aquifer through the vapor intrusion to indoor air pathway)
- Future recreational users from exposure to metals, SVOCs, and PCBs in surface soil
- Future residents (adult and child) from exposure to metals, VOCs, SVOCs, pesticides, and PCBs in surface and subsurface soil; to mercury, VOCs, and SVOCs in groundwater (A--aquifer through the vapor intrusion to indoor air pathway); and metals, VOCs, and pesticides in the B-aquifer through domestic use

- Future construction workers from exposure to metals, VOCs, and SVOCs in subsurface soil and metals, VOCs, SVOCs, and pesticides in groundwater

Additionally, ROCs were identified for soil and structures at Parcel B (**Table 3-2**) (Navy, 2009). Radionuclides of potential concern (ROPCs) and metals were identified as potential concerns for groundwater migrating to the bay within IR-07/18 if future development actions mobilize impacted soil left in place.

3.2.3.3 Ecological Risk

A screening-level ecological risk assessment (SLERA) was conducted in support of the ROD Amendment to evaluate potential ecological risks from exposure to shoreline sediment. The SLERA identified the following potential unacceptable risks to ecological receptors (**Table 3-1**):

- Sediment: Potential unacceptable risks to benthic invertebrates, birds, and mammals from selected metals, pesticides, PAHs, and PCBs in sediment along the Parcel B shoreline
- Groundwater: Potential unacceptable risk to aquatic organisms from mercury in groundwater under the assumption that groundwater mixes with surface water in San Francisco Bay; in addition, potential risks to ecological receptors from chromium VI, copper, lead, and nickel based upon review of groundwater data in the Amended ROD (Navy, 2009); metals not identified as COCs in the SLERA due to low frequency of detection and no defined plume, included for monitoring purposes

3.3 Remedial Action Objectives

The Parcel B ROD was signed on October 7, 1997 (Navy, 1997), two ESDs were signed on August 24, 1998 (Navy, 1998) and May 4, 2000 (Navy, 2000), and the Amended ROD was signed on January 14, 2009 (Navy, 2009).

Table 3-3 summarizes the basis for action, RAOs, remedy components, performance metrics, and expected outcomes for Former Parcel B. The presence of VOCs in groundwater and soil may contribute to the presence of VOCs in soil gas; therefore, the vapor intrusion pathway is included as a basis for action and development of RAOs.

The Navy developed RGs to meet the RAOs for soil, sediment, and groundwater, which are summarized for COCs in **Table 3-1** and for ROCs in **Table 3-2**. The Navy also developed trigger levels (TLs) to evaluate attenuation of contaminants as groundwater moves from inland areas toward the bay. The TLs are as follows: 50 micrograms per liter (μg/L) for chromium VI, 28.04 μg/L for copper, 14.44 μg/L for lead, and 0.6 μg/L for mercury in the surface water of San Francisco Bay. The TLs are conservative, and exceedance of a TL does not necessarily indicate an immediate risk, given dilution and mixing with surface water; nonetheless, a potential for ecological risk was identified if the metals in groundwater discharge undiluted to the bay.

3.4 Remedial Actions

This section presents a summary of the remedy implemented and ongoing O&M actions. Although there are a ROD and post-ROD decision documents for all of Parcel B, IR-07/18, Parcel B-1, and Parcel B-2 are managed independently and have individual protectiveness determinations, so they are evaluated individually.

3.4.1 IR-07/18

The RA for IR-07/18 includes the following major components:

- Soil excavation and removal to address COCs in soil
- Durable cover installation and maintenance to address COCs and ROCs in soil
- LTM of methane in soil gas
- LTM of groundwater for COCs and ROPCs
- Radiological surveys and remediation through soil removal and durable cover installation
- ICs for soil and groundwater

Figures 3-1, **3-2**, and **3-3** show the remedy components.

3.4.1.1 Remedy Implementation

Soil Excavation and Removal

Soil excavation was conducted in two phases after the initial ROD (**Figure 3-1**): from 1998 to 1999 and again in 2000 to 2001. Approximately 42,200 cubic yards of soil was removed from 25 areas between July 1998 and September 1999. However, RGs were not met, and an additional 27,700 cubic yards were removed from 10 areas between May 2000 and December 2001 (ChaduxTt, 2008). However, RGs were not met during the second excavation, and the Navy re-evaluated the approach in the Technical Memorandum in Support of a ROD Amendment (ChaduxTt, 2007) to include parcel-wide covers to address potential risk from remaining ubiquitous metals and other COCs at Parcel B (including IR-07/18), which was included in the Amended ROD (Navy, 2009). Responses completed for the soil RAOs applicable to IR-07/18, which includes soil excavation and removal, is documented in the RACR for IR-07/18 (ERRG, 2012a).

Durable Cover Installation

The construction of durable covers began in June 2010 and was completed in September 2011. Completion of the durable covers, along with implementation of ICs discussed in **Section 1.3.4.2**, meets the RAOs for soil applicable to IR-07/18. Response complete for soil is documented in the RACR for IR-07/18 (ERRG, 2012a).

Durable covers consist of shoreline revetment, soil covers, and asphalt covers at IR-07/18, as shown on **Figure 3-3** and described as follows:

- **Shoreline Revetment:** The shoreline revetment includes, from the bottom up, filter fabric, 6 to 12 inches of filter rock, and 2.5 to 3 feet of riprap. The filter fabric is designed to prevent migration of soil and sediment to San Francisco Bay; the filter rock and riprap layers protect the fabric from damage by wave action.

- **Soil Covers:** In the area identified as radiologically impacted in the Amended ROD (Navy, 2009), the cover includes, from the bottom up, 1 foot of clean imported soil, a demarcation layer that includes an orange geotextile and metallic demarcation tape placed over the fabric in a 10- by 10-foot grid, and 2 feet of clean imported soil for a total of 3 feet of cover. In areas not identified as radiologically impacted in the Amended ROD, the cover is composed of 2 feet of clean imported soil. The final cover includes surface completions for groundwater monitoring wells and methane monitoring probes, as well as stormwater drainage features.

- **Asphalt Covers:** An asphalt cover was constructed over a small area (about 60 feet by 130 feet) in the southeastern corner of IR-07 to allow for a more gradual transition to the final asphalt cover in the adjoining area of Parcel B-1. The asphalt cover included 2 inches of asphalt over 4 inches of aggregate base course.

Long-term Monitoring of Methane

The Navy conducted a TCRA to address methane in soil gas at IR-07 in 2008. The Navy excavated 17,000 cubic yards of soil, including the organic layer considered to be the source of methane in soil gas (ERRG, 2012a). Methane was not detected in any gas monitoring probes in samples collected semiannually since the probes were installed in November 2008. Response complete for soil gas was documented in the RACR for IR-07/18 (ERRG, 2012a), and the methane probes were decommissioned in 2012 (ERRG, 2012c).

Groundwater Monitoring

LTM was initiated in 2004 and is currently conducted under the Basewide Groundwater Monitoring Program (BGMP). Groundwater sampling is conducted semiannually for metals (COCs) and ROPCs in two San Francisco Bay margin monitoring wells (IR07MW24A and IR07MW26A) to ensure that redevelopment does not mobilize contaminants that could migrate into the bay and adversely impact ecological receptors (Navy, 2010). Annual and semiannual groundwater monitoring reports from 2019 through 2022 were reviewed (TRBW, 2020b, 2020c, 2021, 2022a, 2022b, 2023).

Since at least 2009, concentrations of COCs and ROPCs have remained under their TLs, except for lead in September 2017 and March 2022 (TRWB, 2023). Concentrations of lead exceeded the TL but were within the same order of magnitude as the TL (14.44 µg/L) at two locations (23 and 23.9 µg/L) in March 2022 and were below laboratory detection limits during the September 2022 event (**Appendix E, Figure 3-5**). The TL exceedances have been infrequent during monitoring. However, if concentrations consistently exceed a TL, the Remedial Action Monitoring Plan (RAMP) provides several additional evaluations that may occur, including increasing the frequency of monitoring, monitoring farther downgradient, using site-specific detailed information to more accurately estimate attenuation, or implementing a selected remediation alternative for groundwater treatment (ChaduxTt, 2010).

Radiological Surveys and Remediation

The Navy completed a Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) Class 1 survey of the entire surface of IR-07/18, and the top 1 foot of soil was remediated in place to levels specified in the Amended ROD (Navy, 2009) before placement of the final cover. Material beneath the 1 foot was not remediated, requiring additional radiological ICs and the demarcation layer under the durable cover within the radiological IC area.

About 470 cubic yards of soil from the inland areas and additional sediment and debris (concrete, brick, and metal) from the shoreline were removed because cesium or radium concentrations exceeded RGs or because the waste was unable to be scanned and thus was assumed to be low-level radioactive waste (LLRW). No radiological releases were confirmed, and no radiological devices were discovered during any of the radiological surveys. In total, 109 LLRW bins (representing about 1,970 tons of waste) were removed and disposed of offsite as LLRW. In addition, about 5,390 tons of nonhazardous waste and 2,940 tons of non-Resource Conservation and Recovery Act hazardous waste were removed and disposed of offsite. The California Department of Public Health (CDPH) completed further surface scans at IR-07/18 before and after the soil cover was installed. CDPH concluded that there was no evidence or indication of radiological health and safety concerns based on surface gamma radiation in the surveyed areas of IR-07/18 (CDPH, 2013).

There are no buildings and there are no areas subject to radiological rework within the boundary of IR-07/18.

Institutional Controls

The entire area of IR-07/18 (about 14 acres) is subject to general soil and groundwater ICs. A portion of IR-07/18 (about 11 acres) is subject to ICs specifically related to radionuclides (**Figure 3-2**). IC performance objectives were developed and presented in the LUC RD (ChaduxTt, 2010). **Table 1-2** summarizes the IC performance objectives to be implemented through land use restrictions for the site.

3.4.1.2 Remedy Operations and Maintenance

Ongoing O&M at IR-07/18 includes maintaining the integrity of the soil cover, revetment, asphalt cover, and IC inspections. The inspection and maintenance requirements for the remedy are described in the Final O&M Plan (ERRG, 2012b). Annual Operation and Maintenance Summary Reports (AOMSRs) are prepared to summarize inspections and maintenance performed and to document the effectiveness of the remedy components. AOMSRs from 2019, 2020, 2021, and 2022 were reviewed (Innovex-ERRG Joint Venture, 2020, 2021a; APTIM, 2022, 2023).

Durable Cover Maintenance

Annual reports indicated the shoreline revetment was in good condition. No signs of vegetation or trash, pests, excessive vehicle traffic, settlement or movement, improper placement of fabric, vandalism or theft, cover soil overtopping, wave overtopping, or scouring were observed.

Annual inspections found the soil cover to be in good condition, with no signs of settling, slope failure, cracking, soil movement, or erosion. Minor evidence of burrowing animals was noted in one area of the parcel in 2019, further monitoring of this area has been performed since its inspection, and expansion of the burrowed area was not noted. Drainage swales within the soil cover were also found to be in good condition. Vegetation growth was well established over the soil cover, with no bare areas observed. Vegetation on the soil cover was mowed in August 2019, August 2020, and January 2022. No signs of excessive vehicle traffic on the cover were observed. No exposure of the demarcation layer was observed in any area, and no tree or deep-rooting plant growth that could compromise the demarcation layer was present on the soil cover. No signs of vandalism or settling were noted in the retaining wall area.

The asphalt cover was generally found to be in good condition. No signs of cracking of the curbs, vandalism, ponding, settlement, or excessive vehicle traffic were observed. Minor cracking (less than 0.25-inch width) was observed due to vegetation growth through seams in the asphalt cover. In areas of minor cracking, no asphalt repair was required; however, ongoing vegetation management and monitoring of the observed minor cracking are recommended. Vegetation growing through cracks in the asphalt pavement cover was removed in October 2020. Vegetation growth and damage was noted on the asphalt curve along Donahue Avenue in the 2021 Report (Aptim, 2022). In January 2022, the vegetation growth was removed, and the cracking was sealed using a rubberized asphalt crack filler.

The 2019 survey data for the settlement monuments indicated Monument 2 in IR-07/18 showed negligible change in elevation (that is, less than 0.1 foot of settlement) since surveyed in 2018. Therefore, the next time Monument 2 will need to be surveyed is 2024. Monument 1 in IR-07/18 will be resurveyed in 2023.

Institutional Controls Compliance

ICs are inspected annually, and no deficiencies or inconsistent uses were observed during the review. General site conditions were determined to be good. Remedy components, such as survey benchmarks and monitoring well vault covers, were found to be in good condition.

Navy controls access to the parcel using security fencing, signage, locks, and gates, which were found to be in good condition, with no signs of damage or vandalism. A breach in the chain-link perimeter fence along northeastern IR07/18 boundary was observed in 2019 resulting in fence repairs (Innovex-ERRG Joint Venture, 2020).

3.4.2 Parcel B-1

The RA for Parcel B-1 includes the following major components:

- Soil excavation and removal to address COCs in soil
- Durable cover installation and maintenance to address COCs in soil
- SVE to address VOCs in soil gas at IR-10
- In situ biological treatment to address VOCs in groundwater at IR-10
- LTM and MNA of groundwater for COCs
- Radiological surveys and remediation through soil excavation and sanitary sewer line and storm drain removal
- ICs for VOC vapors

Figures 3-1, **3-2**, and **3-4** show the locations of major remedy components.

3.4.2.1 Remedy Implementation

Soil Excavation and Removal

Excavation and removal of soil containing COCs at concentrations greater than RGs were conducted from 2010 to 2011 (**Figure 3-1**). In total, approximately 25.5 loose cubic yards of soil was excavated from one hotspot area in Parcel B-1 to address lead in soil and was then disposed of offsite. The excavation was backfilled with clean imported soil. Completion of construction activities is documented in the *RACR for Soil Hotspot Locations at Parcel B, D-1, and G* (ERRG, 2011).

Durable Cover Installation

Construction of the durable covers at Parcel B-1 began in 2012 and was completed in 2015. Completion of the durable covers along with ICs discussed in **Section 1.3.4.2** meets the RAOs for soil at Parcel B-1. Response complete is documented in the RACR for the Durable Covers Remedy in Parcel B-1 (ERRG, 2017). Durable covers consist of shoreline revetment, soil cover, asphalt cover, and building foundations at Parcel B-1, as shown on **Figure 3-4** and described as follows:

- **Shoreline Revetment:** Shoreline revetment was constructed along the portion of Parcel B adjacent to IR-07/18 (ERRG, 2017). The shoreline revetment includes, from the bottom up, filter fabric, 6 to 12 inches of filter rock, and 2.5 to 3 feet of riprap. The filter fabric is designed to prevent migration of soil and sediment to San Francisco Bay; the filter rock and riprap layers protect the fabric from damage by wave action.

- **Soil Cover:** A vegetated soil cover was constructed on the hillside portions of Parcel B-1 (ERRG, 2017). The soil cover is composed of 2 feet of clean imported soil. The soil cover includes surface completions for groundwater monitoring wells and stormwater drainage features.

- **Asphalt Cover:** An asphalt concrete cover was constructed over the remaining upland areas of Parcel B-1 (ERRG, 2017). The asphalt cover consists of 4 inches of aggregate base course overlain by 2 inches of asphaltic concrete. Drainage features such as swales, diversion berms, catch basins, and storm drainpipes were incorporated into the asphalt cover to convey stormwater offsite.

- **Building Foundations:** Cracks and penetrations in building foundations were repaired using a variety of materials, such as concrete, non-shrink grout, and asphaltic concrete, to prevent access to underlying soil (ERRG, 2017). Additionally, access to soil under buildings (for example, crawl spaces) was blocked with durable wire mesh.

Soil Vapor Extraction at IR-10

The SVE system in Building 123 at IR-10 was originally installed in 2000 as a pilot study, was later expanded in 2005 as part of another pilot study, and was expanded again in May 2013 as part of the RA. The SVE system consists of a blower, blower motor, electrical panel, SVE wells, vapor monitoring wells, liquid/air separator, transfer pump, liquid storage tank, connection hoses, level switches, system interlocks and controls, and gauges (ERRG, 2015c).

The system operated intermittently after restarting in 2013. Concentrations of VOCs decreased to below soil gas action levels (SGALs) during operations and rebounded after every operating period within approximately 6 weeks. Overall, approximately 122 pounds of trichloroethene (TCE) was removed from the beginning of the system operations (December 2000) through the end of May 2019. The February 2018 to May 2019 operating period reported removal of approximately 7.22 pounds of VOCs and 6.62 pounds of TCE. The February 2018 to May 2019 report recommended additional long-term SVE operation at IR-10 be evaluated based on the diffusion-limited conditions, low mass removal rates, and operational costs associated with achieving RGs using this technology. An optimization review of the SVE remedy was recommended to determine whether other measures, such as remedy improvements or alternatives, can be implemented to enhance RA performance (Insight-ESI, 2023). The most recent operating period (October 2019 to April 2020) represented approximately 21 percent of the total operating period but removed approximately 1.4 pounds of TCE, or 1.2 percent of the total mass removal (Innovex-ERRG Joint Venture, 2021b).

The original intent of the SVE system was as a source-reduction measure, and the other actions associated with the remedy provide overall protectiveness to meet the RAOs (Navy, 2009). Evaluation of VOC mass removal rates and cumulative mass removed by the SVE system indicated that system operation reached a point of diminishing returns and, in general, appears to have had limited effectiveness in extracting significant VOC mass from subsurface soils. This is likely a result of low permeability and diffusion-limited soils. Therefore, soil excavation and subsequent confirmation monitoring is planned for IR-10 to address VOC soil contamination to a depth of 10 feet bgs (Insight-ESI, 2023).

Biological Amendment Injection at IR-10

Groundwater remediation to treat the IR-10 VOCs plume in Parcel B-1 near Building 123 was conducted in 2013. Approximately 2,658 pounds of polylactate hydrogen release compound primer and 5,490 pounds of polylactate hydrogen release compound were injected into 45 groundwater injection points in March 2013 (ERRG, 2015). Approximately 152 pounds of polylactate substrate was injected at each location (approximately 7.6 pounds of polylactate substrate per vertical foot). Post-injection monitoring is currently ongoing under the BGMP.

Groundwater LTM and MNA

Groundwater is sampled through the BGMP. At Parcel B-1, groundwater monitoring was initiated in 2004 and currently consists of sampling six groundwater monitoring wells screened in the A-aquifer for VOCs and metals, as well as MNA parameters to evaluate and track natural attenuation processes. The BGMP is routinely optimized based on monitoring data. The sampling protocol was amended so that monitoring well IR20MW17A, which was only sampled for vinyl chloride (VC), was revised to include 1,2-dichloroethene and TCE for consistency in monitoring the VOC plume at IR-10 (TRBW, 2020a). Annual and semiannual groundwater monitoring reports from 2019 through 2021 were also reviewed (TRBW, 2020b; 2020c, 2022a, 2022b, 2023). **Appendix E** presents exceedances of RGs (identified as project action limits [PALs]) from 2019, 2020, 2021, and 2022.

One VOC (VC) exceeded its RG in multiple wells for all sampling events from 2019 to 2022. One additional VOC (TCE) exceeded its RG in one well during the March 2021 sampling event but did not exceed before or after that event. Exceedances of RGs from the 2022 BGMP sampling are shown on **Figure 3-5**. Concentrations of TCE and VC were within historical ranges for all monitoring wells in Parcel B-1. The presence of VC demonstrates that TCE biodegradation is occurring in groundwater in Parcel B-1 (TRBW, 2023).

Radiological Surveys and Remediation

ROCs suspected to be present at Parcel B include cobalt-60 (Co-60), strontium-90 (Sr-90), cesium-137 (Cs-137), radium-226 (Ra-226), and plutonium-239 (Pu-239). The Navy conducted TCRAs at Parcel B (both Parcels B-1 and B-2) to address potential radioactive contamination in storm drains and sanitary sewer lines and radiologically impacted structures. In total, 65,184 cubic yards of soil was excavated during removal of 24,826 linear feet of sanitary sewer and storm drain lines. Approximately 6,641 cubic yards of soil was disposed of offsite as LLRW based on surface scan and analytical laboratory results. Additionally, final status surveys (FSSs) were performed at four radiologically impacted buildings (103, 113, 113A, and 146) and three former building sites (114, 142, and 157) (TtEC, 2012).

TCRA data were reviewed as described in **Section 1.4.3**, and radiological retesting, including sampling and surveys of soils previously investigated during sanitary sewer line storm drain removal and resurvey of impacted buildings and former building sites, is currently being conducted to determine if current site conditions are compliant with the RAOs.

Institutional Controls

The land use and activity restrictions are described in the LUC RD Report (ChaduxTt, 2011a). As described in the Amended ROD (Navy, 2009), the entire area of Parcel B-1 is subject to ICs. A portion of Parcel B-1 is also subject to ICs related to VOC vapors (**Figure 3-2**). The ARICs related to VOC vapors will be redefined after the IR-10 RA is complete and documented in the Remedial Action Work Plan (RAWP; Insight-ESI, 2023). **Table 1-2** summarizes the IC performance objectives to be implemented through land use restrictions for the site.

3.4.2.2 Remedy Operations and Maintenance

Ongoing O&M at Parcel B-1 includes maintaining the integrity of the soil cover, revetment, and asphalt cover, and IC inspections. The inspection and maintenance requirements for the remedy are described in the Final O&M Plan (ERRG, 2016). AOMSRs are prepared to summarize inspections and maintenance performed and to document the effectiveness of the remedy components. AOMSRs from 2019, 2020, 2021, and 2022 were reviewed (Innovex-ERRG Joint Venture, 2020, 2021a; APTIM, 2022, 2023).

Durable Cover Maintenance

The shoreline revetment was determined to be in good condition. No signs of vegetation or trash, pests, excessive vehicle traffic, settlement or movement, improper placement of fabric, vandalism or theft, cover soil overtopping, wave overtopping, or scouring were observed.

Annual inspections found the soil cover to be in good condition, with no signs of settling, slope failure, cracking, soil movement, or erosion. Minor evidence of burrowing animals was noted in one area of Parcel B-1 in 2021; however, no corrective actions were recommended. Drainage swales within the soil cover were also found to be in good condition. Vegetation growth was well established over the soil cover, with no bare areas observed. Vegetation on the soil cover was mowed in August 2019 and August 2020. No signs of excessive vehicle traffic on the cover were observed.

The asphalt cover was generally found to be in good condition, except for minor sinkholes on the northern side of Parcel B-1 near the former dry dock observed during the September 2021 inspection, which were repaired. Vegetation observed growing through cracks in the asphalt pavement cover was removed in October 2020 and December 2021.

Building foundations were found to be in good condition, with no new or expanding cracking. Generally, swales and check dams were clean and intact; however, minor coating of sediment was noted and removed in the drainage swale northwest of Building 146. Signs of excessive vehicle traffic (such as minor cracking in the asphalt surface) within the drainage swale southwest of Building 123 prompted the construction of a vehicle crossing using rock and steel plates in March 2018. The vehicle crossing was observed to be intact and in good condition. However, access to Parcel B-1 should continue to be restricted to limit degradation to the swale and associated asphalt cover.

The 2019 survey data for the settlement monuments indicated Monument SM-1 in Parcel B-1 showed negligible change in elevation (that is, less than 0.1 foot of settlement) since surveyed in 2018. Therefore, the next time Monument SM-1 will need to be surveyed is 2024. Monuments SM-2 and SM-3 will need to be resurveyed in 2023.

Institutional Controls Compliance

ICs are inspected annually, and no deficiencies or inconsistent uses were observed during the review. General site conditions were determined to be good. Remedy components, such as survey benchmarks and monitoring well vault covers, were found to be in good conditions.

Navy controls access to the parcel using security fencing, signage, locks, and gates, which were found to be in good condition, with no signs of damage or vandalism.

3.4.3 Parcel B-2

The RA for Parcel B-2 includes the following major components:

- Soil excavation and removal to address COCs in soil
- Durable cover installation and maintenance to address COCs in soil
- ISS of mercury in groundwater at IR-26
- LTM and MNA of groundwater for COCs
- Radiological surveys and remediation through soil excavation and sampling during sanitary sewer line storm drain removal and resurvey of impacted buildings and former building sites
- ICs for soil, groundwater, and VOC vapors

Figures 3-1, 3-2, and **3-6** show the locations of major remedy components.

3.4.3.1 Remedy Implementation

Soil Excavation and Removal

Excavation and removal of soil containing COCs at concentrations greater than RGs were conducted from 2010 to 2011. In total, approximately 118 loose cubic yards of soil was excavated from two hotspot areas in Parcel B-2 to address lead and PAHs in soil and was disposed of offsite. Excavations were backfilled with clean imported soil. The *RACR for Soil Hotspot Locations at Parcel B, D-1, and G* (ERRG, 2011) documents completion of excavation activities and response complete.

Durable Cover Installation

Construction of the durable covers at Parcel B-2 began in 2012 and was completed in 2015. Completion of the durable covers along with ICs discussed in **Section 1.3.4.2** meets the RAOs for soil at Parcel B-2. Response complete is documented in the RACR for the Durable Covers Remedy in Parcel B-2 (Innovex-ERRG Joint Venture, 2018a). Durable covers consist of shoreline revetment, asphalt cover, and building foundations at Parcel B-2 shown on **Figure 3-6** and described as follows:

- **Shoreline Revetment:** Shoreline revetment was constructed along approximately 1,800 linear feet of shoreline at IR-23 and IR-26 (Innovex-ERRG Joint Venture, 2018a). An unforeseen discovery of TPH contamination along a 230-foot section of the IR-26 shoreline (in Parcel B-2) delayed completion of the revetment to allow for the TPH contamination to be delineated and removed. The shoreline revetment includes, from the bottom up, filter fabric, 6 to 12 inches of filter rock, and 2.5 to 3 feet of riprap. The filter fabric is designed to prevent migration of soil and sediment to San Francisco Bay; the filter rock and riprap layers protect the fabric from damage by wave action.
- **Asphalt Cover:** An asphalt concrete cover was constructed over the remaining upland areas of Parcel B-2 (Innovex-ERRG Joint Venture, 2018a). The asphalt cover consists of 4 inches of aggregate base course overlain by 2 inches of asphaltic concrete. Drainage features, such as swales, diversion berms, catch basins, and storm drain pipes, were incorporated into the asphalt cover to convey stormwater offsite.
- **Building Foundations:** Cracks and penetrations in building foundations were repaired using a variety of materials, such as concrete, non-shrink grout, and asphaltic concrete, to prevent access to underlying soil (Innovex-ERRG Joint Venture, 2018a). Additionally, access to soil under buildings (for example, crawl spaces) was blocked with durable wire mesh.

In Situ Stabilization of Mercury in Groundwater at IR-26

During the Third Five-Year Review for HPNS, the Navy identified that concentrations of mercury in groundwater at IR-26 Parcel B-2 continue to exceed the TL of 0.6 µg/L and recommended evaluation of the mass flux of mercury to San Francisco Bay to estimate potentially discharging mercury concentrations (Navy, 2013). An investigation to further evaluate the lateral and vertical extent of mercury in groundwater was conducted. The evaluation also included modeling, which indicated that at the concentrations reported during sampling and based on site-specific hydrogeologic inputs, there is a potential that the discharge exceeds ambient levels (TriEco-Tt, 2016). As a result, ISS using an organo-sulfur compound injected into groundwater was completed in December 2017. The goal of the remedy was to reduce concentrations to be less than the TL of 0.6 µg/L in groundwater.

An estimated 32,000 pounds of the organo-sulfur compound MetaFix was injected into the subsurface at IR-26. A total of 43 of 52 planned injection locations were injected with a MetaFix -guar gum slurry using direct-push technology and a bottom-up injection pattern (KMJV, 2021). Four quarters of post-injection monitoring was included as part of the performance monitoring for the ISS injections. Additionally, the performance monitoring wells are also sampled for dissolved mercury (as well as other Parcel B COCs) as part of the BGMP.

Performance monitoring and review of BGMP data from the performance monitoring wells are as follows (KMJV, 2021; TRBW, 2023):

- IR26MW49A: Dissolved mercury exceeded the TL during baseline and performance and BGMP monitoring. The most recent dissolved mercury concentrations were 1.01 µg/L in March/April 2019, 3.45 µg/L in September 2019, 0.494 µg/L in June 2020, 3.57 µg/L in September 2021, and 1.79 µg/L and 5.55 µg/L in March and September 2022, respectively (TRBW, 2023). The Mann-Kendall statistical evaluation indicates a decreasing trend (KMJV, 2021).
- IR26MW50A: Dissolved mercury was not detected during baseline or any post-treatment monitoring.
- IR26MW51A: Dissolved mercury exceeded the TL during baseline sampling but was not detected during seven of eight post-treatment monitoring events through June 2020. The only detection exceeded the TL with a concentration of 1.66 µg/L in December 2019.
- IR26MW70A: Dissolved mercury was not detected during baseline or any post-treatment monitoring.
- IR26MW71A: Dissolved mercury exceeded the TL during baseline and performance monitoring. Concentrations fluctuated between less than detection limits to a high of 8.55 µg/L. In 2022 concentrations were 1.18 µg/L and 1.75 µg/L in March and September, respectively. Seasonal variability and possible localized releases from native sediment may be contributing factors to the continued fluctuations of dissolved mercury. Native sediment at this location consists of silty clay, organic materials, and silty sand to silty clay. The Mann-Kendall statistical evaluation concluded that there was insufficient evidence of a trend (KMJV, 2021).

Monitoring is ongoing under the BGMP. Mercury detections in 2022 were within the historical range of concentrations.

Groundwater Monitoring

Groundwater is sampled through the BGMP. At Parcel B-2, groundwater LTM was initiated in 2004 and currently consists of sampling 12 groundwater monitoring wells screened in the A-aquifer for VOCs, dichlorodifluoromethane (Freon-12), and metals, as well as MNA parameters. The BGMP is routinely optimized based on monitoring data. The sampling protocol for Parcel B-2 has not been amended. Annual and semiannual groundwater monitoring reports from 2019 through 2021 were also reviewed (TRBW, 2020b, 2020c, 2021, 2022a, 2022b, 2023). **Appendix E** presents exceedances of RGs (identified as PALs) from 2019, 2020, 2021, and 2022. **Figure 3-5** shows exceedances of RGs from 2022.

Freon-12, lead, and mercury were the only COCs that exceeded RGs or TLs during this review period. Historically, Freon-12 has been detected only in monitoring well IR26MW41A, and before September 2018, concentrations were highly variable (TRBW, 2022b). Freon-12 was not detected in monitoring well IR26MW41A in March 2021, which was the fifth consecutive event concentrations had been less than the RG of 14 µg/L, but then exceeded the RG in September 2021 with a concentration of 21 µg/L and was not detected in 2022. Lead exceeded the TL (14.44 µg/L) at IR26MW70A with a result of 17.7 µg/L in March 2022, it did not exceed in September and was within the historic range for lead in Parcel B-2 (TRBW, 2023). Dissolved mercury exceedances have been previously discussed.

Radiological Surveys and Remediation

ROCs suspected to be present at Parcel B include cobalt-60 (Co-60), strontium-90 (Sr-90), cesium-137 (Cs-137), radium-226 (Ra-226), and plutonium-239 (Pu-239). The Navy conducted TCRAs at Parcel B (both Parcels B-1 and B-2) to address potential radioactive contamination in storm drains and sanitary sewer lines and radiologically impacted structures. In total, 65,184 cubic yards of soil was excavated during removal of 24,826 linear feet of sanitary sewer and storm drain lines. Approximately 6,641 cubic yards of soil was disposed of offsite as LLRW based on surface scan and analytical laboratory results. Additionally, FSSs were performed at two radiologically impacted buildings (130 and 140), and the Building 140 discharge channel (TtEC, 2012).

Institutional Controls

The land use and activity restrictions are described in the LUC RD Report (ChaduxTt, 2011a). As described in the Amended ROD (Navy, 2009), the entire area of Parcel B-2 is subject to soil and groundwater ICs. A portion of Parcel B-2 is also subject to ICs related to VOC vapors (**Figure 3-2**). The ARICs related to VOC vapors may be redefined when land is planned for transfer. **Table 1-2** summarizes the IC performance objectives to be implemented through land use restrictions for the site.

3.4.3.2 Remedy Operations and Maintenance

Ongoing O&M at Parcel B-2 includes maintaining the integrity of the revetment and asphalt cover and performing IC inspections. The inspection and maintenance requirements for the remedy are described in the Final O&M Plan for Parcel B-2 (Innovex-ERRG Joint Venture, 2018b). AOMSRs are prepared to summarize inspections and maintenance performed and to document the effectiveness of the remedy components. AOMSRs from 2019, 2020, 2021, and 2022 were reviewed (Innovex-ERRG Joint Venture, 2020, 2021a; APTIM, 2022, 2023).

Durable Cover Maintenance

The shoreline revetment was determined to be in good condition. No signs of vegetation or trash, pests, excessive vehicle traffic, settlement or movement, improper placement of fabric, vandalism or theft, cover soil overtopping, wave overtopping, or scouring were observed.

The asphalt cover was generally found to be in good condition, except for two small areas of subsidence noted south of Building 140 during the September 2019 and October 2020 and potholes near Building 130 and Building 140 observed during the September 2021 inspection. The small subsidence areas damaged were repaired. Vegetation observed growing through cracks in the asphalt pavement cover was removed in October 2020 and December 2021.

Building foundations were found to be in good condition, with no new or expanding cracking. Generally, swales and check dams were clean and intact.

No settlement monuments were surveyed in Parcel B-2 during this review period. Monument SM-4 will be resurveyed in 2023.

Institutional Controls Compliance

ICs are inspected annually, and no deficiencies or inconsistent uses were observed during the review. General site conditions were determined to be good. Remedy components, such as survey benchmarks and monitoring well vault covers, were found to be in good conditions.

The Navy controls access to the parcel using security fencing, signage, locks, and gates, which were found to be in good condition with no signs of damage or vandalism. However, during the September 2021 inspection, the metal hasp on a door that secures Building 159 was found broken during the annual inspection. The door was re-secured to Building 159 to prevent unauthorized access.

3.4.4 Progress Since the Fourth Five-Year Review

Table 3-4 summarizes issues, recommendations, and follow-up actions from the Fourth Five-Year Review.

3.5 Technical Assessment

3.5.1 Question A: Is the Remedy Functioning as Intended by the Decision Document?

3.5.1.1 IR-07/18

Yes. Based on the review of historical documents, annual IC inspections, and the Five-Year Review inspection, the remedy at IR-07/18 is functioning as intended.

Exposure pathways that could result in an unacceptable risk are being controlled through the durable covers and ICs. The shoreline revetment, soil cover, and asphalt cover are in good condition, and any minor issues have been repaired. No deficiencies or inconsistent uses of the ICs were observed during the inspections. Radiological concerns in soil are addressed by the cover with demarcation layer and ICs. Groundwater monitoring of metals and radionuclides is ongoing, and TLs were not exceeded during this review period.

3.5.1.2 Parcel B-1

Yes. Based on the review of historical documents, annual IC inspections, and the Five-Year Review inspection, the remedy at Parcel B-1 is functioning as intended.

Soil hotspot areas were removed through excavation and offsite disposal. Exposure pathways to residual COCs that could result in an unacceptable risk are being controlled through the durable covers and ICs. The soil cover, shoreline revetment, and asphalt cover are in good condition, and any minor issues have been repaired. VC and TCE groundwater exceedances of the RGs were reported for 2019 to 2021. The presence of VC demonstrates that TCE biodegradation is occurring in groundwater in Parcel B-1 (TRBW, 2022b). The SVE system was operated as a source-reduction measure and reached a point of diminishing returns in 2020. Proposed work to remove the SVE system and to excavate soil exceedances (Insight-ESI, 2023) will further address VOC contamination at IR-10. No deficiencies or inconsistent uses of the ICs were observed during the inspections. Radiological concerns were addressed through previous radiological surveys and remediation of soil and building structures, and radiological retesting is being conducted to confirm that the RAO has been met, with the goal of unrestricted closure.

3.5.1.3 Parcel B-2

Yes. Although mercury continues to exceed TLs in groundwater collected from downgradient monitoring wells, protectiveness is not affected, and the RAO is still being met. The RAO is stated as follows:

> Prevent or <u>minimize</u> migration to the surface water of San Francisco Bay of chromium VI, copper, lead, and mercury in the A-aquifer groundwater that would result in concentrations of chromium VI above 50 µg/L, copper above 28.04 µg/L, lead above 14.44 µg/L, and mercury above 0.6 µg/L in the surface water of San Francisco Bay. This RAO is intended to protect the beneficial uses of the bay, including ecological receptors (Navy, 2009).

Protectiveness is not affected based on the following rationale:

- Although dissolved mercury in groundwater exceeds the TL in two locations, Mann-Kendall analysis indicates it is decreasing at one location (KMJV, 2021), indicating partial success of the ISS remedy at minimizing migration to the surface water.
- The TL is the Hunters Point groundwater ambient level (HGAL), which is not a risk-based concentration, formal RG, or ARAR according to the ROD Amendment (Navy, 2009).
- The screening of groundwater data against the TL or other surface water benchmarks, such as the National Recommended Water Quality Criteria (NRWQC; USEPA, 2023), conservatively assumes that ecological receptors are directly exposed to measured concentrations in groundwater. However, there will be a mixing zone where groundwater interfaces with surface water. The extent of that zone is unknown, but mixing is expected to occur, and the concentrations would decrease with distance from the mixing zone and tidal action. Site-specific mixing factors can range from 1 to several thousand. For example, USEPA uses a default mixing and attenuation factor of 20 to address the dilution of soil leachate as it moves through the groundwater aquifer (USEPA, 1996). Furthermore, mixing studies conducted by State of Washington, Department of Ecology (2009) found that the majority of the reduction in porewater concentrations was because of dilution by surface water and averaged 90 percent (that is, a dilution factor of 0.1). Assuming a similar dilution factor, the maximum post-injection detected concentration of dissolved mercury (8.55 µg/L) would be 0.855 µg/L, which does not exceed the NRWQC of 0.94 µg/L (USEPA, 2023).

Review of annual O&M inspections, historical documents, and the Five-Year Review inspection indicates that the durable covers and ICs are effective. Soil hotspot areas were removed through excavation and offsite disposal. Exposure pathways that could result in an unacceptable risk to human receptors are being controlled through the durable covers and ICs. The soil cover, shoreline revetment, and asphalt cover are in good condition, and any minor issues have been repaired. No deficiencies or inconsistent uses of the ICs were observed during the inspections. Radiological concerns are addressed through past radiological work, and radiological retesting is being conducted to confirm that the RAO has been met, with the goal of unrestricted closure. With the exception of dissolved mercury at one location, groundwater monitoring indicates COCs in groundwater are decreasing or continue to be less than RGs and TLs.

3.5.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used at the Time of the Remedy Selection Still Valid?

Yes. Based on the results of the ARAR evaluation, HHRA analysis, and ERA analysis discussed in the following sections, the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection are still valid. Although there have been some changes to toxicity values and risk assessment methods, these changes do not affect remedy protectiveness.

3.5.2.1 ARAR Evaluation

The Navy evaluated the ARARs established in the RODs for Parcel B. No changes to location-specific or action-specific ARARs that would affect the protectiveness of the remedies were identified. Changes to chemical-specific ARARs for individual chemicals are discussed in the following HHRA and ERA Analysis sections.

In 2021, California Public Resources Code Division 20.6.5, California Sea Level Rise Mitigation and Adaptation Act of 2021, was passed; however, no regulations have been promulgated to implement the act. The Navy is addressing SLR as discussed in **Section 1.4.2** of this Five-Year Review.

3.5.2.2 HHRA Analysis

The HHRA evaluation was conducted by comparing the human health RGs from the Amended ROD (Navy, 2009) with current risk-based criteria based on the same exposure scenario, and ARARs, if available. In September 2018, the State of California promulgated the *Toxicity Criteria for Human Health Risk Assessments, Screening Levels, and Remediation Goals* regulation (Toxicity Criteria Rule [TCR]). The TCR is codified at Cal. Code Regs., title 22, division 4.5, chapter 51, article 2, §§ 69020, 69021, and 69022. The TCR specifies the DTSC-preferred toxicity criteria (identified in TCR Appendix I, Tables A and B) to use to prepare HHRAs and to calculate screening levels and RGs based on human health risk at California hazardous waste and hazardous substance release sites. For this Five-Year Review, the USEPA recommended toxicity criteria hierarchy for HHRAs was followed to calculate the current comparison criteria discussed herein (USEPA, 2003):

- Tier 1 - USEPA Integrated Risk Information System (IRIS)
- Tier 2 - USEPA Provisional Peer-Reviewed Toxicity Values (PPRTVs)
- Tier 3 – Other sources in the order listed:
  - Agency for Toxic Substances and Disease Registry minimal risk levels
  - California Environmental Protection Agency Office of Environmental Health Hazard Assessment toxicity values
  - Screening toxicity values provided in USEPA PPRTV appendices
  - USEPA Health Effects Summary Table values

USEPA has incorporated this toxicity criteria hierarchy into its RSLs, which are updated semi-annually.

Response complete for soil is achieved with excavation, durable cover construction and maintenance, and ICs, as documented in the respective RACRs for IR-07/18, Parcel B-1, and Parcel B-2 (ERRG, 2011, 2012a, 2017; Innovex-ERRG Joint Venture, 2018a). Therefore, any changes in exposure assumptions and toxicity data would not affect protectiveness of the remedy.

Table 3-5 shows the RGs and current comparison criteria for groundwater. The RGs for the groundwater COCs in the Amended ROD (Navy, 2009) were based on consideration of exposure scenario-specific (residential or industrial vapor intrusion and construction worker trench exposure [A-aquifer], or residential domestic use [B-aquifer]) risk-based- concentrations (based on a cancer risk of 10^{-6} or a noncancer hazard index of 1), laboratory practical quantitation limits (PQLs), chemical-specific ARARs, and HGALs. RGs were compared with the following current comparison criteria (USEPA, 2022a):

- A-aquifer Groundwater: Vapor intrusion screening levels (VISLs) calculated using the current USEPA VISL calculator for the residential and commercial scenarios
- B-aquifer Groundwater: Current USEPA tap water RSLs, California MCLs, and USEPA MCLs

For the majority of the COCs where the risk-based concentration was selected as the RG, the current risk-based concentration (RSL, DTSC-screening level [SL], or VISL) is higher.

There are a few cases where a current risk-based concentration (VISL) is less than a risk-based RG (or the PQL or HGAL) from the Amended ROD (Navy, 2009; **Table 3-5**).

Although some current risk-based levels are less than the RGs, the ICs that are currently in place and the durable cover across the site prevent exposure to site media; therefore, the remedy remains protective. There may be changes with HHRA analysis for the construction worker scenario. However, those changes will not affect the RGs for the construction worker scenario identified in the ROD because ICs require identification and management of potential risks to construction workers through the preparation and approval of plans and specifications for all construction activities that may pose unacceptable exposure to construction workers. There have been no changes in current exposure pathways based on the site controls or changes in planned future site use since the ROD that would change the protectiveness of the current remedy.

Radiological Risk Review

In October 2020, after the preparation of the Five-Year Review addenda, USEPA introduced a PRG calculation method called “Peak PRG,” which computes PRGs accounting for ingrowth and decay of progeny over time. An evaluation was performed for this Five-Year Review to assess whether this change affected the continued protectiveness of the current soil RGs for future residents. Exposure calculations were performed using the USEPA PRG Calculator (USEPA, 2022b). For this soil evaluation, the estimated excess cancer risk was calculated using the “Peak Risk” time interval of 1,000 years (Navy, 2020). The soil RGs were used as exposure point concentrations, and the cumulative cancer risk was calculated as the sum of risks from all ROCs. **Appendix F** presents the estimated excess cancer risks calculated from this evaluation and the supporting data. Under CERCLA, cleanup goals are considered protective if excess cancer risks from site exposures remain within the 10^{-4} to 10^{-6} range. Based on the findings of this evaluation, the soil RGs are within this range and continue to be protective for future residential exposures.

There were no changes to the risk assessment methods related to structures or buildings for radiological concerns since the last Five-Year Review.

3.5.2.3 ERA Analysis

The ERA evaluation was conducted by reviewing the exposure and toxicity assumptions used in the SLERA, identifying the most sensitive receptor that was used as the basis of the ecological RGs or TLs and comparing them with current standards of practice for ERAs to determine if the RGs remain protective. Overall, the SLERA was a very conservative assessment, and minor changes to risk methodology or current sources of exposure and toxicity values do not significantly affect the resulting RGs or TLs. The key input parameters are summarized as follows:

- Exposure Factors and Assumptions: Potential exposures to sediment were evaluated for benthic invertebrates, birds, and mammals. Exposures were evaluated for both surface (0 to 2 feet bgs) and subsurface (2.5 to 4 feet bgs) sediments, although the biologically active zone is considered to occur within the top 0.5 foot bgs. The deeper sediments were evaluated under the assumption that erosion may expose deeper sediments to the surface. The sources of exposure factors for birds and mammals, including body weight, ingestion rate, and dietary items, are still in use today and represent current state of practice. Area use factors were not used to estimate potential exposure for birds or mammals (that is, receptors were assumed to spend 100 percent of their life within the site boundary).
- Toxicity Values: Toxicity values used for benthic invertebrates, birds, and mammals are still used in ERAs, although there are additional sources for some analytes that are more commonly used. Toxicity values used to evaluate potential risks to benthic invertebrates were effects range median (ERM) values (Long et al., 1995). Toxicity reference values (TRVs) used for birds and mammals were the Region 9 Biological Technical Assistance Group (BTAG) TRVs (USEPA Region 9 BTAG, 1998) or wildlife TRVs (Sample et al., 1996). The benthic invertebrate sediment ERMs and bird and mammal TRVs (Sample et al., 1996) are still commonly used. The Region 9 BTAG TRVs are not used as often and are typically placed after USEPA ecological soil screening level (EcoSSL)-based TRVs. The differences in TRVs between the sources vary depending on the analyte. For some analytes, the EcoSSL TRVs are more conservative than the Region 9 BTAG TRVs, and, for others, the EcoSSL TRVs are less conservative. However, overall use of the Region 9 BTAG TRVs in estimating risk or deriving RGs remains protective because area use factors were not used.
- Risk Estimation: Recommendations for retaining analytes as COCs were made based on hazard quotient exceeding 1 at the Low Effect toxicity level for at least one receptor group. Additional lines of evidence to weigh the significance of an exceedance were not employed.

Table 3-6 summarizes the sediment COCs identified for ecological receptors. along with the basis of the RGs, comparison with current state of practice, and evaluation of protectiveness. Overall, slight changes in toxicity values would not significantly change the results of the risk assessment or derivation of risk-based concentrations that were evaluated for use as RGs. The sediment RGs remain protective for ecological receptors.

Table 3-7 presents groundwater COCs with a summary of TLs and current surface water quality criteria from NRWQC (USEPA, 2023) and the San Francisco Basin Plan (SFRWCQB, 2019). Groundwater data were compared with surface water screening levels and HGALs in the SLERA to evaluate potential for risk to aquatic organisms in San Francisco Bay. The evaluation of groundwater was very conservative because it was assumed that aquatic receptors would have direct exposure to chemicals in groundwater at their measured concentrations.

Mercury was the only metal retained as a potential risk to aquatic organisms in the SLERA. Chromium VI, copper, and lead were also included in the groundwater RAO based on review of data during the Amended ROD (Navy, 2009). The chronic NRWQC for chromium VI and the HGALs for copper, lead, and mercury were retained as TLs for monitoring purposes only as surface water benchmarks are not ARARs for ecological exposures to groundwater.

3.5.3 Question C: Has Any Other Information Come to Light that Could Question the Protectiveness of the Remedy?

Yes. As identified in the Fourth Five-Year Review, there is uncertainty with the radiological survey and remediation work. The Navy is in the process of implementing corrective actions to ensure the radiological remedies specified in the decision documents were implemented as intended; however, this work is ongoing. Radiological retesting is currently being conducted at Parcels B-1 and B-2; long-term protectiveness will be confirmed upon completion. Until retesting is complete, Navy controls access to the parcel through fencing, locked gates and institutional controls (restricting intrusive work and maintaining durable covers).

3.6 Issues, Recommendations, and Follow-up Actions

Table 3-8 summarizes the identified issues, recommendations, and follow-up actions for Parcels B-1 and B-2.

No issues have been identified for IR-07/18 that prevent the remedy from being protective of human health and the environment; therefore, no recommendations or follow-up actions are required to ensure protectiveness of the remedy.

3.6.1 Other Findings

The following findings were identified that do not affect current or future remedy protectiveness but warrant consideration as part of CERCLA cleanup and site management.

3.6.1.1 PFAS

As discussed in **Section 1.4.1**, a Basewide PA was conducted to identify potential PFAS release areas based on historical use or limited sampling data. The following is a summary of the areas identified for additional investigation in the PA (Multi-MAC JV, 2022) and SI (Liberty JV, 2023):

- **Parcels B-1 and B-2 A-aquifer Groundwater**: A-aquifer groundwater beneath Parcels B-1 and B-2 was identified for additional investigation because of past industrial use in the parcels and PFOA, PFOS, PFNA, and PFHxS exceeded project screening levels during the SI.
- **Parcel B-1:** IR-10, Battery and Metal Plating Shop, was identified as an area where further investigation is warranted to determine the presence of PFAS in soil and groundwater based on historical site use and limited groundwater sampling results that detected PFOA, PFOS, PFNA, PFBS, and PFHxS. PFOA, PFOS, and PFNA exceeded project screening levels in groundwater during the SI.

Exposure to groundwater and soil is restricted by ICs within the HPNS, and the City and County of San Francisco prohibits installation of domestic wells within city and county limits.

3.6.1.2 Climate Resilience

The CRA estimates that groundwater emergence may occur within IR-07/18 and Parcels B-1 and B-2 by the year 2065 (**Appendix A**).

A site-specific study is recommended to assess whether the projected climate change vulnerabilities are likely to result in additional CERCLA risk.

3.6.1.3 Site Management Strategy

The Navy is reassessing the site management strategy for Parcel B based on the following considerations:

- The Navy is planning to conduct a detailed assessment of groundwater COC concentrations to document and eliminate COCs that have achieved response complete and to tabulate groundwater and soil COC concentrations to ensure health and safety professionals have the information needed to protect future construction workers.
- The Navy is also planning to optimize the monitoring frequency and locations for areas that have not undergone any changes that could affect the concentrations of chemicals, metals, and/or ROPCs in groundwater (for example, RA or development construction).

3.7 Statement of Protectiveness

3.7.1 IR-07/18

Protectiveness Determination: Protective

Protectiveness Statement: The remedy at IR-07/18 is protective of human health and the environment.

The RAOs for soil and soil gas have been met through excavation and removal of contaminated soil, durable covers, and ICs. Groundwater monitoring indicates that COCs and ROPCs are less than TLs during the majority of sampling events.

3.7.2 Parcel B-1

Protectiveness Determination: Short-term Protective

Protectiveness Statement: The remedy at Parcel B-1 is currently protective of human health and the environment. To determine whether the remedy can be considered protective in the long term, the radiological retesting work and the excavation of VOC-impacted soil will be completed.

The RAOs for soil are met through hotspot excavation and offsite disposal, durable covers, and ICs. Excavation of VOC-impacted soil will permanently remove the source of VOCs to soil gas and groundwater. Groundwater LTM and MNA is ongoing. Exposure to groundwater is controlled through ICs. Radiological retesting is ongoing to confirm that levels in soils and structures are protective of human health. Until retesting is complete, short-term protectiveness is met through Navy controls such as access to the parcel through fencing, locked gates, and ICs (restricting intrusive work and maintaining durable covers).

3.7.3 Parcel B-2

Protectiveness Determination: Short-term Protective

Protectiveness Statement: The remedy at Parcel B-2 is currently protective of human health and the environment. To determine whether the remedy can be considered protective in the long term, the radiological retesting work will be completed.

The RAOs for soil are met through durable covers and ICs. Groundwater LTM and MNA is ongoing. Exposure to groundwater is controlled through ICs. Radiological retesting is ongoing to confirm that levels in soil and structures are protective of human health. Until retesting is complete, short-term protectiveness is met through Navy controls such as access to the parcel through fencing, locked gates, and ICs (restricting intrusive work and maintaining durable covers).

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Table 3-1. Parcel B Chemicals of Concern and Remediation Goals

Exposure Medium	Exposure Scenario	Chemical of Concern	Amended ROD Remediation Goal (2009)	Source of Remediation Goal
Soil (mg/kg)	Residential	Antimony	10	RBC
		Aroclor-1254	0.093	RBC
		Aroclor-1260	0.21	RBC
		Arsenic	11.1	HPAL
		Benzo(a)anthracene	0.37	RBC
		Benzo(a)pyrene	0.33	PQL
		Benzo(b)fluoranthene	0.34	RBC
		Benzo(k)fluoranthene	0.34	RBC
		Beta-BHC	0.0066	RBC
		Bis(2-ethylhexyl)phthalate	1.1	RBC
		Cadmium	3.5	RBC
		Copper	159	RBC
		Dibenz(a,h)anthracene	0.33	PQL
		Dieldrin	0.0034	PQL
		Heptachlor epoxide	0.0017	PQL
		Indeno(1,2,3-cd) pyrene	0.35	RBC
		Iron	58,000	HPAL
		Lead	155	RBC
		Manganese	1,431	HPAL
		Mercury	2.3	HPAL
		Naphthalene	1.7	RBC
		Tetrachloroethene	0.48	RBC
		Trichloroethene	2.9	RBC
		Vanadium	117	HPAL
		Zinc	373	RBC
	Recreational	Aroclor-1254	0.74	RBC
		Aroclor-1260	0.74	RBC
		Arsenic	11.1	HPAL
		Benzo(a)pyrene	0.33	PQL
		Lead	155	RBC
	Industrial	Arsenic	11.1	HPAL
		Benzo(a)anthracene	1.8	RBC
		Benzo(a)pyrene	0.33	PQL
	Construction Worker	Aroclor-1260	2.1	RBC
		Arsenic	11.1	HPAL
		Benzo(a)pyrene	0.65	RBC
		Lead	800	RBC
		Trichloroethene	151	RBC
Sediment (mg/kg)	Ecological Receptor	Aluminum	3400	RBC
		Copper	270	RBC
		Dibenz(a,h)anthracene	0.33	PQL
		Dieldrin	0.008	RBC
		Lead	218	RBC
		Methoxychlor	0.4	RBC
		Total Aroclors	0.18	RBC
		Total DDT	0.046	RBC
		Zinc	410	RBC

Table 3-1. Parcel B Chemicals of Concern and Remediation Goals

Exposure Medium	Exposure Scenario	Chemical of Concern	Amended ROD Remediation Goal (2009)	Source of Remediation Goal
Groundwater - A-aquifer (µg/L)	Residential Vapor Intrusion	1,2,4-Trichlorobenzene	66	RBC
		1,2,4-Trimethylbenzene	25	RBC
		1,2-Dichlorobenzene	2,561	RBC
		1,2-Dichloroethane	2.3	RBC
		1,2-Dichloroethene (total)	209	RBC
		1,2-Dichloropropane	1.1	RBC
		1,3,5-Trimethylbenzene	19	RBC
		1,4-Dichlorobenzene	2.1	RBC
		2-Methylnaphthalene	707	RBC
		Benzene	0.5	PQL
		Bromodichloromethane	1	RBC
		Chlorobenzene	392	RBC
		Chloroethane	6.5	RBC
		Chloroform	1	PQL
		cis-1,2-Dichloroethene	209	RBC
		Dichlorodifluoromethane	14	RBC
		Mercury	0.68	RBC
		Methylene chloride	27	RBC
		Naphthalene	3.6	RBC
		Tetrachloroethene	1	PQL
		trans-1,2-Dichloroethene	182	RBC
		Trichloroethene	2.9	RBC
		Trichlorofluoromethane	176	RBC
		Vinyl chloride	0.5	PQL
	Industrial Vapor Intrusion	Chloroform	1.2	RBC
	Construction Worker Trench Exposure	1,2,4-Trichlorobenzene	55	RBC
		1,2,4-Trimethylbenzene	72	RBC
		1,2-Dichlorobenzene	2,215	RBC
		1,2-Dichloroethane	30	RBC
		1,2-Dichloroethene (total)	363	RBC
		1,2-Dichloropropane	40	RBC
		1,4-Dichlorobenzene	68	RBC
		2,4,6-Trichlorophenol	15	RBC
		2,4-Dimethylphenol	9,801	RBC
		2,4-Dinitrotoluene	179	RBC
		2-Methylnaphthalene	140	RBC
		4-Methylphenol	3,500	RBC
		Arsenic	40	RBC
		Benzene	22	RBC
		Benzo(a)anthracene	2	PQL
		Benzo(a)pyrene	2	PQL
		Bromodichloromethane	26	RBC
		Chlorobenzene	594	RBC
		Chloroform	36	RBC
		Chrysene	6.4	RBC
		cis-1,2-Dichloroethene	363	RBC
		Mercury	4.68	RBC
		Naphthalene	20	RBC
		Pentachlorophenol	25	PQL
		Tetrachloroethene	19	RBC
		trans-1,2-Dichloroethene	721	RBC
		Trichloroethene	374	RBC
		Vinyl chloride	7.2	RBC

Table 3-1. Parcel B Chemicals of Concern and Remediation Goals

Exposure Medium	Exposure Scenario	Chemical of Concern	Amended ROD Remediation Goal (2009)	Source of Remediation Goal
Groundwater - B-aquifer (µg/L)	Residential Domestic Use	1,4-Dichlorobenzene	7.5	ARAR
		Antimony	43.26	HGAL
		Arsenic	27.34	HGAL
		Benzene	5	ARAR
		Chloroethane	4.6	RBC
		Manganese	8,140	HGAL
		Pentachlorophenol	25	PQL
		Thallium	12.97	HGAL
		Trichloroethene	5	ARAR

µg/L = microgram(s) per liter
ARAR = applicable or relevant and appropriate requirement
BHC = benzene hexachloride
DDT = dichlorodiphenyltrichloroethane
HGAL = Hunters Point groundwater ambient level
HPAL = Hunters Point ambient level
mg/kg = milligram(s) per kilogram
PQL = practical quantitation limit
RBC = risk-based concentration
ROD = Record of Decision

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Table 3-2. Parcel B Remediation Goals for Radionuclides

Radionuclide	Surfaces (dpm/100cm^2)		Soil[c] (pCi/g)		Water[e] (pCi/L)
	Equipment, Waste[a]	Structures[b]	Construction Worker	Residential[g]	Equipment, Waste[a]
Cesium-137	5,000	5,000	0.113	0.113	119
Cobalt-60	5,000	5,000	0.0602	0.0361	100
Plutonium-239	100	100	14	2.59	15
Radium-226	100	100	1.0[d]	1.0[d]	5.0[f]
Strontium-90	1,000	1,000	10.8	0.331	8

Sources:

Department of the Navy (Navy). 2006. *Base-wide Radiological Removal Action, Action Memorandum – Revision 2006, Hunters Point Shipyard, San Francisco, California* . Final. April 21.

United States Environmental Protection Agency (USEPA). 2000. *Radionuclides Notice of Data Availability Technical Support Document* . Targeting and Analysis Branch, Standards and Risk Management Division, Office of Groundwater and Drinking Water. March.

[a] Based on “AEC Regulatory Guide 1.86” (1974); goals for removable surface activity are 20 percent of these values.

[b] Goals are based on 25 millirem per year (USEPA does not believe this NRC regulation is protective of human health and the environment, and the HPNS cleanup goals are more protective. This regulation is an ARAR only for radiologically impacted sites that are undergoing TCRAs, and any additional remedial action required for those sites. It is not an ARAR for radiologically impacted portions of IR-07/18 that will be transferred with engineering and institutional controls for radiological contaminants.

[c] USEPA PRGs for two future use scenarios

[d] Goal is 1 pCi/g above background per agreement with USEPA.

[e] Release criteria for water were derived from *Radionuclides Notice of Data Availability Technical Document* (USEPA, 2000) by comparing the limits from two criteria and using the most conservative value.

[f] Goal is for total radium concentration.

[g] Also applies to scanned surface soil at IR-07/18.

AEC = Atomic Energy Commission
ARAR = applicable or relevant and appropriate requirement
cm^2 = square centimeter(s)
dpm = disintegration(s) per minute
HPNS = Hunters Point Naval Shipyard
NRC = Nuclear Regulatory Commission
pCi/g = picocurie(s) per gram
pCi/L = picocurie(s) per liter
PRG = preliminary remediation goal
TCRA = time-critical removal action
USEPA = United States Environmental Protection Agency

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Table 3-3. Parcel B Remedial Action Summary and Expected Outcomes

Media	Risk/Basis for Action	Reasonably Anticipated Land Use	RAO	Remedy Component	Parcel[a]	Performance Metric	Expected Outcome
Soil, Soil Gas, and Sediment	**Human Health**: Unacceptable risk to industrial workers from exposure to metals and SVOCs; recreational users from exposure to metals, SVOCs, and PCBs; residents from exposure to metals, VOCs, SVOCs, pesticides, and PCBs; and construction worker from metals, VOCs, and SVOCs in surface or subsurface soil and VOCs in indoor air via the vapor intrusion pathway Potential presence of ROCs in soil beneath the cover at IR-07/18	**Current use:** Limited access unoccupied and unused buildings, few commercial buildings **Future use**: Mixed use, including mixed residential/retail, a research and development area, a cultural and educational area, and open space	1. Prevent exposure to organic and inorganic compounds in soil at concentrations above remediation goals developed in the HHRA (Table 8-1 from Amended ROD [Navy, 2009]) for the following exposure pathways: a) Ingestion of, outdoor inhalation of, and dermal exposure to soil b) Ingestion of homegrown produce by residents in research and development and mixed-use reuse areas.	Soil Excavation	IR-07/18	Approximately 69,900 cubic yards of soil was removed from IR-07/18 from 1998 to 2001; however, RGs were not met and the soil remedy approach from the 1997 ROD (Navy, 1997) was re-evaluated to address ubiquitous metals and remaining COCs in soil. The Amended ROD (Navy, 2009) documents a parcel-wide application of durable covers to address these risks.	Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.
					B-1 and B-2	Hotspot excavation to remove lead and PAH-impacted soil from the site to prevent exposure to humans and wildlife. Excavations were backfilled with clean imported soil	
				Durable Covers	IR-07/18	Durable covers to provide physical barriers to prevent exposure of humans and wildlife include the following: 1) A 3-foot (minimum) vegetated soil cover with a demarcation layer over IR-07/18 upland areas within the ARIC 2) A 2-foot (minimum) vegetated soil cover over IR-07/18 upland areas outside of the ARIC 3) A 6-inch (minimum) asphalt cover comprising 4 inches of aggregate base and 2 inches of asphalt over IR-07/18 upland areas outside of the ARIC that required paving Covers are inspected and maintained to prevent exposure to COCs and ROCs.	
					B-1 and B-2	Durable covers to provide physical barriers to prevent exposure of humans and wildlife include the following: 1) A 2-foot-thick (minimum) vegetated soil cover 2) A 6-inch-thick (minimum) asphaltic pavement cover 3) Repaired concrete building foundations Covers are inspected and maintained to prevent exposure to COCs.	
				ICs	All	ICs to maintain durable covers and security features, restrict land-disturbing activities, and prohibit growing produce in native soil for human consumption	
			2. Prevent exposure to VOCs in soil gas at concentrations that would pose unacceptable risk (that is, risk greater than 10^{-6}) via indoor inhalation of vapors.	SVE	B-1	SVE to remove VOCs from soil gas. SVE system was operated intermittently as part of the remedy at IR-10 from March 2013 until May 2019 when evaluation of the mass removal rates indicated that the system had limited effectiveness extracting VOCs	
				Soil Excavation		Planned: Excavation to remove VOC-impacted soil source area beneath Building 123 (IR-10), backfilling with clean fill, and post-excavation soil vapor monitoring to SGALs for residential use	
				ICs	B-1 and B-2	ICs to prohibit construction of enclosed structures unless prior written approval of vapor mitigation strategies is granted by the FFA signatories	
	Presence of residual methane post-TCRA in IR-07/18		3. Reduce presence of methane in soil gas so that concentrations do not accumulate and become explosive in structures.	Soil Gas LTM	IR-07/18	Soil gas LTM to monitor concentrations of residual methane. Post-TCRA methane concentrations have been reduced to less than the lower explosive limit, and monitoring was discontinued in 2012.	
				ICs	IR-07/18	ICs to prohibit construction of enclosed structures unless prior written approval of vapor mitigation strategies is granted by the FFA signatories and the CDPH	

Table 3-3. Parcel B Remedial Action Summary and Expected Outcomes

Media	Risk/Basis for Action	Reasonably Anticipated Land Use	RAO	Remedy Component	Parcel[a]	Performance Metric	Expected Outcome
Soil, Soil Gas, and Sediment	**Ecological:** Potential unacceptable risk to benthic invertebrates, birds, and mammals from metals, pesticides, and PCBs in sediment	**Current use:** Limited access unoccupied and unused buildings, few commercial buildings **Future use**: Mixed use, including mixed residential/retail, a research and development area, a cultural and educational area, and open space	4. Prevent or minimize exposure of ecological receptors to organic and inorganic compounds in soil and sediment in shoreline areas at concentrations above remediation goals established for sediment (Table 8-1 from Amended ROD [Navy, 2009]).	Durable Cover	All	Durable covers to provide physical barriers to prevent exposure of humans and wildlife to COCs along the shoreline. Durable cover consists of a 3-foot-thick (minimum) shoreline revetment structure made of riprap with underlying geotextile. Covers are inspected and maintained to prevent exposure to COCs.	Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.
Groundwater	**Human Health**: Risk to industrial workers and residents from VOCs in A-aquifer through the vapor intrusion pathway; construction workers through direct contact with VOCs, SVOCs, and metals in A-aquifer groundwater and vapors in trenches; and residents through VOCs, and metals in B-aquifer groundwater from domestic use		1. Prevent exposure to VOCs and mercury in the A-aquifer groundwater at concentrations above remediation goals via indoor inhalation of vapors from groundwater (Table 8-3 from Amended ROD [Navy, 2009]).	In Situ Groundwater Remediation and Monitoring	B-1	Polylactate hydrogen was injected into 45 groundwater injection points to treat the VOC plume near Building 123 in IR-10. Post-injection monitoring is ongoing.	
					B-2	Organo-sulfur compound was injected into 43 groundwater injection points to treat dissolved mercury plume at IR-26 to the TL. Results were mixed and mercury continues to exceed TLs in downgradient monitoring wells.	
				ICs	B-1 and B-2	ICs to prohibit construction of enclosed structures unless prior written approval of vapor mitigation strategies is granted by the FFA signatories	
				MNA	B-1 and B-2	MNA of groundwater to monitor VOC attenuation. Although exceedances of the VC and TCE RGs have occurred, VOC concentrations are within historical ranges for all monitoring wells, and the presence of VC demonstrates that TCE biodegradation is occurring in groundwater in Parcel B-1. VOCs in Parcel B-2 are consistently less than RGs.	
			2. Prevent direct exposure to B-aquifer groundwater at concentrations above remediation goals (Table 8-3 from Amended ROD [Navy, 2009]) through the domestic use pathway (for example, drinking water or showering).	ICs	All	ICs to prohibit the use of groundwater and installation of new groundwater wells for domestic purposes	
			3. Prevent or minimize exposure of construction workers to metals, VOCs, and SVOCs in the A-aquifer groundwater at concentrations above remediation goals from dermal exposure and inhalation of vapors from groundwater (Table 8-3 from Amended ROD [Navy, 2009]).	ICs	All	ICs restrict land-disturbing activity unless prior written approval is granted by the FFA signatories (and CDPH at IR-07/18).	

Table 3-3. Parcel B Remedial Action Summary and Expected Outcomes

Media	Risk/Basis for Action	Reasonably Anticipated Land Use	RAO	Remedy Component	Parcel[a]	Performance Metric	Expected Outcome
Groundwater	**Ecological:** Potential migration pathway of metals to surface water	**Current use:** Limited access unoccupied and unused buildings, few commercial buildings **Planned Future Use:** Open space, education and cultural use, industrial, and mixed-use (including potential residential use)	4. Prevent or minimize migration to the surface water of San Francisco Bay of chromium VI, copper, lead, and mercury in the A-aquifer groundwater that would result in concentrations of chromium VI above 50 µg/L, copper above 28.04 µg/L, lead above 14.44 µg/L, and mercury above 0.6 µg/L in the surface water of San Francisco Bay. This RAO is intended to protect the beneficial uses of the bay, including ecological receptors.	LTM	All	LTM of groundwater in wells installed near the bay to monitor metals concentrations in groundwater and to verify that metals concentrations in groundwater do not exceed TLs that might pose a risk to the San Francisco Bay if mobilized from redevelopment actions. IR-07/18: Concentrations of metals do not exceed TLs. Parcel B-1: Concentrations of metals do not exceed TLs. Parcel B-2: Concentrations of dissolved mercury exceed TLs.	Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.
Radiologically Impacted Soil and Structures	**Human Health:** Radiological risks for soil and structures (storm drains, sanitary sewers, buildings) were greater than 10^{-6}.		1. Prevent exposure to radionuclides of concern in concentrations that exceed remediation goals (Table 8-4 from Amended ROD [Navy, 2009]) for the ingestion or inhalation exposure pathways.	Survey, Decontamination, and Removal of Radiologically Impacted Structures and Soil	B-1 and B-2	Identification and removal of historical subsurface storm drain and sanitary sewer utilities and screening and remediation of buildings, former building sites, and discharge channel as part of the TCRA for radionuclides. Radiological retesting is currently being conducted to confirm site conditions are compliant with the RAO.	
				Surface Scan for Radiological Materials and Excavation and Disposal of Radiological Anomalies	IR-07/18	MARSSIM Class 1 Survey of the entire surface of IR-07/18 was completed. Soil, sediment, and debris that exceeded release criteria or was assumed to be LLRW was removed.	
				Durable Cover with Demarcation Layer	IR-07/18	Durable covers provide physical barriers to prevent exposure of humans and wildlife to potential ROCs. The demarcation layer within the cover over potentially radiologically impacted areas serves as a warning against digging into potentially contaminated soil. Covers are inspected and maintained to prevent exposure to COCs.	
				LTM	IR-07/18	Groundwater LTM to monitor potential ROC concentrations. Since at least 2009, concentrations of potential ROCs have remained less than TLs.	
				ICs	IR-07/18	ICs to prohibit excavation below the demarcation layer unless prior written approval is granted by the FFA signatories and CDPH (ERRG, 2012b).	

Table 3-3. Parcel B Remedial Action Summary and Expected Outcomes

References:

Department of the Navy (Navy). 1997. *Hunters Point Shipyard, Parcel B, Final Record of Decision*. Engineering Field Activity West, Naval Facilities Engineering Command. October 7.

Navy. 2009. *Amended Parcel B Record of Decision, Hunters Point Naval Shipyard, San Francisco, CA*. Final. January 14.

ERRG. 2012b. *Operation and Maintenance Plan for Installation Restoration Sites 07 and 18 in Parcel B, Hunters Point Naval Shipyard, San Francisco, California*. Final. October.

[a] IR-07/18, Parcel B-1, and Parcel B-2 were included in a single ROD/Amended ROD (Navy, 1997, 2009) for former Parcel B; however, the remedy components associated with a number of RAOs was specific to a site or parcel as noted in the Parcel column.

µg/L = microgram(s) per liter
ARIC = area requiring institutional controls
CDPH = California Department of Public Health
COC = chemical of concern
FFA = Federal Facilities Agreement
HHRA = human health risk assessment
IC = institutional control
LTM = long-term monitoring
LUC = land use control
MARSSIM = Multi-Agency Radiation Survey and Site Investigation Manual
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RAO = remedial action objective
RD = remedial design
RG = remediation goal
ROC = radionuclide of concern
ROD = Record of Decision
SGAL = soil gas action level
SVE = soil vapor extraction
SVOC = semivolatile organic compound
TCE = trichloroethene
TCRA = time-critical removal action
TL = trigger level
VC = vinyl chloride
VOC = volatile organic compound

Table 3-4. Fourth Five-Year Review Parcel B Issues, Recommendations, and Follow-up Actions

Parcel/Site	Fourth Five-Year Review Protectiveness	Issue	Recommendation (Milestone)	Date Complete/ Current Status
B-1	Will be protective	SVE implementation in Parcels B-1 and C is reducing source mass, but with limited effectiveness due to diffusion-limited conditions in the subsurface. Although ICs will maintain future protectiveness, source-removal inefficiency is extending the period within which SVE will be implemented.	It is recommended that use of the SVE technology be evaluated for each treatment area due to inefficiency caused by diffusion-limited conditions. Site-specific studies (e.g., remedy analyses) should be performed to estimate the magnitude and extent of source mass at each treatment area in Parcels B-1 and C to determine if other measures could be implemented to enhance SVE performance in the future. Any changes implemented to the approach for reducing source contamination in SVE areas should be discussed in the next Five-Year Review report. Changes made to the treatment approach should be considered for any other SVE treatment areas at HPNS, including areas where treatment is planned but has not yet been initiated. (12/31/2019)	**Completed February 2021.** The system was operated most recently from October 2019 to April 2020, resulting in the removal of 1.4 pounds of TCE. Post-SVE shutdown rebound monitoring demonstrated that the SVE system reached a point of diminishing returns (Navy, 2019, Innovex-ERRG Joint Venture, 2021). Therefore, soil excavation and subsequent confirmation monitoring is planned for IR-10 to address VOC soil contamination to a depth of 10 feet bgs (Insight-ESI, 2023).
B-1, B-2	Will be protective	The regulatory agencies do not agree with the Navy's risk assessment methodology used to reduce the ARICs for VOC vapors.	The Navy intends to consider agency concerns (including specific recommendations made by USEPA) and reevaluate its approach to calculating SGALs, which may affect the ARICs for VOC vapors at Parcels B-1, B-2, D-1, and G. Appendix E (of the Fourth Five-Year Review) evaluated how USEPA's recommendations may affect the SGALs and the ARICs for VOC vapors. Based on the information in Appendix E, none of the potential changes to the ARICs for VOC vapors affect the current protectiveness of the remedies at Parcels B-1, B-2, D-1, and G. The regulatory agencies are currently reviewing and re-evaluating their methods for assessing vapor intrusion risk. Once consensus is achieved, the Navy should reevaluate its approach for calculating SGALs and adjusting ARICs for VOC vapors. The new SGALs would be developed based on the most current standards, toxicity criteria, and risk assessment methods. The new SGALs would be used to redefine the ARICs for soil gas at each parcel prior to property transfer. Any changes to soil gas risk assessment methodology should be discussed in the next Five-Year Review report. (12/31/2019)	**Completed September 2023.** A remedial action is currently being planned to address VOCs at Building 123, Site 10 (within Parcel B-1). A dual tracking approach is being used to evaluate methods to calculate SGALs for the removal which includes Method 1: Federal Toxicity Criteria Hierarchy (USEPA, 2003) and Method 2: State of California Toxicity Criteria Hierarchy using DTSC toxicity criteria for human health risk assessments. The Navy will evaluate differences between the Method 1 and Method 2 risk estimates in the risk characterization. The Navy will also discuss results of the risk characterization and its recommendations for updating VI areas requiring ICs with the BCT prior to submitting the draft RACR for BCT review (Insight-ESI, 2023). While there is disagreement about the method to calculate the SGALs which may affect ARIC boundaries, the final ARICs that will be surveyed and recorded in quitclaim deeds and covenants to restrict land use will be established in agreement with the BCT. Because attenuation of VOCs is likely to occur, ARICs for VOC vapors, and likewise SGALs that are the basis of the ARICs, in Parcels B-1 and B-2 will be re-evaluated and finalized during preparation for property transfer. Protectiveness is not affected because the Navy currently controls the property and land use, and future protectiveness will not be affected because the ARICs will be established in the appropriate legal documentation.
B-1, B-2	Will be protective	The Navy has determined that a significant portion of the radiological survey and remediation work completed to date was not reliable because of manipulation or falsification of data by one of its radiological contractors. A long-term protectiveness evaluation of the radiological RGs has not yet been completed for the Fourth Five-Year Review, and it is currently not known if the RAOs for radionuclides have been achieved in Parcels B-1, B-2, C, D-1, D-2, G, E, UC-1, UC-2, and UC-3.	See **Section 1.4.3** for the long-term protectiveness evaluation component of this recommendation. The Navy is in the process of implementing corrective actions to ensure that the radiological remedies specified in the decision documents are implemented as intended. It is anticipated that the radiological rework will be completed prior to the next Five-Year Review.	**Long-term Protectiveness Evaluation: Completed June 2020**. Addenda to the Fourth Five-Year Review were prepared to evaluate the Radiological RGs for soil and buildings. The conclusions of both reports were that the current RGs were protective of human health and the environment (Navy, 2020a, 2020b). **In Progress.** Planning for the radiological retesting of soil and surveys of building and former building structures at Parcel B (including Parcels B-1 and B-2) was initiated in February 2019. Fieldwork activities were initiated in fall 2022. Upon completion, radiological rework will be summarized in a RACR anticipated to be completed in 2025.

References:

Department of the Navy (Navy). 2019. *Fourth Five-Year Review, Hunters Point Naval Shipyard, San Francisco, California*. July.

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Navy. 2020b. *Addendum to the Five-Year Review, Evaluation of Radiological Remedial Goals for Building Structures, Hunters Point Naval Shipyard, San Francisco, CA*. June 18.

ARIC = area requiring institutional controls
BCT = BRAC Cleanup Team
bgs = below ground surface
BRAC = Base Realignment and Closure
DTSC = California Department of Toxic Substances Control
HPNS = Hunters Point Naval Shipyard
IC = institutional control
Navy = Department of the Navy
RACR = Remedial Action Completion Report
RG = remediation goal
SGAL = soil gas action level
SVE = soil vapor extraction
TCE = trichloroethene
USEPA = United States Environmental Protection Agency
VI = vapor intrusion
VOC = volatile organic compound

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Table 3-5. Parcel B Chemicals of Concern and Current Comparison Criteria for Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	Values from Amended ROD		Current Comparison Criteria				
			Amended ROD Remediation Goal (2009)	Source of Remediation Goal	11/2022 USEPA RSL or VISL[a]	Basis of RSL or VISL (C/NC)	DTSC-SL	California MCL	USEPA MCL
Groundwater A-Aquifer (µg/L)	Residential Vapor Intrusion	1,2,4-Trichlorobenzene	66	RBC	35.9	NC	NA	5	70
		1,2,4-Trimethylbenzene	25	RBC	248	NC	NA	None	None
		1,2-Dichlorobenzene	2,561	RBC	2660	NC	NA	600	600
		1,2-Dichloroethane	2.3	RBC	2.24	C	NA	0.5	5
		1,2-Dichloroethene (total)	209	RBC	109	NC	NA	6 / 10	70 / 100
		1,2-Dichloropropane	1.1	RBC	6.58	C	NA	5	5
		1,3,5-Trimethylbenzene	19	RBC	175	NC	NA	None	None
		1,4-Dichlorobenzene	2.1	RBC	2.59	C	NA	5	75
		2-Methylnaphthalene	707	RBC	NITD		NA	None	None
		Benzene	0.5	PQL	1.59	C	NA	1	5
		Bromodichloromethane	1	RBC	0.876	C	NA	80	80
		Chlorobenzene	392	RBC	410	NC	NA	70	100
		Chloroethane	6.5	RBC	9190	NC	NA	None	None
		Chloroform	1	PQL	0.814	C	NA	80	80
		cis-1,2-Dichloroethene	209	RBC	250	NC	NA	6	70
		Dichlorodifluoromethane	14	RBC	7.44	NC	NA	None	None
		Mercury	0.68	RBC	0.889	NC	NA	2	2
		Methylene chloride	27	RBC	763	C	NA	5	5
		Naphthalene	3.6	RBC	4.59	C	NA	None	None
		Tetrachloroethene	1	PQL	14.9	C	NA	5	5
		trans-1,2-Dichloroethene	182	RBC	109	NC	NA	10	100
		Trichloroethene	2.9	RBC	1.19	C	NA	5	5
		Trichlorofluoromethane	176	RBC	NITD		NA	150	None
		Vinyl chloride	0.5	PQL	0.147	C	NA	0.5	2
	Industrial Vapor Intrusion	Chloroform	1.2	RBC	3.55	C	NA	80	80

Table 3-5. Parcel B Chemicals of Concern and Current Comparison Criteria for Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	Values from Amended ROD		Current Comparison Criteria				
			Amended ROD Remediation Goal (2009)	Source of Remediation Goal	11/2022 USEPA RSL or VISL[a]	Basis of RSL or VISL (C/NC)	DTSC-SL	California MCL	USEPA MCL
Groundwater B-Aquifer (µg/L)	Residential Domestic Use	1,4-Dichlorobenzene	7.5	ARAR	0.48	C	No value	5	75
		Antimony	43.26	HGAL	7.8	NC	No value	6	6
		Arsenic	27.34	HGAL	0.052	C	0.0082	10	10
		Benzene	5	ARAR	0.46	C	0.15	1	5
		Chloroethane	4.6	RBC	8300	NC	No value	None	None
		Manganese	8,140	HGAL	430	NC	No value	None	None
		Pentachlorophenol	25	PQL	0.041	C	No value	1	1
		Thallium	12.97	HGAL	0.2	NC	0.59	2	2
		Trichloroethene	5	ARAR	0.49	C	No value	5	5

[a] VISL presented for A-aquifer groundwater, RSL for all other media and groundwater aquifers.

Notes:
Shading indicates current comparison criteria is lower than Amended ROD Remediation Goal unless Remediation Goal is Background.

µg/L = microgram(s) per liter
ARAR = applicable or relevant and appropriate requirement
C = carcinogen
DTSC = California Department of Toxic Substances Control
HGAL = Hunters Point groundwater ambient level
MCL = maximum contaminant level
mg/kg = milligram(s) per kilogram
NA = not available
NC = noncarcinogen
PQL = practical quantitation limit
RBC = risk-based concentration
ROD = Record of Decision
RSL = regional screening level
SL = screening level
USEPA = United States Environmental Protection Agency
VISL = vapor intrusion screening level

Table 3-6. Parcel B Chemicals of Concern for Ecological Receptors - Sediment

Exposure Medium	Exposure Scenario	Chemical of Concern	Amended ROD Remediation Goal (2009)	Source of Remediation Goal/Target Level	Receptor Basis	Toxicity Value Used as Source of Remediation Goal	Changes in Exposure Factors?	Changes in Toxicity Values?	Remediation Goal Still Protective?
Sediment (mg/kg)	Ecological Receptor	Aluminum	3,400	RBC	Small Mammals	Sample et al., 1996	No	TRV scaling is no longer used. Sample et al. (1996) is still used.	Yes. Changes to toxicity values would not alter the overall conclusion of the risk assessment or significantly alter the derivation of RBCs. RG is still protective.
		Copper	270	RBC	Benthic macroinvertebrates	ERM	No	No	Yes. Source of benchmark used as RG is still in use today.
		Dibenz(a,h)anthracene	0.33	PQL	Benthic macroinvertebrates	ERM	No	No	Yes. Source of the RG is the PQL. Analyte was only identified as a COC for subsurface sediments (2.5 to 4 feet bgs) which are not in the biologically active zone.
		Dieldrin	0.008	RBC	Benthic macroinvertebrates	ERM	No	No	Yes. Source of benchmark used as RG is still in use today.
		Lead	218	RBC	Benthic macroinvertebrates	ERM	No	No	Yes. Source of benchmark used as RG is still in use today.
		Methoxychlor	0.4	RBC	Birds	BTAG TRVs for DDT	No	TRV scaling is no longer used. Bird TRVs are available for methoxyclor in LANL (2022) and are less conservative (higher) than those from BTAG.	Yes. TRVs used to derive the RG are more conservative than TRVs commonly used today. RG is overprotective.
		Total Aroclors	0.18	RBC	Benthic macroinvertebrates	ERM	No	No	Yes. Source of benchmark used as RG is still in use today.
		Total DDT	0.046	RBC	Benthic macroinvertebrates	ERM	No	No	Yes. Source of benchmark used as RG is still in use today.
		Zinc	410	RBC	Benthic macroinvertebrates	ERM	No	No	Yes. Source of benchmark used as RG is still in use today.

Table 3-6. Parcel B Chemicals of Concern for Ecological Receptors - Sediment

Reference:

Sample, B.E., D.M. Opresko, and G.W. Suter II. 1996. *Toxicological Benchmarks for Wildlife: 1996 Revision*. ES/ER/TM-86/R3. ORNL, Oak Ridge, Tennessee.
Los Alamos National Laboratory (LANL). 2022. EcoRisk database. Release 4.2. November.

bgs = below ground surface
BTAG = Biological Technical Assistance Group
COC = chemical of concern
DDT = dichlorodiphenyltrichloroethane
ERM = effects range median
LANL = Los Alamos National Laboratory
mg/kg = milligram(s) per kilogram
PQL = practical quantitation limit
RBC = risk-based concentration
RG = remediation goal
ROD = Record of Decision
TRV = toxicity reference value

Table 3-7. Parcel B Chemicals of Potential Concern for Ecological Receptors - Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	Amended ROD Trigger Level (2009)	Source of Trigger Level	Receptor Basis	NRWQC (2023)	Basin Plan SF Bay (2019)	Value Still Protective?	Notes
Groundwater (µg/L)	Ecological Receptor	Chromium VI	50	NRWQC - CCC	Aquatic Organisms	50	50	Yes	Analyte was not identified as posing potential risk to ecological receptors in the SLERA. It was included in the monitoring due to detections in well IR10MW12A/IR10MW82A. The TL is a risk-based criteria for surface water exposures but is not an ARAR for ecological exposure to groundwater.
		Copper	28.04	HGAL	Aquatic Organisms	3.1	6	Yes	Analyte was not identified as posing potential risk to ecological receptors in the SLERA due to low FOD and no defined plume. However, it was included in the monitoring plan. The TL is based on ambient levels and is not a risk-based value. Risk-based criteria for surface water (NRWQC and Basin Plan) are for comparison purposes only and are not ARARs for groundwater exposures.
		Lead	14.44	HGAL	Aquatic Organisms	8.1	8.1	Yes	Analyte was not identified as posing potential risk to ecological receptors in the SLERA due to low FOD and no defined plume. However, it was included in the monitoring plan. The TL is based on ambient levels and is not a risk-based value. Risk-based criteria for surface water (NRWQC and Basin Plan) are for comparison purposes only and are not ARARs for groundwater exposures.
Groundwater (µg/L)	Ecological Receptor	Mercury	0.6	HGAL	Aquatic Organisms	0.94 (D)	0.03 mg/kg fish tissue	Yes	Detected in well IR26MW47A/49A greater than TL. Assumes aquatic receptors are exposed to full concentration detected in groundwater well. Potential for mixing is not accounted for in the comparisons with the TL. The TL is based on ambient levels and is not a risk-based value. Risk-based criteria for surface water (NRWQC and Basin Plan) are for comparison purposes only and are not ARARs for groundwater exposures. The 2019 update to the San Francisco Bay Basin Plan (2019) has revised the mercury goal to a tissue-based value.

Table 3-7. Parcel B Chemicals of Potential Concern for Ecological Receptors - Groundwater

Reference:

San Francisco Bay Region Water Quality Control Board (SFRWQCB). 2019. *San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan). California Regional Water Quality Control Board – San Francisco Bay Region* . November.

µg/L = microgram(s) per liter
ARAR = applicable or relevant and appropriate requirement
CCC = criterion continuous concentration
(D) = dissolved
FOD = frequency of detection
HGAL = Hunters Point groundwater ambient level
mg/kg = milligram(s) per kilogram
NRWQC = National Recommended Water Quality Criteria
ROD = Record of Decision
SLERA = screening-level ecological risk assessment
TL = trigger level

Table 3-8. Parcel B Issues, Recommendations, and Follow-up Actions

Parcel	Issue	Recommendations/ Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
						Current	Future
B-1 B-2	As identified in the Fourth Five-Year Review, there is uncertainty with a portion of the radiological survey and remediation work performed between 2004 and 2016 under the Basewide Radiological Removal Action, Action Memorandum (Navy, 2006). The Navy is in the process of implementing corrective actions to ensure the radiological remedies specified in the decision documents were implemented as intended; however, this work is ongoing.	Complete radiological retesting at radiologically impacted sites, including current and former buildings and soil areas investigated under the Radiological Removal Action, Action Memorandum (Navy, 2006) and areas where evaluations determined previous data were unreliable.	Navy	USEPA	2/27/2025	N	Y

Source: Navy. 2006. *Base-wide Radiological Removal Action, Action Memorandum – Revision 2006*, Hunters Point Shipyard, San Francisco, California. Final. April 21.

Navy = Department of the Navy
USEPA = United States Environmental Protection Agency

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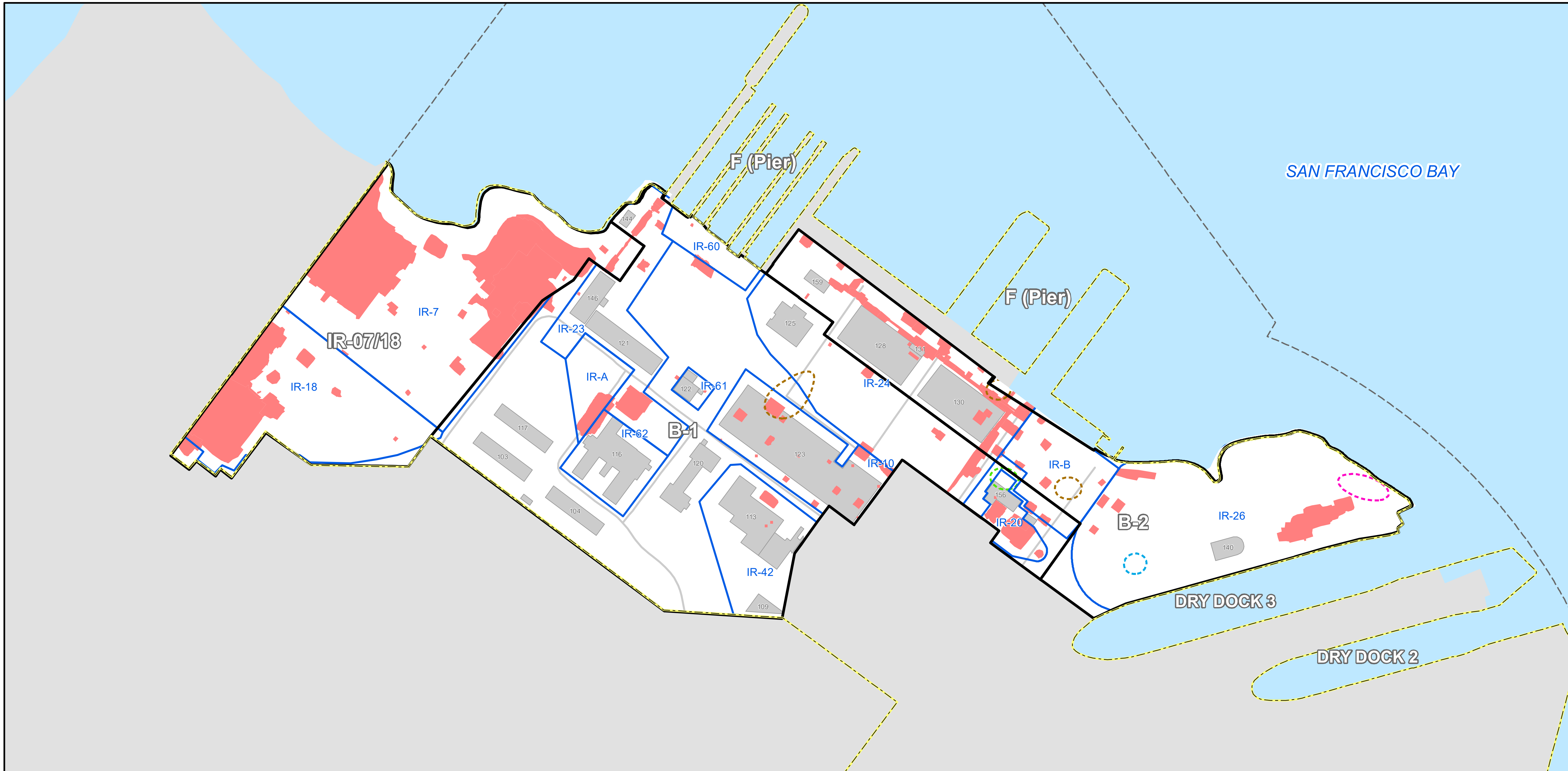

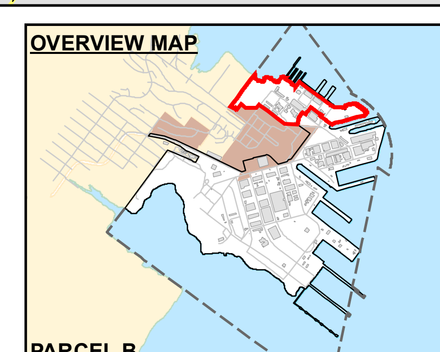

Figure 3-1
Parcel B (Installation Restoration Sites 07 and 18, Parcels B-1 and B-2)
Fifth Five-Year Review Report
Hunters Point Naval Shipyard, San Francisco, California

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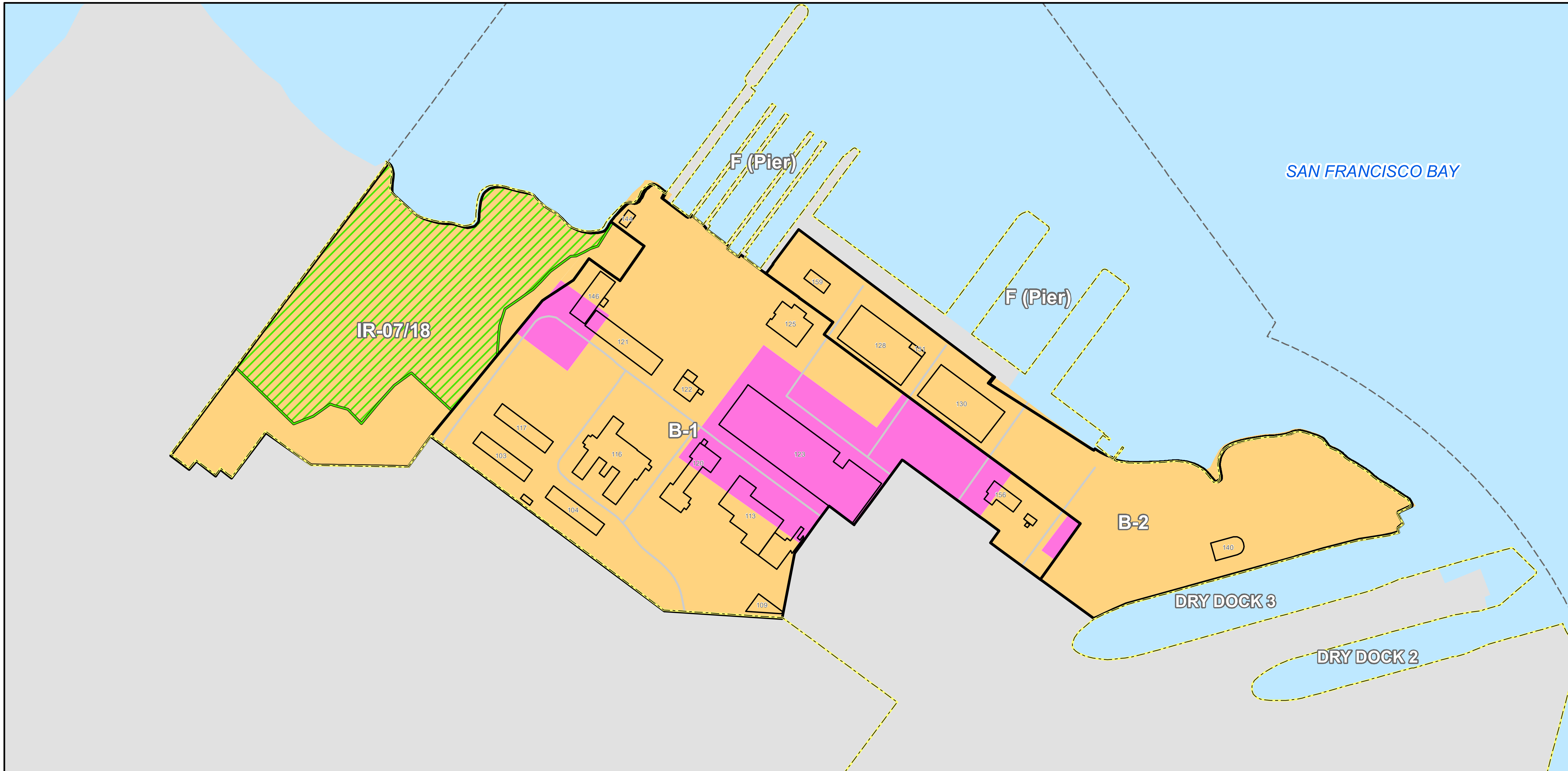

LEGEND

- Hunters Point Naval Shipyard Boundary
- Parcel Boundary
- Parcel F (Water) Boundary
- Water
- Building
- Road

Institutional Controls

- ARIC for Soil and Groundwater Use (General)
- ARIC for Soil, Groundwater Use, and Restrictions Related to VOC Vapors
- ARIC for Potential Radionuclides

ARIC = area requiring institutional controls
VOC = volatile organic compound

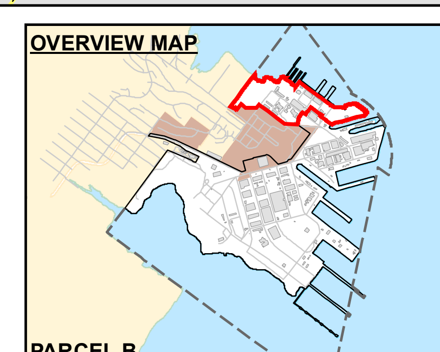

Figure 3-2
Parcel B (Installation Restoration Sites 07 and 18, Parcels B-1 and B-2)
Institutional Controls
Fifth Five-Year Review Report
Hunters Point Naval Shipyard, San Francisco, California

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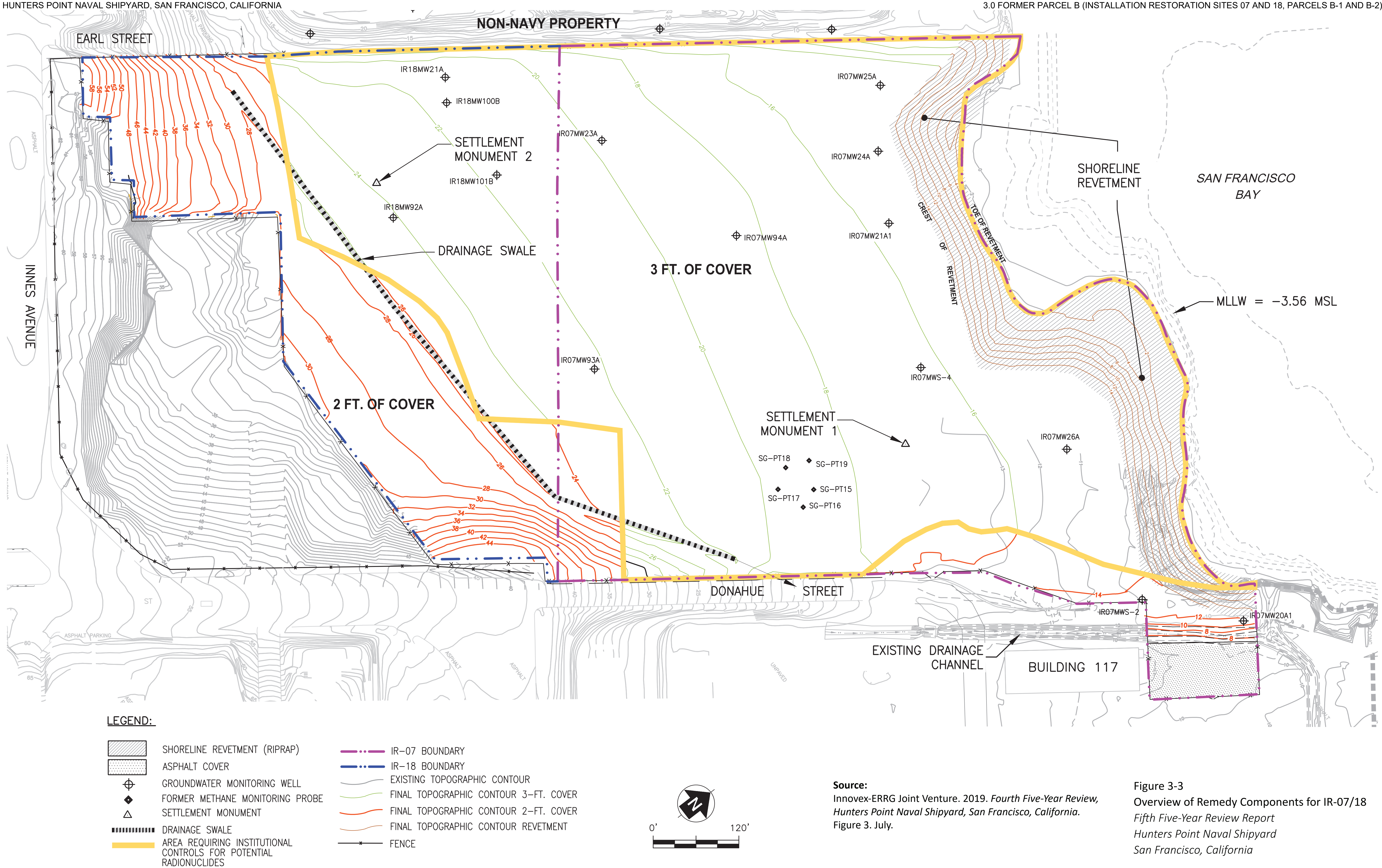

Source:
Innovex-ERRG Joint Venture. 2019. *Fourth Five-Year Review, Hunters Point Naval Shipyard, San Francisco, California.* Figure 3. July.

Figure 3-3
Overview of Remedy Components for IR-07/18
Fifth Five-Year Review Report
Hunters Point Naval Shipyard
San Francisco, California

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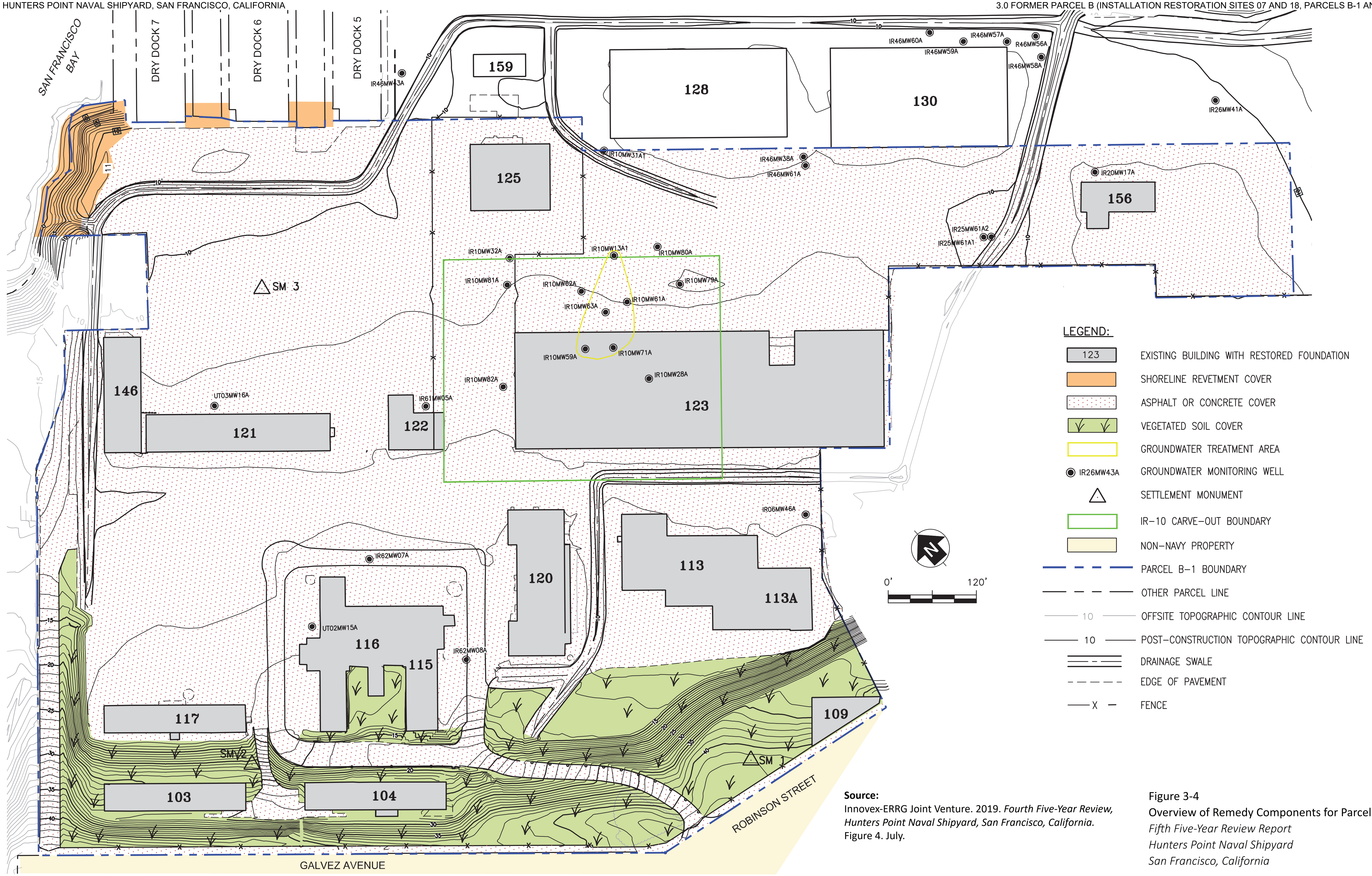

Source:
Innovex-ERRG Joint Venture. 2019. *Fourth Five-Year Review, Hunters Point Naval Shipyard, San Francisco, California.* Figure 4. July.

Figure 3-4
Overview of Remedy Components for Parcel B-1
Fifth Five-Year Review Report
Hunters Point Naval Shipyard
San Francisco, California

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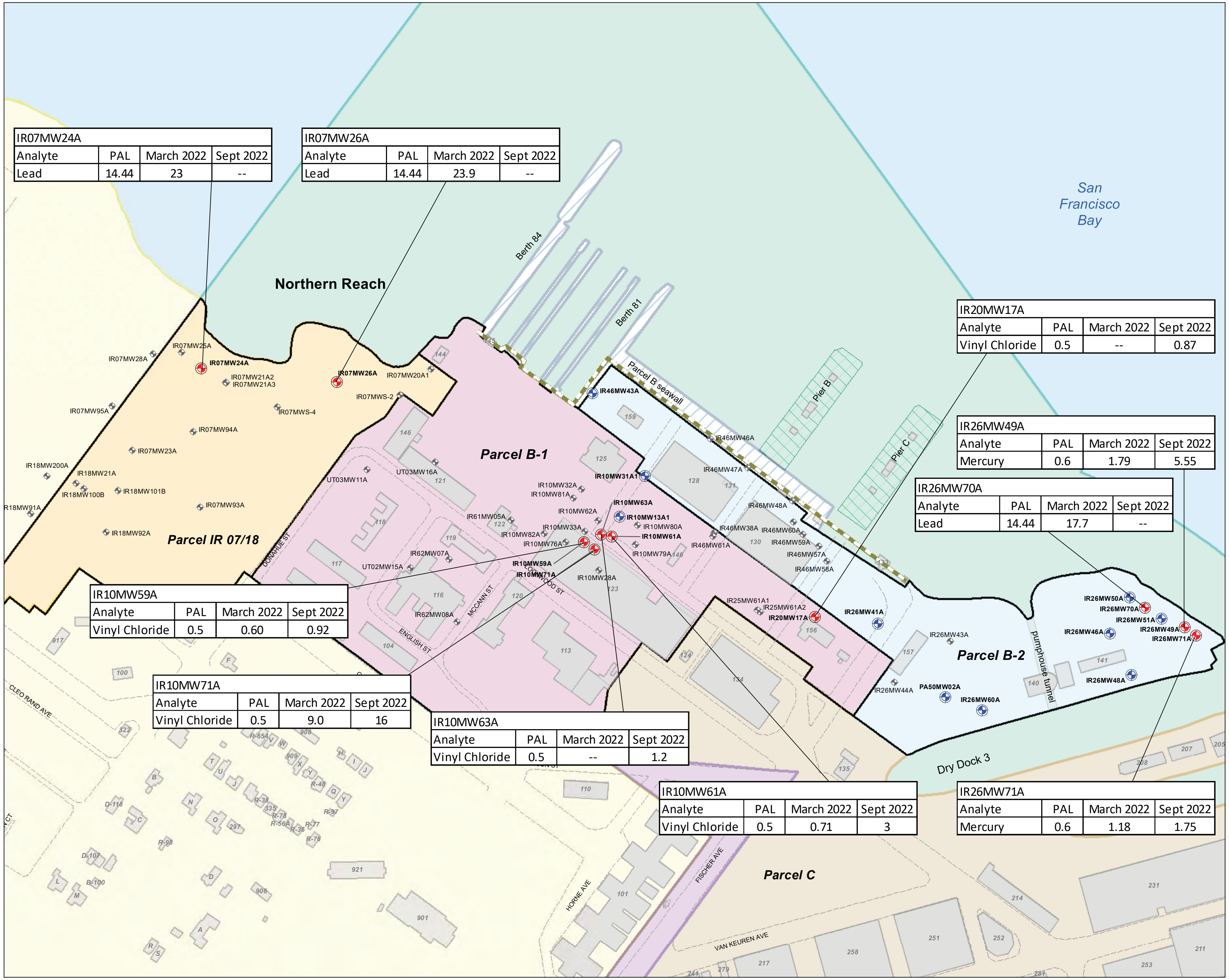

IR07MW24A			
Analyte	PAL	March 2022	Sept 2022
Lead	14.44	23	--

IR07MW26A			
Analyte	PAL	March 2022	Sept 2022
Lead	14.44	23.9	--

IR20MW17A			
Analyte	PAL	March 2022	Sept 2022
Vinyl Chloride	0.5	--	0.87

IR26MW49A			
Analyte	PAL	March 2022	Sept 2022
Mercury	0.6	1.79	5.55

IR26MW70A			
Analyte	PAL	March 2022	Sept 2022
Lead	14.44	17.7	--

IR10MW59A			
Analyte	PAL	March 2022	Sept 2022
Vinyl Chloride	0.5	0.60	0.92

IR10MW71A			
Analyte	PAL	March 2022	Sept 2022
Vinyl Chloride	0.5	9.0	16

IR10MW63A			
Analyte	PAL	March 2022	Sept 2022
Vinyl Chloride	0.5	--	1.2

IR10MW61A			
Analyte	PAL	March 2022	Sept 2022
Vinyl Chloride	0.5	0.71	3

IR26MW71A			
Analyte	PAL	March 2022	Sept 2022
Mercury	0.6	1.18	1.75

LEGEND

- IR26MW51A Monitoring Well exceeding remediation goals
- IR26MW71A BGMP Monitoring Well
- IR26MW43A Other Monitoring Well (Not Sampled)
- Parcel B seawall
- Roads

Parcels

- B-1
- B-2
- C
- F (Pier)
- F (Water)
- Demolished Pier
- UC-2
- Buildings
- IR 07/18
- Non - Navy property
- San Francisco Bay

NOTE:
All units in micrograms per liter - µg/L

BGMP - Basewide Groundwater Monitoring Program
PAL - Project Action Level
µg/L - Micrograms per Liter

GRAPHIC SCALE
0 300 FEET

Source:
TRBW. 2023. *2022 Basewide Annual Groundwater Monitoring Report, Hunters Point Naval Shipyard, San Francisco, California.* June 2023. DRAFT

Figure 3-5
March and September 2022 Exceedances of Remediation Goals in Parcels B-1, B-2, and IR 07/18
Fifth Five-Year Review Report
Hunters Point Naval Shipyard
San Francisco, California

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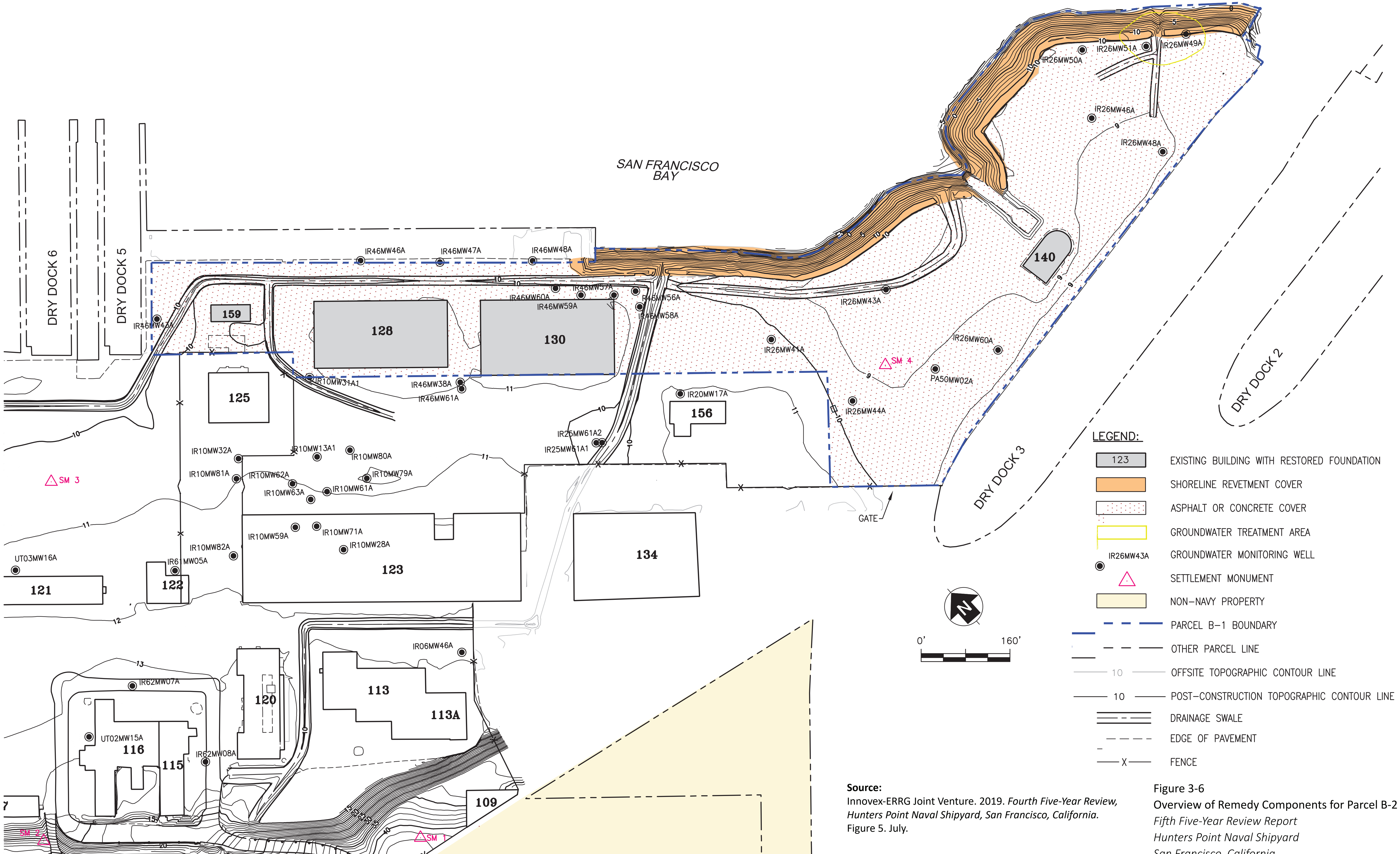

Source:
Innovex-ERRG Joint Venture. 2019. *Fourth Five-Year Review, Hunters Point Naval Shipyard, San Francisco, California.* Figure 5. July.

Figure 3-6
Overview of Remedy Components for Parcel B-2
Fifth Five-Year Review Report
Hunters Point Naval Shipyard
San Francisco, California

230307115911_589d933e Figure_3-4_B-2

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4.0 Former Parcel C (Parcels C and UC-2)

4.1 Site History and Background

Former Parcel C is the oldest portion of the shipyard and was used almost exclusively for industrial purposes since the late 1800s. The central portion of the shipyard was formerly part of the industrial support area and was used for shipping, ship repair, and office and commercial activities. NRDL used portions of Parcel C.

Former Parcel C is bounded by Former Parcel B to the north, Parcel A to the west, Former Parcel D to the south, and the San Francisco Bay to the east. Former Parcel C covered approximately 79 acres, which was subdivided into two parcels in 2008: Parcel C (73 acres) and Parcel UC-2 (3.9 acres) (**Figure 4-1**).

The following IR sites are located in Parcels C and UC-2:

- Parcel C: IR-06 (partial), IR-25, IR-27, IR-28, IR-29, IR-30, IR-57, IR-58, IR-63, and IR-64
- Parcel UC-2: IR-06 (partial)

Four IR sites (IR-45, IR-49, IR-50, and IR-51) are facility-wide utilities that cut across other IR sites or are the locations of former transformer storage areas. Investigations at Parcels C and UC-2 began in 1994 as shown in the following chronology.

Parcel C Chronology

Date	Investigation/Action
1994	SI
3/1997	RI
1996–1997	Exploratory Excavation Removal Action
1996–1997	Storm Drain Sediment Removal
1996–1998	FS (initial phase)
7/1998–9/1999	Soil Removals at IR-06 and IR-25
1999	Risk Management Review
4/2001	Groundwater Treatability Study at Building 253
2000–2002	Fuel and Steam Line TCRA
2001–2002	SVE Treatability Studies
9/2002	Groundwater Treatability Study at Building 272
2002–2004	Waste Consolidation and Removal Activities
2003	Encapsulation of Drainage Culvert Sediment at Dry Dock 4
2004	Degreaser Pit/Separator Demolition at RU-C5 HRA
2004–Ongoing	Groundwater Monitoring under the BGMP
2004–2005	Groundwater Treatability Study at Building 134 Follow-on Groundwater Treatability Study at Building 272

Parcel C Chronology	
Date	**Investigation/Action**
2008	Revised FS
12/2009	Parcel UC-2 ROD
2009–2010	Groundwater Treatability Study at Building 253
2010–2011	Groundwater Treatability Study at Building 134
9/2010	Parcel C ROD
2012	Pre-design Investigation RU-C2 RD for Parcel C Treatability Study RU-C5 Durable Cover installation Parcel UC-2
2013	RAWPs for Parcel C Third Five-Year Review for HPNS RACR for Durable Covers at UC-2
2013–2015	Soil Excavation and Disposal, Parcel C
2013–2018	SVE System Operation, Parcel C
2013–Ongoing	Groundwater Remediation and Performance Monitoring
10/2014	ESD to the Final ROD for Parcel C
2015	Transfer of Parcel UC-2 to the City and County of San Francisco’s OCII
2015–2016	Durable Cover Installation, Parcel C
2017	RACR for Durable Covers in Parcel C
2019	Fourth Five-Year Review for HPNS
2019	Groundwater remediation in RU-C1 and RU-C2
2021	Groundwater remediation in RU-C4
2022–Ongoing	Radiological Retesting Fieldwork Parcel C

4.2 Site Characterization

This section summarizes the findings from various investigations at Parcels C and UC-2 that are pertinent to the Five-Year Review.

4.2.1 Physical Characteristics

4.2.1.1 Surface Features

Parcel C is located in the lowlands portion of HPNS, and ground surface elevations generally range from 0 to 10 feet above msl. More than 90 percent of Parcel C is covered by pavement and former industrial buildings. The area surrounding and adjacent to Dry Dock 2 and Dry Dock 3 was identified as the Hunters Point Commercial Dry Docks Historical District.

Surface water runoff was historically collected in the storm drain system and discharged to the bay through outfalls. However, the storm drains and sewer lines were removed during ongoing radiological investigations, and surface drainage swales redirect stormwater to San Francisco Bay.

4.2.1.2 Geology and Hydrogeology

The western portion of Parcel C contains native soil over shallow bedrock, whereas most of the parcel consists of flat lowlands. The lowlands were constructed by placing borrowed fill material from various sources, including crushed serpentinite bedrock from the adjacent highland, construction debris, and waste materials (such as used sandblast materials). The serpentinite bedrock and serpentine bedrock-derived fill material consist of minerals that naturally contain asbestos and relatively high concentrations of arsenic, manganese, nickel, and other ubiquitous metals.

The following is a summary of hydrostratigraphic units at Parcel C (SulTech, 2008; ECC-Insight, 2019):

- A-Aquifer: Depth to the top of the A-aquifer occurs at approximately 8 to 10 feet bgs across most of Parcels C and UC-2. Groundwater flows to the southeast or northeast, directly toward the bay or dry dock, at bayside perimeter locations of the parcels. The A-aquifer averages between 20 and 25 feet thick over most of Parcels C and UC-2. Tidal fluctuations were observed from 150 to 500 feet inland from the bay.
- Bay Mud: The Bay Mud is present at Parcels C and UC-2. It generally thickens from 0 feet in the southwest to 40 feet in the northeast. A 5- to 12-foot-thick Sandy Lean Clay layer was identified in borings advanced during previous investigations within the RU-C2 area, which also acts as an aquitard separating the A- and B-aquifers when Bay Mud is absent (ECC-Insight, 2019).
- B-Aquifer: The B-aquifer is present over an area of approximately 22 acres, or about 28 percent of Parcel C, in the east-central area. It is semiconfined by Bay Mud and Sandy Lean Clay (ECC-Insight, 2019). It is not present at Parcel UC-2.
- Fractured Water-bearing Zone (F-WBZ): The water table is present within the saturated F-WBZ over approximately 30 acres (38 percent) of Parcel C.

As discussed in **Section 1.3.4.3**, the entire A-aquifer and the B-aquifer within Parcel C, with the exception of a small portion of the B-aquifer associated with Parcel B (RU-5, in the area of Building 134), meets the Resolution 88-63 exception criteria. Similarly, the exception applies to F-WBZ where it is in direct contact with or hydrogeologically connected to the overlying A- and B-aquifers.

4.2.2 Land Use

4.2.2.1 Current Land Use

Parcel C is currently owned by the federal government and is under the jurisdiction of the Navy. There are no tenants at Parcel C.

Parcel UC-2 was transferred out of federal ownership to the City and County of San Francisco’s OCII in late 2015 and is currently used as a roadway and utility corridor.

4.2.2.2 Future Land Use

According to the Redevelopment Plan (SFRA, 2010), Parcel C is expected to be zoned to accommodate buildings for cultural and institutional uses; research and development; and mixed-use areas for live/work spaces for artists that will include studios, galleries, warehouses, and hotels. The area along the eastern portion of Parcel C bounded by the bay will be set aside as open space.

4.2.3 Basis for Taking Action

This section describes the results of site investigations and risk assessments that provide the basis for taking action at Parcel C. Details are provided in the RI (PRC et al., 1997), FS (SulTech, 2008), Parcel C ROD (Navy, 2010) and ESD (Navy, 2014), and Parcel UC-2 ROD (Navy, 2009).

4.2.3.1 Site Investigations and Pre-ROD Removal Actions

Previous investigations at Parcel C identified metals, VOCs, PAHs, and PCBs in soil; VOCs, PAHs, SVOCs, and metals in groundwater; and radiologically impacted structures and soil. The Navy has currently defined four Rus for groundwater: RU-C1, RU-C2, RU-C4 (includes former RU-C3), and RU-C5. Rus consist of an area of a known source of contamination and the area of contaminated groundwater associated with that source.

The Navy has completed a number of removal actions and treatability studies at Parcel C. Two key soil removal actions reduced or eliminated certain risks to human health and ecological receptors. More than 3,000 samples were collected, and approximately 9,600 cubic yards of soil was excavated during the exploratory excavations and the steam and fuel lines TCRA. Past and ongoing treatability studies at Parcel C have focused on technologies to reduce VOCs in groundwater and soil, including zero-valent iron (ZVI) injection and sequential anaerobic or aerobic bioremediation. Based on these removal actions and studies, the sources and extent of the remaining contamination in soil and groundwater have been well characterized (Navy, 2010).

4.2.3.2 Human Health Risk

A quantitative HHRA was completed for Parcels C and UC-2 as part of the 1997 RI (PRC et al., 1997) and was updated in the 2008 FS (SulTech, 2008). Human health risks were characterized separately for COCs and ROCs. The RODs for Parcels C and UC-2 (Navy, 2010, 2009, respectively) identified the following unacceptable human health risks from nonradiological chemicals (**Table 4-1**):

- Future industrial users from exposure to metals, VOCs, and SVOCs in surface (0 to 2 feet bgs) and subsurface soil (0 to 10 feet bgs), and VOCs in groundwater (in A-aquifer through the vapor intrusion to indoor air pathway)
- Future recreational users from exposure to metals and SVOCs in surface soil (0 to 2 feet bgs)
- Future residents (adult and child) from exposure to metals, VOCs, SVOCs, pesticides, and PCBs in surface (0 to 2 feet bgs) and subsurface soil (0 to 10 feet bgs); VOCs in A-aquifer through the vapor intrusion to indoor air pathway; and metals, VOCs, SVOCs, and pesticides in B-aquifer through domestic use (in RU-C5 only)
- Future construction workers from exposure to metals, SVOCs, and PCBs in subsurface soil (0 to 10 feet bgs) and VOCs in groundwater (A-aquifer through direct exposure and VOCs in trenches)

Table 4-2 presents ROCs from radiologically impacted buildings, storm drains, sanitary sewers, and associated soil identified at Parcels C and UC-2 (Tetra Tech, 2008).

4.2.3.3 Ecological Risk

The Navy concluded in the RI (PRC et al., 1997) that limited viable habitat is available for terrestrial wildlife at Parcel C because most of the site is covered with pavement and most of the terrestrial component of the shoreline at Parcel C is paved. The tidal area associated with the shoreline is associated with Parcel F. Therefore, ecological risk associated with exposure to soil was not evaluated further in the FS.

The Navy completed a screening evaluation of surface water quality to assess potential exposure by aquatic wildlife to groundwater as it interacts with the surface water of San Francisco Bay. Results of the screening evaluation indicated two metals (chromium VI and zinc) in groundwater may pose a potential risk to aquatic wildlife. However, groundwater monitoring data indicate metals migrate at a much slower rate than groundwater flows; thus, discharge of metals to the bay is not imminent. **Table 4-1** presents chemicals of ecological concern (COECs) and TLs. It is necessary to monitor affected areas to determine whether the plume is migrating and whether it will discharge to the bay at concentrations that exceed surface water criteria.

No COECs were identified in UC-2 groundwater.

4.3 Remedial Action Objectives

In 2009, the Navy divided Parcel C into two new parcels: Parcels C and UC-2.

The ROD for Parcel C was signed on September 30, 2010 (Navy, 2010), and an ESD to modify removal action boundaries was signed in October 2014 (Navy, 2014). **Table 4-3** summarizes the basis for action, reasonably anticipated land use, RAOs, remedy components, performance metrics, and expected outcomes for Parcel C. The presence of VOCs in groundwater and soil may contribute to the presence of VOC in soil gas; therefore, the vapor intrusion pathway is included as a basis for action and development of RAOs.

The ROD for Parcel UC-2 was signed on December 17, 2009 (Navy, 2009). **Table 4-4** summarizes the basis for action, reasonably anticipated land use, RAOs, remedy components, performance metrics, and expected outcomes for Parcel UC-2. One overall remedy was selected for Parcels C and UC-2, but many actions in the overall remedy were not applicable to Parcel UC-2; **Table 4-4** presents only applicable components.

Tables 4-1 and **4-2** summarize the Navy-developed RGs to meet the RAOs for soil, groundwater, and radiologically impacted media. The Navy also developed TLs for use in monitoring concentrations of metals in groundwater, as summarized in **Table 4-1**, in the A-aquifer for the protection of the environment. The TLs are conservative, and exceedance of a TL does not necessarily indicate an immediate risk, given dilution and mixing with surface water; nonetheless, a potential for ecological risk was identified if the metals in groundwater discharge undiluted to the bay.

4.4 Remedial Actions

4.4.1 Parcel C

The RA for Parcel C includes the following major components:

- Soil excavation and removal to address COC in soil
- Durable cover installation and maintenance to address COCs in soil
- SVE to address VOCs in soil gas

- In situ treatment to address VOCs and metals in groundwater
- Groundwater monitoring, including in situ treatment performance monitoring, LTM of metals, and MNA of VOCs
- Radiological surveys and remediation through soil excavation and removal of sanitary sewer and storm drain lines
- ICs for soil, soil gas, and groundwater

Remedy components are shown on **Figure 4-1, 4-2,** and **4-3**.

4.4.1.1 Remedy Implementation

Soil Excavation and Removal

An ESD was finalized in October 2014 documenting a change to the excavation boundaries based on a tiered action level approach to remove the highest concentrations of COCs and relying on durable covers and ICs to meet the soil RAOs (Navy, 2014). Between 2013 and 2015, approximately 28,261 bank cubic yards (BCY) of contaminated soil was excavated from 18 excavation areas within Parcel C (RU-C1, C4, and C5 and Building 241) and disposed of offsite (APTIM, 2018). Excavations were successfully completed to remove contaminated soil with concentrations 5 to 10 times greater than the RGs in accordance with the Final RAWP (CB&I, 2013). Excavations were backfilled with clean fill.

Although excavations within RU-C2 were completed, achievement of RGs was not documented (IGI, 2020); however, the excavated area is under durable cover as described in the following section, thereby preventing current and future exposure to contaminated soil.

Additional Soil and Source Excavation

Additional areas of soil excavation were identified during preparation of the RAWP for groundwater (ECC-Insight and CDM Smith, 2017). Pre-RA characterization was completed over two mobilizations between November 2017 and July 2018, and identified several significant changes to the RAWP, including the following:

- **RU-C1:** Based on groundwater concentrations in samples collected from monitoring well IR28MW557A, which exhibited high concentrations of VOCs, the suspected source (sumps within Building 253) was confirmed with the identification of dense nonaqueous phase liquid (DNAPL) in the center of the former paint room (within Building 253); consequently, excavation and removal of the sumps was not conducted (ECC-Insight, 2019). The Navy is evaluating options to treat the DNAPL source area and, subsequently, the associated groundwater plume.
- **RU-C2:** Soil concentrations in confirmation samples from excavation 20B-1 at Building 251 remained greater than RGs and are a continuing sources to groundwater. However, further excavation was not completed because pre-RA characterization activities indicated that the lateral and vertical extent of COCs was greater than the ROD's soil excavation limit of 10 feet bgs (Navy, 2009) and would require extensive shoring in Building 251 to complete. The Navy is evaluating a revised approach to achieve soil RAOs and address a potential ongoing source to A-aquifer groundwater (ECC-Insight, 2019).

Durable Cover Installation

The construction of durable covers began in June 2015 and was completed in May 2016. Completion of the durable covers along with implementation of ICs, discussed in

Section 1.3.4.2, meets the RAOs for soil applicable to Parcel C. Response complete for soil is documented in the RACR for durable covers remedy in Parcel C (TtEC, 2017c). Durable covers consist of shoreline armoring; soil cover installation; asphalt cover installation, replacement, or repairs; and building foundation repairs, as shown on **Figure 4-2** and described as follows:

- Shoreline Armoring: Shoreline armoring was constructed along approximately 80 linear feet of deteriorated seawall northeast of Building 231. Shoreline armoring included, from the bottom up, filter fabric to prevent migration of soil to San Francisco Bay, a 6-inch minimum layer of filter rock, and a 3-foot minimum layer of riprap to protect the fabric from wave action.
- Soil Cover: A 2-foot-thick soil cover made up of clean imported soil was constructed on the hillside in the northwestern corner of Parcel C (RU-C5). The soil cover includes surface completions for monitoring wells.
- Asphalt Cover: The asphalt cover was constructed over the remaining areas of Parcel C. Most of Parcel C was covered with degraded asphalt pavement before the RA, and the existing asphalt pavement was repaired or replaced as needed to create a continuous intact cover. Repaired areas were typically overlain with new asphaltic concrete to achieve a 2-inch-thick cover. Asphalt replacement consisted of 4 inches of aggregate base course overlain by 2 inches of asphaltic concrete. Drainage features, such as swales, catch basins, and storm drain pipes, were incorporated into the asphalt cover to convey stormwater offsite (TtEC, 2017c).
- Building Foundation Repairs: Building foundation repairs were completed by using a variety of materials such as concrete, non-shrink grout, and asphaltic concrete, to prevent access to underlying soil. Building foundations that could not be restored or repaired (for example, historical buildings) were secured using a combination of steel plates, framed plywood walls, wire mesh, or chain-link fence to prevent access. Access to soil under buildings through crawlspaces and vaults was blocked with durable wire mesh or secured with steel ties.

Soil Vapor Extraction and Monitoring

Construction and operation of five SVE systems to remediate 8 soil vapor areas within RU-C1, RU-C4, and RU-C5 began in 2013 (**Figure 4-3**; APTIM, 2018). Each system includes a blower, blower motor, main control panel, SVE wells, vapor monitoring wells, liquid/air separator, transfer pump and liquid storage tank, conveyance piping and connection hoses, granular activated carbon vessels, level switches, system interlocks and controls, and gauges. The following is a summary of each system's operation timeframe and cumulative VOC removal:

- Area 1 (RU-C4): Constructed and operated for 4 months in 2001; operated August 2014 to February 2016, May 2016 to June 2017. Estimated cumulative removal was 3.9 pounds (predominantly TCE).
- Area 2 (RU-C2): Constructed but not yet operated.
- Areas ¾/5 (RU-C5): Constructed and operated for 5 months in 2001; operated August 2014 to December 2015. Areas 4 and 5 SVE system constructed in February 2016. SVE Areas ¾/5 operated May 2016 to November 2016. Estimated cumulative removal was 1.95 pounds (predominantly tetrachloroethene [PCE] and TCE).

- Areas 6/7 (RU-C1): Constructed and operated for 3 months in 2001; operated August 2014 to July 2014, September to December 2015, and May 2016 to September 2016. Estimated cumulative removal was 4.33 pounds (predominantly TCE).
- Area 8 (RU-C1): Constructed and operated for 4 months in 2001; operated August 2014 to February 2016, and July to September 2016. Estimated cumulative removal was 23.21 pounds (predominantly PCE and TCE).

The evaluation of the VOC mass removed as a result of the SVE O&M in SVE Areas 1, ¾/5, and 6/7 indicate that the SVE operation in Parcel C has reached points of diminishing return and, in general, has had limited effectiveness in treating mass in soil due to the following primary reasons:

- The shallow groundwater table (mostly less than 7 feet bgs in all areas and 2 feet bgs in SVE Area 3) limits the effectiveness of the SVE system.
- Low SVE rates limited by low-permeability soil or sediment and water entrainment in the SVE wells.
- RAs (groundwater treatment) in the vicinity of SVE areas are not yet complete and likely contributing to the apparent ineffectiveness of SVE in reducing vapor concentrations to less than SGALs.

The Navy is in the process of reviewing the strategy for addressing soil gas at all Parcel C areas in conjunction with additional in situ groundwater remediation activities that are ongoing (ECC-Insight and CDM Smith, 2019).

In Situ Groundwater Remediation

In situ groundwater remediation consists of treating COCs (VOCs or chromium VI) in A-aquifer groundwater using ZVI or an injected biological substrate in the groundwater plumes at RU-C1, RU-C2, RU-C4, and RU-C5. Target treatment area and subsequent performance metrics were selected based on active treatment criteria (ATCs) developed in the FS (SulTech, 2008), ROD (Navy, 2010), and RD (KCH, 2012). The groundwater ATCs and activities are as follows:

- ZVI treatment to target hotspot areas where concentrations of PCE exceed 15 µg/L or concentrations of TCE exceed 110 µg/L.
- Anaerobic in situ bioremediation (ISB) treatment targeted areas where VOCs exceed the RG by factors ranging from 10 to 50 and where chromium VI exceeds RGs. Zinc was initially targeted for active treatment but was documented not to be warranted based on pre-remedial characterization sampling (APTIM, 2018).
- Aerobic ISB treatment will target areas where 1,4-dichlorobenzene is greater than 21 µg/L or chlorobenzene is greater than 3,900 µg/L.

Between 2013 and 2017, groundwater remediation was conducted in chlorinated ethene and chromium VI plumes within RU-C1, C4, and C5 (APTIM, 2018). Chlorinated ethene plumes were treated in situ by direct injection of ZVI or an anaerobic organic substrate (sodium lactate) with bioaugmentation (*Dehalococcoides*, specifically SDC-9). The chromium VI plumes were treated using anaerobic ISB by injecting food-grade molasses as a substrate. Aerobic treatment was completed by direct injection of an oxygen-releasing compound (PermeOx Ultra). The following is a summary of the approximate injection totals:

- 206,183 pounds of ZVI was injected into 40 injection points.

- 123,503 gallons of diluted sodium lactate with SDC-9 culture was injected into 131 injection points.
- 16,064 gallons of food-grade molasses and water were injected into 17 injection points.
- 5,975 pounds of PermeOx Ultra was injected into eight injection points.

Monitoring results showed that the concentrations of COCs in source areas were significantly reduced by ZVI and anaerobic or aerobic ISB treatment activities in RU-C1, C4, and C5. Post-injection monitoring is currently being conducted under the BGMP. Chromium VI was successfully reduced by anaerobic bioremediation in target treatment areas within RU-C1 and RU-C5 with concentrations remaining less than treatment goals through the end of the performance monitoring period. Groundwater treatment minimized the potential for chromium VI to migrate to the bay at concentrations greater than the surface water quality criteria (APTIM, 2018).

In 2019, RU-C1 and RU-C2 were treated using a ZVI, Lactoil/WilclearPlus amendment mix; 249,120 pounds of ZVI and 1,130 gallons of Lactoil/WilclearPlus were injected. Bioaugmentation with KB-1 (SIREM) culture was completed in RU-C2 (ECC-Insight and CDM Smith, 2021). Performance monitoring is ongoing, and additional investigations and RAs are planned in RU-C1 (DNAPL source investigation), RU-C2, RU-C4, and RU-C5 (IGI, 2020; Gilbane, 2022). In September through December 2021, an RA was completed in RU-C4 to treat VOCs (IGI, 2020; TRBW, 2022b).

Groundwater Monitoring

Groundwater monitoring is conducted under the BGMP and includes LTM, remedy performance monitoring, and MNA, depending on the plume being monitored. Data evaluation and proposed changes to the Parcel C BGMP sampling locations, analytical requirements, and sampling frequency and approach have been presented in the Parcel C Remedial Action Monitoring Reports (RAMRs) for review and concurrence by BCT before incorporation into the BGMP (IGI, 2020).The Navy and the FFA regulatory parties are currently evaluating different approaches to present future changes to Parcel C BGMP sampling locations, analytical requirements, and sampling frequency. Changes to which FFA regulatory parties have agreed in writing will be implemented per the agreement before incorporation into the BGMP. Performance monitoring is generally conducted for a Parcel C groundwater plume at frequencies of 1, 3, 6, 9, and 12 months during the first year after in situ groundwater injections and semiannually during the second year to obtain a minimum of seven data points for evaluation. The following criteria are used to determine how a BGMP well is monitored and to define key decision points:

- If COC concentration trend analyses of specific BGMP COC plume wells evaluated as part of the Parcel C RAMR show stable, no trend, or declining COC concentration trends greater than ATCs, then performance monitoring at that BGMP plume well will continue.
- If COC concentration trend analyses of specific BGMP COC plume wells evaluated as part of the Parcel C RAMR show stable or declining COC concentration trends greater than RGs (but less than ATCs), then the MNA monitoring period will ensue until RGs are met.
- If statistical data demonstrate that concentrations are less than RGs following the minimum 2 years of performance monitoring and 1 year of MNA monitoring, closure of the plume will be initiated, with BCT review and concurrence.

- If COC concentration trend analyses of specific BGMP COC plume wells evaluated as part of the Parcel C RAMR show stable, no trend, or increasing COC concentration trends greater than ATCs, then performance monitoring at that BGMP plume well will continue and the Navy will consider further active treatment.

As a result, the number of monitoring wells sampled during each monitoring event can fluctuate based on data and recommendations from BCT. Annual and semiannual groundwater monitoring reports from 2019 through 2022 were also reviewed (TRBW, 2020b, 2020c, 2022a, 2022b, 2023b). **Appendix E** presents exceedances of the RGs (identified as PALs) and the ATCs from 2019, 2020, 2021, and 2022.

Figures 4-4 through **4-7** present groundwater concentrations from the 2021 annual monitoring. The following is a summary of the most recent (2022) groundwater monitoring results by RU and plume at Parcel C and the RAMR evaluating the 2021 data (IGI, 2023).

RU-C1 (Figure 4-4)

- Plume RU-C1-1 is currently undergoing performance monitoring for ISB and ZVI injections that were completed in May 2019 to treat VOCs. Benzene, PCE, TCE, and VC consistently exceeded RGs from 2019 to 2022, and benzene, VC, and PCE exceeded the ATCs during one or more rounds of sampling. Six A-aquifer monitoring wells were sampled in March and September 2022. Benzene, PCE, TCE, and VC exceeded RGs in March and benzene and PCE exceeded the RGs in September. PCE also exceeded ATC in March but not in September. The presence of VC indicates that biodegradation is occurring. Performance monitoring is expected to continue until data are statistically less than ATCs. Based on data up to December 2021 PCE data is statistically higher than the ATC; however, statistical trends indicate it is probably decreasing (IGI, 2023).
- Plume RU-C1-2 is currently undergoing MNA for VOCs (PCE and degradation products TCE, cis-1,2-dichloroethene [cis-1,2-DCE], and VC). PCE has sporadically exceeded the RG in one location throughout the monitoring period and benzene exceeded the RG during the January through June sampling periods of 2019 and 2020. Five A-aquifer monitoring wells were sampled in March 2022 with only benzene exceeding the RG. Five A-aquifer monitoring wells were sampled in September 2022, and there were no exceedances of RGs. There were no exceedances of ATCs during this monitoring period. MNA parameters indicate moderate to high potential for anaerobic attenuation of COCs. Statistical evaluation indicates that PCE (no trend) and benzene (stable trend) have UCLs that exceed the RG at one well each. MNA will continue until statistical data demonstrate that concentrations are less than RGs, at which time plume closure may be initiated with BCT review and concurrence (IGI, 2023).
- Plume RU-C1-3 is currently undergoing performance monitoring for ISB and ZVI injections that were completed in 2016 to treat VOCs. Additional characterization in 2017 to 2018 indicated the presence of DNAPL and light nonaqueous phase liquid (LNAPL) source under the paint room and sumps in Building 253, in the southern portion of RU-C1-3. Eight A-aquifer monitoring wells were sampled in both March and September 2022, and several VOCs (1,1,2,2-tetrachloroethane, 1,1-dichloroethane, 1,2,4-trimethylbenzene, 1,2-DCE 1,3,5-trimethylbenzene, cis-1,2-DCE, benzene, isopropylbenzene, naphthalene, PCE, TCE, and VC) exceeded RGs at one or more locations during 2019, 2020, 2021 and 2022 events, and 1,2-DCE, benzene, and VC exceeded ATCs in 2022. Non-aqueous phase liquid (NAPL) has also been observed in IR28MW557A, and concentrations are greatest in samples

collected from that location (**Appendix E** and **Figure 4-4**). Performance monitoring will continue and the Navy is planning to address the DNAPL source area and dissolved groundwater plume (IGI, 2023).

- RU-C1-4 was sampled in March and September 2022 (three A-aquifer monitoring wells just south of Dry Dock 2: IR28MW561A, IR28MW125A, and IR28MW562A) for chromium VI. Monitoring was discontinued in 2020 after the UCL of the mean for all COCs was less than RGs but was added back to the BGMP in September 2021 based on discussions between regulatory agencies and the Navy. Chromium VI was not detected in any monitoring wells and has not exceeded the RG of 50 µg/L since February 2014 (TRBW, 2023).

RU-C2 (Figure 4-5)

- Plume RU-C2-1 is currently undergoing performance monitoring for ISB completed in 2013 to treat VOCs. Eleven monitoring wells in both the A- and B-aquifer were sampled in 2022. In the A-aquifer, PCE, TCE, 1,4-dichlorobenzene, benzene, chlorobenzene, chloroform, and VC exceeded RGs at one or more samples during one or more sampling events during the review period. PCE, benzene, chloroform, and VC exceeded ATCs at one or more locations during one or more sampling events during this review period (2019-2022). Data indicate that degradation is occurring and conditions are favorable for continued degradation (IGI, 2023). Performance monitoring will continue because the criteria for MNA have not been met and additional RAs are planned for the RU-C2-1 plume (Gilbane, 2022). Adding sampling of a downgradient well, IR28MW398A, to the BGMP was recommended (IGI, 2023).

  Monitoring in the B-aquifer was discontinued in September 2020 because there were no RAOs for the B-aquifer in the ROD (Navy, 2010); however, after concerns were raised by the USEPA and Regional Water Board in July 2021 (USEPA and Regional Water Board, 2021), B-aquifer monitoring was reinstated. PCE was the most widely detected chemical in the B-aquifer with concentrations ranging from 15 to 270 µg/L (less than 100 times the federal MCL of 5 µg/L) in 2022. TCE, vinyl chloride, and benzene were detected in B-aquifer samples at concentrations within 1 to 10 times their respective MCLs (IGI, 2023).

- Plume RU-C2-2 is currently undergoing MNA for VOCs. Monitoring wells in both the A- and B-aquifer are sampled. PCE, carbon tetrachloride, and chloroform have exceeded the RGs and ATCs at one or more location during this review period (2019 to 2022). PCE was the only VOC to exceed the RG in a single well during both sampling events in 2022 (RUC2MW11A). A review of MNA geochemical parameters indicated that conditions within the ISB treatment area are generally moderately conducive to anaerobic degradation. In 2021, the UCL of the mean of chloroform and carbon tetrachloride were below the RG with the exception of one location. However, PCE began exceeding the RG sporadically and was added to the statistical evaluation for the plume in 2021 (IGI, 2021) and exhibits an increasing trend using data through September 2021 (IGI, 2023). MNA will continue until criteria for plume closure have been met.

- Plume RU-C2-3 is currently undergoing performance monitoring for ISB and ZVI injections conducted in May 2019 for VOCs (primarily chloroform, TCE, and carbon tetrachloride). Monitoring wells in fractured bedrock and the A-aquifer are sampled and 1,4-dichlorobenzene, benzene, carbon tetrachloride, chloroform, TCE, and VC in groundwater exceeded RGs, and carbon tetrachloride, chloroform, and VC exceeded ATCs in one or more locations in March and September 2022. Conditions were considered generally favorable for anaerobic degradation (IGI, 2023). Statistical evaluation of the data indicates that multiple carbon tetrachloride, benzene, and 1,4-dichlorobenzene are increasing in one or more locations. Notably, carbon tetrachloride (increasing trend) and chloroform (stable trend) UCL data from downgradient well IR28MW940F continues to exceed ATCs. The Navy intends to prepare a RAWP to implement additional phases of remediation to address persistent chlorinated methane concentrations above ATCs in the vicinity of IR28MW940F. Performance monitoring will continue until conditions for MNA have been met.

RU-C4 (Figure 4-5)

- Plume RU-C4-1 is the only groundwater plume in RU-C4 and is currently undergoing performance monitoring for ISB and ZVI injections completed in September through December 2021 to treat VOCs (primarily PCE and degradation products). Groundwater samples were collected from 6 monitoring wells in March 2022, 19 monitoring wells in September 2022, and 12 monitoring wells in December 2022. All monitoring wells were in the A-aquifer except IR28MW272F, which is in the F-WBZ. In 2022, 1,2-dichloroethane, 1,4-dichlorobenzene, benzene, chloroform, cis-1,2-DCE, TCE, and VC exceeded the RGs in one or more locations. TCE and VC exceeded ATCs in 2019, 2020, and 2022, but there were no exceedances of ATCs in 2021; however, the BGMP did not include wells within the RA treatment area in 2021 Performance monitoring is underway.

RU-C5 (Figure 4-6)

- Plume RU-C5-1 is currently undergoing performance monitoring for ISB and ZVI injections completed in 2014 and 2016 to treat VOCs. Seven A-aquifer monitoring wells are sampled for VOCs and MNA parameters. Several VOCs (1,1-dichloroethane, 1,2-DCE, benzene, cis-1,2-DCE, PCE, TCE, and VC) exceeded their RGs, and PCE, TCE, and VC exceeded their ATCs in one or more location and events during this review period. Samples collected at IR06MW67A consistently exhibit the highest concentrations and statistical evaluation indicates COC concentrations are stable, no trend, or increasing/probably increasing. Conditions are favorable for MNA and presence of increasing concentrations of degradation products indicate that biodegradation is occurring (IGI, 2023). Performance monitoring will continue, and additional RA is planned to address persistent COCs greater than ATCs in the IR06MW67A area (Gilbane, 2022; IGI, 2023).
- Plume RU-C5-2 was sampled in September 2021 for chromium VI. Like plume RU-C1-4, sampling at RU-C5-2 was discontinued because conditions for plume closure were met; however, sampling three fractured bedrock monitoring wells (IR06MW68F, IR06MW69F, and IR06MW70FR) was added back into the BGMP based on discussions between the agencies and the Navy. Chromium VI was reported at a concentration of 40.2 µg/L, less than the TL of 50 µg/L, in September 2021 and was not detected in March or September 2022. Chromium VI has historically been detected in RU-C5-2 at concentrations less than the TL since the wells were incorporated into the BGMP in 2015 (TRBW, 2023).
- Plume RU-C5-3 is currently undergoing performance monitoring for aerobic ISB injections completed in February 2016 to address VOCs (primarily naphthalene). Samples are collected from three A-aquifer monitoring wells and analyzed for VOCs, chromium VI, and MNA parameters. Naphthalene has consistently exceeded the RG in one location (IR06MW42A) during all sampling events during this review period. Chromium VI was not detected in groundwater during any events during this review period. There were no exceedances of ATCs during this review period, but statistical evaluation in the 2021 RAMR

indicated the UCL of naphthalene exceeded the ATC. Conditions have transitioned from being favorable for aerobic degradation in 2019 to anaerobic in 2020 (unfavorable for naphthalene degradation), and naphthalene is stable based on statistical evaluation (IGI, 2023). Performance monitoring will continue, and an additional RA is planned to address persistent naphthalene greater than the ATC (Gilbane, 2022).

- Plume RU-C5-4 is currently undergoing performance monitoring for ISB and ZVI injections completed in January to February 2016 to address VOCs. Four A-aquifer monitoring wells are sampled for VOCs and MNA parameters. Benzene and VC exceeded their RGs but not ATCs during this review period. MNA parameters indicate conditions are favorable for anaerobic bioremediation (IGI, 2023). Statistical evaluation completed on 2021 and earlier data indicated that the UCL for VC continued to exceed the ATC, so performance monitoring continued through 2021. Continued performance monitoring was recommended in the Fall 2021 RAMR (IGI, 2023).
- Plume RU-C5-5 is currently undergoing performance monitoring for aerobic ISB completed in February 2016 and an additional RA in 2021 to address VOCs (primarily chlorinated benzenes). In 2022, three monitoring wells were sampled in March, five different monitoring wells were sampled in June, and all eight were sampled in September. Eight VOCs (1,2-dichloroethane, 1,4-dichlorobenzene, benzene, chlorobenzene, naphthalene, PCE, TCE, and VC) exceeded their respective RGs, and 1,4-dichlorobenzene, benzene, and chlorobenzene exceeded their ATCs in 2022 Performance monitoring for the 2021 RA is currently underway.

Radiological Surveys and Remediation

ROCs suspected to be present at Parcel C include potassium-40 (K-40), Co-60, Sr-90, Cs-137, Ra-226, thorium-232 (Th-232), and Pu-239. The following buildings at Parcel C were designated as radiologically impacted: Buildings 203, 205 and discharge tunnel, 211, 214, 224, 241, 253, 271, and 272. The Navy conducted a TCRA at Parcel C to address potential radioactive contamination in storm drains and sanitary sewer lines and radiologically impacted structures (TtEC, 2016, 2017b). In total, 67,596 cubic yards of soil was excavated during removal of 31,190 linear feet of sanitary sewer and storm drain lines. Approximately 6,641 cubic yards of soil was disposed of offsite as LLRW based on surface scan and analytical laboratory results. Additional characterization surveys of the sanitary sewer lines and storm drains withing the Parcel C Historic District were also performed (APTIM, 2020). Additionally, FSSs were performed at six radiologically impacted buildings (Buildings 203, 214, 224, 241, 271, and 272) and radiologically impacted sites (North Pier and Ship Berths 1 to 5) (TtEC, 2016, 2017a, 2017b). Additional surveys are planned at three radiologically impacted buildings (Buildings 211, 253, and the discharge channel at Building 205) (TtEC, 2017b).

The TCRA data were reviewed as described in **Section 1.4.3**, and radiological retesting, including sampling and surveys of soils previously investigated during sanitary sewer line storm drain removal and resurvey of impacted buildings and former building sites, is currently being conducted to determine if current site conditions are compliant with the RAOs.

Institutional Controls

The entire area of Parcel C (73 acres) is subject to soil, soil gas, and groundwater ICs. IC performance objectives were developed and presented in the ROD (Navy, 2010) and LUC RD (Appendix B of KCH, 2012). **Table 1-2** summarizes the IC performance objectives to be implemented through land use restrictions for the site.

4.4.1.2 Remedy Operations and Maintenance

Ongoing O&M at Parcel C includes maintaining the integrity of the durable covers and IC inspections. The inspection and maintenance requirements for the durable covers are described in the Final O&M Plan for Parcel C (Navy, 2017). AOMSRs are prepared to summarize inspections and maintenance performed and to document the effectiveness of the remedy components. AOMSRs from 2019, 2020, 2021, and 2022 were reviewed (Innovex-ERRG Joint Venture, 2020, 2021; APTIM, 2022, 2023).

Durable Cover Maintenance

The shoreline armoring was determined to be in good condition. No signs of vegetation or trash, pests, excessive vehicle traffic, settlement or movement, wave overtopping, or scouring were found.

Annual inspections found the soil cover to be in good condition, with no signs of settling, slope failure, cracking, soil movement, erosion, or burrowing pests. Vegetation growth was well established over the soil cover, with no bare areas observed.

The asphalt cover was generally in good condition with the exception of the eastern portion of Parcel C where sinkholes greater than 4 feet deep were found at several locations. Two areas of previous repair were heavily deteriorated and formed major sinkholes (7 feet wide by 25 feet long by 6 feet deep and 6 feet wide by 20 feet long by 7 feet deep). A 7-foot-deep void observed along the pier edge that allowed water to wash in and out with the tide may have contributed to the sinkholes. The sinkholes were repaired. Subsidence was noted near Buildings 205, 207, and 208 between Dry Dock 2 and Dry Dock 3 that required extensive repairs outside of routine O&M, and 100 feet of permanent chain-link fence was installed across Building 208 to secure the end of the pier. Minor sinkholes (less than 4 feet deep) were observed during the 2022 inspection; however, repairs were not recommended until the completion of radiological retesting in the area to minimize generating waste and rework.

Building foundations were generally in good condition, and any cracks or potholes were repaired during routine O&M activities.

Institutional Control Compliance

ICs are inspected annually, and no deficiencies or inconsistent uses were observed during the review. General site conditions were determined to be good. Remedy components, such as survey benchmarks and monitoring well vault covers, were found to be in good conditions.

The Navy controls access to the parcel using security fencing, signage, locks, and gates, which were found to be in good condition. However, during the September 2021 inspection, the metal hasp on a door that secures Building 367 was found broken during the annual inspection. The door was re-secured on Building 367 to prevent unauthorized access (APTIM, 2022).

4.4.2 Parcel UC-2

The RA for Parcel UC-2 includes the following major components:

- Durable cover installation and maintenance to address COCs in soil
- Radiological surveys and remediation through soil excavation and removal of sanitary sewer and storm drain lines
- LTM of groundwater for COCs
- ICs for VOCs

Figures 4-1, 4-2, and **4-7** show remedy components.

4.4.2.1 Remedy Implementation

Durable Cover Installation

Durable covers were constructed between May 14, 2012, and September 18, 2012. Completion of the durable covers along with ICs, as discussed in **Section 1.3.4.2**, meets the RAOs for soil in Parcel UC-2. Response complete is documented in the RACR for Parcels UC-1 and UC-2 (ERRG, 2013). The RA includes installation and repair of durable covers, including soil covers, asphalt covers, and building foundations, to minimize exposure of humans and wildlife to potential COCs in underlying soil, as shown on **Figure 4-7** and described as follows:

- **Soil Cover:** A 2-foot-thick soil cover made up of clean imported fill was installed over previously vegetated areas by removing 2 feet of existing soil so that the surface of the newly installed cover matched historical site grades. Live beach strawberry, California poppy, and summer lupine plants were then hand-planted across the entire soil cover to provide future slope stability and aesthetic appeal.
- **Asphalt Covers:** An 8-inch asphalt cover, with a minimum of 4 inches of asphalt concrete and 4 inches of aggregate base, was installed. Existing AC covers that were in good condition were left in place and incorporated into the final AC cover. Degraded existing AC covers were repaired by removing and replacing one or more of the following: AC cover, aggregate base, or subbase material, depending on the level of degradation. AC covers with minor cracking were repaired by applying an asphalt seal to fill the cracks.
- **Restored Building Foundations:** Concrete building foundations and sidewalks were restored and incorporated into the durable cover, and cracks and penetrations were filled with non-shrink grout.

Radiological Surveys and Remediation

The ROPCs at Parcels UC-2 include Cs-137, Ra-226, and Sr-90, and are associated with sanitary sewer lines and storm drain lines (Navy, 2009). The Navy conducted TCRAs at Parcel UC-2 to address potential radioactive contamination in storm drains and sanitary sewer lines at Parcels UC-1 (adjacent to Parcel UC-2) and UC-2 (ChaduxTt, 2010a; TtEC, 2011). In total, approximately 20,680 cubic yards of soil was excavated during removal of approximately 6,407 linear feet of sanitary sewer and storm drain lines. Approximately 1,138 cubic yards of soil was disposed of offsite as LLRW based on surface scan and analytical laboratory results. TCRAs for radionuclides were completed, and the radiological RGs established in the ROD for Parcel UC-2 were presumed to be met (Navy, 2009).

The TCRA data were reviewed, as described in **Section 1.4.3**, and radiological retesting, including sampling and surveys of soils previously investigated during sanitary sewer line storm drain removal and resurvey of impacted buildings and former building sites, is currently being conducted to determine if current site conditions are compliant with the RAOs.

Groundwater LTM

Groundwater monitoring at Parcel UC-2 is conducted under the BGMP. Annual and semiannual groundwater monitoring reports from 2019 through 2022 were reviewed (TRBW, 2020b, 2020c, 2021, 2022a, 2022b, 2023) **Appendix E** presents exceedances of RGs (identified as PALs) from 2019, 2020, 2021, and 2022.

Two groundwater monitoring wells are sampled semiannually for VOCs. Carbon tetrachloride and chloroform consistently exceed the RGs; however, during 2022, carbon tetrachloride was the only COC that exceeded the RG. Concentrations of carbon tetrachloride are generally within 1 order of magnitude of the RG (0.5 µg/L), and concentrations of chloroform are generally the same order of magnitude as the RG (1 µg/L). No RA for groundwater treatment is required at this time. Ownership of Parcel UC-2 has been transferred to the City of San Francisco and is no longer Navy property; however, sampling of the monitoring wells is still included in the BGMP.

Institutional Controls

The entire area of Parcel UC-2 (3.9 acres) is subject to soil and groundwater ICs. IC performance objectives were developed and presented in the ROD (Navy, 2009) and LUC RD (ChaduxTt, 2010b). A portion of Parcel UC-2 located adjacent to Parcel UC-1, is also subjected to ARICs for VOCs. **Table 1-2** summarizes the IC performance objectives to be implemented through land use restrictions for the site. The ICs are currently being enforced through a Covenant to Restrict Use of Property recorded on September 16, 2015 (Navy, 2015).

4.4.2.2 Remedy Operations and Maintenance

Ongoing O&M at Parcel UC-2 is the responsibility of the City and County of San Francisco OCII's contractor in accordance with the approved Risk Management Plan (Geosyntec, 2019) and O&M Plan (Navy, 2013). Annual reports from the City and County of San Francisco's OCII contractor summarizing durable cover O&M and IC inspections were reviewed (Geosyntec-Albion Joint Association, 2020, 2021, 2022).

Durable Cover Maintenance

Minor settling was observed during the 2021 inspection, and evidence of burrowing pests within the soil cover were observed during the 2020 and 2021 inspections. Repairs were conducted in October 2020, December 2021, and January 2022. Vegetation in the soil cover is in good condition.

In general, the durable cover was found in good condition with minor crack and pothole repairs completed during O&M. An area in Parcel UC-2, the Hunters Point Artists Parcel, was scheduled for redevelopment, resulting in removal of the durable cover in the area in October 2017. Construction was put on hold indefinitely in June 2018, leaving a portion of the durable cover missing. The area is secured with a chain-link fence surrounding the uncovered area and is treated with tackifier annually for dust control. A Notice of Termination for the Hunters Point Artists Parcel project was submitted to the State Water Boards Stormwater Multiple Applications and Report Tracking System in August 2020.

Institutional Controls Compliance

No deficiencies or inconsistent uses were observed during the review period.

4.4.3 Progress Since the Fourth Five-Year Review

Table 4-5 summarizes issues, recommendations, and follow-up actions from the Fourth Five-Year Review.

4.5 Technical Assessment

4.5.1 Question A: Is the Remedy Functioning as Intended by the Decision Document?

4.5.1.1 Parcel C

Yes. Based on the review of historical documents, annual O&M inspections, and the Five-Year Review inspection, the remedy at Parcel C is functioning as intended.

Soil hotspot areas were removed through excavation and offsite disposal and additional hot spot removal is planned to address deeper than anticipated chemicals at Building 251. Exposure pathways that could result in an unacceptable risk are being controlled through durable covers and ICs. The shoreline revetment, soil cover, and asphalt cover are in good condition, and any minor issues have been repaired. Areas needing repair outside of typical O&M are secured to prevent access. Although the SVE soil remedy did not function as well as intended, the SVE technology was intended to remove source-level concentrations and meet RAOs through other remedy components. Short-term protectiveness is achieved because ICs are in place to ensure current and future exposures through the vapor intrusion pathway do not occur. Groundwater remediation and MNA/LTM are ongoing, and ICs prevent exposure to groundwater while treatment is ongoing. Radiological concerns are addressed through previous radiological surveys and remediation of soil and building structures, and radiological retesting is being conducted to confirm that the RAO has been met, with the goal of unrestricted closure. Radiological retesting is underway.

4.5.1.2 Parcel UC-2

Yes. Based on the review of historical documents, annual O&M inspections, and the Five-Year Review inspection, the remedy at Parcel UC-2 is functioning as intended.

Exposure pathways that could result in an unacceptable risk are being controlled through durable covers and ICs. Groundwater monitoring is ongoing, and ICs prevent exposure to groundwater until that time. The soil and asphalt covers are in good condition, and any minor issues have been repaired. Radiological concerns are addressed through previous radiological surveys and remediation of soil and building structures, and radiological retesting is being conducted to confirm that the RAO has been met, with the goal of unrestricted closure. Radiological retesting is planned for 2023.

4.5.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used at the Time of the Remedy Selection Still Valid?

Yes. Based on the results of the ARAR evaluation, HHRA analysis, and ERA analysis discussed in the following sections, the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection are still valid. Although there have been some changes to toxicity values and risk assessment methods, these changes do not affect remedy protectiveness.

4.5.2.1 ARAR Evaluation

The Navy evaluated the ARARs established in the RODs and ESD for Parcel C and Parcel UC-2. No changes to location-specific or action-specific ARARs that would affect the protectiveness of the remedies were identified. Changes to chemical-specific ARARs for individual chemicals are discussed in the following HHRA and ERA Analysis sections.

In 2021, California Public Resources Code Division 20.6.5, California Sea Level Rise Mitigation and Adaptation Act of 2021, was passed; however, no regulations have been promulgated to implement the act. The Navy is addressing SLR, as discussed in **Section 1.4.2**, of this Five-Year Review.

4.5.2.2 HHRA Analysis

As **Section 3.5.2.1** notes, in 2018, the State of California promulgated the TCR. However, the Navy continues to view the values identified in the USEPA IRIS database (a Tier 1 value) as the primary source of toxicity factors for risk-related calculations. The HHRA evaluation was conducted by comparing the human health RGs from the ROD with current risk-based criteria based on the same exposure scenario and ARARs, if available. Response complete for soil was achieved with excavation, durable cover construction and maintenance, and ICs as documented in the respective RACRs for Parcels C and UC-2 (TtEC, 2017c; ERRG, 2013). Therefore, any changes in exposure assumptions and toxicity data would not affect protectiveness of the remedy.

Table 4-6 shows the RGs and current comparison criteria for groundwater. The RGs for the groundwater COCs included in the ROD were based on consideration of exposure scenario-specific (residential or industrial vapor intrusion and construction worker trench exposure [A-aquifer], or residential domestic use [B-aquifer in RU-C5 only]), risk-based concentrations (based on a cancer risk of 10^{-6} or a noncancer hazard index of 1); laboratory PQLs; chemical-specific ARARs; and HGALs. RGs were compared with the following current comparison criteria (USEPA, 2022a):

- A-aquifer Groundwater: VISLs calculated using the current USEPA VISL calculator for the residential and commercial scenarios.
- B-aquifer Groundwater: Current USEPA tapwater RSLs, California MCLs, and USEPA MCLs.

For groundwater, there are a few cases where a current risk-based concentration (VISL or RSL) is less than a risk-based RG (or the PQL or HGALs) from the ROD (**Table 4-6**). Although current risk-based levels for some chemicals are lower than the RGs, the ICs that are currently in place and the durable cover across the site prevent exposure to site media; therefore, the remedy remains protective. There may be changes with HHRA analysis for the construction worker scenario. However, those changes will not affect the RGs for the construction worker scenario identified in the ROD because ICs require identification and management of potential risks to construction workers through the preparation and approval of plans and specifications for all construction activities that may pose unacceptable exposure to construction workers. There have been no changes in current exposure pathways based on the site controls, or changes in planned future site use since the ROD that would change the protectiveness of the current remedy.

Radiological Risk Review

In October 2020, after the preparation of the Five-Year Review addenda, USEPA introduced a PRG calculation method called “Peak PRG,” which computes PRGs accounting for ingrowth and decay of progeny over time. An evaluation was performed for this Five-Year Review to assess whether this change affected the continued protectiveness of the current soil RGs for future residents. Exposure calculations were performed using the USEPA PRG Calculator (USEPA, 2022b). For this soil evaluation, the estimated excess cancer risk was calculated using the “Peak Risk” time interval of 1,000 years (Navy, 2020). The soil RGs were used as exposure point concentrations, and the cumulative cancer risk was calculated as the sum of risks from all ROCs. **Appendix F** presents the calculated estimated excess cancer risks from this evaluation and the supporting data. Under CERCLA, cleanup goals are considered protective if excess cancer risks from site exposures remain within the 10^{-4} to 10^{-6} range. Based on the findings of this evaluation, the soil RGs are within this range and continue to be protective for future residential exposures.

There were no changes to the risk assessment methods related to structures or buildings for radiological concerns since the last Five-Year Review.

4.5.2.3 ERA Analysis

Table 4-7 presents groundwater COCs with a summary of TLs and current surface water quality criteria. Groundwater data were compared with surface water screening levels to evaluate potential for risk to aquatic organisms in San Francisco Bay. The evaluation of groundwater was very conservative because it was assumed that aquatic receptors would have direct exposure to chemicals in groundwater at their measured concentrations.

Chromium VI and zinc were retained for ongoing monitoring. Concentrations of chromium VI were successfully reduced by anaerobic bioremediation in target treatment areas within RU-C1 and RU-C5, with concentrations remaining less than treatment goals through the end of the performance monitoring period. Groundwater treatment minimized the potential for chromium VI to migrate to the bay at concentrations greater than the surface water quality criteria. The chronic marine NRWQC (USEPA, 2023) for each metal was set as the TL. These values have not changed since the FS and ROD were completed. The TLs remain current and protective of surface water exposures for aquatic organisms. Surface water TLs are for monitoring purposes only because surface water benchmarks are not ARARs for ecological exposures to groundwater.

4.5.3 Question C: Has Any Other Information Come to Light that Could Question the Protectiveness of the Remedy?

Yes. As identified in the Fourth Five-Year Review, there is uncertainty with a portion of the radiological survey and remediation work. The Navy is in the process of implementing corrective actions to ensure the radiological remedies specified in the decision documents were implemented as intended; however, this work is ongoing. Radiological retesting is currently being conducted at Parcels C and UC-2; long-term protectiveness will be confirmed upon completion.

4.6 Issues, Recommendations, and Follow-up Actions

Table 4-8 summarizes the issues, recommendations, and follow-up actions identified for Parcels C and UC-2.

4.6.1 Other Findings

The following findings were identified that do not directly relate to achieving or maintaining remedy protectiveness but are relevant to overall site management.

4.6.1.1 PFAS

As discussed in **Section 1.4.1**, a Basewide PA was conducted to identify potential PFAS release areas based on historical use or limited sampling data. The following is a summary of the areas identified for additional investigation in the PA (Multi-MAC JV, 2022) and SI (Liberty JV, 2023):

- **Parcel C A-aquifer Groundwater:** A-aquifer groundwater beneath Parcel C was identified for additional investigation because of past industrial use in the parcels and PFOA, PFOS, PFNA, and PFHxS exceeded project screening levels during the SI.
- **Parcel C:** Building 215, Fire Station, was identified as an area where further investigation is warranted in the form based on historical activities. During the SI, PFOA and PFOS exceeded project screening levels in soil and PFOA, PFOS, PFNA, and PFHxS exceeded project screening levels in groundwater.

There are no PFAS areas identified for additional investigation in Parcel UC-2. Exposure to groundwater and soil is restricted by ICs within the HPNS and the City and County of San Francisco prohibits installation of domestic wells within city and county limits.

4.6.1.2 Climate Resilience

The CRA estimates that groundwater emergence due to SLR may occur within Parcel C by the year 2065 (**Appendix A**). No SLR effects are anticipated for Parcel UC-2 by the year 2065.

A site-specific study at Parcel C is recommended to assess whether the projected climate change vulnerabilities in 2065 are likely to result in additional CERCLA risk.

4.6.1.3 Site Management Strategy

The Navy is reassessing the site management strategy for Parcels C and UC-2 based on the following considerations:

- The Navy is planning to conduct a detailed assessment of groundwater COC concentrations to document and eliminate COCs that have achieved response complete and to tabulate groundwater and soil COC concentrations to ensure health and safety professionals have the information needed to protect future construction workers.
- The Navy is also planning to optimize the monitoring frequency and locations for areas that have not undergone any changes that could affect the concentrations of chemicals or metals in groundwater (for example, RA or development construction).

4.7 Statement of Protectiveness

4.7.1 Parcel C

Protectiveness Determination: Short-term Protective

Protectiveness Statement: The remedy at Parcel C is currently protective of human health and the environment. To determine whether the remedy can be considered protective in the long term, the radiological retesting work and soil excavation and groundwater remediation will be completed.

The RAOs for soil are met through hotspot excavation and disposal, durable covers, and ICs. Groundwater remediation is ongoing, and, once active treatment is complete, MNA will continue until COCs reach RGs. Until that time, ICs control exposure to groundwater. Radiological retesting is ongoing to confirm that levels in soil and structures are protective of human health.

Until retesting is complete, short-term protectiveness is met through Navy controls such as access to the parcel through fencing, locked gates, and ICs (restricting intrusive work and maintaining durable covers).

4.7.2 Parcel UC-2

Protectiveness Determination: Short-term Protective

Protectiveness Statement: The remedy at Parcel UC-2 is currently protective of human health and the environment. To determine whether the remedy can be considered protective in the long term, the radiological retesting work will be completed.

The RAOs for soil are met through durable covers and ICs. Groundwater monitoring is ongoing. Radiological retesting is ongoing to confirm that levels in soil and structures are protective of human health. Until retesting is complete, short-term protectiveness is met through Navy controls such as access to the parcel through fencing, locked gates, and ICs (restricting intrusive work and maintaining durable covers).

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Table 4-1. Parcel C and UC-2 Chemicals of Concern and Remediation Goals

Exposure Medium	Exposure Scenario	Chemical of Concern	ROD Remediation Goal (2008)[a]	Source of Remediation Goal	Parcel
Soil (mg/kg)	Residential	1,2-Dichloroethane	0.28	RBC	C
		1,4-Dichlorobenzene	2	RBC	C
		2-Methylnaphthalene	150	RBC	C
		3,3'-Dichlorobenzidine	1.6	PQL	C
		Antimony	10	RBC	C
		Aroclor-1254	0.093	RBC	C
		Aroclor-1260	0.21	RBC	C
		Arsenic	11.1	HPAL	C, UC-2
		Benzene	0.18	RBC	C
		Benzo(a)anthracene	0.37	RBC	C
		Benzo(a)pyrene	0.33	PQL	C
		Benzo(b)fluoranthene	0.34	RBC	C
		Benzo(k)fluoranthene	0.34	RBC	C
		bis(2-Ethylhexyl)phthalate	1.1	RBC	C
		Cadmium	3.5	RBC	C
		Chrysene	3.3	RBC	C
		Copper	160	RBC	C
		Dibenz(a,h)anthracene	0.33	PQL	C
		Dieldrin	0.003	PQL	C
		gamma-BHC (Lindane)	0.0026	RBC	C
		Heptachlor epoxide	0.002	PQL	C
		Hexachlorobenzene	0.33	PQL	C
		Indeno(1,2,3-cd)pyrene	0.35	RBC	C
		Iron	58,000	HPAL	C
		Lead	155	RBC	C
		Manganese	1,431	HPAL	C, UC-2
		Mercury	2.28	HPAL	C
		Naphthalene	1.7	RBC	C
		Nickel	2,650	HPAL	C
		n-Nitroso-di-n-propylamine	0.33	PQL	C
		Organic Lead	0.5	PQL	C
		Tetrachloroethene	0.48	RBC	C
		Thallium	5	RBC	C
		Trichloroethene	2.9	RBC	C
		Vanadium	117	HPAL	C
		Vinyl chloride	0.024	RBC	C
		Zinc	370	RBC	C
	Industrial	1,4-Dichlorobenzene	4.5	RBC	C
		Aroclor-1260	1	RBC	C
		Arsenic	11.1	HPAL	C
		Benzene	0.39	RBC	C
		Benzo(a)anthracene	1.8	RBC	C
		Benzo(a)pyrene	0.33	PQL	C
		Benzo(b)fluoranthene	1.8	RBC	C
		Benzo(k)fluoranthene	1.8	RBC	C
		Chrysene	18	RBC	C
		Dibenz(a,h)anthracene	0.33	PQL	C
		Indeno(1,2,3-cd)pyrene	1.8	RBC	C
		Lead	800	RBC	C
		Organic Lead	0.5	PQL	C
		Tetrachloroethene	1.5	RBC	C
		Trichloroethene	6.6	RBC	C
		Vinyl chloride	0.055	RBC	C

Table 4-1. Parcel C and UC-2 Chemicals of Concern and Remediation Goals

Exposure Medium	Exposure Scenario	Chemical of Concern	ROD Remediation Goal (2008)[a]	Source of Remediation Goal	Parcel
Soil (mg/kg)	Recreational	Arsenic	11.1	HPAL	C
		Benzo(a)pyrene	0.33	PQL	C
		Lead	155	RBC	C
	Construction	Aroclor-1260	2.1	RBC	C
		Arsenic	11.1	HPAL	C, UC-2
		Benzo(a)anthracene	6.5	RBC	C
		Benzo(a)pyrene	0.65	RBC	C
		Benzo(b)fluoranthene	6.5	RBC	C
		Benzo(k)fluoranthene	6.5	RBC	C
		Dibenz(a,h)anthracene	1.1	RBC	C
		Indeno(1,2,3-cd)pyrene	6.5	RBC	C
		Lead	800	RBC	C
		Manganese	6,900	RBC	C, UC-2
		Organic Lead	0.5	PQL	C
		Thallium	20	RBC	C
A-Aquifer (μg/L)	Residential - Vapor Intrusion	1,1,2,2-Tetrachloroethane	3	RBC	C
		1,1,2-Trichloroethane	4	RBC	C
		1,1-Dichloroethane	6.5	RBC	C
		1,2,3-Trichloropropane	0.5	PQL	C
		1,2,4-Trimethylbenzene	25	RBC	C
		1,2-Dichlorobenzene	2,600	RBC	C
		1,2-Dichloroethane	2.3	RBC	C
		1,2-Dichloroethene (Total)	210	RBC	C
		1,2-Dichloropropane	1.1	RBC	C
		1,3,5-Trimethylbenzene	19	RBC	C
		1,4-Dichlorobenzene	2.1	RBC	C
		Benzene	0.5	PQL	C
		Bromodichloromethane	1	RBC	C
		Carbon Tetrachloride	0.5	PQL	C, UC-2
		Chlorobenzene	390	RBC	C
		Chloroethane	6.5	RBC	C
		Chloroform	0.7	RBC	C, UC-2
		cis-1,2-Dichloroethene	210	RBC	C
		cis-1,3-Dichloropropene	0.5	PQL	C
		Dibromochloromethane	2.6	RBC	C
		Isopropylbenzene	7.8	RBC	C
		Methylene Chloride	27	RBC	C
		Naphthalene	3.6	RBC	C
		Tetrachloroethene	0.54	RBC	C
		trans-1,2-Dichloroethene	180	RBC	C
		trans-1,3-Dichloropropene	0.5	PQL	C
		Trichloroethene	2.9	RBC	C, UC-2
		Trichlorofluoromethane	180	RBC	C
		Vinyl Chloride	0.5	PQL	C
	Industrial- Vapor Intrusion	1,1,2,2-Tetrachloroethane	5.1	RBC	C
		1,1,2-Trichloroethane	6.7	RBC	C
		1,1-Dichloroethane	11	RBC	C
		1,2,3-Trichloropropane	0.5	PQL	C
		1,2,4-Trimethylbenzene	25	RBC	C
		1,2-Dichloroethane	3.9	RBC	C
		1,2-Dichloroethene (Total)	210	RBC	C
		1,2-Dichloropropane	1.8	RBC	C
		1,3,5-Trimethylbenzene	19	RBC	C
		1,4-Dichlorobenzene	3.6	RBC	C
		Benzene	0.63	RBC	C
		Bromodichloromethane	1.7	RBC	C
		Carbon Tetrachloride	0.5	PQL	C
		Chlorobenzene	390	RBC	C
		Chloroform	1.2	RBC	C

Table 4-1. Parcel C and UC-2 Chemicals of Concern and Remediation Goals

Exposure Medium	Exposure Scenario	Chemical of Concern	ROD Remediation Goal (2008)[a]	Source of Remediation Goal	Parcel
A-Aquifer (µg/L)	Industrial- Vapor Intrusion	cis-1,2-Dichloroethene	210	RBC	C
		cis-1,3-Dichloropropene	0.5	PQL	C
		Isopropylbenzene	7.8	RBC	C
		Methylene Chloride	46	RBC	C
		Naphthalene	6	RBC	C
		Tetrachloroethene	0.9	RBC	C
		trans-1,3-Dichloropropene	0.5	PQL	C
		Trichloroethene	4.8	RBC	C
		Trichlorofluoromethane	180	RBC	C
		Vinyl Chloride	0.5	PQL	C
	Construction Worker	1,1,2-Trichloroethane	40	RBC	C
		1,2,3-Trichloropropane	0.6	RBC	C
		1,2,4-Trichlorobenzene	41	RBC	C
		1,2,4-Trimethylbenzene	53	RBC	C
		1,2-Dichlorobenzene	1700	RBC	C
		1,2-Dichloroethane	22	RBC	C
		1,2-Dichloroethene (Total)	270	RBC	C
		1,2-Dichloropropane	30	RBC	C
		1,4-Dichlorobenzene	52	RBC	C
		Benzene	16	RBC	C
		Bromodichloromethane	19	RBC	C
		Carbon Tetrachloride	15	RBC	C, UC-2
		Chlorobenzene	450	RBC	C
		Chloroform	26	RBC	C
		cis-1,2-Dichloroethene	270	RBC	C
		Naphthalene	16	RBC	C
		Tetrachloroethene	18	RBC	C
		Trichloroethene	290	RBC	C
		Vinyl Chloride	5.4	RBC	C
		2,4-Dimethylphenol	9800	RBC	C
		2,4-Dinitrotoluene	180	RBC	C
		3,4-Dimethylphenol	700	RBC	C
		4-Methylphenol	3500	RBC	C
		Benzo(a)anthracene	0.67	RBC	C
		Benzo(a)pyrene	0.05	RBC	C
		Benzo(b)fluoranthene	0.45	RBC	C
		Benzo(k)fluoranthene	0.45	RBC	C
		Chrysene	6.7	RBC	C
		Pentachlorophenol	50	PQL	C
	Protection of the Environment [b]	Chromium VI	50	SWC	C
		Zinc	81	SWC	C
B - Aquifer (RU-C5 Plume Only) (µg/L)	Residential - Domestic Use	Chromium VI	109	MCL	C
		Antimony	6	MCL	C
		Arsenic	10	MCL	C
		Iron	10,950	RBC	C
		Manganese	8,140	HPAL	C
		Thallium	2	MCL	C
		1,1-Dichloroethane	5	MCL	C
		1,2,4-Trichlorobenzene	70	MCL	C
		1,2,4-Trimethylbenzene	12	RBC	C
		1,2-Dichlorobenzene	600	MCL	C
		1,2-Dichloroethane	0.5	MCL	C
		1,2-Dichloroethene (Total)	6	MCL	C
		1,2-Dichloropropane	5	MCL	C
		1,3,5-Trimethylbenzene	12	RBC	C
		1,3-Dichlorobenzene	183	MCL	C
		1,4-Dichlorobenzene	5	MCL	C
		Benzene	1	MCL	C

Table 4-1. Parcel C and UC-2 Chemicals of Concern and Remediation Goals

Exposure Medium	Exposure Scenario	Chemical of Concern	ROD Remediation Goal (2008)[a]	Source of Remediation Goal	Parcel
B - Aquifer (RU-C5 Plume Only) (µg/L)	Residential - Domestic Use	Bromodichloromethane	80	MCL	C
		Chlorobenzene	70	MCL	C
		Chloroethane	4.6	MCL	C
		Chloroform	80	MCL	C
		cis-1,2-Dichloroethene	6	MCL	C
		Methylene Chloride	5	MCL	C
		Naphthalene	0.093	RBC	C
		Tetrachloroethene	5	MCL	C
		trans-1,2-Dichloroethene	10	MCL	C
		Trichloroethene	5	MCL	C
		Trichlorofluoromethane	1,288	RBC	C
		Vinyl Chloride	0.5	MCL	C
		2,4-Dimethylphenol	730	MCL	C
		2,4-Dinitrotoluene	10	MCL	C
		2-Methylnaphthalene	24	MCL	C
		2-Methylphenol	1,825	MCL	C
		4-Methylphenol	182	MCL	C
		Benzo(a)anthracene	0.2	MCL	C
		Benzo(a)pyrene	0.2	MCL	C
		Bis(2-ethylhexyl)phthalate	4	MCL	C
		Carbazole	10	MCL	C
		Chrysene	0.2	MCL	C
		Dibenzofuran	12	MCL	C
		Hexachloroethane	1.7	MCL	C
		Pentachlorophenol	1	MCL	C
		Aldrin	0.05	MCL	C
		alpha-BHC	1	MCL	C
		Dieldrin	0.02	MCL	C
		Heptachlor Epoxide	0.01	MCL	C

Reference:

Navy. 2014. *Explanation of Significant Differences to the Final Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California.* Final. October.

[a] In cooperation with the FFA signatories, the Navy developed a revised tiered approach that reduces excavation of soil that will not pose an unacceptable risk to human health and the environment once the remedy is fully implemented. Application of tiered action levels for the excavation portion of the selected soil remedy resulted in changes to the specific numerical RGs identified in the ROD as summarized in Table 4-1 of the ESD (Navy, 2014).

[b] Protection of the environment protects or minimizes discharge that would be above the specified remediation goals; specific trigger levels are developed for each plume. Groundwater remediation goals for chromium VI and zinc are at the point of discharge to the bay.

µg/L = microgram(s) per liter
BHC = benzene hexachloride
ESD = Explanation of Significant Differences
FFA = Federal Facilities Agreement
HPAL = Hunters Point Ambient Level
MCL = maximum contaminant level
mg/kg = milligram(s) per liter
Navy = Department of the Navy
PQL = practical quantitation limit
RBC = risk-based concentration
RG = remediation goal
ROD = Record of Decision
SWC = Surface Water Criteria

Table 4-2. Parcels C and UC-2 Remediation Goals for Radionuclides

Radionuclide	Surfaces (dpm/100cm^2)		Soil[c] (pCi/g)	Water[e] (pCi/L)	Parcel
	Equipment, Waste[a]	Structures[b]			
Cesium-137	5,000	5,000	0.113	119	C, UC-2
Cobalt-60	5,000	5,000	0.0361	100	C
Plutonium-239	100	100	2.59	15	C
Radium-226	100	100	1 [d]	5	C, UC-2
Strontium-90	1,000	1,000	0.331	8	C, UC-2
Thorium-232	1,000	37	1.69	15	C

Source of Goals:

Department of the Navy (Navy). 2006. *Base-wide Radiological Removal Action, Action Memorandum – Revision 2006, Hunters Point Shipyard, San Francisco, California*. Final. April 21.

United States Environmental Protection Agency (USEPA). 2000. *Radionuclides Notice of Data Availability Technical Support Document*. Targeting and Analysis Branch, Standards and Risk Management Division, Office of Groundwater and Drinking Water. March.

[a] Based on “AEC Regulatory Guide 1.86” (1974). Goals for removable surface activity are 20 percent of these values.

[b] Goals are based on 25 millirem per year (USEPA does not believe this NRC regulation is protective of human health and the environment, and the HPNS cleanup goals are more protective. This regulation is an ARAR only for radiologically impacted sites that are undergoing TCRAs and any additional remedial action required for those sites. It is not an ARAR for radiologically impacted portions of IR Sites 7 and 18 that will be transferred with engineering and institutional controls for radiological contaminants.)

[c] USEPA PRGs for two future use scenarios.

[d] Goal is 1 pCi/g above background per agreement with USEPA.

[e] Release criteria for water were derived from *Radionuclides Notice of Data Availability Technical Document* (USEPA, 2000) by comparing the limits from two criteria and using the most conservative value.

AEC = Atomic Energy Commission
ARAR = applicable or relevant and appropriate requirement
cm^2 = square centimeter(s)
dpm = disintegration(s) per minute
HPNS = Hunters Point Naval Shipyard
NRC = Nuclear Regulatory Commission
pCi/g = picocurie(s) per gram
pCi/L = picocurie(s) per liter
PRG = preliminary remediation goal
TCRA = time-critical removal action
USEPA = United States Environmental Protection Agency

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Table 4-3. Parcel C Remedial Action Summary and Expected Outcomes

Media	Risk/Basis for Action	Reasonably Anticipated Land Use	RAO	Remedy Component	Performance Metric	Expected Outcome
Soil	**Human Health:** Unacceptable risk to potential future industrial users from exposure to metals, VOCs, and SVOCs in soil; recreational users from exposure to metals and SVOCs in soil; residents (adult and child) from metals, VOCs, SVOCs, pesticides, and PCBs in soil; and construction workers from metals, SVOCs, and PCBs in soil. Potential volatilization of VOCs and some SVOCs from soil into soil gas and/or indoor air via the VI pathway.	**Current use:** limited access unoccupied and unused buildings **Planned Future use**: Mixed use, including mixed residential/ retail and research and development	1. Prevent or minimize exposure to organic and inorganic chemicals in soil at concentrations above remediation goals developed in the HHRA for the following exposure pathways: a. Ingestion of, outdoor inhalation of, and dermal exposure to surface and subsurface soil. b. Ingestion of homegrown produce in native soil.	Excavation	Excavation to remove COCs in soil that exceeded RGs and action levels established in the 2014 ESD (Navy, 2014). Completed in 2015.	Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.
				Durable covers	Durable covers to provide physical barriers to prevent exposure to metals in soil. Durable covers include: 1) a 3-foot-thick (minimum) shoreline armoring, 2) a 2-foot-thick (minimum) vegetated soil cover, 3) a 6-inch-thick (minimum) asphaltic pavement cover, and 4) repaired concrete building foundations. Covers are inspected and maintained to prevent exposure to COCs.	
				ICs	ICs to maintain durable covers, restrict land use and land-disturbing activity, and prohibit growing vegetables or fruits in native soil for human consumption	
Soil Gas			2. Prevent or minimize exposure to VOCs in soil gas at concentrations that would pose unacceptable risk via indoor inhalation of vapors. Table 7 of the final soil gas memorandum (ChaduxTt, 2010) lists the volatile chemicals. This list includes SVOCs (such as pesticides and PAHs). Remediation goals for VOCs to address exposure via indoor inhalation of vapors may be superseded based on COC identification information from future soil gas surveys. Future action levels would be established for soil gas, would account for vapors from both soil and groundwater, and would be calculated based on a cumulative excess cancer risk level of 10^{-6} using the accepted methodology for risk assessments at HP[N]S.	SVE	SVE to remove VOCs from soil gas. Five SVE systems within RU-C1, RU-C2, RU-C4, and RU-C5 were operated from 2014 to 2017 with limited success due to shallow groundwater table, low permeability soil/sediment, water entrainment in the SVE wells, and ongoing remedial actions that may contribute to ineffectiveness of removal. The Navy is in the process of reviewing the strategy for addressing soil vapor exceedances at all Parcel C Areas in conjunction with additional in-situ groundwater remediation activities that are ongoing.	
				ICs	ICs to prohibit construction of enclosed structures unless prior written approval of vapor mitigation strategies is granted by the FFA signatories.	
Groundwater	**Human Health:** Potential volatilization of VOCs from soil and A-aquifer groundwater into soil gas and/or indoor air via the VI pathway. Potential unacceptable risks to future construction workers from dermal exposure to COCs in A-aquifer groundwater and VOCs through volatilization in trenches. Potential unacceptable risks to residents through COCs in B-aquifer groundwater from domestic use (RU-C5 only).		1. Prevent or minimize exposure to VOCs in the A-aquifer groundwater at concentrations above remediation goals via indoor inhalation of vapors from groundwater. 2. Prevent or minimize direct exposure to the groundwater that may contain COCs through the domestic use pathway in the B-aquifer, RU-C5 only (for example, drinking water or showering). 3. Prevent or minimize exposure of construction workers to metals and VOCs in the A-aquifer groundwater at concentrations above remediation goals from dermal exposure and inhalation of vapors from groundwater.	Groundwater treatment	In-situ groundwater remediation to active treatment criteria consisting of injecting ZVI or a biological substrate to treat COCs (VOCs and hexavalent chromium) in RU-C1, RU-C2, RU-C4, and RU-C5. The first round of injections was conducted from 2013 to 2017 and the latest round was in 2021. Performance monitoring is ongoing for plumes that have not met MNA criteria (COCs statistically below ATCs). Additional treatment, moving to MNA, or plume closure is determined through decision criteria that were established in the RD.	
				MNA	Upon completion of groundwater treatment, MNA will be conducted to monitor COC degradation, aquifer conditions, and plume stability until RGs are met.	
				ICs	ICs to prohibit construction of enclosed structures, the use of groundwater and installation of new groundwater wells for domestic purposes, and to restrict land-disturbing activity unless prior written approval is granted by the FFA signatories	

Table 4-3. Parcel C Remedial Action Summary and Expected Outcomes

Media	Risk/Basis for Action	Reasonably Anticipated Land Use	RAO	Remedy Component	Performance Metric	Expected Outcome
Groundwater	Potential migration pathway of contaminants	**Current use:** limited access unoccupied and unused buildings **Planned Future use**: Mixed use, including mixed residential/ retail and research and development	4. Prevent or minimize migration to the surface water of San Francisco Bay of chromium VI and zinc in A-aquifer groundwater that would result in concentrations of chromium VI above 50 µg/L and zinc above 81 µg/L at the point of discharge to the bay.	Groundwater treatment and monitoring	In-situ groundwater remediation consisting of injecting food-grade molasses was completed in RU-C3 and RU-C5 to reduce hexavalent chromium via anaerobic bioremediation. Zinc was initially targeted for active remediation but was documented not to be warranted based on pre-remedial characterization sampling. Concentrations are below treatment goals.	Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.
				LTM	Groundwater LTM to monitor hexavalent chromium and zinc concentrations and migration. LTM will continue until concentrations are below TLs protective of the bay.	
Radiologically Impacted Soil and Structures	**Human Health:** Radiological risks for soil and structures (storm drains, sanitary sewers, buildings) were greater than 10^{-6}.		1. Prevent or minimize exposure to radionuclides of concern in concentrations that exceed remediation goals for all potentially complete exposure pathways (for example, external radiation, soil ingestion, and inhalation of resuspended radionuclides in soil or dust).	Survey, decontamination, and removal of radiologically impacted structures and soil	Identification and removal of historical subsurface storm drain and sanitary sewer utilities and screening and remediation of buildings, and former building sites as part of the TCRA for radionuclides. Radiological retesting is currently being conducted to confirm site conditions are compliant with the RAO.	

References:

ChaduxTt, A Joint Venture of St. George Chadux Corp. and Tetra Tech EM Inc. (ChaduxTt). 2010. *Memorandum: Approach for Developing Soil Gas Action Levels for Vapor Intrusion Exposure at Hunters Point Shipyard, Hunters Point Shipyard, San Francisco, California*.

Navy. 2014. *Explanation of Significant Differences to the Final Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California*. Final. October.

µg/L = microgram(s) per liter
ATC = active treatment criterion
COC = chemical of concern
ESD = Explanation of Significant Differences
FFA = Federal Facilities Agreement
HHRA = human health risk assessment
HPNS = Hunters Point Naval Shipyard
IC = institutional control
LTM = long-term monitoring
LUC = land use control
MNA = monitored natural attenuation
Navy = Department of the Navy
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RAO = remedial action objective
RD = remedial design
RG = remediation goal
SVE = soil vapor extraction
SVOC = semivolatile organic compound
TCRA = time-critical removal action
VI = vapor intrusion
VOC = volatile organic compound
ZVI = zero-valent iron

Table 4-4. Parcel UC-2 Remedial Action Summary and Expected Outcomes

Media	Risk/Basis for Action	Reasonably Anticipated Land Use	RAO	Remedy Component	Performance Metric	Expected Outcome
Soil	**Human Health:** Unacceptable risk to potential future residents (adult and child) and construction workers from metals in soil. Potential volatilization of VOCs and some SVOCs from soil into soil gas and/or indoor air via the VI pathway.	**Current use:** Utility corridor, access road, unused buildings. **Future use**: Mixed use, including mixed residential/retail and research and development (industrial)	1. Prevent or minimize exposure to inorganic chemicals in soil at concentrations above remediation goals developed in the HHRA for the following exposure pathways: a) Ingestion of, outdoor inhalation of, and dermal exposure to surface and subsurface soil b) Ingestion of homegrown produce by residents in mixed-use and research and development blocks	Durable covers	Durable covers (asphalt pavement or vegetated soil) to provide physical barriers to prevent exposure to metals in soil. Durable covers include: 1) a 2-foot-thick (minimum) vegetated soil cover, 2) a 6-inch-thick (minimum) asphaltic pavement cover, and 3) repaired concrete building foundations. Covers are inspected and maintained to prevent exposure to COCs.	Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.
				ICs	ICs to maintain durable covers, restrict land use and land-disturbing activity, and prohibit growing vegetables or fruits in native soil for human consumption	
Soil Gas			2. Prevent or minimize exposure to VOCs in soil gas at concentrations that would pose unacceptable risk via indoor inhalation of vapors. Remediation goals for VOCs to address exposure via indoor inhalation of vapors may be superseded based on COC identification information from future soil gas surveys. Future action levels would be established for soil gas, would account for vapors from both soil and groundwater, and would be calculated based on a cumulative risk level of 10^{-6} using the accepted methodology for risk assessments at HP[N]S.	ICs	ICs to prohibit construction of enclosed structures unless prior written approval of vapor mitigation strategies is granted by the FFA signatories.	
Groundwater	**Human Health:** Risk to potential future residents from VOCs in A-aquifer through the vapor intrusion pathway, construction workers through vapors in trenches.		1. Prevent or minimize exposure to VOCs in the A-aquifer groundwater at concentrations above remediation goals via indoor inhalation of vapors from groundwater. 2. Prevent or minimize direct exposure to the groundwater that may contain COCs through the domestic use pathway (for example, drinking water or showering). 3. Prevent or minimize exposure of construction workers to VOCs in the A-aquifer groundwater at concentrations above remediation goals from dermal exposure and inhalation of vapors from groundwater.	LTM	LTM of groundwater is conducted to monitor COC concentrations in groundwater. Parcel UC-2 has been transferred to the City of San Francisco and is no longer on Navy property. Monitoring of these two wells will continue semiannually to assess trends in concentrations of carbon tetrachloride and chloroform at Parcel UC-2; no remedial action for groundwater treatment is required at this time. Ownership of Parcel UC-2 has been transferred to the City of San Francisco and is no longer Navy property; however, sampling of the monitoring wells is still included in the BGMP.	
				ICs	ICs to prohibit construction of enclosed structures, the use of groundwater and installation of new groundwater wells for domestic purposes, and to restrict land-disturbing activity unless prior written approval is granted by the FFA signatories.	
Radiologically Impacted Soil and Structures	**Human Health:** Radiological risks for soil and structures (storm drains and sanitary sewers) were greater than 10^{6}.		1. Prevent or minimize exposure to radionuclides of concern in concentrations that exceed remediation goals for all potentially complete exposure pathways (for example, external radiation, soil ingestion, and inhalation of resuspended radionuclides in soil or dust).	Survey, decontamination, and removal of radiologically impacted structures and soil	Identification and removal of historical subsurface storm drain and sanitary sewer utilities and screening and remediation of buildings, and former building sites as part of the TCRA for radionuclides. Radiological retesting is planned to confirm site conditions are compliant with the RAO.	

Table 4-4. Parcel UC-2 Remedial Action Summary and Expected Outcomes

BGMP = Basewide Groundwater Monitoring Program
COC = chemical of concern
FFA = Federal Facilities Agreement
HHRA = human health risk assessment
HPNS = Hunters Point Naval Shipyard
IC = institutional control
LTM = long-term monitoring
LUC = land use control
Navy = Department of the Navy
RAO = remedial action objective
RD = remedial design
SVOC = semivolatile organic compound
TCRA = time-critical removal action
VI = vapor intrusion
VOC = volatile organic compound

Table 4-5. Fourth Five-Year Review Parcel C and UC-2 Issues, Recommendations, and Follow-up Actions

Parcel/Site	Fourth Five-Year Review Protectiveness	Issue	Recommendation (Milestone)	Date Complete/Current Status
C	Will be protective	SVE implementation in Parcels B-1 and C is reducing source mass, but with limited effectiveness due to diffusion-limited conditions in the subsurface. Although ICs will maintain future protectiveness, source removal inefficiency is extending the period within which SVE will be implemented.	It is recommended that use of the SVE technology be evaluated for each treatment area due to inefficiency caused by diffusion-limited conditions. Site-specific studies (e.g., remedy analyses) should be performed to estimate the magnitude and extent of source mass at each treatment area in Parcels B-1 and C to determine if other measures could be implemented to enhance SVE performance in the future. Any changes implemented to the approach for reducing source contamination in SVE areas should be discussed in the next Five-Year Review report. Changes made to the treatment approach should be considered for any other SVE treatment areas at HPNS, including areas where treatment is planned but has not yet been initiated. (12/31/2019)	**Completed February 2019:** The SVE systems at Parcel C were turned off between 2016 and 2017 when they reached points of diminishing returns primarily because of shallow groundwater, low permeability soils, and additional remedial actions pending in the treatment areas. The Navy will review the strategy for addressing soil gas at all Parcel C Areas after completion of additional in-situ groundwater remediation activities that are ongoing and discussed in **Section 4.4.1** of this Five-Year Review (ECC-Insight and CDM Smith, 2019).
C and UC-2	Will be protective (C) Short-term protective (UC-2)	The Navy has determined that a significant portion of the radiological survey and remediation work completed to date was not reliable because of manipulation and/or falsification of data by one of its radiological contractors. A long-term protectiveness evaluation of the radiological RGs has not yet been completed for this fourth Five-Year Review, and it is currently not known if the RAOs for radionuclides have been achieved in Parcels B-1, B-2, C, D-1, D-2, G, E, UC-1, UC-2, and UC-3.	Refer to **Section 1.4.3** for the long-term protectiveness evaluation component of this recommendation. The Navy is in the process of implementing corrective actions to ensure that the radiological remedies specified in the decision documents are implemented as intended. It is anticipated that the radiological rework will be completed prior to the next Five-Year Review.	**Long-term Protectiveness Evaluation: Completed June 2020**. Addenda to the Fourth Five-Year Review were prepared to evaluate the Radiological RGs for soil and buildings. The conclusions of both reports were that the current RGs were protective of human health and the environment (Navy, 2020a, 2020b). **In Progress:** Planning for the radiological retesting of soil and surveys of building structures at Parcel C was initiated in February 2019. Fieldwork activities were initiated in Spring 2022. Radiological retesting will be summarized in a radiological RACR anticipated to be completed in 2025. Planning for the radiological retesting of soil at Parcel UC-2 was initiated in February 2019. Fieldwork began in 2023. Radiological retesting will be summarized in a radiological RACR anticipated to be completed in 2028.

References:

Department of the Navy (Navy). 2020a. *Addendum to the Five-Year Review, Evaluation of Radiological Remedial Goals for Soil, Hunters Point Naval Shipyard, San Francisco, California.* June 18.

Navy. 2020b. *Addendum to the Five-Year Review, Evaluation of Radiological Remedial Goals for Building Structures, Hunters Point Naval Shipyard, San Francisco, CA*. June 18.

ECC-Insight, LLC and CDM Smith. 2019. *Parcel C Soil Vapor Extraction System Operation and Maintenance Summary Report, Hunters Point Naval Shipyard, San Francisco, California*. Final. February.

HPNS = Hunters Point Naval Shipyard
IC = institutional control
Navy = Department of the Navy
RACR = Remedial Action Completion Report
RAO = remedial action objective
RG = remediation goal
SVE = soil vapor extraction

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Table 4-6. Parcels C and UC-2 Chemicals of Concern and Current Comparison Criteria for Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	Values from ROD			Current Comparison Criteria				
			ROD Remediation Goal (2009/2010)	Source of Remediation Goal	Parcel	11/2022 USEPA RSL or VISL[a]	Basis of RSL or VISL (C/NC)	DTSC-SL	California MCL	USEPA MCL
A-Aquifer (µg/L)	Residential Vapor Intrusion	1,1,2,2-Tetrachloroethane	3	RBC	C	3.23	C	NA	1	NA
		1,1,2-Trichloroethane	4	RBC	C	5.21	C	NA	5	5
		1,1-Dichloroethane	6.5	RBC	C	7.64	C	NA	5	NA
		1,2,3-Trichloropropane	0.5	PQL	C	22.3	NC	NA	0.005	NA
		1,2,4-Trimethylbenzene	25	RBC	C	248	NC	NA	NA	NA
		1,2-Dichlorobenzene	2,600	RBC	C	2660	NC	NA	600	600
		1,2-Dichloroethane	2.3	RBC	C	2.24	C	NA	0.5	5
		1,2-Dichloroethene (Total)	210	RBC	C	109	NC	NA	6 / 10	70 / 100
		1,2-Dichloropropane	1.1	RBC	C	6.58	C	NA	5	5
		1,3,5-Trimethylbenzene	19	RBC	C	175	NC	NA	NA	NA
		1,4-Dichlorobenzene	2.1	RBC	C	2.59	C	NA	5	75
		Benzene	0.5	PQL	C	1.59	C	NA	1	5
		Bromodichloromethane	1	RBC	C	0.876	C	NA	80	80
		Carbon Tetrachloride	0.5	PQL	C, UC-2	0.415	C	NA	0.5	5
		Chlorobenzene	390	RBC	C	410	NC	NA	70	100
		Chloroethane	6.5	RBC	C	9190	NC	NA	NA	NA
		Chloroform	0.7	RBC	C, UC-2	0.814	C	NA	80	80
		cis-1,2-Dichloroethene	210	RBC	C	250	NC	NA	6	70
		cis-1,3-Dichloropropene	0.5	PQL	C	4.84	C	NA	0.5	NA
		Dibromochloromethane	2.6	RBC	C	NITD		NA	80	80
		Isopropylbenzene	7.8	RBC	C	887	NC	NA	NA	NA
		Methylene Chloride	27	RBC	C	763	C	NA	5	5
		Naphthalene	3.6	RBC	C	4.59	C	NA	NA	NA
		Tetrachloroethene	0.54	RBC	C	14.9	C	NA	5	5
		trans-1,2-Dichloroethene	180	RBC	C	109	NC	NA	10	100
		trans-1,3-Dichloropropene	0.5	PQL	C	4.84	NC	NA	0.5	NA
		Trichloroethene	2.9	RBC	C, UC-2	1.19	C	NA	5	5
		Trichlorofluoromethane	180	RBC	C	NITD		NA	150	NA
		Vinyl Chloride	0.5	PQL	C	0.147	C	NA	0.5	2

Table 4-6. Parcels C and UC-2 Chemicals of Concern and Current Comparison Criteria for Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	Values from ROD			Current Comparison Criteria				
			ROD Remediation Goal (2009/2010)	Source of Remediation Goal	Parcel	11/2022 USEPA RSL or VISL[a]	Basis of RSL or VISL (C/NC)	DTSC-SL	California MCL	USEPA MCL
A-Aquifer (µg/L)	Industrial- Vapor Intrusion	1,1,2,2-Tetrachloroethane	5.1	RBC	C	14.1	C	NA	1	NA
		1,1,2-Trichloroethane	6.7	RBC	C	22.8	C	NA	5	5
		1,1-Dichloroethane	11	RBC	C	33.4	C	NA	5	NA
		1,2,3-Trichloropropane	0.5	PQL	C	93.7	NC	NA	0.000005	NA
		1,2,4-Trimethylbenzene	25	RBC	C	1040	NC	NA	NA	NA
		1,2-Dichloroethane	3.9	RBC	C	9.78	C	NA	0.5	5
		1,2-Dichloroethene (Total)	210	RBC	C	457	NC	NA	6 / 10	70 / 100
		1,2-Dichloropropane	1.8	RBC	C	28.7	C	NA	5	5
		1,3,5-Trimethylbenzene	19	RBC	C	733	NC	NA	NA	NA
		1,4-Dichlorobenzene	3.6	RBC	C	11.3	C	NA	5	75
		Benzene	0.63	RBC	C	6.93	C	NA	1	5
		Bromodichloromethane	1.7	RBC	C	3.82	C	NA	80	80
		Carbon Tetrachloride	0.5	PQL	C	1.81	C	NA	0.5	5
		Chlorobenzene	390	RBC	C	1720	NC	NA	70	100
		Chloroform	1.2	RBC	C	3.55	C	NA	80	80
		cis-1,2-Dichloroethene	210	RBC	C	1050	NC	NA	6	70
		cis-1,3-Dichloropropene	0.5	PQL	C	21.1	C	NA	0.5	NA
		Isopropylbenzene	7.8	RBC	C	3730	NC	NA	NA	NA
		Methylene Chloride	46	RBC	C	9230	C	NA	5	5
		Naphthalene	6	RBC	C	20.1	C	NA	NA	NA
		Tetrachloroethene	0.9	RBC	C	65.2	C	NA	5	5
		trans-1,3-Dichloropropene	0.5	PQL	C	21.1	C	NA	0.5	NA
		Trichloroethene	4.8	RBC	C	7.4	C	NA	5	5
		Trichlorofluoromethane	180	RBC	C	NITD		NA	150	NA
		Vinyl Chloride	0.5	PQL	C	2.45	C	NA	0.5	2
	Construction Worker	1,1,2-Trichloroethane	40	RBC	C	NA	NA	NA	NA	NA
		1,2,3-Trichloropropane	0.6	RBC	C	NA	NA	NA	NA	NA
		1,2,4-Trichlorobenzene	41	RBC	C	NA	NA	NA	NA	NA
		1,2,4-Trimethylbenzene	53	RBC	C	NA	NA	NA	NA	NA
		1,2-Dichlorobenzene	1700	RBC	C	NA	NA	NA	NA	NA

Table 4-6. Parcels C and UC-2 Chemicals of Concern and Current Comparison Criteria for Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	Values from ROD			Current Comparison Criteria				
			ROD Remediation Goal (2009/2010)	Source of Remediation Goal	Parcel	11/2022 USEPA RSL or VISL[a]	Basis of RSL or VISL (C/NC)	DTSC-SL	California MCL	USEPA MCL
A-Aquifer (µg/L)	Construction Worker	1,2-Dichloroethane	22	RBC	C	NA	NA	NA	NA	NA
		1,2-Dichloroethene (Total)	270	RBC	C	NA	NA	NA	NA	NA
		1,2-Dichloropropane	30	RBC	C	NA	NA	NA	NA	NA
		1,4-Dichlorobenzene	52	RBC	C	NA	NA	NA	NA	NA
		Benzene	16	RBC	C	NA	NA	NA	NA	NA
		Bromodichloromethane	19	RBC	C	NA	NA	NA	NA	NA
		Carbon Tetrachloride	15	RBC	C, UC-2	NA	NA	NA	NA	NA
		Chlorobenzene	450	RBC	C	NA	NA	NA	NA	NA
		Chloroform	26	RBC	C	NA	NA	NA	NA	NA
		cis-1,2-Dichloroethene	270	RBC	C	NA	NA	NA	NA	NA
		Naphthalene	16	RBC	C	NA	NA	NA	NA	NA
		Tetrachloroethene	18	RBC	C	NA	NA	NA	NA	NA
		Trichloroethene	290	RBC	C	NA	NA	NA	NA	NA
		Vinyl Chloride	5.4	RBC	C	NA	NA	NA	NA	NA
		2,4-Dimethylphenol	9800	RBC	C	NA	NA	NA	NA	NA
		2,4-Dinitrotoluene	180	RBC	C	NA	NA	NA	NA	NA
		3,4-Dimethylphenol	700	RBC	C	NA	NA	NA	NA	NA
		4-Methylphenol	3500	RBC	C	NA	NA	NA	NA	NA
		Benzo(a)anthracene	0.67	RBC	C	NA	NA	NA	NA	NA
		Benzo(a)pyrene	0.05	RBC	C	NA	NA	NA	NA	NA
		Benzo(b)fluoranthene	0.45	RBC	C	NA	NA	NA	NA	NA
		Benzo(k)fluoranthene	0.45	RBC	C	NA	NA	NA	NA	NA
		Chrysene	6.7	RBC	C	NA	NA	NA	NA	NA
		Pentachlorophenol	50	PQL	C	NA	NA	NA	NA	NA
	Protection of the Environment	Chromium VI	50	SWC	C	NA	NA	NA	NA	NA
		Zinc	81	SWC	C	NA	NA	NA	NA	NA
B - Aquifer (RU-C5 Plume Only) (µg/L)	Residential - Domestic Use	Chromium VI [b]	109	RBC [c]	C	0.035	C	NA	50	100
		Antimony	6	MCL	C	7.8	NC	NA	6	6
		Arsenic	10	MCL	C	0.052	C	0.0082	10	10
		Iron	10,950	RBC	C	14000	NC	NA	NA	NA

Table 4-6. Parcels C and UC-2 Chemicals of Concern and Current Comparison Criteria for Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	Values from ROD			Current Comparison Criteria				
			ROD Remediation Goal (2009/2010)	Source of Remediation Goal	Parcel	11/2022 USEPA RSL or VISL[a]	Basis of RSL or VISL (C/NC)	DTSC-SL	California MCL	USEPA MCL
B - Aquifer (RU-C5 Plume Only) (µg/L)	Residential - Domestic Use	Manganese	8,140	HGAL	C	430	NC	NA	NA	NA
		Thallium	2	MCL	C	0.2	NC	0.059	2	2
		1,1-Dichloroethane	5	MCL	C	2.8	C	2.8 (USEPA)	5	NA
		1,2,4-Trichlorobenzene	70	MCL	C	1.2	C	0.46	5	70
		1,2,4-Trimethylbenzene	12	RBC	C	56	NC	NA	NA	NA
		1,2-Dichlorobenzene	600	MCL	C	30	NC	NA	600	600
		1,2-Dichloroethane	0.5	MCL	C	0.17	C	0.17 (USEPA)	0.5	5
		1,2-Dichloroethene (Total)	6	MCL	C	25	NC	6 / 10	6 / 10	70 / 100
		1,2-Dichloropropane	5	MCL	C	0.85	C	NA	5	5
		1,3,5-Trimethylbenzene	12	RBC	C	60	NC	NA	NA	NA
		1,3-Dichlorobenzene	183	RBC [c]	C	NA	NA	NA	NA	NA
		1,4-Dichlorobenzene	5	MCL	C	0.48	C	NA	5	75
		Benzene	1	MCL	C	0.46	C	0.15	1	5
		Bromodichloromethane	80	MCL	C	0.13	C	0.13 (USEPA)	80	80
		Chlorobenzene	70	MCL	C	78	NC	NA	70	100
		Chloroethane	4.6	RBC [c]	C	8300	NC	NA	NA	NA
		Chloroform	80	MCL	C	0.22	C	NA	80	80
		cis-1,2-Dichloroethene	6	MCL	C	25	NC	12	6	70
		Methylene Chloride	5	MCL	C	11	C	1.7	5	5
		Naphthalene	0.093	RBC	C	0.12	C	0.12	NA	NA
		Tetrachloroethene	5	MCL	C	11	C	0.084	5	5
		trans-1,2-Dichloroethene	10	MCL	C	68	NC	110	10	100
		Trichloroethene	5	MCL	C	0.49	C	NA	5	5
		Trichlorofluoromethane	1,288	RBC	C	5200	NC	1700	150	NA
		Vinyl Chloride	0.5	MCL	C	0.019	C	0.0098	0.5	2
		2,4-Dimethylphenol	730	RBC [c]	C	360	NC	NA	NA	NA

Table 4-6. Parcels C and UC-2 Chemicals of Concern and Current Comparison Criteria for Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	Values from ROD			Current Comparison Criteria				
			ROD Remediation Goal (2009/2010)	Source of Remediation Goal	Parcel	11/2022 USEPA RSL or VISL[a]	Basis of RSL or VISL (C/NC)	DTSC-SL	California MCL	USEPA MCL
B - Aquifer (RU-C5 Plume Only) (μg/L)	Residential - Domestic Use	2,4-Dinitrotoluene	10	RBC [c]	C	0.24	C	0.11 (USEPA)	NA	NA
		2-Methylnaphthalene	24	RBC [c]	C	36	NC	17	NA	NA
		2-Methylphenol	1,825	RBC [c]	C	930	NC	NA	NA	NA
		4-Methylphenol	182	RBC [c]	C	370	NC	NA	NA	NA
		Benzo(a)anthracene	0.2	RBC [c]	C	0.03	C	0.017	NA	NA
		Benzo(a)pyrene	0.2	MCL	C	0.025	C	NA	0.2	0.2
		Bis(2-ethylhexyl)phthalate	4	MCL	C	5.6	C	NA	4	6
		Carbazole	10	RBC [c]	C	NA		NA	NA	NA
		Chrysene	0.2	RBC [c]	C	25	C	NA	NA	NA
		Dibenzofuran	12	RBC [c]	C	7.9	NC	4	NA	NA
		Hexachloroethane	1.7	RBC [c]	C	0.33	C	NA	NA	NA
		Pentachlorophenol	1	MCL	C	0.041	C	NA	1	1
		Aldrin	0.05	RBC [c]	C	0.00092	C	0.0092 (USEPA)	NA	NA
		alpha-BHC	1	RBC [c]	C	0.0072	C	0.011	NA	NA
		Dieldrin	0.02	RBC [c]	C	0.0018	C	0.00066 (USEPA)	NA	NA
		Heptachlor Epoxide	0.01	MCL	C	0.0014	C	0.0014 (USEPA)	0.01	0.2

Table 4-6. Parcels C and UC-2 Chemicals of Concern and Current Comparison Criteria for Groundwater

[a] VISL presented for A-aquifer groundwater, RSL for B-aquifer groundwater.

[b] MCLs shown are for total chromium, no MCLs available for Chromium VI.

[c] Risk-based concentration was identified as "MCL" in the ROD.

Notes:

Shading indicates current comparison criteria is lower than ROD Remediation Goal unless Remediation Goal is HGAL.

μg/L = microgram(s) per liter
BHC = benzene hexachloride
C = carcinogen
DTSC = California Department of Toxic Substances Control
HGAL = Hunters Point groundwater ambient level
MCL = maximum contaminant level
NA = not available
NC = noncarcinogen
NITD = no inhalation toxicity data
PQL = practical quantitation limit
RBC = risk-based concentration
ROD = Record of Decision
RSL = Regional Screening Level
SL = screening level
SWC = Surface Water Criteria
USEPA = United States Environmental Protection Agency
VISL = vapor intrusion screening level

Table 4-7. Parcel C Chemicals of Potential Concern for Ecological Receptors - Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	ROD Trigger Level (2008)	Source of Trigger Level	Receptor Basis	NRWQC (2023)	Basin Plan SF Bay (2019)	Value Still Protective?	Notes
Groundwater (µg/L)	Ecological Receptor	Chromium VI	50	NRWQC - CCC	aquatic organisms	50	50	Yes	Analyte was included in the monitoring due to detections at Dry Dock 2 and Building 253. Exceeding the trigger level does not indicate immediate risk but a potential exists if the plume migrates toward the bay. The trigger level is a risk based criteria for surface water exposures but is not an ARAR for ecological exposure to groundwater.
		Zinc	81	NRWQC - CCC	aquatic organisms	81	81	Yes	Analyte was included in the monitoring due to detections at RU-C1 wells. Exceeding the trigger level does not indicate immediate risk but a potential exists if the plume migrates toward the bay. The trigger level is a risk based criteria for surface water exposures but is not an ARAR for ecological exposure to groundwater.

µg/L = microgram(s) per liter
ARAR = applicable or relevant and appropriate requirement
CCC = Criterion Continuous Concentration
NRWQC = National Recommended Water Quality Criteria
ROD = Record of Decision

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Table 4-8. Parcel C and UC-2 Issues, Recommendations, and Follow-up Actions

Parcel	Issue	Recommendations/ Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
						Current	Future
C	As identified in the Fourth Five-Year Review there is uncertainty with a portion of the radiological survey and remediation work performed between 2004 and 2016 under the Basewide Radiological Removal Action, Action Memorandum (Navy, 2006). The Navy is in the process of implementing corrective actions to ensure the radiological remedies specified in the decision documents were implemented as intended; however, this work is ongoing.	Complete radiological retesting at radiologically impacted sites, including current and former buildings and soil areas investigated under the Radiological Removal Action, Action Memorandum (Navy, 2006) and areas where evaluations determined previous data were unreliable.	Navy	USEPA	2/5/2025	N	Y
UC-2					3/2/2028		

Source: Navy. 2006. *Base-wide Radiological Removal Action, Action Memorandum – Revision 2006, Hunters Point Shipyard, San Francisco, California*. Final. April 21.

Navy = Department of the Navy
USEPA = United States Environmental Protection Agency

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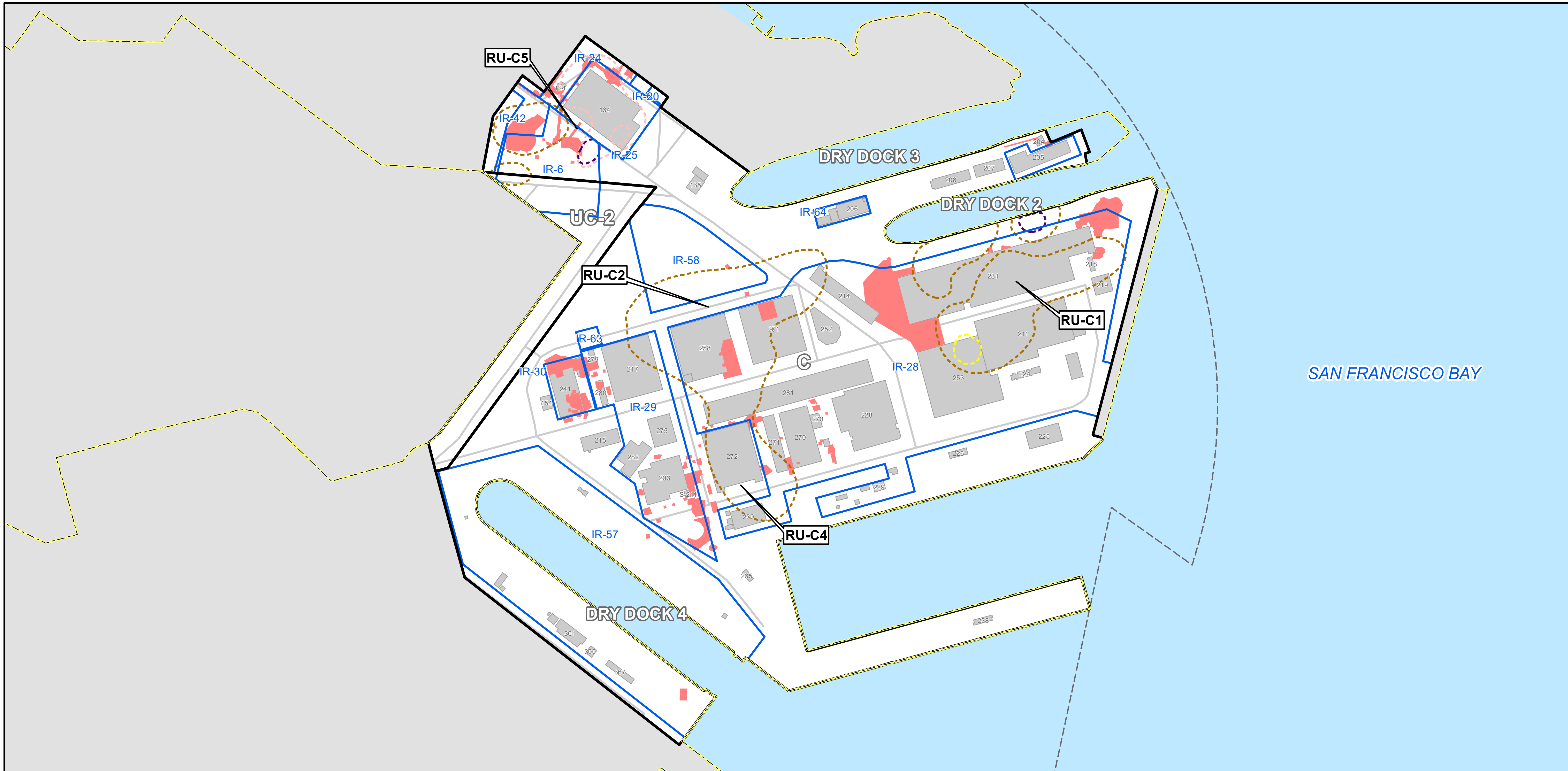

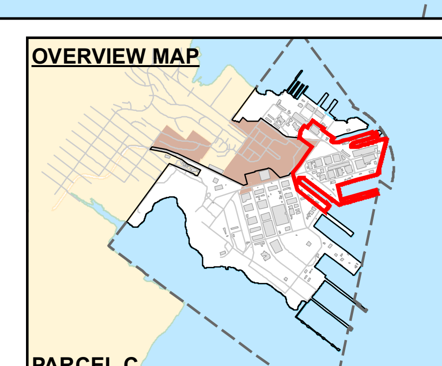

Figure 4-1
Parcel C (Parcels C and UC-2)
Fifth Five-Year Review Report
Hunters Point Naval Shipyard, San Francisco, California

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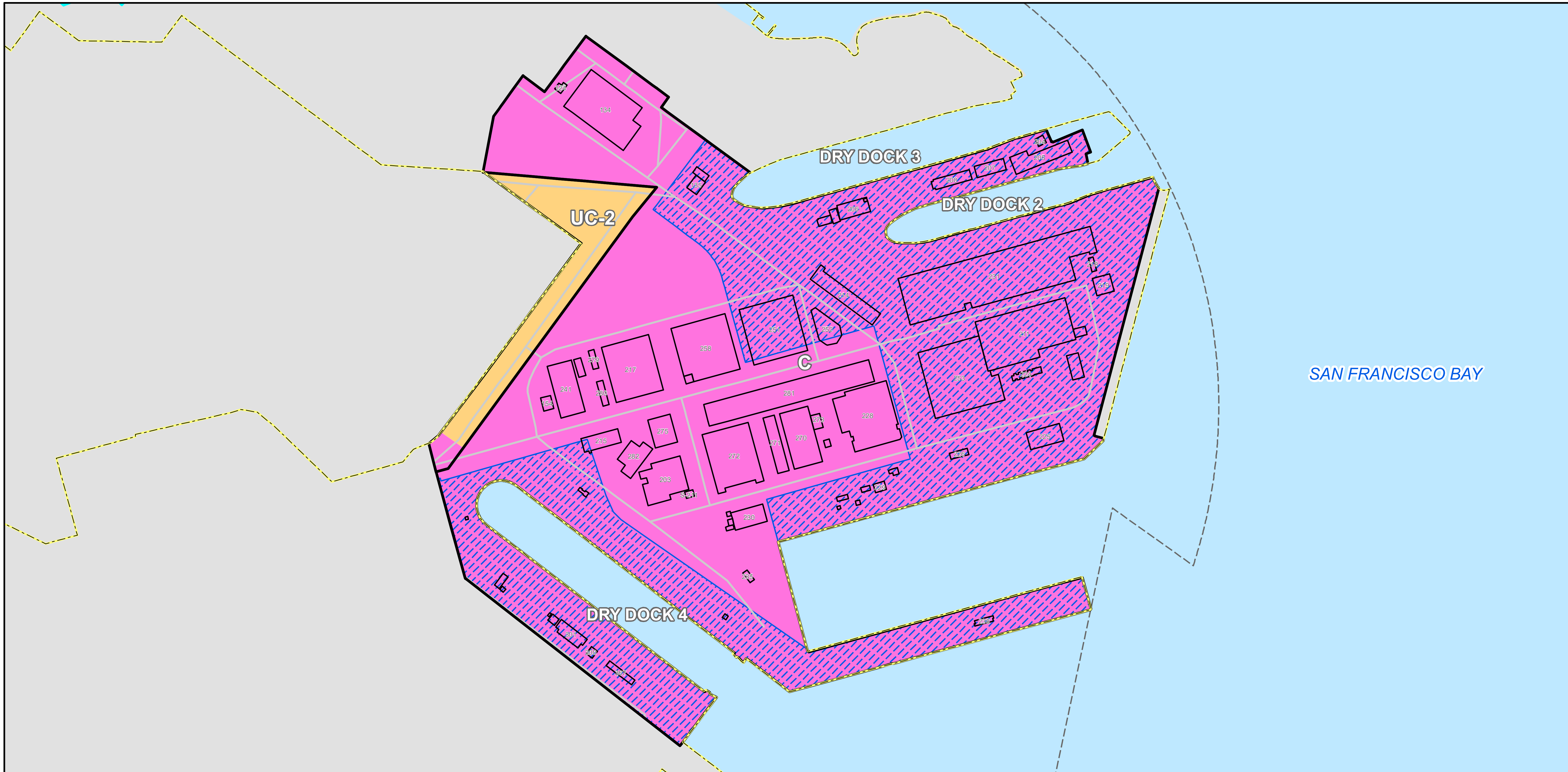

LEGEND

Hunters Point Naval Shipyard Boundary
Parcel Boundary
Parcel F (Water) Boundary
Water
Building
Road

Institutional Controls

Additional Restrictions (Open Space, Educational/Cultural, and/or Maritime/Industrial Use
ARIC for Soil and Groundwater Use (General)
ARIC for Soil, Groundwater Use, and Restrictions Related to VOC Vapors

ARIC = area requiring institutional controls
VOC = volatile organic compound

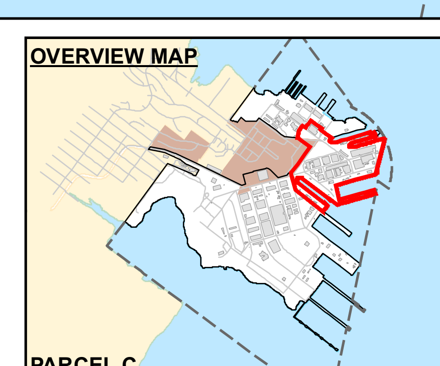

Figure 4-2
Parcel C (Parcels C and UC-2) Institutional Controls
Fifth Five-Year Review Report
Hunters Point Naval Shipyard, San Francisco, California

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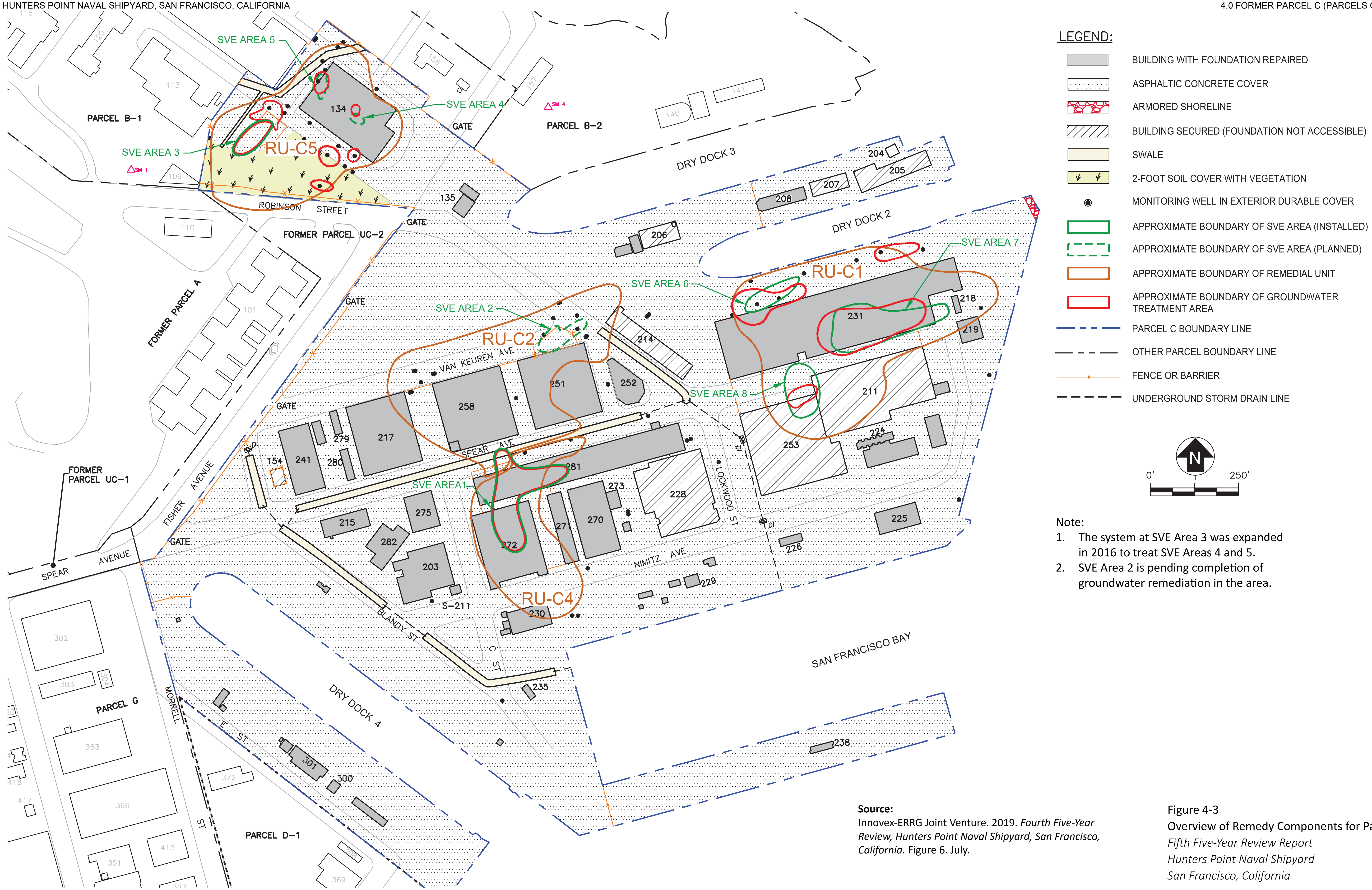

Note:

1. The system at SVE Area 3 was expanded in 2016 to treat SVE Areas 4 and 5.
2. SVE Area 2 is pending completion of groundwater remediation in the area.

Source:
Innovex-ERRG Joint Venture. 2019. *Fourth Five-Year Review, Hunters Point Naval Shipyard, San Francisco, California.* Figure 6. July.

Figure 4-3
Overview of Remedy Components for Parcel C
Fifth Five-Year Review Report
Hunters Point Naval Shipyard
San Francisco, California

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IR28MW556A			
Analyte	PAL	March 2022	Sept 2022
Benzene	0.5	--	2
Vinyl Chloride	0.5	--	1.1

IR28MW127A			
Analyte	PAL	March 2022	Sept 2022
Benzene	0.5	0.55	--

RUC11MW01A			
Analyte	PAL	March 2022	Sept 2022
Benzene	0.5	0.61	0.71
Vinyl Chloride	0.5	5.3	2.2

IR28MW128A			
Analyte	PAL	March 2022	Sept 2022
Benzene	0.5	0.9	4.9
Trichloroethene	2.9	3.9	--

IR28MW934A			
Analyte	PAL	March 2022	Sept 2022
Benzene	0.5	2.5 J	0.7
Hexavalent Chromium	50	67.5	--
Vinyl Chloride	0.5	12 J	40

IR28MW931A			
Analyte	PAL	March 2022	Sept 2022
Benzene	0.5	--	0.54
Vinyl Chloride	0.5	21	19

IR28MW557A			
Analyte	PAL	March 2022	Sept 2022
1,1-Dichloroethane	6.5	8.7 J	7.6
1,2,4-Trimethylbenzene	25	560	590
1,2-Dichloroethene (total)	210	6,000	3,200
1,3,5-Trimethylbenzene	19	170	190
Benzene	0.5	12 J	11
Cis-1,2-Dichloroethene	210	6,000	3,100
Isopropylbenzene	7.8	30 J	31
Naphthalene	3.6	120	110
Trichloroethene	2.9	11 J	5.3
Vinyl Chloride	0.5	4,200	4,700

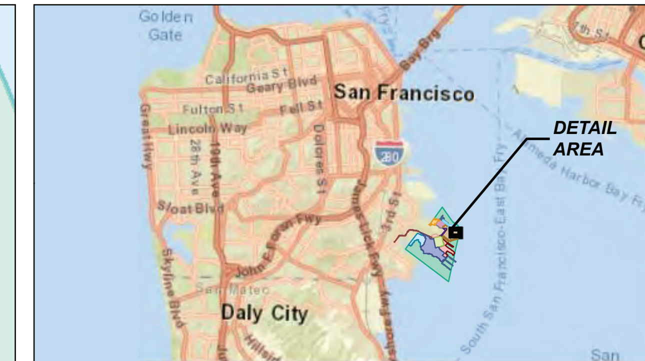
PA28MW50A			
Analyte	PAL	March 2022	Sept 2022
Benzene	0.5	0.84	0.8
Vinyl Chloride	0.5	1.2	1.9

IR28MW338A			
Analyte	PAL	March 2022	Sept 2022
Tetrachloroethene	0.54	16	--
Trichloroethene	2.9	12	--
Vinyl Chloride	0.5	8.8	12

IR28MW354A			
Analyte	PAL	March 2022	Sept 2022
Trichloroethene	2.9	14	10
Vinyl Chloride	0.5	--	1.5

IR28MW475A			
Analyte	PAL	March 2022	Sept 2022
Benzene	0.5	0.57	0.55
Vinyl Chloride	0.5	35	1.1

IR28MW916A			
Analyte	PAL	March 2022	Sept 2022
1,1-Dichloroethane	6.5	15	16
Benzene	0.5	1.4	1.4
Trichloroethene	2.9	7.6	--
Vinyl Chloride	0.5	110	36



LEGEND

- IR26MW51A — Monitoring Well exceeding remediation goals
- IR26MW71A — BGMP Monitoring Well
- IR26MW43A — Other Monitoring Well (Not Sampled)
- Roads

Parcels

- C
- F (Pier)
- Buildings
- F (Water)
- Approximate Area of Groundwater COC Plume That Exceed Remediation Goals
- Approximate Area of Groundwater COC Plume That Exceed ATCs
- Historical Groundwater Plume
- ISB Treatment Area
- Naphthalene Area
- Chromium Area

NOTE:
All units In micrograms per liter - µg/L

BGMP - Basewide Groundwater Monitoring Program
PAL - Project Action Level
RU - Remediation Unit
µg/L - Micrograms per Liter
VOCs - Volatile Organic Compounds

GRAPHIC SCALE
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Source:
TRBW. 2023. *2022 Basewide Annual Groundwater Monitoring Report, Hunters Point Naval Shipyard, San Francisco, California.* June 2023. DRAFT

Figure 4-4
March and September 2022 Exceedances of Remediation Goals in Parcel C Remedial Units C-1
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Hunters Point Naval Shipyard
San Francisco, California

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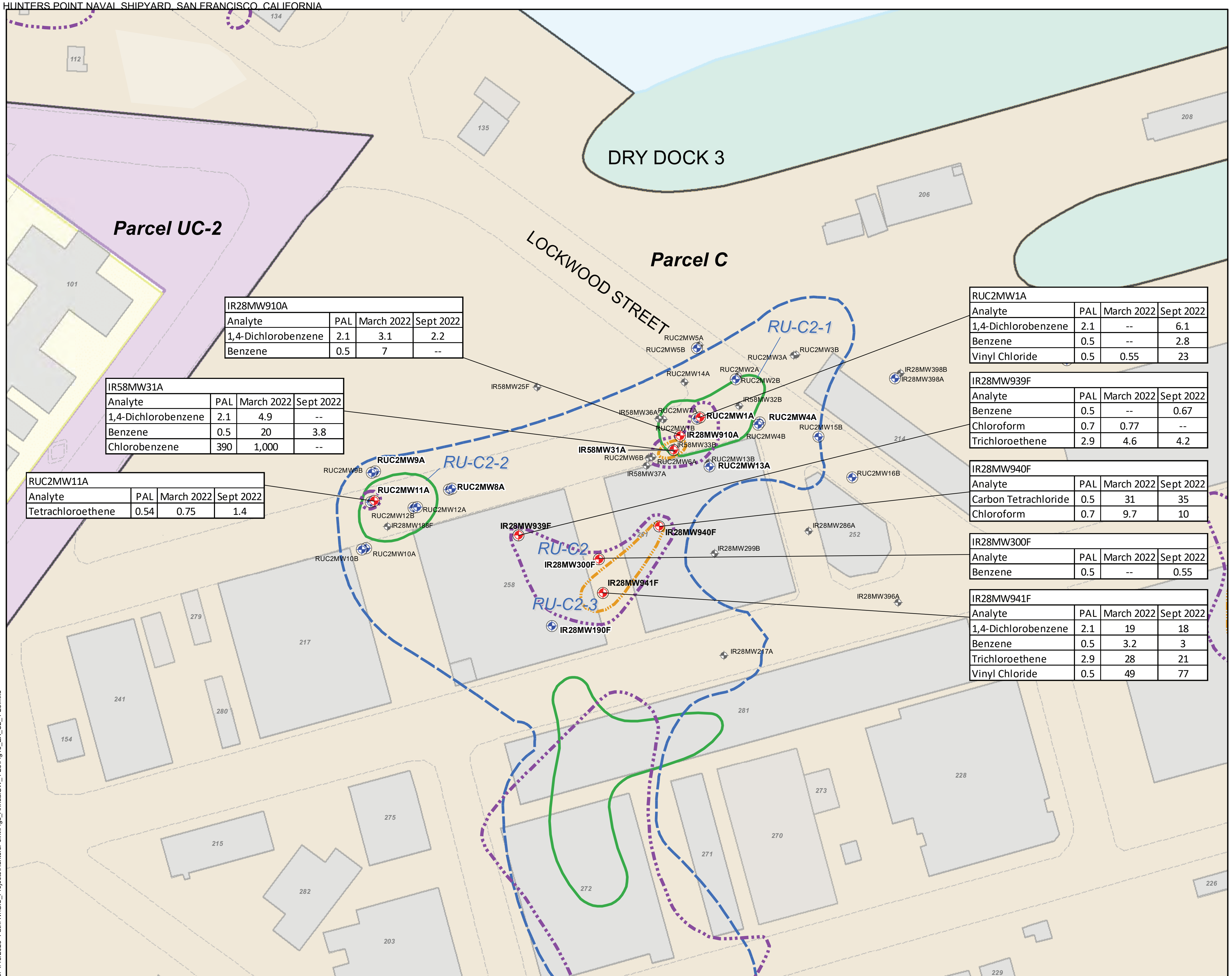

IR28MW910A			
Analyte	PAL	March 2022	Sept 2022
1,4-Dichlorobenzene	2.1	3.1	2.2
Benzene	0.5	7	--

IR58MW31A			
Analyte	PAL	March 2022	Sept 2022
1,4-Dichlorobenzene	2.1	4.9	--
Benzene	0.5	20	3.8
Chlorobenzene	390	1,000	--

RUC2MW11A			
Analyte	PAL	March 2022	Sept 2022
Tetrachloroethene	0.54	0.75	1.4

RUC2MW1A			
Analyte	PAL	March 2022	Sept 2022
1,4-Dichlorobenzene	2.1	--	6.1
Benzene	0.5	--	2.8
Vinyl Chloride	0.5	0.55	23

IR28MW939F			
Analyte	PAL	March 2022	Sept 2022
Benzene	0.5	--	0.67
Chloroform	0.7	0.77	--
Trichloroethene	2.9	4.6	4.2

IR28MW940F			
Analyte	PAL	March 2022	Sept 2022
Carbon Tetrachloride	0.5	31	35
Chloroform	0.7	9.7	10

IR28MW300F			
Analyte	PAL	March 2022	Sept 2022
Benzene	0.5	--	0.55

IR28MW941F			
Analyte	PAL	March 2022	Sept 2022
1,4-Dichlorobenzene	2.1	19	18
Benzene	0.5	3.2	3
Trichloroethene	2.9	28	21
Vinyl Chloride	0.5	49	77

LEGEND

- IR26MW51A Monitoring Well exceeding remediation goals
- IR26MW71A BGMP Monitoring Well
- IR26MW43A Other Monitoring Well (Not Sampled)
- Roads

Parcels

- C
- F (Water)
- UC-2
- Buildings
- Non - Navy Property
- Approximate Area of Groundwater COC Plume That Exceed Remediation Goals
- Approximate Area of Groundwater COC Plume That Exceed ATCs
- Historical Groundwater Plume
- ISB Treatment Area
- Naphthalene Area

NOTE:
All units in micrograms per liter - µg/L
BGMP - Basewide Groundwater Monitoring Program
PAL - Project Action Level
NS – not sampled by BGMP, monitoring well sampled by remedial action contractor
RU - Remedial Unit
µg/L - Micrograms per Liter
VOCs - Volatile Organic Compounds

GRAPHIC SCALE
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Source:
TRBW. 2023. *2022 Basewide Annual Groundwater Monitoring Report, Hunters Point Naval Shipyard, San Francisco, California.* June 2023. DRAFT

Figure 4-5
March and September 2022 Exceedances of Remediation Goals in Parcel C Remedial Unit C-2
Fifth Five-Year Review Report
Hunters Point Naval Shipyard
San Francisco, California

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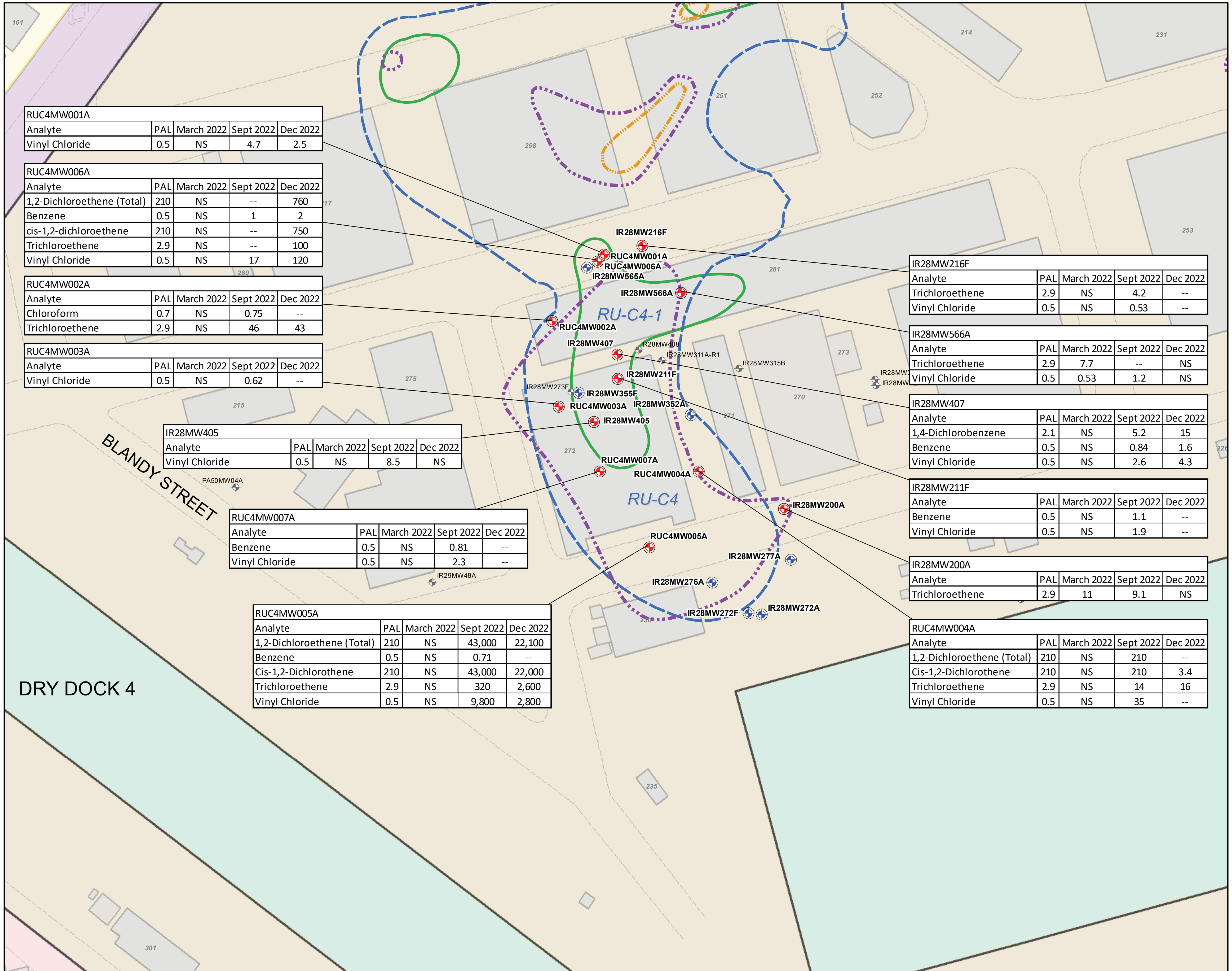

RUC4MW001A				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
Vinyl Chloride	0.5	NS	4.7	2.5

RUC4MW006A				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
1,2-Dichloroethene (Total)	210	NS	--	760
Benzene	0.5	NS	1	2
cis-1,2-dichloroethene	210	NS	--	750
Trichloroethene	2.9	NS	--	100
Vinyl Chloride	0.5	NS	17	120

RUC4MW002A				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
Chloroform	0.7	NS	0.75	--
Trichloroethene	2.9	NS	46	43

RUC4MW003A				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
Vinyl Chloride	0.5	NS	0.62	--

IR28MW405				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
Vinyl Chloride	0.5	NS	8.5	NS

RUC4MW007A				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
Benzene	0.5	NS	0.81	--
Vinyl Chloride	0.5	NS	2.3	--

RUC4MW005A				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
1,2-Dichloroethene (Total)	210	NS	43,000	22,100
Benzene	0.5	NS	0.71	--
Cis-1,2-Dichlorothene	210	NS	43,000	22,000
Trichloroethene	2.9	NS	320	2,600
Vinyl Chloride	0.5	NS	9,800	2,800

IR28MW216F				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
Trichloroethene	2.9	NS	4.2	--
Vinyl Chloride	0.5	NS	0.53	--

IR28MW566A				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
Trichloroethene	2.9	7.7	--	NS
Vinyl Chloride	0.5	0.53	1.2	NS

IR28MW407				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
1,4-Dichlorobenzene	2.1	NS	5.2	15
Benzene	0.5	NS	0.84	1.6
Vinyl Chloride	0.5	NS	2.6	4.3

IR28MW211F				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
Benzene	0.5	NS	1.1	--
Vinyl Chloride	0.5	NS	1.9	--

IR28MW200A				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
Trichloroethene	2.9	11	9.1	NS

RUC4MW004A				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
1,2-Dichloroethene (Total)	210	NS	210	--
Cis-1,2-Dichlorothene	210	NS	210	3.4
Trichloroethene	2.9	NS	14	16
Vinyl Chloride	0.5	NS	35	--

LEGEND

IR26MW51A Monitoring Well exceeding remediation goals

IR26MW71A BGMP Monitoring Well

IR26MW43A Other Monitoring Well (Not Sampled)

Roads

Parcels

C

F (Water)

UC-2

Buildings

Non - Navy Property

Approximate Area of Groundwater COC Plume That Exceed Remediation Goals

Approximate Area of Groundwater COC Plume That Exceed ATCs

Historical Groundwater Plume

ISB Treatment Area

Naphthalene Area

NOTE:
All units in micrograms per liter - µg/L
BGMP - Basewide Groundwater Monitoring Program
PAL - Project Action Level
NS – not sampled by BGMP, monitoring well sampled by remedial action contractor
RU - Remedial Unit
µg/L - Micrograms per Liter
VOCs - Volatile Organic Compounds

GRAPHIC SCALE
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Source:
TRBW. 2023. *2022 Basewide Annual Groundwater Monitoring Report, Hunters Point Naval Shipyard, San Francisco, California.* June 2023. DRAFT

Figure 4-6
March and September 2022 Exceedances of Remediation Goals in Parcel C Remedial Units C-4
Fifth Five-Year Review Report
Hunters Point Naval Shipyard
San Francisco, California

Date: 4/13/2023 Path: N:\GIS_Projects\HuntersPoint\Figs_AnnualGW_4-23\Fig16_EX_C4_4-23.mxd

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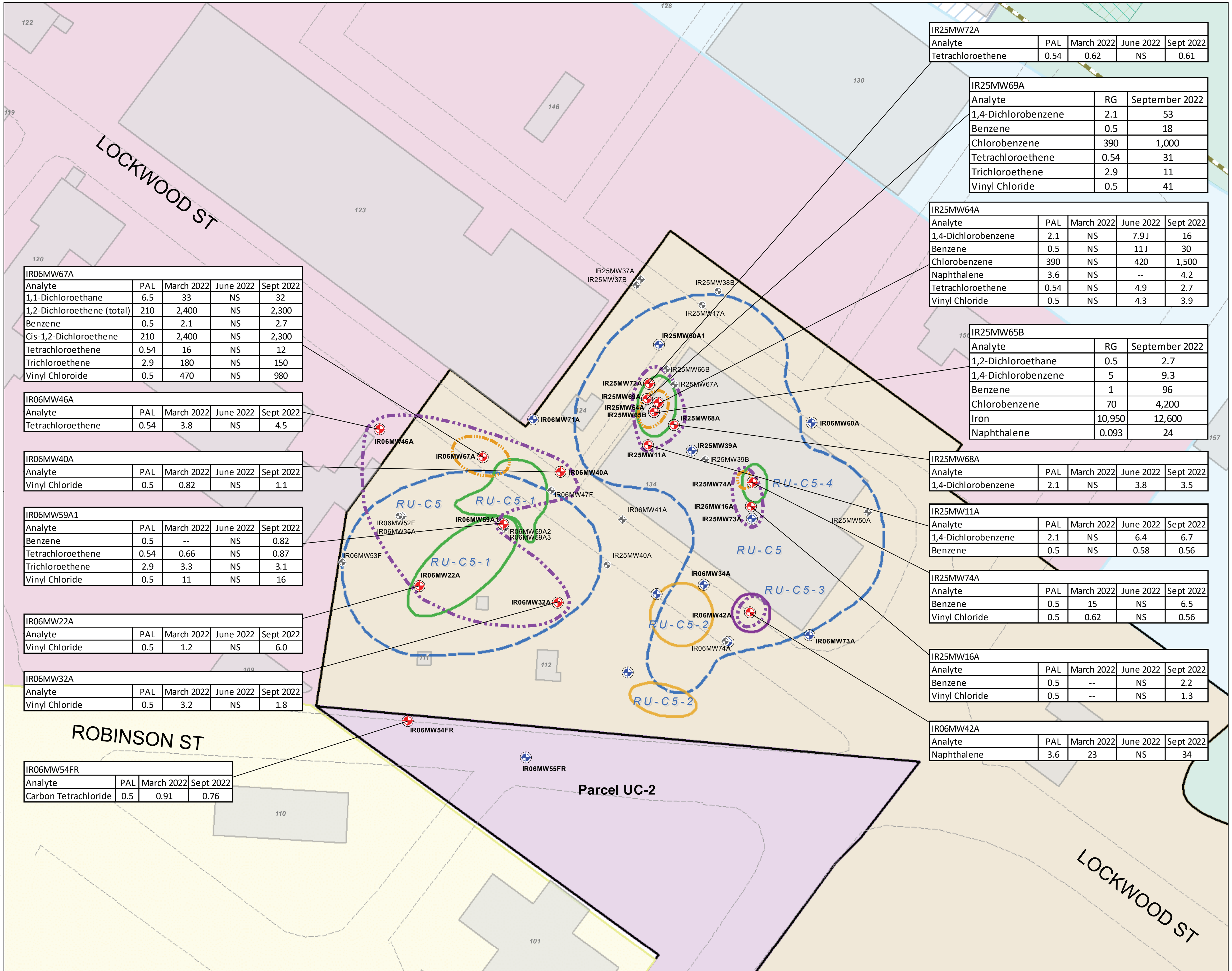

IR25MW72A				
Analyte	PAL	March 2022	June 2022	Sept 2022
Tetrachloroethene	0.54	0.62	NS	0.61

IR25MW69A		
Analyte	RG	September 2022
1,4-Dichlorobenzene	2.1	53
Benzene	0.5	18
Chlorobenzene	390	1,000
Tetrachloroethene	0.54	31
Trichloroethene	2.9	11
Vinyl Chloride	0.5	41

IR25MW64A				
Analyte	PAL	March 2022	June 2022	Sept 2022
1,4-Dichlorobenzene	2.1	NS	7.9 J	16
Benzene	0.5	NS	11 J	30
Chlorobenzene	390	NS	420	1,500
Naphthalene	3.6	NS	--	4.2
Tetrachloroethene	0.54	NS	4.9	2.7
Vinyl Chloride	0.5	NS	4.3	3.9

IR25MW65B		
Analyte	RG	September 2022
1,2-Dichloroethane	0.5	2.7
1,4-Dichlorobenzene	5	9.3
Benzene	1	96
Chlorobenzene	70	4,200
Iron	10,950	12,600
Naphthalene	0.093	24

IR25MW68A				
Analyte	PAL	March 2022	June 2022	Sept 2022
1,4-Dichlorobenzene	2.1	NS	3.8	3.5

IR25MW11A				
Analyte	PAL	March 2022	June 2022	Sept 2022
1,4-Dichlorobenzene	2.1	NS	6.4	6.7
Benzene	0.5	NS	0.58	0.56

IR25MW74A				
Analyte	PAL	March 2022	June 2022	Sept 2022
Benzene	0.5	15	NS	6.5
Vinyl Chloride	0.5	0.62	NS	0.56

IR25MW16A				
Analyte	PAL	March 2022	June 2022	Sept 2022
Benzene	0.5	--	NS	2.2
Vinyl Chloride	0.5	--	NS	1.3

IR06MW42A				
Analyte	PAL	March 2022	June 2022	Sept 2022
Naphthalene	3.6	23	NS	34

IR06MW67A				
Analyte	PAL	March 2022	June 2022	Sept 2022
1,1-Dichloroethane	6.5	33	NS	32
1,2-Dichloroethene (total)	210	2,400	NS	2,300
Benzene	0.5	2.1	NS	2.7
Cis-1,2-Dichloroethene	210	2,400	NS	2,300
Tetrachloroethene	0.54	16	NS	12
Trichloroethene	2.9	180	NS	150
Vinyl Chloroide	0.5	470	NS	980

IR06MW46A				
Analyte	PAL	March 2022	June 2022	Sept 2022
Tetrachloroethene	0.54	3.8	NS	4.5

IR06MW40A				
Analyte	PAL	March 2022	June 2022	Sept 2022
Vinyl Chloride	0.5	0.82	NS	1.1

IR06MW59A1				
Analyte	PAL	March 2022	June 2022	Sept 2022
Benzene	0.5	--	NS	0.82
Tetrachloroethene	0.54	0.66	NS	0.87
Trichloroethene	2.9	3.3	NS	3.1
Vinyl Chloride	0.5	11	NS	16

IR06MW22A				
Analyte	PAL	March 2022	June 2022	Sept 2022
Vinyl Chloride	0.5	1.2	NS	6.0

IR06MW32A				
Analyte	PAL	March 2022	June 2022	Sept 2022
Vinyl Chloride	0.5	3.2	NS	1.8

IR06MW54FR			
Analyte	PAL	March 2022	Sept 2022
Carbon Tetrachloride	0.5	0.91	0.76

LEGEND

- IR26MW51A Monitoring Well exceeding remediation goals
- IR26MW71A BGMP Monitoring Well
- IR26MW43A Other Monitoring Well (Not Sampled)
- Roads
- Parcel B seawall

Parcels

- B-1
- C
- F (Water)
- B-2
- UC-2
- F (Pier)
- Buildings
- Non - Navy Property
- Approximate Area of Groundwater COC Plume That Exceed Remediation Goals
- Approximate Area of Groundwater COC Plume That Exceed ATCs
- Historical Groundwater Plume
- ISB Treatment Area
- Naphthalene Area
- Chromium Area

NOTE:
All units in micrograms per liter - µg/L
BGMP - Basewide Groundwater Monitoring Program
PAL - Project Action Level
RU - Remedial Unit
NS – not sampled by BGMP, monitoring well sampled by remedial action contractor
µg/L - Micrograms per Liter
VOCs - Volatile Organic Compounds

GRAPHIC SCALE
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Source:
TRBW. 2023. *2022 Basewide Annual Groundwater Monitoring Report, Hunters Point Naval Shipyard, San Francisco, California.* June 2023. DRAFT

Figure 4-7
March and September 2022 Exceedances of Remediation Goals in Parcel C Remedial Unit C-5 and Parcel UC-2
Fifth Five-Year Review Report
Hunters Point Naval Shipyard
San Francisco, California

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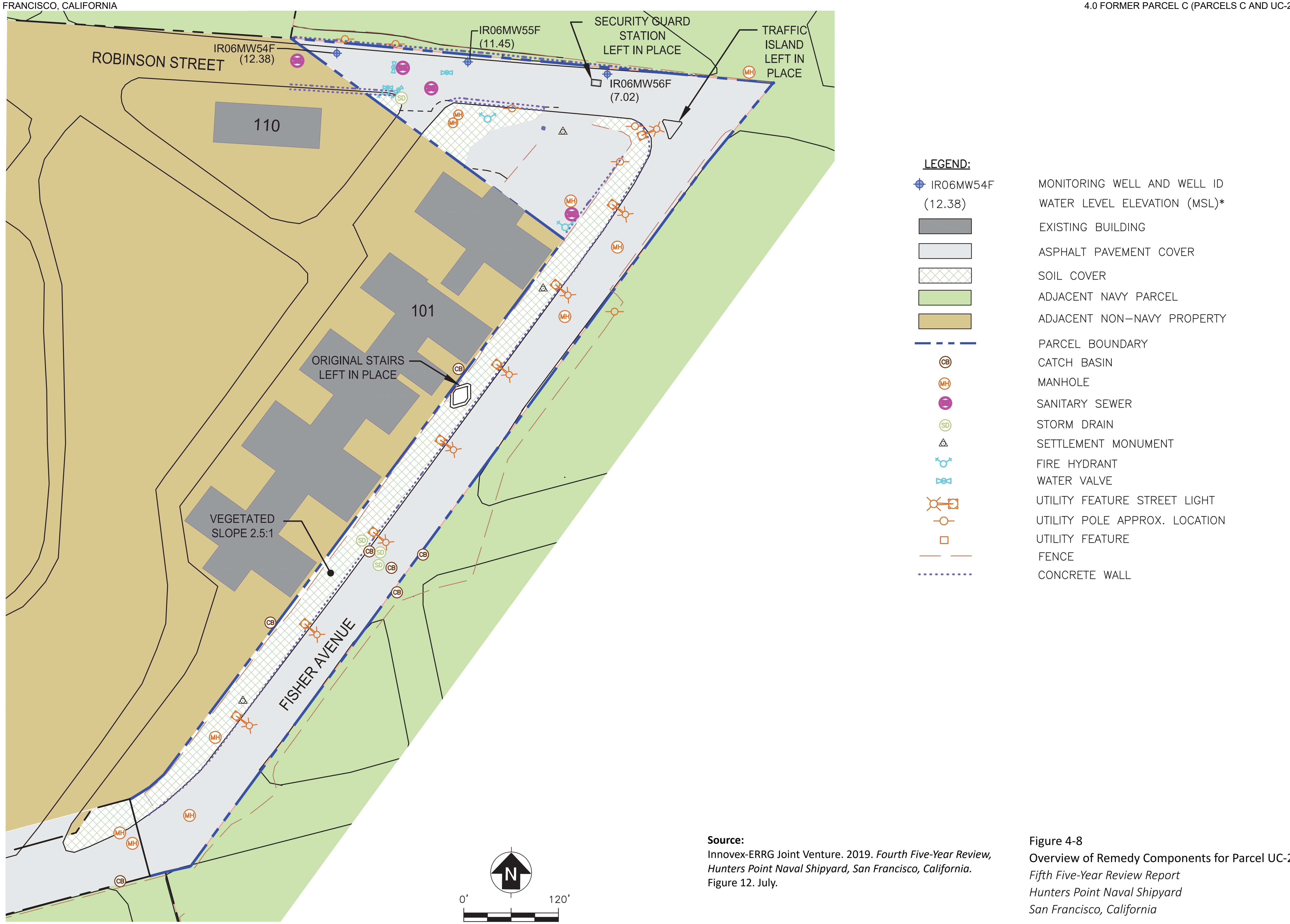

Source:
Innovex-ERRG Joint Venture. 2019. *Fourth Five-Year Review, Hunters Point Naval Shipyard, San Francisco, California.* Figure 12. July.

Figure 4-8
Overview of Remedy Components for Parcel UC-2
Fifth Five-Year Review Report
Hunters Point Naval Shipyard
San Francisco, California

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5.0 Former Parcel D (Parcels D-1, D-2, UC-1, and G)

5.1 Site History and Background

Former Parcel D was formerly part of the industrial support area and was used for shipping, ship repair, and office and commercial activities. Portions of the parcel were used by NRDL (Navy, 2009a).

Former Parcel D is located in the central portion of HPNS and is bordered by Former Parcel C to the northeast, Parcel A to the north/northwest, Parcel E to the west/southwest and the San Francisco Bay to the east. Former Parcel D covered approximately 98 acres which has been subdivided into Parcel D-1 (48.7 acres), Parcel D-2 (5 acres), Parcel UC-1 (3.6 acres), and Parcel G (40 acres) (**Figure 5-1**).

The following IR sites are located in Former Parcel D:

- Parcel D-1: IR-16, IR-17, IR-22, IR-32, IR-35, IR-48, IR-53, IR-55, IR-68, IR-69, and IR-70
- Parcel D-2: none
- Parcel UC-1: none
- Parcel G: IR-09, IR-33, IR-34, IR-37, IR-44, IR-65, IR-66, IR-67, and IR-71

IR-09, the former Pickling and Plate Yard was identified as a source of chromium VI and possibly nickel in groundwater. IR-71 was identified as a solvent plume area. Investigations and actions at Parcel D began in 1988, as shown in the following chronology

Parcel D Chronology

Date	Investigation/Action
1988–1997	RI
1989	PCB-Contaminated Soil Removal at IR-08
1991-1993	UST and Aboveground Storage Tank Removal
1994	SI for Parcels B, C, D, and E
1991-1995	Basewide removal of sandblast waste
1994-1996	Contaminated equipment and residue removal – IR-09
1996	Removal of Cesium-Impacted Soil (Building 364)
1996–1997	Exploratory Excavation Removal Action
1996–1997	Removal of Storm Drain Sediment
1996–1997	FS
2001	TCRA for Non-VOCs in Soil
2001-2002	Radiological TCRA
2002	Groundwater Data Gaps Investigation
2002–2003	Waste Consolidation and Removal Activities
2003–2004	Soil Stockpile Removal Action
2004	HRA

Parcel D Chronology	
Date	**Investigation/Action**
2004-ongoing	Groundwater Monitoring under BGMP
2006–2011	Storm Drain and Sanitary Sewer Removal Actions
2007	Revised FS
2008-2009	Treatability Study for Groundwater at Parcels D-1 and G
2/2009	ROD for Parcel G
7/2009	ROD for Parcels D-1 and UC-1
8/2010	NFA ROD for Parcel D-2
2010-2011	Soil excavation and removal Parcel G
2010-2013	Soil Excavation and Removal at Parcel D-1 Phase I Radiological TCRA for Parcel D-1
2011	RACR for Soil Hotspot Removal at Parcel D and G
2012	Durable Cover Installation Parcel UC-1
2012-2013	Durable Cover Installation Parcel G
2013	Third Five-Year Review for HPNS RACR for Durable Covers and Groundwater Remediation in Parcel UC-1
2014	RACR for Durable Covers in Parcel G
2014-2017	Phase II Radiological TCRA for Parcel D-1
2015	Parcel UC-1 Transferred to OCII
2016-2018	Durable Cover Installation at Parcel D-1
4/2017	ESD to the Final ROD for Parcel G
2018	RACR for Durable Cover in Phase I area of Parcel D-1
2019	Fourth Five-Year Review for HPNS
2022-ongoing	Radiological Retesting in Parcel G
2023	Focused FS Parcel D-1

5.2 Site Characterization

This section summarizes the findings from various investigations at Former Parcel D that are pertinent to the Five-Year Review.

5.2.1 Physical Characteristics

5.2.1.1 Surface Features

Former Parcel D is located in the lowlands portion of HPNS and ground surface elevations range between 0 and 10 feet above msl. The majority (approximately 85 percent) of the surface is covered with pavement and former industrial buildings. Surface water runoff was historically collected in the storm drain system and discharged to the bay through outfalls; however, the storm drains and sewer lines were removed during radiological investigations and stormwater is redirected to San Francisco Bay via surface drainage swales.

5.2.1.2 Geology and Hydrogeology

The majority of the parcel consists of lowlands that were filled by placing borrowed fill material from various sources, including crushed serpentinite bedrock from the adjacent highland, construction debris, and waste materials (such as used sandblast materials). The serpentinite bedrock and serpentine bedrock-derived fill material consist of minerals that naturally contain asbestos and relatively high concentrations of arsenic, manganese, nickel, and other ubiquitous metals.

The following is a summary of hydrostratigraphic units at Former Parcel D (SulTech, 2007):

- **A-Aquifer**: The A-aquifer is present throughout Former Parcel D. Groundwater flow is complex because it is affected by a groundwater sink located near the former boundary of Parcel D (currently in Parcel E), a groundwater mound in Parcel E, leaks of groundwater into former sanitary sewers, recharge from water supply lines, and tides in the bay. Most groundwater flows toward the bay except in the western portion of Parcel D which flows away from the mound and toward the sink in Parcel E. The A-aquifer averages between 10 and 40 feet thick with an average thickness of 25 feet over most of Former Parcel D. Tidal fluctuations were observed from 150 to 500 feet inland from the bay.
- **Bay Mud**: The Bay Mud is absent in the northern part of Former Parcel D (Parcels D-2, UC-1, and G) where the A-aquifer is in direct communication with the bedrock aquifer. It is thickest in the southeastern part of the parcel (Parcel D-1).
- **B-Aquifer**: The B-aquifer consists of small laterally discontinuous permeable sediment lenses of gravel, sand, silty sand, or clayey sand intermingled with aquitard. The largest B-aquifer area is present near the center of the parcel (Parcel G) and is approximately 1,500 feet wide, 1,000 feet long and 20 to 30 feet thick. It is not present in Parcel D-2 and UC-1.

As discussed in **Section 1.3.4.3**, the entire A-aquifer meets the Resolution 88-63 exception criteria. Although it does not meet the Resolution 88-63 exception criteria, the B-aquifer has a low potential for drinking water use.

5.2.2 Land Use

5.2.2.1 Current Land Use

Parcels D-1 and G are currently owned by the federal government under the jurisdiction of the Navy. There are no tenants at Parcels D-1 and G.

Parcels D-2 and UC-1 were transferred out of federal ownership to the OCII in late 2015. Redevelopment activities were temporarily suspended pending completion of the corrective actions related to the radiological remediation. In the interim, access restrictions are in place to limit exposure of property users to hazardous substances.

5.2.2.2 Future Land Use

According to the Redevelopment Plan (SFRA, 2010), Parcel D-1 is zoned for maritime-industrial and industrial use, and Parcel G is zoned for open space, education and cultural use, industrial, and mixed use (including potential residential use). Parcels D-2 and UC-1 are expected to be zoned for research and development (potential for residential use).

5.2.3 Basis for Taking Action

This section describes the results of site investigations and risk assessments that provide the basis for taking action at Parcel D. Details are provided in the RI (PRC et al., 1996), FS (SulTech, 2007), Parcels D-1 and UC-1 ROD (Navy, 2009a), Parcel G ROD (Navy, 2009b) and Parcel D-2 ROD (Navy, 2010).

5.2.3.1 Site Investigations and Pre-ROD Removal Actions

Previous investigations at Former Parcel D identified metals and PAHs in soil (Parcels D-1, UC-1, and G), metals and VOCs in groundwater (Parcels D-1 and G), and radiologically impacted structures and soil (Parcels D-1, D-2, UC-1, and G).

Several removal actions have occurred throughout Former Parcel D including underground storage tank removals, sandblast grit removal, storm drain sediment removal, and a TCRA to remove contaminated soil from IR-09, IR-37, and IR-65 within Parcel G. Contamination in soil and groundwater remained after these removal actions (Navy, 2009a, 2009b).

A groundwater treatability study was conducted prior to the RODs using ZVI to address VOCs in two plumes (identified as IR-71 West and IR-71 East) originating in Parcel G and extending into Parcel D-1. Approximately 136,000 pounds of ZVI was injected into 88 groundwater injection points in the IR-71 West plume between October and December 2008. A post-injection groundwater and soil vapor assessment was conducted between December 2008 and April 2009 to verify the effectiveness of the ZVI treatment. The treatability study concluded the IR-71 West plume required treatment with ZVI to address chloroform in groundwater and the IR-71 East plume did not require treatment to address VOCs in groundwater (Alliance, 2010).

5.2.3.2 Human Health Risk

A quantitative HHRA was completed for Parcel D as part of the RI (PRC et al., 1996), updated in the 2002 draft revised FS for Parcel D, and updated again in the 2007 Revised FS (SulTech, 2007) to account for the soil data collected during the 2004 TCRA, and to incorporate changes in regulatory guidance and toxicological criteria that occurred since the previous HHRAs. Human health risks were characterized separately for COCs and ROCs. The following unacceptable human health risks from nonradiological chemicals were identified in the ROD for Parcels D-1, UC-1 and/or G (**Table 5-1**):

- Future industrial users from exposure to metals in surface soil (0 to 2 feet bgs) and subsurface soil (0 to 10 feet bgs), and VOCs in groundwater (in A-aquifer beneath Parcels D-1 and G through the vapor intrusion to indoor air pathway).
- Future recreational users from exposure to metals and PAHs in surface soil (0 to 2 feet bgs).
- Future residents (adult and child) from exposure to metals and PAHs in surface soil (0 to 2 feet bgs) and subsurface soil (0 to 10 feet bgs) and VOCs in groundwater (A-aquifer beneath Parcels D-1 and G through the vapor intrusion to indoor air pathway and B-aquifer through domestic use).
- Future construction workers from exposure to metals and PAHs in subsurface soil (0 to 10 feet bgs) and VOCs and metals in A-aquifer groundwater via inhalation and through direct exposure in trenches.

There were no potential unacceptable human health risks associated with nonradiological chemicals for Parcel D-2 and no RA is required for nonradiological chemicals.

Additionally, ROCs within impacted buildings, storm drains, sanitary sewers, and associated soil were identified at Parcels D-1, D-2, UC-1, and G (**Table 5-2**) (TtEC, 2008).

5.2.3.3 Ecological Risk

The Navy concluded that limited viable habitat is available for terrestrial wildlife at Former Parcel D because most of the site is covered with pavement and most of the terrestrial component of the shoreline at Parcel D is paved (PRC et al., 1996). The tidal area associated with the shoreline is associated with Parcel F. Therefore, ecological risk associated with exposure to soil was not evaluated further.

The Navy completed a screening evaluation of surface water quality to assess potential exposure by aquatic wildlife to groundwater as it interacts with the surface water of San Francisco Bay. Results of the screening evaluation indicated two metals (chromium VI and nickel) in groundwater may pose a potential risk to aquatic wildlife. However, groundwater monitoring data indicate metals migrate at a much slower rate than groundwater flows; thus, discharge of metals to the bay is not imminent. COECs and TLs are presented in **Table 5-1**.

No COECs were identified in the B-aquifer.

5.3 Remedial Action Objectives

The ROD for Parcels D-1 and UC-1 was signed on July 24, 2009 (Navy, 2009b). **Table 5-3** summarizes the basis for action, RAOs, remedy components, performance metrics, and expected outcomes for Parcels D-1 and UC-1.

The ROD for Parcel G was signed on February 18, 2009 (Navy, 2009a) and the ESD was signed on April 19, 2017 (Navy, 2017). **Table 5-4** summarizes the basis for action, RAOs, remedy components, performance metrics, and expected outcomes for Parcel G. The presence of VOCs in groundwater and soil may contribute to the presence of VOC in soil gas, therefore the vapor intrusion pathway is included as a basis for action and development of RAOs.

The Navy developed RGs to meet the RAOs for soil, sediment, and RGs and TLs for groundwater which are summarized for COCs (or COECs) in **Table 5-1** and for ROCs in **Table 5-2.** The TLs are conservative, and exceedance of a TL does not necessarily indicate an immediate risk, given dilution and mixing with surface water; nonetheless a potential for ecological risk was identified if the metals in groundwater discharge undiluted to the bay.

The No Further Action ROD for Parcel D-2 was signed on August 9, 2010 (Navy, 2010).

5.4 Remedial Actions

5.4.1 Parcel D-1

The RA for Parcel D-1 includes the following major components:

- Soil excavation and removal to address COCs in soil
- Durable cover installation and maintenance to address COCs in soil
- In situ treatment for VOCs and metals in groundwater
- LTM of groundwater for COCs
- Radiological surveys and remediation through removal of all radiologically impacted soil and structures

- ICs for soil and groundwater

Remedy components are shown on **Figures 5-1** and **5-2**.

5.4.1.1 Remedy Implementation

Soil Excavation and Removal

Excavation and removal of soil containing COCs above RGs was conducted from 2010 to 2011 and in a second phase in 2013. In total, approximately 237 loose cubic yards of soil was excavated from six hotspot areas in Parcel D-1 to address PAH contamination in soil. Four of the hotspot areas were removed during the first phase of the RA conducted between August 2010 and May 2011. The two remaining hotspot areas were removed during the second phase of the RA conducted between May 2013 and July 2013, when the radiological screening yard was inactive. All excavated soil was disposed of offsite and the excavations were backfilled with clean imported soil (ERRG, 2011 and 2014). One soil stockpile, totaling 75 cubic yards, identified in the RD was also removed and disposed of offsite. Completion of construction activities is documented in the *RACR for Soil Hotspot Locations at Parcels B, D-1, and G* (ERRG, 2011).

Durable Cover Installation

Durable covers consist of seawall stabilization, asphalt concrete durable covers, and building foundations. Durable covers were installed in two phases at Parcel D-1. Phase I was conducted from May 2016 to February 2017 (APTIM, 2018, **Figure 5-3**) and Phase II was conducted from August to November 2018 (APTIM, 2021). Completion of the durable covers along with ICs discussed in **Section 1.3.4.2** meets the RAOs for soil at Parcel D-1. Response complete for the Phase I area soil is documented in the RACR for Parcel D-1, Phase I (APTIM, 2018). The RACR for Phase II is pending completion of a Focused FS to address radioactive objects that were identified during construction of the cover (discussed in **Radiological Surveys and Remediation** below).

- **Seawall Stabilization**. Repairs to the subgrade were made behind the Parcel D-1 seawalls along portions of the piers to provide a stable vertical surface for attaching the durable cover. Where necessary, granular fill or, where greater than 18 inches was needed, gabion baskets were used to restore the area behind the seawall to meet surrounding grade. A layer of geotextile was emplaced to minimize fine soil from entering the bay and prevent soil from “piping” through the riprap, and riprap was placed over the fabric. Along Berth 15 of the Gun Mole Pier, an approximately 40-foot long segment of seawall was heavily corroded and gabion baskets were installed along the interior sheet pile wall rather than the outer seawall. The durable cover was installed to the edge of the gabion basket and a fence and entry gate were installed surrounding the area to prevent access.

- **Asphalt Cover**. New asphalt cover was installed over portions of the site that did not have an existing asphalt cover. Low-lying areas were filled with clean fill and a minimum 4-inch thick layer of recycled aggregate base course was emplaced with a minimum 2-inches of asphaltic concrete wear surface. Areas with existing asphalt cover were repaired either by removing and replacing the cover or by repairing where cracks were between ¼ to ¾ inches wide by hot-pouring crack sealant.

- **Building foundation repairs**. Eleven buildings are located within Parcel D-1: Buildings 274, 306, 307, 308, 368, 369 381, 523, 525, 526, and 530. Where needed, building foundation repairs were completed by using a variety of materials such as concrete, non-shrink grout, and asphaltic concrete, to prevent access to underlying soil. Building foundations that could not be restored or repaired (for example, historical buildings) were secured using a combination of steel plates, framed plywood walls, wire mesh, and/or chain-link fence to prevent access. Access to soil under buildings through crawlspaces and vaults was blocked with durable wire mesh or secured with steel ties. A transformer was found inside of Building 369 and testing indicated that the oil did not contain PCBs so it was recycled (APTIM, 2018). Asbestos tile was identified in Buildings 526 and 530, which was removed and disposed of by a California-licensed asbestos abatement contractor (APTIM, 2021).

In Situ Groundwater Remediation

The active treatment portion of the IR-71 plume was conducted within Parcel G and is discussed in **Section 5.4.4**. There were no active groundwater treatment activities conducted within the boundary of Parcel D-1.

Groundwater Monitoring

Groundwater monitoring is conducted under the BGMP to evaluate COCs concentration trends. VOC analysis was discontinued in 2012 since concentrations were below the RG and were stable and declining (Navy, 2012). Annual and semiannual groundwater monitoring reports from 2019 through 2022 were reviewed (TRBW, 2020a, 2020b, 2021, 2022a, 2022b, 2023). Three monitoring wells are currently sampled semiannually for metals. There were no exceedances of the TLs during any of the sampling events (**Appendix E**). Concentrations of metals have remained under RGs and TLs since 2004 with the exception of silver in July 2008 and lead in September 2015 in 1 monitoring well.

The Parcel D-1 RAMP (ChaduxTt, 2011a) states that groundwater samples will be collected semiannually until at least two years after property redevelopment to ensure redevelopment activities do not mobilize metals that could migrate into the bay.

Radiological Surveys and Remediation

The TCRA for radiologically impacted soil and structures at Parcel D-1 was completed in two phases. Phase I addressed the northern portion of Parcel D-1 and was initiated in 2009 and completed in 2013 (Shaw, 2014). The second phase was initiated in 2013 and completed in 2017. During Phase II excavation work, low-level radiological objects (ROs) were discovered in areas that were not considered radiologically impacted. The Navy determined that these objects were within the fill soil used to expand the shipyard after 1946. Based on the post-removal sampling completed during both phases, all radiologically impacted soil and structures identified in the HRA were removed. Additionally, there is a high degree of confidence that discrete ROs were removed to a depth of 2 feet bgs. However, there is a potential for ROs to be present in material below 2 feet bgs where shoreline expansion has occurred since 1946 (Gilbane, 2019).

The ROD anticipated that the TCRA for radiologically impacted structures would result in unrestricted radiological release of Parcel D-1. However, due to the potential for radiological items to be present in fill, unrestricted radiological release could not be achieved for Parcel D-1. Land use and activity restrictions are currently in place to prohibit land-disturbing activities throughout Parcel D-1 until the LUC RD is amended to mitigate risk to human health relating to the potential presence of ROs in material below 2 feet. The Focused FS to evaluate additional remedies to address radiologically impacted soil at was finalized in 2023 (Innovex-ERRG Joint Venture, 2023) and the Proposed Plan and Amended ROD is pending.

Institutional Controls

The entire area of Parcel D-1 (48.7 acres) is subject to soil and groundwater ICs. A portion of Parcel D-1 is also subject to ICs for VOCs; however, the extent is currently under evaluation as discussed in the following paragraph. IC performance objectives were developed and presented in the ROD (Navy, 2009b) and LUC RD (ChaduxTt, 2011b). The IC performance objectives to be implemented through land use restrictions for the site are summarized in **Table 1-2**.

Vapor intrusion ARICs are based on a soil gas survey completed in 2010 (Sealaska Environmental Services, 2013). As requested by USEPA, the Fourth Five-Year Review evaluated the SGALs and ARICs boundary for VOCs in soil gas based on a grid overlay and risk screening estimates/ grid block. One block was identified for additional investigation due to the noncancer hazard index exceeding 1.0. Current and future exposures are being controlled under Navy ownership, however, this additional block may warrant further evaluation prior to Navy transfer of this parcel (APTIM, 2021).

5.4.1.2 Remedy Operations and Maintenance

Ongoing O&M at Parcel D-1 includes maintaining the integrity of the durable covers and IC inspections. The inspection and maintenance requirements for the durable covers are described in the Final O&M Plan for Parcel D-1 (APTIM, 2018, 2019). AOMSRs are prepared to summarize inspections and maintenance performed and to document the effectiveness of the remedy components. AOMSRs from 2019, 2020, 2021, and 2022 were reviewed (Innovex-ERRG Joint Venture, 2020, 2021; APTIM, 2022, 2023).

Durable Cover Maintenance

The shoreline armoring was found to be in good condition with the exception of the north side of Gun Mole Pier during the 2021 inspection, which showed signs of rock movement, but the integrity of the riprap was not compromised and was still functioning,

Overall, the durable covers were in good repair with the exception of several cracks and sinkholes on Gun Mole Pier. A large sinkhole that could not be repaired was identified during the 2020 inspection. Twelve sinkholes were identified in 2021, nine of which were repaired, and three were deemed no longer repairable and the area was permanently fenced off to prevent access (APTIM, 2022).

Institutional Controls Compliance

ICs are inspected annually and no deficiencies or inconsistent uses were observed during the reviews. General site conditions were determined to be good. Remedy components such as survey benchmarks and monitoring well vault covers were found to be in good condition.

Navy controls access to the parcel using security fencing, signage, locks, and gates which were found to be in good condition, with no signs of damage or vandalism.

5.4.2 Parcel UC-1

The RA for Parcel UC-1 includes the following major components:

- Durable cover installation and maintenance to address COCs in soil
- Radiological surveys and remediation through soil excavation and removal of sanitary sewer and storm drain lines
- ICs for soil

Remedy components are shown on **Figures 5-1, 5-2,** and **5-4**.

5.4.2.1 Remedy Implementation

Durable Covers

Durable covers were constructed between May 14, 2012 and September 18, 2012. Completion of the durable covers along with ICs as discussed in **Section 1.3.4.2** meets the RAOs for soil in Parcel UC-1; response complete is documented in the RACR for Parcels UC-1 and UC-2 (ERRG, 2013). The RA included installation and repair of durable covers, including soil covers, asphalt covers, and building foundations, to minimize exposure of humans and wildlife to potential COCs in underlying soil. The following is a description of each cover type:

- **Soil Cover**. A 2-foot thick soil cover comprised of clean imported fill was installed over previously vegetated areas by removing two feet of existing soil so that the surface of the newly installed cover matched historical site grades. Live beach strawberry, California poppy, and summer lupine plants were then hand-planted across the entire soil cover to provide future slope stability and aesthetic appeal.
- **Asphalt Covers**. An 8-inch asphalt cover, comprising 4 inches (minimum) of AC and 4 inches (minimum) of aggregate base, was installed. Existing asphalt covers that were in good condition were left in place and incorporated into the final asphalt pavement cover. Degraded existing asphalt covers were repaired by removing and replacing one or more of the following: asphalt concrete cover, aggregate base, or subbase material, depending the level of degradation. Asphalt concrete covers with minor cracking were repaired by applying an asphalt seal to fill the cracks.
- **Restored Building Foundations**. Concrete building foundations and sidewalks were restored and incorporated into the durable cover and cracks and penetrations were filled with non-shrink grout.

Radiological Surveys and Remediation

ROPCs at Parcel UC-1 include Cs-137, Co-60, Pu--239, Ra-226, Sr-90, Th-232, tritium (hydrogen-3), and uranium-235 (U-235) (Navy, 2009a). The Navy conducted TCRAs at Parcel UC-1 to address potential radioactive contamination in storm drains and sanitary sewer lines at Parcels UC-1 and UC-2 (ChaduxTt, 2010a; TtEC, 2011). In total, approximately 20,680 cubic yards of soil were excavated during removal of approximately 6,407 linear feet of sanitary sewer and storm drain lines. Approximately 1,138 cubic yards of soil was disposed of offsite as LLRW based on surface scan and analytical laboratory results. Additionally, FSSs were performed at two radiologically impacted buildings (819 and 823) [TtEC, 2011].

The TCRA data was reviewed as described in **Section 1.4.3** and radiological retesting, including sampling and surveys of soils previously investigated during sanitary sewer line storm drain removal and resurvey of impacted buildings and former building sites, is in progress to determine if current site conditions are compliant with the RAOs.

Institutional Controls

The entire area of Parcel UC-1 is subject to soil ICs. The majority of Parcel UC-1 is also subjected to ARICs for VOCs. The IC performance objectives were developed and presented in the ROD (Navy, 2009b) and LUC RD (ChaduxTt, 2010b) and are summarized in **Table 1-2**. The ICs are currently being enforced through a Covenant to Restrict Use of Property recorded on September 16, 2015 (Navy, 2015).

5.4.2.2 Remedy Operations and Maintenance

Ongoing O&M at Parcel UC-1 is the responsibility of the OCII's contractor in accordance with the approved RMP (Geosyntec, 2019) and O&M plan (Navy, 2013). Annual reports from the OCII contractor summarizing durable cover O&M and IC inspections were reviewed (Geosyntec-Albion Joint Association, 2020, 2021, 2022).

Durable Cover Maintenance

Minor settling was observed during the 2021 inspection and evidence of burrowing pests within the soil cover were observed during the 2020 and 2021 inspections. Repairs were conducted in October 2020, December 2021, and January 2022. Vegetation in the soil cover is in good condition. In general, the durable cover was found in good condition with minor crack and pothole repairs completed during O&M.

Land Use Controls Compliance

No deficiencies or inconsistent uses were observed during the review period.

5.4.3 Parcel D-2

An NFA ROD was signed for Parcel D-2 in 2010 after the TCRA remediated all radiological concerns at Parcel D-2 (Navy, 2010). The pre-TCRA ROPCs at Parcel D-2 included Cs-137, Ra-226, Sr-90 (Navy, 2010). The Navy conducted TCRAs from 2004 to 2010 at Parcel D-2 to address potential radioactive contamination in storm drains and sanitary sewer lines and radiologically impacted structures. In total, 1,988 linear feet of trench and 1,434 cubic yards of soil were excavated; approximately 45 cubic yards of soil was disposed of offsite as LLRW based on surface scan and analytical laboratory results (TtEC, 2011a). Additionally, a FSS was performed at one radiologically impacted building (Building 813) (TtEC, 2011a).

The TCRA data was reviewed as described in **Section 1.4.3** and radiological retesting, including sampling and surveys of soils previously investigated during sanitary sewer line storm drain removal and resurvey of impacted buildings and former building sites, is in progress to determine if current site conditions are acceptable for UU/UE.

5.4.4 Parcel G

The RA for Parcel G includes the following major components:

- Soil excavation and removal to address COCs in soil
- Durable cover installation and maintenance to address COCs in soil
- In situ treatment to address COCs in groundwater
- Groundwater monitoring including MNA and LTM to address VOCs and metals in groundwater
- Radiological surveys and remediation through soil excavation and removal of sanitary sewer and storm drain lines
- ICs for soil and groundwater

Remedy components are shown on **Figures 5-1, 5-2,** and **5-5**.

5.4.4.1 Remedy Implementation

Soil Excavation and Removal

In total, approximately 66 loose cubic yards of soil was excavated from two hotspot areas in Parcel G to address PAH and lead contamination in soil between August 2010 and May 2011. All excavated soil was disposed of offsite and the excavations were backfilled with clean imported soil. Two soil stockpile, totaling 20 cubic yards, identified in the RD were also removed and disposed of offsite. Completion of construction activities is documented in the *RACR for Soil Hotspot Locations at Parcels B, D-1, and G* (ERRG, 2011).

Durable Cover Installation

Durable covers at Parcel G consist of asphalt concrete durable covers and building foundations. Work was initiated in June 2012 and was completed in October 2013. Completion of the durable covers along with ICs discussed in **Section 1.3.4.2** meets the RAOs for soil at Parcel G; response complete for soil is documented in the RACR for Parcel G (Arcadis, 2014a).

- **Asphalt Durable Cover**. Existing asphalt concrete in functional and reparable condition were sealed with asphalt crack seal or, in areas with larger cracks, application of additional layers of asphalt concrete over the existing surface. Portions of Parcel G where asphalt pavement was not exposed at the ground surface received new pavement construction. New construction included the reuse of the aggregate base material present at the site and import of new aggregate base material. New pavement was constructed on approximately 66 percent of the exterior ground surface area or about 44 percent of the total parcel area. The overall thickness of the aggregate base was a minimum of 4 inches with a minimum of 2 inches of asphalt concrete wear surface. Pavement restoration and subgrade preparation were conducted in a manner that improves site drainage and directs runoff to the existing swales that run through Parcel G as specified in the Grading, Drainage, and Paving Plan (Arcadis, 2012). This improvement was achieved by establishing proper pavement grades and slopes that allow for positive drainage away from buildings and into the four swales on Parcel G, which run north to south, and limits upland accumulation of stormwater.
- **Building foundation repairs**. Twelve buildings are located within Parcel G: Buildings 302, 324, 351, 363, 366, 401, 402, 404, 407, 411, 415, and 439. Where needed, building foundation repairs were completed by using a variety of materials such as concrete, non-shrink grout, and asphaltic concrete, to prevent access to underlying soil. Building foundations that could not be restored or repaired were secured using a combination of steel plates, framed plywood walls, wire mesh, and/or chain-link fence to prevent access. Access to soil under buildings through crawlspaces and vaults was blocked with durable wire mesh or secured with steel ties.

The site was secured with temporary K-rail barriers and signs to prevent access.

In Situ Groundwater Treatment

The Navy conducted a treatability study using ZVI at Parcel G in 2008 to evaluate technologies to address VOCs and metals in groundwater beneath IR-09 (North) and IR-71 (Alliance, 2010). Three additional plumes were originally identified for treatment (within IR-33, IR-71 East, and IR-09 South) but treatment was not required based on a soil gas investigation that indicated soil gas levels were acceptable. After the treatability study, concentrations of COCs in groundwater within the treatability study area dropped below the RGs established in the ROD except for groundwater at one well (IR09MW07A) in the deeper portion of the upper A-aquifer. The Navy decided, with the concurrence from the BCT, not to continue to treat the deeper portions of the A-aquifer. The risk related to VOCs in groundwater was based on migration to indoor air from the shallow groundwater, and the study concluded that the associated risk to commercial/industrial workers was less than the target risk threshold and that RAOs are being met. Response complete for groundwater treatment is documented in the RACR for Parcel G (Arcadis, 2014a).

Groundwater Monitoring

Groundwater monitoring is conducted under the BGMP to evaluate COCs concentration trends. Chromium VI sampling was discontinued in 2012 because concentrations were below the TL and were stable or decreasing (Navy, 2012). Annual and semiannual groundwater monitoring reports from 2019 through 2022 were reviewed (TRBW, 2020a, 2020b, 2021, 2022a, 2022b, 2023). Exceedances of the RGs (identified as PALs) from 2019, 2020, 2021, and 2022 are presented in **Appendix E**.

Two monitoring wells are sampled semiannually for VOCs under the BGMP; however, One monitoring well (IR71MW03A) was inaccessible because of the ongoing radiological rework during the 2021 and 2022 events. Chloroform and carbon tetrachloride exceeded the RG in 2022, and PCE has historically exceeded the RG in groundwater from IR71MW03A during one or more sampling events during this Five-Year Review period.

Radiological Surveys and Remediation

The ROPCs at Parcel G include Cs-137, Co-60, Pu-239, Ra-226, Sr-90, Th-232, tritium, and U-235 (Navy, 2009a). The Navy conducted a TCRA at Parcel G to address potential radioactive contamination in storm drains and sanitary sewer lines and radiologically impacted structures. In total, 50,688 cubic yards of soil were excavated during removal of 23,166 linear feet of sanitary sewer and storm drain lines. Approximately 6,228 cubic yards of soil was disposed of offsite as LLRW based on surface scan and analytical laboratory results. Additionally, FSSs were performed at seven radiologically impacted buildings (351, 351A, 366, 401, 408, 411, 439) and one former site (317/364/365) [TtEC, 2011b].

The TCRA data was reviewed as described in **Section 1.4.3** and radiological retesting, including sampling and surveys of soils previously investigated during sanitary sewer line storm drain removal and resurvey of impacted buildings and former building sites, is currently being conducted to determine if current site conditions are compliant with the RAOs.

Institutional Controls

The entire area of Parcel G (49 acres) is subject to soil and groundwater ICs. A portion of Parcel G is also subject to ICs for VOCs (**Figure 5-2**). IC performance objectives were developed and presented in the ROD (Navy, 2009b) and LUC RD (ChaduxTt, 2011b) and were updated in the ESD to remove residential restrictions throughout the majority of the site (Navy, 2017). The IC performance objectives to be implemented through land use restrictions for the site are summarized in **Table 1-2**.

5.4.4.2 Remedy Operations and Maintenance

Ongoing O&M at Parcel G includes maintaining the integrity of the durable covers and IC inspections. The inspection and maintenance requirements for the durable covers are described in the Final O&M Plan for Parcel G (Arcadis, 2014b). AOMSRs are prepared to summarize inspections and maintenance performed and to document the effectiveness of the remedy components. AOMSRs from 2019, 2020, 2021, and 2022 were reviewed (Innovex-ERRG Joint Venture, 2020, 2021; APTIM, 2022, 2023).

Durable Cover Maintenance

In general, the durable covers were in good condition with some minor subsidence around Building 351 that was repaired in 2019. Beginning in 2020, radiological retesting was being conducted which limited site access to perform durable cover inspections; however, the areas that could be inspected were in generally good condition with areas that could easily be repaired. Swales and check dams were in good condition.

Institutional Controls Compliance

ICs are inspected annually and no deficiencies or inconsistent uses were observed during the reviews. General site conditions were determined to be good. Remedy components such as survey benchmarks and monitoring well vault covers were found to be in good condition.

Navy controls access to the parcel using security fencing, signage, locks, and gates which were found to be in good condition, with no signs of damage or vandalism.

5.4.5 Progress Since the Fourth Five-Year Review

Issues, recommendations, and follow-up actions from the Fourth Five-Year Review are summarized in **Table 5-5**.

5.5 Technical Assessment

5.5.1 Question A: Is the Remedy Functioning as Intended by the Decision Document?

5.5.1.1 Parcel D-1

Yes. Based on the review of historical documents, annual O&M inspections, and the Five-Year Review inspection the remedy at Parcel D-1 is functioning as intended.

Soil hotspot areas were removed through excavation and offsite disposal. Exposure pathways to residual COCs that could result in an unacceptable risk are being controlled through durable covers and ICs. The shoreline revetment, soil cover, and asphalt cover are in good condition, and any minor issues have been repaired. Areas needing repair outside of typical O&M are secured to prevent access. Groundwater COCs have been consistently below TLs and RGs. The radiological component of the remedy is currently being revised to include the potential presence of RO in soil deeper than 2 feet, in the interim, exposure pathways are being controlled through existing ICs. Radiological concerns are addressed through previous radiological surveys and remediation of soil and building structures and radiological retesting was initiated in 2023 to confirm that the RAO has been met, with the goal of unrestricted closure.

5.5.1.2 Parcel UC-1

Yes. Based on the review of historical documents, annual O&M inspections, and the Five-Year Review inspection the remedy at Parcel UC-1 is functioning as intended.

Exposure pathways that could result in an unacceptable risk are being controlled through durable covers and ICs. The soil and asphalt covers are in good condition, and any minor issues have been repaired. Radiological concerns are addressed through previous radiological surveys and remediation of soil and building structures and radiological retesting, with the goal of unrestricted closure. Radiological retesting was initiated in 2023.

5.5.1.3 Parcel D-2

There are no remedy components for Parcel D-2 in the decision document. Radiological concerns are addressed through previous radiological surveys and remediation of soil and building structures and radiological retesting, with the goal of unrestricted closure. Radiological was initiated in 2023.

5.5.1.4 Parcel G

Yes. Based on the review of historical documents, annual O&M inspections, and the Five-Year Review inspection the remedy at Parcel G is functioning as intended.

Soil hotspot areas were removed through excavation and offsite disposal. Exposure pathways to residual COCs that could result in an unacceptable risk are being controlled through durable covers and ICs. The durable covers are in good condition and any minor issues have been repaired. Groundwater monitoring of COCs is ongoing. In the interim, exposure pathways are being controlled through ICs. Radiological concerns are addressed through previous radiological surveys and remediation of soil and building structures and radiological retesting is being conducted to confirm that the RAO has been met, with the goal of unrestricted closure.

5.5.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used at the Time of the Remedy Selection Still Valid?

Yes. Based on the results of the ARAR evaluation, HHRA analysis, and ERA analysis discussed in the following sections, the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection are still valid. Although there have been some changes to toxicity values and risk assessment methods, these changes do not affect remedy protectiveness.

5.5.2.1 ARAR Evaluation

The Navy evaluated the ARARs established in the RODs and ESD for Parcels D-1, D-2, G, and UC-1, collectively known as Former Parcel D. No changes to location-specific or action-specific ARARs that would affect the protectiveness of the remedies were identified. Changes to chemical-specific ARARs for individual chemicals are discussed in the HHRA and ERA Analysis below.

The California Public Resources Code Division 20.6.5, California Sea Level Rise Mitigation and Adaptation Act of 2021, was passed in 2021; however, no regulations have been promulgated to implement the Act. The Navy is addressing SLR as discussed in Section 2.2.2 of this Five-Year Review.

5.5.2.2 HHRA Analysis

As **Section 3.5.2.1** notes, in 2018, the State of California promulgated the TCR. However, the Navy continues to view the values identified in the USEPA IRIS database (a Tier 1 value) as the primary source of toxicity factors for risk-related calculations. The HHRA evaluation was conducted by comparing the human health RGs from the RODs to current risk-based criteria based on the same exposure scenario, and ARARs, if available. Response complete for soil was achieved with hotspot excavation, durable cover construction and maintenance, and ICs as documented in the respective RACRs for Parcel D-1, UC-1, and G (ERRG, 2011, 2013; APTIM, 2018; Arcadis, 2014a). Therefore, any changes in exposure assumptions and toxicity data would not affect protectiveness of the remedy.

Table 5-6 shows the RGs and current comparison criteria for groundwater. The RGs for the groundwater COCs included in the ROD were based on consideration of exposure scenario-specific (residential or industrial vapor intrusion and construction worker trench exposure [A-aquifer], or residential domestic use [B-aquifer]) risk-based concentrations (based on a cancer risk of 10-6 or a noncancer hazard index of 1), laboratory PQLs, chemical-specific ARARs, and Hunters Point groundwater ambient levels. RGs were compared to the following current comparison criteria (USEPA, 2002a):

- A-aquifer groundwater: VISLs calculated using the current USEPA VISL calculator for the residential and commercial scenarios.
- B-aquifer groundwater: current USEPA tapwater RSLs, California MCLs, and USEPA MCLs.

For the majority of the COCs where the risk-based concentration was selected as the RG, the current risk-based concentration (RSL or VISL) is higher. For groundwater, the current risk-based concentration (VISL) for TCE for the residential receptor is slightly lower than the risk-based RG from the ROD (see **Table 5-6**). Although current risk-based levels are lower than the RGs in some cases, the ICs that are currently in place and the durable cover across the site prevent exposure to site media, and therefore, the remedy remains protective. There may be changes with HHRA analysis for the construction worker scenario. However, those changes will not affect the RGs for the construction worker scenario identified in the ROD because ICs require identification and management of potential risks to construction workers through the preparation and approval of plans and specifications for all construction activities that may pose unacceptable exposure to construction workers. There have been no changes in current exposure pathways based on the site controls, or changes in planned future site use since the ROD that would change the protectiveness of the current remedy.

Radiological Risk Review

In October 2020, after the preparation of the Five-Year Review addenda, USEPA introduced a PRG calculation method called “Peak PRG,” which computes PRGs accounting for ingrowth and decay of progeny over time. An evaluation was performed for this Five-Year Review to assess whether this change affected the continued protectiveness of the current soil RGs for future residents. Exposure calculations were performed using the USEPA PRG Calculator (USEPA, 2022b). For this soil evaluation, the estimated excess cancer risk was calculated using the “Peak Risk” time interval of 1,000 years (Navy, 2020). The soil RGs were used as exposure point concentrations and the cumulative cancer risk was calculated as the sum of risks from all ROCs. **Appendix F** presents the calculated estimated excess cancer risks calculated from this evaluation and the supporting data. Under CERCLA, cleanup goals are considered protective if excess cancer risks from site exposures remain within the 10^{-4} to 10^{-6} range. Based on the findings of this evaluation, the soil RGs are within this range and continue to be protective for future residential exposures.

There were no changes to the risk assessment methods related to structures or buildings for radiological concerns since the last Five-Year Review.

5.5.2.3 ERA Analysis

There were no COECs identified for Former Parcel D. However, groundwater has been monitored for chromium VI and nickel to evaluate potential for risk to aquatic organisms in San Francisco Bay should groundwater reach the bay. **Table 5-7** presents the TLs and current surface water quality criteria. The chronic marine NRWQC (USEPA, 2023) was set as the TL for chromium VI. This value has not changed since the ROD was completed. The TL for nickel is the HGAL and represents ambient conditions. The TLs remain current and protective of surface water exposures for aquatic organisms. Surface water TLs are for monitoring purposes only as surface water benchmarks are not ARARs for ecological exposures to groundwater.

5.5.3 Question C: Has Any Other Information Come to Light that Could Question the Protectiveness of the Remedy?

Yes. As identified in the Fourth Five-Year Review there is uncertainty with a portion of the radiological survey and remediation work. The Navy is in the process of implementing corrective actions to ensure the radiological remedies specified in the decision documents were implemented as intended; however, this work is ongoing. Radiological retesting is currently being conducted at Parcels G, D-1, D-2, and UC-1; long-term protectiveness will be confirmed upon completion.

5.6 Issues, Recommendations, and Follow-up Actions

Issues, recommendations, and follow-up actions were identified for Parcels D-1, UC-1, D-2, and G as summarized in **Table 5-8**.

5.6.1 Other Findings

The following findings were identified that do not directly relate to achieving or maintaining remedy protectiveness but are relevant to overall site management.

5.6.1.1 PFAS

As discussed in **Section 1.4.1,** a Basewide PA was conducted to identify potential PFAS release areas based on historical use or limited sampling data. The following is a summary of the areas identified for additional investigation in the PA (Multi-MAC JV, 2022) and SI (Liberty JV, 2023b):

- **Parcels D-1 and G A-aquifer groundwater:** A-aquifer groundwater beneath Parcels D-1 and G was identified for additional investigation because of past industrial use in the Parcels and PFOA, PFOS, and PFHxS exceeded project screening levels in soil and groundwater during the SI.
- **Parcel D-1:** Poseidon Area (Buildings 377, 384, 385, and 387), IR-69 (Bilge Water Pump House), and IR-70 (Former drum and tank storage area) were identified as areas where further investigation is warranted to determine the presence of PFAS in soil based on historical site use. Upon further review and visual inspections, the Poseidon Area was not sampled in the SI as there was limited soil to sample and any release that may have occurred as a result of site operations would have been released into San Francisco Bay over 40 years ago (no later than 1972). It is also significant to note that this area was identified for the storage of AFFF but there is no evidence that a release of AFFF had occurred (Liberty JV, 2023a). However, it was recommended for further investigation because PFAS were detected in other areas of HPNS.

- **Parcel G:** IR-09 (Pickling and Plating Yard) was identified as an area where further investigation is warranted based on historical site use and limited groundwater sampling results that contained PFOA PFOS, PFBS, and PFHxS. PFOA, PFOS, and PFHxS exceeded project screening levels in groundwater during the SI.

There were no areas identified for investigation in Parcels D-2 and UC-1. Exposure to groundwater and soil is restricted by ICs within the HPNS and the City and County of San Francisco prohibits installation of domestic wells within city and county limits.

5.6.1.2 Climate Resilience

The CRA estimates that groundwater emergence due to SLR may occur within Parcel D-1 by the year 2035 and Parcel G by the year 2065 (**Appendix A**). There are no anticipated effects of SLR on Parcels D-2 and UC-1.

A site-specific study is recommended at Parcels D-1 and G to assess whether the projected climate change vulnerabilities are likely to result in additional CERCLA risk.

5.6.1.3 Site Management Strategy

The Navy is reassessing the site management strategy for Parcels D-1 and G based on the following considerations:

- The Navy is planning to conduct a detailed assessment of groundwater COC concentrations to document and eliminate COCs that have achieved response complete and to tabulate groundwater and soil COC concentrations to ensure health and safety professionals have the information needed to protect future construction workers.
- The Navy is also planning to optimize the monitoring frequency and locations for areas that have not undergone any changes that could affect the concentrations of chemicals and/or metals in groundwater (for example, remedial action or development construction).

5.7 Statement of Protectiveness

5.7.1 Parcel D-1

Protectiveness Determination: Short-term Protective

Protectiveness Statement: The remedy at Parcel D-1 is currently protective of human health and the environment. In order to determine whether the remedy can be considered protective in the long term, the radiological retesting work will be completed, and additional actions implemented to address the potential presence of ROs in subsurface soil.

The RAOs for soil are met through soil hotspot excavation and offsite disposal, durable covers, and ICs. Groundwater monitoring is ongoing and COCs have been consistently below RGs and TLs. Radiological retesting is ongoing to confirm that levels in soil and existing structures are protective of human health and post-ROD documentation is being prepared to address ROs in subsurface soil. Until retesting is complete, short-term protectiveness is met through Navy controls such as access to the parcel through fencing, locked gates, and ICs (restricting intrusive work and maintaining durable covers).

5.7.2 Parcel D-2

Protectiveness Determination: Short-term Protective

Protectiveness Statement: The remedy at Parcel D-2 is currently protective of human health and the environment.

Parcel D-2 was acceptable for UU/UE upon completion of the radiological TCRA; however, in order to determine whether the parcel remains acceptable for UU/UE, the radiological retesting work will be completed. Until retesting is complete, exposure to ROCs in site media is being controlled through security features such as fencing, locked gates, and signage.

5.7.3 Parcel UC-1

Protectiveness Determination: Short-term Protective

Protectiveness Statement: The remedy at Parcel UC-1 is currently protective of human health and the environment. In order to determine whether the remedy can be considered protective in the long term, the radiological retesting work will be completed.

The RAOs for soil are met through durable covers and ICs. Radiological retesting is ongoing to confirm that levels in soil and existing structures are protective of human health. Until retesting is complete, short-term protectiveness is met through Navy controls such as access to the parcel through fencing, locked gates, and ICs (restricting intrusive work and maintaining durable covers).

5.7.4 Parcel G

Protectiveness Determination: Short-term Protective

Protectiveness Statement: The remedy at Parcel G is currently protective of human health and the environment. In order to determine whether the remedy can be considered protective in the long term, the radiological retesting work will be completed.

The RAOs for soil are met through soil hotspot excavation and offsite disposal, durable covers, and ICs. Groundwater treatment is completed, and monitoring is ongoing. Radiological retesting is ongoing to confirm that levels in soil and existing structures are protective of human health. While retesting is ongoing, short-term protectiveness is met through Navy controls such as access to the parcel through fencing, locked gates, and ICs (restricting intrusive work and maintaining durable covers).

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Table 5-1. Parcels D-1, G, and UC-1 Chemicals of Concern and Remediation Goals

Exposure Medium	Exposure Scenario	Chemical of Concern	ROD Remediation Goal (2009)	Source of Remediation Goal	Parcel
Soil (mg/kg)	Residential	Manganese	1,431	HPAL	D-1, UC-1, G
		Arsenic	11.1	HPAL	D-1, UC-1
		Benzo(a)pyrene	0.33	PQL	D-1, UC-1
		Benzo(b)fluoranthene	1.76	RBC	D-1, UC-1
	Recreational	Arsenic	11.1	HPAL	G
		Benzo(a)pyrene	0.33	PQL	G
	Industrial	Arsenic	11.1	HPAL	G
		Benzo(a)pyrene	0.33	PQL	G
		Benzo(b)fluoranthene	1.76	RBC	G
		Lead	800	RBC	G
	Construction Worker	Arsenic	11.1	HPAL	D-1, UC-1, G
		Benzo(a)pyrene	0.65	RBC	D-1, UC-1, G
		Lead	800	RBC	G
		Manganese	6,889	RBC	D-1, UC-1, G
Groundwater (µg/L)	Residential – Vapor Intrusion	Chloroform	1	PQL	G
		Methylene Chloride	27	RBC	G
		Trichloroethene	2.9	RBC	G
	Industrial – Vapor Intrusion	Benzene	0.63	RBC	D-1, UC-1, G
		Carbon Tetrachloride	0.5	PQL	D-1, UC-1, G
		Chloroform	1.2	RBC	D-1, UC-1, G
		Naphthalene	6	RBC	D-1, UC-1, G
		Tetrachloroethene	1	PQL	D-1, UC-1, G
		Trichloroethene	4.8	RBC	D-1, UC-1, G
		Xylene (total)	337	RBC	D-1, UC-1, G
	Construction Worker – Trench Exposure	Arsenic	40	RBC	D-1, UC-1, G
		Benzene	17	RBC	D-1, UC-1, G
		Naphthalene	17	RBC	D-1, UC-1, G
		Tetrachloroethene	18	RBC	D-1, UC-1, G
		Xylene (total)	861	RBC	D-1, UC-1, G
	Migration to Surface Water of Bay [a]	Chromium VI	50	SWC	D-1, UC-1, G
		Nickel	96.5	HPAL	D-1, UC-1, G

[a] Migration to Surface Water of Bay addresses discharge that would be above the specified remediation goals; specific trigger levels are developed for each plume. Groundwater remediation goals for chromium VI and zinc are at the point of discharge to the bay.

µg/L = microgram(s) per liter

HPAL = Hunters Point ambient level

PQL = practical quantitation limit

RBC = risk-based concentration

ROD = Record of Decision

SWC = Surface Water Criteria

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Table 5-2. Parcels D-1, G, and UC-1 Remediation Goals for Radionuclides

Radionuclide	Surfaces (dpm/100cm²)		Soil (pCi/g)		Water (pCi/L)	Parcel
	Equipment and Waste[a]	Structures[b]	Construction Worker[c]	Resident[e]		
Cesium-137	5,000	5,000	0.113	0.113	119	D-1, G, UC-1
Cobalt-60	5,000	5,000	0.0602	0.0361	100	D-1, G, UC-1
Plutonium-239	100	100	14	2.59	15	D-1, G, UC-1
Radium-226	100	100	1[d]	1[d]	5	D-1, G, UC-1
Strontium-90	1,000	1,000	10.8	0.331	8	D-1, G, UC-1
Thorium-232	1,000	36.5	19	1.69	15	D-1, G, UC-1
Hydrogen-3	5,000	5,000	4.23	2.28	20,000	D-1, G, UC-1
Uranium-235 + daughters	5,000	488	0.398	0.195	30	D-1, G, UC-1

Source of Goals:

Department of the Navy (Navy). 2006. *Base-wide Radiological Removal Action, Action Memorandum – Revision 2006, Hunters Point Shipyard, San Francisco, California*. Final. April 21.

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[a] Limits for removable surface activity are 20 percent of these values.

[b] Remediation goals are consistent with those issued in the Radiological TCRA Action Memo. Remediation goals meet the 25 millirem per year residual dose level consistent with 10 CFR Section 20.1402. Furthermore, for most radionuclides of concern, goals meet the 15 millirem per year residual dose level consistent with the 1997 USEPA OSWER Directive (OSWER No. 9200.4-18). Of exception, is the goal for Thorium-232 which because of detection limit technical limitations, corresponds to a dose of 25 millirems per year.

[c] Applicable to Parcel G only

[d] Goal is 1 pCi/g above background per agreement with USEPA.

[e] All radiologically impacted soils in this parcel will be remediated according to Residential Remediation Goals.

Note: Unless otherwise stated, the radiological remediation goals in this table are based on total activity per sample including the background.

CFR = Code of Federal Regulations
cm^2 = square centimeter(s)
dpm = disintegration(s) per minute
OSWER = Office of Solid Waste and Emergency Response
pCi/g = picocurie(s) per gram
pCi/L = picocurie(s) per liter
TCRA = time-critical removal action
USEPA = United States Environmental Protection Agency

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Table 5-3. Parcel D-1 and UC-1 Remedial Action Summary and Expected Outcomes

Media	Risk/Basis for Action	Reasonably Anticipated Land Use	RAO	Remedy Component	Parcel	Performance Metric	Expected Outcome
Soil	**Human Health:** Unacceptable risks to potential future industrial or construction workers from exposure to PAHs and metals in surface and subsurface soils. Potential volatilization of VOCs from soil into soil gas and/or indoor air via the VI pathway.	**Current use:** limited access, unoccupied and unused buildings **Planned Future Use:** Industrial/Maritime Industrial	1. Prevent exposure to PAHs and metals in soil at concentrations above remediation goals developed in the HHRA for the following exposure pathways: Ingestion of, outdoor inhalation of, and dermal exposure to surface and subsurface soil by industrial workers or construction workers 2. Prevent exposure to VOCs in soil gas at concentrations that would pose unacceptable risk via indoor inhalation of vapors. Remediation goals for VOCs to address exposure via indoor inhalation of vapors may be superseded based on COC identification information from future soil gas surveys. Future action levels would be established for soil gas, would account for vapors from both soil and groundwater, and would be calculated based on a cumulative risk level of 10^{-6} using the accepted methodology for risk assessments at HP[N]S.	Excavation	D-1	Excavation and offsite disposal of COC-contaminated soil to industrial-based RGs. One soil stockpile identified in the remedial design was also removed and disposed offsite.	Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.
				Durable Covers	D-1 and UC-1	Durable covers to provide physical barriers to prevent exposure to PAHs and metals in soil. Durable covers include: 1) a 3-foot-thick (minimum) shoreline armoring (D-1 only) 2) a 2-foot-thick (minimum) vegetated soil cover (UC-1 only) 3) a 6-inch-thick (minimum) asphaltic pavement cover 4) repaired concrete building foundations Covers are inspected and maintained to prevent exposure to COCs.	
				ICs	D-1 and UC-1	ICs to maintain durable covers, restrict land use and land-disturbing activity and, in areas for VOC ICs, prohibit construction of enclosed structures unless prior written approval is granted by the FFA signatories	
Groundwater	**Human Health:** Unacceptable risks to potential future industrial or construction workers from exposure to VOCs in indoor air from A-aquifer groundwater via the vapor intrusion pathway. Unacceptable risks to potential future construction workers through dermal contact with metals and VOCs in A-aquifer groundwater and volatilization of VOCs.		1. Prevent exposure by industrial workers to VOCs in the A-aquifer groundwater at concentrations above remediation goals via indoor inhalation of vapors from groundwater. 2. Prevent or minimize exposure of construction workers to metals and VOCs in the A-aquifer groundwater at concentrations above remediation goals from dermal exposure and inhalation of vapors from groundwater.	Groundwater treatment	D-1	A pre-ROD groundwater treatability study was completed, consisting of injection of approximately 136,000 pounds of zero valent iron into the A-aquifer. Concentrations of VOCs were treated to below RGs established for D-1 groundwater and active treatment was not required.	
				Groundwater LTM	D-1	Groundwater monitoring is ongoing. VOC monitoring was discontinued in 2012 when RGs were met. Concentrations of metals continue to be below RGs and TLs since 2004 with the exception of silver in July 2008 and lead in September 2015 in 1 monitoring well.	
				ICs	D-1	ICs to prohibit construction of enclosed structures, the use of groundwater and installation of new groundwater wells for domestic purposes, and to restrict land-disturbing activity unless prior written approval is granted by the FFA signatories.	
Radiologically Impacted Soil and Structures	**Human Health:** Radiological risks for soil and structures (storm drains, sanitary sewers, buildings) were greater than 10^{-6}.		1. Prevent exposure to radionuclides of concern in concentrations that exceed remediation goals for all potentially complete exposure pathways.	Survey, decontamination, and removal of radiologically impacted structures and soil	D-1 and UC-1	Radiologically impacted structures and soil was removed during the Basewide TCRA. Low-level radiological objects were identified in soil within Parcel D-1 and may be present at depths greater than 2 feet bgs. Additional remedy evaluation is currently under way to address these objects. Additionally, radiological rescanning is currently being completed. While the remedy evaluation and retesting is underway, exposure pathways are being controlled through ICs.	

Table 5-3. Parcel D-1 and UC-1 Remedial Action Summary and Expected Outcomes

bgs = below ground surface
COC = chemical of concern
FFA = Federal Facilities Agreement
HHRA = human health risk assessment
HPNS = Hunters Point Naval Shipyard (referred in the ROD as HPS)
IC = institutional control
LTM = long-term monitoring
LUC = land use control
PAH = polycyclic aromatic hydrocarbon
RAO = remedial action objective
RD = remedial design
RG = remediation goal
ROD = Record of Decision
TCRA = time-critical removal action
TL = trigger level
VI = vapor intrusion
VOC = volatile organic compound

Table 5-4. Parcel G Remedial Action Summary and Expected Outcomes

Media	Risk/Basis for Action	Reasonably Anticipated Land Use	RAO	Remedy Component	Performance Metric	Expected Outcome
Soil	**Human Health:** Unacceptable risks to potential future industrial, residential, or construction workers from exposure to PAHs and metals in surface and subsurface soils. Potential volatilization of VOCs from soil into soil gas and/or indoor air via the VI pathway.	**Current use:** Limited access unoccupied and unused buildings, few commercial buildings **Planned Future Use:** Open space, education and cultural use, industrial, and mixed-use (including potential residential use)	1. Prevent exposure to organic and inorganic chemicals in soil at concentrations above remediation goals developed in the HHRA for the following exposure pathways: a) Ingestion of, outdoor inhalation of, and dermal exposure to surface and subsurface soil b) Ingestion of homegrown produce by residents in mixed-use blocks	Excavation	Excavation and offsite disposal of COC-contaminated soil to industrial-based RGs. Two soil stockpiles identified in the remedial design were also removed and disposed offsite.	Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.
				Durable Covers	Durable covers to provide physical barriers to prevent exposure to PAHs and metals in soil. Durable covers include: 1) a 6-inch-thick (minimum) asphaltic pavement cover and 2) repaired concrete building foundations. Covers are inspected and maintained to prevent exposure to COCs.	
				ICs	ICs to maintain durable covers, restrict land use and land-disturbing activity, and prohibit growing produce in native soil for human consumption in mixed-use blocks.	
			2. Prevent exposure to VOCs in soil gas at concentrations that would pose unacceptable risk via indoor inhalation of vapors. Remediation goals for VOCs to address exposure via indoor inhalation of vapors may be superseded based on COC identification information from future soil gas surveys. Future action levels would be established for soil gas, would account for vapors from both soil and groundwater, and would be calculated based on a cumulative risk level of 10^{-6} using the accepted methodology for risk assessments at HP[N]S.	ICs	ICs to prohibit construction of enclosed structures unless prior written approval of vapor mitigation strategies is granted by the FFA signatories.	
Groundwater	**Human Health:** Unacceptable risks to potential future industrial, residential, or construction workers from exposure to VOCs in indoor air from A-aquifer groundwater via the vapor intrusion pathway. Unacceptable risks to potential future construction workers through dermal contact with metals and VOCs in A-aquifer groundwater and volatilization of VOCs. Potential migration pathway of contaminants to San Francisco Bay.		1. Prevent exposure to VOCs in the A-aquifer groundwater at concentrations above remediation goals via indoor inhalation of vapors from groundwater. 2. Prevent direct exposure to the groundwater that may contain COCs through the domestic use pathway (for example, drinking water or showering). 3. Prevent or minimize exposure of construction workers to metals and VOCs in the A-aquifer groundwater at concentrations above remediation goals from dermal exposure and inhalation of vapors from groundwater. 4. Prevent or minimize migration to the surface water of San Francisco Bay of chromium VI and nickel in A-aquifer groundwater that would result in concentrations of chromium VI above 50 µg/L, and nickel above 96.5 µg/L at the point of discharge to the Bay.	Groundwater treatment	A pre-ROD groundwater treatability study was completed, consisting of injection of approximately 136,000 pounds of zero valent iron into the A-aquifer. Concentrations of VOCs were below the RGs in all monitoring wells except one location at the time of the RD, therefore additional treatment was determined to be unnecessary.	
				Groundwater monitoring	Groundwater monitoring is ongoing. Sampling for hexavalent chromium was discontinued in 2012 because concentrations were below TLs and were stable or decreasing. VOCs continue to exceed RGs and monitoring will continue until RGs have been met.	
				ICs	ICs to prohibit extraction of groundwater and installation of new groundwater wells with the exception of environmental sampling and monitoring requirements described in the ROD. ICs within areas with VOCs to prohibit construction of enclosed structures unless prior written approval is granted by the FFA signatories.	
Radiologically Impacted Soil and Structures	**Human Health:** Radiological risks for soil and structures (storm drains, sanitary sewers, buildings) were greater than 10^{-6}.		1. Prevent exposure to radionuclides of concern in concentrations that exceed remediation goals for all potentially complete exposure pathways.	Survey, decontamination, and removal of radiologically impacted structures and soil	Radiologically impacted structures and soil was removed during the Basewide TCRA. Radiological retesting is currently being completed. While the rescanning is underway, exposure pathways are being controlled through ICs.	Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.

Table 5-4. Parcel G Remedial Action Summary and Expected Outcomes

μg/L = microgram(s) per liter
COC = chemical of concern
FFA = Federal Facilities Agreement
HHRA = human health risk assessment
HPNS = Hunters Point Naval Shipyard (referenced in ROD as HPS)
IC = institutional control
LTM = long-term monitoring
LUC = land use control
PAH = polycyclic aromatic hydrocarbon
RAO = remedial action objective
RD = remedial design
RG = remediation goal
ROD = Record of Decision
TCRA = time-critical removal action
TL = trigger level
VI = vapor intrusion
VOC = volatile organic compound

Table 5-5. Fourth Five-Year Review Parcels D-1, D-2, UC-1, and G Issues, Recommendations, and Follow-up Actions

Parcel/ Site	Fourth Five-Year Review Protectiveness	Issue	Recommendation (Milestone)	Date Complete/ Current Status
D-1, G	Short-term protective	The regulatory agencies do not agree with the Navy's risk assessment methodology used to reduce the ARICs for VOC vapors.	The Navy intends to consider agency concerns (including specific recommendations made by EPA) and reevaluate its approach to calculating SGALs, which may affect the ARICs for VOC vapors at Parcels B-1, B-2, D-1, and G. Appendix E (of the Fourth Five-Year Review) evaluated how EPA's recommendations may affect the SGALs and the ARICs for VOC vapors. Based on the information in Appendix E, none of the potential changes to the ARICs for VOC vapors affect the current protectiveness of the remedies at Parcels B-1, B-2, D-1, and G. The regulatory agencies are currently reviewing and reevaluating their methods for assessing vapor intrusion risk. Once consensus is achieved, the Navy should reevaluate its approach for calculating SGALs and adjusting ARICs for VOC vapors. The new SGALs would be developed based on the most current standards, toxicity criteria, and risk assessment methods. The new SGALs would be used to redefine the ARICs for soil gas at each parcel prior to property transfer. Any changes to soil gas risk assessment methodology should be discussed in the next Five-Year Review report. (12/31/2019)	No changes to the VOC ARIC are planned for Parcel D-1 or G at this time. Because attenuation of VOCs is likely to occur, ARICs for VOC vapors, and likewise SGALs that are the basis of the ARICs, in Parcels D-1 and G will be re-evaluated during preparation for property transfer. While there is disagreement about the method to calculate the SGALs, which may affect ARIC boundaries, the final ARICs that will be surveyed and recorded in quitclaim deeds and covenants to restrict land use will be established in agreement with the BCT. Protectiveness is not affected because the Navy currently controls the property and land use, and future protectiveness will not be affected because the ARICs will be established in the appropriate legal documentation.
D-1, D-2, UC-1, and G	Short-term protective	The Navy has determined that a significant portion of the radiological survey and remediation work completed to date was not reliable because of manipulation and/or falsification of data by one of its radiological contractors. A long-term protectiveness evaluation of the radiological RGs has not yet been completed for this fourth Five-Year Review, and it is currently not known if the RAOs for radionuclides have been achieved in Parcels B-1, B-2, C, D-1, D-2, G, E, UC-1, UC-2, and UC-3.	Refer to **Section 1.4.3** for the long-term protectiveness evaluation component of this recommendation. The Navy is in the process of implementing corrective actions to ensure that the radiological remedies specified in the decision documents are implemented as intended. It is anticipated that the radiological rework will be completed prior to the next Five-Year Review.	**Long-term Protectiveness Evaluation: Completed June 2020**. Addenda to the Fourth Five-Year Review were prepared to evaluate the Radiological RGs for soil and buildings. The conclusions of both reports were that the current RGs were protective of human health and the environment (Navy, 2020a, 2020b). **In Progress.** The radiological retesting of soil and surveys of building structures at Parcel D-1 was initiated in 2023. Radiological rework will be summarized in a radiological RACR anticipated to be completed in 2026. Planning for the radiological retesting of soil and building structures at Parcels D-2 and UC-1 was initiated in February 2019. Fieldwork activities were initiated in 2023. Radiological rework will be summarized in a radiological removal action construction summary report anticipated to be completed in 2028. The radiological retesting of soil and building structures at Parcel G was initiated in Fall 2018. Fieldwork activities were initiated in Fall 2020. Radiological rework will be summarized in a radiological RACR anticipated to be completed in 2025.

References:

Navy. 2020a. *Addendum to the Five-Year Review, Evaluation of Radiological Remedial Goals for Soil, Hunters Point Naval Shipyard, San Francisco, California*. June 18.

Navy. 2020b. *Addendum to the Five-Year Review, Evaluation of Radiological Remedial Goals for Building Structures, Hunters Point Naval Shipyard, San Francisco, CA*. June 18.

ARIC = area requiring institutional controls
BCT = BRAC Cleanup Team
BRAC = Base Realignment and Closure
Navy = Department of the Navy
RG = remediation goal
RACR = removal action completion report
SGAL = soil gas action level
USEPA = United States Environmental Protection Agency
VOC = volatile organic compound

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Table 5-6. Parcels D-1, G, and UC-1 Chemicals of Concern and Current Comparison Criteria for Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	Values from ROD			Current Comparison Criteria				
			ROD Remediation Goal (2009, 2010)	Source of Remediation Goal	Parcel	11/2022 USEPA RSL or VISL	Basis of RSL or VISL (C/NC)[a]	DTSC-SL	Cal MCL	USEPA MCL
Groundwater (µg/L)	Residential – Vapor Intrusion	Chloroform	1	PQL	G	0.814	C	NA	80	80
		Methylene Chloride	27	RBC	G	763	C	NA	5	5
		Trichloroethene	2.9	RBC	G	1.19	C	NA	5	5
	Industrial – Vapor Intrusion	Benzene	0.63	RBC	D1, UC-1, G	6.93	C	NA	1	5
		Carbon Tetrachloride	0.5	PQL	D1, UC-1, G	1.81	C	NA	0.5	5
		Chloroform	1.2	RBC	D1, UC-1, G	3.55	C	NA	80	80
		Naphthalene	6	RBC	D1, UC-1, G	20.1	C	NA	None	None
		Tetrachloroethene	1	PQL	D1, UC-1, G	65.2	C	NA	5	5
		Trichloroethene	4.8	RBC	D1, UC-1, G	7.4	C	NA	5	5
		Xylene (total)	337	RBC	D1, UC-1, G	1620	NC	NA	1,750	10,000
	Construction Worker – Trench Exposure	Arsenic	40	RBC	D1, UC-1, G	NA		NA	NA	NA
		Benzene	17	RBC	D1, UC-1, G	NA	C	NA	NA	NA
		Naphthalene	17	RBC	D1, UC-1, G	NA	C	NA	NA	NA
		Tetrachloroethene	18	RBC	D1, UC-1, G	NA	C	NA	NA	NA
		Xylene (total)	861	RBC	D1, UC-1, G	NA	NC	NA	NA	NA

[a] VISL presented for A-aquifer groundwater

Notes:

Shading indicates current comparison criteria is lower than ROD Remediation Goal.

µg/L = microgram(s) per liter
C = carcinogen
DTSC = California Department of Toxic Substances Control
MCL = maximum contaminant level
NA = not available
NC = noncarcinogen
PQL = practical quantitation limit
RBC = risk-based concentration
ROD = Record of Decision
RSL = Regional Screening Level
SL = screening level
USEPA = United States Environmental Protection Agency
VISL = vapor intrusion screening level

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Table 5-7. Parcels D-1, UC-1, and G Chemicals of Potential Concern for Ecological Receptors - Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	ROD Trigger Level (2009)	Source of Trigger Level	Receptor Basis	NRWQC (2023)	Basin Plan SF Bay (2019)	Value Still Protective ?	Notes
Groundwater (µg/L)	Ecological Receptor	Chromium VI	50	NRWQC - CCC	aquatic organisms	50	50	Yes	Analyte was included in the monitoring plan for Parcel D. The trigger level is a risk based criteria for surface water exposures but is not an ARAR for ecological exposure to groundwater. Exceeding the trigger level does not indicate immediate risk but a potential exists if the plume migrates toward the bay.
		Nickel	96.5	HGAL	aquatic organisms	8.2 (D)	8.2 (D)	Yes	The trigger level is based on ambient levels and is not a risk-based value. Risk-based criteria for surface water (NRWQC and Basin Plan) are for comparison purposes only and are not ARARs for groundwater exposures.

µg/L = microgram(s) per liter
ARAR = applicable or relevant and appropriate requirement
CCC = Criterion Continuous Concentration
(D) = dissolved
HGAL = Hunters Point groundwater ambient level
NRWQC = National Recommended Water Quality Criteria
ROD = Record of Decision

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Table 5-8. Parcels D-1, D-2, UC-1, and G Issues, Recommendations, and Follow-up Actions

<table>
<tr><th rowspan="2">Parcel</th><th rowspan="2">Issue</th><th rowspan="2">Recommendations/ Actions</th><th rowspan="2">Party Responsible</th><th rowspan="2">Oversight Agency</th><th rowspan="2">Milestone Date</th><th colspan="2">Affects Protectiveness (Y/N)</th></tr>
<tr><th>Current</th><th>Future</th></tr>
<tr><td>D-1</td><td rowspan="4">As identified in the Fourth Five-Year Review there is uncertainty with a portion of the radiological survey and remediation work performed between 2004 and 2016 under the Basewide Radiological Removal Action, Action Memorandum (Navy, 2006). The Navy is in the process of implementing corrective actions to ensure the radiological remedies specified in the decision documents were implemented as intended; however, this work is ongoing.</td><td rowspan="4">Complete radiological retesting at radiologically impacted sites, including current and former buildings and soil areas investigated under the Radiological Removal Action, Action Memorandum (Navy, 2006) and areas where evaluations determined previous data were unreliable.</td><td rowspan="4">Navy</td><td rowspan="4">USEPA</td><td>11/27/2026</td><td rowspan="4">N</td><td rowspan="4">Y</td></tr>
<tr><td>UC-1</td><td>3/2/2028</td></tr>
<tr><td>D-2</td><td>3/2/2028</td></tr>
<tr><td>G</td><td>10/2/2025</td></tr>
<tr><td>D-1</td><td>ROs were identified during excavation and remediation of soil in areas that were not considered radiologically impacted. There is a high degree of confidence that discrete ROs were removed to a depth of 2 feet bgs. However, there is a potential for ROs to be present in material below 2 feet bgs where shoreline expansion has occurred since 1946.</td><td>Evaluate additional remedies to address the potential presence of ROs in material 2 feet bgs and prepare the appropriate post-ROD documentation.</td><td>Navy</td><td>USEPA</td><td>12/20/2024</td><td>N</td><td>Y</td></tr>
</table>

Source: Navy. 2006. *Base-wide Radiological Removal Action, Action Memorandum – Revision 2006, Hunters Point Shipyard, San Francisco, California*. Final. April 21.

bgs = below ground surface
Navy = Department of the Navy
RO = radiological object
ROD = Record of Decision
USEPA = United States Environmental Protection Agency

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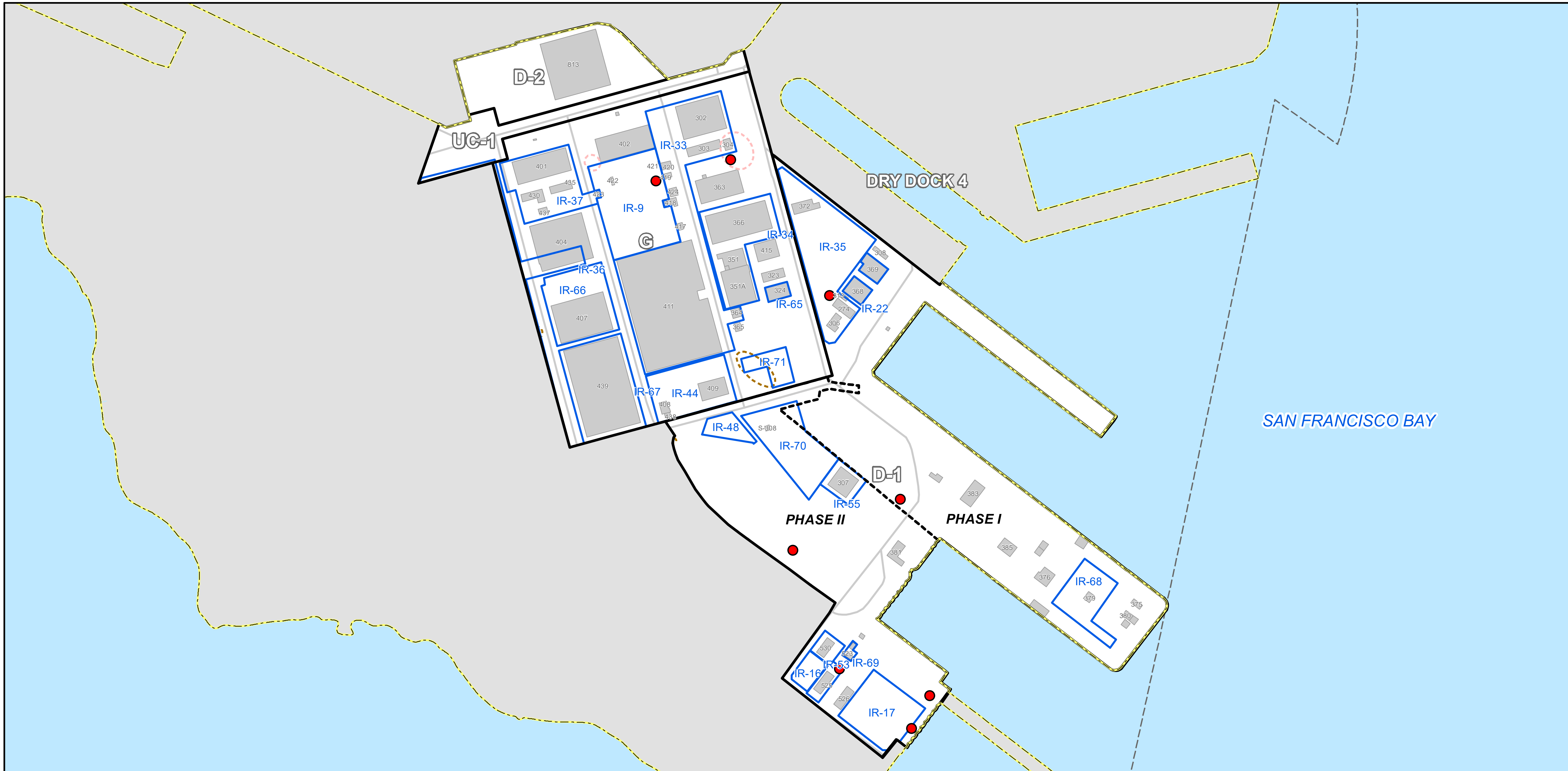


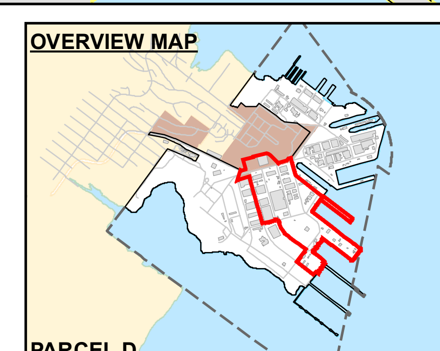
LEGEND

- Hunters Point Naval Shipyard Boundary
- Parcel Boundary
- Parcel F (Water) Boundary
- IR Site
- Approximate Hotspot Excavation Areas
- Water
- Building
- Road
- Phase II Boundary

Plume Detection Area

- Naphthalene
- VOC

IR = Installation Restoration
VOC = volatile organic compound



0 225 450 Feet

N

Figure 5-1
Parcel D (Parcels D-1, D-2, G, and UC-1)
Fifth Five-Year Review Report
Hunters Point Naval Shipyard, San Francisco, California

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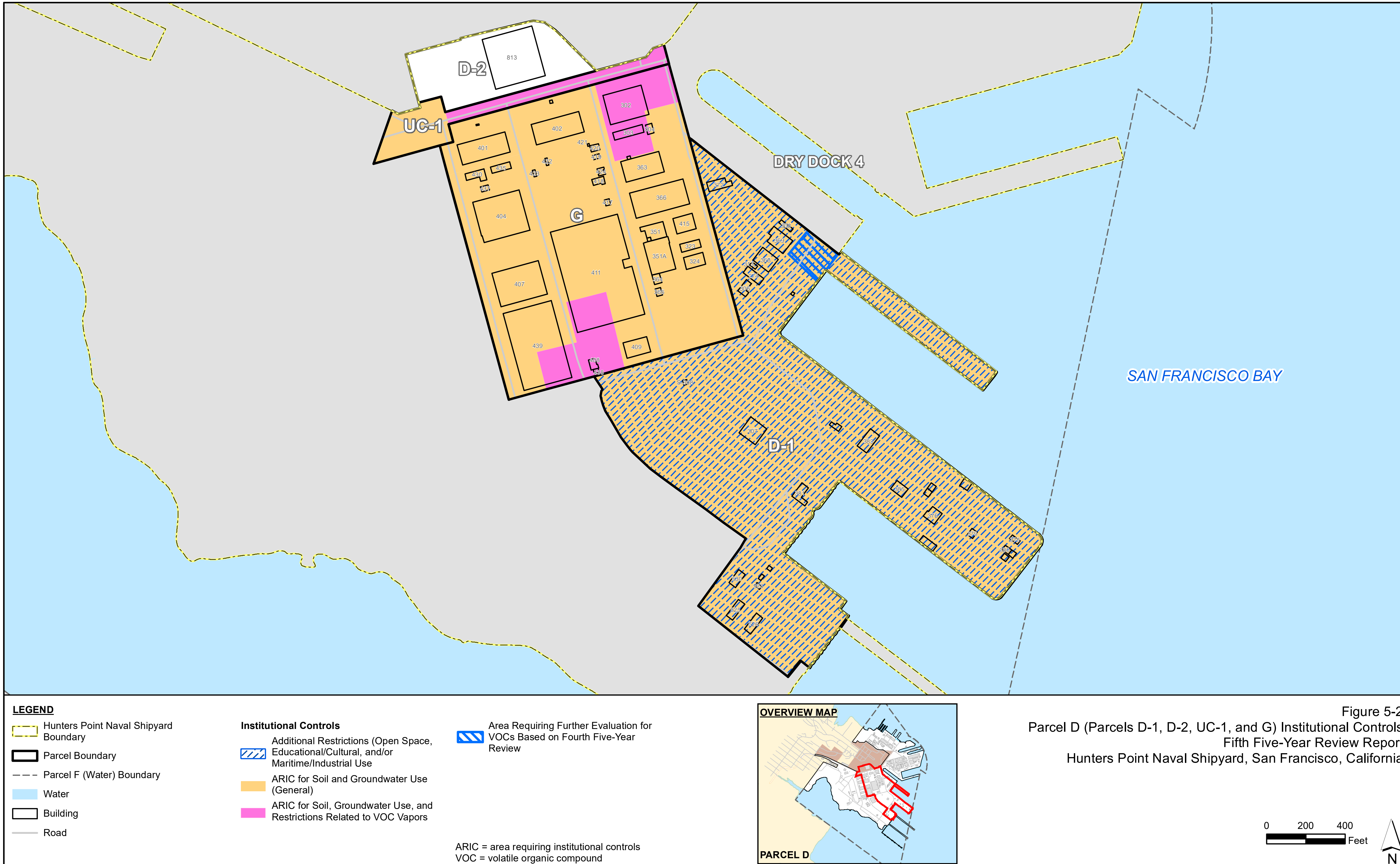

Figure 5-2
Parcel D (Parcels D-1, D-2, UC-1, and G) Institutional Controls
Fifth Five-Year Review Report
Hunters Point Naval Shipyard, San Francisco, California

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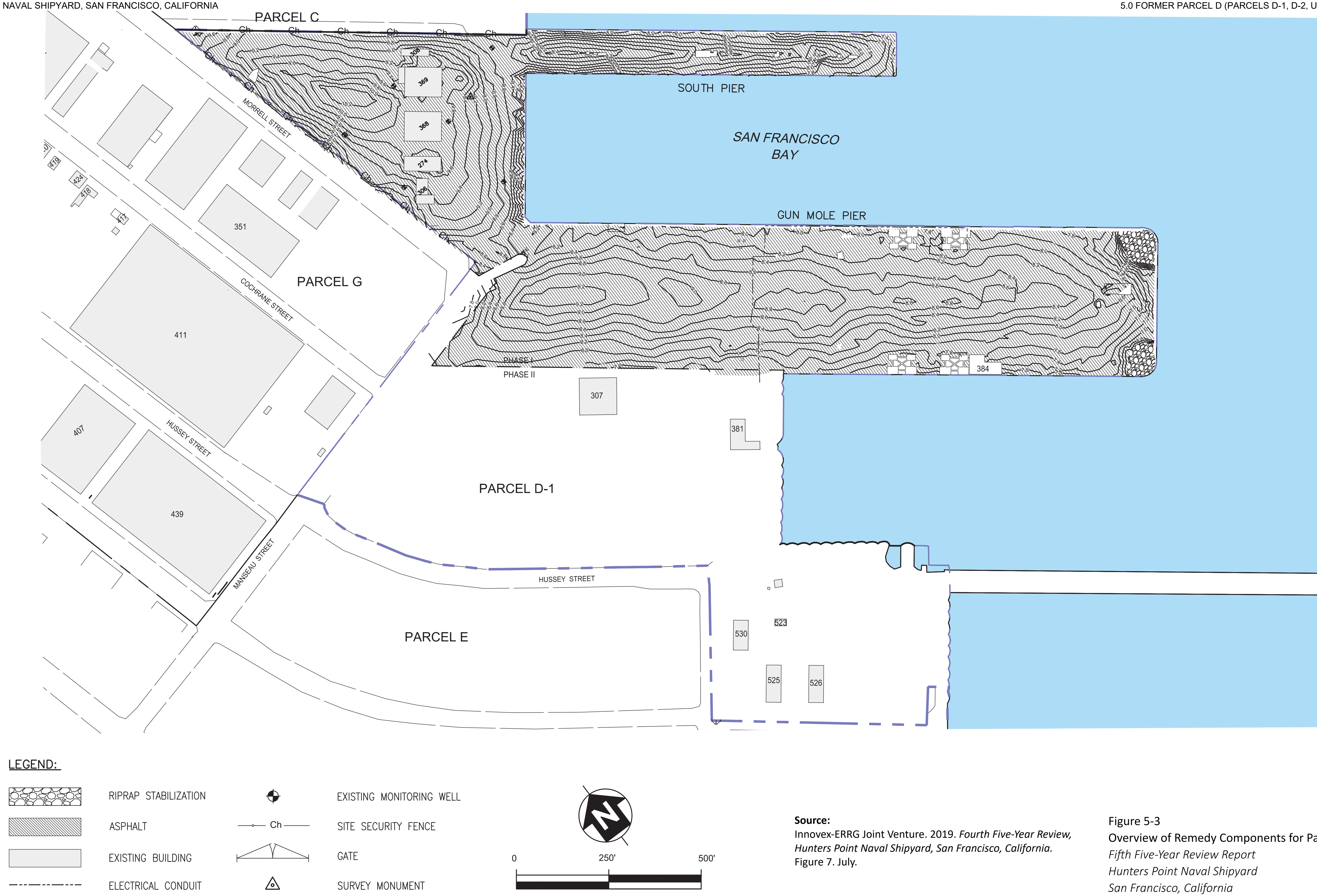

Source:
Innovex-ERRG Joint Venture. 2019. *Fourth Five-Year Review, Hunters Point Naval Shipyard, San Francisco, California.* Figure 7. July.

Figure 5-3
Overview of Remedy Components for Parcel D-1
Fifth Five-Year Review Report
Hunters Point Naval Shipyard
San Francisco, California

230307115911_589d933e Figure_5-2_D-1

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Source:
Innovex-ERRG Joint Venture. 2019. *Fourth Five-Year Review, Hunters Point Naval Shipyard, San Francisco, California.* Figure 11. July.

Figure 5-4
Overview of Remedy Components for Parcel UC-1
Fifth Five-Year Review Report
Hunters Point Naval Shipyard
San Francisco, California

230307115911_589d933e Figure_5-3_UC-1

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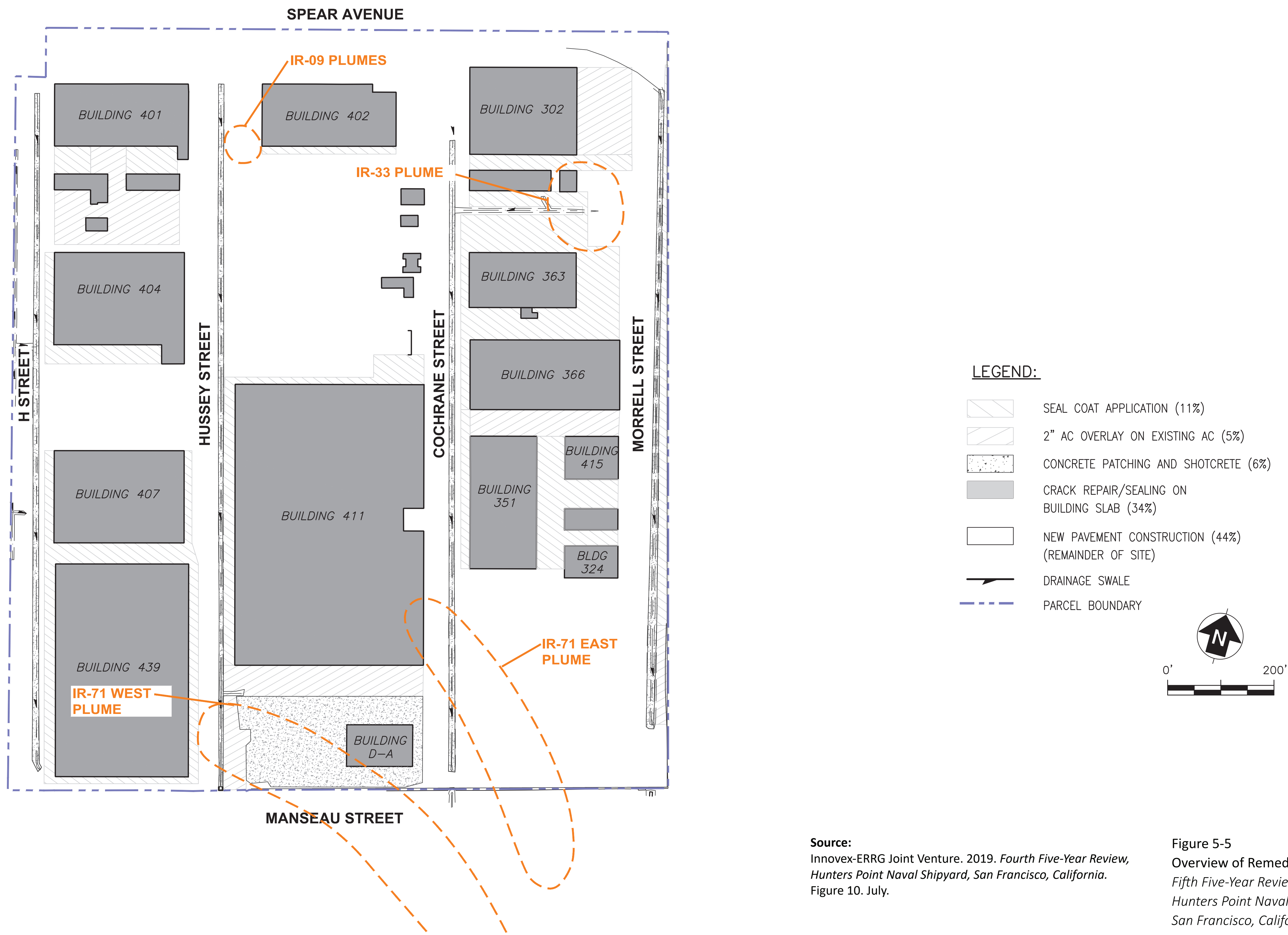

Source:
Innovex-ERRG Joint Venture. 2019. *Fourth Five-Year Review, Hunters Point Naval Shipyard, San Francisco, California.* Figure 10. July.

Figure 5-5
Overview of Remedy Components for Parcel G
Fifth Five-Year Review Report
Hunters Point Naval Shipyard
San Francisco, California

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6.0 Former Parcel E (Parcels E, E-2, and UC-3)

6.1 Site History and Background

Former Parcel E was used as an industrial support area, including a warehouse (Building 406) where chlorinated solvents were released and Former Oily Waste Ponds (known as IR-03) where spent waste oil was stored from 1944 to 1974. Shoreline areas of Parcel E (known as IR-02) were used to store construction materials and industrial materials, as well as to dispose of industrial waste and construction debris. During its occupancy of HPNS (between 1976 and 1986), Triple A allegedly disposed of hazardous wastes at various locations at HPNS, including possibly discharging waste oil within Parcel E using belowground fuel and steam lines. NRDL conducted research activities within Parcel E, most notably at the former 500 series buildings in the southwestern portion of Parcel E and within the Building 707 Triangle Area which may have discharged small amounts of low-level radioactive liquids into sanitary sewer, storm drain, and septic sewer lines; as a result, sanitary sewer, storm drain, and septic sewer lines throughout Parcel E were identified in the HRA as radiologically impacted. Dials, gauges, and deck markers painted with radioluminescent paint (containing low levels of Ra-226) to make the devices glow in the dark were disposed of along the shoreline (IR-02 and IR-03). Sandblast waste from cleaning ships used during weapons testing in the South Pacific may have been disposed of at IR-02.

Parcel E has been subdivided into Parcels E (128 acres), E-2 (47 acres), and UC-3 (11 acres). Parcel E consists of shoreline and lowland coast along the southwestern portion of HPNS, and contains 17 existing buildings, 25 former buildings, 1 ship berth, numerous IR sites, and future reuse areas (Navy, 2013) (**Figure 6-1**).

The following IR sites are present:

- Parcel E – IR-02, IR-03, IR-04, IR-05, IR-08, IR-11, IR-12, IR-13, IR-14, IR-15, IR-36, IR-38, and IR-39
- Parcel E-2 – IR-01/21
- Parcel UC-3 – Portions of IR-04, IR-52, IR-56, IR-74

Parcel E also includes four IR sites that were established for the former utility network at HPNS: IR-45 (steam line system), IR-47 (fuel distribution lines), IR-50 (storm drain and sanitary sewer systems), and IR-51 (former electrical transformer locations) (ERRG, 2012). Investigations and actions at Parcel E began in 1984, as shown in the following chronology.

Parcel E Chronology	
Date	**Investigation/Action**
1984	Initial Assessment Study
1988–1989	Solid Waste Air Quality Assessment Test
1988	OU RI Phase 1 Reconnaissance
1988–1992	OU-1 RI
1989	Removal of Soil at IR-08 PCB Spill Area
1991	Removal of Floating Product at IR-03

Parcel E Chronology

Date	Investigation/Action
1991–1992	Intertidal Sediment Study
1993	Phase II Radiological Investigation
1994	SI
1996	Exploratory Excavations at IR-11/14/15
1997	RI
1996–1997	Removal of Sediment from the Storm Drain System Phase III Radiological Investigation
1996–1998	Installation of Sheet Pile Wall and Low-Permeability Cap at the Former Oily Waste Ponds in IR-03
1997–1998	FS Groundwater Extraction System and Containment Barrier
1998–1999	Phase IV Radiological Investigation
1999–2000	Parcel E Validation Study and Protective Soil Concentrations Technical Memorandum
2000–2001	Interim Landfill Cap Construction
2000–2002	Groundwater Data Gaps Investigation SVE Treatability Study
2001–2002	Nonstandard Data Gaps Investigation Wetland Delineation and Wetland Functions Assessment
2001	Removal of Soil with Non-VOCs at IR-08 Radiological Investigation of Parcel E Shoreline
2001–2005	Radiological Investigations, Phase V (and other interim investigations)
2002	Standard Data Gaps Investigation
2002–2004	Waste Consolidation and Removal
2002–2003	Construction of Landfill Gas (LFG) Control System
2002–2005	Parcels E and E-2 Shoreline Investigation and Risk Assessment
2003–2004	HRA Parcel E Shoreline Debris Removal
2003	Stockpile Inventory
2003–2004	Removal of Soil Stockpiles
2003– Present	Landfill Gas Monitoring and Control
2004	Removal of TPH-Contaminated Soil from Various Locations Metal Slag Area Characterization
2005–2007	Metal Debris Reef and Metal Slag Area Removal Action

Parcel E Chronology	
Date	**Investigation/Action**
	Removal of Soil at IR-02 Northwest and IR-02 Central Area PCB Hotspot Area Removal Action (Phase I)
2008	Revised RI, including HHRA and ERA
2009–2011	Groundwater Treatability Study at IR-56
2009–2012	Groundwater Characterization and ZVI Treatability Study at Various VOC Groundwater Plumes
2009—present	Basewide Radiological TCRA and retesting
2010–2012	PCB Hotspot Area Removal Action (Phase II)
2011–2016	Characterization and Treatability Study at IR-03
2011	RI/FS for Parcel E-2
2012	Ship Shielding Area Removal Action Final FS for Parcels E and UC-3
11/2012	ROD for Parcel E-2
2013	Soil Excavation Characterization
12/2013	ROD for Parcel E
1/2014	ROD for Parcel UC-3
2014–2016	Phase 1 Hotspot Removal and Nearshore Slurry Wall Installation Parcel E-2
2016	RD and Design Basis Report and LUC RD for Parcel UC-3
2016–2019	Phase 2 Hotspot Removal, Upland Slurry Wall, Shoreline revetment, and foundation layer installation Parcel E-2
2018	RD for Parcel E LUC RD for Parcel E RACR for Soil Hotspot Excavation, Durable Cover, and Groundwater Remediation Parcel UC-3
2019	Parcel E RA initiation

6.2 Site Characterization

This section summarizes the findings from various investigations at Parcels E, E-2, and UC-3 that are pertinent to the Five-Year Review.

6.2.1 Physical Characteristics

6.2.1.1 Surface Features

Parcels E, E-2, and UC-3 are located in the lowlands of HPNS with surface elevations ranging from 0 to 30 feet above msl; predominant ground surface elevations range from 7 to 10 feet above msl (ERRG, 2012; KCH, 2014). The only surface water features within Parcel E are wetlands areas located along the shoreline. About 30 percent of Parcel E is ruderal habitat characterized by scattered shrubs and grasses, and about 65 percent is covered by pavement with some sparse vegetation. The remaining 5 percent of Parcel E consists of beach areas, intertidal areas, and wetland areas (ERRG, 2012). Wetlands are also located in the Panhandle Area and Shoreline Area within Parcel E-2 (**Figure 6-1**) (Navy, 2012).

Parcel E contains buildings and paved areas over the northern portion of the parcel and is undeveloped/wetland areas in the southern portion. Parcel E-2 is a landfill with an interim cover (installed in 2000) and open undeveloped areas.

Parcel UC-3 is predominantly paved or open undeveloped land consisting of a railroad right-of-way west of HPNS and an access road (Crisp Road) north of Parcels E and E-2.

6.2.1.2 Geology and Hydrogeology

The Parcels E, E-2, and UC-3 area was created by filling in the bay margin with various materials, including native soil, rock, and sediments, as well as construction and industrial debris (Navy, 2012). Nearly all of the Parcels E, E-2, and UC-3 area was developed from Artificial Fill made up largely of crushed serpentinite bedrock from the hillsides; as a result, high levels of naturally occurring bedrock metals, such as arsenic and manganese, are present in fill materials throughout the parcel.

The following is a summary of hydrostratigraphic units at Parcel E and E-2:

- **A-Aquifer**: The A-aquifer covers almost all of Parcel E, from a few feet to over 50 feet thick. However, the lateral continuity of the A-aquifer is disrupted by numerous low-permeability zones because of the heterogeneous nature of the Artificial Fill. The A-aquifer is unconfined throughout most of Parcel E, but semiconfined conditions may exist in many places where fine-grained sediments below the water table overlie more permeable materials. Depth to groundwater ranges from 4 to 15 feet bgs, with an average depth to groundwater across Parcel E of about 8 feet bgs. A-aquifer groundwater flow patterns at Parcel E are complex. The prominent flow directions are influenced by two major features: (1) the large groundwater sink along the boundary between Parcels D and E, and (2) a groundwater divide in the central shoreline area. The natural flow of groundwater toward the bay from the topographically high area of Parcel A is typically disrupted by these two features (Barajas, 2008). Groundwater at Parcel E generally flows southeast (TRWB, 2022). A groundwater mound exists in the center of Parcel E-2, causing groundwater to flow both east and west. Various groundwater sinks exist across the HPNS, including in the Panhandle and eastern boundary of Parcel E-2 (TRWB, 2022).
- **Bay Mud**: The Bay Mud Deposits range from 5 to 76 feet thick under most of Parcel E (Barajas, 2008). The aquitard is thickest in the southern portion of Parcel E along the shoreline (CES, 2018a). The aquitard is absent in the northern portion of Parcel E, along Crisp Avenue (Parcel UC3), in the northwest corner of Parcel E-2, and in the areas of the bedrock highs (Barajas, 2008; Navy, 2012). In locations where the Mud Bay deposits are absent, the A- and B-aquifers are in hydraulic communication and behave as a single aquifer.
- **B-Aquifer**: Groundwater flow in the B-aquifer is generally toward the southeast. However, groundwater in Parcel E-2 from the B-aquifer flows west from the Panhandle Area to the adjacent offsite properties to the west (TRWB, 2022).

As discussed in **Section 1.3.4.3**, the entire A-aquifer meets the Resolution 88-63 exception criteria. Although it does not meet the Resolution 88-63 exception criteria, the B-aquifer has a low potential for drinking water use.

6.2.2 Land Use

6.2.2.1 Current Land Use

Parcel E is a former industrial use area with most areas subject to restricted access because of ongoing remediation. Building 606, located in the southeast portion of Parcel E near the Parcel D-1 boundary, is the only occupied building at Parcel E; it is currently leased to the San Francisco Police Department (Navy, 2013). Parcel E-2 is a landfill and Parcel UC-3 is a road and utility corridor.

6.2.2.2 Future Land Use

The City and County of San Francisco's amended Redevelopment Plan identifies Parcel E as proposed Shipyard South Multi-Use District (planned mixed use) and Shipyard Shoreline Open Space District (open space) (SFRA, 2010). The boundary between Parcels E and E-2 was revised such that Parcel E-2 is now limited to open space (Navy, 2012). The future reuse of Parcel UC-3 will be mixed use in the eastern half of Crisp Road that borders Parcel E, and commercial and light industrial uses in the western half of Crisp Road and the railroad right-of-way (AFW, 2016a).

6.2.3 Basis for Taking Action

This section describes the results of site investigations and risk assessments that provide the basis for taking action at Parcels E, E-2, and UC-3. Details for Parcel E are provided in the Revised RI (Barajas, 2008), FS (ERRG, 2012), radiological addendum to the FS (ERRG and RSRS, 2012), RD (CES, 2018a), and Parcel E ROD (Navy, 2013). Details for Parcel E-2 are provided in the RI/FS (ERRG and Shaw, 2011), radiological addendum (ERRG and RSRS, 2011) and Parcel E-2 ROD (Navy, 2012). Details for Parcel UC-3 are provided in the Revised Parcel E RI Report (Barajas, 2008), Parcel E Groundwater Treatability Study (Shaw, 2011), Parcel E radiological addendum (ERRG and RSRS, 2012), Parcel E FS (ERRG, 2012), Parcel E Soil Excavation Characterization (Arcadis, 2013), and Parcel UC-3 ROD (KCH, 2014).

6.2.3.1 Site Investigations and Pre-ROD Removal Actions

Previous investigations at Parcels E, E2, and UC3 identified metals, VOCs, SVOCs, PCBs, pesticides, dioxins and furans, and TPH in soil; methane in landfill gas (Parcel E2); metals, VOCs, SVOCs, PCBs, pesticides, TPH, and anions in groundwater; NAPL at IR-03 (Parcel E); metals, PCBs, and pesticides in sediment; and radionuclides in soil, sediment, groundwater, and structures.

Since the Initial Assessment Study identified several environmental investigation sites in 1984, the Navy has performed multiple environmental investigations at Parcels E, E2, and UC3 to further evaluate IR sites associated with former shipyard operations. The Navy has completed a number of removal actions and treatability studies at Parcels E, E-2, and UC-3. The Navy performed several treatability studies that involved testing technologies to reduce VOCs in groundwater and soil as summarized in the chronology and respective RODs. The Navy has collected extensive information during these investigations and studies, as well as during ongoing environmental monitoring programs for groundwater (Navy, 2013).

NAPL, both dense NAPL (DNAPL) and/or light NAPL (LNAPL) has been periodically measured in Parcel E (IR Sites 02, 03, and 14, **Figure 6-1**). NAPL at the Former Oily Waste Ponds (IR-03) contains VOCs, SVOCs, PCBs, and TPH that are a source to soil and groundwater contamination (CES, 2018a). The DNAPL typically consists of chlorinated solvents such as PCE and TCE, while the LNAPL typically consists of petroleum hydrocarbons such as fuel and waste oil (TRBW, 2022).

6.2.3.2 Human Health Risk

A quantitative HHRA was completed for Parcel E and UC-3 as part of the Revised RI for Parcel E (Barajas, 2008) and for Parcel E-2 as part of the RI/FS for Parcel E-2 (ERRG and Shaw, 2011). Human health risks were characterized separately for COCs and ROCs. The following unacceptable risks from COCs were identified (**Table 6-1** and **6-2**):

For Parcel UC-3:

- Future industrial workers from exposure to metals, SVOCs (primarily PAHs), and TPH in surface soil (0 to 2 feet bgs), subsurface soil (0 to 10 feet bgs)

For all parcels:

- Future recreational users from exposure to metals, SVOCs (primarily PAHs), pesticides, PCBs, and TPH in surface soil and PCBs in shoreline sediment (0 to 2 feet bgs).
- Future residents (adult and child) from exposure to metals, VOCs, SVOCs (primarily PAHs), pesticides, PCBs, and TPH in surface soil (0 to 2 feet bgs), subsurface soil (0 to 10 feet bgs), and metals and VOCs in A-aquifer groundwater through the vapor intrusion to indoor air pathway and metals, VOCs, SVOCs (primarily PAHs), pesticides, PCBs, and TPH in B-aquifer through domestic use.
- Future construction workers from exposure to metals, VOCs, SVOCs (primarily PAHs), pesticides, PCBs, and TPH in subsurface soil (0 to 10 feet bgs) and SVOCs (primarily PAHs) and lead in A-aquifer groundwater through direct exposure and VOCs in trenches.

Additionally, unacceptable risk from ROCs in soil was identified for future residents, recreational users, and outdoor workers at Parcels E, E-2, and UC-3 (**Table 6-3**) (ERRG and RSRS, 2011, 2012).

6.2.3.3 Ecological Risk

Two assessments of ecological risk evaluations were performed for Parcel E: (l) the baseline ecological risk assessment (BERA), which evaluated risks from exposure to soil in areas planned for open space reuse along the Parcel E shoreline; and (2) the SLERA, which evaluated risks from exposure to sediment in the intertidal zone along the shoreline for both Parcels E and E-2. The BERA found potential risk to birds and mammals from exposure to copper, lead, and total PCBs in soil along the shoreline. The SLERA found potential risk to benthic invertebrates, birds, and mammals from exposure to metals and total PCBs in surface and subsurface sediments along the shoreline and metals, PCBs, pesticides, and total TPH in groundwater (Barajas, 2008; Navy, 2013).

The SLERA for Parcel E-2 evaluated potential risks to wildlife, specifically benthic invertebrates, birds, and mammals, exposed to intertidal sediments at Parcel E-2. The shoreline SLERA concluded that concentrations of copper and lead in sediment along the Parcel E-2 shoreline are a potential source of contamination to Parcel F. In addition, benthic invertebrates, birds, and mammals are at risk from exposure to PCBs in surface sediments along the Parcel E-2 shoreline (ERRG and Shaw, 2011). Based on the SLERA results, chemical concentrations in soil, shoreline sediment, and groundwater in Parcel E-2 pose a potential threat to wildlife (Navy, 2012). In addition, the SLERA identified COPECs in groundwater for the migration to surface water pathway which include: copper, lead, zinc, un-ionized ammonia, sulfide, cyanide, PCBs, and TPH.

A summary of the COECs identified in the RODs are provided in **Table 6-1** and **6-2** for soil/shoreline sediment and groundwater, respectively.

6.3 Remedial Action Objectives

The ROD for Parcel E was signed in December 2013 (Navy, 2013). **Table 6-4** summarizes the basis for action, RAOs, remedy components, performance metrics, and expected outcomes.

The ROD for Parcel E-2 was signed in November 2012 (Navy, 2012). **Table 6-5** summarizes the basis for action, RAOs, remedy components, performance metrics, and expected outcomes.

The ROD for Parcel UC-3 was signed on January 21, 2014 (Navy, 2014). **Table 6-6** summarizes the basis for action, RAOs, remedy components, performance metrics, and expected outcomes.

The presence of VOCs in groundwater and soil may contribute to the presence of VOC in soil gas, therefore the vapor intrusion pathway is included as a basis for action and development of RAOs for all parcels.

The Navy developed RGs to meet the RAOs for soil, sediment, and RGs and TLs for groundwater which are summarized for COCs/COECs in **Table 6-1** and **6-2**, and for ROCs in **Table 6-3.**

6.4 Remedial Actions

6.4.1 Parcel E

The RA for Parcel E includes the following major components:

- Soil and nearshore sediment excavation and removal to address COCs in soil and nearshore sediment
- Investigation and closure of steam and fuel line system to address potential continuing sources of COCs
- SVE to address VOCs in soil gas
- Durable cover installation to address COCs in soil
- Shoreline protection to address COCs in nearshore sediment and soil
- In situ groundwater treatment for VOCs
- Installation of a belowground barrier to contain COCs and NAPL in groundwater and prevent migration
- Monitoring and MNA of groundwater for VOCs
- Removal and treatment of NAPL source
- Radiological screening and remediation through soil excavation, removal of sanitary sewer and storm drain lines, and FSSs area at three radiologically impacted buildings (404, 414, and 810)
- ICs for to radionuclides

Remedy components are shown on **Figure 6-1, 6-2,** and **6-3**.

6.4.1.1 Remedy Implementation

Remedy construction and implementation is currently underway and is being conducted in phases as described in the Phase 1 RAWP (APTIM, 2019a), Phase 2 RAWP (Gilbane, 2019), and Phase 3 RAWP (APTIM, 2019b). Radiological remediation within Parcel E will be addressed by a future Phase 4 task order, to be completed following the Phase 2 RA and before the unrestricted release of Parcel E. The RA construction began in October 2019 and is currently in progress. The following sections provide the current status of remedy implementation; however, progress at this time has not been documented in a construction completion, or RACR.

Soil Excavation and Removal

Excavation activities were conducted from May 2020 to November 2022 (report pending). The objective of the soil excavation was to remove and dispose of contaminated soil in selected areas (referred to as Tier 1, Tier 2, and TPH locations) that contain nonradioactive chemicals at concentrations exceeding risk-based levels, as well as separate and dispose of materials and soil with radioactive contamination found in these areas.

- Tier 1 locations contain COCs at concentrations greater than 10 times the RGs.
- Tier 2 locations contain COCs at concentrations greater than 5 times the RGs.
- TPH locations contain TPH (commingled with CERCLA-contaminants) at concentrations exceeding the petroleum source criterion (3,500 milligrams per kilogram).

As part of Phase 1 RA, excavation of contaminated material was performed until the Tier 2 soil action levels have been achieved, the excavation reaches 10 feet in depth or bedrock/Bay Mud is encountered, whichever is shallower, or upon the Navy's determination to limit excavation. Additional excavation may be completed in the event that methane-generating debris is encountered while completing the six nearby source-removal excavations in the IR-12 Area. Additional excavation may also be completed in areas of VOC-impacted soil beneath Building 406 in lieu of SVE if Building 406 has been removed prior to conducting RA (APTIM, 2019a). Building 406 had not been demolished at the time of this review.

In addition, there are 11 planned shoreline excavation areas for the Phase 3 RA at Parcel E (APTIM, 2019b). Shoreline excavation at IR-03 (Phase 2) is discussed in the Nonaqueous Phase Liquid Removal and Treatment section below.

Closure of Fuel and Steam Lines

Inactive underground steam and fuel lines located within Parcel E that are potential continuing sources of contamination to soil and/or groundwater will be inspected and either removed or closed-in-place as part of the Phase 1 RA. This work is anticipated to be initiated in spring 2025.

Parcel E contains approximately 2,700 linear feet of inactive underground steam lines that are contained in concrete utilidors (i.e., concrete-lined utility chases) with access points every 200 to 400 feet. Visual inspections and/or sampling will be conducted to evaluate whether individual steam lines, condensate, and pump return lines within Parcel E have been used to transfer waste oil and, if so, whether they leaked onto the concrete utilidors. If the sampling shows that steam lines are contaminated with waste oil, they will be cleaned or removed. Uncontaminated steam lines at Parcel E may be capped and abandoned in place or removed for offsite recycling or disposal (APTIM, 2019a).

Parcel E contains approximately 3,100 linear feet of inactive underground fuel (**Figure 6-3**). Most of the fuel lines are buried directly in soil, although some lines may be located within concrete utilidors. The primary fuel line at Parcel E extends from the Parcels D-1 and E boundary (near former ship Berth 29) to the locations of a former aboveground storage tank (S-505) in IR-02 Southeast, and the Former Oily Waste Ponds (IR-03). The fuel lines will be exposed and inspected to evaluate the condition of the lines, valves, and flanges, and to identify whether fluids or combustible vapors are present in the lines. Residual fluids will be sampled and removed. Fuel lines will be evaluated for potential historic leaks and the surrounding soil will be evaluated for signs of contamination. Fuel lines may be removed or closed-in-place (APTIM, 2019a).

Soil Vapor Extraction

SVE is planned as a source-reduction measure to address VOC-contaminated soil beneath Building 406 in the event that the building has not been removed prior to the time of RA (CES, 2018a). If Building 406 has been removed prior to RA, then excavation may be used in lieu of SVE to remove VOC source material in the area. If Building 406 remains in place, VOCs the vapor intrusion pathway will be evaluated (APTIM, 2019a). This work is anticipated to be initiated in spring 2025.

The following soil gas surveys will be completed: soil gas monitoring at existing VOC plumes at Building 406, IR-04, and IR-12; supplemental methane monitoring will be performed at the potential debris removal area within IR-12; and a focused soil gas survey will be performed in redevelopment areas planned for mixed use to evaluate residual VOCs in soil (APTIM, 2019a).

Durable Cover Installation

The sitewide cover will be composed of either: 1) a minimum 2-foot erosion resistant layer of soil; 2) a minimum 2-inch layer of asphaltic concrete underlain by a minimum 4-inch compacted aggregate base foundation layer; or 3) a minimum 4-foot layer of shoreline armoring comprised of riprap overlying filter rock for steeper slopes (i.e., 3H:1V) and course sand overlying light riprap and filter rock for shallower slopes (i.e., 7H:1V) (APTIM, 2019a). The asphalt and concrete surfaces in the northern portion of Parcel E are part of the future Multi-Use District. The 2-foot-thick soil cover in the southern portion and northwestern edge adjacent to Parcel E-2 are part of the future open space area (CES, 2018a). This work is expected to be initiated in fall 2026.

Shoreline Protection

Shoreline protection will be installed along approximately 3,730 feet of exposed IR-02 shoreline and 550 feet of IR-03 shoreline within Parcel E (**Figure 6-3**). Two separate types of shoreline protection are planned or have been installed:

- **Armored revetment (rock revetment)**: The armored revetment was installed from June 2020 to July 2022 and includes natural rock armor facing (i.e., riprap), with a 3-foot high concrete seawall incorporated into the revetment crest, and will be constructed in the steep and narrow shoreline areas. This revetment has been designed to be stable to wave action and provide protection from exposure to potentially contaminated sediment.
- **Hybrid shoreline stabilization**: The shoreline stabilization will be installed from summer 2023 to summer 2024 and will include natural shoreline materials (i.e., coarse sand) underlain by rock armor (i.e., riprap) and will be constructed in the gradually sloped and wide shoreline areas. This protection measure will provide a more natural look along the shoreline

and be more aesthetically pleasing. The primary structural component of the hybrid stabilization design is the underlying riprap rock layer, which is sized based on a worst-case scenario of the rock being exposed to wave action. The overlying sand will improve pedestrian access to shoreline areas and provide an additional layer of protection from exposure to potentially contaminated sediment under the rock armor.

To increase the wave run-up protection level above the +9-foot msl elevation for the armored revetment sections, a 3-foot high concrete seawall will be constructed at the crest of the revetment terminating at elevation 12-feet msl. The seawall is intended to maximize the shoreline protection without substantially increasing the fill volume and associated weight of additional shoreline revetment (CES, 2018a).

In Situ Groundwater Remediation

In situ groundwater VOC treatment will be implemented after the remedial excavations in the treatment area(s) are completed, the performance wells are installed, and baseline sampling conducted (anticipated spring 2025). Groundwater treatment will be completed at the Building 406 Chlorinated VOC (CVOC) Plume, and potentially at the IR-04 CVOC plume, depending on characterization sampling results. Groundwater CVOC plume areas where CVOC concentrations are consistently detected above the GWTDCs (CES, 2018a) will be remediated using in situ bioremediation (ISB) of a carbon source and a dechlorinating microbial consortium injected into the subsurface. In-situ groundwater treatment is intended to be a focused short-term action that enhances degradation of VOCs, at which point MNA and ICs will be relied upon to meet the RAOs (APTIM, 2019a).

Belowground Barrier

A cement-bentonite slurry wall was installed during the Phase 3 RA (from April to July 2020) as a belowground barrier to control discharge of contaminated groundwater. This slurry wall ties into the previously installed Parcel E-2 nearshore slurry wall and extends to the southeastern limits of IR-02 Northwest. The total length of the IR-02 Northwest slurry wall is approximately 1,090 feet, including a 20-foot-long overlap with the Parcel E-2 nearshore slurry wall to form a continuous low-permeability barrier between the two parcels (APTIM, 2019b).

A second slurry wall will be installed at IR-03 as discussed in the Nonaqueous Phase Liquid Removal and Treatment section below.

Groundwater Monitoring

Groundwater monitoring wells and soil gas monitoring points will be installed in VOC-impacted plumes located near Building 406 (IR-36), IR-04, IR-12A, and IR-12B to monitor remedial progress. In addition, groundwater monitoring wells will be installed in remedial excavation areas after backfilling activities are completed to replace wells required for Phase 1 groundwater monitoring. Groundwater and soil gas monitoring will be conducted at IR-36 to support the selected remedy, including documenting the beneficial impact to groundwater quality following implementation of ISB (APTIM, 2019a).

Ten monitoring wells and piezometers will be installed during Phase 2 to complete the RA monitoring well network. The design of the IR-03 slurry wall includes monitoring wells and piezometers to measure groundwater levels and the hydraulic gradient across the IR-03 slurry wall. Existing groundwater monitoring wells within the IR-03 area will be removed during the site preparation phase, and new monitoring wells and piezometers will be installed after the IR-03 slurry wall and ISS are constructed.

Groundwater is currently sampled through the BGMP. Groundwater monitoring wells screened in the A-aquifer are sampled for VOCs, metals, PCBs, pesticides, and TPH. Radionuclides are also sampled at Parcel E to demonstrate, consistent with previous radiological investigations, that radionuclides are not present in groundwater at activity levels that are both statistically significant and pose an unacceptable risk to human health and the environment (TRBW, 2022b). Exceedances of the RGs (identified as PALs) from 2019, 2020, 2021, and 2022 are presented in **Appendix E**. Nickel, zinc, naphthalene, total TPH, and VC have exceeded the RGs and/or TLs in one or more locations during this review period. While these exceedances were identified, the locations are upgradient of the slurry wall, which was designed to contain the metals and other chemicals, preventing discharge to surface water.

The current monitoring program will continue in accordance with the selected remedy identified in the ROD (Navy, 2013). Additional sampling is also being conducted to support the multiple phases of RA being completed in Parcel E. Once RA is completed in Parcel E, then the monitoring program will be conducted in accordance with the RAMP (CES, 2019).

Nonaqueous Phase Liquid Removal and Treatment

NAPL will be addressed at Parcel E through a combination of excavation, ISS treatment, and a slurry wall (Gilbane, 2019). A summary of the planned actions are as follows:

- Shoreline excavation of NAPL up to the Bay Mud Layer was completed at IR-03 from August 2021 to April 2023.
- ISS treatment will be initiated in winter 2023 and will consist of bentonite slurry and cement grout mixed with the soil to create a solidified and stabilized soil-bentonite-cement monolith. The anticipated ISS area is approximately 69,000 square feet, with the estimated target zone of soil ranging from 12 to 30 feet bgs. The ISS treatment at IR-03 is targeted to areas with the highest total TPH concentrations (i.e., greater than 9,000 mg/kg), indicating that high-saturation and mobile NAPL are present (Gilbane, 2019).
- A cement-bentonite slurry wall will be constructed at IR-03 and the surrounding area (**Figure 6-3**). Construction is planned for prior to spring 2024. The IR-03 slurry wall will encompass the extent of known groundwater contamination, including areas with elevated TPH concentrations in soil that may serve as secondary sources, providing a low-permeability barrier to prevent or minimize flow of contaminated groundwater toward San Francisco Bay from areas upgradient of the wall. A cement-bentonite backfill mix is proposed for the IR-03 slurry wall, which will create self-hardening slurry that will act as both the trench stabilizing slurry and the final backfill material (Gilbane, 2019).

During the Phase 2 shoreline excavation, a temporary sheet pile wall will be installed along the excavation area to provide stability for the shoreline and prevent releases to the San Francisco Bay during excavation (Gilbane, 2019).

Radiological Surveys and Remediation

The ROPCs at Parcel E include Co-60, Cs-137, Ra-226, Sr-90, U-235, Pu-239, and americium-241 (Am-241) (Navy, 2013).

The Navy conducted TCRAs to address potential radioactive contamination in the interior Parcel E area, including storm drains and sanitary sewer lines and radiologically impacted structures (TtEC, 2012a). In total, 6,984 cubic yards of soil were excavated during removal of 5,131 linear feet of sanitary sewer and storm drain lines. Approximately 177 cubic yards of soil was disposed of offsite as LLRW based on surface scan and analytical laboratory results. FSSs were performed within the interior Parcel E area at three radiologically impacted buildings (404, 414, and 810), three radiological sites (Building 701 Site, Building 704 Site, and the IR-04 Former Scrap Yard Site, which includes the former Building 807 Site) (TtEC, 2012b). Additionally, FSSs were performed at other areas within Parcel E at 13 radiologically impacted buildings (406, 500, 509, 521, and 529) and 7 radiological sites (Former Building 500 Series, Former Building 503 Site, Former Building 506 Site, Former Building 507 Site, Former Building 508 Site, Former Building 510/510A Site, Former Building 517 Site, Former Building 520 Site, Building 707 Triangle Area, and Former Shack 79 and 80 Site) (TtEC, 2010, 2012c, 2012d, 2012e, 2012f, 2013a, 2013b, 2013c, 2013d, 2013e, 2013f, 2013g, 2014, and 2016).

The TCRA data was reviewed as described in **Section 1.4.3** and radiological retesting, including sampling and surveys of soils previously investigated during sanitary sewer line storm drain removal and resurvey of impacted buildings and former building sites, is currently being conducted to determine if current site conditions are compliant with the RAOs.

Institutional Controls

The entire area of Parcel E (about 128 acres) is subject to ICs. IR-02 (Former Disposal Areas) and IR-03 (Former Oily Waste Ponds) are subject to ICs specifically related to radionuclides (**Figure 6-2**). IC performance objectives were developed and presented in the LUC RD (CES, 2018b). The IC performance objectives to be implemented through land use restrictions for the site are summarized in **Table 1-2**. The Navy currently controls land use and access to the Parcel while RAs are ongoing.

6.4.1.2 Remedy Operations and Maintenance

Because remedy construction is ongoing, there are no O&M activities.

6.4.2 Parcel E-2

The RA for Parcel E-2 includes the following major components:

- Excavation and disposal of COCs in soil and sediment and debris and construction of tidal and non-tidal wetlands
- Durable cover installation to address COCs in soil and landfill material
- Installation of a belowground barrier (slurry wall) to contain COCs in groundwater and prevent migration
- LTM of groundwater for COCs
- Landfill gas monitoring, collection, and treatment
- Radiological screening and remediation through conducted TCRAs
- ICs for land use

Remedy components are shown on **Figure 6-1, 6-2,** and **6-4**.

6.4.2.1 Remedy Implementation

Soil, Sediment, and Debris Excavation, Consolidation, and/or Removal

Hotspot delineation and excavation of contaminated materials in Parcel E-2 was conducted over two phases. Phase I was completed from June 2005 to September 2006. The Phase 1 TCRA at the PCB Hotspot Areas was performed to remove contaminated soil and debris, possibly containing low-level radioactive material. The removal action goals included removal of free-phase petroleum hydrocarbons to a practical extent. Approximately 44,500 cubic yards of contaminated soil, including 611 cubic yards of material with radionuclides, was excavated from this area in the southeast portion of Parcel E-2. From March 2010 to November 2012, a Phase 2 TCRA at the PCB Hotspot Areas was performed to remove contaminated soil and debris from the shoreline portion of the PCB Hotspot Area, and other select hotspots identified in the RI/FS Report. Approximately 42,200 cubic yards of contaminated soil and 3,000 cubic yards of large debris were excavated from areas not addressed during the Phase 1 TCRA (KEMRON, 2018). Because all hotspots identified for removal in the TCRAs were not removed at the time the ROD was in preparation, the remaining hotspot removal was incorporated into the remedy.

From November 2014 through March 2016, the remaining Hotspots in Parcel E-2 as determined by the Design Basis Report (DBR) (ERRG, 2014) were excavated as part of the Phase 1 Parcel E-2 RA. Approximately 39,000 BCY of PCB, TPH, lead, copper and PCE-contaminated soil were excavated from within the Panhandle, Shoreline, and East Adjacent Areas. In addition, approximately 5,324 BCY of soil and debris were excavated prior to installation of the nearshore slurry wall, and another 3,499 BCY of material were trenched during slurry wall installation (Gilbane, 2018a).

As part of the Phase 2 RA, the tidal and freshwater wetland areas were excavated and graded to the subgrade design as specified in the DBR (ERRG, 2014). Approximately 51,902 cy of soil, sediment and debris was excavated and radiologically screened from the tidal and freshwater wetland. While grading within the vicinity of the freshwater wetland, approximately 1,204 cy of material suspected of containing methane-generating debris were removed (APTIM, 2021). During the Phase 3 RA, the contractor will build approximately 3.18 acres of tidal wetlands and approximately 1.59 acres of freshwater wetlands in the Panhandle Area in accordance with the DBR (ERRG, 2014; KEMRON, 2018).

Waste generated during RA construction and grading activities, including soil, sediment, and non-recyclable or non-reusable debris, provided it met the consolidation criteria, was consolidated on site to establish the top of foundation layer elevation (ERRG, 2014). Radiologically cleared debris such as concrete, bricks, timber, metal, etc., were resized and reshaped as necessary, and buried at least 5 feet below the final protective layer to minimize the potential for damage to the final cover system. This depth was specified to result in a minimum cover thickness of 7 feet over consolidated debris, corresponding to 3 feet of cover fill over the debris, 2 feet of foundation layer soil, and 2 feet of cover soil over the liner. Based on the foundation grading plan, the northwest area of the landfill was selected for the waste (i.e., debris) consolidation area because it had the greatest capacity to receive waste while meeting the waste consolidation criteria established within the DBR (ERRG, 2014). An estimated 9,754 cy of debris was generated during grading operations (APTIM, 2021).

Durable Cover Installation

Durable covers at Parcel E-2 will be constructed under the Phase 3 RA, anticipated to be complete in summer 2023 and will consist of vegetated soil cover over the entire parcel as follows:

- A minimum 2-foot thick foundation soil layer consisting of radiologically cleared soil located directly beneath a protective liner.
- A minimum 2-foot-thick soil cover (vegetative soil layer) with protective liner and demarcation layer in non-wetland areas, and a minimum 4-foot-thick soil cover in the new wetlands directly over the foundation layer, in accordance with the DBR (ERRG, 2014).

- A demarcation layer will be installed at the bottom of the vegetative soil cover where necessary to mark the potential presence of remaining radiological hazardous substances.
- All non-wetland areas will be covered with a protective liner that will include a geocomposite drainage layer. In non-wetland areas that are radiologically impacted, the upper layer of geotextile fabric within the geocomposite drainage layer will also serve as the demarcation layer. That is, the upper layer of fabric will be orange-colored and overlain by magnetic marking tape, and will then be covered by 2 feet of soil (KEMRON, 2018).

Radiologically cleared soil was reused for construction of the final foundation layer. A portion of the foundation layer and the remaining layers of the covers are pending installation.

Shoreline Revetment

The shoreline revetment was installed along approximately 1,800 feet of shoreline where Parcel E-2 meets Parcel F. The revetment is approximately 35 feet wide with a crest elevation of +9 feet msl. A concrete seawall is incorporated into the crest of the revetment to protect against additional wave run-up from the design storm conditions (CB&I, 2016; APTIM, 2021). During the installation of the shoreline revetment an additional excavation 6 feet into Parcel F was completed to assure the integrity of the revetment structure during future remediation activities within the San Francisco Bay (APTIM, 2021). After the installation of the shoreline revetment, 4 piezometers, 3 monitoring wells, and 13 leachate monitoring/extraction wells were installed, predominantly in accordance with the DBR (ERRG, 2014; APTIM, 2021).

Belowground Barrier (Slurry Walls)

Two belowground barriers were installed as follows:

- A nearshore cement-bentonite slurry wall was installed during the Phase 1 Parcel E-2 RA to control discharge of contaminated groundwater. This slurry wall was installed near the shoreline adjacent to the Parcel E-2 Landfill and eastern boundary of the parcel (**Figure 6-4**). The nearshore slurry wall extends about 1,250 feet along the western edge of the landfill waste, to the Parcel E boundary to the south. It is aligned with the shape of the Parcel E-2 shoreline to prevent groundwater located bayward of the landfill waste from contacting surface water in San Francisco Bay and divert nearshore groundwater flow to the southeast toward adjacent Parcel E (Gilbane, 2014). At Parcel E-2, an aquitard exists in the form of a Bay Mud layer, the top of which is located between 4 and 18 feet bgs. The specifications dictated that the nearshore slurry wall would be keyed a minimum of 2 feet into the Bay Mud aquitard, and would extend up to 2.5 feet below the design finish grade (ERRG, 2014).
- An upland cement-bentonite slurry wall was installed during Phase 2 Parcel E-2 RA. As designed, the upland slurry wall extends approximately 571 feet from the northern parcel boundary to the southern extent of the landfill waste in the western portion of Parcel E-2 (ERRG, 2014; APTIM, 2021). It is aligned perpendicular to the direction of groundwater flow in the western portion of the site to divert upgradient offsite groundwater away from groundwater that contacts landfill waste. As designed, the upland slurry wall is considered a “hanging” slurry wall because it was not intended to key into an aquitard. The upland slurry wall was designed to be installed from the planned finish grade, down through a thin noncontiguous lens of Bay Mud, to an elevation of approximately -10 feet below msl. Some groundwater will flow under the upland slurry wall, but groundwater modeling predictions (ERRG, 2014) indicate that upgradient flow will mostly be diverted around the upland slurry wall or diverted to the freshwater wetland via a French drain installed on the upgradient side

of the upland slurry wall to divert groundwater and surface water runoff to the freshwater wetland (APTIM, 2021). The French drain consisted of a buried 4-inch perforated schedule 80 PVC pipe embedded within the trench filled with gravel and geofabric (APTIM, 2021).

Landfill Gas Controls and Monitoring

During the Phase 3 RA, a new gas control and collection system (GCCS) will be installed, anticipated in summer 2023, consisting of active LFG extraction wells; conveyance piping; an extraction blower; a methane and non-methane organic compounds (NMOC) LFG treatment system; an existing LFG collection trench; subsurface methane monitoring probes, and methane monitoring points throughout the GCCS to monitor its successful operation. An existing barrier wall and LFG collection trench was installed from August 2002 to May 2003 along the northern Parcel E-2 boundary to address LFG migration beneath the University of California San Francisco (UCSF) facility. The barrier is approximately 1,475 feet long and consists of interlocking high-density polyethylene panels installed to depths below the water table in that region. The LFG collection trench was installed between the barrier wall and the landfill waste. It consists of a perforated pipe wrapped with geotextile and set above the seasonal high water table and surrounded with backfilled sand and gravel. Ten SVE wells will be decommissioned and 34 LFG extraction wells installed. Major components of the LFG treatment facility include an electric blower; activated carbon and potassium permanganate pre-treatment adsorptive filters to remove NMOCs; an enclosed ground flare to oxidize methane; and a condensate collection and storage system. The LFG treatment facility will be located in the East Adjacent Area. Eighteen additional gas monitoring probes will be installed to complete the network (KEMRON, 2018).

The purpose of monitoring the landfill surface is to confirm that the remedy (including the GCCS, soil cover, and protective liner) is inhibiting emissions of fugitive LFG and maintaining ambient concentrations of NMOCs less than site-specific action levels (KEMRON, 2018).

Groundwater Monitoring

Groundwater is sampled through the BGMP. At Parcel E-2 groundwater LTM was initiated in 2012 and consisted of sampling 13 groundwater monitoring wells screened in the A-aquifer and B-aquifer for VOCs, SVOCs, metals (including chromium VI), PCBs, pesticides, and TPH. Radionuclides are also sampled at Parcel E-2 to verify that ROPCs are not being mobilized in groundwater. Exceedances of the RGs or TLs (identified as PALs) from 2019, 2020, 2021, and 2022 are presented in **Appendix E**. Arsenic, cyanide, un-ionized ammonia, and TPH have exceeded comparison criteria in one or more location during one or more sampling events during this review period. The monitoring wells are all located upgradient from the slurry wall discussed in the previous section.

The RA is in progress and the monitoring network has been changed throughout construction activities due to well decommissioning, access, and/or other issues to prevent sampling. Therefore, monitoring data do not provide insight into the effectiveness of the RA but can provide pre-RA completion baseline information.

The current monitoring program will continue in accordance with the selected remedy identified in the ROD (Navy, 2012). RA is currently being conducted in Parcel E-2 in accordance with the Final Design Basis Report (ERRG, 2014) and Work Plan (CB&I, 2016). Once the RA is completed the Parcel E-2 data will be collected as part of the BGMP.

Radiological Surveys and Remediation

The ROPCs at Parcel E-2 include Co-60, Cs-137, Ra-226, and Sr-90 (Navy, 2012). The Navy conducted TCRAs at Parcel E-2 to address potential radioactive contamination at several areas, including the PCB Hotspot Area, Metal Slag Area, and Ship Shielding Area (Gilbane, 2018a) and is addressing potential residual radioactive contamination at the Parcel E-2 landfill and adjacent areas through RAs (APTIM, 2019a, 2019b, 2021; Gilbane, 2019).

Institutional Controls

The entire area of Parcel E-2 (about 47 acres) is subject to ICs. IC performance objectives were developed and presented in the LUC RD (CES, 2018b). The IC performance objectives to be implemented through land use restrictions for the site are summarized in **Table 1-2**. The Navy currently controls land use and access to the parcel while RAs are ongoing.

6.4.2.2 Remedy Operations and Maintenance

Because remedy construction is not complete and is ongoing, there are no O&M activities related to the RA. However, O&M activities related to the existing landfill and landfill gas monitoring are ongoing.

Landfill Cap Inspections

The existing landfill cap area is inspected to ensure the integrity of the interim landfill cap and landfill gas control and monitoring system (Tetra Tech, 2003). The inspection typically includes inspecting the property fence, gas vents, vegetation and irrigation system, burrowing animals and deterrent system, and conducting settlement surveys. Since the remedy construction was initiated in 2019 vegetation and the top foot of soil, irrigation system, and burrowing animal deterrents were removed and settlement surveys were discontinued until the final remedy is in place (INYA, 2022).

Landfill Gas Monitoring

Landfill gas is currently monitored and reported in accordance with the Final Interim Landfill Gas Monitoring and Control Plan (Tetra Tech, 2004). Methane concentrations were generally below action levels until spring 2020 when methane exceeded action levels at the fenceline. Concentrations remained generally below action levels until July 2021 and December 2021 when the active venting system was turned on and powered by a generator beginning in January 2022 (INYA, 2022). The system is currently operational and powered by solar power (INYA, 2023). Methane concentrations were below action levels after the system was turned on until December 2022 when methane exceeded action levels at the fence line again. The exceedance was being investigated at the time the quarterly report was being prepared (INYA, 2023). Methane concentrations did not exceed at the monitoring points on UCSF property during October 2018 to December 2022 monitoring period. NMOC concentrations have been below action levels for all monitoring areas through the period from January 2019 until December 2022 (INYA, 2023). On June 21, 2023, the Navy detected a methane gas reading above the State of California action level at an HPNS landfill gas monitoring probe. The probe is located inside the landfill perimeter. It is approximately 200 feet southeast of the UCSF compound, which borders the Parcel E-2 boundary.

Upon notification of the reading, the Navy notified UCSF, the California Department of Recycling and Recovery, and the HPNS Base Closure Team. The Navy has increased the frequency of monitoring at the gas monitoring probe with the elevated reading to determine if this was an isolated case. To date, readings continue to remain elevated at that location. To provide protectiveness of human health, the Navy is measuring the air to confirm no methane is escaping from the gas monitoring probe or the landfill perimeter. The Navy has not detected any methane. The Navy will maintain the increased monitoring frequency through resolution of this situation and is collaborating with regulatory agencies to resolve the methane issue.

6.4.3 Parcel UC-3

The RA for Parcel UC-3 includes the following major components:

- Soil hotspot excavation and removal to address COCs in soil
- Steam line closure
- Durable cover installation and maintenance to address COCs in soil
- Soil gas sampling to identify areas impacted by VOCs
- In situ treatment and MNA for VOCs in groundwater
- Radiological surveys and remediation through soil excavation, removal of sanitary sewer and storm drain lines, and TCRAs
- ICs for soil and groundwater

Remedy components are shown on **Figure 6-1, 6-2,** and **6-5**.

6.4.3.1 Remedy Implementation

Soil Hotspot Excavation and Removal

Soil excavations were conducted in April and November 2017 to remove soil to levels below 5 times the RG for residential exposure. Three hotspot areas were excavated for a total of 783 cubic yards. Excavations were backfilled with clean fill. Response complete for soil was documented in the RACR for Parcel UC-3 (Gilbane, 2018c).

Steam Line Closure

As discussed in the Parcel E summary, the steam lines at HPNS may have been a source of contamination so steam line closure was included as a remedy component. Steam line closure RAs for Parcel UC-3 were determined post-ROD to be unnecessary to protect human health and the environment because (1) the portion of the steam line within Parcel UC-3 was not used for conveying oil; (2) the portion of the steam line system within Parcel UC-3 was assessed during previous site investigations with no evidence of contamination; and (3) the portions of the steam line system within Parcel UC-3 are outside of the area where previous investigations identified waste oil impacts in the steam lines (AFW, 2016a).

Durable Cover Installation

Durable covers consisting of asphalt concrete were installed in the eastern portion of Crisp Road to eliminate the exposure pathway for residual contamination left in place (**Figure 6-5**). Durable covers were not required in the railroad right-of-way or on Crisp Road between the right-of-way and Redevelopment Block MU-3. Completion of the durable covers along with ICs as discussed in **Section 1.3.4.2** meets the RAOs for soil in Parcel UC-3; response complete is documented in the RACR for Parcel UC-3 (Gilbane, 2018c). Covers consisted of:

- Existing asphalt concrete pavement that did not require repairs
- Existing concrete sidewalks and concrete utility trench and covers
- Repaired asphalt concrete to a minimum 4-inch thickness

- Newly installed minimum 4-inch thick asphalt concrete over areas where a cover had not been or where the existing pavement could not be repaired

Soil Gas Monitoring

A soil gas survey was conducted to confirm whether the ARIC for potential VOCs in groundwater and soil gas was warranted. Samples were collected from three soil gas probes in May 2017 and benzene exceeded the project screening goal of 8.39 micrograms per cubic meter with a concentration of 10 micrograms per cubic meter, resulting in the retention of the ARIC (Gilbane, 2018c).

In situ Groundwater Remediation and Monitoring

ISB and MNA were selected in the ROD to reduce VOCs, specifically TCE, in groundwater; however, based on historical and current (2018) data, TCE concentrations were below RGs since 1996 and below the 2.9 µg/L vapor intrusion criteria since 2009 (Gilbane, 2018c). Additional remediation for groundwater was not warranted since TCE concentrations were below RGs and natural attenuation processes had effectively reduced COCs below vapor intrusion criterion. Since RGs were met, groundwater is response complete for unlimited use/unrestricted exposure which is documented in the RACR for Parcel UC-3 and no further groundwater sampling is warranted (Gilbane, 2018c).

Radiological Surveys and Remediation

The ROCs suspected to be present at Parcel UC-3 include Cs-137, Ra-226, and Sr-90 (Navy, 2014). The Navy conducted TCRAs at Parcel UC-3 to address potential radioactive contamination in storm drains and sanitary sewer lines (TtEC, 2012a). In total, approximately 18,024 cubic yards of soil were excavated during removal of approximately 18,363 linear feet of sanitary sewer and storm drain lines. Approximately 1,879 cubic yards of soil was disposed of offsite as LLRW based on surface scan and analytical laboratory results.

The TCRA data was reviewed as described in **Section 1.4.3** and radiological retesting, including sampling and surveys of soils previously investigated during sanitary sewer line storm drain removal and resurvey of impacted buildings and former building sites, is currently being conducted to determine if current site conditions are compliant with the RAOs.

Institutional Controls

The entire area of Parcel UC-3 (about 11 acres) is subject to ICs prohibiting growing produce in native soil and use of groundwater. The portion of Parcel UC-3 that is adjacent to Parcel E is also subjected to general soil and groundwater ICs and a small portion is subject to ICs related to VOCs (**Figure 6-2**). IC performance objectives were developed and presented in the LUC RD (AFW, 2016b). The IC performance objectives to be implemented through land use restrictions for the site are summarized in **Table 1-2**.

6.4.3.2 Remedy Operations and Maintenance

Ongoing O&M at Parcel UC-3 includes maintaining the integrity of the durable covers and IC inspections. The inspection and maintenance requirements for the durable covers are described in the Final O&M Plan for Parcel UC-3 (Gilbane, 2018b). AOMSRs are prepared to summarize inspections and maintenance performed and to document the effectiveness of the remedy components. AOMSRs from 2019, through 2023 were reviewed (Innovex-ERRG Joint Venture, 2020, 2021a; APTIM, 2022, 2023).

Durable Cover Maintenance

In general, the durable covers were in good condition with some minor deterioration around metal trench plates and a storm drain that were repaired in 2022 (APTIM, 2023). The metal trench plates were installed to temporarily cover sections of the road that were deteriorated but are frequently used by heavy trucks during RA activities at Parcels E and E-2.

Institutional Controls Compliance

ICs are inspected annually and no deficiencies or inconsistent uses were observed during the reviews. General site conditions were determined to be good. Remedy components such as survey benchmarks and monitoring well vault covers were found to be in good condition.

Navy controls access to the portion of the parcel adjacent to Parcel E using security fencing, signage, locks, and gates which were found to be in good condition, with no signs of damage or vandalism. The remaining portion of the parcel did not show any indications of incompatible land use.

6.4.4 Progress Since the Fourth Five-Year Review

Issues, recommendations, and follow-up actions from the Fourth Five-Year Review are summarized in **Table 6-7**.

6.5 Technical Assessment

While the remedy construction is not complete for Parcels E and E-2, evaluation of Technical Assessment Question A is not feasible. However, because the RODs were signed in 2013 and 2012, respectively, Technical Assessment Question B is evaluated. Because the remedy is still under construction, the Navy considers a Will Be Protective determination to be appropriate for Parcels E and E-2.

6.5.1 Question A: Is the Remedy Functioning as Intended by the Decision Document?

Parcel E

Technical assessment related to remedy function was not conducted because the remedy is still under construction. However, the remedy is being constructed in accordance with the requirements in the ROD (Navy, 2013), Design (CES, 2018a), and RAWPs (APTIM, 2019a, 2019b; Gilbane, 2019). Controls such as a temporary sheet pile wall and silt fencing are in place to prevent erosion and migration of subsurface contaminants during construction.

Parcel E-2

Technical assessment related to remedy function was not conducted because the majority of the remedy is still under construction or O&M data collection is still in progress for an evaluation. However, the remedy is being constructed in accordance with the requirements in the ROD (Navy, 2013), DBR (ERRG, 2014), and RAWP (KEMRON, 2018). The nearshore slurry wall has been constructed; hot spots have been excavated and removed; and a portion of the landfill cover base has been installed (Gilbane, 2018a). The remaining remedy construction is ongoing. Landfill gas is being monitored under the interim monitoring plan, and active venting is ongoing to reduce methane concentrations to below action levels at the points of compliance.

Parcel UC-3

Yes. Based on the review of historical documents, annual O&M inspections, and the Five-Year Review inspection the remedy at Parcel UC-3 is functioning as intended.

Soil hotspot areas were removed through excavation and offsite disposal. Exposure pathways to residual COCs that could result in an unacceptable risk are being controlled through durable covers and ICs. Asphalt cover is in good condition, and any minor issues have been repaired. Groundwater has met RGs and response complete. Radiological concerns are addressed through previous radiological surveys and remediation of soil and structures (utilities) and radiological retesting, with the goal of unrestricted closure.

6.5.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used at the Time of the Remedy Selection Still Valid?

Parcels E and E-2

Because the remedy is still under construction at Parcels E and E-2, only toxicity data and cleanup levels used at the time of remedy selection are evaluated for Question B.

Any changes in toxicity data or cleanup levels would not affect protectiveness because protectiveness is assured through the remedies for soil (excavation, durable covers and/or landfill cover, and ICs) that prevent exposure to COCs in soil. Similarly, although there may be changes with HHRA analysis for the construction worker scenario exposure to A-aquifer groundwater, those changes will not affect protectiveness because ICs will require identification and management of potential risks to construction workers.

Although residential use is an unlikely use scenario, the ROD establishes residential use-based cleanup levels for groundwater in the B-aquifer that are either a risk-based calculation, based on background, or established ARARs. **Tables 6-8** and **6-9** show the RGs and current comparison criteria for groundwater use as a domestic supply for Parcels E and E-2, respectively. There have been no changes since the ROD for Parcel E. There are three COCs with current comparison criteria that are lower than the RG for Parcel E-2:

- The RG for 1,2,3-tricholoropropane (1 µg/L) was based on the practical quantitation limit at the time of the ROD (2012); however, the California MCL of 0.005 µg/L was promulgated in 2017 and the California MCL was identified as an ARAR.
- The RG for 4-nitrophenol is a risk-based calculation and is higher than the RSL for nitrobenzene, which is used as a proxy for 4-nitrophenol. The toxicity and chemical-specific information for nitrobenzene has not changed since the ROD was signed in 2012 and there have been no changes in exposure assumptions or site conditions that would affect the risk-based assumptions used in the ROD. Therefore, the RG for 4-nitrophenol remains protective.
- The risk-based RG for chromium VI is higher than the current RSL. The toxicity and chemical-specific information for chromium VI has also not changed since the ROD was signed in 2012 and there have been no changes in exposure assumptions or site conditions that would affect the risk-based assumptions used in the ROD. Therefore, the RG for chromium VI remains protective.

These changes do not affect protectiveness because parcel-wide ARICs prohibit the use of groundwater. Further, all three COCs were below detection limits during the 2022 BGMP sampling (TRBW, 2023). However, because 1,2,3-trichloropropane is based on an ARAR and the ARAR has changed since the ROD was signed, the Navy intends to update the BGMP to use a laboratory method that can meet the level of detection required to meet the California MCL of 0.005 µg/L and prepare post-ROD change documentation to update the RG for 1,2,3-trichloropropane consistent with the current ARAR.

Parcel UC-3

Yes. Based on the results of the ARAR evaluation and HHRA analysis discussed in the following sections, the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection are still valid. Although there have been some changes to toxicity values and risk assessment methods, these changes do not affect remedy protectiveness.

ARAR Evaluation

The Navy evaluated the ARARs established in the ROD for Parcel UC-3. No changes to location-specific or action-specific ARARs that would affect the protectiveness of the remedies were identified. Changes to chemical-specific ARARs for individual chemicals are discussed in the HHRA Analysis below.

The California Public Resources Code Division 20.6.5, California Sea Level Rise Mitigation and Adaptation Act of 2021, was passed in 2021; however, no regulations have been promulgated to implement the Act. The Navy is addressing SLR as discussed in **Section 1.4.2** of this Five-Year Review.

HHRA Analysis

As **Section 3.5.2.1** notes, in 2018, the State of California promulgated the TCR. However, the Navy continues to view the values identified in the USEPA IRIS database (a Tier 1 value) as the primary source of toxicity factors for risk-related calculations. The HHRA evaluation was conducted by comparing the human health RGs from the ROD to current risk-based criteria based on the same exposure scenario, and ARARs, if available. Response complete for soil at UC-3 is achieved with hotspot excavation, durable cover construction and maintenance, and ICs as documented in the RACR for Parcel UC-3 (Gilbane, 2018b). Therefore, any changes in exposure assumptions and toxicity data for soil COCs would not affect protectiveness of the remedy.

Table 6-10 shows the RGs and current comparison criteria for groundwater. The RGs for the groundwater COCs included in the Parcel UC-3 ROD are based on consideration of exposure scenario-specific (construction worker trench exposure [A-aquifer]) risk-based concentrations (based on a cancer risk of 10^{-6} or a noncancer hazard index of 1), laboratory PQLs, chemical-specific ARARs, and Hunters Point groundwater ambient levels. There were only three groundwater COCs identified for Parcel UC-3: TCE, 1,2-dichloroethene (total), and VC.

While the construction worker scenario was selected as the only risk pathway for Parcel UC-3 RGs were compared to the following current comparison criteria for UU/UE:

- A-aquifer groundwater: VISLs calculated using the current USEPA VISL calculator for the residential and commercial scenarios (USEPA, 2022a).

Although the comparison criteria are lower than the RG, as discussed in **Section 6.4.3**, TCE was the only COC that was detected in groundwater and was below the 2008 groundwater criterion for vapor intrusion (2.9 µg/L) in 2009 and subsequent monitoring events. The groundwater data from 2015 and 2016 (final four sampling events) was below laboratory detection limits, which ranged from 0.3 to 0.5 µg/L (Gilbane, 2018b). Therefore, the conditions for UU/UE related to groundwater have been met and changes in toxicity, exposure scenarios, and ARARs do not affect protectiveness.

Radiological Risk Review

In October 2020, after the preparation of the Five-Year Review addenda, USEPA introduced a PRG calculation method called "Peak PRG," which computes PRGs accounting for ingrowth and decay of progeny over time. An evaluation was performed for this Five-Year Review to assess whether this change affected the continued protectiveness of the current soil RGs for future residents. Exposure calculations were performed using the USEPA PRG Calculator (USEPA, 2022b). For this soil evaluation, the estimated excess cancer risk was calculated using the "Peak Risk" time interval of 1,000 years (Navy, 2020). The soil RGs were used as exposure point concentrations and the cumulative cancer risk was calculated as the sum of risks from all ROCs. **Appendix F** presents the calculated estimated excess cancer risks calculated from this evaluation and the supporting data. Under CERCLA, cleanup goals are considered protective if excess cancer risks from site exposures remain withing the 10^{-4} to 10^{-6} range. Based on the findings of this evaluation, the soil RGs are within this range and are protective for future residential exposures.

There were no changes to the risk assessment methods related to structures or buildings for radiological concerns since the last Five-Year Review.

6.5.3 Question C: Has Any Other Information Come to Light that Could Question the Protectiveness of the Remedy?

Yes. As identified in the Fourth Five-Year Review there is uncertainty with a portion of the radiological survey and remediation work. The Navy is in the process of implementing corrective actions to ensure the radiological remedies specified in the decision documents were implemented as intended; however, this work is ongoing. Radiological retesting is currently being conducted at Parcel UC-3; long-term protectiveness will be confirmed upon completion.

6.6 Issues, Recommendations, and Follow-up Actions

Issues, recommendations, and follow-up actions were identified for Parcel UC-3 as summarized in **Table 6-9**.

6.6.1 Other Findings

The following findings were identified that do not directly relate to achieving or maintaining remedy protectiveness but are relevant to overall site management.

6.6.1.1 PFAS

As discussed in **Section 1.4.1**, a Basewide PA was conducted to identify potential PFAS release areas based on historical use or limited sampling data. There were no individual areas identified for investigation in the form of an SI with the exception of the general approach to sample all A-aquifer groundwater beneath Parcels E and E-2 (Multi-MAC JV, 2022). During the SI, PFOA, PFOS, PFNA, PFHxA (Parcel E-2 only), and PFHxS exceeded project screening levels in soil and groundwater and additional investigation was recommended (Liberty JV, 2023).

There were no areas identified for investigation at Parcel UC-3. Exposure to groundwater is restricted by ICs within the HPNS, and the City and County of San Francisco prohibits installation of domestic wells within city and county limits.

6.6.1.2 Climate Resilience

The CRA estimates that groundwater emergence from SLR may occur within Parcel E by the year 2065 (**Appendix A**). There are no estimated effects from SLR on Parcel UC-3. Some vulnerabilities to climate change were identified for Parcel E-2.

A site-specific study at Parcel E is recommended to assess whether the projected climate change vulnerabilities are likely to result in additional CERCLA risk.

At Parcel E-2, potential vulnerabilities were identified that could affect the LFG treatment system, such as vulnerability to power outages from extreme weather events or wildfires. However, O&M of the remedy includes routine inspections conducted during monitoring events and inspections following any catastrophic event (earthquakes, floods, or fires and explosions). Repairs will be made promptly for continued operation and to ensure protectiveness of the remedy (ERRG, 2014). The Parcel E-2 remedy design includes several additional components that make the remedy resilient through the year 2065 including the seawall, slurry walls, and freshwater and tidal wetlands that are discussed in detail in **Appendix A**.

6.6.1.3 Site Management Strategy

Parcel UC-3 groundwater has achieved response complete and poses no unacceptable risk for unlimited use/unrestricted exposure (Gilbane, 2018b). The Navy plans to remove groundwater ICs, which are no longer necessary to ensure protection of human health and the environment.

6.6.1.4 Remediation Goal Updates

The California MCL for 1,2,3-trichloropropane was promulgated after the Parcel E-2 ROD was finalized. The Navy intends to prepare post-ROD change documentation in the form of a memo to file to reflect this change.

6.7 Statement of Protectiveness

6.7.1.1 Parcel E

Protectiveness Determination: Will Be Protective

Protectiveness Statement: The remedy at Parcel E Will be Protective upon completion of remedy construction and completion of the radiological retesting.

In the interim, exposures to COCs in soil, sediment, and groundwater are being controlled during construction using temporary sheet piles, erosion control measures, security fencing to prevent unauthorized access, and ICs. The RAOs for soil will be met through excavation and offsite disposal, closure of fuel and steam lines, installation of durable covers, and ICs. The RAOs for soil gas will be met through SVE or excavation to address VOCs, and ICs. The RAOs for shoreline sediment will be met through excavation and offsite disposal, durable cover installation, shoreline protection, and a sea wall. The RAOs for groundwater will be met through in situ groundwater treatment, installation of a belowground barrier, monitoring, and ICs.

The RAOs for radiologically impacted media will be met through radiological surveys, decontamination, and removal of radiologically impacted structures and soil and sediment, and ICs. The RAOs for NAPL will be met through removal and treatment of NAPL source, ISS, and containment.

Soil excavation to remove COC- and radiologically impacted soil has been completed. The following remedy components are under construction: installation of the shoreline armored revetment and the cement-bentonite slurry wall and belowground barrier, removal of sanitary sewer and storm drain lines, and excavation of NAPL followed by initiation of the ISS treatment. Groundwater is currently being monitored through the BGMP.

6.7.1.2 Parcel E-2

Protectiveness Determination: Will Be Protective

Protectiveness Statement: The remedy at Parcel E-2 Will be Protective upon completion of remedy construction.

Soil and sediment hotspots have been removed and the final cover is currently under construction. Landfill gas venting and monitoring is ongoing during construction activities. Exposure to soil and groundwater is currently being controlled through security fencing to prevent unauthorized access, signage, and ICs. The RAOs for soil will be met through hotspot removal, soil cover and sea wall, and ICs.

The radiological RAOs will be met through radiological screening and removal, installation of a soil cover with demarcation layer, and ICs. The RAOs for landfill gas will be met through landfill gas monitoring, removal, and treatment, landfill cover monitoring, and ICs. The RAOs for groundwater will be met through LTM and ICs. The RAOs for surface water will be met through installation of the protective soil cover, slurry walls, diversion to tidal and non-tidal constructed wetlands, and outfall monitoring.

The following activities have been completed: soil excavation to remove COC- and low-level radiologically impacted soil, installation of soil layer of radiologically cleared soil and a soil cover, installation of the shoreline armored revetment, cement-bentonite slurry walls along the shoreline and in the upland portion of the parcel, and the installation of a portion of the landfill gas collection and treatment system. Groundwater is currently being monitored through the BGMP.

6.7.1.3 Parcel UC-3

Protectiveness Determination: Short-term Protective

Protectiveness Statement: The remedy at Parcel UC-3 is currently protective of human health and the environment. In order to determine whether the remedy can be considered protective in the long term, the radiological retesting work must be completed.

The RAOs for soil are met through hotspot excavation, durable covers and ICs. Groundwater RGs have been met. Radiological retesting is planned to confirm that levels in soil are protective of human health. Until retesting is complete, short-term protectiveness is met through Navy controls such as access to the parcel through fencing, locked gates, and ICs (restricting intrusive work and maintaining durable covers).

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Table 6-1. Parcels E and UC-3 Chemicals of Concern and Remediation Goals

Exposure Medium	Exposure Scenario	Chemical of Concern	ROD Remediation Goal (2013, 2014)	Source of Remediation Goal	Parcel
Soil (mg/kg)	Residential	3,3'-Dichlorobenzidine	1.6	RBC	E
		4-Nitrophenol	0.29	RBC	E
		4,4'-DDD	2.1	RBC	E
		4,4'-DDE	1.6	RBC	E
		Aldrin	0.024	RBC	E
		alpha-BHC	0.0019	RBC	E
		Antimony	10	RBC	E, UC-3
		Aroclor-1254	0.093	RBC	E
		Aroclor-1260	0.21	RBC	E, UC-3
		Arsenic	11.1	HPAL	E
		Benzene	0.18	RBC	E, UC-3
		Benzo(a)anthracene	0.37	RBC	E, UC-3
		Benzo(a)pyrene	0.33	PQL	E, UC-3
		Benzo(b)fluoranthene	0.34	RBC	E, UC-3
		Benzo(k)fluoranthene	0.34	RBC	E, UC-3
		Bis(2-ethylhexyl)phthalate	1.1	RBC	E, UC-3
		Cadmium	3.5	RBC	E, UC-3
		Carbazole	2.2	RBC	E
		Copper	160	RBC	E, UC-3
		Dibenz(a,h)anthracene	0.33	PQL	E, UC-3
		Dieldrin	0.0033	PQL	E
		gamma-BHC	0.0026	PQL	E
		Heptachlor epoxide	0.0017	RBC	E, UC-3
		Indeno(1,2,3-cd)pyrene	0.35	RBC	E, UC-3
		Iron	58,000	HPAL	E, UC-3
		Lead	155	RBC	E, UC-3
		Manganese	1,431	HPAL	E, UC-3
		Mercury	2.28	HPAL	E, UC-3
		n-Nitroso-di-n-propylamine	0.33	PQL	E
		n-Nitrosodiphenylamine	0.68	RBC	E
		Naphthalene	1.7	RBC	E
		Pentachlorophenol	2.6	RBC	E
		Thallium	5	RBC	E, UC-3
		Vanadium	117	HPAL	E, UC-3
		Trichloroethene	2.9	RBC	E
		Zinc	370	RBC	E, UC-3
		Xylene	270	RBC	E, UC-3
		Total TPH [a]	3,500	--	E, UC-3
	Recreational	Aroclor-1254	0.74	RBC	E
		Aroclor-1260	0.74	RBC	E, UC-3
		Arsenic	11.1	HPAL	E, UC-3
		Benzo(a)anthracene	1.3	RBC	E, UC-3
		Benzo(a)pyrene	0.33	PQL	E, UC-3
		Benzo(b)fluoranthene	1.3	RBC	E, UC-3
		Benzo(k)fluoranthene	1.3	RBC	E, UC-3
		Chrysene	13	RBC	E
		Copper	470[a]	--	E, UC-3
		Dibenz(a,h)anthracene	0.33	PQL	E, UC-3
		Dieldrin	0.12	RBC	E
		Heptachlor epoxide	0.21	RBC	E, UC-3
		Indeno(1,2,3-cd)pyrene	1.3	RBC	E, UC-3
		Lead	155	RBC	E, UC-3
		Manganese	2,430	RBC	E, UC-3
		Mercury	210	RBC	E, UC-3
		n-Nitroso-di-n-propylamine	0.33	PQL	E
		Zinc	719[a]	--	E
		Total TPH [a]	3,500	--	E, UC-3

Table 6-1. Parcels E and UC-3 Chemicals of Concern and Remediation Goals

Exposure Medium	Exposure Scenario	Chemical of Concern	ROD Remediation Goal (2013, 2014)	Source of Remediation Goal	Parcel
Soil (mg/kg)	Industrial	Arsenic	11.1	HPAL	UC-3
		Benzo(a)anthracene	1.8	RBC	UC-3
		Benzo(a)pyrene	0.33	PQL	UC-3
		Benzo(b)fluoranthene	1.8	RBC	UC-3
		Benzo(k)fluoranthene	1.8	RBC	UC-3
		Copper	76000	RBC	UC-3
		Dibenz(a,h)anthracene	0.33	PQL	UC-3
		Indeno(1,2,3-cd)pyrene	1.8	RBC	UC-3
		Lead	800	RBC	UC-3
		Total TPH [a]	3500	--	UC-3
	Construction Workers	1,2,4-Trichlorobenzene	230	RBC	E
		1,2,4-Trimethylbenzene	170	RBC	E
		1,3,5-Trimethylbenzene	69	RBC	E
		Aldrin	0.54	RBC	E
		Antimony	120	RBC	E, UC-3
		Aroclor-1248	2.1	RBC	E
		Aroclor-1254	2.1	RBC	E
		Aroclor-1260	2.1	RBC	E, UC-3
		Arsenic	11.1	HPAL	E, UC-3
		Benzene	9.4	RBC	E, UC-3
		Benzo(a)anthracene	6.4	RBC	E, UC-3
		Benzo(a)pyrene	0.65	RBC	E, UC-3
		Benzo(b)fluoranthene	6.5	RBC	E, UC-3
		Benzo(k)fluoranthene	6.5	RBC	E, UC-3
		Copper	11,000	RBC	E, UC-3
		Dibenz(a,h)anthracene	1.1	RBC	E, UC-3
		Dioxins/furans (TEQ)[b]	0.000023	--	E
		Indeno(1,2,3-cd)pyrene	6.5	RBC	E, UC-3
		Iron	93,000	RBC	E, UC-3
		Lead	800	RBC	E, UC-3
		Manganese	6,900	RBC	E, UC-3
		Mercury	93	RBC	E, UC-3
		n-Nitroso-di-n-propylamine	1.3	RBC	E
		Naphthalene	75	RBC	E
		Nickel	5,800	RBC	E
		Vanadium	310	RBC	E, UC-3
		Total TPH [a]	3,500	--	E, UC-3
Shoreline Sediment (mg/kg)	Ecological Receptors	Cadmium	3.14	HPAL	E
		Copper	124	HPAL	E
		Lead	218	RBC	E
		Mercury	2.28	RBC	E
		Molybdenum	2.68	HPAL	E
		Zinc	158	SF Bay Ambient Level	E
		Total DDT	0.0461	RBC	E
		Total Aroclors (PCBs)	0.2	SF Bay Ambient Level	E

Table 6-1. Parcels E and UC-3 Chemicals of Concern and Remediation Goals

Exposure Medium	Exposure Scenario	Chemical of Concern	ROD Remediation Goal (2013, 2014)	Source of Remediation Goal	Parcel
Groundwater (µg/L)	Construction Worker Exposure to A-Aquifer Groundwater	1,2-Dichloroethene (total)	270	RBC	E, UC-3
		1,4-Dichlorobenzene	52	RBC	E
		Arsenic	39	RBC	E
		Benzo(a)anthracene	0.65	RBC	E
		Benzo(a)pyrene	0.05	PQL	E
		Benzo(b)fluoranthene	0.45	RBC	E
		Chrysene	6.7	RBC	E
		Indeno(1,2,3-cd)pyrene	0.31	RBC	E
		Naphthalene	16	RBC	E
		Pentachlorophenol	50	PQL	E
		Tetrachloroethene	18	RBC	E
		Trichloroethene	290	RBC	E, UC-3
		Vinyl chloride	5.4	RBC	E, UC-3
	Domestic Use Exposure to B-Aquifer Groundwater	1,1- Dichloroethene	6	MCL	E
		cis-1,2- Dichloroethene	6	MCL	E
		trans-1,2- Dichloroethene	10	MCL	E
		1,4-Dichlorobenzene	5	MCL	E
		Arsenic	27.3	HPAL	E
		Manganese	8,140	HPAL	E
		Tetrachloroethene	5	MCL	E
		Thallium	12.97	HPAL	E
		Trichloroethene	5	MCL	E
		Vinyl chloride	0.5	MCL	E
	Aquatic Wildlife Exposure to A-Aquifer Groundwater	Total TPH (goals vary based on distance from the bay) [a]	1,400 to 20,000	--	E

[a] The total TPH remediation goal is based on the petroleum source criterion for HPNS

[b] Remediation goal for dioxins and furans is expressed as a TEQ, which is calculated by multiplying the concentration of each dioxin and furan congener by a toxicity equivalency factor established by the 2005 World Health Organization and based on each congener's toxicity relative to 2,3,7,8-tetrachlorodibenzo-p-dioxin.

Notes:

The distance-based T Distance from shoreline

Distance from shoreline Feet	Total TPH (µg/L)	Distance from shoreline Feet	Total TPH (µg/L)
0–<25	1,400	125–<150	6,949
25–<50	1,467	150–<175	9,539
50–<75	2,092	175–<200	12,604
75–<100	3,216	200–<225	16,145
100–<125	4,839	≥225	20,000

< = less than
µg/L = microgram(s) per liter
BHC = benzene hexachloride
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethene
DDT = dichlorodiphenyltrichloroethane
HPAL = Hunters Point ambient level
HPNS = Hunters Point Naval Shipyard
MCL = maximum contaminant level
mg/kg = milligram(s) per liter
PCB = polychlorinated biphenyl
PQL = practical quantitation limit
RBC = risk-based concentration
ROD = Record of Decision
TEQ = toxic equivalent quotient
TPH = total petroleum hydrocarbons

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Table 6-2. Parcel E-2 Chemicals of Concern and Remediation Goals

Exposure Medium	Exposure Scenario	Chemical of Concern	ROD Remediation Goal (2012)	Source of Remediation Goal
Soil & Sediment	Recreational (Soil)	Antimony	270	RBC
		Aroclor-1242	0.74	RBC
		Aroclor-1248	0.74	RBC
		Aroclor-1254	0.74	RBC
		Aroclor-1260	0.74	RBC
		Arsenic	11.1	HPAL
		Benzo(a)anthracene	1.3	RBC
		Benzo(a)pyrene	0.33	PQL
		Benzo(b)fluoranthene	1.3	RBC
		Benzo(k)fluoranthene	1.3	RBC
		Dieldrin	0.12	RBC
		Heptachlor epoxide	0.21	RBC
		Indeno(1,2,3-cd)pyrene	1.3	RBC
		Lead	155	RBC
		Total PCBs (Non-Dioxin)[a]	0.74	RBC
	Construction Worker (Soil)	4,4'-DDT	45	RBC
		Antimony	120	RBC
		Aroclor-1016	7.4	RBC
		Aroclor-1248	2.1	RBC
		Aroclor-1254	2.1	RBC
		Aroclor-1260	2.1	RBC
		Arsenic	11.1	HPAL
		Benzo(a)anthracene	6.5	RBC
		Benzo(a)pyrene	0.65	RBC
		Benzo(b)fluoranthene	6.5	RBC
		Benzo(k)fluoranthene	6.5	RBC
		Cadmium	150	RBC
		Copper	11,000	RBC
		Dibenz(a,h)anthracene	1.1	RBC
		Dieldrin	0.57	RBC
		Dioxin (TEQ)[b]	0.000023	RBC
		Heptachlor epoxide	1	RBC
		Indeno(1,2,3-cd)pyrene	6.5	RBC
		Iron	93,000	RBC
		Lead	800	RBC
		Manganese	6,900	RBC
		Naphthalene	75	RBC
		Total PCBs (non-dioxin)[a]	2.1	RBC
		Total TPH[c]	3,500	RBC
		Vanadium	310	RBC
	Terrestrial wildlife	Cadmium	4.2	RBC
		Copper	470	RBC
		Lead	197	RBC
		Manganese	2,433	RBC
		Mercury	1	RBC
		Nickel	1,941	RBC
		Vanadium	117	HPAL
		Zinc	719	RBC
		Total DDT	3.53	RBC
		Total PCBs	37	RBC
		Total HMW PAHs	231	RBC

Table 6-2. Parcel E-2 Chemicals of Concern and Remediation Goals

Exposure Medium	Exposure Scenario	Chemical of Concern	ROD Remediation Goal (2012)	Source of Remediation Goal
Soil & Sediment	Aquatic Wildlife	Antimony	25	RBC
		Copper	270	RBC
		Lead	218	RBC
		Mercury	0.71	RBC
		Nickel	112	RBC
		Zinc	410	RBC
		Total DDTs	0.046	RBC
		Dieldrin	0.008	RBC
		Endrin	0.045	RBC
		Total PCBs	0.18	RBC
Groundwater (µg/L)	Domestic Use of Deep Groundwater (B-Aquifer)	1,1-Dichloroethane	5	PQL
		1,2,3-Trichloropropane	1	PQL
		1,2-Dichloroethane	0.5	MCL
		1,4-Dichlorobenzene	5	MCL
		4-Nitrophenol[d]	3.4	RBC
		Aroclor-1016	0.5	MCL
		Aroclor-1242	0.5	MCL
		Aroclor-1254	0.5	MCL
		Aroclor-1260	0.5	MCL
		Arsenic	10	MCL
		Benzene	1	MCL
		Benzo(a)anthracene	0.2	MCL
		Benzo(a)pyrene	0.2	MCL
		Benzo(b)fluoranthene	0.2	MCL
		Benzo(k)fluoranthene	0.2	MCL
		Bis(2-ethylhexyl)phthalate	10	PQL
		beta-BHC	0.05	PQL
		Carbon tetrachloride	0.5	MCL
		Chloroform	80	MCL
		Chromium VI	109	RBC
		Chrysene	0.56	RBC
		Dibenz(a,h)anthracene	2	MCL
		Dieldrin	0.02	PQL
		Heptachlor	0.01	MCL
		Heptachlor epoxide	0.01	MCL
		Heptachlor epoxide A	0.01	MCL
		Heptachlor epoxide B	0.01	MCL
		Indeno(1,2,3-cd)pyrene	0.2	MCL
		Iron	10,950	RBC
		Lead	15	MCL
		Methylene chloride	5	MCL
		Naphthalene	1	PQL
		Tetrachloroethene	5	MCL
		Thallium	2	MCL
		Trichloroethene	5	MCL
		Vinyl chloride	0.5	MCL
	Wild Life in Bay	Total TPH	1,400 to 20,000	RBC

Table 6-2. Parcel E-2 Chemicals of Concern and Remediation Goals

Exposure Medium	Exposure Scenario	Chemical of Concern	ROD Remediation Goal (2012)	Source of Remediation Goal

[a] Aroclor-1254 used for PCBs.

[b] Remediation goal for Dioxins/furans (TEQ) is based on 2,3,7,8-TCDD. The dioxin/furan TEQ is calculated by multiplying the concentration of each dioxin and furan congener by the toxicity equivalency factor established by the 2005 World Health Organization and based on each congener's toxicity relative to 2,3,7,8-tetrachlorodibenzo-p-dioxin.

[c] The total TPH remediation goal is based on the petroleum source criterion for HPNS.

[d] Nitrobenzene used as surrogate for 4-nitrophenol

Notes:

The distance-based TPH criteria are as follows:

Distance from shoreline Feet	Total TPH (µg/L)	Distance from shoreline Feet	Total TPH (µg/L)
0–<25	1,400	125–<150	6,949
25–<50	1,467	150–<175	9,539
50–<75	2,092	175–<200	12,604
75–<100	3,216	200–<225	16,145
100–<125	4,839	≥225	20,000

< = less than
µg/L = microgram(s) per liter
BHC = benzene hexachloride
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethene
DDT = dichlorodiphenyltrichloroethane
HMW = high molecular weight
HPAL = Hunters Point ambient level
HPNS = Hunters Point Naval Shipyard
MCL = maximum contaminant level
mg/kg = milligram(s) per liter
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
PQL = practical quantitation limit
RBC = risk-based concentration
ROD = Record of Decision
TCDD
TEQ = toxic equivalent quotient
TPH = total petroleum hydrocarbons

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Table 6-3. Parcels E and E-2 Remediation Goals for Radionuclides

Radionuclide	Surfaces (dpm/100cm^2)		Soil (pCi/g)		Parcel
	Equipment, Waste[a]	Structures[b]	Construction/ Industrial/ Outdoor Worker [c]	Resident[c]	
Americium-241	100	100	5.67	1.36	E
Cesium-137	5,000	5,000	0.113	0.113	E, E-2
Cobalt-60	5,000	5,000	0.252 [d]	0.252 [d]	E, E-2
Plutonium-239	100	100	14	2.59	E
Radium-226	100	100	1.0 [e]	1.0 [e]	E, E-2
Strontium-90	1,000	1,000	10.8	0.331	E, E-2
Uranium-235	5,000	488	0.398	0.195	E

Source of Goals:

Department of the Navy (Navy). 2006. *Base-wide Radiological Removal Action, Action Memorandum – Revision 2006, Hunters Point Shipyard, San Francisco, California* . Final. April 21.

United States Environmental Protection Agency (USEPA). 2000. *Radionuclides Notice of Data Availability Technical Support Document* . Targeting and Analysis Branch, Standards and Risk Management Division, Office of Groundwater and Drinking Water. March.

[a] Based on “AEC Regulatory Guide 1.86” (1974). Goals for removable surface activity are 20 percent of these values

[b] Goals are based on 25 millirem per year (USEPA does not believe this NRC regulation is protective of human health and the environment, and the HPNS cleanup goals are more protective. This regulation is an ARAR only for radiologically impacted sites that are undergoing TCRAs and any additional remedial action required for those sites.)

[c] RGs for two future use scenarios; however, the residential RGs will apply in all Parcel E and E-2 areas. These more conservative RGs will enhance protectiveness of the remedial action, particularly as it relates to future property transfer and the potential need to apply institutional controls for radionuclides (Parcel E only).

[d] RG for Cobalt-60 was revised to support efficient laboratory gamma spectroscopy analysis of soil samples. This revised RG maintains morbidity risks within the U.S. Environmental Protection Agency-defined acceptable range and permits an exposure level that does not increase the risk of cancer from a potential exposure to Cobalt-60.

[e] Objective is 1 pCi/g above background per agreement with U.S. Environmental Protection Agency

AEC = Atomic Energy Commission
ARAR = applicable or relevant and appropriate requirement
cm^2 = square centimeter(s)
dpm = disintegration(s) per minute
HPNS = Hunters Point Naval Shipyard
NRC = Nuclear Regulatory Commission
pCi/g = picocurie(s) per gram
pCi/L = picocurie(s) per liter
RG = remediation goal
TCRA = time-critical removal action
USEPA = United States Environmental Protection Agency

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Table 6-4. Parcel E Remedial Action Summary and Expected Outcomes

Media	Risk/Basis for Action	Reasonably Anticipated Land Use	RAO	Remedy Component	Performance Metric	Expected Outcome
Soil	**Human Health:** Potential unacceptable risks to future recreational users from exposure to metals, SVOCs, pesticides, PCBs, and TPH in surface and subsurface soil; future residents from exposure to metals, VOCs, SVOCs, pesticides, PCBs, and TPH in surface and subsurface soil; future construction workers from exposure to metals, VOCs, SVOCs, pesticides, PCBs, and TPH in subsurface soil.	**Current use**: limited access unoccupied and unused buildings **Planned Future use**: Open space, and mixed-use (including residential)	1. Prevent exposure of humans to inorganic and organic chemicals in soil at concentrations exceeding the remediation goals (see Table 5 of the Parcel E ROD [Navy, 2013]) for the following exposure pathways: a) Ingestion of, outdoor inhalation of, and dermal exposure to soil from 0 to 10 feet bgs by residents in areas zoned for mixed-use reuse b) Ingestion of homegrown produce in native soil in areas zoned for mixed-use reuse c) Ingestion of, outdoor inhalation of, and dermal exposure to soil from 0 to 2 feet bgs by recreational users in areas zoned for open space reuse d) Ingestion of, outdoor inhalation of, and dermal exposure to soil from 0 to 10 feet bgs by construction workers in all areas	Excavation and Offsite Disposal	Excavation and offsite disposal of Tier 1 (COCs in soil at concentrations 10 times the RGs), Tier 2 (COCs in soil at concentrations 5 times the RGs), and TPH (greater than 3,500 mg/kg of TPH) hotspot areas is currently in progress.	Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.
				Closure of Fuel and Steam Lines	Inspection and removal of inactive fuel and steam lines that may be acting as a continuing source of COCs (particularly VOCs and SVOCs).	
				Durable Cover	Durable covers to provide physical barriers to prevent exposure of humans and wildlife to residual COCs in soil after excavation. Durable covers include: 1) a 2-foot (minimum) vegetated soil cover over the southern portion of Parcel E. The areas within IR-03 and the northwest portion of IR-02 will have a protective liner installed beneath the soil cover to minimize water seeping into contaminated soil. 2) a 6-inch (minimum) asphalt cover comprising 4 inches of aggregate base and 2 inches of asphalt over the northern portion of Parcel E. 3) A 3-foot (minimum) vegetated soil cover with a demarcation layer over IR-02 and IR-03 within the radiological ARIC; Cover installation is in progress and when installed, they will be inspected and maintained to prevent exposure to COCs.	
				ICs	ICs to maintain durable covers and security features, restrict land use and land disturbing activities, and prohibit growing produce in native soil for human consumption.	
Soil Gas	**Human Health:** Potential volatilization of VOCs and some SVOCs from soil into soil gas and/or indoor air via the VI pathway.		1. Prevent exposure of humans to VOCs in soil gas at concentrations that would pose unacceptable risk via indoor inhalation of vapors. Table 7 of ChaduxTt (2010), lists risk-based action levels for various volatile chemicals, including SVOCs and pesticides, that may pose an unacceptable risk via indoor inhalation of vapors. These soil gas action levels will be used for an initial risk-based screening of data collected during a future soil gas survey (such as the survey to be performed at Building 406 and VOC groundwater plumes following active treatment). After the initial risk-based screening, areas with unacceptable risk will be further evaluated using location-specific data (i.e., physical characteristics of the soil) to assess potential exposures consistent with the most current State of California and USEPA vapor intrusion guidance. In addition, risks and hazards at these areas will be further characterized using the accepted methodology for risk assessments at HPNS. Section 2.9.2.1 of the Parcel E ROD (Navy, 2013) provides additional information on the future soil gas survey and potential actions that may be prompted based on the results of the risk and hazard evaluation.	SVE	RA Pending: If Building 406 has not been demolished, operation of an SVE system where volatile chemicals are present in soil and soil gas until soil gas action levels are achieved or asymptotic conditions are reached. If Building 406 has been demolished at the time of the RA, excavation and offsite removal may be performed instead of SVE.	
				ICs	ICs to prohibit construction of enclosed structures unless prior written approval of vapor mitigation strategies is granted by the FFA signatories.	

Table 6-4. Parcel E Remedial Action Summary and Expected Outcomes

<table>
<tr><th>Media</th><th>Risk/Basis for Action</th><th>Reasonably Anticipated Land Use</th><th>RAO</th><th>Remedy Component</th><th>Performance Metric</th><th>Expected Outcome</th></tr>
<tr><td rowspan="2">Shoreline Sediment</td><td rowspan="2">Human Health: Potential unacceptable risk to future recreational users from exposure to PCBs in shoreline sediment.
Ecological: Potential unacceptable risks to benthic invertebrates from exposure to metals, PCBs, and pesticides; to birds from PCBs; and to mammals from metals and PCBs in nearshore sediment.</td><td rowspan="9">Current use: limited access unoccupied and unused buildings
Planned Future use: Open space, and mixed-use (including residential)</td><td rowspan="2">1. Prevent exposure of humans to COCs in shoreline sediment at concentrations exceeding the remediation goals in Table 6 of the Parcel E ROD.
2. Prevent exposure of benthic invertebrates, birds, and mammals to COECs in shoreline sediment at concentrations exceeding the remediation goals in Table 6 of the Parcel E ROD (Navy, 2013).</td><td>Excavation and Offsite Disposal</td><td>Excavation of minimum 2.5 feet of nearshore sediment (the biologically active zone) and offsite disposal to remove COECs/COCs from nearshore sediment. The excavation will be backfilled with natural materials such as sand and rock.</td><td rowspan="9">Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.</td></tr>
<tr><td>Durable Cover and
Sea Wall</td><td>Durable cover to provide a physical barrier to prevent exposure of humans and wildlife to residual COCs in nearshore sediment. The nearshore sediment durable cover consists of a minimum 4-foot layer of shoreline armoring a minimum 4-foot layer of shoreline armoring comprised of riprap overlying filter rock for steeper slopes (i.e., 3H:1V) and course sand overlying light riprap and filter rock for shallower slopes (i.e., 7H:1V). Shoreline revetment installation is in progress and when installed, they will be inspected and maintained to prevent exposure to COCs.
To increase wave run-up protection above the +9 foot msl elevation for the armored revetment sections, a 3-foot high concrete seawall was constructed at the crest of the revetment, terminating at an elevation of 12 feet msl.</td></tr>
<tr><td rowspan="4">Groundwater</td><td rowspan="4">Human Health: Potential unacceptable risks to future residents (adult and child) from exposure to metals, VOCs, SVOCs (primarily PAHs), pesticides, PCBs, and TPH in B-aquifer through domestic use; and future construction workers from exposure to SVOCs and lead in A-aquifer groundwater from direct exposure to A-aquifer groundwater and VOCs in trenches.
Ecological: Potential migration of metals, PCBs, and pesticides in groundwater discharging to surface water at concentrations above surface water criteria for aquatic wildlife.</td><td rowspan="4">1. Prevent or minimize exposure of construction worker to VOCs in A-aquifer groundwater by dermal exposure and inhalation of vapors with chemicals exceeding remediation goals (Table 7 of the Parcel E ROD).
2. Prevent or minimize exposure of humans to COCs in the B-aquifer at concentrations exceeding remediation goals (Table 7 of the Parcel E ROD) via the domestic use pathway.
3. Prevent or minimize migration of arsenic, copper, lead, nickel, zinc, Aroclor-1254, Aroclor-1260, alpha-chlordane, and 4,4’-DDE to prevent discharge (into San Francisco Bay) that would result in concentrations exceeding corresponding surface water quality criteria for aquatic wildlife.
4. Prevent or minimize migration of A-aquifer groundwater containing total TPH concentrations greater than 1,400 µg/L (where commingled with CERCLA-regulated substances) into San Francisco Bay.</td><td>In-situ Treatment</td><td>In-situ treatment of groundwater through biological remediation or ZVI injections to remove VOCs from areas exceeding active treatment criteria. Groundwater remediation will be initiated after soil excavation and durable covers are installed.</td></tr>
<tr><td>Below-ground barrier</td><td>A cement-bentonite slurry wall will be installed to control discharge of contaminated groundwater along IR-02.</td></tr>
<tr><td>Groundwater monitoring</td><td>Groundwater monitoring will be conducted to assess treatment and below-ground barrier performance, COC concentration trends, plume stability, and attenuation of VOCs where MNA conditions are met after active treatment. Monitoring will continue until RGs are met.</td></tr>
<tr><td>ICs</td><td>ICs to prohibit construction of enclosed structures, the use of groundwater and installation of new groundwater wells for domestic purposes, and to restrict land disturbing activities which includes activities that causes or facilitates the movement of groundwater known to be contaminated with COCs unless prior written approval is granted by the FFA signatories</td></tr>
<tr><td rowspan="3">Nonaqueous Phase Liquid</td><td rowspan="3">Presence of NAPL as a potential continuing source of COCs to soil and groundwater.</td><td rowspan="3">1. Prevent or minimize migration of NAPL to prevent discharge that would result in COEC concentrations greater than the surface water quality criteria for aquatic wildlife.
2. Prevent or minimize migration of NAPL to prevent discharge that would result in total TPH groundwater concentrations greater than 1,400 µg/L into San Francisco Bay.</td><td>Source Removal</td><td>Excavation of NAPL-impacted soils and nearshore sediment to the Bay Mud to remove the potential ongoing source to soil and groundwater at IR-03.</td></tr>
<tr><td>In-situ Stabilization</td><td>ISS consisting of cement-bentonite slurry and grout mixed with NAPL-impacted soil to create a soil-bentonite-cement monolith in the areas with the highest total TPH concentrations.</td></tr>
<tr><td>Containment</td><td>Containment of NAPL-impacted areas through a cement-bentonite slurry wall constructed at IR-03 and the surrounding area to encompass the extent of known groundwater contamination that may serve as a potential secondary source of COCs to groundwater.</td></tr>
</table>

Table 6-4. Parcel E Remedial Action Summary and Expected Outcomes

Media	Risk/Basis for Action	Reasonably Anticipated Land Use	RAO	Remedy Component	Performance Metric	Expected Outcome
Radiologically Impacted Media	Human Health: Radiological risks for soil and structures (storm drains, sanitary sewers, buildings) were greater than 10^{-6}.	**Current use:** limited access unoccupied and unused buildings **Planned Future use**: Open space, and mixed-use (including residential)	1. Prevent exposure to ROCs at activity levels that exceed remediation goals (see Table 8 of the Parcel E ROD [Navy, 2013]) for all potentially complete exposure pathways (which include external exposure, ingestion, and inhalation of soil based on the CSM for human health).	Survey, decontamination, and removal of radiologically impacted structures and soil	Identification and removal of historical subsurface storm drain and sanitary sewer utilities and screening and remediation of buildings, and former building sites as part of the TCRA for radionuclides. Radiological retesting is currently being conducted to confirm site conditions are compliant with the RAO.	Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.
				ICs	ICs to restrict land disturbing activities which includes activities that causes or facilitates the movement of groundwater known to be contaminated with ROCs and to prohibit excavation below the demarcation layer unless prior written approval is granted by the FFA signatories	

References:

Department of the Navy (Navy). 2013. *Record of Decision for Parcel E, Hunters Point Naval Shipyard, San Francisco, California.* Final. December.

ChaduxTt. 2010. *Memorandum: Approach for Developing Soil Gas Action Levels for Vapor Intrusion Exposure at Hunters Point Shipyard, Hunters Point Shipyard, San Francisco, California*. Final. April 30.

µg/L = microgram(s) per liter
ARIC = area requiring institutional controls
bgs = below ground surface
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
COC = chemical of concern
COEC = chemical of ecological concern
CSM = conceptual site model
DDE = dichlorodiphenyldichloroethane
FFA = Federal Facilities Agreement
HPNS = Hunters Point Naval Shipyard
IC = institutional control
ISS = in situ stabilization
LUC = land use control
mg/kg = milligram(s) per kilogram
MNA = monitored natural attenuation
msl = mean sea level
NAPL = nonaqueous phase liquid
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RA = remedial action
RAO = remedial action objective
RD = remedial design
RG = remediation goal
ROC = radionuclide of concern
ROD = Record of Decision
SVE = soil vapor extraction
SVOC = semivolatile organic compound
TCRA = time-critical removal action
TPH = total petroleum hydrocarbons
USEPA = United States Environmental Protection Agency
VI = vapor intrusion
VOC = volatile organic compound

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Table 6-5. Parcel E-2 Remedial Action Summary and Expected Outcomes

Media	Risk/Basis for Action	Reasonably Anticipated Land Use	RAO	Remedy Component	Performance Metric	Expected Outcome
Soil and Sediment	**Human Health**. Unacceptable risks to future recreational users and construction workers from exposure to metals, SVOCs, pesticides, PCBs, TPH landfill debris, and ROCs in soil and sediment. **Ecological.** Risks to wildlife from exposure to metals, pesticides, PCBs, and PAHs in soil and sediment.	**Current use:** limited access, landfill **Planned Future use:** Recreational/Open Space	1. Prevent human exposure to inorganic and organic chemicals at concentrations greater than remediation goals (see Table 5 of [Navy 2012]) for the following exposure pathways: a) Ingestion of, outdoor inhalation of, and dermal exposure to solid waste, soil, or sediment from 0 to 2 feet bgs by recreational users throughout Parcel E-2. b) Ingestion of, outdoor air inhalation of, and dermal exposure to solid waste, soil, or sediment from 0 to 10 feet bgs by construction workers throughout Parcel E-2. 2. Prevent ecological exposure to concentrations of inorganic and organic chemicals in solid waste or soil greater than remediation goals (see Table 5 of [Navy 2012]) from 0 to 3 feet bgs by terrestrial wildlife throughout Parcel E-2. 3. Prevent ecological exposure to concentrations of inorganic and organic chemicals in intertidal sediment greater than remediation goals (see Table 5 of [Navy 2012]) from 0 to 2.5 feet bgs by aquatic wildlife throughout the Shoreline Area.	Hot Spot Removal	Excavation and offsite disposal of soil, sediment, and debris with concentrations of COCs or COECs exceeding RGs for recreational/construction worker or ecological receptor and backfill with clean fill. Freshwater and salt-water wetlands are being constructed in removal areas in the western portion of Parcel E-2. This work is currently in progress.	Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.
				Soil Cover and Sea Wall	Soil cover to provide a physical barrier to prevent exposure of humans and wildlife to residual COCs and debris in soil after excavation. The cover consists of a minimum 2-foot thick soil cover over the entire Parcel E-2 area with a geomembrane liner in all areas except the constructed wetland to minimize water seeping into the subsurface and deter burrowing animals. The liner and foundation layer have been placed. Final cover is currently under construction. A rock revetment and sea wall was constructed prior to installation of the cover to mitigate erosion. The soil cover and rock revetment/sea wall will be inspected and maintained prevent exposure to COCs and landfill debris.	
				ICs	ICs to maintain soil covers and security features, restrict land use and land disturbing activities, and prohibit growing produce in native soil for human consumption.	
			1. Prevent exposure to ROCs at activity levels that exceed remediation goals (see Table 6 of [Navy 2012]) for all potentially complete exposure pathways.	Radiological Screening and Removal	Radiological screening during hot spot removal, revetment and wetland creation, and soil cover installation to identify radiological contamination above the RG. If identified, materials will be removed and disposed of offsite. A final surface survey will be completed when all remediation activities are complete to identify and remove radiological contamination exceeding RGs to 1 foot bgs.	
				Demarcation Layer	A demarcation layer will be installed within the cover over potentially radiologically impacted areas and landfill material serves as a warning against digging into potentially contaminated materials.	
				ICs	ICs to prohibit excavation below the demarcation layer unless prior written approval is granted by the FFA signatories and CDPH.	

Table 6-5. Parcel E-2 Remedial Action Summary and Expected Outcomes

Media	Risk/Basis for Action	Reasonably Anticipated Land Use	RAO	Remedy Component	Performance Metric	Expected Outcome
Landfill Gas	**Human Health.** Unacceptable risks to potential future industrial and residential users from exposure to landfill gas vapors.	**Current use:** limited access, landfill **Planned Future use:** Recreational/Open Space	1. Control methane concentrations to 5 percent (by volume in air) or less at subsurface points of compliance. 2. Control methane concentrations to 1.25 percent (by volume in air) or less in onsite structures ("onsite" for this ROD is defined as any area within the subsurface points of compliance for landfill gas). 3. Prevent exposure to non-methane organic compounds (NMOCs) at concentrations greater than 500 ppmv at the subsurface points of compliance. 4. Prevent exposure to NMOCs at concentrations greater than 5 ppmv above background levels in the breathing zone of onsite workers and visitors.	Landfill Gas Removal and Treatment	Collection and treatment of landfill gas through a collection system and controlled flare to treat methane and/or adsorption to treat NMOCs. An interim system is currently operating and will be expanded when the landfill cover construction has been completed.	
				Landfill Gas Monitoring	Landfill gas monitoring will be performed to demonstrate compliance with ARARs.	
				ICs	ICs to prohibit construction of enclosed structures unless prior written approval is granted by the FFA signatories and the CDPH and complies with the substantive provisions of ARARs regarding post-closure land uses.	
Groundwater	**Human Health.** Unacceptable risks to potential future residential users from metals, VOCs, SVOCs, pesticides, and PCBs in groundwater if used as a potable source (B-aquifer)		1. Prevent exposure to groundwater that may contain COCs at concentrations greater than remediation goals (see Table 7 of [Navy 2012]) through the domestic use pathway. 2. Prevent or minimize migration of B-aquifer groundwater that may contain COCs at concentrations greater than remediation goals (see Table 7 of [Navy 2012]) beyond the point of compliance (defined in the RI/FS Report at the downgradient boundary of Parcel E-2).	LTM	Groundwater LTM to verify that chemical concentrations in groundwater do not exceed concentrations designated by the RAOs at the point of compliance.	Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.
				ICs	ICs to prohibit extraction of groundwater and installation of new groundwater wells and prohibit use of or access to groundwater	
	Human Health. Unacceptable risks to potential future construction workers from dermal exposure to and vapor inhalation from lead and SVOCs in A-aquifer groundwater		1. Prevent or minimize dermal exposure to and vapor inhalation from A-aquifer groundwater containing COCs at concentrations greater than remediation goals (see Table 7 in [Navy 2012]) by construction workers.	ICs	ICs to restrict land disturbing activities which includes activities that causes or facilitates the movement of groundwater known to be contaminated with COCs or ROCs.	
	Ecological. Risks to aquatic wildlife from COECs (metals, anions, PCBs, and TPH) in groundwater through the groundwater to surface water pathway.		1. Prevent or minimize migration of COPECs to prevent discharge that would result in concentrations greater than the corresponding water quality criteria for aquatic wildlife. 2. Prevent or minimize migration of A-aquifer groundwater containing total TPH concentrations greater than the remediation goal (see Table 7 of [Navy 2012]) (where commingled with CERCLA substances) into San Francisco Bay.	Slurry Walls, Freshwater and Tidal Wetlands and Drain	Two slurry walls comprised of cement-bentonite mixture were installed to prevent migration of groundwater from the landfill to the bay and upgradient groundwater from entering the landfill material. The nearshore slurry wall was installed along the shoreline adjacent to the landfill and east adjacent area to prevent bayward groundwater in the landfill area from entering the bay. The upland slurry wall was installed from the northern parcel boundary to the southern extent of the landfill waste perpendicular to groundwater flow to divert upgradient offsite groundwater away from groundwater that contacts landfill waste. Groundwater will be diverted around the upland slurry wall or via a French drain system into the freshwater wetland.	
Surface Water			1. Prevent or minimize migration of COPECs to prevent discharge that would result in concentrations greater than the corresponding water quality criteria for aquatic wildlife.			

Table 6-5. Parcel E-2 Remedial Action Summary and Expected Outcomes

Reference:

Department of the Navy (Navy). 2012. *Record of Decision for Parcel E-2, Hunters Point Naval Shipyard, San Francisco, California. Final.* November.

ARAR = applicable or relevant and appropriate requirement
bgs = below ground surface
CDPH = California Department of Public Health
COC = chemical of concern
COEC = chemical of ecological concern
COPEC = chemical of potential ecological concern
FFA = Federal Facilities Agreement
IC = institutional control
LTM = long-term monitoring
LUC = land use control
NMOC = non-methane organic compounds
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
ppmv = part(s) per million volume
RAO = remedial action objective
RD = remedial design
RG = remediation goal
RI/FS = Remedial Investigation/Feasibility Study
ROC = radionuclide of concern
ROD = Record of Decision
SVOC = semivolatile organic compound
TPH = total petroleum hydrocarbons

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Table 6-6. Parcel UC-3 Remedial Action Summary and Expected Outcomes

Media	Risk/Basis for Action	Reasonably Anticipated Land Use	RAO	Remedy Component	Performance Metric	Expected Outcome
Soil	**Human Health.** Unacceptable risk to industrial workers from exposure to metals, SVOCs and TPH; recreational users and residents from metals, SVOCs, pesticides, PCBs, and TPH; and construction worker from metals, SVOCs, PCBs, and TPH in surface and/or subsurface soil.	**Current use:** Utility corridor and railroad right-of-way **Future use**: Mixed use, including mixed residential/retail and research and development (industrial)	1. Prevent unacceptable exposure of humans to chemicals and radionuclides in soil at concentrations exceeding the RGs (Table 7 of the Parcel UC-3 ROD [Navy, 2014]) for the following exposure pathways: a) Ingestion of, outdoor inhalation of, and dermal exposure to soil from 0 to 10 feet bgs by residents in areas zoned for mixed-use reuse. b) Ingestion of homegrown produce in native soil in areas zoned for mixed-use reuse. c) Ingestion of, outdoor inhalation of, and dermal exposure to soil from 0 to 10 feet bgs by construction workers in all areas. d) Ingestion of, outdoor inhalation of, and dermal exposure to soil from 0 to 10 feet bgs by industrial users of the railroad right-of-way.	Excavation and offsite disposal	Excavation of soil from areas with COC concentrations above 5 times the RGs for industrial and residential use were removed.	Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.
				Durable covers	Durable covers installed in the eastern portion of UC-3 to provide physical barriers to prevent exposure to metals in soil. The durable cover consists of a 4-inch-thick (minimum) asphaltic pavement cover that was either newly installed or repaired existing cover to meet the minimum criteria in the RD. Covers were not required in the western portion of UC-3. Covers are inspected and maintained to prevent exposure to COCs.	
				ICs	ICs to maintain durable covers, restrict land use and land-disturbing activity, and prohibit growing produce in native soil in the areas zoned for mixed-use.	
Soil Gas	Potential volatilization of VOCs and from soil into soil gas and/or indoor air via the VI pathway.		1. Prevent exposure of humans to VOCs in soil gas at concentrations that would pose unacceptable risk via indoor inhalation of vapors. Table 7 of the final soil gas memorandum (ChaduxTt, 2010) lists risk-based action levels for various volatile chemicals, including SVOCs, that may pose an unacceptable risk via indoor inhalation of vapors. These soil gas action levels will be used for an initial risk-based screening of data collected during future soil gas surveys (such as the surveys to be performed at the IR Site 56 VOC groundwater plume following active treatment). After the initial risk-based screening, areas with unacceptable risk will be further evaluated using location-specific data (i.e., physical characteristics of the soil) to assess potential exposures consistent with the State of California and USEPA vapor intrusion guidance. In addition, risks and hazards at these areas will be further characterized using the accepted methodology for risk assessments at HPNS.	Soil Gas Survey	A soil gas survey was conducted to confirm whether concentrations of VOCs warranted ICs. Results exceeded the comparison criteria established in the Sampling and Analysis plan and the ICs for VOCs were retained over a portion of Parcel UC-3.	
				ICs	ICs to prohibit construction of enclosed structures unless prior written approval of vapor mitigation strategies is granted by the FFA signatories	
Groundwater	**Human Health:** Risk to industrial workers and residents from VOCs in A-aquifer through the vapor intrusion pathway, construction workers through vapors in trenches. Risks to potential future residents from metals and VOCs in B-aquifer groundwater via domestic use.		1. Prevent or minimize unacceptable exposure of humans to COCs in the B-aquifer at concentrations exceeding RGs via the domestic use pathway.	Groundwater Treatment and MNA	ISB and MNA were selected in the ROD to remove VOCs, specifically TCE, in groundwater; however, based on historical and current (2018) data, TCE concentrations were below RGs since 1996 and below the 2.9 µg/L vapor intrusion criteria since 2009 (Gilbane, 2018). Additional remediation for groundwater was not warranted since TCE concentrations were below RGs and natural attenuation processes had effectively reduced COCs below vapor intrusion criterion.	
				ICs	ICs to prohibit the use of groundwater and installation of new groundwater wells for domestic purposes	
			2. Prevent or minimize unacceptable exposure of construction workers to VOCs in A-aquifer groundwater by dermal exposure and inhalation of vapors with chemicals exceeding RGs.	ICs	ICs to restrict land-disturbing activity unless prior written approval is granted by the FFA signatories	

Table 6-6. Parcel UC-3 Remedial Action Summary and Expected Outcomes

Media	Risk/Basis for Action	Reasonably Anticipated Land Use	RAO	Remedy Component	Performance Metric	Expected Outcome
Radiologically Impacted Soil and Structures	**Human Health:** Radiological risks for soil and structures (storm drains and sanitary sewers) were greater than 10-6.	**Current use:** Utility corridor and railroad right-of-way **Future use**: Mixed use, including mixed residential/retail and research and development (industrial)	1. Prevent exposure to radiological isotopes at activity levels that exceed remediation goals for all potentially complete exposure pathways (which include external exposure, ingestion, and inhalation of soil based on the CSM for human health).	Survey, decontamination, and removal of radiologically impacted structures and soil	Identification and removal of historical subsurface storm drain and sanitary sewer utilities and screening and remediation of buildings, and former building sites as part of the TCRA for radionuclides. Radiological retesting is planned to confirm site conditions are compliant with the RAO.	Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.

References:

Department of the Navy (Navy). 2014. *Record of Decision for Parcel UC-3, Hunters Point Naval Shipyard, San Francisco, California*. Final. January.

ChaduxTt. 2010. *Memorandum: Approach for Developing Soil Gas Action Levels for Vapor Intrusion Exposure at Hunters Point Shipyard, Hunters Point Shipyard, San Francisco, California*. Final. April 30.

Gilbane. 2018 *Remedial Action Completion Report Parcel UC-3, Hunters Point Naval Shipyard. San Francisco, California*. July.

µg/L = microgram(s) per liter
bgs = below ground surface
COC = chemical of concern
CSM = conceptual site model
FFA = Federal Facilities Agreement
HPNS = Hunters Point Naval Shipyard
IC = institutional control
IR = Installation Restoration
ISB = in situ biodegradation
LUC = land use control
MNA = monitored natural attenuation
PCB = polychlorinated biphenyl
RAO = remedial action objective
RD = remedial design
RG = remediation goal
ROD = Record of Decision
SVOC = semivolatile organic compound
TCE = trichloroethene
TCRA = time-critical removal action
TPH = total petroleum hydrocarbons
USEPA = United States Environmental Protection Agency
VI = vapor intrusion
VOC = volatile organic compound

Table 6-7. Fourth Five-Year Review Parcel E Issues, Recommendations, and Follow-up Actions

Parcel/Site	Fourth Five-Year Review Protectiveness	Issue	Recommendation (Milestone)	Date Complete/Current Status
E and UC-3	Will be protective (E) Short-term protective (UC-3)	The Navy has determined that a significant portion of the radiological survey and remediation work completed to date was not reliable because of manipulation and/or falsification of data by one of its radiological contractors. A long-term protectiveness evaluation of the radiological RGs has not yet been completed for this fourth Five-Year Review, and it is currently not known if the RAOs for radionuclides have been achieved in Parcels B-1, B-2, C, D-1, D-2, G, E, UC-1, UC-2, and UC-3.	Refer to **Section 1.4.3** for the long-term protectiveness evaluation component of this recommendation. The Navy is in the process of implementing corrective actions to ensure that the radiological remedies specified in the decision documents are implemented as intended. It is anticipated that the radiological rework will be completed prior to the next Five-Year Review.	**Long-term Protectiveness Evaluation: Completed June 2020**. Addenda to the Fourth Five-Year Review were prepared to evaluate the Radiological RGs for soil and buildings. The conclusions of both reports were that the current RGs were protective of human health and the environment (Navy, 2020a, 2020b). **In progress.** The radiological retesting of soil at Parcel UC-3 was initiated in February 2019. Fieldwork activities were initiated in 2023. Radiological retesting will be summarized in a radiological removal action construction summary report anticipated to be completed in 2028. The radiological retesting of soil and surveys of building structures at Parcel E was initiated in Fall 2019. Fieldwork activities for radiological retesting are expected to begin in 2026. Radiological retesting will be summarized in a radiological removal action construction summary report anticipated to be completed in 2029.

References:

Department of the Navy (Navy). 2020a. *Addendum to the Five-Year Review, Evaluation of Radiological Remedial Goals for Soil, Hunters Point Naval Shipyard, San Francisco, California.* June 18.

Navy. 2020b. *Addendum to the Five-Year Review, Evaluation of Radiological Remedial Goals for Building Structures, Hunters Point Naval Shipyard, San Francisco, CA*. June 18.

RAO = remedial action objective
RG = remediation goal

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Table 6-8. Parcel E Chemicals of Concern and Current Comparison Criteria for Domestic Use of Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	Values from ROD		Current Comparison Criteria				
			ROD Remediation Goal (2013, 2014)	Source of Remediation Goal	11/2022 USEPA RSL or VISL	Cancer/ Noncancer Basis	DTSC-SL	Cal MCL	USEPA MCL
Groundwater (µg/L)	Domestic Use Exposure to B-Aquifer Groundwater	1,1- Dichloroethene[a]	6	MCL	280	NC	130	6	7
		cis-1,2- Dichloroethene[a]	6	MCL	25	NC	12	6	70
		trans-1,2- Dichloroethene[a]	10	MCL	68	NC	110	10	100
		1,4-Dichlorobenzene	5	MCL	0.48	C	No value	5	75
		Arsenic	27.3	HPAL	0.052	C	0.0082	10	10
		Manganese	8,140	HPAL	430	NC	No value	None	None
		Tetrachloroethene	5	MCL	11	C	0.084	5	5
		Thallium	12.97	HPAL	0.2	NC	0.059	2	2
		Trichloroethene	5	MCL	0.49	C	No value	5	5
		Vinyl chloride	0.5	MCL	0.019	C	0.0098	0.5	2

[a] Remediation goals for select VOCs were added to the ROD because of their relationship to other VOCs (e.g., 1,1-dichloroethene and 1,2-dichloroethene are degradation products of trichloroethene) that were identified as chemicals of concern in the FS Report. The remediation goal for tetrachloroethene in A-aquifer groundwater is based on the risk-based criteria presented in the ROD for HPNS Parcel C. The remediation goals for 1,1-dichloroethene and 1,2-dichloroethene in B-aquifer groundwater are based on the State of California maximum contaminant limits.

µg/L = microgram(s) per liter
C = carcinogen
Cal = California
DTSC = California Department of Toxic Substances Control
FS = Feasibility Study
HPAL = Hunters Point ambient level
HPNS = Hunters Point Naval Shipyard
MCL = maximum contaminant level
NA = not available
NC = noncarcinogen
ROD = Record of Decision
RSL = Regional Screening Level
SL = screening level
USEPA = United States Environmental Protection Agency
VISL = vapor intrusion screening level
VOC = volatile organic compound

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Table 6-9. Parcel E-2 Chemicals of Concern and Current Comparison Criteria for Domestic Use of Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	Values from ROD		Current Comparison Criteria				
			ROD Remediation Goal (2012)	Source of Remediation Goal	11/2022 USEPA RSL	Basis of RSL (C/NC)	DTSC-SL	Cal MCL	USEPA MCL
Groundwater (µg/L)	Domestic Use of Deep Groundwater (B-Aquifer)	1,1-Dichloroethane	5	PQL	2.8	C	2.8 (USEPA)	5	None
		1,2,3-Trichloropropane	1	PQL	0.00075	C	0.0002	0.005	None
		1,2-Dichloroethane	0.5	MCL	0.17	C	0.17 (USEPA)	0.5	5
		1,4-Dichlorobenzene	5	MCL	0.48	C	No value	5	75
		4-Nitrophenol[a]	3.4	RBC	0.14	C	No value	None	None
		Aroclor-1016	0.5	MCL	0.22	C	0.22 (USEPA)	None	0.5
		Aroclor-1242	0.5	MCL	0.0078	C	No value	None	0.5
		Aroclor-1254	0.5	MCL	0.0078	C	0.0079 (USEPA)	None	0.5
		Aroclor-1260	0.5	MCL	0.0078	C	No value	None	0.5
		Arsenic	10	MCL	0.052	C	0.0082	10	10
		Benzene	1	MCL	0.46	C	0.15	1	5
		Benzo(a)anthracene	0.2	MCL	0.03	C	0.017	None	None
		Benzo(a)pyrene	0.2	MCL	0.025	C	No value	0.2	0.2
		Benzo(b)fluoranthene	0.2	MCL	0.25	C	No value	None	None
		Benzo(k)fluoranthene	0.2	MCL	2.5	C	No value	None	None
		Bis(2-ethylhexyl)phthalate	10	PQL	5.6	C	No value	4	6
		beta-BHC	0.05	PQL	0.025	C	0.0014 (USEPA)	None	None
		Carbon tetrachloride	0.5	MCL	0.46	C	0.45 (USEPA)	0.5	5
		Chloroform	80	MCL	0.22	C	No value	80	80
		Chromium VI [b]	109	RBC	0.035	C	No value	50	100
		Chrysene	0.56	RBC	25	C	No value	None	None
		Dibenz(a,h)anthracene	2	MCL	0.025	C	0.0061	None	None
		Dieldrin	0.02	PQL	0.0018	C	0.00066 (USEPA)	None	None
		Heptachlor	0.01	MCL	0.0014	C	0.0014 (USEPA)	0.01	0.4
		Heptachlor epoxide	0.01	MCL	0.0014	C	0.0014 (USEPA)	0.01	0.2
		Heptachlor epoxide A	0.01	MCL	0.0014	C	0.0014 (USEPA)	0.01	0.2
		Heptachlor epoxide B	0.01	MCL	0.0014	C	0.0014 (USEPA)	0.01	0.2
		Indeno(1,2,3-cd)pyrene	0.2	MCL	0.25	C	No value	None	None
		Iron	10,950	RBC	14000	NC	No value	None	None
		Lead	15	MCL	15	NC	No value	15	15
		Methylene chloride	5	MCL	11	C	1.70	5	5
		Naphthalene	1	PQL	0.12	C	0.12	None	None
		Tetrachloroethene	5	MCL	11	C	0.084	5	5
		Thallium	2	MCL	0.2	NC	0.059	2	2
		Trichloroethene	5	MCL	0.49	C	No value	5	5
		Vinyl chloride	0.5	MCL	0.019	C	0.0098	0.5	2

[a] Nitrobenzene used as surrogate for 4-nitrophenol

[b] MCLs shown are for total chromium, no MCLs available for Chromium VI

Notes:

Shading indicates current comparison criteria is lower than ROD remediation goal

BHC = benzene hexachloride
C = carcinogen
Cal = California
DTSC = California Department of Toxic Substances Control
MCL = maximum contaminant level
NA = not available
NC = noncarcinogen
PQL = practical quantitation limit
RBC = risk-based concentration
ROD = Record of Decision
RSL = Regional Screening Level
SL = screening level
USEPA = United States Environmental Protection Agency

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Table 6-10. Parcel UC-3 Chemicals of Concern and Current Comparison Criteria for Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	Values from ROD			Current Comparison Criteria (for UU/UE scenario)				
			ROD Remediation Goal (2013)	Source of Remediation Goal	Parcel	11/2022 USEPA RSL or VISL	11/2022 USEPA RSL or VISL[a]	DTSC-SL	Cal MCL	USEPA MCL
Groundwater (µg/L)	Construction Worker Exposure to A-Aquifer Groundwater	1,2-Dichloroethene (total)	270	RBC	UC-3	109	NC	NA	6 / 10	70 / 100
		Trichloroethene	290	RBC	UC-3	1.19	C	NA	5	5
		Vinyl chloride	5.4	RBC	UC-3	0.147	C	NA	0.5	2

[a] VISL for residential use presented for A-aquifer groundwater for conservative comparison.

Notes:
Shading indicates current comparison criteria is lower than ROD Remediation Goals.

µg/L = microgram(s) per liter
C = carcinogen
Cal = California
DTSC = California Department of Toxic Substances Control
MCL = maximum contaminant level
NA = not available
NC = noncarcinogen
RBC = risk-based concentration
ROD = Record of Decision
RSL = Regional Screening Level
SL = screening level
USEPA = United States Environmental Protection Agency
UU/UE = unlimited use and unrestricted exposure
VISL = vapor intrusion screening level

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Table 6-11. Parcel UC-3 Issues, Recommendations, and Follow-up Actions

Parcel	Issue	Recommendations/ Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
						Current	Future
UC-3	As identified in the Fourth Five-Year Review there is uncertainty with a portion of the radiological survey and remediation work performed between 2004 and 2016 under the Basewide Radiological Removal Action, Action Memorandum (Navy, 2006). The Navy is in the process of implementing corrective actions to ensure the radiological remedies specified in the decision documents were implemented as intended; however, this work is ongoing.	Complete radiological retesting at radiologically-impacted sites, including current and former buildings and soil areas investigated under the Radiological Removal Action, Action Memorandum (Navy, 2006) and areas where evaluations determined previous data were unreliable.	Navy	USEPA	3/2/2028	N	Y

Source: Navy. 2006. B*ase-wide Radiological Removal Action, Action Memorandum – Revision 2006, Hunters Point Shipyard, San Francisco, California*. Final. April 21.

Navy = Department of the Navy
USEPA = United States Environmental Protection Agency

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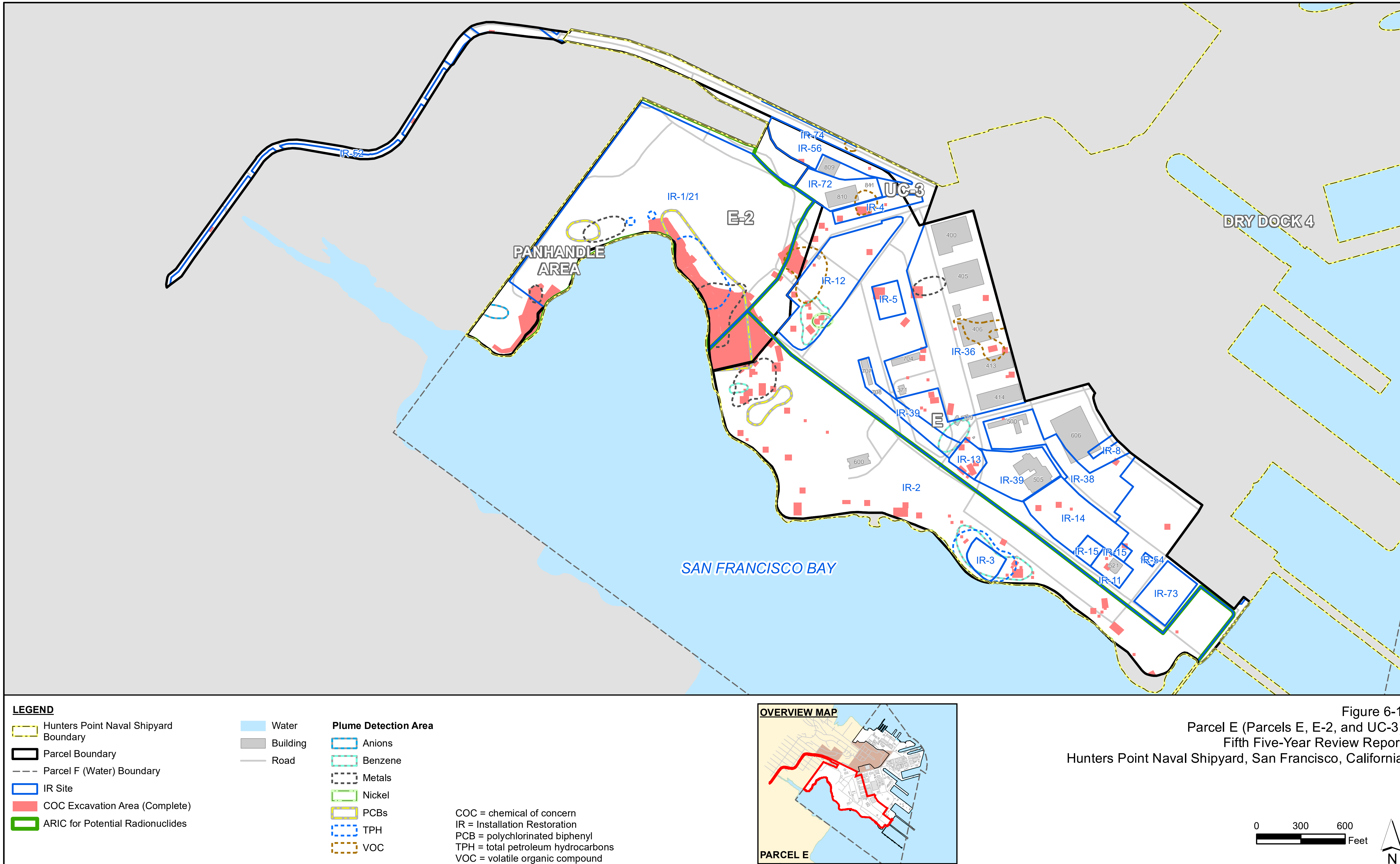

Figure 6-1
Parcel E (Parcels E, E-2, and UC-3)
Fifth Five-Year Review Report
Hunters Point Naval Shipyard, San Francisco, California

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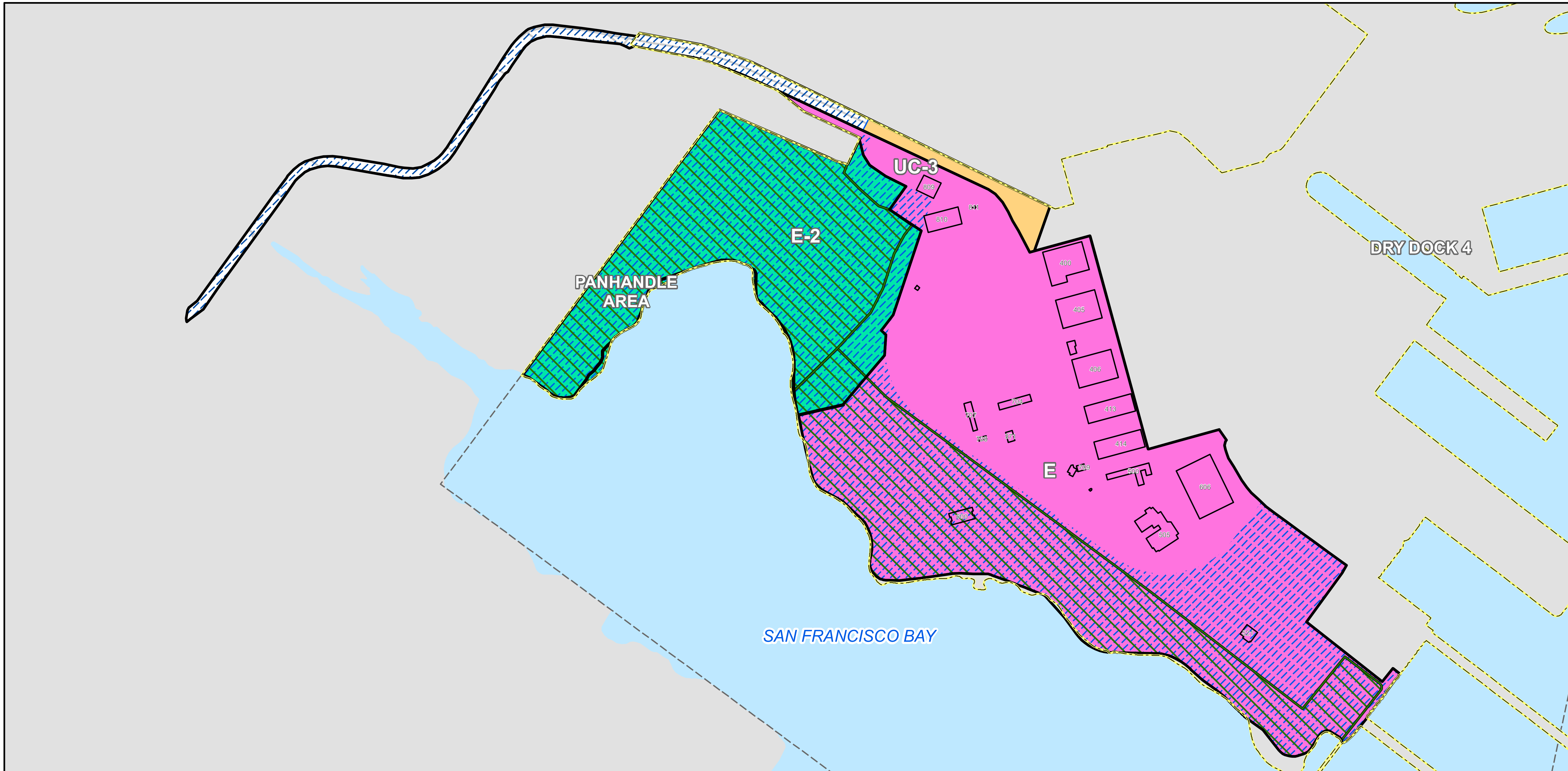

LEGEND

- Hunters Point Naval Shipyard Boundary
- Parcel Boundary
- Parcel F (Water) Boundary
- Water
- Building
- Road

Institutional Controls

- ARIC for Soil and Groundwater Use (General)
- Additional Restrictions (Open Space, Educational/Cultural, and/or Maritime/Industrial Use
- ARIC for Soil, Groundwater Use, and Restrictions Related to VOC Vapors
- Landfill Cap and Vegetative Cover
- ARIC for Potential Radionuclides

ARIC = area requiring institutional controls
VOC = volatile organic compound

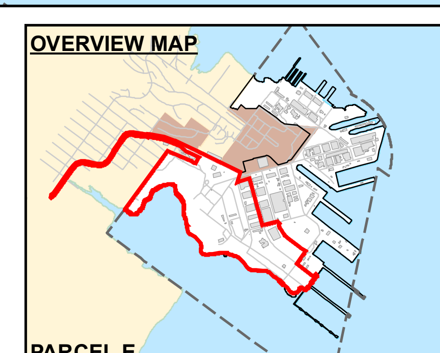

Figure 6-2
Parcel E (Parcels E, E-2, and UC-3) Institutional Controls
Fifth Five-Year Review Report
Hunters Point Naval Shipyard, San Francisco, California

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Source:
Innovex-ERRG Joint Venture. 2019. *Fourth Five-Year Review, Hunters Point Naval Shipyard, San Francisco, California.* Figure 8. July.

Figure 6-3
Overview of Remedy Components for Parcel E
Fifth Five-Year Review Report
Hunters Point Naval Shipyard
San Francisco, California

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Source:
Innovex-ERRG Joint Venture. 2019. *Fourth Five-Year Review, Hunters Point Naval Shipyard, San Francisco, California.* Figure 9. July.

Figure 6-4
Overview of Remedy Components for Parcel E-2
Fifth Five-Year Review Report
Hunters Point Naval Shipyard
San Francisco, California

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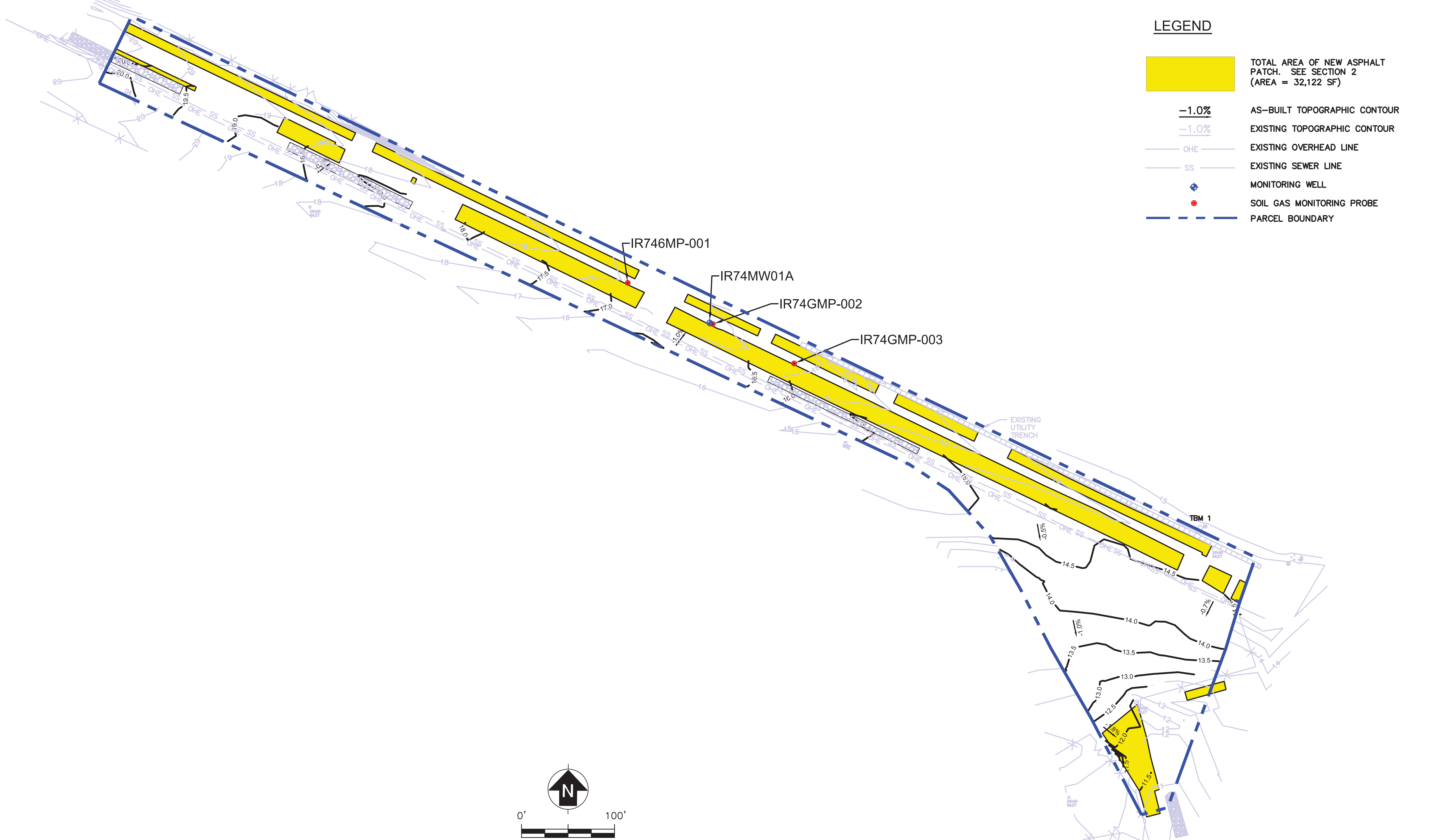

Source:
Innovex-ERRG Joint Venture. 2019. *Fourth Five-Year Review, Hunters Point Naval Shipyard, San Francisco, California.* Figure 13. July.

Figure 6-5
Overview of Remedy Components for Parcel UC-3
Fifth Five-Year Review Report
Hunters Point Naval Shipyard
San Francisco, California

230307115911_589d933e Figure_6-6_UC-3

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Appendix A
Climate Resilience Assessment

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Contents

Tables

Figures

Acronyms and Abbreviations

bgs	below ground surface
BGMP	Basewide Groundwater Monitoring Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chemicals of concern
CVOCs	chlorinated volatile organic compound
CRA	climate resilience assessment
DoD	Department of Defense
DEM	digital elevation models
DCAT	DoD Climate Assessment Tool
DRSL	DoD Regional Sea Level Database
DTSC	Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
ft	feet
GIS	Geographical Information System
GHG	Green House Gas Emissions
HPNS	Hunters Point Naval Shipyard
IR	installation restoration
LFG	landfill gas
LTM	long-term monitoring
MSL	mean sea level
MHHW	Mean Higher High Water
Navy	Department of the Navy
PCB	polychlorinated biphenyl
PAH	polycyclic aromatic hydrocarbon
RD	remedial design
RG	remedial goal
ROD	Record of Decision
SLR	sea level rise
SVE	soil vapor extraction
USACE	U.S. Army Corps of Engineers

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Executive Summary

As part of the fifth Five-Year Review, this screening-level Climate Resilience Assessment (CRA) assessed climate-related hazards, their potential impacts, and whether vulnerabilities were projected that may impact the protectiveness of the remedies at Former Hunters Point Naval Shipyard (HPNS) in San Francisco, California. The Department of the Navy used methodologies that are consistent with guidance provided in the *DoD* [Department of Defense] *Climate Assessment Tool* (DCAT; 2020); U.S. Environmental Protection Agency's *Memorandum: Consideration of Climate Resilience in the Superfund Cleanup Process for NonFederal National Priorities List Sites* (2021); U.S. Army Corps of Engineers (USACE's) *Procedures to Evaluate Sea Level Change: Impacts, Responses, and Adaptation* (2014); and the Department of Toxic Substances Control's Draft *Sea Level Rise Guidance to DTSC Project Managers for Cleanup Activities* (2023). The HPNS CRA is a unique case study designed to address the concerns raised by the San Francisco Civil Grand Jury report regarding sea level rise (SLR) (City and County of San Francisco Civil Grand Jury, 2022).

Climate Change Hazards

The CRA evaluated eight climate-related hazards using DCAT. The eight hazards include: coastal flooding, extreme weather events, drought, wildfire, riverine flooding, extreme temperature, energy demand, and land degradation. The primary climate-related hazard identified for HPNS is coastal flooding. Coastal flooding is caused by SLR (that is, seawater inundation) and groundwater emergence. Groundwater table rise to within 3 feet below ground surface (bgs) was also assessed. Coastal flooding can either be permanent (because of permanent SLR) or transient (because of storm surges). Other climate hazards identified for HPNS include extreme weather events and wildfires. These hazards are considered relatively transient. The probability of a major wildfire impacting the urban industrial area of South San Francisco and HPNS is considered low but was qualitatively evaluated for remedies with aboveground components that could be affected. Storm surges were evaluated as part of this CRA.

SLR projections developed for HPNS are based on the 2021 *DoD Regional Sea Level* (DRSL) database developed as part of the U.S. Climate Resilience Toolkit (https://toolkit.climate.gov/tool/department-defense-regional-sea-level-drsl-database). The DRSL database was developed in 2015. The 20-year and 50-year USACE planning and construction design time horizons lead to SLR projections for the years 2035 and 2065. The DRSL database provides Installation-specific, regionalized SLR scenarios for 1,744 active DoD and Base Realignment and Closure installations worldwide and is now being incorporated into the master planning at these installations.

The HPNS CRA used the highest Green House Gas emissions for SLR projections of 1.0 feet and 3.2 feet for the years 2035 and 2065, respectively, to represent a conservative upper limit of the range of SLR scenarios evaluated in this assessment. Groundwater rise from SLR was conservatively projected based on a 1:1 ratio consistent with the City of Alameda's 2022 *Climate Adaptation and Hazard Mitigation Plan*. The DRSL projections take into account both SLR and land subsidence and are generally consistent with the projections in the California Ocean Protection Council and California Natural Resources Agency's *State of California Sea-Level Rise Guidance Document, 2018 Update* (CNRA, 2018) .

Potential Impacts and Vulnerabilities

The HPNS CRA identified the following potential impacts that may be attributable to climate change:

- In 2035, limited impact from permanent groundwater emergence is projected to occur in Parcel D-1 (**Figure 3-1** and **Table 2-2**).
- In 2065, limited impacts from permanent groundwater emergence is projected to occur in Installation Restoration (IR) Sites 7 and 18 (IR 7/18), Parcels B-1 and B-2, C, D-1, E and E-2 (**Figure 3-2** and **Table 2-2**).

The HPNS CRA identified the following potential vulnerabilities resulting from the impacts previously identified:

- In 2035, a potential vulnerability to human receptors from permanent groundwater emergence at Parcel D-1.
- In 2065, potential vulnerability to human receptors at the current ground surface from heavy metals due to groundwater emergence at IR 7/18, Parcels B-1, B-2, C, D-1, and E.
- In 2065, potential vulnerability to San Francisco Bay receptors from heavy metals due to groundwater emergence at IR 7/18, Parcels B-1, B-2, C, D-1, and E.
- Potential vulnerability of the Parcel E-2 landfill gas (LFG) treatment system to wildfires.

CRA Recommendations in the Five-Year Review

If a vulnerability is projected to result in a potentially new exposure scenario for either human or ecological receptors through 2065, then an IR site-specific study is recommended to evaluate the potential Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) risk to human and ecological receptors to inform the next Five-Year Review.

1. Based on 2035 SLR projections, an IR site-specific study is recommended to assess whether the projected climate change vulnerability is likely to result in additional CERCLA risk at Parcel D-1.
2. Based on 2065 SLR projections, IR site-specific studies are recommended to assess whether the projected climate change vulnerabilities are likely to result in additional CERCLA risk at IR 7/18, Parcels B-1, B-2, C, D-1, and E.

1.0 Introduction

As part of Former Hunters Point Naval Shipyard's (HPNS's) fifth Five-Year Review, a Climate Resilience Assessment (CRA) was completed to evaluate potential impacts from climate change-related hazards to remedy protectiveness. The Department of the Navy (Navy) used methodologies that are consistent with guidance provided in the *DoD* [Department of Defense] *Climate Assessment Tool* (DCAT; 2020), U.S. Environmental Protection Agency's *Memorandum: Consideration of Climate Resilience in the Superfund Cleanup Process for NonFederal National Priorities List Sites* (2021); U.S. Army Corps of Engineers' (USACE's) *Procedures to Evaluate Sea Level Change: Impacts, Responses, and Adaptation* (2014); and the Department of Toxic Substances Control's (DTSC's) *Draft Sea Level Rise Guidance to DTSC Project Managers for Cleanup Activities* (2023). **Figure 1-1** describes the four screening steps used to complete this CRA and are as follows:

1. Climate Hazards: Identify climate change related hazards that apply to HPNS using DCAT.
2. Climate Impacts: Areas that are projected to be impacted from the primary hazards identified in step 1.
3. Exposure Scenarios: Assess the potential for new exposure scenarios.
4. Vulnerability Assessment: Determine whether a potentially new exposure scenario exceeds the adaptive capacity of the site.

This screening-level CRA evaluated the following eight climate-related hazards identified in the DCAT: coastal flooding, extreme weather events, drought, wildfire, riverine flooding, extreme temperature, energy demand, and land degradation. **Table 1-1** describes the nature of these hazards.

The most important climate hazard and associated impact identified at HPNS is coastal flooding, because of its proximity to San Francisco Bay and because residual chemicals of concern (COCs) are present in subsurface soils and groundwater. Coastal flooding can be permanent (because of permanent sea level rise [SLR]) or transient (because of storm surges). The other climate hazards identified were wildfires and extreme weather events. These hazards are considered relatively transient. Regarding extreme weather events, permanent SLR can amplify the impacts of storm surges, which was evaluated in this screening-level CRA. The following describes the sections provided in this Five-Year Review:

- **Section 2** assesses the coastal flooding hazard and identifies the parcels (and installation restoration [IR] sites) projected to be impacted by permanent seawater inundation or storm surges using the 2021 *DoD Regional Sea Level* (DRSL) database developed as part of the U.S. Climate Resilience Toolkit (https://toolkit.climate.gov/tool/department-defense-regional-sea-level-drsl-database).
- **Section 3** assesses the coastal flooding hazard in terms of SLR causing groundwater table emergence at the ground surface and identifies the areas affected. Groundwater table rise within 3 feet below ground surface (bgs) was also assessed.
- **Section 4** assesses whether or not the other seven hazards are projected to impact the parcels at HPNS.
- **Section 5** identifies the potential new exposure scenarios attributable to climate change applicable to residual chemicals of concern (COCs). It also assesses the adaptive capacity

of the IR sites' remedies to the climate hazards in the areas of impact. Consequently, remedies are identified as either resilient or vulnerable to each climate hazard.

- **Section 6** presents the conclusions and recommendations of the screening level CRA.
- **Section 7** presents the references cited.

2.0 Impacts of Seawater Inundation

HPNS is bounded on three sides by San Francisco Bay. Several parcels and IR sites are located near the current shoreline. It is expected that SLR will result in coastal flooding, primarily because of the upland advancement of seawater, but also because of groundwater emergence based on the current ground elevation.

Flooding can either be permanent (for example, a rising mean sea level [MSL] and high tide) or transient (for example, storm surges or extreme precipitation events). Gradual and permanent SLR causes permanent seawater inundation of increasingly upland areas along the coast. For this assessment, permanent seawater inundation is defined by an upland area projected to be impacted by daily high tides, forming a permanently higher intertidal zone. Transient flooding is caused by storm surges that temporarily raise sea level and bring seawater temporarily upland. Transient flood waters recede within hours or days.

2.1 Sea Level Rise Projections

SLR projections developed for HPNS are based on the 2021 DRSL database for the years 2035 and 2065. The DRSL database was developed in 2015 and provides regionalized SLR scenarios for 1,744 active DoD and Base Realignment and Closure installations worldwide and is now being incorporated into the master planning at these installations. The years 2035 and 2065 are based on the 20-year and 50-year time horizons used by USACE for planning. The period 2023 through 2065 also approximates the 30-year timeframe discussed in the *Draft Sea Level Rise Guidance to DTSC Project Managers for Cleanup Activities* (DTSC, 2023), as the timeframe for a phased approach to plan.

DRSL is a scenario-driven tool. Scenarios are not deterministic or probabilistic, but rather attempt to bound scientific and human-influenced about the future uncertainties (for example, greenhouse gas [GHG] emission futures). The advantage of DRSL is that it incorporates regional land subsidence estimates into the SLR projections. Adjustments to the regional scenarios of 2035 and 2065 were developed in DRSL on a site-specific basis and include local vertical land movement, dynamic sea level, and polar ice melt.

The DRSL projections for SLR, applicable to HPNS, are summarized in **Table 2-1**. For HPNS, DRSL projects an MSL rise of between 0.3 foot (lowest) and 1.0 foot (highest) by 2035, and between 0.6 and 3.2 feet by 2065 for the San Francisco Bay Area, using 1992 as the baseline year. **Figure 2-1** shows the actual SLR measured in five tide gauges nearest HPNS over the past 30 years (1992 through 2022). The difference between SLR projections for lowest and highest GHG emissions scenarios widens by 2065, as uncertainty grows over the trajectory of SLR further out in time.

For HPNS, the highest GHG emissions and resulting SLR projections of 1.0 foot and 3.2 feet for the years 2035 and 2065, respectively (**Table 2-1**), are the most conservative projections in DRSL and were used as the upper limit of the range evaluated in this assessment. The DRSL projections take into account both SLR and land subsidence of 0.3 feet in 2065, and are generally consistent with the projections in the *State of California Sea-Level Rise Guidance Document, 2018 Update* (CNRA, 2018).

2.2 Seawater Inundation Impacts

Seawater inundation, as previously described, is the permanent overland flooding of seawater that happens because of permanent MSL rise and daily high tides. The tidal datum Mean Higher

High Water (MHHW) is a standard elevation used as a baseline, above which inundation often is depicted on digital elevation models (DEM) and inundation maps (Hall, 2016). Similarly, MHHW is the standard vertical datum used in several online SLR mapping tools (for example, National Oceanic and Atmospheric Administration SLR Viewer and Naval Facilities Engineering Systems Command geo-readiness explorer Flood Inundation Surge Hazard). Therefore, this study has used MHHW in 1992 as the datum, above which SLR is mapped and the potential for seawater inundation of upland areas is evaluated. As a risk-averse case, an upland area is considered permanently flooded when it experiences daily flooding during high tide.

In addition, vertical land elevations in the U.S. were identified and referenced using the North American Vertical Datum and tidal datums are created through local surveys between tidal and geodetic benchmarks. Geographical Information System (GIS) mapping was used to compare the land topography to SLR projections. GIS maps were developed for the highest GHG emissions scenarios in **Table 2-1**. Several past and currently planned remedy design features are effective measures to prevent permanent seawater inundation in 2035 and 2065. These include a revetment and a seawall and berms along the coastline of Parcels E-2 and E. Additionally, 2 or 3 feet of fill has been added for vegetative covers in several parcels (NAVFAC, 2014). Therefore, the DEM for HPNS was adjusted to include the IR site management remedies (including additional fill, berms, and seawall extensions) that are planned for completion in the next 10 years. In all seawater inundation maps, any isolated low-lying areas showing upland accumulation of seawater were eliminated if they did not have connectivity with the sea.

Figures 2-2 and **2-3** show the potential for permanent seawater inundation in 2035 and 2065, for the highest SLR scenarios in DRSL. Except for some marginal seawater encroachment at the edges of some parcels, no permanent seawater inundation is projected in any of the parcels during 2035 and 2065, under the highest SLR scenario. **Tables 2-2 and 2-3** lists the impacts of coastal flooding (seawater and groundwater) in the parcels at HPNS for the years 2035 and 2065, respectively. Permanent seawater inundation is not projected through year 2065 under the highest SLR scenarios.

2.3 Storm Surges

Storm surges can cause transient flooding and the surges have the potential to reach farther upland from the coastline in conjunction with SLR. DRSL projects that a 100-year storm surge would add 5.9 feet to the MHHW. Conservatively, it was assumed that the storm surge and high tide occur simultaneously. The transient flooding because of the combined effect of SLR and a 100-year storm surge is mapped on **Figures 2-4** and **2-5** for 2035 and 2065, respectively. As seen from the differences in the extent of flooding between the lowest and highest scenarios, the degree of SLR projected greatly affects the size of the areas impacted by the storm surge. The following summarizes the potential effects from storm surges based on the highest SLR scenarios in 2035 and 2065:

- In 2035, a 100-year storm surge is not projected to impact Parcels F or UC-3. Portions of IR 7/18, and Parcels B-1, B-2, C, D-1, E, and the low-lying areas of E-2 are projected to be impacted. The low-lying areas in the panhandle of Parcel E-2 are wetlands under construction as part of the Remedial Action. The wetlands are designed to mitigate the impact of storms (**Table 2-2**).
- In 2065, a 100-year storm surge would impact portions of all parcels (**Table 2-3**).

Impacts from storm surges will be addressed in accordance with the long-term monitoring (LTM) plan for each IR site or parcel. Storm events of a certain magnitude trigger an ad hoc inspection with repairs.

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3.0 Sea Level Rise Impacts on Shallow Groundwater

Groundwater emergence at the ground surface can occur in areas where the groundwater table is projected to rise above the current land surface from SLR. Impacts from groundwater table rise to within 3 feet of the ground surface was also evaluated to assess potential vulnerabilities to vapor intrusion or preferential pathways along underground utility corridors.

3.1 Groundwater Emergence

Groundwater table rise projections were prepared by the method described by Hoover et al. (Hoover, 2017). This is also the method used by the City of Alameda (City of Alameda, 2022) for assessing climate-related impacts on the groundwater table. To determine permanent SLR-induced groundwater table rise, MSL was used as the datum. A 1:1 ratio of groundwater table rise to MSL rise was used, and the projected groundwater rise was added to a baseline as described in the next paragraph. It is unlikely that SLR will uniformly be linear at a 1:1 ratio in all parcels. However, this approximation is effective for areas that are flux controlled; that is, where the sea level and tidal fluctuations have influence over an aquifer (Plane E, 2019). This method provides a conservative upper limit to groundwater rise because of SLR.

The HPNS Basewide Groundwater Monitoring Program (BGMP) has been collecting groundwater monitoring data, including groundwater elevations, regularly since 2002. This database was evaluated to determine the baseline potentiometric surface. The monitoring wells of primary focus in this assessment are screened in Aquifer A, which is the uppermost, unconfined water-bearing zone at HPNS. Wells IR39MW21A and PA39MW02A were selected as indicator wells because they are the closest to the area where groundwater emergence is projected to occur first. Measurements from 2002 to 2022 were reviewed to determine the date when the indicator wells had their highest groundwater elevations; the date determined was December 7, 2012 for both wells. Next, all monitoring wells with measurements on this date were further filtered to only provide monitoring wells screened within the water table Aquifer A. Ultimately, groundwater elevation measurements from a total of 125 monitoring wells from across HPNS that were measured on December 7, 2012 and screened within Aquifer A were then used to develop the baseline potentiometric surface.

The same adjusted DEM used to evaluate seawater inundation was used in this groundwater assessment. **Figures 3-1** and **3-2** show groundwater emergence at HPNS in 2035 and 2065, respectively. **Tables 2-2** and **2-3** provides a list of areas projected to be impacted by groundwater table rise in 2035 and 2065.

In summary, groundwater table emergence is expected to be minimal but present in Parcel D-1 by 2035 and is projected to appear in several parcels by 2065 in the highest SLR scenario. The Navy will track actual water table trends in the HPNS BGMP, to compare measurements to projections over time.

3.2 Groundwater Table Rise to Within 3 Feet of Ground Surface

In addition to identifying areas of groundwater emergence, the same methodology was applied to identify areas that may experience a groundwater table rise to a depth of 3 feet bgs. This is a depth at which building infrastructure, such as sewer lines, may be present; however, all sewer and storm drains have been removed at HPNS. The density requirement for backfilled trench soil is 90 percent relative density by test method ASTM D1557; therefore, it is unlikely to act as a preferential pathway.

The historical high groundwater table from December 2012 was used as the baseline. **Figures 3-3** and **3-4** show the areas where the groundwater table is projected to be within 3 feet bgs in 2035 and 2065, respectively. The following potential impacts from groundwater table rise were projected for 2035 and 2065 based on the highest SLR scenario:

- In 2035, IR 7/18 and Parcels E-2 and UC-3 are not impacted; however, limited areas in Parcels B-1, B-2, C, D-1, E, and G may experience groundwater table rise within 3 feet bgs (**Table 2-2, Figure 3-3**).
- In 2065, all parcels except Parcel UC-3 are impacted in limited areas by groundwater table rise to within 3 feet bgs. (**Table 2-3, Figure 3-4**).

4.0 Impacts of Other Climate Hazards

This section describes the other DCAT-identified climate hazards in addition to coastal flooding at HPNS. The following impacts from climate-related hazards are anticipated at HPNS:

- Extreme weather events. The number of days with extreme 1-day or 2-day precipitation events could increase.
- Drought. Future years could see extended periods of drought during the dry months and shorter wetter periods during wet months.
- Wildfires. Future years could see higher instances of wildfires following extended periods of drought.
- Energy demand. Future years could see more power outages, with potential impacts on the Parcel E-2 landfill operation.

Transient climate change phenomena that may impact a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site will be managed and addressed as part of regular inspections, maintenance, and repairs as required in the land use control remedial design (RD) and applicable Operations and Maintenance and LTM plans for each IR site or parcel. **Table 4-1** presents the hazards and whether a parcel may be affected.

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5.0 Vulnerability Assessment

This section discusses the projected vulnerabilities as a result of potentially new future exposure scenarios from the primary hazard identified to impact HPNS: coastal flooding. A review of the remedy components at Parcel E-2 (landfill) that take into account climate resilience is also included in this section.

5.1 Assessment Methodology

The vulnerability assessment evaluates whether the impacts identified in this screening level CRA indicate a projected new exposure scenario that may impact the CERCLA risk assessed at the IR site. If yes, a site is determined to be vulnerable. If no, the site is determined to be resilient. Factors that affect the assessment include chemicals of concern (COCs) that may persist through 2035 and 2065, and whether there are new exposure pathways that were not previously addressed in the remedies.

COCs: Site COCs identified as most likely to persist in 2035 are chlorinated volatile organic compounds (CVOCs), heavy metals, polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs). Site COCs identified as most likely to persist in 2065 are heavy metals, PCBs, and PAHs.

New Exposure Pathways: Groundwater emergence because of SLR is projected to occur in limited areas beginning in 2035 as follows:

- In 2035, groundwater emergence is projected in a limited area in Parcel D-1 (**Figure 3-1**).
- In 2065, groundwater emergence is projected in limited areas in IR 7/18, Parcels B-1, B-2, C, D-1, and E (**Figure 3-2**).

Vulnerabilities: When the likelihood for migration of these COCs to potential receptors is assessed, the following vulnerabilities attributable to climate change are identified at HPNS:

- Potential vulnerability of human receptors at the ground surface to heavy metals because of groundwater emergence.
- Potential vulnerability of ecological receptors in the bay to heavy metals because of groundwater emergence.

The Navy has been monitoring water levels and COC trends for the past 21 years as part of the BGMP and will continue to monitor COC concentrations to inform the CRA in the next Five-Year Review.

5.2 Potential New Exposure Scenarios for Residual COCs

Residual COCs are expected to remain onsite in areas not remediated to unrestricted reuse in accordance with each parcel's Record of Decision (ROD) and the HPNS reuse plan.

Based on the description of the parcels, IR sites, COCs, and past or future remedies in this Five-Year Review, the following potential new exposure scenarios are identified as relevant to the primary climate hazard anticipated at HPNS, coastal flooding. Coastal flooding includes the impacts of permanent SLR, the associated groundwater emergence, and transient storm surges):

- Potential new exposure to CVOCs from vapor intrusion because of groundwater table rise to 3 feet bgs

- Potential new exposure of human receptors at the current ground surface to heavy metals because of groundwater emergence
- Potential new exposure of ecological receptors in the bay to heavy metals because of groundwater emergence

5.3 Assessing the Resilience to Coastal Flooding

Coastal flooding is the primary climate change hazard that is projected to impact HPNS. Parcel D-1 is the only parcel projected to be impacted in 2035. The following parcels are projected to be impacted in 2065: IR 7/18, Parcels B-1, B-2, C, D-1, and E. **Tables 5-1** and **5-2** list the results of this vulnerability assessment.

5.3.1 Potential New Exposure to CVOCs from Vapor Intrusion due to Groundwater Table Rise to 3 feet bgs

This exposure scenario examines a potential hypothetical future scenario, in which a rising groundwater table causes CVOC plumes to enter sewer lines or come in contact with foundations of buildings, thus increasing the potential for CVOC vapor intrusion into buildings, where occupants could potentially be exposed to CVOC vapors. This assessment found no new or increased exposure created in this scenario, based on the following findings:

- All sewer lines in the impacted parcels and IR sites with CVOC plumes have either been removed or will be removed.
- Following past and future treatment of source areas, most of the residual CVOC plumes in parcels like Parcels B-1 and G have been greatly reduced in concentration (NAVFAC, 2020). In Parcel C (IR 28), where previous treatment of a CVOC source left residual source mass, additional treatment (excavation and bioremediation) is planned. By 2035, any residual CVOCs in groundwater are projected to attenuate below remedial goals (RGs).

5.3.2 Potential New Exposure of Human Receptors at the Current Ground Surface to Heavy Metals due to Groundwater Emergence

This exposure scenario assesses the possibility that groundwater emergence could lead to new potential exposures to heavy metals at the ground surface. In some parcels, asphalt covers have been placed on soils that contain levels of residual heavy metals, in order to isolate them from potential aboveground receptors. If near-surface soils with elevated concentrations of heavy metals are present under the asphalt covers, a relatively permanent rise in the groundwater table could bring dissolved metals to the surface (through cracks in the asphalt or from the sides of the paved areas), without the attenuating effect of cleaner soil covers.

Depending on the varying land use scenarios, potential receptors could include construction workers, industrial workers, recreational users, or (in parts of Parcel C planned for mixed use) residents or residents growing produce (Table 4-3 in this Five-Year Review). Potential new exposures for these aboveground receptors are unlikely in areas with vegetative covers, namely, Parcel E-2 and portions of Parcels E (IR-2SE), B-1, and IR 7/18. However, this CRA found some potential vulnerabilities for these aboveground receptors in areas with asphalt covers, namely, Parcels D-1, B-2, and C and portions of Parcels E, B-1, and IR 7/18.

IR site-specific studies may be warranted in the future to evaluate the risk associated with this projected vulnerability.

5.3.3 Potential New Exposure of Ecological Receptors in the Bay to Heavy Metals due to Groundwater Emergence

As described in **Section 5.3.2**, in future climate-driven scenarios, residual heavy metals in vadose zone soil could dissolve in rising groundwater. In areas with a vegetative cover (with 2 or 3 feet of clean soil), the solubilized heavy metals are likely to sorb to clean soil along the path to the bay, as is evident in past groundwater data (TRBW, 2022). Past groundwater monitoring data show no sustained exceedance of aquatic ecology-based trigger levels, with a reduction in concentration of metals evident in monitoring wells in parcels where remedial excavations have taken place. One exception is heavy metals like zinc that exceed the trigger levels in monitoring well IR02MW373A in Parcel E. Additional excavation remedies are planned near this well in the future to target the exceedances here. Additionally, a near-shore slurry wall is planned to contain groundwater COCs before discharge to the Bay. Similarly, in Parcel B-2 (IR 26), annual monitoring indicates an exceedance for mercury, but additional remedies are planned to address that. This illustrates the continuous cycle of annual monitoring and refocusing of remedies that are already in place, leading to continuing improvements that are expected to help achieve the remedial action objectives at HPNS.

In areas with an asphalt cover, heavy metals in near-surface soils could emerge at the ground surface with the groundwater. In this scenario, there is potential for heavy metals in the emergent groundwater to migrate to the bay. Such migration could occur if the emerging groundwater laden with metals drains to the bay through surface features (for example, drainage swales or storm water drains) or merges with seawater during storm surges or rainstorms and then drains to the bay, potentially at levels that exceed surface water quality criteria for ecological receptors. Therefore, this scenario is a potential climate-driven vulnerability in areas with asphalt cover at HPNS.

5.3.4 Potential New Exposure of Subsurface Remedy Infrastructure to Saltwater Intrusion

The groundwater at many locations, especially in the portions of the parcels near the coastline are brackish and high in saltwater components, such as chloride, indicating that saltwater intrusion is an ongoing phenomenon. None of the parcels have remedies that require ongoing use of subsurface remedy infrastructure (for example, no pump-and-treat systems with subsurface extraction wells). There is a soil vapor extraction (SVE) system at IR Site 10 in Parcel B-1 that has subsurface components, but it is slated for decommissioning, as it has reached asymptotic conditions. Parcel E-2 (landfill) is decommissioning its SVE wells and installing 34 LFG extraction wells, but these are above the elevation expected of groundwater table rise by 2065. There are several monitoring wells throughout all the parcels that will continue to be sampled in the future. The groundwater at many locations is high in saltwater components, such as chloride, indicating that saltwater intrusion is an ongoing phenomenon. Monitoring wells at HPNS are designed for brackish or saline environments and will undergo routine maintenance and/or replacement in the future. Therefore, all parcels at HPNS are resilient to this potential exposure scenario.

5.3.5 Potential New Exposure of Bay Ecological Receptors to Heavy Metals, PCBs and PAHs from Erosion due to Storm Surges

This scenario is considered because several parcels are projected to flood temporarily during a 100-year storm. Soils with residual COCs may impact the bay during high erosion storm events.

Figures 2-4 and **2-5** show projected areas of transient flooding due to storms projected in years 2035 and 2065, respectively.

Excavation remedies reduce heavy metals, PCBs and PAHs to their applicable RGs in accordance with each parcel's ROD. Because the land in many parcels at HPNS is relatively flat and all parcels have durable covers, either vegetative cover or asphalt cover, there is less likelihood of erosion-related impacts on underlying COCs. Of the two parcels expected to experience the most flooding, Parcel D-1 has asphalt cover throughout the parcel and Parcel E has a mix of asphalt cover and vegetative cover planned. In addition, parts of Parcel E-2 have a protective liner underneath the vegetative cover, to minimize water seeping into the soil with elevated COCs below. The parcels on the southern side of HPNS are lined with seawall and many of the parcels on the northern side have revetments, which will further reduce the impact of storm surges and waves. In addition, wetlands have been incorporated into Parcel E-2 and those will act to reduce storm surges and wave action as well. Therefore, for multiple reasons, the parcels at HPNS are resilient to this potential exposure scenario.

5.3.6 Parcel E-2 Remedy Resiliency

The Parcel E-2 remedy, currently under construction, incorporates remedy design features that make it resilient to climate impacts and protective of the bay. The Parcel E-2 tidal and freshwater wetlands (under construction) are projected to flood in 2035 and 2065; however, the wetlands were designed to store and transmit seawater, rain, and groundwater to mitigate the effects of SLR in accordance with the RD (ERRG, 2014). In addition to coastal flooding, power interruptions from extreme weather events and wildfires could impact the remedy at Parcel E-2 because the LFG system requires power and has above-ground components that could be damaged by a wildfire.

The following design elements have made the E-2 remedy resilient:

- Excavation and offsite disposal of hotspots
- Grading and onsite consolidation of soil, sediment, and debris. Shoreline revetment (9 feet high) and seawall (additional 3 feet).
- Tidal and freshwater wetlands installed to mitigate the daily influence of tides and periodic influence of waves during storms
- Excavation and shipping out of radiological COCs, removal of sanitary sewers, storm drains, septic and sewer lines
- Landfill cap consisting of 2-foot-thick foundation soil layer, a protective geocomposite liner with drainage layer, and a minimum 2-foot-thick vegetative soil cover
- Groundwater controls, including downgradient slurry wall (keyed into aquitard), upgradient slurry wall, French drain upgradient to divert groundwater around the landfill, and monitoring wells around the landfill that are regularly monitored. Downgradient groundwater monitoring wells so far have not shown exceedances of applicable risk thresholds for any of the COCs monitored.
- LFG controls, including an active collection and treatment system to control LFG emissions and migration
- Regular maintenance, monitoring, and institutional controls, including
  - Cover integrity inspections

- Groundwater and LFG monitoring
- Stormwater and erosion controls
- Wetlands monitoring and maintenance
- Inspections after a qualifying event (earthquake, storm event, or system alarm)
- Prompt repairs to any damage observed during routine and event-triggered inspections

The revetment is designed to withstand a 100-year storm and the addition of the seawall makes the landfill resilient to projected SLR through year 2065 (3.2 feet projected SLR highest GHG scenario). Drainage channels, culvert, and outfall structures around the landfill are designed to accommodate peak flows from a 1,000-year storm (ERRG, 2014). Any damage to the system would be promptly repaired to comply with the Operations and Maintenance plan. Therefore, the landfill is resilient to climate change impacts through 2065.

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6.0 Conclusions and Recommendations

The following section discusses the conclusions and recommendations of the screening-level CRA.

6.1 Conclusions

The CRA concluded that the past and ongoing remedies implemented by the Navy have made the parcels at HPNS resilient to most impacts projected to result from the climate change hazards identified by DCAT. The vulnerabilities to climate change identified in this CRA include the following:

- In 2035, a potential vulnerability to human receptors and San Francisco Bay receptors from heavy metals and low-level radiological objects to permanent groundwater emergence at Parcel D-1.
- In 2065, potential vulnerability to human receptors and San Francisco Bay receptors from heavy metals because of permanent groundwater emergence at IR 7/18, Parcels B-1, B-2, C, D-1, and E.
- Potential vulnerability of the Parcel E-2 LFG treatment system to wildfires.

CRA Recommendations in the Five-Year Review

If a vulnerability is projected to result in a potentially new exposure scenario for either human or ecological receptors, then further IR site-specific study is recommended to evaluate whether there may be additional CERCLA risk as a result of the vulnerability. The findings for this CRA are as follows:

- Based on 2035 SLR projections, an IR site-specific study is recommended to assess whether the projected climate change vulnerabilities are likely to result in additional CERCLA risk at Parcel D-1.
- Based on 2065 SLR projections, IR site-specific studies are recommended to assess whether the projected climate change vulnerabilities are likely to result in additional CERCLA risk at IR 7/18, Parcels B-1, B-2, C, D-1, and E.

For future Five-Year Reviews, the following are recommended to assess the impact of the projected vulnerabilities identified in this CRA:

- **Verification of HPNS SLR Projections:** SLR projections can be verified by tracking the five tide gauges nearest to HPNS. The DCAT guides users to a sea level tracker developed by USACE (USACE, 2023), where SLR measurements in tide gauges can be plotted against a 19-year moving average that accounts for normal fluctuations over one tidal cycle.
- **Annual Evaluation of Groundwater Elevation Data:** Evaluate the impacts of SLR on groundwater elevations over time. Perform an annual evaluation to compare tidal gauge trends to shallow water table elevation trends.

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Tables

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Table 1-1. Eight Climate Change Related Hazards Identified in DCAT

Continental United States Climate Hazard	Supporting Indicators
Drought	Flash drought frequency, drought year frequency, aridity, consecutive dry days, mean annual runoff
Coastal Flooding	Coastal flood extent, coastal erosion
Riverine Flooding	Riverine flood extent, flood magnification factor, maximum 1-day precipitation, maximum 5-day precipitation, extreme precipitation days
Heat	Days above 95°F, 5-day maximum temperature, high heat days, frost days, high Heat Index days
Energy Demand	Heating degree days, cooling degree days, 5-day minimum temperature, 5-day maximum temperature
Land Degradation	Fire season length, aridity, soil loss, coastal erosion, permafrost hazard
Wildfire	Fuel abundance, ignition rate, fire season length, flash drought frequency
Historical Extreme Conditions	Tornado frequency, hurricane wind> 50 knots, hurricane maximum precipitation, hurricane frequency, ice storms, historic drought frequency, ice jams, wildland urban interface

Table 2-1. SLR Projections for 2035 and 2065 in DRSL

Global GHG Scenario	Site-specific Sea Level Rise Projections Including Vertical Land Movement	
	2035 (ft)	2065 (ft)
Lowest	0.3	0.6
Low	0.3	1.0
Medium	0.7	1.6
High	0.7	2.3
Highest	1.0	3.2

Table 2-2. Impacts of Coastal Flooding in Parcels by 2035

Parcel	Impacted by Groundwater emergence	Impacted by 100-year storm	Impacted by Groundwater Table Rise to 3 feet bgs
IR 7/18	No	Yes. IR 7/18	No
B-1	No	Yes. IR 10, 23, 24, 60, 61	Yes. IR 20, 62
B-2	No	Yes. IR 24, 26	Yes. IR 26
C	No	Yes. IR 27, 28, 29, 57, 64	Yes. IR 25, 28
D-1	Yes	Yes. IR 17, 55, 68, 70	Yes. IR 70
E	No	Yes. IR 2, 8, 13, 14, 36, 38, 39	Yes. IR 2, 8, 13, 36, 39
E-2	No	Yes. IR 1/21	No
G	No	No	Yes. IR 9, 33, 34, 37
UC-3	No	No	No

Table 2-3. Impacts of Coastal Flooding in Parcels by 2065

Parcel	Impacted by Groundwater emergence	Impacted by 100-year storm	Impacted by Groundwater Table Rise to 3 ft bgs
IR 7/18	Yes. IR 7/18	Yes. IR 7/18	Yes. IR 7/18
B-1	Yes. IR 23, 24, 60	Yes. IR 10, 23, 24, 60, 61	Yes. IR 10, 20, 62
B-2	Yes. IR 26	Yes. IR 26	Yes. IR 26
C	Yes. IR 27, 28, 57	Yes. IR 27, 28, 29, 30, 57, 58, 63, 64	Yes. IR 25, 28
D-1	Yes. IR 17, 53, 68, 69	Yes. IR 16, 17, 22, 35, 48, 53, 55, 68, 69, 70	Yes. IR 22, 55, 70
E	Yes. IR 2, 38, 39	Yes. IR 2, 3, 5, 8, 11, 12, 13, 14, 36, 38, 39, 73	Yes. IR 2, 4, 8, 13, 14, 15, 36, 39
E-2	Yes. IR 1/21	Yes. IR 1/21	Yes. IR 1/21
G	No	Yes. IR 9, 33, 34, 37, 44, 65, 66, 67, 71	Yes. IR 9, 33, 34, 37
UC-3	No	No	No

Table 4-1. Impacts of Other Climate Hazards (Other than Coastal Flooding)

Parcel	Extreme weather events (rain storms)	Drought	Wildfires	Riverine Flooding	Extreme Temperatures	Energy Demand	Land Degradation
All Parcels (except E-2)	Yes	Yes	Yes	No	No	No	No
E-2	Yes	Yes	Yes	No	No	Yes	No

Table 5-1. Resilience of Parcels to Coastal Flooding Impacts in 2035

Parcel	Impacted By Groundwater Emergence	Impacted by 100-year storm	Impacted by Groundwater Table Rise to 3 ft bgs	Potential new exposure to CVOCs from vapor intrusion due to groundwater table rise to 3 ft bgs	Potential new exposure of human receptors at the ground surface to heavy metals due to groundwater emergence	Potential new exposure of ecological receptors in the bay to heavy metals due to groundwater emergence	Potential new exposure of subsurface remedy infrastructure to saltwater intrusion	Potential new exposure of human receptors to heavy metals from erosion due to storm surges
IR 7/18	No	Yes. IR 7/18	No	No	No	No	No	No
B-1	No	Yes. IR 10, 23, 24, 60, 61	Yes. IR 20, 62	No	No	No	No	No
B-2	No	Yes. IR 24, 26	Yes. IR 26	No	No	No	No	No
C	No	Yes. IR 27, 28, 29, 57, 64	Yes. IR 25, 28	No	No	No	No	No
D-1	Yes. (outside of IR boundary)	Yes. IR 17, 55, 68, 70	Yes. IR 70	No	Yes	Yes	No	No
E	No	Yes. IR 2, 8, 13, 14, 36, 38, 39	Yes. IR 2, 8, 13, 36, 39	No	No	No	No	No
E-2	No	Yes. IR 1/21	No	No	No	No	No. LFG extraction wells and collection trench above groundwater table rise	No
G	No	No	Yes. IR 9, 33, 34, 37	No	No	No	No	No
UC-3	No	No	No	No	No	No	No	No

Table 5-2. Resilience of Parcels to Coastal Flooding Impacts in 2065

Parcel	Impacted by Groundwater emergence	Impacted by 100-year storm	Impacted by Groundwater Table Rise to 3 ft bgs	Potential new exposure to CVOCs from vapor intrusion due to groundwater table rise to 3 ft bgs	Potential new exposure of human receptors to heavy metals at the current ground surface due to groundwater emergence	Potential new exposure of ecological receptors in the bay to heavy metals due to groundwater table emergence	Potential new exposure of subsurface remedy infrastructure to saltwater intrusion	Potential new exposure of human receptors to heavy metals from erosion due to storm surges
IR 7/18	Yes. IR 7/18	Yes. IR 7/18	Yes. IR 7/18	No	Yes. (in areas with asphalt cover)	Yes. (in areas with asphalt cover)	No	No
B-1	Yes. IR 23, 24, 60	Yes. IR 10, 23, 24, 60, 61	Yes. IR 10, 20, 62	No	Yes. (in areas with asphalt cover)	Yes. (in areas with asphalt cover)	No	No
B-2	Yes. IR 26	Yes. IR 26	Yes. IR 26	No	Yes	Yes	No	No
C	Yes. IR 27, 28, 57	Yes. IR 27, 28, 29, 30, 57, 58, 63, 64	Yes. IR 25, 28	No	Yes	Yes	No	No
D-1	Yes. IR 17, 53, 68, 69	Yes. IR 16, 17, 22, 35, 48, 53, 55, 68, 69, 70	Yes. IR 22, 55, 70	No	Yes	Yes	No	No
E	Yes. IR 2, 38, 39	Yes. IR 2, 3, 5, 8, 11, 12, 13, 14, 36, 38, 39, 73	Yes. IR 2, 4, 8, 13, 14, 15, 36, 39	No	Yes. (in areas with asphalt cover)	Yes. (in areas with asphalt cover)	No	No
E-2	No	No	No	No	No	No	No	No
G	No	Yes. IR 9, 33, 34, 37, 44, 65, 66, 67, 71	Yes. IR 9, 33, 34, 37	No	No	No	No	No
UC-3	No	No	No	No	No	No	No	No

Table 5-3. Resilience of Parcels to Other Climate Hazards

Parcel	Potential new exposure of human receptors to heavy metals from erosion due to rain storms	Potential new exposure from vapor intrusion due to a drop in groundwater table during drought	Potential new concern due to wildfires	Potential new concern due to inability to meet energy demand during power outage	Potential new concern due to land degradation
IR 7/18	No	No	No	No	No
B-1	No	No	No	No	No
B-2	No	No	No	No	No
C	No	No	No	No	No
D-1	No	No	No	No	No
E	No	No	No	No	No
E-2	No	No	Yes (LFG Treatment System)	No	No
G	No	No	No	No	No
UC-3	No	No	No	No	No

Figures

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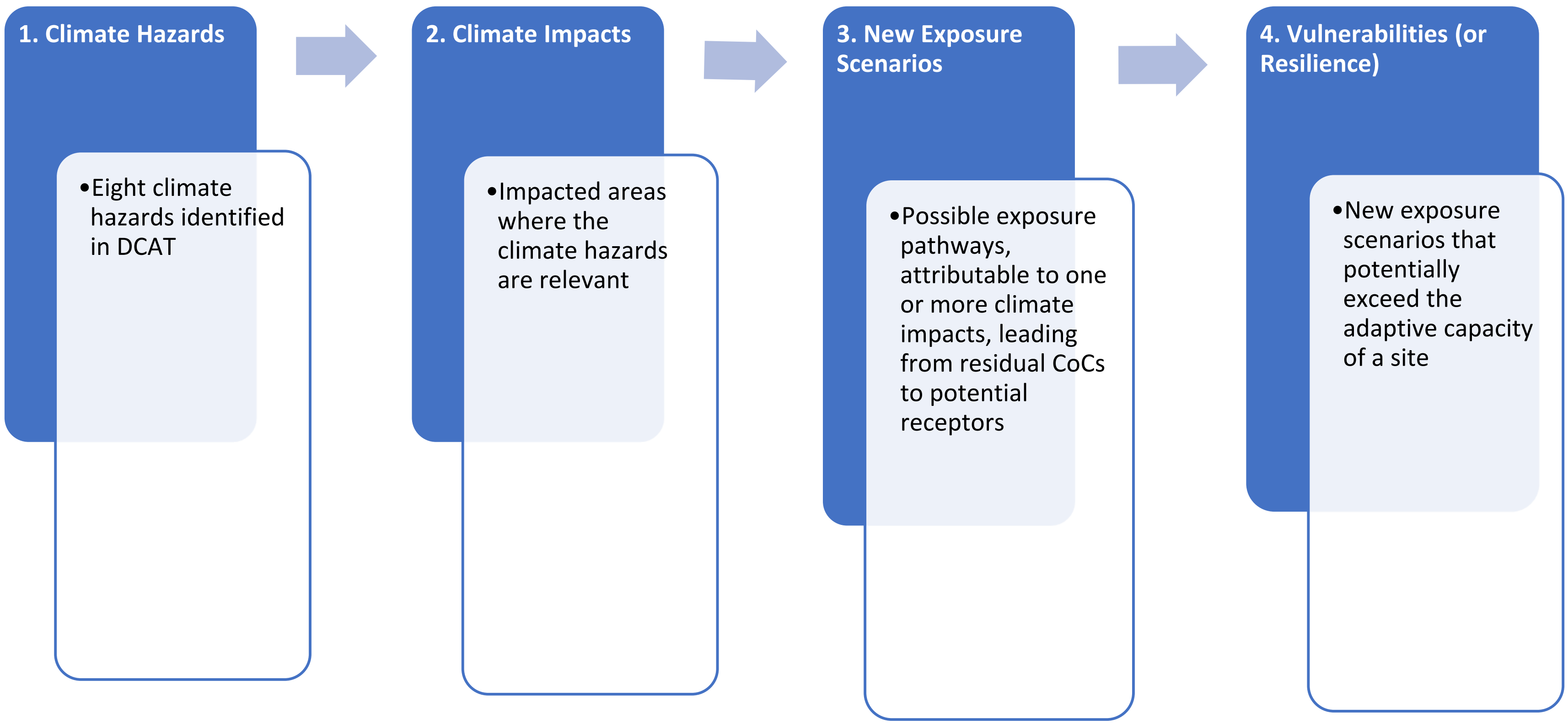

Figure 1-1. Steps in the CRA leading from climate-related hazards to identification of potential vulnerabilities or resilience

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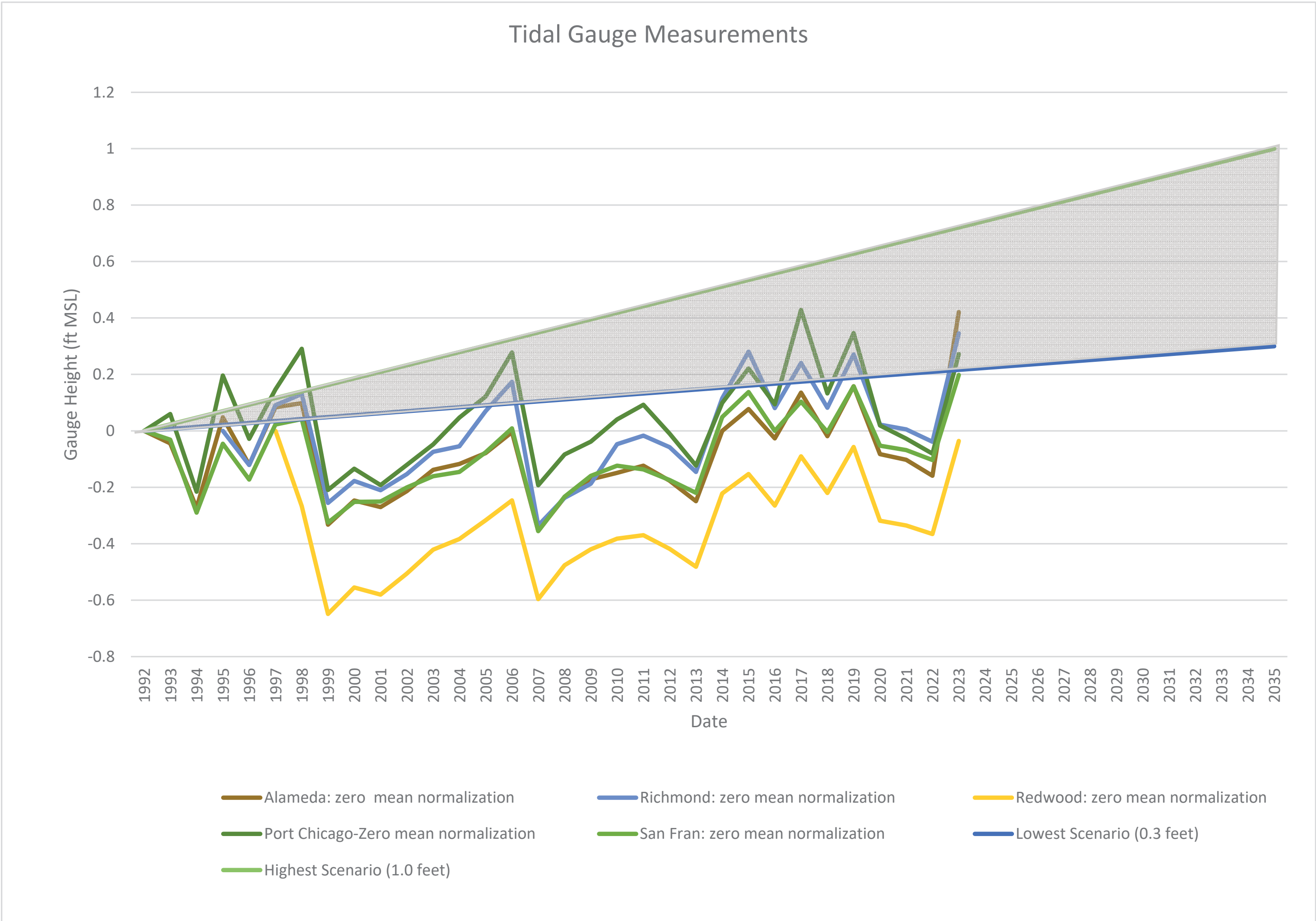

Figure 2-1
Actual Sea Level Rise Measurements in Five Tidal Gauges Nearest to Former Hunters Point Naval Shipyard Compared to DRSL Projected Range to Year 2035

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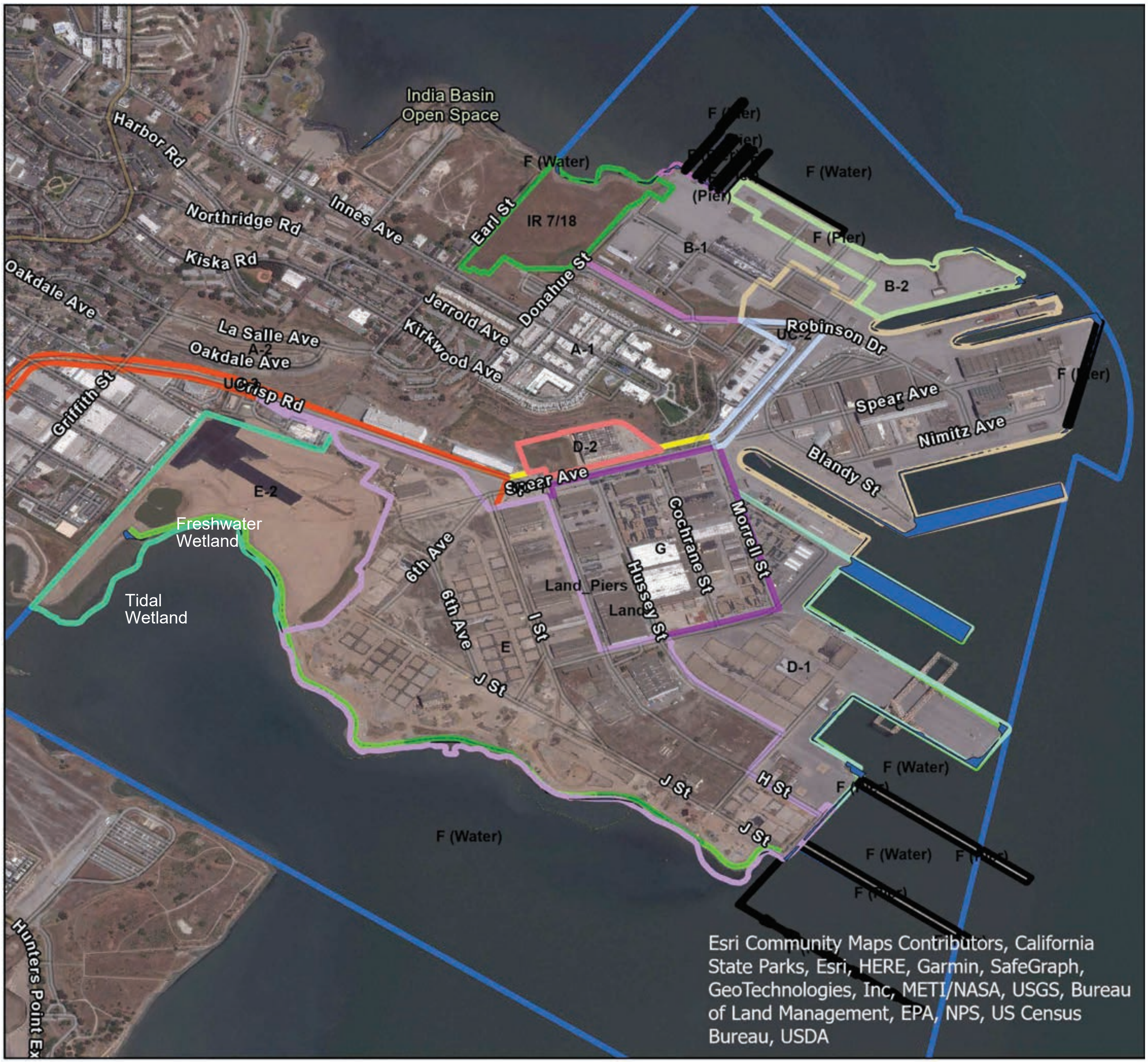


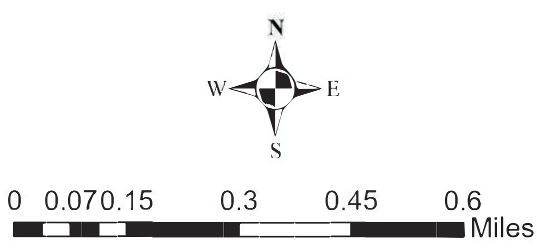
Parcels

- B-1
- B-2
- C
- D-1
- D-2
- E
- E-2
- F (Pier)
- F (Water)
- G
- IR 7/18
- UC-1
- UC-2
- UC-3

Features

- Permanent Inundation due to sea level rise only
- Berms
- Seawall_12ft

Global GHG Scenarios 2035
Permanent Inundation
due to Sea Level Rise
Highest GHG: 1.0 feet above MSL
Figure 2-2



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Map Units: Degree

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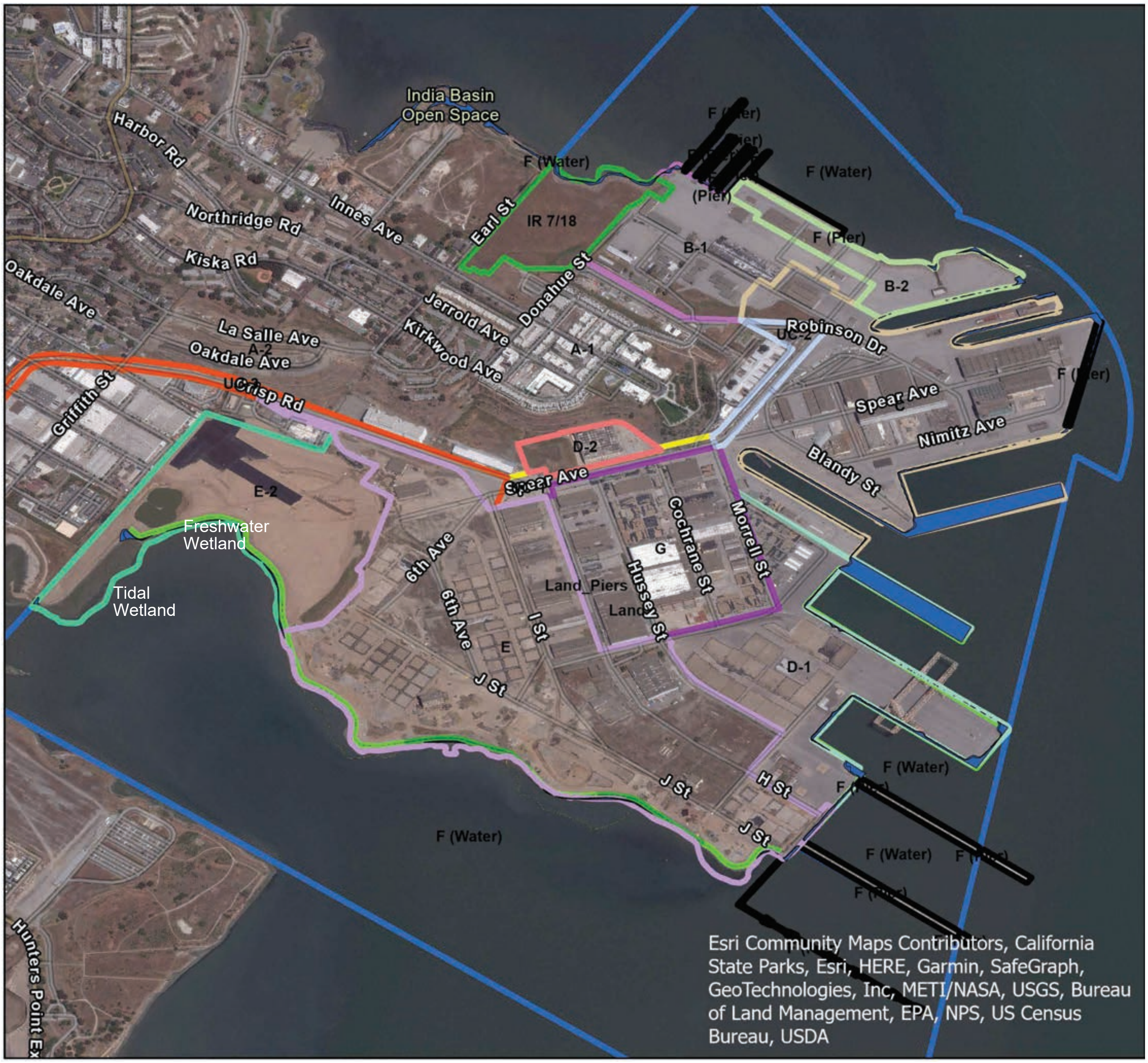

Parcels

- B-1
- B-2
- C
- D-1
- D-2
- E
- E-2
- F (Pier)
- F (Water)
- G
- IR 7/18
- UC-1
- UC-2
- UC-3

Features

- Permanent Inundation due to sea level rise only
- Berms
- Seawall_12ft

Global GHG Scenarios 2065
Permanent Inundation
due to Sea Level Rise
Highest GHG: 3.2 feet above MSL
Figure 2-3

N
W E
S

0 0.07 0.15 0.3 0.45 0.6 Miles

Spatial Reference
Name: GCS WGS 1984
GCS: GCS WGS 1984
Datum: WGS 1984
Map Units: Degree

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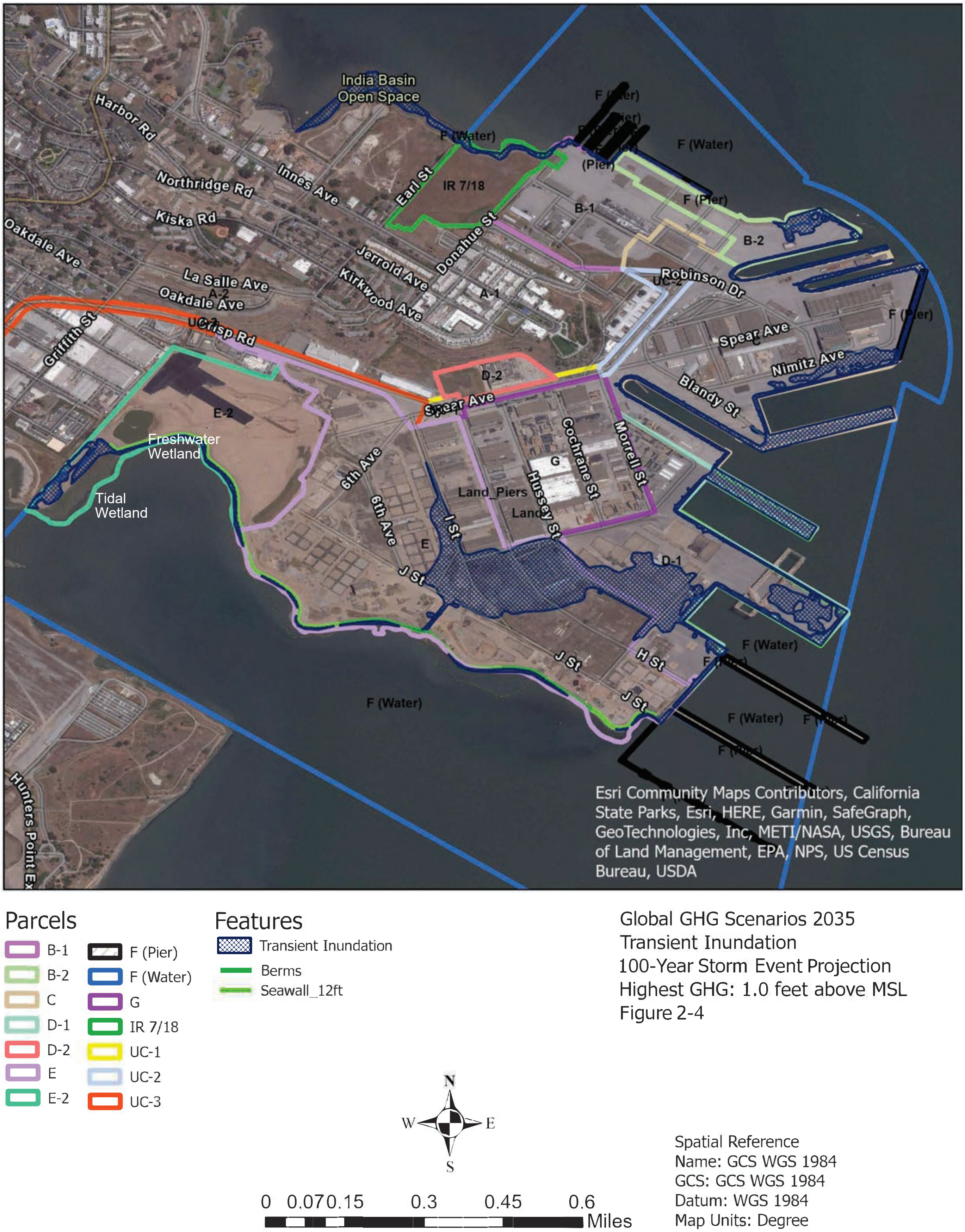

Global GHG Scenarios 2035
Transient Inundation
100-Year Storm Event Projection
Highest GHG: 1.0 feet above MSL
Figure 2-4

Spatial Reference
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GCS: GCS WGS 1984
Datum: WGS 1984
Map Units: Degree

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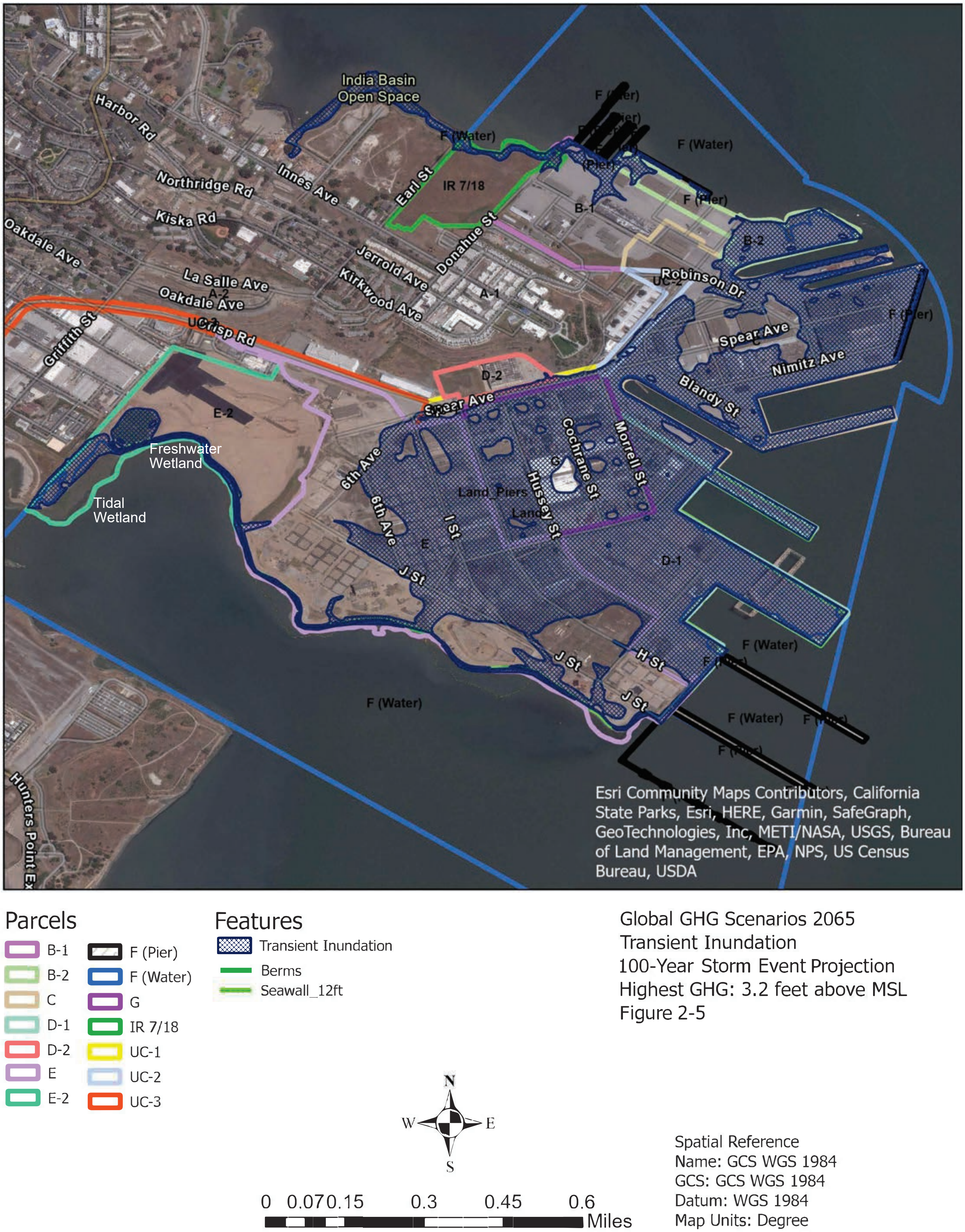

Global GHG Scenarios 2065
Transient Inundation
100-Year Storm Event Projection
Highest GHG: 3.2 feet above MSL
Figure 2-5

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Parcels

B-1
B-2
C
D-1
D-2
E
E-2
F (Pier)
F (Water)
G
IR 7/18
UC-1
UC-2
UC-3

Features

Groundwater Emergence
Berms
Seawall_12ft

Global GHG Scenarios 2035
Groundwater Emergence
Highest GHG: 1.0 ft above MSL
Figure 3-1

N
W E
S

0 0.07 0.15 0.3 0.45 0.6
Miles

Spatial Reference
Name: GCS WGS 1984
GCS: GCS WGS 1984
Datum: WGS1984
Map Units: Degrees

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Global GHG Scenarios 2065
Groundwater Emergence
Highest GHG: 3.2 ft above MSL
Figure 3-2

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F (Water)
IR 7/18
B-1
F (Water)
B-2
UC-2
F (Pier)
A-2
A-1
UC-3
C
D-2
UC-1
E-2
G
Land_Piers
Land
E
D-1
F (Water)
F (Water)
F (Water)
F (Water)
Parcels
B-1
B-2
C
D-1
D-2
E
E-2
F (Pier)
F (Water)
G
IR 7/18
UC-1
UC-2
UC-3
Features
Well locations where groundwater is projected to be less than 3 feet below ground surface
Berms
Seawall_12ft
Global GHG Scenarios 2035
Groundwater Table Rise to 3 ft bgs
Highest GHG: 1.0 ft above MSL
Figure 3-3
N
W
E
S
0
0.07
0.15
0.3
0.45
0.6
Miles
Spatial Reference
Name: GCS WGS 1984
GCS: GCS WGS 1984
Datum: WGS1984
Map Units: Degrees

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Global GHG Scenarios 2065
Groundwater Table Rise to 3 ft bgs
Highest GHG: 3.2 ft above MSL
Figure 3-4

Spatial Reference
Name: GCS WGS 1984
GCS: GCS WGS 1984
Datum: WGS1984
Map Units: Degrees

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Appendix B
Interview Summaries

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INTERVIEW RECORD		
Site Name: Hunters Point Naval Shipyard		**EPA ID No.:** CA1170090087
Subject: Five-Year Review O&M Interview		**Date:** 2/7/2023
Type: Telephone Visit Other **Location of Visit:** Questions and responses provided via e-mail.		
Contact Made By:		
Name: Jamie Egan	**Title:** Project Manager	**Organization:** CH2M HILL
Individual Contacted:		
Name: Lou Ehrhard	**Title:** Project Manager	**Organization:** Kemron
E-Mail Address: lehrhard@kemron.com		

Summary Of Conversation

1. What is your affiliation with the Former Hunter's Point Naval Shipyard and what is your role in regard to the oversight of any of the Five Year Review sites/parcels? The sites are as follows:

- Installation Restoration [IR] Sites 7 and 18
- Parcel B-1
- Parcel B-2
- Parcel C
- Parcel D-1
- Parcel D-2
- Parcel E
- Parcel E-2
- Parcel F (Final ROD pending)
- Parcel UC-1
- Parcel UC-2
- Parcel UC-3

Project Manager for the Parcel E-2, Phase III scope, consisting of construction of the landfill cap over the main portion of the existing landfill and installation of the gas control and containment system. I am responsible for the implementation of the Phase III construction scope as well as preparation of plans and reports, including O&M Plans.

2. Over the past five years, have you been involved in on-going communication with the Navy in regard to the Navy's environmental activities at any of the Five-Year Review sites?

Yes, we have weekly calls with the Navy to discuss the scope and progress of the construction at Parcel E-2.

3. Is there an on-site O&M Presence at any of the Five-Year Review sites? Please describe staff O&M activities and their frequency.

As part of our scope, we had a requirement to inspect the revetment wall at Parcel E-2 constructed by others. Two years of inspections were performed, on a quarterly basis in 2020 and on a semiannual basis in 2021, and this scope has been completed.

4. Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines since the start-up or in the last five years at any of the Five-Year Review sites? Please describe and include whether they affect the protectiveness of the remedy.

No, as the landfill cap and gas control and containment system remedy has not yet been completed O&M of the landfill cap at Parcel E-2 has not started.

5. Have there been unexpected O&M difficulties or changes in costs since start-up or in the last five years at any of the Five-Year Review sites? If so, please give details.

No.

6. Have there been opportunities to optimize O&M or sampling efforts at any of the Five-Year Review sites? Please describe changes and results or improved efficiency?

No, O&M for the Parcel E-2 landfill cover has not yet started.

INTERVIEW RECORD		
Site Name: Hunters Point Naval Shipyard		**EPA ID No.:** CA1170090087
Subject: Five-Year Review O&M Interview		**Date:** 2/7/2023
Type: Telephone Visit Other **Location of Visit:** Questions and responses provided via e-mail.		
Contact Made By:		
Name: Jamie Egan	**Title:** Project Manager	**Organization:** CH2M HILL
Individual Contacted:		
Name: Brett Womack	**Title:** Project Manager	**Organization:** GES-AIS
E-Mail Address: bwomack@ges-ais.com		

Summary Of Conversation

1. What is your affiliation with the Former Hunter's Point Naval Shipyard and what is your role in regard to the oversight of any of the Five Year Review sites/parcels? The sites are as follows:

- Installation Restoration [IR] Sites 7 and 18
- Parcel B-1 – ***Radiological Rework Contractor (active)***
- Parcel B-2 – ***Radiological Rework Contractor (active)***
- Parcel C – ***Radiological Rework Contractor (active)***
- Parcel D-1 – ***RCA Operator – RSY pads (active)***
- Parcel D-2 – ***Radiological Rework Contractor (not active)***
- Parcel E – ***RA Contractor, Phase 2 (active)***
- Parcel E-2
- Parcel F (Final ROD pending)
- Parcel UC-1 – ***Radiological Rework Contractor (not active)***
- Parcel UC-2 – ***Radiological Rework Contractor (not active)***
- Parcel UC-3 – ***Radiological Rework Contractor (not active)***

2. Over the past five years, have you been involved in on-going communication with the Navy in regard to the Navy's environmental activities at any of the Five-Year Review sites?

Yes.

3. Is there an on-site O&M Presence at any of the Five-Year Review sites? Please describe staff O&M activities and their frequency.

GES has no O&M presence beyond requirements on active work sites. Active mowing/vegetation control and swale maintenance is performed by ERRG.

4. Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines since the start-up or in the last five years at any of the Five-Year Review sites? Please describe and include whether they affect the protectiveness of the remedy.

No change to my knowledge.

5. Have there been unexpected O&M difficulties or changes in costs since start-up or in the last five years at any of the Five-Year Review sites? If so, please give details.

Unaware.

6. Have there been opportunities to optimize O&M or sampling efforts at any of the Five-Year Review sites? Please describe changes and results or improved efficiency?

Unaware.

INTERVIEW RECORD

Site Name: Hunters Point Naval Shipyard	**EPA ID No.:** CA1170090087
Subject: Five-Year Review O&M Interview	**Date:** 2/20/2023

Type: Telephone Visit Other

Location of Visit: Questions and responses provided via e-mail.

Contact Made By:

Name: Jamie Egan	**Title:** Project Manager	**Organization:** CH2M HILL

Individual Contacted:

Name: Doug Delong	**Title:** CSO Facility/ Compliance Project Manager	**Organization:** NAVFAC BRAC

E-Mail Address: douglas.e.delong.ctr@us.navy.mil

Summary Of Conversation

1. What is your affiliation with the Former Hunter's Point Naval Shipyard and what is your role in regard to the oversight of any of the Five Year Review sites/parcels? The sites are as follows:

- Installation Restoration [IR] Sites 7 and 18
- Parcel B-1
- Parcel B-2
- Parcel C
- Parcel D-1
- Parcel D-2
- Parcel E
- Parcel E-2
- Parcel F (Final ROD pending)
- Parcel UC-1
- Parcel UC-2
- Parcel UC-3

I am the BRAC PMO-W's Caretaker Site Office (CSO) Facility/Compliance Project Manager. Our RPM team work[s] out of San Diego & the CSO team works out of the Treasure Island office. I provide the daily access, coordination to all the parcels on HPS as well as review & coordination of the waste manifests generated.

2. Over the past five years, have you been involved in on-going communication with the Navy in regard to the Navy's environmental activities at any of the Five-Year Review sites?

As a member of the BRAC-PMO staff, I work with the Navy on a daily basis, all day, every year. I attend & contribute at the weekly QC meetings.

3. Is there an on-site O&M Presence at any of the Five-Year Review sites? Please describe staff O&M activities and their frequency.

We have a contract to various contractors, to maintain ongoing O&M issues at all the parcels. The current contractors doing ongoing operations within them (i.e., APTIM, GES) maintain the Parcels and as issues arise, they are dealt with, on an as needed base. I.e. daily fence breaches or scheduled, sampling wells.

4. Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines since the start-up or in the last five years at any of the Five-Year Review sites? Please describe and include whether they affect the protectiveness of the remedy.

No significant changes to the five-year- O&M requirements other that what is approved by the signature authorities & contracts

5. Have there been unexpected O&M difficulties or changes in costs since start-up or in the last five years at any of the Five-Year Review sites? If so, please give details.

No unexpected O&M difficulties or changes that I am aware of.

6. Have there been opportunities to optimize O&M or sampling efforts at any of the Five-Year Review sites? Please describe changes and results or improved efficiency?

From time-to-time when we have another contractor requiring access to a parcel, we have the prime contractor, work with the sub, so both parties can continue their requirements without interfering with one another (i.e., working different hours or a different location within the parcel so both have access)

Appendix C
Site Inspection and Photograph Logs

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Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: Installation Restoration Site 07 and 18	**Date of inspection:** 2/9/2023
Location and Region: Hunters Point Naval Shipyard San Francisco, CA, Region 9	**EPA ID:** CA1170090087
Agency, office, or company leading the five-year review: Department of the Navy	**Weather/temperature:** Sunny, 50s

Remedy Includes: (Check all that apply)

☐ Landfill cover/containment ☒ Monitored natural attenuation
☐ Access controls ☐ Groundwater containment
☒ Institutional controls ☐ Vertical barrier walls
☐ Groundwater pump and treatment
☐ Surface water collection and treatment
☒ Other Durable cover consisting of a soil cover, shoreline revetment (riprap), asphaltic concrete pavement

Attachments: ☐ Inspection team roster attached ☒ Site map attached

II. INTERVIEWS (Interviews Conducted Separately)

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
☒ O&M manual ☒ Readily available ☐ Up to date ☐Not applicable (N/A)
☒ As-built drawings ☒ Readily available ☐ Up to date ☐ N/A
☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A
Remarks Documents available in the Administrative Record and O&M contractors' offices.

2. **Site-Specific Health and Safety Plan**
☐ Readily available ☐ Up to date ☒ N/A
☐ Contingency plan/emergency response plan ☐ Readily available ☐ Up to date ☒ N/A
Remarks

3. **O&M and OSHA Training Records** ☐ Readily available ☐ Up to date ☐ N/A
Remarks

4. **Permits and Service Agreements**
☐ Air discharge permit ☐ Readily available ☐ Up to date ☒ N/A
☐ Effluent discharge ☐ Readily available ☐ Up to date ☒ N/A
☐ Waste disposal, POTW ☐ Readily available ☐ Up to date ☒ N/A
☐ Other permits ☐ Readily available ☐ Up to date ☒ N/A
Remarks

5.	**Gas Generation Records** ☐ Readily available ☐ Up to date ☒ N/A Remarks Soil gas monitoring is not required as documented in 2012 Operations and Maintenance Plan.[1]
6.	**Settlement Monument Records** ☒ Readily available ☐ Up to date ☐ N/A Remarks
7.	**Groundwater Monitoring Records** ☒ Readily available ☐ Up to date ☐ N/A Remarks: Groundwater monitoring is reported in annual Basewide groundwater monitoring reports.
8.	**Leachate Extraction Records** ☐ Readily available ☐ Up to date ☒ N/A Remarks
9.	**Discharge Compliance Records** ☐ Air ☐ Readily available ☐ Up to date ☒ N/A ☐ Water (effluent) ☐ Readily available ☐ Up to date ☒ N/A Remarks
10.	**Daily Access/Security Logs** ☐ Readily available ☐ Up to date ☒ N/A Remarks: Guarded security gates at Robinson Street and Crisp Road restrict access to Hunters Point Naval Shipyard. City of San Francisco provides security and maintains access logs.
IV. O&M COSTS (Not Applicable for Site Inspection)	
V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A	
A. Fencing	
1.	**Fencing damaged** ☐ Location shown on site map ☒ Gates secured ☐ N/A Remarks Fencing in good condition.
B. Other Access Restrictions	
1.	**Signs and other security measures** ☒ Location shown on site map ☐ N/A Remarks Signs in generally good condition, some fading evident (Photograph 13).
C. Institutional Controls (ICs)	

[1] ERRG. 2012. *Annual Operation and Maintenance Summary Report for Installation Restoration Sites 07 and 18 in Parcel B, Hunters Point Naval Shipyard, San Francisco, California*. October 4.

1. **Implementation and enforcement**
Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) Routine Inspection
Frequency Annually
Responsible party/agency Navy and Navy O&M Contractors (Aptim Federal Services)
Reporting is up-to-date ☒ Yes ☐ No ☐ N/A
Reports are verified by the lead agency ☒ Yes ☐ No ☐ N/A
Specific requirements in deed or decision documents have been met ☒ Yes ☐ No ☐ N/A
Violations have been reported ☐ Yes ☐ No ☒ N/A
Other problems or suggestions: ☐ Report attached
None

2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks No evidence of unauthorized intrusive activities or incompatible land uses.

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident
Remarks

2. **Land use changes on site** ☒ N/A
Remarks

3. **Land use changes off site** ☒ N/A
Remarks

VI. GENERAL SITE CONDITIONS

A. Roads ☐ Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A
Remarks

B. Other Site Conditions

Remarks Some weeds growing near the retainment wall.

VII. LANDFILL COVERS ☒ Applicable ☐ N/A

Note that the durable covers onsite are not engineered landfill covers.

A. Landfill Surface

1. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident
Areal extent Depth
Remarks

2. **Cracks** ☐ Location shown on site map ☒ Cracking not evident
Lengths Widths Depths
Remarks

3.	**Erosion** ☐ Location shown on site map ☒ Erosion not evident Areal extent______________ Depth____________ Remarks___	
4.	**Holes** ☐ Location shown on site map ☒ Holes not evident Areal extent______________ Depth____________ Remarks___	
5.	**Vegetative Cover** ☒ Grass ☒ Cover properly established ☐ No signs of stress ☐ Trees/Shrubs (indicate size and locations on a diagram) Remarks Some minor areas of stressed vegetation from vehicles (Photograph 7) and a small hole in the vegetated cover (Photograph 11).	
6.	**Alternative Cover (Shoreline Revetment)** ☐ N/A Remarks Revetment in good condition, no signs of significant rock movement.	
7.	**Bulges** ☐ Location shown on site map ☒ Bulges not evident Remarks___	
8.	**Wet Areas/Water Damage** ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Location shown on site map Areal extent______________ ☐ Ponding ☐ Location shown on site map Areal extent______________ ☐ Seeps ☐ Location shown on site map Areal extent______________ ☐ Soft subgrade ☐ Location shown on site map Areal extent______________ Remarks___	
9.	**Slope Instability** ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability Remarks___	
B.	**Benches** ☐ Applicable ☒ N/A (Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)	
C.	**Letdown Channels** ☒ Applicable ☐ N/A (Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.) Remarks: Drainage channel along bump-out area north of Building 146 appears clear of heavy vegetation and in good condition.	
1.	**Settlement** ☐ Location shown on site map ☒ No evidence of settlement Remarks___	
2.	**Material Degradation** ☐ Location shown on site map ☒ No evidence of degradation Remarks___	
3.	**Erosion** ☐ Location shown on site map ☒ No evidence of erosion Remarks___	
4.	**Undercutting** ☐ Location shown on site map ☒ No evidence of undercutting Remarks___	

5.	**Obstructions** Type______ ☒ No obstructions ☐ Location shown on site map Remarks______	
6.	**Excessive Vegetative Growth** Type______ ☒ No evidence of excessive growth ☒ Vegetation in channels does not obstruct flow ☐ Location shown on site map Areal extent______ Remarks Minor vegetation growth near retaining wall.	
D. Cover Penetrations ☒ Applicable ☐ N/A		
1.	**Gas Vents** ☐ Active ☐ Passive ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A Remarks______	
2.	**Gas Monitoring Probes** ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A Remarks______	
3.	**Monitoring Wells** (within surface area of landfill) ☒ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☒ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A Remarks None.	
4.	**Leachate Extraction Wells** ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A Remarks______	
5.	**Settlement Monuments** ☐ Located ☒ Routinely surveyed ☐ N/A Remarks Settlement Monument 2 in IR-07/18 is scheduled for surveying in 2024.	
E. Gas Collection and Treatment ☐ Applicable ☒ N/A		
F. Cover Drainage Layer ☐ Applicable ☒ N/A		
G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A		
H. Retaining Walls ☒ Applicable ☐ N/A		
1.	**Deformations** ☐ Location shown on site map ☒ Deformation not evident Remarks______	
2.	**Degradation** ☐ Location shown on site map ☒ Degradation not evident Remarks______	
I. Perimeter Ditches/Off-Site Discharge ☒ Applicable ☐ N/A Remarks: Swales are located in IR-07/IR-18 and are in good shape.		

1.	**Siltation** ☐ Location shown on site map ☒ Siltation not evident Remarks	
2.	**Vegetative Growth** ☐ Location shown on site map ☐ N/A ☒ Vegetation does not impede flow Remarks	
3.	**Erosion** ☐ Location shown on site map ☒ Erosion not evident Remarks None	
4.	**Discharge Structure** ☒ Functioning ☐ N/A Remarks Drainage swale in good condition; check dam clear of debris.	
VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A		
IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A		
A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☒ N/A		
B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A		
C. Treatment System ☐ Applicable ☒ N/A		
D. Monitoring Data		
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality	
2.	Monitoring data suggests: ☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining Remarks Chemicals of concern and radionuclides of concern have not exceeded trigger levels during this review period.	
D. Monitored Natural Attenuation		
1.	**Monitoring Wells** (natural attenuation remedy) ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☒ Good condition ☐ All required wells located ☐ Needs Maintenance ☐ N/A Remarks Monitoring wells routinely inspected and maintained in Basewide groundwater monitoring program.	
X. OTHER REMEDIES - None		
XI. OVERALL OBSERVATIONS		
A.	**Implementation of the Remedy**	
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). No issues observed related to implementation of the remedy (durable covers, ICs, groundwater monitoring) at IR-07/18.	
B.	**Adequacy of O&M**	

	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. Review of O&M reports indicates that issues related to cover maintenance and vegetation are addressed promptly. Signs/fences reported in good condition.
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. None
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. None

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IR-07/18 Photograph 1: *Soil cover near revetment crest. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

IR-07/18 Photograph 2: *Soil cover. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

IR-07/18 Photograph 3: *Soil cover in southwest corner of site showing residential homes nearby. Facing southwest*
Photographed by: Marcella Navas/CH2M, 2/9/2023

IR-07/18 Photograph 4: *Soil cover northeast of Innes Avenue. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

IR-07/18 Photograph 5: *Soil cover near entrance gate adjacent to Donahue Street. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

IR-07/18 Photograph 6: *Soil cover southwest of revetment crest along non-Navy property. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

IR-07/18 Photograph 7: *Vehicle tracks near intersection of Galvez Avenue and Donahue Street. Facing west.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

IR-07/18 Photograph 8: *Drainage channel with gravel patch southwest of Building 146. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

IR-07/18 Photograph 9: *Retaining wall with vegetation growth. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

IR-07/18 Photograph 10: *Shoreline revetment northwest of Building 146. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

IR-07/18 Photograph 11: *View of shoreline revetment west of Building 144. Small hole in vegetated cover. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

IR-07/18 Photograph 12: *Asphalt pavement at bump-out area north of Building 146 and vegetated drainage swale. Facing east.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

IR-07/18 Photograph 13: *Caution sign showing fading from Donahue Street northwest of Building 117. Facing northwest.*

Photographed by: Marcella Navas/CH2M, 2/9/2023

IR-07/18 Photograph 14: *Chain-link fence along Donahue Street. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

IR-07/18 Photograph 15: *Chain-link fence along non-Navy property. Facing southwest.*

Photographed by: Marcella Navas/CH2M, 2/9/2023

IR-07/18 Photograph 16: *Monitoring well southwest of revetment crest. Facing northeast.*

Photographed by: Marcella Navas/CH2M, 2/9/2023

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: Parcel B-1	**Date of inspection:** 2/9/23
Location and Region: Hunters Point Naval Shipyard San Francisco, CA, Region 9	**EPA ID:** CA1170090087
Agency, office, or company leading the five-year review: Department of the Navy	**Weather/temperature:** Sunny, 50s

Remedy Includes: (Check all that apply)

☐ Landfill cover/containment ☒ Monitored natural attenuation
☐ Access controls ☐ Groundwater containment
☒ Institutional controls ☐ Vertical barrier walls
☐ Groundwater pump and treatment
☐ Surface water collection and treatment
☒ Other Durable cover consisting of a soil cover, shoreline revetment (riprap), asphaltic concrete pavement, soil vapor extraction system at IR-10

Attachments: ☐ Inspection team roster attached ☒ Site map attached

II. INTERVIEWS (Interviews Conducted Separately)

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

☒ O&M manual	☒ Readily available	☐ Up to date	☐Not applicable (N/A)
☒ As-built drawings	☒ Readily available	☐ Up to date	☐ N/A
☐ Maintenance logs	☐ Readily available	☐ Up to date	☒ N/A

Remarks Documents available in the Administrative Record and O&M contractors' offices.

2. **Site-Specific Health and Safety Plan**

☐ Readily available ☐ Up to date ☐ N/A
☐ Contingency plan/emergency response plan ☐ Readily available ☐ Up to date ☒ N/A
Remarks

3. **O&M and OSHA Training Records** ☒ Readily available ☐ Up to date ☐ N/A
Remarks

4. **Permits and Service Agreements**

☐ Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A
☐ Effluent discharge	☐ Readily available	☐ Up to date	☒ N/A
☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	☒ N/A
☐ Other permits	☐ Readily available	☐ Up to date	☒ N/A

Remarks

5. **Gas Generation Records** ☐ Readily available ☐ Up to date ☒ N/A
Remarks Soil vapor extraction system monitoring is discussed under Other Remedies.

6.	**Settlement Monument Records** ☒ Readily available ☐ Up to date ☐ N/A Remarks	
7.	**Groundwater Monitoring Records** ☒ Readily available ☐ Up to date ☐ N/A Remarks: Groundwater monitoring is reported in annual Basewide groundwater monitoring reports.	
8.	**Leachate Extraction Records** ☐ Readily available ☐ Up to date ☒ N/A Remarks	
9.	**Discharge Compliance Records** ☐ Air ☐ Readily available ☐ Up to date ☒ N/A ☐ Water (effluent) ☐ Readily available ☐ Up to date ☒ N/A Remarks	
10.	**Daily Access/Security Logs** ☐ Readily available ☐ Up to date ☒ N/A Remarks: Guarded security gates at Robinson Street and Crisp Road restrict access to Hunters Point Naval Shipyard. City of San Francisco provides security and maintains access logs.	
IV. O&M COSTS (Not Applicable for Site Inspection)		
V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A		
A. Fencing		
1.	**Fencing damaged** ☐ Location shown on site map ☐ Gates secured ☐ N/A Remarks Fencing in good condition.	
B. Other Access Restrictions		
1.	**Signs and other security measures** ☐ Location shown on site map ☐ N/A Remarks Signs in generally good condition.	
C. Institutional Controls (ICs)		
1.	**Implementation and enforcement** Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A Type of monitoring (*e.g.*, self-reporting, drive by) Routine Inspection Frequency Annually Responsible party/agency Navy and Navy O&M Contractors (Aptim Federal Services) Reporting is up-to-date ☒ Yes ☐ No ☐ N/A Reports are verified by the lead agency ☒ Yes ☐ No ☐ N/A Specific requirements in deed or decision documents have been met ☒ Yes ☐ No ☐ N/A Violations have been reported ☐ Yes ☐ No ☒ N/A Other problems or suggestions: ☐ Report attached None.	
2.	**Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ☐ N/A Remarks	

D. General	
1.	**Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident Remarks___
2.	**Land use changes on site** ☒ N/A Remarks___
3.	**Land use changes off site** ☒ N/A Remarks___
VI. GENERAL SITE CONDITIONS	
A. Roads ☒ Applicable ☐ N/A	
1.	**Roads damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A Remarks Roads in good condition.
B. Other Site Conditions	
	Remarks Some debris accumulation in drainage ditch and protective riprap around outfalls.
VII. LANDFILL COVERS ☒ Applicable ☐ N/A Note that the durable covers onsite are not engineered landfill covers.	
A. Landfill Surface	
1.	**Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident Remarks___
2.	**Cracks** ☐ Location shown on site map ☒ Cracking not evident Remarks If present, cracks are minor.
3.	**Erosion** ☒ Location shown on site map ☐ Erosion not evident Remarks Small areas of erosion observed southwest of Building 103 (Photograph 2).
4.	**Holes** ☐ Location shown on site map ☒ Holes not evident Remarks___
5.	**Vegetative Cover** ☒ Grass ☒ Cover properly established ☐ No signs of stress ☐ Trees/Shrubs (indicate size and locations on a diagram) Remarks None
6.	**Alternative Cover (Shoreline Revetment)** ☐ N/A Remarks Revetment in good condition.
7.	**Bulges** ☐ Location shown on site map ☒ Bulges not evident Remarks None
8.	**Wet Areas/Water Damage** ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Location shown on site map Areal extent___ ☐ Ponding ☐ Location shown on site map Areal extent___ ☐ Seeps ☐ Location shown on site map Areal extent___ ☐ Soft subgrade ☐ Location shown on site map Areal extent___ Remarks Drainage swale contained standing water but no depressions with standing water observed.

9. **Slope Instability**
☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability
Remarks None

B. Benches ☐ Applicable ☒ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

C. Letdown Channels ☐ Applicable ☒ N/A
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

D. Cover Penetrations ☒ Applicable ☐ N/A

1. **Gas Vents** ☐ Active ☐ Passive
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A
Remarks____________________

2. **Gas Monitoring Probes**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☒ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks Soil vapor monitoring probes and system shut down and pending removal.

3. **Monitoring Wells** (within surface area of landfill)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks None

4. **Leachate Extraction Wells**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A
Remarks____________________

5. **Settlement Monuments** ☐ Located ☒ Routinely surveyed ☐ N/A
Remarks Settlement Monument 1 is scheduled for surveying in 2024.

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

F. Cover Drainage Layer ☐ Applicable ☒ N/A

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

H. Retaining Walls ☒ Applicable ☐ N/A

1. **Deformations** ☐ Location shown on site map ☐ Deformation not evident
Remarks No deformations observed. Retaining walls in good condition (Photograph 1).

2. **Degradation** ☐ Location shown on site map ☐ Degradation not evident
Remarks No degradation observed. Retaining wall in good condition (Photograph 1).

I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☒ N/A
Remarks:

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☒ N/A

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A

C. Treatment System ☐ Applicable ☒ N/A

D. Monitoring Data

1. Monitoring Data
☒ Is routinely submitted on time ☒ Is of acceptable quality

2. Monitoring data suggests:
☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
☒ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☒ Good condition
☒ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks Monitoring wells inspected and repaired as needed as part of the Basewide groundwater monitoring program.

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

Soil vapor extraction (SVE) System:

1. **SVE wells and conveyance piping**
☐ Functioning ☐ Good condition ☐ Needs Maintenance ☒ N/A
Remarks SVE system is currently off and pending removal.

2. **SVE treatment system components**
☐ Functioning ☐ Good condition ☐ Needs Maintenance ☒ N/A
Remarks SVE system is currently off and pending removal.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).
Remedy is effective and functioning as intended. SVE reached asymptotic conditions and a soil removal action is planned to address residual volatile organic compounds. Durable covers are intact and maintained and ICs are effective.

B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. O&M is effective and addresses routine maintenance to durable covers as needed.
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. None observed.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. No opportunities for optimization outside of efforts to routinely optimize the Basewide groundwater monitoring program network and sampling strategy.

Parcel B-1 Photograph 1: *Retaining wall southwest of Building 113. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel B-1 Photograph 2: *Soil cover southwest of Building 103 adjacent to Galvez Avenue. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel B-1 Photograph 3: *Outfall protection for storm drainpipe southwest of Building 120. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel B-1 Photograph 4: *Asphalt pavement cover southeast of Building 121. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

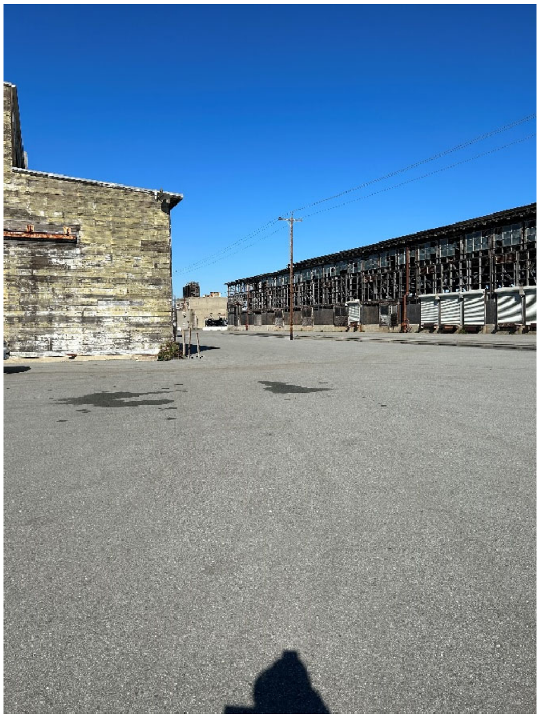
Parcel B-1 Photograph 5: *Asphalt pavement cover southwest of Building 121. Cover is generally intact and in good condition. Facing east.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel B-1 Photograph 6: *Asphalt pavement cover along Donahue Street. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

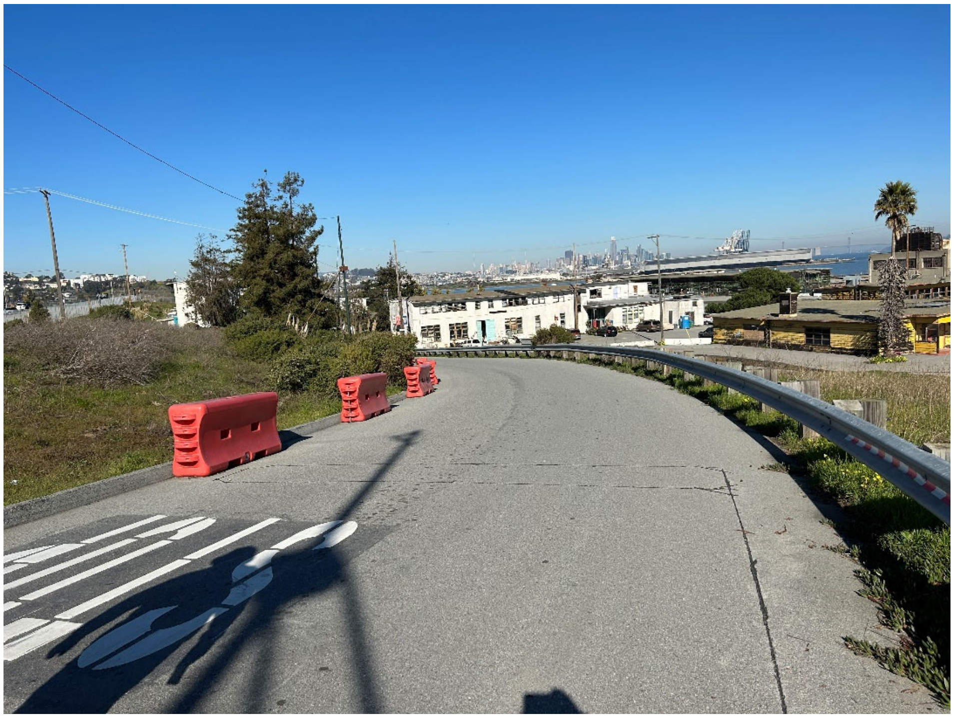
Parcel B-1 Photograph 7: *Drainage swale in asphalt pavement cover southwest of Building 123, with accumulation of water. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel B-1 Photograph 8: *Soil cover on slope southwest of Building 113. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel B-1 Photograph 9: *Drainage swale in asphalt pavement cover southwest of Building 120, with small accumulation of water. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023



Parcel B-1 Photograph 10: *Asphalt pavement cover northeast of Building 113. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023



Parcel B-1 Photograph 11: *Asphalt cover southwest of Building 113. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel B-1 Photograph 12: *Driveway northeast of Buildings 103 and 117. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel B-1 Photograph 13: *Asphalt pavement cover and soil cover southwest of Building 113. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel B-1 Photograph 14: *Drainage swale in asphalt pavement cover southwest of Building 120. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

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Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: Parcel B-2	**Date of inspection:** 2/9/23
Location and Region: Hunters Point Naval Shipyard San Francisco, CA, Region 9	**EPA ID:** CA1170090087
Agency, office, or company leading the five-year review: Department of the Navy	**Weather/temperature:** Sunny, 50s

Remedy Includes: (Check all that apply)

☐ Landfill cover/containment ☒ Monitored natural attenuation
☐ Access controls ☐ Groundwater containment
☒ Institutional controls ☐ Vertical barrier walls
☐ Groundwater pump and treatment
☐ Surface water collection and treatment
☒ Other Durable cover consisting of a soil cover, shoreline revetment (riprap), asphaltic concrete pavement

Attachments: ☐ Inspection team roster attached ☒ Site map attached

II. INTERVIEWS (Interviews Conducted Separately)

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
☒ O&M manual ☒ Readily available ☐ Up to date ☐Not applicable (N/A)
☐ As-built drawings ☒ Readily available ☐ Up to date ☐ N/A
☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A
Remarks__Documents available in the Administrative Record and O&M contractors' offices.___

2. **Site-Specific Health and Safety Plan**
☐ Readily available ☐ Up to date ☒ N/A
☐ Contingency plan/emergency response plan ☐ Readily available ☐ Up to date ☒ N/A
Remarks

3. **O&M and OSHA Training Records** ☐ Readily available ☐ Up to date ☐ N/A
Remarks

4. **Permits and Service Agreements**
☐ Air discharge permit ☐ Readily available ☐ Up to date ☒ N/A
☐ Effluent discharge ☐ Readily available ☐ Up to date ☒ N/A
☐ Waste disposal, POTW ☐ Readily available ☐ Up to date ☒ N/A
☐ Other permits____________________ ☐ Readily available ☐ Up to date ☒ N/A
Remarks

5. **Gas Generation Records** ☐ Readily available ☐ Up to date ☒ N/A
Remarks

6.	**Settlement Monument Records** ☒ Readily available ☐ Up to date ☐ N/A Remarks	
7.	**Groundwater Monitoring Records** ☒ Readily available ☐ Up to date ☐ N/A Remarks: Groundwater monitoring is reported in annual Basewide groundwater monitoring reports.	
8.	**Leachate Extraction Records** ☐ Readily available ☐ Up to date ☒ N/A Remarks	
9.	**Discharge Compliance Records** ☐ Air ☐ Readily available ☐ Up to date ☒ N/A ☐ Water (effluent) ☐ Readily available ☐ Up to date ☒ N/A Remarks	
10.	**Daily Access/Security Logs** ☐ Readily available ☐ Up to date ☒ N/A Remarks: Guarded security gates at Robinson Street and Crisp Road restrict access to Hunters Point Naval Shipyard. City of San Francisco provides security and maintains access logs.	
IV. O&M COSTS (Not Applicable for Site Inspection)		
V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A		
A. Fencing		
1.	**Fencing damaged** ☐ Location shown on site map ☒ Gates secured ☐ N/A Remarks Fencing in good condition.	
B. Other Access Restrictions		
1.	**Signs and other security measures** ☐ Location shown on site map ☐ N/A Remarks Signs in generally good condition, buildings locked.	
C. Institutional Controls (ICs)		
1.	**Implementation and enforcement** Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A Type of monitoring (*e.g.*, self-reporting, drive by) Routine Inspection Frequency Annually Responsible party/agency Navy and Navy O&M Contractors (Aptim Federal Services) Reporting is up-to-date ☒ Yes ☐ No ☐ N/A Reports are verified by the lead agency ☒ Yes ☐ No ☐ N/A Specific requirements in deed or decision documents have been met ☒ Yes ☐ No ☐ N/A Violations have been reported ☐ Yes ☐ No ☒ N/A Other problems or suggestions: ☐ Report attached None	
2.	**Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A Remarks None	

D. General		
1.	**Vandalism/trespassing**	☒ Location shown on site map ☐ No vandalism evident Remarks Evidence of graffiti on buildings (Photograph 2).
2.	**Land use changes on site**	☒ N/A Remarks
3.	**Land use changes off site**	☒ N/A Remarks
VI. GENERAL SITE CONDITIONS		
A. Roads ☒ Applicable ☐ N/A		
1.	**Roads damaged**	☐ Location shown on site map ☒ Roads adequate ☐ N/A Remarks None
B. Other Site Conditions		
	Remarks General site conditions are good. Trenching is being conducted for radiological rework.	
VII. COVERS ☒ Applicable ☐ N/A Note that the durable covers onsite are not engineered landfill covers.		
A. Surface		
1.	**Settlement** (Low spots)	☐ Location shown on site map ☒ Settlement not evident Remarks None
2.	**Cracks**	☒ Location shown on site map ☐ Cracking not evident Remarks Minor cracking observed with vegetation growing (Photograph 16).
3.	**Erosion**	☐ Location shown on site map ☒ Erosion not evident Remarks
4.	**Holes**	☐ Location shown on site map ☒ Holes not evident Remarks
5.	**Vegetative Cover**	☐ Grass ☐ Cover properly established ☐ No signs of stress ☐ Trees/Shrubs (indicate size and locations on a diagram) Remarks No vegetative cover.
6.	**Alternative Cover (Shoreline Revetment)**	☐ N/A Remarks Shoreline revetment in good condition with minor areas of vegetation growth (Photograph 16). No signs of major rock movement.
7.	**Bulges**	☐ Location shown on site map ☒ Bulges not evident Remarks None
8.	**Wet Areas/Water Damage**	☒ Wet areas/water damage not evident ☐ Wet areas ☐ Location shown on site map Areal extent ☐ Ponding ☐ Location shown on site map Areal extent ☐ Seeps ☐ Location shown on site map Areal extent ☐ Soft subgrade ☐ Location shown on site map Areal extent Remarks Standing water present from heavy rains during preceding day.

9. **Slope Instability**
☐ Slides ☐ Location shown on site map ☐ No evidence of slope instability
Remarks Not applicable.

B. Benches ☐ Applicable ☒ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

C. Letdown Channels ☐ Applicable ☒ N/A
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

D. Cover Penetrations ☒ Applicable ☐ N/A

1. **Gas Vents** ☐ Active ☐ Passive
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A
Remarks______________________________

2. **Gas Monitoring Probes**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A
Remarks______________________________

3. **Monitoring Wells** (within surface area of landfill)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A
Remarks______________________________

4. **Leachate Extraction Wells**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A
Remarks______________________________

5. **Settlement Monuments** ☐ Located ☒ Routinely surveyed ☐ N/A
Remarks Minimal settlement observed; no monuments scheduled for surveying in the next 2 years.

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

F. Cover Drainage Layer ☐ Applicable ☒ N/A

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

H. Retaining Walls ☒ Applicable ☐ N/A

1.	**Deformations** ☐ Location shown on site map ☒ Deformation not evident Remarks None
2.	**Degradation** ☐ Location shown on site map ☒ Degradation not evident Remarks None
I. Perimeter Ditches/Off-Site Discharge ☒ Applicable ☐ N/A Remarks: Swales are located near Building 140 and 130, appear in good condition.	
1.	**Siltation** ☐ Location shown on site map ☒ Siltation not evident Remarks None observed.
2.	**Vegetative Growth** ☐ Location shown on site map ☒ N/A ☐ Vegetation does not impede flow Remarks Swales are in asphaltic concrete pavement.
3.	**Erosion** ☐ Location shown on site map ☒ Erosion not evident Remarks Swales are in asphaltic concrete pavement.
4.	**Discharge Structure** ☒ Functioning ☐ N/A Remarks Discharge point appears in good condition with nothing impeding the flow.
VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A	
IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A	
A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☒ N/A	
B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A	
C. Treatment System ☐ Applicable ☒ N/A	
D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining Remarks In situ treatment for mercury was completed but concentrations continue to exceed trigger levels.
D. Monitored Natural Attenuation	
1.	**Monitoring Wells** (natural attenuation remedy) ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance ☐ N/A Remarks Monitoring wells inspected and repaired as needed as part of the Basewide groundwater monitoring program.

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

Remarks: In situ groundwater remediation was conducted. There are no physical structures or ongoing maintenance.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).
Durable cover, ICs are effective and functioning as designed. Groundwater monitoring data for mercury continue to exceed trigger levels after remediation activities were completed.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.
O&M efforts to maintain the durable cover and security features are effective.

C. Early Indicators of Potential Remedy Problems

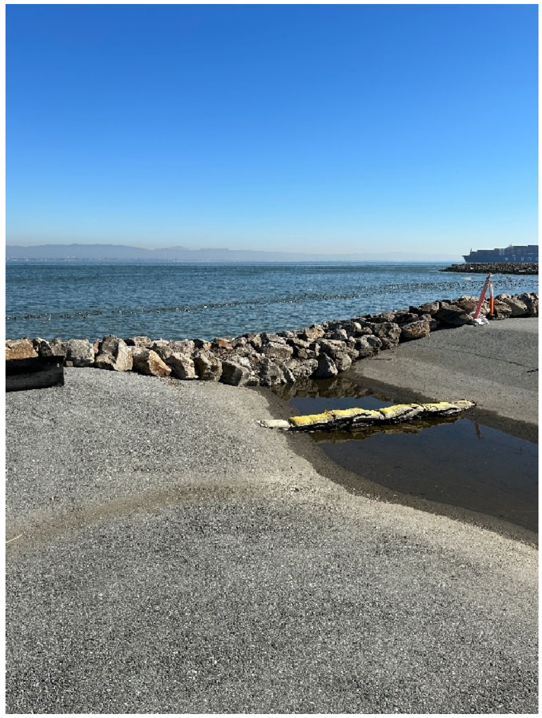
Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.
None observed.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.
No opportunities for optimization outside of efforts to routinely optimize the Basewide groundwater monitoring program network and sampling strategy.

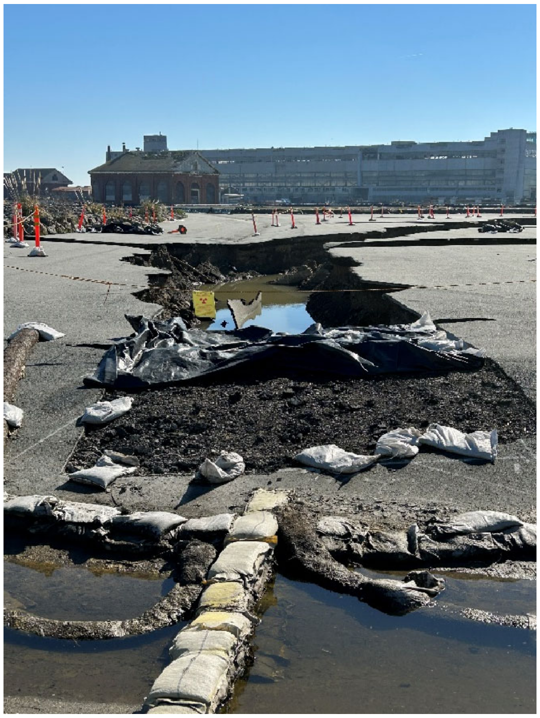
Parcel B-2 Photograph 1: *Drainage swale in asphalt pavement cover northwest of Building 159. Facing north.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel B-2 Photograph 2: *Drainage swale in asphalt pavement cover and graffiti north of Building 128. Facing west.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

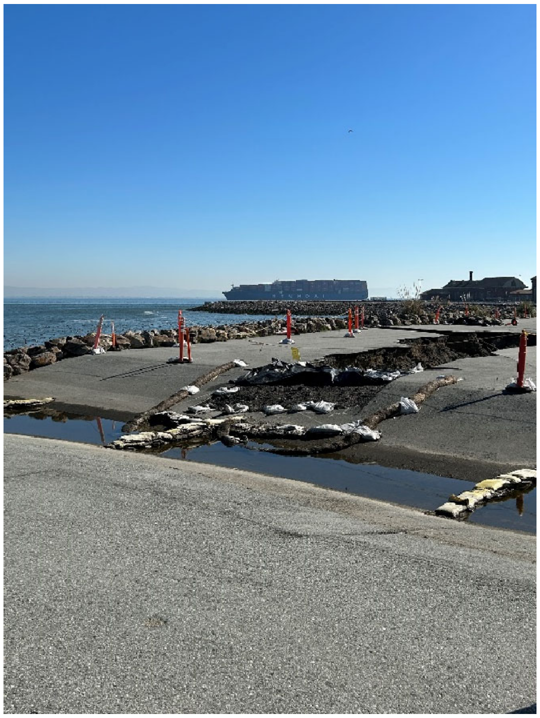


Parcel B-2 Photograph 3: *Swale outfall northeast of Building 130. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

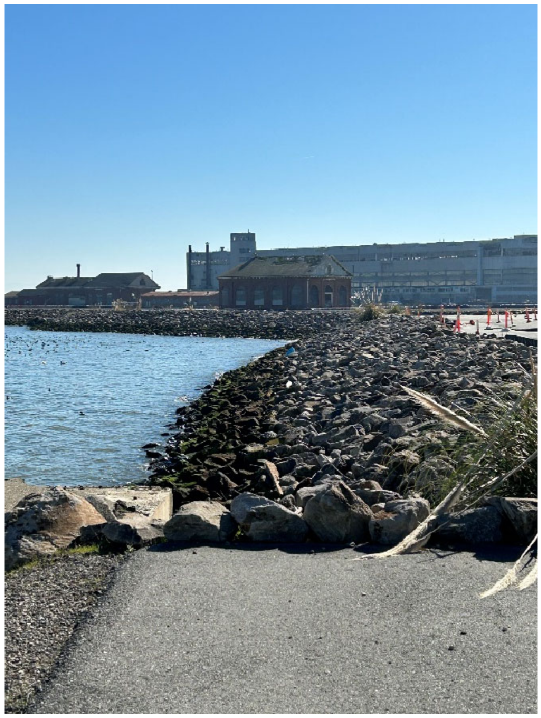
Parcel B-2 Photograph 4: *Swale east of Building 130. Facing south.*
Photographed by: Marcella Navas/CH2M, 2/9/2023



Parcel B-2 Photograph 5: *Trenching east of Building 130 located south of outfall. Facing east.*
Photographed by: Marcella Navas/CH2M, 2/9/2023



Parcel B-2 Photograph 6: *Trenching east of Building 130. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023



Parcel B-2 Photograph 7: *Shoreline revetment southwest of Building 140. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel B-2 Photograph 8: *Shoreline revetment north of Building 140. Facing west.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel B-2 Photograph 9: *Do Not Enter sign and locked door, Building 128. Facing north*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel B-2 Photograph 10: *View of the Building 128 foundation. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel B-2 Photograph 11: *Chain-link fence along Parcel B-1 boundary. Facing west.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel B-2 Photograph 12: *Monitoring well. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel B-2 Photograph 13: *Asphalt pavement cover. Facing west.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

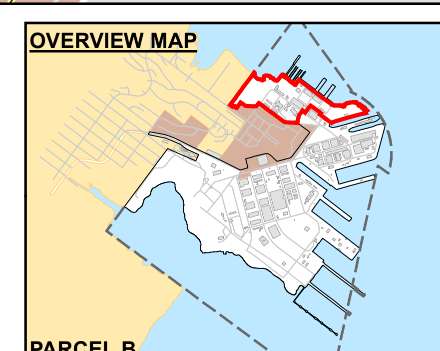
Parcel B-2 Photograph 14: *Construction area with containment west of Building 140. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel B-2 Photograph 15: *Asphalt pavement cover. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel B-2 Photograph 16: *Revetment crest northeast of Building 140. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

LEGEND

- Hunters Point Naval Shipyard Boundary
- Parcel Boundary
- Parcel F (Water) Boundary
- Former Navy Property
- Non-Navy Property
- Photograph Location
- Water
- Building
- Road



Parcel B (Installation Restoration Sites 07 and 18, Parcels B-1 and B-2)
Five-Year Review Site Inspection Photograph Locations
Five-Year Review of Remedial Actions
Hunters Point Naval Shipyard, San Francisco, California

0 200 400 Feet
1 Inch = 300 Feet
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Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: Parcel C	**Date of inspection:** 2/9/23
Location and Region: Hunters Point Naval Shipyard San Francisco, CA, Region 9	**EPA ID:** CA1170090087
Agency, office, or company leading the five-year review: Department of the Navy	**Weather/temperature:** Sunny 50s

Remedy Includes: (Check all that apply)

☐ Landfill cover/containment ☒ Monitored natural attenuation
☐ Access controls ☐ Groundwater containment
☒ Institutional controls ☐ Vertical barrier walls
☐ Groundwater pump and treatment
☐ Surface water collection and treatment
☒ Other Durable cover consisting of a soil cover, shoreline armoring (small area), asphaltic concrete pavement, soil vapor extraction, groundwater remediation (injections).

Attachments: ☐ Inspection team roster attached ☒ Site map attached

II. INTERVIEWS (Interviews Conducted Separately)

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

☒ O&M manual ☒ Readily available ☐ Up to date ☐Not applicable (N/A)
☒ As-built drawings ☒ Readily available ☐ Up to date ☐ N/A
☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A
Remarks Documents available in the Administrative Record and O&M contractors' offices.

2. **Site-Specific Health and Safety Plan**

☒ Readily available ☐ Up to date ☐ N/A
☐ Contingency plan/emergency response plan ☐ Readily available ☐ Up to date ☒ N/A
Remarks Documents available in O&M contractors' offices.

3. **O&M and OSHA Training Records** ☒ Readily available ☐ Up to date ☐ N/A
Remarks Documents available in O&M contractors' offices.

4. **Permits and Service Agreements**

☐ Air discharge permit ☐ Readily available ☐ Up to date ☒ N/A
☐ Effluent discharge ☐ Readily available ☐ Up to date ☒ N/A
☐ Waste disposal, POTW ☐ Readily available ☐ Up to date ☒ N/A
☐ Other permits____________________ ☐ Readily available ☐ Up to date ☒ N/A
Remarks____

5. **Gas Generation Records** ☐ Readily available ☐ Up to date ☒ N/A
Remarks

6. **Settlement Monument Records** ☒ Readily available ☐ Up to date ☐ N/A
Remarks Settlement monuments surveyed as part of O&M if required.

7. **Groundwater Monitoring Records** ☒ Readily available ☐ Up to date ☐ N/A
Remarks: Groundwater monitoring is reported in annual Basewide groundwater monitoring reports.

8. **Leachate Extraction Records** ☐ Readily available ☐ Up to date ☒ N/A
Remarks

9. **Discharge Compliance Records**
☐ Air ☐ Readily available ☐ Up to date ☒ N/A
☐ Water (effluent) ☐ Readily available ☐ Up to date ☒ N/A
Remarks

10. **Daily Access/Security Logs** ☐ Readily available ☐ Up to date ☒ N/A
Remarks: Guarded security gates at Robinson Street and Crisp Road restrict access to Hunters Point Naval Shipyard. City of San Francisco provides security and maintains access logs.

IV. O&M COSTS (Not Applicable for Site Inspection)

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☒ Gates secured ☐ N/A
Remarks Fence in good condition (Photographs 1, 2, 4, 9, 17).

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A
Remarks Permanent and temporary signs during active work in good condition (Photograph 19).

C. Institutional Controls (ICs)

1. **Implementation and enforcement**
Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) Routine Inspection
Frequency Annually
Responsible party/agency Navy and Navy O&M Contractors (Aptim Federal Services)

Reporting is up-to-date ☒ Yes ☐ No ☐ N/A
Reports are verified by the lead agency ☒ Yes ☐ No ☐ N/A
Specific requirements in deed or decision documents have been met
☒ Yes ☐ No ☐ N/A
Violations have been reported ☐ Yes ☐ No ☒ N/A
Other problems or suggestions: ☐ Report attached
None; no incompatible land uses observed or unauthorized intrusive activities.

2.	**Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A Remarks None	
D. General		
1.	**Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident Remarks None	
2.	**Land use changes on site** ☒ N/A Remarks None	
3.	**Land use changes off site** ☒ N/A Remarks None	
VI. GENERAL SITE CONDITIONS		
A. Roads ☒ Applicable ☐ N/A		
1.	**Roads damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A Remarks None	
B. Other Site Conditions		
	Remarks Active work is being conducted related to radiological rescanning efforts; many areas of site are inaccessible while work is ongoing but stormwater best management practices are in use (Photographs 9, 11, 12).	
VII. COVERS ☒ Applicable ☐ N/A Note that the durable covers onsite are not engineered landfill covers.		
A. Surface		
1.	**Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident Remarks None	
2.	**Cracks** ☐ Location shown on site map ☐ Cracking not evident Remarks Minimal cracking outside of active treatment areas, large areas of piers are fenced off due to sinkholes identified during O&M, repairs will be completed when trenching work is complete.	
3.	**Erosion** ☐ Location shown on site map ☒ Erosion not evident Remarks Soil cover is in good condition with no apparent erosion. Not all of the site was able to be inspected because of fencing and active work.	
4.	**Holes** ☐ Location shown on site map ☐ Holes not evident Remarks Not all of the site was able to be inspected because of fencing and active work. Past O&M records indicate sinkholes and potholes occur along waterfront.	
5.	**Vegetative Cover** ☒ Grass ☒ Cover properly established ☒ No signs of stress ☐ Trees/Shrubs (indicate size and locations on a diagram) Remarks Cover in good condition (Photographs 1 and 2).	
6.	**Alternative Cover (Shoreline Revetment)** ☒ N/A Remarks Unable to access during inspection. O&M reports consistently note shoreline revetment is in good condition.	
7.	**Bulges** ☐ Location shown on site map ☒ Bulges not evident Remarks Not applicable for durable cover.	

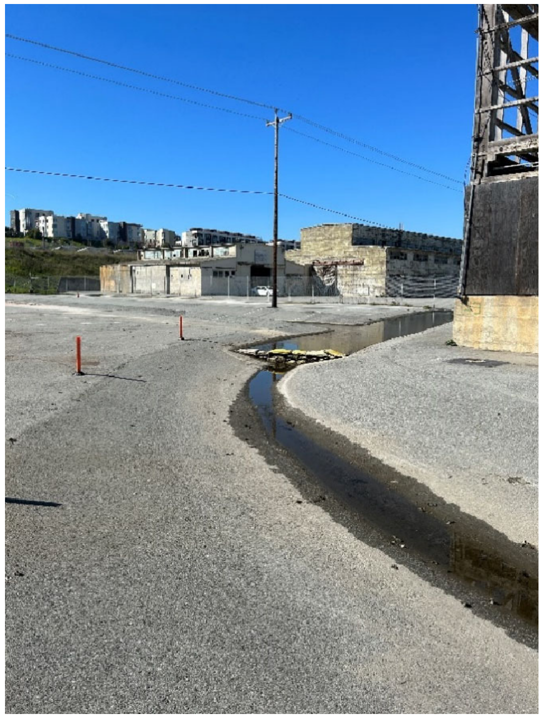
8. **Wet Areas/Water Damage** ☐ Wet areas/water damage not evident ☒ Wet areas ☐ Location shown on site map Areal extent______________ ☐ Ponding ☐ Location shown on site map Areal extent______________ ☐ Seeps ☐ Location shown on site map Areal extent______________ ☐ Soft subgrade ☐ Location shown on site map Areal extent______________ Remarks Water present in drainage swales and in an active trench from recent heavy rains.	
9. **Slope Instability** ☐ Slides ☐ Location shown on site map ☐ No evidence of slope instability Remark Not applicable at Parcel C.	
B. Benches ☐ Applicable ☒ N/A (Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)	
C. Letdown Channels ☐ Applicable ☒ N/A (Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)	
D. Cover Penetrations ☒ Applicable ☐ N/A	
1. **Gas Vents** ☐ Active ☐ Passive ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A Remarks	
2. **Gas Monitoring Probes** ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A Remarks	
3. **Monitoring Wells** (within surface area of landfill) ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A Remarks See Groundwater Monitoring section.	
4. **Leachate Extraction Wells** ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A Remarks	
5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed ☒ N/A Remarks Not scheduled for surveying in the next 3 years at Parcel C.	
E. Gas Collection and Treatment ☐ Applicable ☒ N/A	
F. Cover Drainage Layer ☐ Applicable ☒ N/A	
G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A	
H. Retaining Walls ☐ Applicable ☒ N/A	

I. Perimeter Ditches/Off-Site Discharge ☒ Applicable ☐ N/A Remarks: Drainage swales in good condition.		
1.	**Siltation** ☐ Location shown on site map ☒ Siltation not evident Remarks None	
2.	**Vegetative Growth** ☐ Location shown on site map ☒ N/A ☐ Vegetation does not impede flow Remarks None.	
3.	**Erosion** ☐ Location shown on site map ☒ Erosion not evident Remarks None	
4.	**Discharge Structure** ☒ Functioning ☐ N/A Remarks None	
VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A		
IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A		
A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☒ N/A		
B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A		
C. Treatment System ☐ Applicable ☒ N/A		
D. Monitoring Data		
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality	
2.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining Remarks Groundwater plumes in some portions of the site have declined to below active treatment levels, others continue to exceed and are undergoing active treatment.	
D. Monitored Natural Attenuation		
1.	**Monitoring Wells** (natural attenuation remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☐ All required wells located ☐ Needs Maintenance ☐ N/A Remarks Monitoring wells are inspected, sampled, and repaired under the Basewide groundwater monitoring program and plume-specific remediation actions.	
X. OTHER REMEDIES		
If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction. Soil vapor extraction (SVE) System: 3.**SVE wells and conveyance piping** ☐ Functioning ☒ Good condition ☐ Needs Maintenance ☐ N/A 4.**SVE treatment system components** ☐ Functioning ☒ Good condition ☐ Needs Maintenance ☐ N/A Remarks SVE systems are currently not operating until active treatment is complete and an evaluation of the remedy is completed. Piping is in good condition (Photographs 4 and 5).		

XI. OVERALL OBSERVATIONS	
A.	**Implementation of the Remedy**
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). Remedy for Parcel C consists of durable covers, active groundwater remediation and monitoring, and ICs to prevent exposure to chemicals of concern and radionuclides of concern in groundwater, soil, and structures. The remedy is functioning as intended, groundwater is being monitored, and the monitoring and treatment approach is conducted as defined in the remedial action work plan and remedial action monitoring plans. Durable covers are maintained through the O&M program and access restrictions appear effective in preventing unauthorized access to the site. Active trenching work is underway.
B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. O&M is effective in identifying areas for repair and conducting routine repairs. O&M reports indicate some areas with more frequent and larger sinkholes that require repairs outside of routine O&M scope. These areas are monitored and access is restricted by permanent fencing.
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. Increased frequency of sinkholes that cause damage to the durable cover may be caused by aging infrastructure underlying Parcel C. Infrastructure repairs are not under the responsibility of environmental restoration. Exposure is controlled through fencing, signage, and other mechanisms to prevent access to the area.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. No opportunities outside of optimization documented in the remedy evaluations routinely conducted for the groundwater remedy.

Parcel C Photograph 1: *Soil cover west of Building 134. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel C Photograph 2: *Soil cover west of Building 134. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023



Parcel C Photograph 3: *Drainage swale southwest of Building 134. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel C Photograph 4: *SVE treatment systems surrounded by chain-link fence. Facing west.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

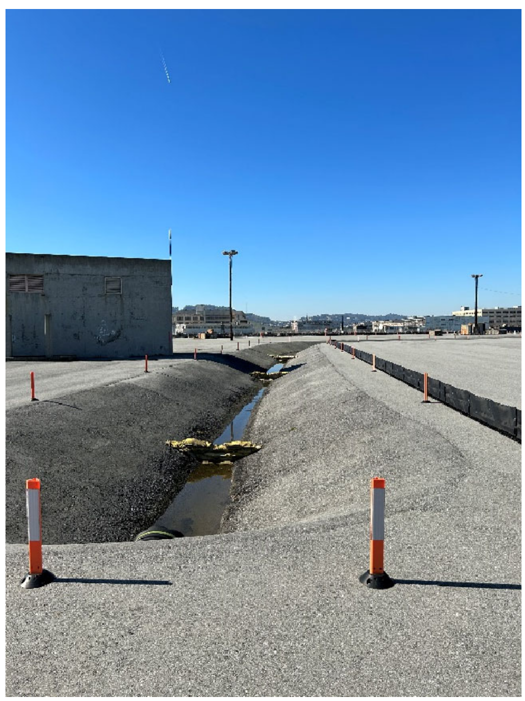
Parcel C Photograph 5: *SVE treatment systems surrounded by chain-link fence. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel C Photograph 6: *Asphalt pavement cover southeast of Building 134. Facing north.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel C Photograph 7: *Asphalt pavement cover southwest of Building 214 along Lockwood Avenue. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel C Photograph 8: *Asphalt pavement cover alongside Parcel G and Parcel U2. Barrier to prevent access. Facing south.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel C Photograph 9: *Stormwater best management practices around catch basins during active trenching work. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023



Parcel C Photograph 10: *Paved drainage swale outfall south of Building 230. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel C Photograph 11: *Storage of stockpiles with stormwater management best management practices surrounding and intact. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel C Photograph 12: *Stormwater best management practice around catch basin west of Building 231. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel C Photograph 13: *Asphalt paved drainage swale along Spear Avenue between Building 281 and 251. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel C Photograph 14: *Paved drainage swale southeast of Building 235. Outfall south of Building 234. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel C Photograph 15: *Paved drainage swale southwest of Building 230. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel C Photograph 16: *Asphalt pavement cover southeast of Building 228 along Nimitz Avenue. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel C Photograph 17: *Chain-link fence in between parcel UC-2 along Fischer Avenue. Facing west.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

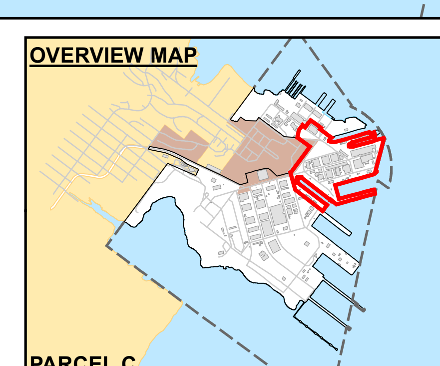
Parcel C Photograph 18: *Monitoring well south of Building 271 along Nimitz Avenue. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel C Photograph 19: *Signs signaling caution near trenching between of Building 134 and 135 outside of gated area of Parcel B-1. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel C Photograph 20: *Planned excavation area west of Building 253. Facing east.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

LEGEND

- Hunters Point Naval Shipyard Boundary
- Parcel Boundary
- Parcel F (Water) Boundary
- Former Navy Property
- Non-Navy Property
- Photograph Location
- Water
- Building
- Road



Parcel C (Parcels C and UC-2)
Five-Year Review Site Inspection Photograph Locations
Five-Year Review of Remedial Actions
Hunters Point Naval Shipyard, San Francisco, California

0 200 400 Feet
1 Inch = 350 Feet
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Five-Year Review Site Inspection Checklist

I. SITE INFORMATION

Site name: Parcel D-1	**Date of inspection:** 2/9/23
Location and Region: Hunters Point Naval Shipyard San Francisco, CA, Region 9	**EPA ID:** CA1170090087
Agency, office, or company leading the five-year review: Department of the Navy	**Weather/temperature:** Sunny 50s

Remedy Includes: (Check all that apply)

☐ Landfill cover/containment ☒ Monitored natural attenuation
☐ Access controls ☐ Groundwater containment
☒ Institutional controls ☐ Vertical barrier walls
☐ Groundwater pump and treatment
☐ Surface water collection and treatment
☒ Other Durable cover consisting of a soil cover, shoreline revetment (riprap), asphaltic concrete pavement

Attachments: ☐ Inspection team roster attached ☒ Site map attached

II. INTERVIEWS (Interviews Conducted Separately)

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

☒ O&M manual ☒ Readily available ☐ Up to date ☐Not applicable (N/A)
☒ As-built drawings ☒ Readily available ☐ Up to date ☐ N/A
☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A
Remarks Documents available in the Administrative Record and O&M contractors' offices.

2. **Site-Specific Health and Safety Plan**

☒ Readily available ☐ Up to date ☐ N/A
☐ Contingency plan/emergency response plan ☐ Readily available ☐ Up to date ☒ N/A
Remarks Available in O&M contractors' offices.

3. **O&M and OSHA Training Records** ☒ Readily available ☐ Up to date ☐ N/A
Remarks Available in O&M contractors' offices.

4. **Permits and Service Agreements**

☐ Air discharge permit ☐ Readily available ☐ Up to date ☒ N/A
☐ Effluent discharge ☐ Readily available ☐ Up to date ☒ N/A
☐ Waste disposal, POTW ☐ Readily available ☐ Up to date ☒ N/A
☐ Other permits__________ ☐ Readily available ☐ Up to date ☒ N/A
Remarks__________

5. **Gas Generation Records** ☐ Readily available ☐ Up to date ☒ N/A
Remarks

6.	**Settlement Monument Records** ☒ Readily available ☐ Up to date ☐ N/A Remarks Records in O&M reports.	
7.	**Groundwater Monitoring Records** ☒ Readily available ☐ Up to date ☐ N/A Remarks: Groundwater monitoring is reported in annual Basewide groundwater monitoring reports.	
8.	**Leachate Extraction Records** ☐ Readily available ☐ Up to date ☒ N/A Remarks	
9.	**Discharge Compliance Records** ☐ Air ☐ Readily available ☐ Up to date ☒ N/A ☐ Water (effluent) ☐ Readily available ☐ Up to date ☒ N/A Remarks	
10.	**Daily Access/Security Logs** ☐ Readily available ☐ Up to date ☒ N/A Remarks: Guarded security gates at Robinson Street and Crisp Road restrict access to Hunters Point Naval Shipyard. City of San Francisco provides security and maintains access logs.	
IV. O&M COSTS (Not Applicable for Site Inspection)		
V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A		
A. Fencing		
1.	**Fencing damaged** ☐ Location shown on site map ☒ Gates secured ☐ N/A Remarks No damage observed.	
B. Other Access Restrictions		
1.	**Signs and other security measures** ☐ Location shown on site map ☐ N/A Remarks Signs legible, access is controlled in active trenching areas. Buildings locked and secure.	
C. Institutional Controls (ICs)		
1.	**Implementation and enforcement** Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A Type of monitoring (*e.g.*, self-reporting, drive by) Routine Inspection Frequency Annually Responsible party/agency Navy and Navy O&M Contractors (Aptim Federal Services) Reporting is up-to-date ☒ Yes ☐ No ☐ N/A Reports are verified by the lead agency ☒ Yes ☐ No ☐ N/A Specific requirements in deed or decision documents have been met ☒ Yes ☐ No ☐ N/A Violations have been reported ☐ Yes ☐ No ☒ N/A Other problems or suggestions: ☐ Report attached None; no incompatible land uses or unauthorized intrusive activities observed.	
2.	**Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A Remarks None	

D. General		
1.	**Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident Remarks None	
2.	**Land use changes on site** ☒ N/A Remarks None	
3.	**Land use changes off site** ☒ N/A Remarks None	
VI. GENERAL SITE CONDITIONS		
A. Roads ☒ Applicable ☐ N/A		
1.	**Roads damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A Remarks None	
B. Other Site Conditions		
	Remarks Active work is being conducted related to radiological rescanning efforts. Many areas of the site are inaccessible while work is ongoing but stormwater best management practices (BMPs) are in use. Old soil stockpiles were observed, secondary containment or other BMPs and signage is present (Photographs 11, 15, and 20).	
VII. COVERS ☒ Applicable ☐ N/A Note that the durable covers onsite are not engineered landfill covers.		
A. Surface		
1.	**Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident Remarks None	
2.	**Cracks** ☐ Location shown on site map ☐ Cracking not evident Remarks Minor cracks along drainage swale and flat asphalt cover where vegetation is growing (Photographs 7, 8, and 9).	
3.	**Erosion** ☐ Location shown on site map ☒ Erosion not evident Remarks None	
4.	**Holes** ☒ Location shown on site map ☐ Holes not evident Remarks Small hole from vegetation growth observed (Photograph 7).	
5.	**Vegetative Cover** ☐ Grass ☐ Cover properly established ☐ No signs of stress ☐ Trees/Shrubs (indicate size and locations on a diagram) Remarks Not applicable.	
6.	**Alternative Cover (Shoreline Revetment)** ☐ N/A Remarks Generally good condition, smaller rocks (3- to 4-inch diameter) appear to have been washed onto the durable cover from the shore (Photographs 17 and 18).	
7.	**Bulges** ☐ Location shown on site map ☒ Bulges not evident Remarks None	

8. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent______________
☐ Ponding ☐ Location shown on site map Areal extent______________
☐ Seeps ☐ Location shown on site map Areal extent______________
☐ Soft subgrade ☐ Location shown on site map Areal extent______________
Remarks None

9. **Slope Instability**
☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability
Remarks Not applicable.

B. Benches ☐ Applicable ☒ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

C. Letdown Channels ☐ Applicable ☒ N/A
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

D. Cover Penetrations ☒ Applicable ☐ N/A

1. **Gas Vents** ☐ Active ☐ Passive
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A
Remarks

2. **Gas Monitoring Probes**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A
Remarks

3. **Monitoring Wells** (within surface area of landfill)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks See Groundwater (Section IX)

4. **Leachate Extraction Wells**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A
Remarks

5. **Settlement Monuments** ☐ Located ☒ Routinely surveyed ☐ N/A
Remarks Settlement monuments in Parcel D are not scheduled for surveying in the next 3 years.

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

F. Cover Drainage Layer ☐ Applicable ☒ N/A

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

H. Retaining Walls ☐ Applicable ☒ N/A

I. Perimeter Ditches/Off-Site Discharge ☒ Applicable ☐ N/A		
	Remarks: Asphalt-lined drainage channels/swales are in good condition (Photographs 4, 5, 6, and 8).	
1.	**Siltation** ☐ Location shown on site map ☒ Siltation not evident Remarks None	
2.	**Vegetative Growth** ☒ Location shown on site map ☐ N/A ☒ Vegetation does not impede flow Remarks Minor vegetation growth (Photographs 8 and 9).	
3.	**Erosion** ☐ Location shown on site map ☒ Erosion not evident Remarks None	
4.	**Discharge Structure** ☒ Functioning ☐ N/A Remarks Structure in good condition (Photograph 8).	
VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A		
IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A		
A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☒ N/A		
B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A		
C. Treatment System ☐ Applicable ☒ N/A		
D. Monitoring Data		
1.	Monitoring Data ☐ Is routinely submitted on time ☒ Is of acceptable quality	
2.	Monitoring data suggests: ☐ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining No chemicals of concern (COCs) exceeded trigger levels during last 2 years of sampling.	
D. Monitored Natural Attenuation		
1.	**Monitoring Wells** (natural attenuation remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☐ All required wells located ☐ Needs Maintenance ☐ N/A Remarks Monitoring wells are inspected, sampled, and repaired under the Basewide groundwater monitoring program and plume-specific remediation actions.	
X. OTHER REMEDIES – None		
XI. OVERALL OBSERVATIONS		
A.	**Implementation of the Remedy**	

	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). Remedy for Parcel D-1 consists of durable covers, groundwater monitoring, and ICs to prevent exposure to COCs and radionuclides of concern (ROCs) in groundwater, soil, and structures. The remedy is functioning as intended, groundwater COCs are below trigger levels. Durable covers are maintained through the O&M program and access restrictions appear effective in preventing unauthorized access to the site. Active trenching work is underway.
B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. A review of O&M reports from 2019-2022 observed degradation in areas of previous repair along Gun Mole Pier that would require repairs outside of the O&M scope. These areas are currently being monitored and access has been restricted.
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. Increased frequency of sinkholes that cause damage to the durable cover may be caused by aging infrastructure underlying Parcel D-1. Infrastructure repairs are not under the responsibility of environmental restoration. Exposure is controlled through fencing, signage, and other mechanisms to prevent access to the area.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. No opportunities for optimization have been identified.

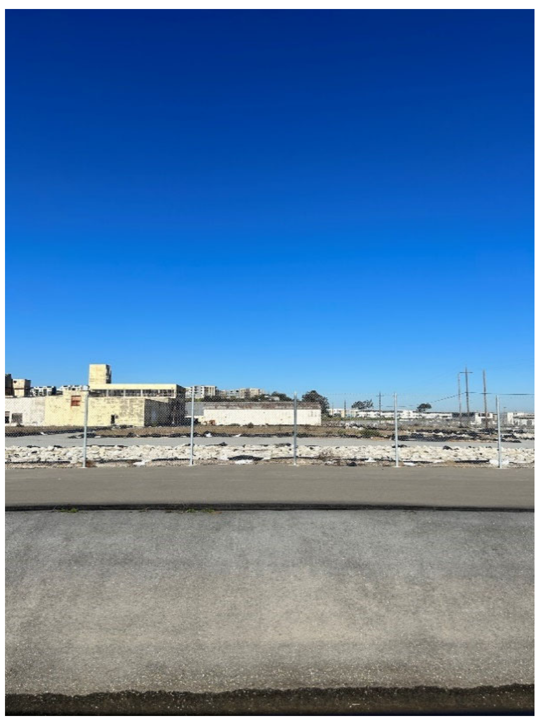
Parcel D-1 Photograph 1: *Asphalt pavement cover adjacent to Parcel G. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel D-1 Photograph 2: *Asphalt pavement cover adjacent to Buildings 306 and 274. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel D-1 Photograph 3: *Asphalt pavement cover adjacent to Buildings 306 and 274. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel D-1 Photograph 4: *Drainage swale adjacent to Parcel G. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel D-1 Photograph 5: *Drainage swale adjacent to Parcel G. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023



Parcel D-1 Photograph 6: *Drainage swale adjacent to Parcel G. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel D1 Photograph 7: *Hole and vegetation adjacent to asphalt drainage swale. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel D-1 Photograph 8: *Drainage swale adjacent to Parcel G. Minor vegetation growth in cracks along the seam between swale material and flat surface material. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel D-1 Photograph 9: *Drainage swale with water southeast to Building 307. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel D-1 Photograph 10: *Building 381, vegetation growth in the seam between exterior cover and building foundation. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel D-1 Photograph 11: *Stormwater management best management practices southwest of Building 307. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel D-1 Photograph 12: *Asphalt pavement cover between Buildings 381 and 383. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

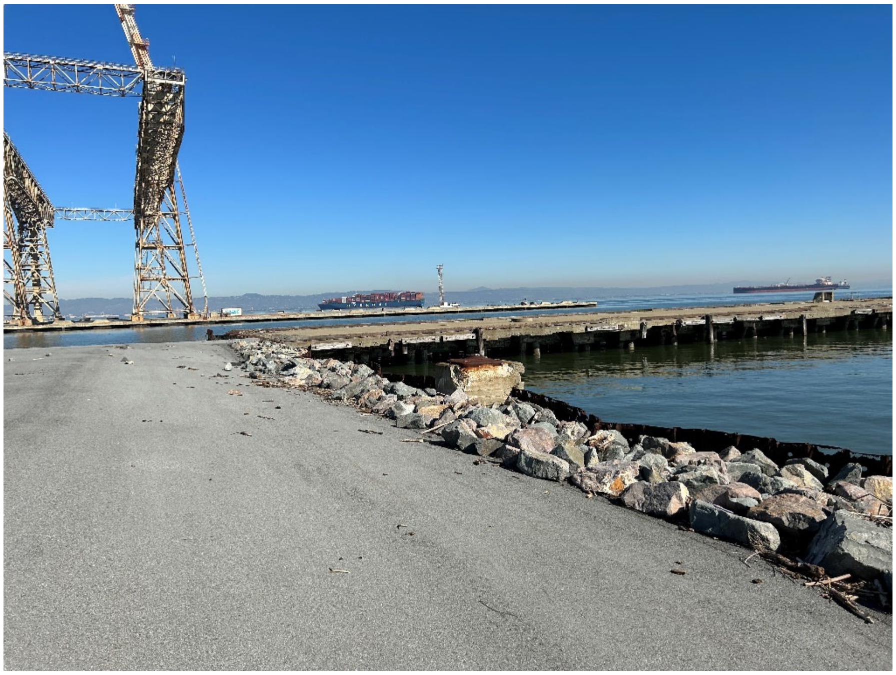
Parcel D-1 Photograph 13: *Asphalt pavement cover adjacent to Building 530. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel D-1 Photograph 14: *Asphalt pavement cover adjacent to Building 530. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel D-1 Photograph 15: *Stockpile east of Building 525 within secondary containment and signage. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel D-1 Photograph 16: *Building 526 foundation. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel D-1 Photograph 17: *Shoreline revetment east of Building 381. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023



Parcel D-1 Photograph 18: *Shoreline revetment east of Building 381. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel D-1 Photograph 19: *Monitoring well completion and repaired boreholes east of Building 523. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel D-1 Photograph 20: *Stockpiles from ongoing work with best management practices surrounding. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: Parcel G	**Date of inspection:** 2/9/23
Location and Region: Hunters Point Naval Shipyard San Francisco, CA, Region 9	**EPA ID:** CA1170090087
Agency, office, or company leading the five-year review: Department of the Navy	**Weather/temperature:** Sunny, 50s
Remedy Includes: (Check all that apply) ☐ Landfill cover/containment ☒ Monitored natural attenuation ☐ Access controls ☐ Groundwater containment ☒ Institutional controls ☐ Vertical barrier walls ☐ Groundwater pump and treatment ☐ Surface water collection and treatment ☒ Other Durable cover consisting of a soil cover, asphaltic concrete pavement	
Attachments: ☐ Inspection team roster attached ☒ Site map attached	
II. INTERVIEWS (Interviews Conducted Separately)	
III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)	
1. **O&M Documents** ☒ O&M manual ☒ Readily available ☐ Up to date ☐Not applicable (N/A) ☒ As-built drawings ☒ Readily available ☐ Up to date ☐ N/A ☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A Remarks Documents available in the Administrative Record and O&M contractors' offices.	
2. **Site-Specific Health and Safety Plan** ☒ Readily available ☐ Up to date ☐ N/A ☐ Contingency plan/emergency response plan ☐ Readily available ☐ Up to date ☒ N/A Remarks Documents available in O&M contractors' offices.	
3. **O&M and OSHA Training Records** ☒ Readily available ☐ Up to date ☐ N/A Remarks Documents available in O&M contractors' offices.	
4. **Permits and Service Agreements** ☐ Air discharge permit ☐ Readily available ☐ Up to date ☒ N/A ☐ Effluent discharge ☐ Readily available ☐ Up to date ☒ N/A ☐ Waste disposal, POTW ☐ Readily available ☐ Up to date ☒ N/A ☐ Other permits____________ ☐ Readily available ☐ Up to date ☒ N/A Remarks	
5. **Gas Generation Records** ☐ Readily available ☐ Up to date ☒ N/A Remarks	
6. **Settlement Monument Records** ☒ Readily available ☐ Up to date ☐ N/A Remarks Settlement monuments surveyed as part of O&M.	

7.	**Groundwater Monitoring Records** ☒ Readily available ☐ Up to date ☐ N/A Remarks: Groundwater monitoring is reported in annual Basewide groundwater monitoring reports.			
8.	**Leachate Extraction Records** ☐ Readily available ☐ Up to date ☒ N/A Remarks			
9.	**Discharge Compliance Records** ☐ Air ☐ Readily available ☐ Up to date ☒ N/A ☐ Water (effluent) ☐ Readily available ☐ Up to date ☒ N/A Remarks			
10.	**Daily Access/Security Logs** ☐ Readily available ☐ Up to date ☒ N/A Remarks: Guarded security gates at Robinson Street and Crisp Road restrict access to Hunters Point Naval Shipyard. City of San Francisco provides security and maintains access logs.			
	IV. O&M COSTS (Not Applicable for Site Inspection)			
	V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A			
A. Fencing				
1.	**Fencing damaged** ☐ Location shown on site map ☒ Gates secured ☐ N/A Remarks Good condition (Photograph 12).			
B. Other Access Restrictions				
1.	**Signs and other security measures** ☐ Location shown on site map ☐ N/A Remarks Area is completely fenced in, cones and flagging around active trench work, signs to warn against entry into buildings (Photographs 8, 14, and 15).			
C. Institutional Controls (ICs)				
1.	**Implementation and enforcement**			
	Site conditions imply ICs not properly implemented	☐ Yes	☒ No	☐ N/A
	Site conditions imply ICs not being fully enforced	☐ Yes	☒ No	☐ N/A
	Type of monitoring (*e.g.*, self-reporting, drive by) Routine Inspection Frequency Annually Responsible party/agency Navy and Navy O&M Contractors (Aptim Federal Services)			
	Reporting is up-to-date	☒ Yes	☐ No	☐ N/A
	Reports are verified by the lead agency	☒ Yes	☐ No	☐ N/A
	Specific requirements in deed or decision documents have been met	☒ Yes	☐ No	☐ N/A
	Violations have been reported	☐ Yes	☐ No	☒ N/A
	Other problems or suggestions: ☐ Report attached None; no incompatible land uses observed or unauthorized intrusive activities.			
2.	**Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A Remarks None			
D. General				

1. **Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident Remarks None	
2. **Land use changes on site** ☒ N/A Remarks None	
3. **Land use changes off site** ☒ N/A Remarks None	
VI. GENERAL SITE CONDITIONS	
A. Roads ☒ Applicable ☐ N/A	
1. **Roads damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A Remarks None	
B. Other Site Conditions	
Remarks Active work is being conducted related to radiological rescanning efforts. Many areas of site are inaccessible while work is ongoing but stormwater best management practices are in use (Photographs 1, 3, 5, 7, 10, 13, 14, 15, and 16).	
VII. COVERS ☒ Applicable ☐ N/A Note that the durable covers onsite are not engineered landfill covers. The durable cover inspection was not completed because active excavation and trenching work is being conducted over the majority of the parcel; complete durable covers are expected to be reinstalled in accordance with the remedial design.	
A. Surface	
B. Benches ☐ Applicable ☒ N/A (Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)	
C. Letdown Channels ☐ Applicable ☒ N/A (Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)	
D. Cover Penetrations ☒ Applicable ☐ N/A	
5. **Settlement Monuments** ☐ Located ☒ Routinely surveyed ☐ N/A Remarks Monument 3723 is scheduled for resurveying in 2025.	
E. Gas Collection and Treatment ☐ Applicable ☒ N/A	
F. Cover Drainage Layer ☐ Applicable ☒ N/A	
G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A	
H. Retaining Walls ☐ Applicable ☒ N/A	
I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☒ N/A	

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A	
IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A	
A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☒ N/A	
B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A	
C. Treatment System ☐ Applicable ☒ N/A	
D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining Monitoring well access is impeded by ongoing work. Concentrations of chemicals of concern (COCs) have been declining.
D. Monitored Natural Attenuation	
1.	**Monitoring Wells** (natural attenuation remedy) ☒ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance ☐ N/A Remarks Monitoring wells are inspected, sampled, and repaired under the Basewide groundwater monitoring program and plume-specific remediation actions.
X. OTHER REMEDIES - None	
XI. OVERALL OBSERVATIONS	
A.	**Implementation of the Remedy**
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). Remedy for Parcel G consists of durable covers, groundwater monitoring, and ICs to prevent exposure to COCs and radionuclides of concern in groundwater, soil, and structures. The remedy is functioning as intended, groundwater COCs are declining. Active trenching work is underway and it is expected that the durable covers will be repaired upon completion.
B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. O&M of the durable covers will be reinstituted when the current investigation is complete and the covers are fully restored.
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. None identified.

D.	Opportunities for Optimization
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. No opportunities outside of optimization is documented in the Basewide groundwater monitoring program for the groundwater remedy.

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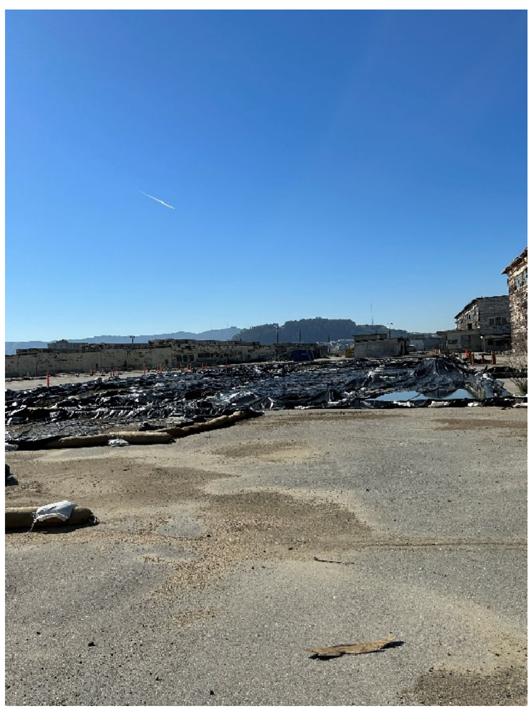
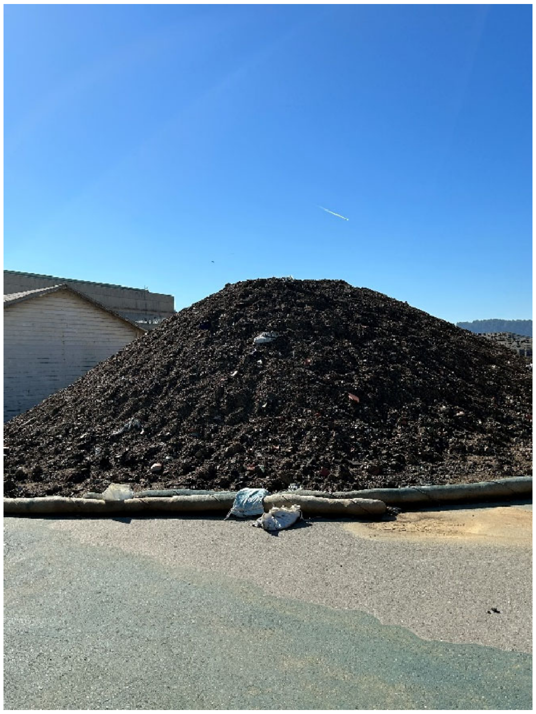
Parcel G Photograph 1: *Excavation between Building 302 and 303. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023



Parcel G Photograph 2: *Stormwater best management practice southeast of Building 402. Facing southwest.* Photographed by: Marcella Navas/CH2M, 2/9/2023



Parcel G Photograph 3: *Stockpile with berm surrounding located east of Building 419. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel G Photograph 4: *Stormwater best management practice east of Building 418. Facing southeast.*

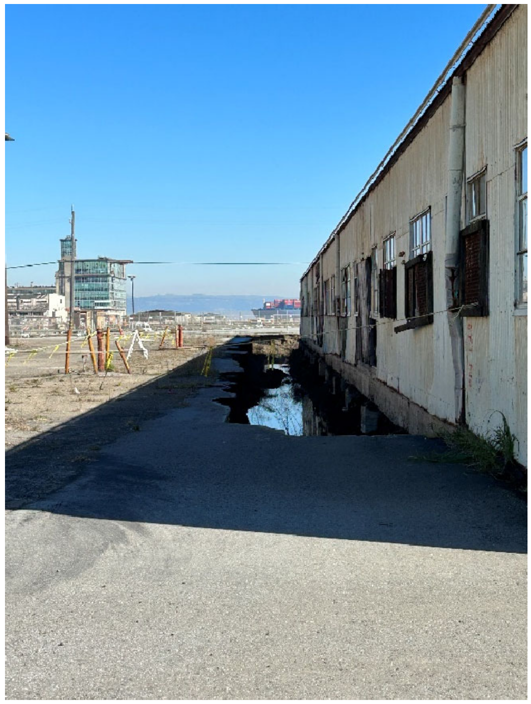
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel G Photograph 5: *Trenching east of Building 366. Facing northeast.*

Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel G Photograph 6: *Stormwater best management practice east of Building 415. Facing southeast.*

Photographed by: Marcella Navas/CH2M, 2/9/2023



Parcel G Photograph 7: *Trenching northwest of Building 363. Facing north.*

Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel G Photograph 8: *Warning sign outside of Building 351. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel G Photograph 9: *Stormwater best management practice along southeast portion of Parcel G along Buildings 415, 323, and 324. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

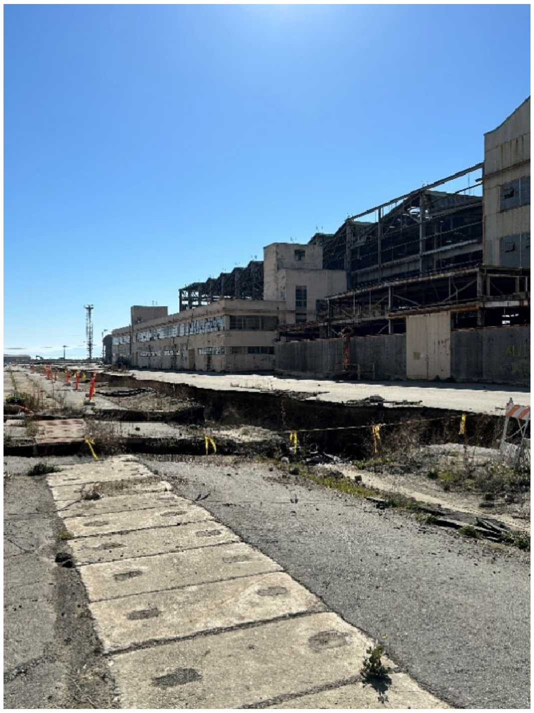
Parcel G Photograph 10: *Excavation west of Building 411 and east of Building 439. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel G Photograph 11: *Stormwater best management practice east of Building 409. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

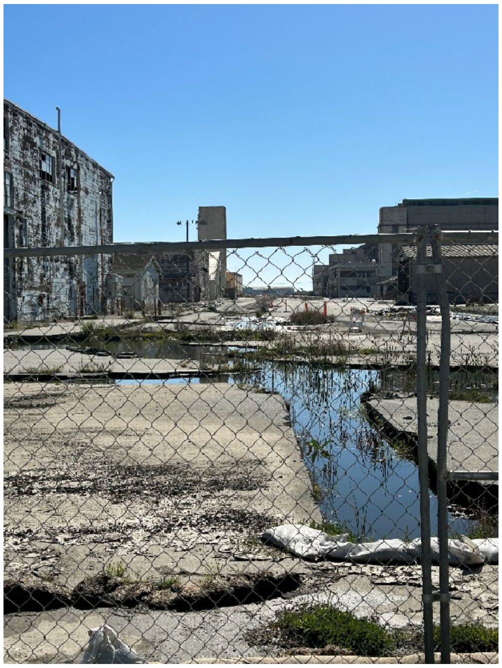
Parcel G Photograph 12: *Chain-link fence located east of Parcel G adjacent to Parcel D-1. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel G Photograph 13: *Stockpile between Building 415 and Building 366. Facing west.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

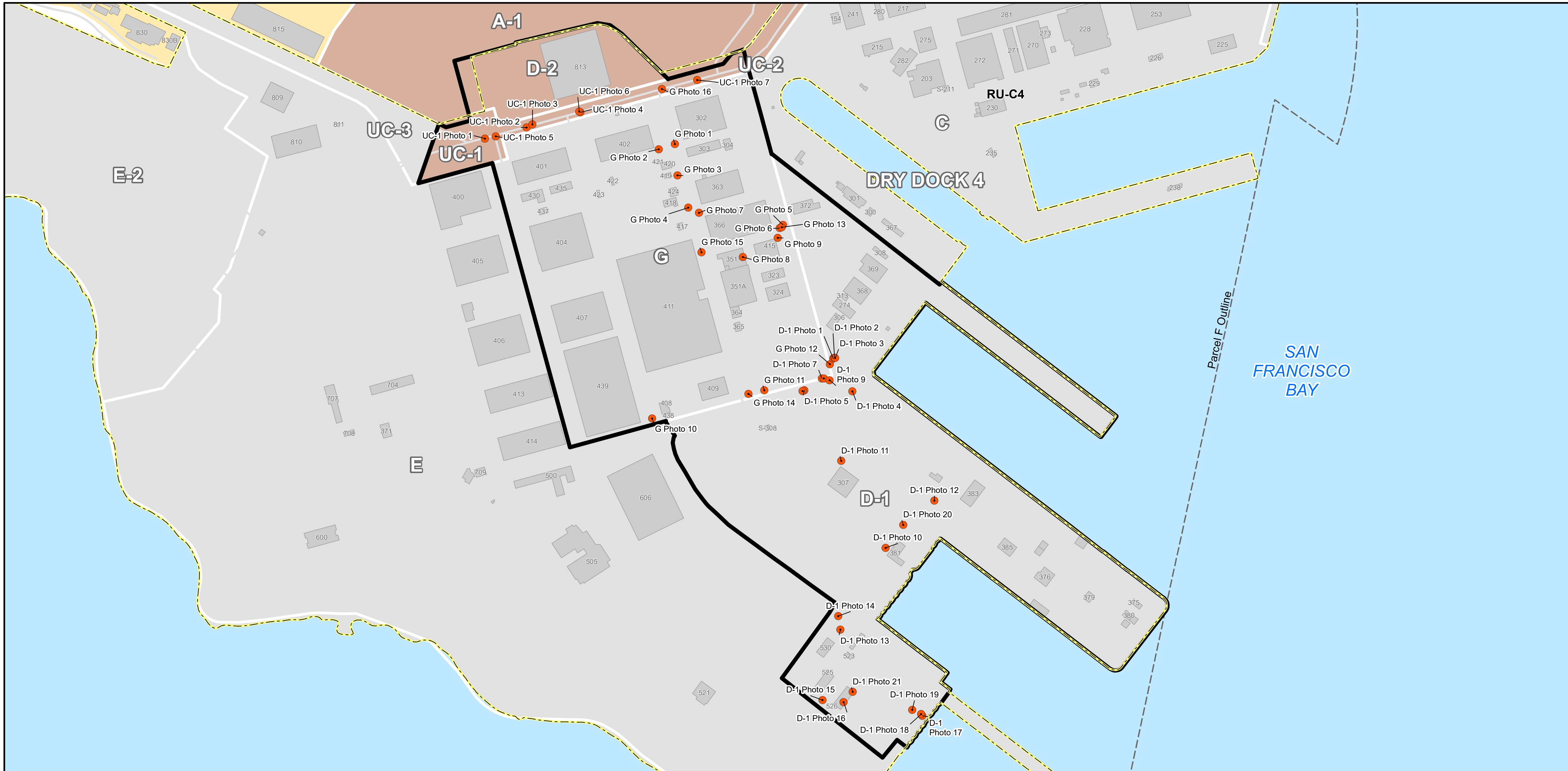
Parcel G Photograph 14: *Asphalt pavement cover, trenching, and stormwater best management practices southeast of Building 411. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023



Parcel G Photograph 15: *Trenching east of Building 411. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

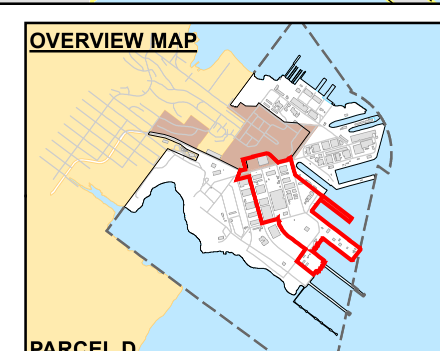


Parcel G Photograph 16: *Trenching between Building 402 and 302 within Parcel G from UC-1. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023



LEGEND

- Hunters Point Naval Shipyard Boundary
- Parcel Boundary
- Parcel F (Water) Boundary
- Former Navy Property
- Non-Navy Property
- Photograph Location
- Water
- Building
- Road



Parcel D (Parcels D-1, D-2, G, and UC-1)
Five-Year Review Site Inspection Photograph Locations
Five-Year Review of Remedial Actions
Hunters Point Naval Shipyard, San Francisco, California

0 200 400 Feet
1 Inch = 450 Feet
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Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: Parcel E	**Date of inspection:** 2/9/23
Location and Region: Hunters Point Naval Shipyard San Francisco, CA, Region 9	**EPA ID:** CA1170090087
Agency, office, or company leading the five-year review: Department of the Navy	**Weather/temperature:** Sunny, 50s
Remedy Includes: (Check all that apply) ☐ Landfill cover/containment ☒ Monitored natural attenuation ☒ Access controls ☐ Groundwater containment ☒ Institutional controls ☒ Vertical barrier walls ☐ Groundwater pump and treatment ☐ Surface water collection and treatment ☒ Other Durable cover consisting of a soil cover, shoreline revetment (riprap), asphaltic concrete pavement, nonaqueous phase liquid (NAPL) removal	
Attachments: ☐ Inspection team roster attached ☒ Site map attached	
II. INTERVIEWS (Interviews Conducted Separately)	
III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)	
1. **O&M Documents** ☐ O&M manual ☐ Readily available ☐ Up to date ☒Not applicable (N/A) ☐ As-built drawings ☐ Readily available ☐ Up to date ☒ N/A ☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A Remarks Remedy construction is currently underway; O&M has not begun	
2. **Site-Specific Health and Safety Plan** ☒ Readily available ☐ Up to date ☐ N/A ☐ Contingency plan/emergency response plan ☐ Readily available ☐ Up to date ☒ N/A Remarks Construction contractors' office.	
3. **O&M and OSHA Training Records** ☒ Readily available ☐ Up to date ☐ N/A Remarks Construction contractors' office.	
4. **Permits and Service Agreements** ☐ Air discharge permit ☐ Readily available ☐ Up to date ☒ N/A ☐ Effluent discharge ☐ Readily available ☐ Up to date ☒ N/A ☐ Waste disposal, POTW ☐ Readily available ☐ Up to date ☒ N/A ☐ Other permits____________ ☐ Readily available ☐ Up to date ☒ N/A Remarks	
5. **Gas Generation Records** ☐ Readily available ☐ Up to date ☒ N/A Remarks	

6.	**Settlement Monument Records** ☐ Readily available ☐ Up to date ☒ N/A Remarks Remedy construction is ongoing, settlement monuments for O&M have not been established.			
7.	**Groundwater Monitoring Records** ☒ Readily available ☐ Up to date ☐ N/A Remarks: Groundwater monitoring is reported in annual Basewide groundwater monitoring reports.			
8.	**Leachate Extraction Records** ☐ Readily available ☐ Up to date ☒ N/A Remarks			
9.	**Discharge Compliance Records** ☐ Air ☐ Readily available ☐ Up to date ☒ N/A ☐ Water (effluent) ☐ Readily available ☐ Up to date ☒ N/A Remarks			
10.	**Daily Access/Security Logs** ☐ Readily available ☐ Up to date ☒ N/A Remarks: Guarded security gates at Robinson Street and Crisp Road restrict access to Hunters Point Naval Shipyard. City of San Francisco provides security and maintains access logs.			
IV. O&M COSTS (Not Applicable for Site Inspection)				
V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A				
A. Fencing				
1.	**Fencing damaged** ☐ Location shown on site map ☒ Gates secured ☐ N/A Remarks Fencing in good condition.			
B. Other Access Restrictions				
1.	**Signs and other security measures** ☒ Location shown on site map ☐ N/A Remarks Signs legible and in good condition (Photographs 6, 11, 12, 17, and 18).			
C. Institutional Controls (ICs) – Remedy ICs are not in fully in place, access and exposure is controlled during active construction per the Remedial Action Work Plan(s).				
D. General				
1.	**Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident Remarks None			
2.	**Land use changes on site** ☒ N/A Remarks None			
3.	**Land use changes off site** ☒ N/A Remarks None			
VI. GENERAL SITE CONDITIONS				
A. Roads ☒ Applicable ☐ N/A				
1.	**Roads damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A Remarks Heavy construction is being conducted within the site and roads show some signs of wear.			
B. Other Site Conditions				

Remarks Ongoing construction through the majority of the parcel.

VII. COVERS ☒ Applicable ☐ N/A

Note that the durable covers onsite are not engineered landfill covers. Cover is in various phases of construction so was not inspected. BMPs to control stormwater during construction are present.

A. Surface – not constructed, not applicable for this FYR site inspection.

B. Benches ☐ Applicable ☒ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

C. Letdown Channels ☐ Applicable ☒ N/A
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

D. Cover Penetrations ☐ Applicable ☒ N/A

5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed ☒ N/A
Remarks Final settlement monuments will be installed when construction is complete.

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

F. Cover Drainage Layer ☐ Applicable ☒ N/A

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

H. Retaining Walls ☐ Applicable ☒ N/A

I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☒ N/A
Remarks:

VIII. VERTICAL BARRIER WALLS ☒ Applicable ☐ N/A

Barrier wall is a remedy component but construction is in progress and was not inspected.

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☒ N/A

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A

C. Treatment System ☐ Applicable ☒ N/A

D. Monitoring Data

1. Monitoring Data
☒ Is routinely submitted on time ☒ Is of acceptable quality

2. Monitoring data suggests:
☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining
Analytes are within or below historical average at Parcel E.

D. Monitored Natural Attenuation

1.	**Monitoring Wells** (natural attenuation remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☐ All required wells located ☐ Needs Maintenance ☐ N/A Remarks Monitoring wells are inspected, sampled, and repaired under the Basewide groundwater monitoring program and plume-specific remediation actions.
	X. OTHER REMEDIES - None
	XI. OVERALL OBSERVATIONS
A.	**Implementation of the Remedy**
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). The remedy at Parcel E consists of excavation and offsite disposal, in situ soil vapor extraction, durable covers, groundwater remediation, barrier walls for groundwater and NAPL, groundwater monitoring, and ICs. The remedy is currently in the construction phase and has not been fully implemented. While construction is ongoing, dust monitoring and access control/signage are being implemented to prevent exposure to contamination.
B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. Not applicable.
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. Not applicable.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. Not applicable.

Parcel E Photograph 1: *Soil stockpile at the intersection of J and Mahan Street with delineator barricading. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E Photograph 2: *Shack on the corner of J Street and 6th Avenue. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E Photograph 3: *Construction debris. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E Photograph 4: *Stockpile with standing water adjacent. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E Photograph 5: *Stockpile with standing water at corner of J and Mahan Street. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E Photograph 6: *Restricted Area signage, stockpile, and best management practice on the corner of 6th Avenue and J Street. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E Photograph 7: *Stockpile near shoreline southeast of J Street. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E Photograph 8: *Stockpiles along fence line. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E Photograph 9: *Stormwater management best management practices along corner of J Street and 6th Avenue. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E Photograph 10: *Building 521 with cordoned work area and warning signs. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E Photograph 11: *Stockpiles with warning signage and sediment control berms along 6th Avenue. Facing southwest.*

Photographed by: Marcella Navas /CH2M, 2/9/2023

Parcel E Photograph 12: *Caution and danger signs along fence line adjacent to H Street. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E Photograph 13: *Overview of northeast end of Parcel E. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E Photograph 14: *Overview of active construction area. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E Photograph 15: *Stockpiles along embankment. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E Photograph 16: *Monitoring well intact and in good condition. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E Photograph 17: *Restricted area signage. Facing southwest*

Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E Photograph 18: *Caution sign around active work. Facing southeast.*
Photographed by: Marcella Navas /CH2M, 2/9/2023

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Five-Year Review Site Inspection Checklist

I. SITE INFORMATION

Site name: Parcel E-2	**Date of inspection:** 2/9/23
Location and Region: Hunters Point Naval Shipyard San Francisco, CA, Region 9	**EPA ID:** CA1170090087
Agency, office, or company leading the five-year review: Department of the Navy	**Weather/temperature:** Sunny, 50s

Remedy Includes: (Check all that apply)

☒ Landfill cover/containment ☒ Monitored natural attenuation
☒ Access controls ☐ Groundwater containment
☒ Institutional controls ☒ Vertical barrier walls
☐ Groundwater pump and treatment
☐ Surface water collection and treatment
☒ Other Durable cover consisting of a soil cover, shoreline revetment (riprap), asphaltic concrete pavement

Attachments: ☐ Inspection team roster attached ☒ Site map attached

II. INTERVIEWS (Interviews Conducted Separately)

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
☒ O&M manual ☐ Readily available ☐ Up to date ☐Not applicable (N/A)
☐ As-built drawings ☐ Readily available ☐ Up to date ☒ N/A
☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A
Remarks O&M ongoing for interim cover and gas control and monitoring system.

2. **Site-Specific Health and Safety Plan**
☒ Readily available ☐ Up to date ☐ N/A
☐ Contingency plan/emergency response plan ☐ Readily available ☐ Up to date ☒ N/A
Remarks Construction contractors' office.

3. **O&M and OSHA Training Records** ☒ Readily available ☐ Up to date ☐ N/A
Remarks Construction contractors' office.

4. **Permits and Service Agreements**
☐ Air discharge permit ☐ Readily available ☐ Up to date ☒ N/A
☐ Effluent discharge ☐ Readily available ☐ Up to date ☒ N/A
☐ Waste disposal, POTW ☐ Readily available ☐ Up to date ☒ N/A
☐ Other permits____________________ ☐ Readily available ☐ Up to date ☒ N/A
Remarks____________________

5. **Gas Generation Records** ☒ Readily available ☒ Up to date ☐ N/A
Remarks Gas monitoring records available in Administrative Record.

6.	**Settlement Monument Records** ☐ Readily available ☐ Up to date ☒ N/A Remarks Landfill settlement surveys available in O&M reports for interim cover.			
7.	**Groundwater Monitoring Records** ☒ Readily available ☐ Up to date ☐ N/A Remarks: Groundwater monitoring is reported in annual Basewide groundwater monitoring reports.			
8.	**Leachate Extraction Records** ☐ Readily available ☐ Up to date ☒ N/A Remarks			
9.	**Discharge Compliance Records** ☐ Air ☐ Readily available ☐ Up to date ☒ N/A ☐ Water (effluent) ☐ Readily available ☐ Up to date ☒ N/A Remarks			
10.	**Daily Access/Security Logs** ☐ Readily available ☐ Up to date ☒ N/A Remarks: Guarded security gates at Robinson Street and Crisp Road restrict access to Hunters Point Naval Shipyard. City of San Francisco provides security and maintains access logs.			
IV. O&M COSTS (Not Applicable for Site Inspection)				
V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A				
A. Fencing				
1.	**Fencing damaged** ☐ Location shown on site map ☒ Gates secured ☐ N/A Remarks Fencing in good condition.			
B. Other Access Restrictions				
1.	**Signs and other security measures** ☐ Location shown on site map ☐ N/A Remarks Signs present and legible.			
C. Institutional Controls (ICs) - Remedy ICs are not in fully in place, access and exposure is controlled during active construction per the Remedial Action Work Plan(s).				
D. General				
1.	**Vandalism/trespassing** ☐ Location shown on site map ☐ No vandalism evident Remarks Graffiti present along inside of seawall (Photographs 7, 9, and 10).			
2.	**Land use changes on site** ☒ N/A Remarks None			
3.	**Land use changes off site** ☒ N/A Remarks None			
VI. GENERAL SITE CONDITIONS				
A. Roads ☒ Applicable ☐ N/A				
1.	**Roads damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A Remarks Access roads are adequate; majority of the area is a construction site.			
B. Other Site Conditions				
	Remarks _Ongoing construction through the majority of the parcel.			

VII. LANDFILL COVERS ☒ Applicable ☐ N/A Landfill cover is currently under construction and was not inspected. An interim soil cover is in place while the final cover is being installed to maintain protectiveness.
A. Landfill Surface
6. **Alternative Cover (Shoreline Revetment)** ☐ N/A Remarks Rocks and sea wall intact. Water accumulated behind sea wall may be a result of overtopping or from heavy rains that recently occurred (Photographs 7, 9, and 10).
B. Benches ☐ Applicable ☒ N/A (Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)
C. Letdown Channels ☐ Applicable ☒ N/A (Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)
D. Cover Penetrations ☐ Applicable ☒ N/A – Cover has not been installed.
E. Gas Collection and Treatment ☒ Applicable ☐ N/A An interim landfill collection and venting system is currently in place and monitored. Monitoring reports are readily available in the Administrative Record.
F. Cover Drainage Layer ☐ Applicable ☒ N/A
G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A
H. Retaining Walls ☒ Applicable ☐ N/A - Seawall
1. **Deformations** ☐ Location shown on site map ☒ Deformation not evident Remarks None
2. **Degradation** ☐ Location shown on site map ☒ Degradation not evident Remarks None
I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☒ N/A Remarks: Not observed.
1. **Siltation** ☐ Location shown on site map ☐ Siltation not evident Remarks Stormwater best management practices employed during remedy construction work.
2. **Vegetative Growth** ☐ Location shown on site map ☒ N/A ☐ Vegetation does not impede flow Remarks None
3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident Remarks Active construction site.
4. **Discharge Structure** ☐ Functioning ☒ N/A Remarks Not observed.
VIII. VERTICAL BARRIER WALLS ☒ Applicable ☐ N/A

1.	**Settlement**	☐ Location shown on site map ☐ Settlement not evident Remarks Area not accessible from construction.
2.	**Performance Monitoring**	Type of monitoring___________________________ ☐ Performance not monitored Remarks Remedy is in construction phase.
IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A		
A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☒ N/A		
B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A		
C. Treatment System ☐ Applicable ☒ N/A		
D. Monitoring Data		
1.	Monitoring Data	☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests:	☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining Groundwater chemicals of concern (COCs) continue to exceed remediation goals but concentrations are similar to or below historical levels.
D. Monitored Natural Attenuation		
1.	**Monitoring Wells** (natural attenuation remedy)	☐ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance ☐ N/A Remarks Wells affected by cap construction will be restored.
X. OTHER REMEDIES - None		
XI. OVERALL OBSERVATIONS		
A.	**Implementation of the Remedy**	
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). The remedy at Parcel E-2 consists of excavation and removal of contaminated soil, installation of a soil cover, installation of belowground barrier walls, removal and treatment of landfill gas, shoreline revetment, and monitoring and ICs. The remedy is currently under construction. While construction is ongoing, an interim cover and landfill gas monitoring and collection system is in place.	
B.	**Adequacy of O&M**	
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. Not applicable.	
C.	**Early Indicators of Potential Remedy Problems**	

	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. Not applicable.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. Not applicable.

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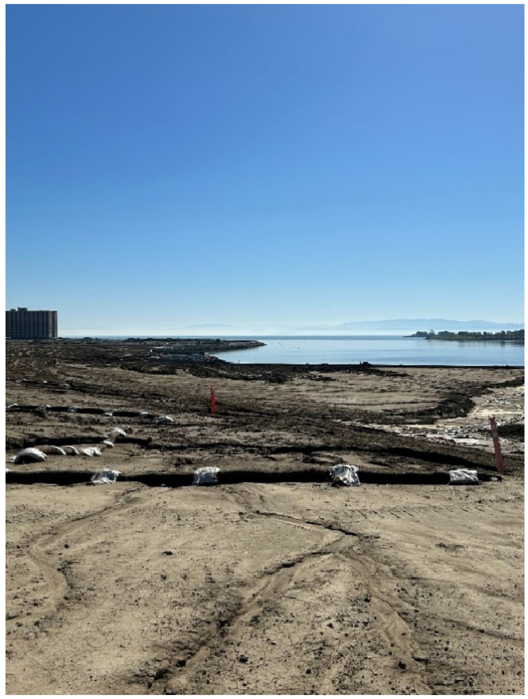
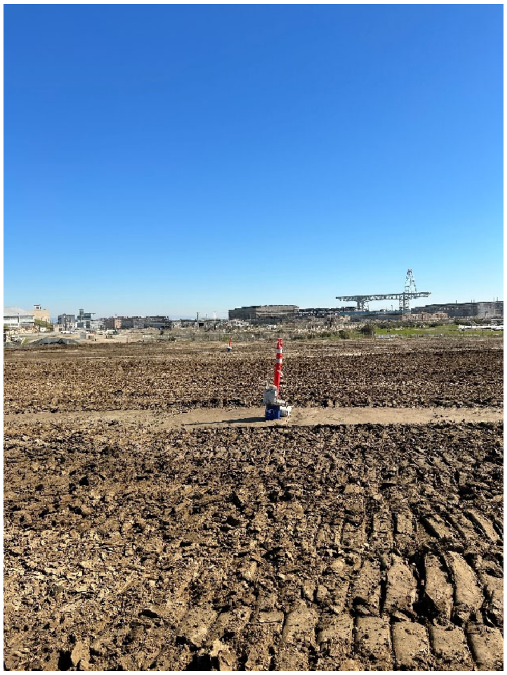


Parcel E-2 Photograph 1: *Active construction with stormwater best management practices. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E-2 Photograph 2: *Storage containers onsite for generators. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E-2 Photograph 3: *Small excavated area within soil cover construction area. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023



Parcel E-2 Photograph 4: *Graded area with marked monitoring point. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E-2 Photograph 5: *Graded area with marked monitoring point. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E-2 Photograph 6: *Storage containers and laydown area. Facing west.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E-2 Photograph 7: *Accumulated water and monitoring well adjacent to shoreline revetment and seawall. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E-2 Photograph 8: *Monitoring well located in soil cover area. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E-2 Photograph 9: *Accumulated water behind seawall in active construction area. Facing southeast.*

Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E-2 Photograph 10: *Graffiti along seawall. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E2 Photograph 11: *Small excavated area with sandbags. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E-2 Photograph 12: *Active soil cover construction area with seawall in the background. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E-2 Photograph 13: *Accumulated water within retention area, active construction site. Facing southwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E-2 Photograph 14: *Stockpile along J Street surrounded by stormwater best management practices. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel E-2 Photograph 15: *Stockpiles along J Street with swale surrounding. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: Parcel UC-1, UC-2, UC-3	**Date of inspection:** 2/9/23
Location and Region: Hunters Point Naval Shipyard San Francisco, CA, Region 9	**EPA ID:** CA1170090087
Agency, office, or company leading the five-year review: Department of the Navy	**Weather/temperature:** Sunny, 50s

Remedy Includes: (Check all that apply)

☐ Landfill cover/containment ☐ Monitored natural attenuation
☐ Access controls ☐ Groundwater containment
☒ Institutional controls ☐ Vertical barrier walls
☐ Groundwater pump and treatment
☐ Surface water collection and treatment
☒ Other Durable cover consisting of a soil cover and/or asphaltic concrete pavement.

Attachments: ☐ Inspection team roster attached ☒ Site map attached

II. INTERVIEWS (Interviews Conducted Separately)

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

☒ O&M manual ☒ Readily available ☐ Up to date ☐Not applicable (N/A)
☒ As-built drawings ☒ Readily available ☐ Up to date ☐ N/A
☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A
Remarks__Documents available in the Administrative Record and O&M contractors' offices.___

2. **Site-Specific Health and Safety Plan**

☐ Readily available ☐ Up to date ☐ N/A
☐ Contingency plan/emergency response plan ☐ Readily available ☐ Up to date ☒ N/A
Remarks Available onsite during inspections.

3. **O&M and OSHA Training Records** ☐ Readily available ☐ Up to date ☐ N/A
Remarks Available in O&M contractor office.

4. **Permits and Service Agreements**

☐ Air discharge permit ☐ Readily available ☐ Up to date ☒ N/A
☐ Effluent discharge ☐ Readily available ☐ Up to date ☒ N/A
☐ Waste disposal, POTW ☐ Readily available ☐ Up to date ☒ N/A
☐ Other permits____________________ ☐ Readily available ☐ Up to date ☒ N/A
Remarks____

5. **Gas Generation Records** ☐ Readily available ☐ Up to date ☒ N/A
Remarks

6.	**Settlement Monument Records** Remarks	☐ Readily available	☐ Up to date	☒ N/A
7.	**Groundwater Monitoring Records** Remarks:	☐ Readily available	☐ Up to date	☒ N/A
8.	**Leachate Extraction Records** Remarks	☐ Readily available	☐ Up to date	☒ N/A
9.	**Discharge Compliance Records**			
	☐ Air	☐ Readily available	☐ Up to date	☒ N/A
	☐ Water (effluent)	☐ Readily available	☐ Up to date	☒ N/A
	Remarks			
10.	**Daily Access/Security Logs**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: Guarded security gates at Robinson Street and Crisp Road restrict access to Hunters Point Naval Shipyard. City of San Francisco provides security and maintains access logs.			

IV. O&M COSTS (Not Applicable for Site Inspection)

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☒ Gates secured ☐ N/A
Remarks Fencing to keep out of other parcels adjacent to UC-1, -2, and -3 (UC-1 Photographs 1, 2, 4, 5, and 6).

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☒ N/A
Remarks

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented	☐ Yes	☒ No	☐ N/A
Site conditions imply ICs not being fully enforced	☐ Yes	☒ No	☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) Routine Inspection
Frequency Annually
Responsible party/agency Navy and Navy O&M Contractors (UC-3), OCII O&M Contractors (UC-1 and UC-2)

Reporting is up-to-date	☒ Yes	☐ No	☐ N/A
Reports are verified by the lead agency	☒ Yes	☐ No	☐ N/A
Specific requirements in deed or decision documents have been met	☒ Yes	☐ No	☐ N/A
Violations have been reported	☐ Yes	☐ No	☒ N/A

Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks None

D. General		
1.	**Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident Remarks None	
2.	**Land use changes on site** ☒ N/A Remarks None	
3.	**Land use changes off site** ☒ N/A Remarks None	
VI. GENERAL SITE CONDITIONS		
A. Roads ☒ Applicable ☐ N/A		
1.	**Roads damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A Remarks Areas where durable cover has been restored apparent (UC-2 Photographs 1, 2, and 3) .	
B. Other Site Conditions		
	Remarks Vegetation observed around Building 815 in cracks around foundation.	
VII. COVERS ☒ Applicable ☐ N/A Note that the durable covers onsite are not engineered landfill covers.		
A. Surface		
1.	**Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident Remarks	
2.	**Cracks** ☐ Location shown on site map ☐ Cracking not evident Remarks Minor cracking along Crisp Road (UC-3, Photograph 6) from increased heavy equipment and truck traffic.	
3.	**Erosion** ☐ Location shown on site map ☒ Erosion not evident Remarks	
4.	**Holes** ☐ Location shown on site map ☒ Holes not evident Remarks	
5.	**Vegetative Cover** ☒ Grass ☒ Cover properly established ☒ No signs of stress ☐ Trees/Shrubs (indicate size and locations on a diagram) Remarks	
6.	**Alternative Cover** ☒ N/A Remarks	
7.	**Bulges** ☐ Location shown on site map ☒ Bulges not evident Remarks	
8.	**Wet Areas/Water Damage** ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Location shown on site map Areal extent ☐ Ponding ☐ Location shown on site map Areal extent ☐ Seeps ☐ Location shown on site map Areal extent ☐ Soft subgrade ☐ Location shown on site map Areal extent Remarks	

9. **Slope Instability**
☐ Slides ☐ Location shown on site map ☐ No evidence of slope instability
Remarks Not applicable.

B. Benches ☐ Applicable ☒ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

C. Letdown Channels ☐ Applicable ☒ N/A
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

D. Cover Penetrations ☐ Applicable ☒ N/A

5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed ☒ N/A
Remarks

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

F. Cover Drainage Layer ☐ Applicable ☒ N/A

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

H. Retaining Walls ☐ Applicable ☒ N/A

I. Perimeter Ditches/Off-Site Discharge ☒ Applicable ☐ N/A

1. **Siltation** ☐ Location shown on site map ☒ Siltation not evident
Remarks

2. **Vegetative Growth** ☐ Location shown on site map ☒ N/A
☒ Vegetation does not impede flow
Remarks

3. **Erosion** ☐ Location shown on site map ☒ Erosion not evident
Remarks

4. **Discharge Structure** ☐ Functioning ☒ N/A
Remarks

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒ N/A

X. OTHER REMEDIES - None

XI. OVERALL OBSERVATIONS

A.	**Implementation of the Remedy**
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). Remedies at Parcels UC-1, UC-2, and UC-3 consist of durable cover and ICs. Cover is in good condition and monitored regularly. UC-1 and UC-2 were transferred and are monitored by the OCII contractor. Reports indicate remedy is functioning and no land use control violations have occurred.
B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. None.
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. None.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. None identified.

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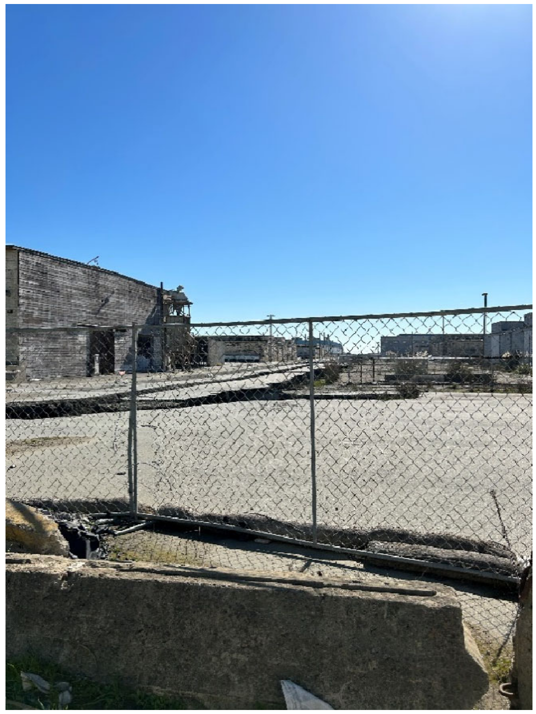


Parcel UC-1 Photograph 1: *Chain-link fence along Parcel UC-1 and Parcel G. Facing south.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel UC-1 Photograph 2: *Chain-link fence along Parcel UC-1 and Parcel G. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

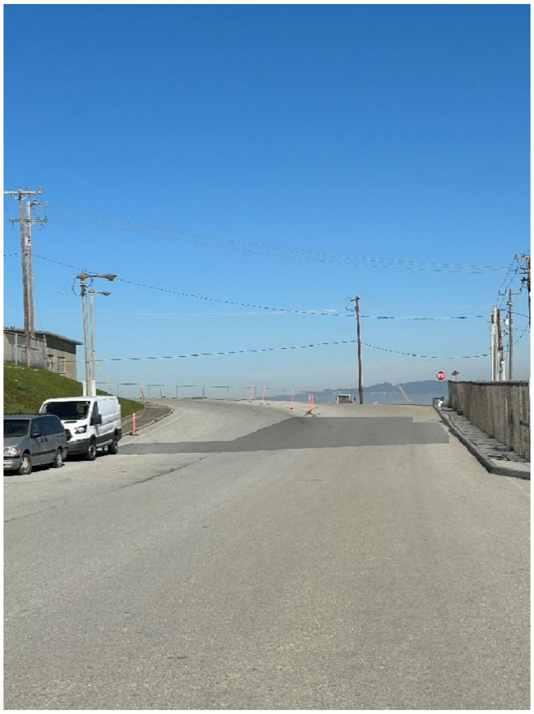
Parcel UC-1 Photograph 3: *Asphalt pavement cover along Spear Avenue. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel UC-1 Photograph 4: *Chain-link fence along Parcel UC-1 north of Building 402. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

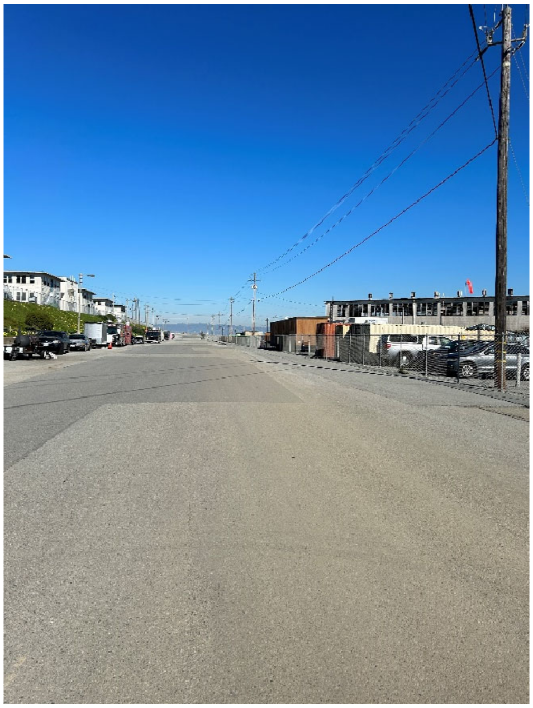
Parcel UC-1 Photograph 5: *Chain-link fence along Parcel UC-1 north of Building 401. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel UC-1 Photograph 6: *Chain-link fence along Spear Avenue between Buildings 401 and 402. Facing south.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel UC-1 Photograph 7: *Asphalt pavement cover between Horn and Spear Avenue. Facing north.*
Photographed by: Marcella Navas/CH2M, 2/9/2023



Parcel UC-2 Photograph 1: *Asphalt pavement cover along Fisher Avenue. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

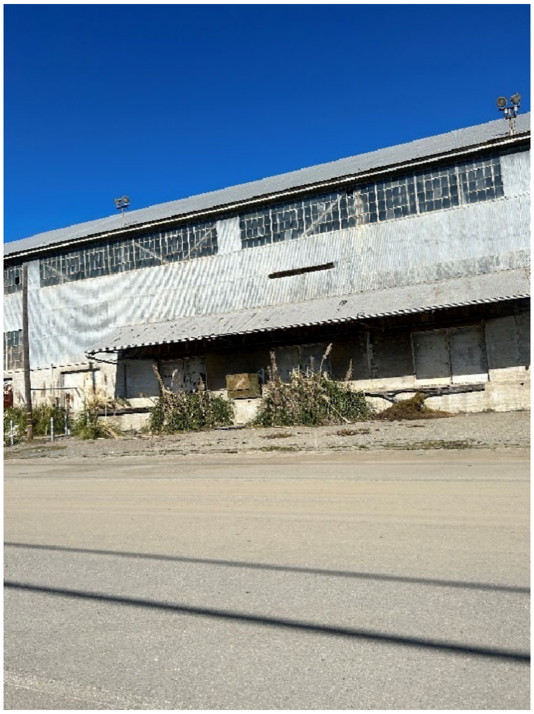


Parcel UC-2 Photograph 2: *Asphalt pavement cover along Fisher Avenue. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel UC-2 Photograph 3: *Asphalt pavement cover along Fisher Avenue. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel UC-3 Photograph 1: *Gravel located south of Building 815. Facing southeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

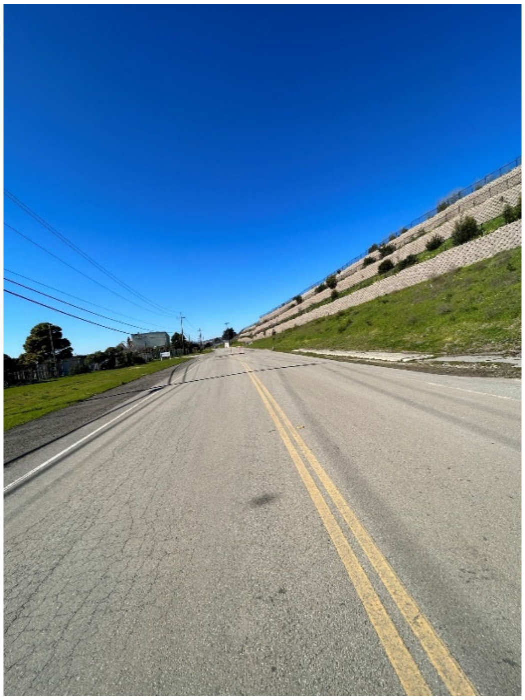
Parcel UC-3 Photograph 2: *Gravel located south of Building 815. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023



Parcel UC-3 Photograph 3: *Overgrowth of vegetation south of Building 815. Facing north.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel UC-3 Photograph 4: *Asphalt pavement cover southeast of Building 815. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel UC-3 Photograph 5: *Asphalt pavement cover southeast of Building 815 located between Parcel UC-1 and Parcel E-2. Facing northeast.*
Photographed by: Marcella Navas/CH2M, 2/9/2023



Parcel UC-3 Photograph 6: *Street along Crisp Road. Facing northwest.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

Parcel UC-3 Photograph 7: *Asphalt pavement cover between Parcel UC-3 and UC-1. Facing south.*
Photographed by: Marcella Navas/CH2M, 2/9/2023

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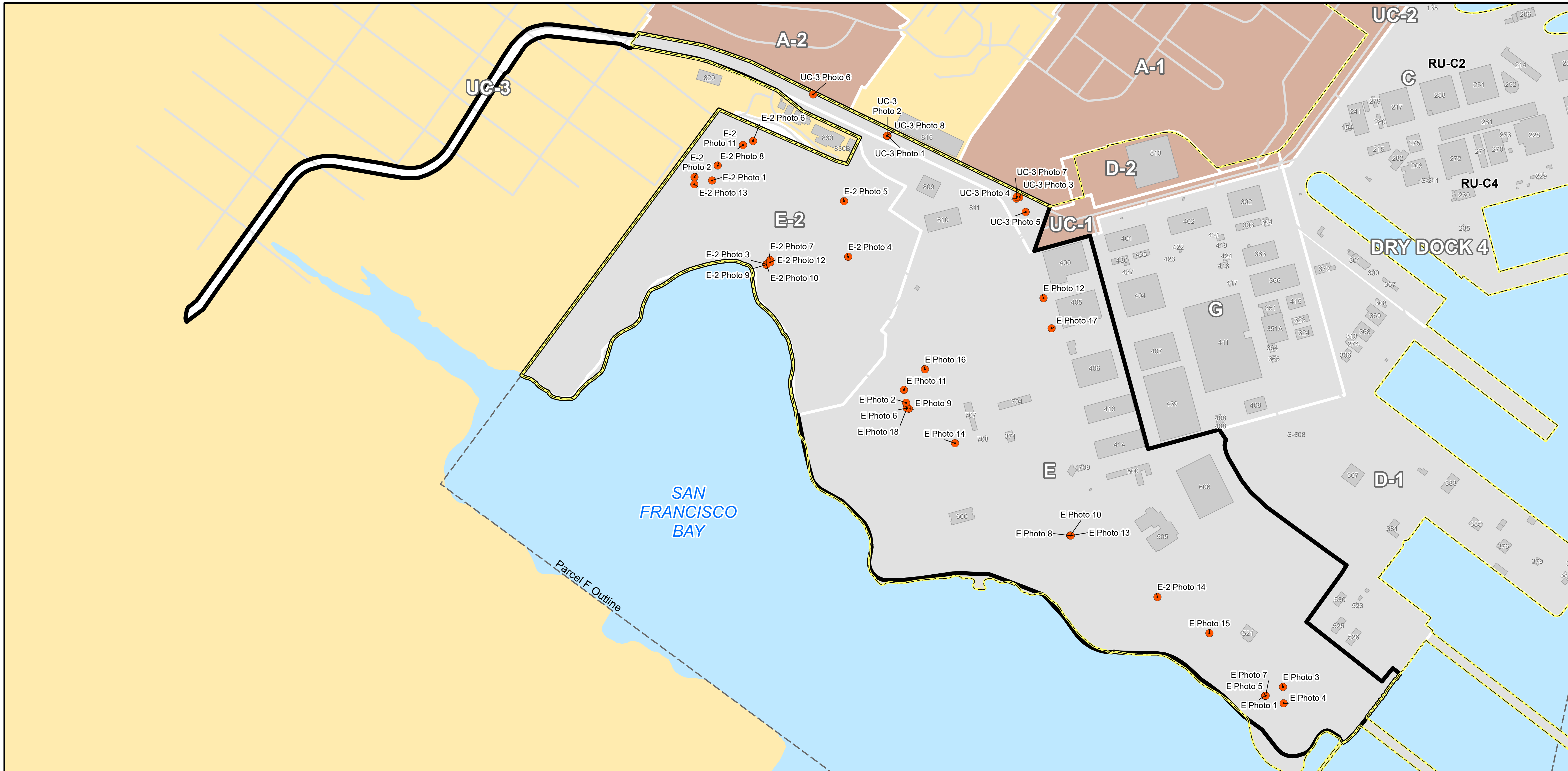
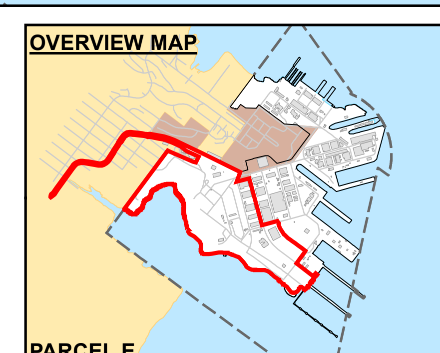


LEGEND

- Hunters Point Naval Shipyard Boundary
- Parcel Boundary
- Parcel F (Water) Boundary
- Former Navy Property
- Non-Navy Property
- Photograph Location
- Water
- Building
- Road



Parcel E (Parcels E, E-2, and UC-3)
Five-Year Review Site Inspection Photograph Locations
Five-Year Review of Remedial Actions
Hunters Point Naval Shipyard, San Francisco, California

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Appendix D
Public Notice

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NTSB probes SFO-bound flight from Maui that dove toward ocean

By Rachel Swan

A United Airlines flight bound for San Francisco plunged to within 775 feet of the ocean shortly after taking off on Dec. 18, according to flight tracker data posted by FlightRadar24.

The data shows a sudden nosedive about 71 seconds after the plane departed from Kahului Airport on Maui, Hawaii. Before plummeting, the Boeing 777 had reached an altitude of 2,200 feet.

Despite the harrowing incident, Flight UA1722 landed safely at San Francisco International Airport, where the pilots filed a safety report, spokespeople for United Airlines said in a statement.

"United then closely coordinated with the (Federal Aviation Administration) and (the Air Line Pilots Association) on an investigation that ultimately resulted in the pilots receiving additional training," the statement read.

The National Transportation Safety Board said Tuesday it was investigating the nose-dive incident.

The two pilots, who have 25,000 hours of flight experience between them, cooperated with the probe, the statement said. It did not explain the circumstances that led to the abrupt descent, nor did it specify whether the flight contained passengers or cargo.

"Safety remains our highest priority," the statement concluded. A spokesperson for San Francisco International Airport declined to comment.

Reach Rachel Swan: rswan@sfchronicle.com.

Paul Chinn/The Chronicle 2020

A United Airlines Boeing 777, like this one at SFO, took a terrifying nosedive toward the Pacific Ocean last December.

KNIGHT

From page A1

and a loaded gun that had been reported stolen fell from his waistband. That same day, police arrested a 19-year-old man for alleged battery against his girlfriend on the platform of the Powell St. Station.

Since 2017, BART has received 509 reports of domestic violence on its trains or in its stations including assault against a partner, spouse or child, and abandoning or neglecting children. Since 2015, the agency has banned more than 300 abusers from riding its trains.

To its credit, the agency isn't trying to hide these grim statistics. In fact, its spokesperson, Alicia Trost, offered them up to me, noting BART is a frequent meeting point for parents who've split up to hand off their children, fueling some of the violence.

Also to its credit, the agency — which has so much to focus on, including its own solvency as ridership remains lackluster due to the pandemic — is trying to do something about it even if publicizing violence isn't exactly great for the bottom line.

"This is what prevents transit agencies from talking about difficult things," Trost told me. "They're so afraid you're reminding people it happens. We've decided not to let that stop us from talking about it."

To that end, passengers will notice new public art that's impossible to ignore throughout BART stations and trains this week. They're gorgeous, brightly colored, sometimes giant images depicting family and friends alongside messages including "Love Shouldn't Hurt," "Be the Friend Who Brings it Up" and "We All Deserve Respect."

The campaign is the brainchild of the Asian Women's Shelter, which received a $50,000 grant from the AAPI Civic Engagement Fund to spread awareness about domestic violence prevention throughout public transit stations and wisely tapped famed New York City artist Amanda Phingbodhipakkiya to create the work.

Hundreds of posters and digital ads will blanket all four downtown San Francisco stations as well as 10 others around the bay and the trains themselves, all space given free by BART. Another grant from the Asian Pacific Fund, as well as private donations, will fund the art's placement in Muni shelters and billboards around the city.

Each piece has a QR code that directs viewers to the website, www.letstalkaboutus.org, with a message about the importance of having difficult conversations with friends and family about domestic violence, and resources for getting help.

Saara Ahmed, community resource coordinator for the Asian Women's Shelter, said the idea is to get people talking about the problem and thinking of what they can do to prevent it.

"These issues can feel really overwhelming and scary and daunting — or something that's really far away and distant," she said. "Like, 'That's not an issue for us.' Having folks reflect on the fact that these things are happening every day in our community, but there's also things we can do every day about them, that's the invitation."

Orchid Pusey, executive director of the Asian Women's Shelter, said it's important to question behaviors that get passed down from one generation to the next and to not be afraid to start tough conversations. Why do some kids feel comfortable treating their mom in a rude, angry way that they'd never treat their dad? Why do some kids get punished for that behavior and others don't? Why do communities rail at outsiders causing harm to their members, but stay quiet when the harm is caused from within?

"There's a lot of gender in it," she said. "And it can be changed."

Phingbodhipakkiya, 34, spent a lot of time in the Bay Area over the past several months talking to victims of domestic violence and crafting her messages and art. She's the daughter of Asian immigrants herself: a Thai dad and Indonesian mom who met in an Atlanta cafe where he was a busboy and she was a business student poring over her books.

"I look at my work as invoking joy and belonging in the face of grief and injustice," she told me. "The reason why I focus so deeply on belonging is it's something that I so rarely felt as a young Asian girl."

She said she loves creating art in the public sphere because it's accessible to anybody — and you can't opt to not see it.

"It's impossible to ignore, which means the truth that I'm speaking through my art is impossible to ignore," she said. "Domestic violence is a topic that's often pushed to the edges of our society. We often only hear whispers about it. I love that we're openly inviting people to join us in fostering healthy, nurturing relationships."

She said she hopes Asian immigrants in particular benefit from her art because they often neglect their own mental health as they work hard to support their families in an unfamiliar place where they might not speak the language.

Recent public art campaigns by Phingbodhipakkiya in New York City, including prominent displays in Times Square, used similar imagery to highlight the importance of standing up to anti-Asian hate, celebrating Asian resilience and defending the Big Apple overall as it weathered the pandemic. "I Still Believe in Our City," one campaign read. (Note to San Francisco leaders: How about a public art campaign sticking up for our city?)

Trost, the BART spokesperson, said the agency hears frequently about gender-based violence and harassment on BART.

The agency in 2021 launched the Not One More Girl campaign to emphasize what to do if you're the victim of sketchy behavior or violence on BART — or if you witness it. (My favorite tip Trost shared for bystanders is ignoring the perpetrator and starting an unrelated conversation with the victim like pretending to know her or asking to sit with her.) Trost said surveys show women and girls felt safer riding transit just knowing the campaign existed.

"Sexual harassment is prevalent on all transit, and we're showing the model for the country," Trost said, noting BART is getting calls from agencies around the U.S. wanting to replicate the campaign.

She said partnering with Phingbodhipakkiya and the Asian Women's Shelter is a natural next chapter in the campaign. At first blush, it might seem counterintuitive to advertise the sexual harassment and violence that occurs on BART, but Trost said the agency and other public transit agencies ignored it for far too long.

"We think everybody already knows it's happening, and talking about it shows we care deeply about it," she told me. "It's better than doing nothing, which is what BART was doing for many years. We'd like to flip that script."

Reach Heather Knight: hknight@sfchronicle.com; Twitter: @hknightsf

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THE San Francisco Disability and Aging Services Commission and its Advisory Council will hold two public hearings to solicit comments and present information on the Area Plan 2023-24 Update. The hybrid in-person/virtual meetings will be held on Wednesday, March 15, 2023 at 10:00 am (1650 Mission Street, 5th Floor – Golden Gate Conference Room) and on Wednesday, April 5, 2023, at 9:30 am (City Hall, 1 Dr. Carlton Goodlett Place, Room 416). For information on how to participate, please contact Ravi Durbeej by phone at (415) 307-0609 or email at Ravi.Durbeej@sfgov.org.

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PUBLIC NOTICE

Hunters Point Naval Shipyard

Notice of Fifth Five-Year Review

NAVFAC

The Navy, as the lead agency, is currently conducting the Fifth Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Five-Year Review for Hunters Point Naval Shipyard (HPNS) in San Francisco, California. HPNS was a naval shipyard operating from 1939 to 1974. The Navy is conducting the Five-Year Review in accordance with the requirements of CERCLA Section 121 (c).

The purpose of this Fifth Five-Year Review is to determine whether the remedies implemented in accordance with the Final Records of Decision and Post-Record of Decision Documents for the following Sites remain protective of human health and the environment:

- Installation Restoration [IR] Sites 7 and 18
- Parcel B-1
- Parcel B-2
- Parcel C
- Parcel D-1
- Parcel D-2
- Parcel E
- Parcel E-2
- Parcel F (Final ROD pending)
- Parcel UC-1
- Parcel UC-2
- Parcel UC-3

The remedies were implemented to address chemicals of concern, including metals, volatile organic compounds, semi-volatile organic compounds, pesticides, polychlorinated biphenyls, and radionuclides in soil, sediment, soil gas, and/or groundwater that pose potentially unacceptable risk to human health and the environment. The remedies include soil removal, covers over surface soil and shoreline sediment, groundwater treatment and/or monitoring, soil vapor extraction and monitoring, and institutional controls. The review provides an update of the status of remedial actions implemented since the Fourth Five-Year Review completed in 2019 and assesses progress made on the recommendations in the Fourth Five-Year Review.

A draft of the Fifth Five-Year Review will be made available for public comment, instructions will be provided in a future public notice and on the HPNS public website. Following the public comment period, the Navy will issue a public notice when the Five-Year Review has been finalized, anticipated December 2023.

For information about the Five-Year Review or any environmental cleanup activities at HPNS please visit the HPNS Public Website https://go.usa.gov/xhqES or contact the following:

Brooks Pauly/Navy
Remedial Project Manager
33000 Nixie Way, Building 50
San Diego, CA 92147
(619) 524-5096
brooks.pauly2.civ@us.navy.mil

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Appendix E
Groundwater Monitoring Summary (DCNs: TRBW-0202-4996-0013; TRBW-0202-4996-0018; TRBW-0202-4996-0022)

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Table 5
Analytical Results Exceeding Project Action Limits
January through December 2019
Hunters Point Naval Shipyard, San Francisco, California

Well ID	Analyte	Project Action Limit (µg/L)	Active Treatment Criteria (µg/L)	1Q/2Q 2019 Result (µg/L)	3Q/4Q 2019 Result (µg/L)
IR Site 07/18					
No Exceedances in IR Site 07/18					
Parcel B-1					
IR10MW13A1	VINYL CHLORIDE	0.5	NA	--	3.1
IR10MW61A	VINYL CHLORIDE	0.5	NA	3.2	4.3
IR10MW63A	VINYL CHLORIDE	0.5	NA	--	1.4
IR10MW71A	VINYL CHLORIDE	0.5	NA	9	19
IR20MW17A	VINYL CHLORIDE	0.5	NA	1.2	0.96
Parcel B-2					
IR26MW49A	MERCURY	0.6	NA	1.01	3.45
Parcel C (RU-C1)					
IR28MW557A	1,1-DICHLOROETHANE	6.5	NA	14 J	13
IR28MW916A	1,1-DICHLOROETHANE	6.5	NA	--	17
IR28MW557A	1,2,4-TRIMETHYLBENZENE	25	NA	700	590
IR28MW934A	1,2,4-TRIMETHYLBENZENE	25	NA	70	--
IR28MW557A	1,2-DICHLOROETHENE (TOTAL)	210	2,100	16,000	14,000
IR28MW557A	1,3,5-TRIMETHYLBENZENE	19	NA	180 J	170
IR28MW934A	1,3,5-TRIMETHYLBENZENE	19	NA	21	--
IR28MW128A	BENZENE	0.5	5	--	1.9
IR28MW338A	BENZENE	0.5	5	0.67	--
IR28MW556A	BENZENE	0.5	5	0.74	--
IR28MW127A	BENZENE	0.5	5	0.51	--
IR28MW557A	BENZENE	0.5	5	19	17
IR28MW916A	BENZENE	0.5	5	--	1.9
IR28MW934A	BENZENE	0.5	5	3.8	3.4 J
IR28MW354A	CHLOROFORM	0.7	7	1.4	--
IR28MW557A	CIS-1,2-DICHLOROETHENE	210	NA	16,000	14,000
IR28MW557A	ISOPROPYLBENZENE	7.8	NA	36 J	30
IR28MW557A	NAPHTHALENE	3.6	NA	190 J	120
IR28MW934A	NAPHTHALENE	3.6	NA	12	15 J
IR28MW338A	TETRACHLOROETHENE	0.54	5.4	15	--
PA28MW52A	TETRACHLOROETHENE	0.54	5.4	2.5	--
IR28MW557A	TETRACHLOROETHENE	0.54	5.4	3.2	--
IR28MW354A	TRICHLOROETHENE	2.9	29	3.5	--
IR28MW557A	TRICHLOROETHENE	2.9	29	49 J	12
IR28MW338A	VINYL CHLORIDE	0.5	25	6.9	--
IR28MW354A	VINYL CHLORIDE	0.5	25	--	11
IR28MW556A	VINYL CHLORIDE	0.5	25	2.3	0.8
IR28MW475A	VINYL CHLORIDE	0.5	25	20	1.6
IR28MW557A	VINYL CHLORIDE	0.5	25	4,300	5,700
IR28MW916A	VINYL CHLORIDE	0.5	25	--	120
IR28MW931A	VINYL CHLORIDE	0.5	25	52	6.9
IR28MW934A	VINYL CHLORIDE	0.5	25	390	180
Parcel C (RU-C2)					
RUC2MW1A	1,2-DICHLOROETHENE (TOTAL)	210	2,100	630	--
IR28MW910A	1,4-DICHLOROBENZENE	2.1	21	3.9	6.7
IR58MW31A	1,4-DICHLOROBENZENE	2.1	21	9.1	5.7

DCN: TRBW-0202-4996-0013

Table 5
Analytical Results Exceeding Project Action Limits
January through December 2019
Hunters Point Naval Shipyard, San Francisco, California

Well ID	Analyte	Project Action Limit (µg/L)	Active Treatment Criteria (µg/L)	1Q/2Q 2019 Result (µg/L)	3Q/4Q 2019 Result (µg/L)
RUC2MW1A	1,4-DICHLOROBENZENE	2.1	21	25	8.8
RUC2MW13A	1,4-DICHLOROBENZENE	2.1	21	--	2.7
IR58MW31A	BENZENE	0.5	5	37	7.7
RUC2MW15B	BENZENE	0.5	5	0.74	0.7
RUC2MW1A	BENZENE	0.5	5	0.74	1
RUC2MW13A	CARBON TETRACHLORIDE	0.5	5	1.8	0.67
RUC2MW08B	CARBON TETRACHLORIDE	0.5	5	0.67	14
RUC2MW11A	CARBON TETRACHLORIDE	0.5	5	3.5	--
RUC2MW11B	CARBON TETRACHLORIDE	0.5	5	--	4.8
IR28MW190F	CARBON TETRACHLORIDE	0.5	5	42	--
IR58MW31A	CHLOROBENZENE	390	3,900	1,500	430
RUC2MW13A	CHLOROFORM	0.7	7	1.3	0.8
RUC2MW15B	CHLOROFORM	0.7	7	1.3	1.5
RUC2MW16B	CHLOROFORM	0.7	7	NS	8.3
RUC2MW2B	CHLOROFORM	0.7	7	0.84	0.99
RUC2MW08B	CHLOROFORM	0.7	7	19	18
RUC2MW09B	CHLOROFORM	0.7	7	--	1.5
RUC2MW11A	CHLOROFORM	0.7	7	1.1	--
RUC2MW11B	CHLOROFORM	0.7	7	--	1.3
IR28MW190F	CHLOROFORM	0.7	7	38	--
RUC2MW1A	CIS-1,2-DICHLOROETHENE	210	NA	600	--
RUC2MW13A	TETRACHLOROETHENE	0.54	5.4	0.55	--
RUC2MW15B	TETRACHLOROETHENE	0.54	5.4	110	70
RUC2MW16B	TETRACHLOROETHENE	0.54	5.4	NS	1.8
RUC2MW1A	TETRACHLOROETHENE	0.54	5.4	1.8	--
RUC2MW1B	TETRACHLOROETHENE	0.54	5.4	8.8	61
RUC2MW2B	TETRACHLOROETHENE	0.54	5.4	18	23
RUC2MW4B	TETRACHLOROETHENE	0.54	5.4	--	23
RUC2MW5B	TETRACHLOROETHENE	0.54	5.4	9.9	21
RUC2MW1B	TPH-TOTAL	20000	NA	24,400 C	32,000 C
RUC2MW4A	TPH-TOTAL	20000	NA	30,000 C	31,000 C
RUC2MW15B	TRICHLOROETHENE	2.9	29	10	36
RUC2MW1A	TRICHLOROETHENE	2.9	29	9	--
IR58MW31A	VINYL CHLORIDE	0.5	25	0.59	--
RUC2MW15B	VINYL CHLORIDE	0.5	25	5.1	36 J
RUC2MW1A	VINYL CHLORIDE	0.5	25	67	20
Parcel C (RU-C4)					
IR28MW407	1,2-DICHLOROETHANE	2.3	115	--	6
IR28MW407	1,4-DICHLOROBENZENE	2.1	21	--	4.3
IR28MW211F	BENZENE	0.5	5	0.58	0.8
IR28MW405	BENZENE	0.5	5	0.73	--
IR28MW407	BENZENE	0.5	5	--	2.2
IR28MW272F	CARBON TETRACHLORIDE	0.5	5	0.51	0.51
IR28MW276A	CARBON TETRACHLORIDE	0.5	5	1.3	2.3
IR28MW272A	CHLOROFORM	0.7	7	0.92	--
IR28MW272F	CHLOROFORM	0.7	7	0.99	0.94
IR28MW276A	CHLOROFORM	0.7	7	--	0.77

Table 5
Analytical Results Exceeding Project Action Limits
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Hunters Point Naval Shipyard, San Francisco, California

Well ID	Analyte	Project Action Limit (µg/L)	Active Treatment Criteria (µg/L)	1Q/2Q 2019 Result (µg/L)	3Q/4Q 2019 Result (µg/L)
IR28MW272A	TRICHLOROETHENE	2.9	29	13	--
IR28MW272F	TRICHLOROETHENE	2.9	29	180	120
IR28MW276A	TRICHLOROETHENE	2.9	29	5.9	4.4
IR28MW277A	TRICHLOROETHENE	2.9	29	5.2	--
IR28MW355F	TRICHLOROETHENE	2.9	29	4.5	--
IR28MW566A	TRICHLOROETHENE	2.9	29	3.2	--
IR28MW211F	VINYL CHLORIDE	0.5	25	3.7	11
IR28MW355F	VINYL CHLORIDE	0.5	25	--	1.7
IR28MW405	VINYL CHLORIDE	0.5	25	--	13
IR28MW407	VINYL CHLORIDE	0.5	25	--	86
IR28MW566A	VINYL CHLORIDE	0.5	25	--	0.8
Parcel C (RU-C5)					
IR06MW67A	1,1-DICHLOROETHANE	6.5	NA	25	12
IR06MW67A	1,2-DICHLOROETHENE (TOTAL)	210	2,100	1,200	--
IR25MW11A	1,4-DICHLOROBENZENE	2.1	21	8.2	8.9
IR25MW64A	1,4-DICHLOROBENZENE	2.1	21	12	17
IR25MW65B	1,4-DICHLOROBENZENE	5	21	10	19
IR25MW68A	1,4-DICHLOROBENZENE	2.1	21	--	2.9
IR06MW67A	BENZENE	0.5	5	2	2.6
IR25MW74A	BENZENE	0.5	5	9.2	5.2
IR25MW11A	BENZENE	0.5	5	1.2	0.73
IR25MW16A	BENZENE	0.5	5	--	1
IR25MW64A	BENZENE	0.5	5	13	21
IR25MW65B	BENZENE	1	5	54	57
IR25MW68A	BENZENE	0.5	5	--	0.96
IR25MW64A	CHLOROBENZENE	390	3,900	510	480
IR25MW65B	CHLOROBENZENE	70	3,900	3,600	1,800
IR06MW67A	CIS-1,2-DICHLOROETHENE	210	NA	1,200	--
IR06MW42A	NAPHTHALENE	4	NA	120	23
IR25MW65B	NAPHTHALENE	0.093	NA	24	44
IR06MW46A	TETRACHLOROETHENE	0.54	5.4	--	4.2
IR06MW67A	TETRACHLOROETHENE	0.54	5.4	15	9.5
IR25MW68A	TETRACHLOROETHENE	0.54	5.4	1.4	--
IR25MW72A	TETRACHLOROETHENE	0.54	5.4	0.84	--
IR06MW67A	TRICHLOROETHENE	2.9	29	200	12
IR06MW22A	VINYL CHLORIDE	0.5	25	2.1	5.1
IR06MW32A	VINYL CHLORIDE	0.5	25	0.95	2.4
IR06MW40A	VINYL CHLORIDE	0.5	25	1.3	2.2
IR06MW59A1	VINYL CHLORIDE	0.5	25	--	1.3
IR06MW67A	VINYL CHLORIDE	0.5	25	380	460
IR25MW16A	VINYL CHLORIDE	0.5	25	--	2.1
IR25MW64A	VINYL CHLORIDE	0.5	25	--	3.8
IR25MW68A	VINYL CHLORIDE	0.5	25	--	0.53
IR25MW74A	VINYL CHLORIDE	0.5	25	0.74	--
Parcel D-1					
No Exceedances in Parcel D-1					
Parcel E[(1)]					

DCN: TRBW-0202-4996-0013

Table 5
Analytical Results Exceeding Project Action Limits
January through December 2019
Hunters Point Naval Shipyard, San Francisco, California

Well ID	Analyte	Project Action Limit (µg/L)	Active Treatment Criteria (µg/L)	1Q/2Q 2019 Result (µg/L)	3Q/4Q 2019 Result (µg/L)
IR03MW218A2	NAPHTHALENE	63	NA	22	NS
IR03MW218A2	TPH-TOTAL	3216	NA	7,180	NS
IR03MW342A	TPH-TOTAL	4839	NA	6,400	NS
IR36MW237A	VINYL CHLORIDE	6.3	NA	45	NS
IR02MW373A	ZINC	81	NA	1,280	NS
Parcel E-2					
IR01MWI-9R	ARSENIC	10	NA	--	14.1
IR01MW38A	CYANIDE	10	NA	--	12.2
IR01MW62A	CYANIDE	10	NA	20	29.7
IR01MW63A	CYANIDE	10	NA	23	26.8
IR01MW60A	TPH-TOTAL	4839	NA	7,600 C	10,200 C
IR01MW64A	TPH-TOTAL	4839	NA	7,911 C	7,100 C
IR01MW66A	TPH-TOTAL	4,839	NA	--	5,400 C
IR01MWI-7R	TPH-TOTAL	1,467	NA	NS	3,200 C
IR01MWI-9R	TPH-TOTAL	2,092	NA	NS	3,000 C
IR01MW38A	UN-IONIZED AMMONIA(1)	25	NA	99 C	170 C
IR01MW48A	UN-IONIZED AMMONIA(1)	25	NA	63 C	491 C
IR01MW60A	UN-IONIZED AMMONIA(1)	25	NA	--	27 C
IR01MWI-9R	UN-IONIZED AMMONIA(1)	25	NA	NS	419 C
Parcel G					
IR33MW64A	CARBON TETRACHLORIDE	0.5	NA	1	--
IR33MW64A	CHLOROFORM	1	NA	8.1	--
IR71MW03A	TETRACHLOROETHENE	0.54	NA	1.3 J	1.8
Parcel UC-2					
IR06MW54F	CARBON TETRACHLORIDE	0.5	NA	4	1.6
IR06MW55F	CARBON TETRACHLORIDE	0.5	NA	0.84	--
IR06MW54F	CHLOROFORM	1	NA	1.6	1.2

Notes/Abbreviations:
(1) Parcel E is sampled annually during 1Q2Q 2019
Grey box = concentration exceeded both the Project Action Limit and the Active Treatment Criteria
-- = did not exceed the PAL during sampling event
µg/L = micrograms per liter
C = Calculated
J = estimated
NA = Active Treatment Criteria values are only used for Parcel C Remedial Action and are not applicable for other Parcels
NS = not sampled
IR = Installation Restoration
1Q2Q = first quarter/second quarter
3Q/4Q = third quarter/fourth quarter

Table 5
Analytical Results Exceeding Project Action Limits and Active Treatement Criteria
January through December 2020
Hunters Point Naval Shipyard, San Francisco, California

Well ID	Analyte	Project Action Limit (µg/L)	Active Treatment Criteria (µg/L)	1Q/2Q 2020 Result (µg/L)	3Q/4Q 2020 Result (µg/L)
IR Site 07/18					
No Exceedances in IR 07/18					
Parcel B-1					
IR10MW59A	VINYL CHLORIDE	0.5	NA	--	2.3
IR10MW61A	VINYL CHLORIDE	0.5	NA	3.9	4.4
IR10MW63A	VINYL CHLORIDE	0.5	NA	1.3	1.5
IR10MW71A	VINYL CHLORIDE	0.5	NA	16	21
IR20MW17A	VINYL CHLORIDE	0.5	NA	0.92	1.1
Parcel B-2					
IR26MW49A	MERCURY	0.6	NA	--	2.38
IR26MW71A	MERCURY	0.6	NA	1.72	1.47
PA50MW02A	MERCURY	0.6	NA	--	0.829
Parcel C (RU-C1)					
Plume C1-1					
IR28MW338A	TETRACHLOROETHENE	0.54	5.4	1	--
IR28MW338A	VINYL CHLORIDE	0.5	25	26	21
IR28MW556A	BENZENE	0.5	5	1.2	0.79
IR28MW556A	VINYL CHLORIDE	0.5	25	2.1	0.85
PA28MW50A	BENZENE	0.5	5	--	0.73
PA28MW50A	VINYL CHLORIDE	0.5	25	--	1.1
Plume C1-2					
PA28MW52A	TETRACHLOROETHENE	0.54	5.4	--	0.61
IR28MW127A	BENZENE	0.5	5	0.62	--
Plume C1-3					
IR28MW128A	BENZENE	0.5	5	1.4	2.2
IR28MW354A	TRICHLOROETHENE	2.9	29	3.1	3.3
IR28MW354A	VINYL CHLORIDE	0.5	25	4.1	2.5
IR28MW475A	BENZENE	0.5	5	0.79	--
IR28MW475A	VINYL CHLORIDE	0.5	25	21	3.2
IR28MW475A	ZINC	81	NA	155	--
IR28MW557A	1,1-DICHLOROETHANE	6.5	NA	14 J	11
IR28MW557A	1,2,4-TRIMETHYLBENZENE	25	NA	690	580
IR28MW557A	1,2-DICHLOROETHENE (TOTAL)	210	2100	13,000	11,000
IR28MW557A	1,3,5-TRIMETHYLBENZENE	19	NA	180	160
IR28MW557A	BENZENE	0.5	5	19 J	14
IR28MW557A	CIS-1,2-DICHLOROETHENE	210	NA	13,000	11,000
IR28MW557A	ISOPROPYLBENZENE	7.8	NA	35 J	27
IR28MW557A	NAPHTHALENE	3.6	NA	170	130
IR28MW557A	TETRACHLOROETHENE	0.54	5.4	0.62 J	--
IR28MW557A	TRICHLOROETHENE	2.9	29	21 J	10
IR28MW557A	VINYL CHLORIDE	0.5	25	6,400	4,600
IR28MW916A	1,1-DICHLOROETHANE	6.5	NA	11	12
IR28MW916A	BENZENE	0.5	5	1.3	1.3
IR28MW916A	VINYL CHLORIDE	0.5	25	42	0.75
IR28MW931A	BENZENE	0.5	5	--	0.52
IR28MW931A	VINYL CHLORIDE	0.5	25	3.4	6.5
IR28MW934A	BENZENE	0.5	5	1.7	2.1
IR28MW934A	VINYL CHLORIDE	0.5	25	89	54
IR28MW934A	HEXAVALENT CHROMIUM	50	50	202	--

Table 5
Analytical Results Exceeding Project Action Limits and Active Treatement Criteria
January through December 2020
Hunters Point Naval Shipyard, San Francisco, California

Well ID	Analyte	Project Action Limit (µg/L)	Active Treatment Criteria (µg/L)	1Q/2Q 2020 Result (µg/L)	3Q/4Q 2020 Result (µg/L)
Plume C1-4					
No Exceedances in Plume C1-4					
Parcel C (RU-C2)					
Plume C2-1					
IR28MW910A	TETRACHLOROETHENE	0.54	5.4	--	2.3
IR58MW31A	1,4-DICHLOROBENZENE	2.1	21	4.6	3.3
IR58MW31A	BENZENE	0.5	5	6.7	5.2
IR58MW31A	CHLOROBENZENE	390	3,900	480	--
RUC2MW15B	TETRACHLOROETHENE	0.54	5.4	9.3	--
RUC2MW15B	TRICHLOROETHENE	2.9	29	15	--
RUC2MW15B	VINYL CHLORIDE	0.5	25	0.61	--
RUC2MW16B	TETRACHLOROETHENE	0.54	5.4	0.87	--
RUC2MW1A	1,4-DICHLOROBENZENE	2.1	21	4.3	8.5
RUC2MW1A	BENZENE	0.5	5	1.1	2.9
RUC2MW1A	TRICHLOROETHENE	2.9	29	--	5.3
RUC2MW1A	VINYL CHLORIDE	0.5	25	3.6	7.2
RUC2MW1B	TETRACHLOROETHENE	0.54	5.4	56	--
RUC2MW2B	CHLOROFORM	0.7	7	0.94	--
RUC2MW2B	TETRACHLOROETHENE	0.54	5.4	21	--
RUC2MW4B	TETRACHLOROETHENE	0.54	5.4	8.6	--
RUC2MW5B	TETRACHLOROETHENE	0.54	5.4	20	--
Plume C2-2					
RUC2MW08A	TETRACHLOROETHENE	0.54	5.4	--	0.76
RUC2MW08B	CARBON TETRACHLORIDE	0.5	5	17	--
RUC2MW08B	CHLOROFORM	0.7	7	19	--
RUC2MW11A	CARBON TETRACHLORIDE	0.5	5	4.1	--
RUC2MW11A	CHLOROFORM	0.7	7	1.0	--
RUC2MW11A	TETRACHLOROETHENE	0.54	5.4	--	11
Plume C2-3					
IR28MW300F	BENZENE	0.5	5	0.51	0.86
IR28MW939F	BENZENE	0.5	5	1.0	0.76
IR28MW940F	CARBON TETRACHLORIDE	0.5	5	30	29 J
IR28MW940F	CHLOROFORM	0.7	7	9.1	12
IR28MW941F	1,4-DICHLOROBENZENE	2.1	21	11	13
IR28MW941F	BENZENE	0.5	5	3.1	3.8
IR28MW941F	CHLOROFORM	0.7	7	0.80	0.83
IR28MW941F	TRICHLOROETHENE	2.9	29	12	5.1
IR28MW941F	VINYL CHLORIDE	0.5	25	93	140
Parcel C (RU-C4)					
Plume C4-1					
IR28MW200A	TRICHLOROETHENE	2.9	29	--	6.0
IR28MW211F	BENZENE	0.5	5	0.87	1.2
IR28MW211F	VINYL CHLORIDE	0.5	25	10	13
IR28MW216F	TRICHLOROETHENE	2.9	29	--	3.6
IR28MW216F	VINYL CHLORIDE	0.5	25	--	0.62
IR28MW272F	CARBON TETRACHLORIDE	0.5	5	0.60	0.51
IR28MW272F	CHLOROFORM	0.7	7	1.0	1.0
IR28MW272F	TRICHLOROETHENE	2.9	29	150	78
IR28MW276A	TRICHLOROETHENE	2.9	29	6.3	7.3

Table 5
Analytical Results Exceeding Project Action Limits and Active Treatement Criteria
January through December 2020
Hunters Point Naval Shipyard, San Francisco, California

Well ID	Analyte	Project Action Limit (µg/L)	Active Treatment Criteria (µg/L)	1Q/2Q 2020 Result (µg/L)	3Q/4Q 2020 Result (µg/L)
IR28MW405	TRICHLOROETHENE	2.9	29	9.7	3.1
IR28MW405	VINYL CHLORIDE	0.5	25	--	15
IR28MW407	1,2-DICHLOROETHANE	2.3	115	6.7	4.6
IR28MW407	1,4-DICHLOROBENZENE	2.1	21	3.9	4.7
IR28MW407	BENZENE	0.5	5	1.7	2.9
IR28MW407	VINYL CHLORIDE	0.5	25	67	72
IR28MW566A	VINYL CHLORIDE	0.5	25	0.58	1.1
Parcel C (RU-C5)					
Plume C5-1					
IR06MW22A	VINYL CHLORIDE	0.5	25	0.96	18
IR06MW32A	VINYL CHLORIDE	0.5	25	4.1	2.0
IR06MW40A	VINYL CHLORIDE	0.5	25	1.6	1.4
IR06MW59A1	BENZENE	0.5	5	1.6	1.3
IR06MW59A1	TETRACHLOROETHENE	0.54	5.4	1.2	0.90
IR06MW59A1	TRICHLOROETHENE	2.9	29	8.8	5.6
IR06MW59A1	VINYL CHLORIDE	0.5	25	29	20
IR06MW67A	1,1-DICHLOROETHANE	6.5	NA	22	23
IR06MW67A	1,2-DICHLOROETHENE (TOTAL)	210	NA	320	--
IR06MW67A	BENZENE	0.5	5	3.1	3.7
IR06MW67A	CIS-1,2-DICHLOROETHENE	210	NA	320	--
IR06MW67A	TETRACHLOROETHENE	0.54	5.4	13	15
IR06MW67A	TRICHLOROETHENE	2.9	29	69	33
IR06MW67A	VINYL CHLORIDE	0.5	25	520	670
Plume C5-2					
No Exceedances in Plume C5-2					
Plume C5-3					
IR06MW42A	NAPHTHALENE	3.6	NA	7.4	120
Plume C5-4					
IR25MW16A	BENZENE	0.5	5	2.8	2.8
IR25MW16A	VINYL CHLORIDE	0.5	25	1.2	0.52
IR25MW73A	VINYL CHLORIDE	0.5	25	0.61	0.75
IR25MW74A	BENZENE	0.5	5	4.4	4.7
Plume C5-5					
IR25MW11A	1,4-DICHLOROBENZENE	2.1	21	7.5	8.3
IR25MW11A	BENZENE	0.5	5	--	0.62
IR25MW64A	1,4-DICHLOROBENZENE	2.1	21	23	28
IR25MW64A	BENZENE	0.5	5	20	64
IR25MW64A	CHLOROBENZENE	390	3,900	770	1,700
IR25MW64A	VINYL CHLORIDE	0.5	25	2.6	2.1
IR25MW65B	1,4-DICHLOROBENZENE	5	21	15	18
IR25MW65B	BENZENE	1	5	62	80
IR25MW65B	CHLOROBENZENE	70	3,900	4,000	4,200
IR25MW65B	IRON	10,950	NA	--	12,300
IR25MW65B	NAPHTHALENE	0.093	NA	35	36
IR25MW68A	1,4-DICHLOROBENZENE	2.1	21	4.7	3.9
IR25MW68A	BENZENE	0.5	5	1.9	0.51
IR25MW68A	VINYL CHLORIDE	0.5	25	1.2	--
IR25MW72A	1,4-DICHLOROBENZENE	2.1	21	--	3.4
IR25MW72A	TETRACHLOROETHENE	0.54	5.4	--	0.61

Table 5
Analytical Results Exceeding Project Action Limits and Active Treatement Criteria
January through December 2020
Hunters Point Naval Shipyard, San Francisco, California

Well ID	Analyte	Project Action Limit (µg/L)	Active Treatment Criteria (µg/L)	1Q/2Q 2020 Result (µg/L)	3Q/4Q 2020 Result (µg/L)
Parcel D-1					
No Exceedances in Parcel D-1					
Parcel E					
IR02MW373A	NICKEL	96.5	NA	287	--
IR02MW373A	ZINC	81	NA	1,950	--
IR03MW218A2	NAPHTHALENE	63	NA	47 J	--
IR03MW218A2	TPH-TOTAL	3,216	NA	24,510 C	--
IR03MW342A	TPH-TOTAL	4,839	NA	9,000 C	--
IR36MW237A	VINYL CHLORIDE	6.3	NA	70	--
Parcel E-2					
IR01MW31A	UN-IONIZED AMMONIA(1)	25	NA	62 C	48 C
IR01MW38A	CYANIDE	10	NA	16.6	15.2
IR01MW38A	UN-IONIZED AMMONIA(1)	25	NA	154 C	172 C
IR01MW48A	CYANIDE	10	NA	14.1	11.7
IR01MW48A	UN-IONIZED AMMONIA(1)	25	NA	134 C	201 C
IR01MW60A	CYANIDE	10	NA	15.4	--
IR01MW60A	TPH-TOTAL	4,839	NA	8,330 C	11,232 C
IR01MW60A	UN-IONIZED AMMONIA(1)	25	NA	29 C	26 C
IR01MW62A	CYANIDE	10	NA	17.8	28.0
IR01MW62A	ZINC	81	NA	88.3	--
IR01MW63A	CYANIDE	10	NA	21.5	18.1
IR01MW64A	TPH-TOTAL	4,839	NA	--	6,393 C
IR01MWI-9R	ARSENIC	10	NA	--	13.2 J
IR01MWI-9R	CYANIDE	10	NA	10.4	12.4
IR01MWI-9R	TPH-TOTAL	2,092	NA	3,500 C	3,300 C
IR01MWI-9R	UN-IONIZED AMMONIA(1)	25	NA	527 C	610 C
Parcel G					
IR33MW64A	CHLOROFORM	1	NA	--	1.3
IR71MW03A	TETRACHLOROETHENE	0.5	NA	1.7	1.1
Parcel UC-2					
IR06MW54FR	CARBON TETRACHLORIDE	0.5	NA	1.8	1.3
IR06MW54FR	CHLOROFORM	1	NA	1.3	1.4

Abbreviations:
µg/L = micrograms per liter
C= Calculated
NA = Active Treatment Criteria values are only used for Parcel C remedial action and are not applicable for other Parcels at Hunters Point Naval Shipyard
J= estimated
IR= Installation Restoration
Grey box = concentration exceeded both the Project Action Limit and the Active Treatement Criteria

Table 5
Analytical Results Exceeding Project Action Limits and Active Treatement Criteria
January through December 2021
Hunters Point Naval Shipyard, San Francisco, California

Well ID	Analyte	Project Action Limit (µg/L)	Active Treatment Criteria (µg/L)	1Q/2Q 2021 Result (µg/L)	3Q/4Q 2021 Result (µg/L)
IR Site 07/18					
No Exceedances in IR 07/18					
Parcel B-1					
IR10MW13A	VINYL CHLORIDE	0.5	NA	--	1.3
IR10MW59A	VINYL CHLORIDE	0.5	NA	--	2.1
IR10MW61A	VINYL CHLORIDE	0.5	NA	3.4	3.3
IR10MW63A	VINYL CHLORIDE	0.5	NA	--	1.2
IR10MW71A	TRICHLOROETHENE	2.9	NA	3.2	--
IR10MW71A	VINYL CHLORIDE	0.5	NA	17	17
IR20MW17A	VINYL CHLORIDE	0.5	NA	1.1	1.3
Parcel B-2					
IR26MW41A	DICHLORODIFLUOROMETHANE	14	NA	--	21
IR26MW49A	MERCURY	0.6	NA	--	3.57
IR26MW71A	MERCURY	0.6	NA	1.26	5
Parcel C (RU-C1)					
Plume C1-1					
IR28MW338A	TETRACHLOROETHENE	0.54	5.4	13	--
IR28MW338A	TRICHLOROETHENE	2.90	29	8.3	--
IR28MW338A	VINYL CHLORIDE	0.5	25	13	31
IR28MW556A	BENZENE	0.5	5	1.2	1.7
IR28MW556A	VINYL CHLORIDE	0.5	25	1.7	2.2
PA28MW50A	BENZENE	0.5	5	0.88	0.66
PA28MW50A	VINYL CHLORIDE	0.5	25	1	0.67
RUC11MW01A	BENZENE	0.5	5	--	0.64
RUC11MW01A	VINYL CHLORIDE	0.5	25	--	4.3
Plume C1-2					
PA28MW52A	TETRACHLOROETHENE	0.54	5.4	3.4	--
Plume C1-3					
IR28MW128A	BENZENE	0.5	5	--	2.2
IR28MW128A	TRICHLOROETHENE	2.90	29	3.9	--
IR28MW354A	TRICHLOROETHENE	2.9	29	11	--
IR28MW354A	VINYL CHLORIDE	0.5	25	1.5	4.1
IR28MW475A	VINYL CHLORIDE	0.5	25	44	7
IR28MW557A	1,1,2,2-TETRACHLOROETHANE	3	NA	--	3 J
IR28MW557A	1,1-DICHLOROETHANE	6.5	NA	9.5	11 J
IR28MW557A	1,2,4-TRIMETHYLBENZENE	25	NA	560	850
IR28MW557A	1,2-DICHLOROETHENE (TOTAL)	210	2,100	6,500	8,900
IR28MW557A	1,3,5-TRIMETHYLBENZENE	19	NA	160	--
IR28MW557A	BENZENE	0.5	5	10	12 J
IR28MW557A	CARBON TETRACHLORIDE	0.5	5	--	11 J
IR28MW557A	CIS-1,2-DICHLOROETHENE	210	NA	6,500	8,800
IR28MW557A	ISOPROPYLBENZENE	7.8	NA	20	25 J
IR28MW557A	NAPHTHALENE	3.6	NA	84 J	130
IR28MW557A	TRICHLOROETHENE	2.9	29	5.2	5.5 J
IR28MW557A	VINYL CHLORIDE	0.5	25	6,300	7,300

Table 5
Analytical Results Exceeding Project Action Limits and Active Treatement Criteria
January through December 2021
Hunters Point Naval Shipyard, San Francisco, California

Well ID	Analyte	Project Action Limit (µg/L)	Active Treatment Criteria (µg/L)	1Q/2Q 2021 Result (µg/L)	3Q/4Q 2021 Result (µg/L)
Plume C1-3 continued					
IR28MW916A	1,1-DICHLOROETHANE	6.5	NA	11	20
IR28MW916A	BENZENE	0.5	5	1.2	1.7
IR28MW916A	CARBON TETRACHLORIDE	0.5	5	--	20
IR28MW916A	TRICHLOROETHENE	2.9	29	28	--
IR28MW916A	VINYL CHLORIDE	0.5	25	110	0.91
IR28MW931A	BENZENE	0.5	5	--	0.57
IR28MW931A	VINYL CHLORIDE	0.5	25	1.5	14
IR28MW934A	BENZENE	0.5	5	1.7	1.6 J
IR28MW934A	VINYL CHLORIDE	0.5	25	45	40 J
Plume C1-4					
No Exceedances in Plume C1-4					
Parcel C (RU-C2)					
Plume C2-1					
IR28MW910A	TETRACHLOROETHENE	0.54	5.4	--	1.4
IR58MW31A	1,4-DICHLOROBENZENE	2.1	21	4.3	--
IR58MW31A	BENZENE	0.5	5	15	3.3
IR58MW31A	CHLOROBENZENE	390	3,900	1,000	--
RUC2MW1A	1,4-DICHLOROBENZENE	2.1	21	--	5.9
RUC2MW1A	BENZENE	0.5	5	--	2.4
RUC2MW1A	VINYL CHLORIDE	0.5	25	0.84	28
Plume C2-2					
RUC2MW11A	TETRACHLOROETHENE	0.54	5.4	1.1	2
Plume C2-3					
IR28MW300F	BENZENE	0.5	5	0.57	0.68
IR28MW565A	VINYL CHLORIDE	0.5	25	--	1.8
IR28MW939F	BENZENE	0.5	5	0.82	1.1
IR28MW940F	CARBON TETRACHLORIDE	0.5	5	26	40
IR28MW940F	CHLOROFORM	0.7	7	8.8	13
IR28MW941F	1,4-DICHLOROBENZENE	2.1	21	13	17
IR28MW941F	BENZENE	0.5	5	3.2	3.4
IR28MW941F	TRICHLOROETHENE	2.9	29	9.6	14
IR28MW941F	VINYL CHLORIDE	0.5	25	51	50
Parcel C (RU-C4)					
Plume C4-1					
IR28MW200A	TRICHLOROETHENE	2.9	29	6.6	5.5
IR28MW211F	BENZENE	0.5	5	0.91	NS(2)
IR28MW211F	VINYL CHLORIDE	0.5	25	9.7	NS(2)
IR28MW276A	TRICHLOROETHENE	2.9	29	8.8	NS(2)
IR28MW405	TRICHLOROETHENE	2.9	29	12	NS(2)
IR28MW407	1,4-DICHLOROBENZENE	2.1	21	3	NS(2)
IR28MW407	VINYL CHLORIDE	0.5	25	0.93	NS(2)
IR28MW566A	TRICHLOROETHENE	2.9	29	6.1	--
IR28MW566A	VINYL CHLORIDE	0.5	25	2.60	2

Table 5
Analytical Results Exceeding Project Action Limits and Active Treatement Criteria
January through December 2021
Hunters Point Naval Shipyard, San Francisco, California

Well ID	Analyte	Project Action Limit (µg/L)	Active Treatment Criteria (µg/L)	1Q/2Q 2021 Result (µg/L)	3Q/4Q 2021 Result (µg/L)
Parcel C (RU-C5)					
Plume C5-1					
IR06MW22A	VINYL CHLORIDE	0.5	25	2.1	13
IR06MW32A	VINYL CHLORIDE	0.5	25	3.1	--
IR06MW40A	VINYL CHLORIDE	0.5	25	1.1	2 J
IR06MW46A	TETRACHLOROETHENE	0.54	5.4	3.2	2.9
IR06MW59A1	BENZENE	0.5	5	--	1.2
IR06MW59A1	TETRACHLOROETHENE	0.54	5.4	--	1.2
IR06MW59A1	TRICHLOROETHENE	2.9	29	--	10
IR06MW59A1	VINYL CHLORIDE	0.5	25	--	32
IR06MW67A	1,1-DICHLOROETHANE	6.5	NA	34	32
IR06MW67A	1,2-DICHLOROETHENE (TOTAL)	210	NA	1,500	780
IR06MW67A	BENZENE	0.5	5	3	3.2
IR06MW67A	CIS-1,2-DICHLOROETHENE	210	NA	1,500	780
IR06MW67A	TETRACHLOROETHENE	0.54	5.4	37	13
IR06MW67A	TRICHLOROETHENE	2.9	29	350	92
IR06MW67A	VINYL CHLORIDE	0.5	25	1,100	810
Plume C5-2					
No Exceedances in Plume C5-2					
Plume C5-3					
IR06MW42A	NAPHTHALENE	3.6	NA	17	49
Plume C5-4					
IR25MW16A	BENZENE	0.5	5	1.4	1.1
IR25MW16A	VINYL CHLORIDE	0.5	25	--	0.82
IR25MW73A	VINYL CHLORIDE	0.5	25	0.69	0.60
IR25MW74A	BENZENE	0.5	5	9.4	8.7
IR25MW74A	VINYL CHLORIDE	0.5	25	--	0.83
Plume C5-5					
IR25MW11A	1,4-DICHLOROBENZENE	2.1	21	8.7	NS(2)
IR25MW11A	BENZENE	0.5	5	0.72	NS(2)
IR25MW64A	1,4-DICHLOROBENZENE	2.1	21	13	NS(2)
IR25MW64A	BENZENE	0.5	5	15	NS(2)
IR25MW64A	CHLOROBENZENE	390	3,900	690	NS(2)
IR25MW64A	VINYL CHLORIDE	0.5	25	0.75	NS(2)
IR25MW65B	1,4-DICHLOROBENZENE	5	21	23 J	NS(2)
IR25MW65B	BENZENE	1	5	73	NS(2)
IR25MW65B	CHLOROBENZENE	70	3,900	5,100	NS(2)
IR25MW65B	NAPHTHALENE	0.093	NA	50 J	NS(2)
IR25MW65B	IRON	10,950	NA	12,800	NS(2)
IR25MW68A	1,4-DICHLOROBENZENE	2.1	21	5	NS(2)
IR25MW68A	BENZENE	0.5	5	0.71	NS(2)
IR25MW72A	1,4-DICHLOROBENZENE	2.1	21	3.2	--
IR25MW72A	BENZENE	0.5	5	4.3	--
IR25MW72A	CHLOROFORM	0.7	7	--	0.84
IR25MW72A	TETRACHLOROETHENE	0.54	5.4	1.5	1.7
IR25MW72A	VINYL CHLORIDE	0.5	25	0.68	--

Table 5
Analytical Results Exceeding Project Action Limits and Active Treatement Criteria
January through December 2021
Hunters Point Naval Shipyard, San Francisco, California

Well ID	Analyte	Project Action Limit (µg/L)	Active Treatment Criteria (µg/L)	1Q/2Q 2021 Result (µg/L)	3Q/4Q 2021 Result (µg/L)
Parcel D-1					
No Exceedances in Parcel D-1					
Parcel E					
IR02MW373A	NICKEL	96.5	NA	158	--
IR02MW373A	ZINC	81	NA	776	--
Parcel E-2					
IR01MW38A	UN-IONIZED AMMONIA(1)	25	NA	91 C	170 C
IR01MW38A	CYANIDE	10	NA	--	12.1
IR01MW48A	TPH-TOTAL	25	NA	--	4,900 C
IR01MW48A	UN-IONIZED AMMONIA(1)	25	NA	158 C	--
IR01MW60A	TPH-TOTAL	25	NA	--	10,900 C
IR01MW60A	UN-IONIZED AMMONIA(1)	25	NA	--	28 C
IR01MW62A	CYANIDE	10	NA	35.3	39.7
IR01MW64A	TPH-TOTAL	25	NA	--	10,500 C
IR01MW66A	TPH-TOTAL	25	NA	--	5,100 C
IR01MWI-9R	ARSENIC	10	NA	13.1	12.7
IR01MWI-9R	TPH-TOTAL	2,092	NA	2,900 C	3,500 C
IR01MWI-9R	UN-IONIZED AMMONIA(1)	25	NA	152 C	460 C
IR01MWLF2A	ARSENIC	10	NA	10.8	--
Parcel G					
No Exceedances in Parcel G					
Parcel UC-2					
IR06MW54FR	CARBON TETRACHLORIDE	0.5	NA	2.7	1.7
IR06MW54FR	CHLOROFORM	1	NA	1.2	1.4

Abbreviations:
-- = did no exceed project action limit
BGMP = Basewide Groundwater Monitoring Program
µg/L = micrograms per liter
C= Calculated
NA = Active Treatment Criteria values are only used for Parcel C remedial action and are not applicable for other Parcels at Hunters Point Naval Shipyard
NS = not sampled
J= estimated
IR= Installation Restoration
Grey box = concentration exceeded both the Project Action Limit and the Active Treatement Criteria
(1) = Un-ionized ammonia is a calculated amount using pH, temperature, and ammonia.
(2) = Monitoring well not sampled by the BGMP in September 2021 but was sampled by the remedial action contractor in accordance with the Revised Final Phase II Remedial Action Work Plan (ICI 2020c). The data can be found in a seperate summary report.

Table 5
2022 Groundwater Analytical Results
Exceeding Project Action Limits and Active Treatement Criteria
Hunters Point Naval Shipyard, San Francisco, California

Well ID	Analyte	Project Action Limit (µg/L)	Active Treatment Criteria (µg/L)	March 2022 Result (µg/L)	June 2022 Result (µg/L)	September 2022 Result (µg/L)	December 2022 Result (µg/L)
IR Site 07/18							
IR07MW24A	LEAD	14.44	NA	23	NS	--	NS
IR07MW26A	LEAD	14.44	NA	23.9	NS	--	NS
Parcel B-1							
IR10MW59A	VINYL CHLORIDE	0.5	NA	0.60	NS	0.92	NS
IR10MW61A	VINYL CHLORIDE	0.5	NA	0.71	NS	3	NS
IR10MW63A	VINYL CHLORIDE	0.5	NA	--	NS	1.2	NS
IR10MW71A	VINYL CHLORIDE	0.5	NA	9.0	NS	16.0	NS
IR10MW17A	VINYL CHLORIDE	0.5	NA	--	NS	0.87	NS
Parcel B-2							
IR26MW70A	LEAD	14.44	NA	17.7	NS	--	NS
IR26MW49A	MERCURY	0.6	NA	1.79	NS	5.6	NS
IR26MW71A	MERCURY	0.6	NA	1.18	NS	1.75	NS
Parcel C (RU-C1)							
IR28MW557A	1,1-DICHLOROETHANE	6.5	NA	8.7 J	NS	7.6	NS
IR28MW916A	1,1-DICHLOROETHANE	6.5	NA	15	NS	16	NS
IR28MW557A	1,2,4-TRIMETHYLBENZENE	25	NA	560	NS	590	NS
IR28MW557A	1,2-DICHLOROETHENE (TOTAL)	210	2,100	6,000	NS	3,200	NS
IR28MW557A	1,3,5-TRIMETHYLBENZENE	19	NA	170	NS	190	NS
PA28MW50A	BENZENE	0.5	5	0.84	NS	0.8	NS
RUC11MW01A	BENZENE	0.5	5	0.61	NS	0.71	NS
IR28MW127A	BENZENE	0.5	5	0.55	NS	--	NS
IR28MW128A	BENZENE	0.5	5	0.9	NS	4.9	NS
IR28MW475A	BENZENE	0.5	5	0.57	NS	0.55	NS
IR28MW557A	BENZENE	0.5	5	12 J	NS	11	NS
IR28MW556A	BENZENE	0.5	5	--	NS	2	NS
IR28MW916A	BENZENE	0.5	5	1.4	NS	1.4	NS
IR28MW931A	BENZENE	0.5	5	--	NS	0.54	NS
IR28MW934A	BENZENE	0.5	5	2.5 J	NS	0.7	NS
IR28MW557A	CIS-1,2-DICHLOROETHENE	210	NA	6,000	NS	3,100	NS
IR28MW934A	HEXAVALENT CHROMIUM	50	NA	67.5	NS	--	NS
IR28MW557A	ISOPROPYLBENZENE	7.8	NA	30 J	NS	31	NS
IR28MW557A	NAPHTHALENE	3.6	NA	120	NS	110	NS
IR28MW338A	TETRACHLOROETHENE	0.54	5.4	16	NS	--	NS
IR28MW338A	TRICHLOROETHENE	2.9	29	12	NS	--	NS
IR28MW128A	TRICHLOROETHENE	2.9	29	3.9	NS	--	NS
IR28MW354A	TRICHLOROETHENE	2.9	29	14	NS	10	NS
IR28MW557A	TRICHLOROETHENE	2.9	29	11 J	NS	5.3	NS
IR28MW916A	TRICHLOROETHENE	2.9	29	7.6	NS	--	NS
IR28MW338A	VINYL CHLORIDE	0.5	25	8.8	NS	12	NS
IR28MW556A	VINYL CHLORIDE	0.5	25	--	NS	1.1	NS
PA28MW50A	VINYL CHLORIDE	0.5	25	1.2	NS	1.9	NS
RUC11MW01A	VINYL CHLORIDE	0.5	25	5.3	NS	2.2	NS

Table 5
2022 Groundwater Analytical Results
Exceeding Project Action Limits and Active Treatement Criteria
Hunters Point Naval Shipyard, San Francisco, California

Well ID	Analyte	Project Action Limit (µg/L)	Active Treatment Criteria (µg/L)	March 2022 Result (µg/L)	June 2022 Result (µg/L)	September 2022 Result (µg/L)	December 2022 Result (µg/L)
IR28MW354A	VINYL CHLORIDE	0.5	25	--	NS	1.5	NS
IR28MW475A	VINYL CHLORIDE	0.5	25	35	NS	1.1	NS
IR28MW557A	VINYL CHLORIDE	0.5	25	4,200	NS	4,700	NS
IR28MW916A	VINYL CHLORIDE	0.5	25	110	NS	36	NS
IR28MW931A	VINYL CHLORIDE	0.5	25	21	NS	19	NS
IR28MW934A	VINYL CHLORIDE	0.5	25	12 J	NS	40	NS
Parcel C (RU-C2)							
IR28MW910A	1,4-DICHLOROBENZENE	2.1	21	3.1	NS	2.2	NS
IR58MW31A	1,4-DICHLOROBENZENE	2.1	21	4.9	NS	--	NS
RUC2MW1A	1,4-DICHLOROBENZENE	2.1	21	0.53 J	NS	6.1	NS
IR28MW941F	1,4-DICHLOROBENZENE	2.1	21	19	NS	18	NS
IR58MW31A	BENZENE	0.5	5	20	NS	3.8	NS
RUC2MW1A	BENZENE	0.5	5	--	NS	2.8	NS
IR28MW300F	BENZENE	0.5	5	--	NS	0.55	NS
IR28MW910A	BENZENE	0.5	5	7	NS	--	NS
IR28MW939F	BENZENE	0.5	5	--	NS	0.67	NS
IR28MW941F	BENZENE	0.5	5	3.2	NS	3	NS
IR28MW940F	CARBON TETRACHLORIDE	0.5	5	31	NS	35	NS
IR58MW31A	CHLOROBENZENE	390	3900	1,000	NS	--	NS
IR28MW939F	CHLOROFORM	0.7	7	0.77	NS	--	NS
IR28MW940F	CHLOROFORM	0.7	7	9.7	NS	10	NS
RUC2MW11A	TETRACHLOROETHENE	0.54	5.4	0.75	NS	1.4	NS
IR28MW939F	TRICHLOROETHENE	2.9	29	4.6	NS	4.2	NS
IR28MW941F	TRICHLOROETHENE	2.9	29	28	NS	21	NS
RUC2MW1A	VINYL CHLORIDE	0.5	25	0.55	NS	23	NS
IR28MW941F	VINYL CHLORIDE	0.5	25	49	NS	77	NS
Parcel C (RU-C4)							
RUC4MW004A	1,2-DICHLOROETHENE (TOTAL)	210	NA	NS	NS	210	--
RUC4MW005A	1,2-DICHLOROETHENE (TOTAL)	210	NA	NS	NS	43,000	22,100
RUC4MW006A	1,2-DICHLOROETHENE (TOTAL)	210	NA	NS	NS	--	760
IR28MW407	1,4-DICHLOROBENZENE	2.1	21	NS	NS	5.2	15
IR28MW211F	BENZENE	0.5	5	NS	NS	1.1	--
IR28MW407	BENZENE	0.5	5	NS	NS	0.84	1.6
RUC4MW005A	BENZENE	0.5	5	NS	NS	0.71	--
RUC4MW006A	BENZENE	0.5	5	NS	NS	1	2
RUC4MW007A	BENZENE	0.5	5	NS	NS	0.81	--
RUC4MW002A	CHLOROFORM	0.7	7	NS	NS	0.75	--
RUC4MW004A	CIS-1,2-DICHLOROETHENE	210	NA	NS	NS	210	--
RUC4MW005A	CIS-1,2-DICHLOROETHENE	210	NA	NS	NS	43,000	22,000
RUC4MW006A	CIS-1,2-DICHLOROETHENE	210	NA	NS	NS	--	750
IR28MW200A	TRICHLOROETHENE	2.9	29	11	NS	9.1	NS
IR28MW216F	TRICHLOROETHENE	2.9	29	NS	NS	4.2	--

Table 5
2022 Groundwater Analytical Results
Exceeding Project Action Limits and Active Treatement Criteria
Hunters Point Naval Shipyard, San Francisco, California

Well ID	Analyte	Project Action Limit (µg/L)	Active Treatment Criteria (µg/L)	March 2022 Result (µg/L)	June 2022 Result (µg/L)	September 2022 Result (µg/L)	December 2022 Result (µg/L)
IR28MW566A	TRICHLOROETHENE	2.9	29	7.7	NS	--	NS
RUC4MW002A	TRICHLOROETHENE	2.9	29	NS	NS	46	43
RUC4MW004A	TRICHLOROETHENE	2.9	29	NS	NS	14	16
RUC4MW005A	TRICHLOROETHENE	2.9	29	NS	NS	320	2,600
RUC4MW006A	TRICHLOROETHENE	2.9	29	NS	NS	--	100
IR28MW211F	VINYL CHLORIDE	0.5	25	NS	NS	1.9	--
IR28MW216F	VINYL CHLORIDE	0.5	25	NS	NS	0.53	--
IR28MW405	VINYL CHLORIDE	0.5	25	NS	NS	8.5	NS
IR28MW407	VINYL CHLORIDE	0.5	25	NS	NS	2.6	4.3
IR28MW566A	VINYL CHLORIDE	0.5	25	0.53	NS	1.2	NS
RUC4MW001A	VINYL CHLORIDE	0.5	25	NS	NS	4.7	2.5
RUC4MW003A	VINYL CHLORIDE	0.5	25	NS	NS	0.62	--
RUC4MW004A	VINYL CHLORIDE	0.5	25	NS	NS	35	--
RUC4MW005A	VINYL CHLORIDE	0.5	25	NS	NS	9,800	2,800
RUC4MW006A	VINYL CHLORIDE	0.5	25	NS	NS	17	120
RUC4MW007A	VINYL CHLORIDE	0.5	25	NS	NS	2.3	--
Parcel C (RU-C5)							
IR25MW65B	IRON	10,950	NA	NS	13,100	12,600	NS
IR06MW67A	1,1-DICHLOROETHANE	6.5	NA	33	NS	32	NS
IR25MW65B	1,2-DICHLOROETHANE	0.5	NA	NS	--	2.7	NS
IR06MW67A	1,2-DICHLOROETHENE (TOTAL)	210	NA	2,400	NS	2,300	NS
IR25MW11A	1,4-DICHLOROBENZENE	2.1	21	NS	6.4	6.7	NS
IR25MW64A	1,4-DICHLOROBENZENE	2.1	21	NS	7.9 J	16	NS
IR25MW65B	1,4-DICHLOROBENZENE	2.1	21	NS	6.5	9.3	NS
IR25MW68A	1,4-DICHLOROBENZENE	2.1	21	NS	3.8	3.5	NS
IR25MW69A	1,4-DICHLOROBENZENE	2.1	21	NS	40	53	NS
IR06MW59A1	BENZENE	0.5	5	--	NS	0.82	NS
IR06MW67A	BENZENE	0.5	5	2.1	NS	2.7	NS
IR25MW16A	BENZENE	0.5	5	--	NS	2.2	NS
IR25MW74A	BENZENE	0.5	5	15	NS	6.5	NS
IR25MW11A	BENZENE	0.5	5	NS	0.58	0.56	NS
IR25MW64A	BENZENE	0.5	5	NS	11 J	30	NS
IR25MW65B	BENZENE	1	5	NS	58	96	NS
IR25MW69A	BENZENE	0.5	5	NS	12.0	18	NS
IR06MW67A	CIS-1,2-DICHLOROETHENE	210	NA	2,400	NS	2,300	NS
IR25MW64A	CHLOROBENZENE	390	3,900	NS	420	1,500	NS
IR25MW65B	CHLOROBENZENE	70	3,900	NS	3,200	4,200	NS
IR25MW69A	CHLOROBENZENE	390	3,900	NS	650	1,000	NS
IR06MW42A	NAPHTHALENE	3.6	NA	23	NS	34	NS
IR25MW64A	NAPHTHALENE	3.6	NA	NS	--	4.2	NS
IR25MW65B	NAPHTHALENE	0.093	NA	NS	17	24	NS

Table 5
2022 Groundwater Analytical Results
Exceeding Project Action Limits and Active Treatement Criteria
Hunters Point Naval Shipyard, San Francisco, California

Well ID	Analyte	Project Action Limit (µg/L)	Active Treatment Criteria (µg/L)	March 2022 Result (µg/L)	June 2022 Result (µg/L)	September 2022 Result (µg/L)	December 2022 Result (µg/L)
IR06MW46A	TETRACHLOROETHENE	0.54	5.4	3.8	NS	4.5	NS
IR06MW59A1	TETRACHLOROETHENE	0.54	5.4	0.66	NS	0.87	NS
IR06MW67A	TETRACHLOROETHENE	0.54	5.4	16	NS	12	NS
IR25MW64A	TETRACHLOROETHENE	0.54	5.4	NS	4.9 J	2.7	NS
IR25MW69A	TETRACHLOROETHENE	0.54	5.4	NS	22	31	NS
IR25MW72A	TETRACHLOROETHENE	0.54	5.4	0.62	NS	0.61	NS
IR06MW59A1	TRICHLOROETHENE	2.9	29	3.3	NS	3.1	NS
IR06MW67A	TRICHLOROETHENE	2.9	29	180	NS	150	NS
IR25MW69A	TRICHLOROETHENE	2.9	29	NS	7.6	11	NS
IR06MW22A	VINYL CHLORIDE	0.5	25	1.2	NS	6	NS
IR06MW32A	VINYL CHLORIDE	0.5	25	3.2	NS	1.8	NS
IR06MW40A	VINYL CHLORIDE	0.5	25	0.82	NS	1.1	NS
IR06MW59A1	VINYL CHLORIDE	0.5	25	11	NS	16	NS
IR06MW67A	VINYL CHLORIDE	0.5	25	470	NS	980	NS
IR25MW16A	VINYL CHLORIDE	0.5	25	--	NS	1.3	NS
IR25MW74A	VINYL CHLORIDE	0.5	25	0.62	NS	0.56	NS
IR25MW64A	VINYL CHLORIDE	0.5	25	NS	4.3	3.9	NS
IR25MW69A	VINYL CHLORIDE	0.5	25	NS	20	41	NS
Parcel D-1							
No Exceedances in Parcel D-1							
Parcel E							
IR02MW373A	COPPER	28	NA	971	NS	NS	NS
IR02MW126A	LEAD	14.4	NA	17.9	NS	NS	NS
IR02MW373A	LEAD	14.4	NA	33.7	NS	NS	NS
IR02MW373A	NICKEL	96.5	NA	927	NS	NS	NS
IR02MW373A	ZINC	81	NA	5,000	NS	NS	NS
Parcel E-2							
IR01MW403B	1,2-DICHLOROETHANE	0.5	NA	--	NS	0.65	NS
IR01MWI-9R-D	ARSENIC	10	NA	--	NS	10.8	NS
IR01MW38A	CYANIDE	10	NA	--	NS	12.9	NS
IR01MW62A	CYANIDE	10	NA	30	NS	24.8	NS
IR01MWI-9R	CYANIDE	10	NA	--	NS	10.5	NS
IR01MW09B	LEAD	14.4	NA	18.7	NS	--	NS
IR01MW31A	LEAD	14.4	NA	25.9	NS	--	NS
IR01MW403B	LEAD	14.4	NA	28.1	NS	--	NS
IR01MW53BR	LEAD	14.4	NA	22.6	NS	--	NS
IR01MW64A	LEAD	14.4	NA	26.8	NS	--	NS
IR01MW66A	LEAD	14.4	NA	18.0	NS	--	NS
IR01MWLF2A	LEAD	14.4	NA	19.8	NS	--	NS
IR76MW13A	LEAD	14.4	NA	24.6	NS	--	NS

Table 5
2022 Groundwater Analytical Results
Exceeding Project Action Limits and Active Treatement Criteria
Hunters Point Naval Shipyard, San Francisco, California

Well ID	Analyte	Project Action Limit (µg/L)	Active Treatment Criteria (µg/L)	March 2022 Result (µg/L)	June 2022 Result (µg/L)	September 2022 Result (µg/L)	December 2022 Result (µg/L)
IR01MW48A	TPH-TOTAL	4,839	NA	--	NS	7,600 C	NS
IR01MW60A	TPH-TOTAL	4,839	NA	9,799 C	NS	12,545 C	NS
IR01MW64A	TPH-TOTAL	4,839	NA	6,692 C	NS	10,419 C	NS
IR01MW31A	UN-IONIZED AMMONIA(1)	25	NA	369	NS	--	NS
IR01MW38A	UN-IONIZED AMMONIA(1)	25	NA	151	NS	128	NS
IR01MW48A	UN-IONIZED AMMONIA(1)	25	NA	464	NS	376	NS
IR01MW60A	UN-IONIZED AMMONIA(1)	25	NA	39	NS	49	NS
IR01MWI-9R	UN-IONIZED AMMONIA(1)	25	NA	1,945	NS	894	NS
Parcel G							
IR33MW64A	CARBON TETRACHLORIDE	0.5	NA	2.1	NS	0.5	2.1
IR33MW64A	CHLOROFORM	1.0	NA	8.4	NS	--	8.4
Parcel UC-2							
IR06MW54FR	CARBON TETRACHLORIDE	0.5	NA	0.91	NS	0.76	0.91

Notes:
µg/L = micrograms per liter
C= Calculated
NA = Active Treatment Criteria values are only used for Parcel C remedial action and are not applicable for other Parcels at Hunters Point Naval Shipyard
NS = monitoring well not sampled
'-- = analytical result did not exceed PALs or ATCs
ATCs = active treatment criteria
PAL = project action limit
J= estimated
IR= Installation Restoration
Grey box = concentration exceeded both the Project Action Limit and the Active Treatement Criteria
(1) = Un-ionizd ammonia is a calculated amount using the pH, tempurature, and ammonia

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Appendix F
Radiological Review

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Comparison of Estimated Excess Cancer Risk Calculated with the USEPA Radionuclide PRG Calculator Using the Peak Risk Time Interval to those in the 2019 Five-Year Review.

Radionuclide of Concern	Soil Remediation Goals (pCi/g)[a]		Estimated Excess Cancer Risks	
	Outdoor Worker	Residential	Risk (2019 Five-Year Review)[b,d]	Risk Calculated Using the Peak Risk Time Interval[c,d,f]
Americium-241 (Am-241)	5.67	1.36	6.0E-07	6.0E-07
Cesium-137 (Cs-137)	0.113	0.113	2.0E-06	1.9E-06
Cobalt-60 (Co-60)	0.0602	0.0361	1.1E-06	1.1E-06
Europium-152 (Eu-152)	0.13	0.13	3.4E-06	3.4E-06
Europium-154 (Eu-154)	0.23	0.23	4.9E-06	4.9E-06
Plutonium-239 (Pu-239)	14	2.59	6.7E-07	6.7E-07
Radium-226 (Ra-226)	1	1.0	7.9E-05	7.8E-05
Strontium-90 (Sr-90)	10.8	0.331	7.9E-08	7.9E-08
Thallium-232 (Th-232)	2.7	1.69	1.7E-04	1.7E-04
Tritium (H-3)	4.23	2.28	9.6E-06	9.6E-06
Uranium-235 (U-235)	0.398	0.195	1.0E-06	1.1E-06
	Cumulative Risk[e]		2.7E-04	2.7E-04

[a] Table 1 of the 2019 Five-Year Review (Navy, 2019)

[b] Table 5 of the 2019 Five-Year Review (Navy, 2019)

[c] Cancer risk calculated using the "Peak Risk" time interval using the USEPA Radionuclides PRG Calculator (2023).

[d] Residential soil remediation goals are used as exposure point concentrations.

[e] Cumulative cancer risk is calculated summing risks from all radionuclides of concern.

[f] Consistent with the 2019 Five-Year Review, peak risk is calculated within the first 1,000 years peak time period.

pCi/g = picocurie(s) per gram

Sources:

Navy. 2019. *Fourth Five-Year Review, Hunters Point Naval Shipyard, San Francisco, California* . July.

United States Environmental Protection Agency (USEPA). 2020. Preliminary Remediation Goals for Radionuclides (PRG) Calculator. Updated July. https://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search.

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Table F-1. Site-specific Resident Soil Inputs

Variable	Resident Soil Default Value	Form-input Value
A (PEF Dispersion Constant)	16.2302	13.8139
B (PEF Dispersion Constant)	18.7762	20.1624
City (Climate Zone)	Default	San Francisco, CA (2
C (PEF Dispersion Constant)	216.108	234.2869
Cover thickness for GSF_o (gamma shielding factor) cm	0 cm	0 cm
Cover thickness for GSF_b (gamma shielding factor) cm	0 cm	0 cm
$CF_{res\text{-}produce}$ (contaminated plant fraction) unitless	1	1
$ED_{res\text{-}a}$ (produce exposure duration - resident adult) yr	20	20
$ED_{res\text{-}c}$ (produce exposure duration - resident child) yr	6	6
$EF_{res\text{-}a}$ (produce exposure frequency - resident adult) day/yr	350	350
$EF_{res\text{-}c}$ (produce exposure frequency - resident child) day/yr	350	350
TR (produce target cancer risk) unitless	0.000001	0.000001
F(x) (function dependent on U_m/U_t) unitless	0.194	0.0391
PEF (particulate emission factor) m^3/kg	1359344438	4078965032
Q/C_{wind} (g/m^2-s per kg/m^3)	93.77	32.35983268
A_s (acres)	0.5	420
Site area for ACF (area correction factor) m^2	1000000 m^2	1000000 m^2
ED_{res} (soil exposure duration - resident) yr	26	26
$ED_{res\text{-}a}$ (soil exposure duration - resident adult) yr	20	20
$ED_{res\text{-}c}$ (soil exposure duration - resident child) yr	6	6
EF_{res} (soil exposure frequency - resident) day/yr	350	350
$EF_{res\text{-}a}$ (soil exposure frequency - resident adult) day/yr	350	350
$EF_{res\text{-}c}$ (soil exposure frequency - resident child) day/yr	350	350
ET_{res} (soil exposure time - resident) hr/day	24	24
$ET_{res\text{-}a}$ (soil exposure time - resident adult) hr/day	24	24
$ET_{res\text{-}c}$ (soil exposure time - resident child) hr/day	24	24
$ET_{res\text{-}i}$ (soil exposure time - indoor resident) hr/day	16.416	16.416
$ET_{res\text{-}o}$ (soil exposure time - outdoor resident) hr/day	1.752	1.752
GSF_i (gamma shielding factor - indoor) unitless	0.4	0.4
$IFA_{res\text{-}adj}$ (age-adjusted soil inhalation factor - resident) m^3	161000	161000
$IFS_{res\text{-}adj}$ (age-adjusted soil ingestion factor - resident) mg	1120000	1120000
$IRA_{res\text{-}a}$ (soil inhalation rate - resident adult) m^3/day	20	20
$IRA_{res\text{-}c}$ (soil inhalation rate - resident child) m^3/day	10	10
$IRS_{res\text{-}a}$ (soil intake rate - resident adult) mg/day	100	100
$IRS_{res\text{-}c}$ (soil intake rate - resident child) mg/day	200	200
t_{res} (time - resident) yr	26	26
TR (target cancer risk) unitless	0.000001	0.000001
Soil type	Default	Default
U_m (mean annual wind speed) m/s	4.69	3.89
U_t (equivalent threshold value)	11.32	11.32
V (fraction of vegetative cover) unitless	0.5	0.5

Table F-2. Soil PRG Am-241

Resident Parent Risk and CDI at Time=T_0 Soil (no decay)

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Half-life (yr)
Am-241	F	3.77E-08	2.77E-08	1.34E-10	1.84E-10	1.60E-03	4.32E+02

1000000 m^2 Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor	Infinite Soil Volume Concentration (pCi/g)	Ingestion CDI (pCi)	Inhalation CDI (pCi)	External Exposure CDI (pCi-year/g)	Produce Consumption CDI (pCi)
1.00E+00	1.00E+00	1.36E+00	1.52E+03	5.37E-02	1.18E+01	-

Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
2.81E-07	2.03E-09	3.25E-07	-	**6.08E-07**

Table F-3. Soil Peak Times Am-241

Resident Peak Risk Start Times (by route)

Soil

Peak Risk Start Time Ingestion (yrs)	Peak Risk Start Time Inhalation (yrs)	Peak Risk Start Time External Exposure (yrs)
1.00E-08	1.00E-08	1.00E-08

Table F-4. Soil Peak Risk Am-241

Resident Peak Risks

Soil (complete chain decay)

using the peak risk time intervals from PRG calculations (by route)

Isotope	Ingestion Concentration (pCi/g)	Inhalation Concentration (pCi/g)	External Exposure Concentration (pCi/g)	Produce Ingestion Concentration (pCi/g)	Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
Am-241	1.36E+00	1.36E+00	1.36E+00	-	2.75E-07	1.98E-09	3.19E-07	-	**5.95E-07**
Np-237	0.00E+00	0.00E+00	0.00E+00	-	7.87E-13	6.38E-15	2.52E-12	-	**3.31E-12**
Pa-233	0.00E+00	0.00E+00	0.00E+00	-	1.03E-13	3.37E-18	3.88E-11	-	**3.89E-11**
U-233	0.00E+00	0.00E+00	0.00E+00	-	3.55E-17	2.35E-19	1.30E-18	-	**3.70E-17**
Th-229	0.00E+00	0.00E+00	0.00E+00	-	5.56E-20	8.90E-22	2.50E-19	-	**3.07E-19**
Ra-225	0.00E+00	0.00E+00	0.00E+00	-	3.47E-20	1.32E-22	6.75E-21	-	**4.16E-20**
Ac-225	0.00E+00	0.00E+00	0.00E+00	-	6.95E-20	1.43E-22	4.53E-20	-	**1.15E-19**
Fr-221	0.00E+00	0.00E+00	0.00E+00	-	0.00E+00	0.00E+00	1.15E-19	-	**1.15E-19**
At-217	0.00E+00	0.00E+00	0.00E+00	-	0.00E+00	0.00E+00	1.03E-21	-	**1.03E-21**
Bi-213	0.00E+00	0.00E+00	0.00E+00	-	1.70E-22	3.71E-25	5.96E-19	-	**5.96E-19**
Po-213	0.00E+00	0.00E+00	0.00E+00	-	0.00E+00	0.00E+00	1.86E-22	-	**1.86E-22**
Tl-209	0.00E+00	0.00E+00	0.00E+00	-	0.00E+00	0.00E+00	2.37E-19	-	**2.37E-19**
Pb-209	0.00E+00	0.00E+00	0.00E+00	-	8.90E-23	1.04E-27	5.31E-22	-	**6.20E-22**
Total Risk	***-***	***-***	***-***	***-***	***2.75E-07***	***1.98E-09***	***3.19E-07***	***-***	***5.95E-07***

Table F-5. Soil PRG Co-60

Resident Parent Risk and CDI at Time=T_0 Soil (no decay)

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Half-life (yr)
Co-60	S	1.01E-10	1.24E-05	2.23E-11	3.81E-11	1.31E-01	5.27E+00

1000000 m^2 Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor	Infinite Soil Volume Concentration (pCi/g)	Ingestion CDI (pCi)	Inhalation CDI (pCi)	External Exposure CDI (pCi-year/g)	Produce Consumption CDI (pCi)
1.00E+00	1.00E+00	3.61E-02	4.04E+01	1.42E-03	3.12E-01	-

Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
1.54E-09	1.43E-13	3.86E-06	-	**3.86E-06**

Table F-6. Soil Peak Times Co-60

Resident Peak Risk Start Times (by route)

Soil

Peak Risk Start Time Ingestion (yrs)	Peak Risk Start Time Inhalation (yrs)	Peak Risk Start Time External Exposure (yrs)
1.00E-08	1.00E-08	1.00E-08

Table F-7. Soil Peak Risk Co-60

Resident Peak Risks

Soil (complete chain decay)

using the peak risk time intervals from PRG calculations (by route)

Isotope	Ingestion Concentration (pCi/g)	Inhalation Concentration (pCi/g)	External Exposure Concentration (pCi/g)	Produce Ingestion Concentration (pCi/g)	Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
Co-60	3.61E-02	3.61E-02	3.61E-02	-	4.36E-10	4.06E-14	1.09E-06	-	**1.09E-06**
Total Risk	***-***	***-***	***-***	***-***	***4.36E-10***	***4.06E-14***	***1.09E-06***	***-***	***1.09E-06***

Table F-8. Soil PRG Cs-137

Resident Parent Risk and CDI at Time=T_0 Soil (no decay)

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Half-life (yr)
Cs-137	S	1.12E-10	5.52E-10	3.74E-11	4.26E-11	2.30E-02	3.02E+01

1000000 m^2 Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor	Infinite Soil Volume Concentration (pCi/g)	Ingestion CDI (pCi)	Inhalation CDI (pCi)	External Exposure CDI (pCi-year/g)	Produce Consumption CDI (pCi)
1.00E+00	1.00E+00	1.13E-01	1.27E+02	4.46E-03	9.76E-01	-

Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
5.39E-09	5.02E-13	5.39E-10	-	**5.92E-09**

Table F-9. Soil Peak Times Cs-137

Resident Peak Risk Start Times (by route)

Soil

Peak Risk Start Time Ingestion (yrs)	Peak Risk Start Time Inhalation (yrs)	Peak Risk Start Time External Exposure (yrs)
1.00E-08	1.00E-08	1.00E-08

Table F-10. Soil peak Risk Cs-137

Resident Peak Risks
Soil (complete chain decay)
using the peak risk time intervals from PRG calculations (by route)

Isotope	Ingestion Concentration (pCi/g)	Inhalation Concentration (pCi/g)	External Exposure Concentration (pCi/g)	Produce Ingestion Concentration (pCi/g)	Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
Cs-137	1.13E-01	1.13E-01	1.13E-01	-	4.05E-09	3.78E-13	4.06E-10	-	**4.46E-09**
Ba-137m	0.00E+00	0.00E+00	0.00E+00	-	0.00E+00	0.00E+00	1.86E-06	-	**1.86E-06**
Total Risk	***-***	***-***	***-***	***-***	***4.05E-09***	***3.78E-13***	***1.86E-06***	***-***	***1.87E-06***

Table F-11. Soil PRG Eu-152

Resident Parent Risk and CDI at Time=T_0 Soil (no decay)

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Half-life (yr)
Eu-152	F	1.91E-10	5.41E-06	8.33E-12	1.46E-11	5.12E-02	1.35E+01

1000000 m^2 Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor	Infinite Soil Volume Concentration (pCi/g)	Ingestion CDI (pCi)	Inhalation CDI (pCi)	External Exposure CDI (pCi-year/g)	Produce Consumption CDI (pCi)
1.00E+00	1.00E+00	1.30E-01	1.46E+02	5.13E-03	1.12E+00	-

Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
2.12E-09	9.82E-13	6.07E-06	-	**6.08E-06**

Table F-12. Soil Peak Times Eu-152

Resident Peak Risk Start Times (by route)

Soil

Peak Risk Start Time Ingestion (yrs)	Peak Risk Start Time Inhalation (yrs)	Peak Risk Start Time External Exposure (yrs)
1.00E-08	1.00E-08	1.00E-08

Table F-13. Soil Peak Risk Eu-152

Resident Peak Risks

Soil (complete chain decay)

using the peak risk time intervals from PRG calculations (by route)

Isotope	Ingestion Concentration (pCi/g)	Inhalation Concentration (pCi/g)	External Exposure Concentration (pCi/g)	Produce Ingestion Concentration (pCi/g)	Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
Eu-152	1.30E-01	1.30E-01	1.30E-01	-	1.17E-09	5.43E-13	3.36E-06	-	**3.36E-06**
Gd-152	0.00E+00	0.00E+00	0.00E+00	-	1.25E-22	7.30E-25	0.00E+00	-	**1.25E-22**
Sm-148	0.00E+00	0.00E+00	0.00E+00	-	1.20E-37	8.21E-40	0.00E+00	-	**1.21E-37**
Nd-144	0.00E+00	0.00E+00	0.00E+00	-	0.00E+00	0.00E+00	0.00E+00	-	**0.00E+00**
Total Risk	***-***	***-***	***-***	***-***	***1.17E-09***	***5.43E-13***	***3.36E-06***	***-***	***3.36E-06***

Table F-14. PRG Eu-154

Resident Parent Risk and CDI at Time=T_0 Soil (no decay)

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Half-life (yr)
Eu-154	F	2.06E-10	5.85E-06	1.42E-11	2.54E-11	8.06E-02	8.59E+00

1000000 m^2 Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor	Infinite Soil Volume Concentration (pCi/g)	Ingestion CDI (pCi)	Inhalation CDI (pCi)	External Exposure CDI (pCi-year/g)	Produce Consumption CDI (pCi)
1.00E+00	1.00E+00	2.30E-01	2.58E+02	9.08E-03	1.99E+00	-

Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
6.54E-09	1.87E-12	1.16E-05	-	**1.16E-05**

Table F-15. Soil Peak Times Eu-154

Resident Peak Risk Start Times (by route)

Soil

Peak Risk Start Time Ingestion (yrs)	Peak Risk Start Time Inhalation (yrs)	Peak Risk Start Time External Exposure (yrs)
1.00E-08	1.00E-08	1.00E-08

Table F-16. Soil Peak Risk Eu-154

Resident Peak Risks

Soil (complete chain decay)

using the peak risk time intervals from PRG calculations (by route)

Isotope	Ingestion Concentration (pCi/g)	Inhalation Concentration (pCi/g)	External Exposure Concentration (pCi/g)	Produce Ingestion Concentration (pCi/g)	Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
Eu-154	2.30E-01	2.30E-01	2.30E-01	-	2.74E-09	7.83E-13	4.86E-06	-	**4.87E-06**
Total Risk	-	-	-	-	***2.74E-09***	***7.83E-13***	***4.86E-06***	-	***4.87E-06***

Table F-17. Soil PRG H-3

Resident Parent Risk and CDI at Time=T_0 Soil (no decay)

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Half-life (yr)
H-3	S	8.47E-13	0.00E+00	1.44E-13	8.99E-14	5.63E-02	1.23E+01

1000000 m^2 Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor	Infinite Soil Volume Concentration (pCi/g)	Ingestion CDI (pCi)	Inhalation CDI (pCi)	External Exposure CDI (pCi-year/g)	Produce Consumption CDI (pCi)
9.00E-01	1.00E+00	2.28E+00	2.55E+03	2.16E+07	1.77E+01	-

Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
2.30E-10	1.83E-05	0.00E+00	-	**1.83E-05**

Table F-18. Soil Peak times H-3

Resident Peak Risk Start Times (by route)
Soil

Peak Risk Start Time Ingestion (yrs)	Peak Risk Start Time Inhalation (yrs)
1.00E-08	1.00E-08

Table F-19. Soil Peak Risk H-3

Resident Peak Risks

Soil (complete chain decay)

using the peak risk time intervals from PRG calculations (by route)

Isotope	Ingestion Concentration (pCi/g)	Inhalation Concentration (pCi/g)	External Exposure Concentration (pCi/g)	Produce Ingestion Concentration (pCi/g)	Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
H-3	2.28E+00	2.28E+00	-	-	1.21E-10	9.61E-06	-	-	**9.61E-06**
Total Risk	***-***	***-***	***-***	***-***	***1.21E-10***	***9.61E-06***	***-***	***-***	***9.61E-06***

Table F-20. Soil PRG Pu239

Resident Parent Risk and CDI at Time=T_0 Soil (no decay)

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Half-life (yr)
Pu-239	F	5.55E-08	2.09E-10	1.74E-10	2.28E-10	2.87E-05	2.41E+04

1000000 m^2 Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor	Infinite Soil Volume Concentration (pCi/g)	Ingestion CDI (pCi)	Inhalation CDI (pCi)	External Exposure CDI (pCi-year/g)	Produce Consumption CDI (pCi)
1.00E+00	1.00E+00	2.59E+00	2.90E+03	1.02E-01	2.24E+01	-

Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
6.61E-07	5.67E-09	4.68E-09	-	**6.72E-07**

Table F-21. Soil Peak Times Pu-239

Resident Peak Risk Start Times (by route)

Soil

Peak Risk Start Time Ingestion (yrs)	Peak Risk Start Time Inhalation (yrs)	Peak Risk Start Time External Exposure (yrs)
1.00E-08	1.00E-08	1.00E-08

Table F-22. Soil Peak Risk Pu-239

Resident Peak Risks
Soil (complete chain decay)
using the peak risk time intervals from PRG calculations (by route)

Isotope	Ingestion Concentration (pCi/g)	Inhalation Concentration (pCi/g)	External Exposure Concentration (pCi/g)	Produce Ingestion Concentration (pCi/g)	Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
Pu-239	2.59E+00	2.59E+00	2.59E+00	-	6.61E-07	5.67E-09	4.68E-09	-	**6.71E-07**
U-235m	0.00E+00	0.00E+00	0.00E+00	-	4.78E-14	1.91E-19	0.00E+00	-	**4.78E-14**
U-235	0.00E+00	0.00E+00	0.00E+00	-	5.48E-15	3.27E-17	1.58E-13	-	**1.63E-13**
Th-231	0.00E+00	0.00E+00	0.00E+00	-	2.21E-16	1.96E-21	7.12E-15	-	**7.34E-15**
Pa-231	0.00E+00	0.00E+00	0.00E+00	-	2.03E-18	1.83E-20	6.68E-18	-	**8.72E-18**
Ac-227	0.00E+00	0.00E+00	0.00E+00	-	3.49E-19	6.34E-21	1.84E-21	-	**3.57E-19**
Th-227	0.00E+00	0.00E+00	0.00E+00	-	1.51E-19	1.45E-21	4.03E-18	-	**4.18E-18**
Fr-223	0.00E+00	0.00E+00	0.00E+00	-	2.81E-22	2.38E-26	1.73E-20	-	**1.76E-20**
Ra-223	0.00E+00	0.00E+00	0.00E+00	-	7.08E-19	1.22E-21	4.15E-18	-	**4.86E-18**
At-219	0.00E+00	0.00E+00	0.00E+00	-	0.00E+00	0.00E+00	0.00E+00	-	**0.00E+00**
Rn-219	0.00E+00	0.00E+00	0.00E+00	-	0.00E+00	0.00E+00	2.14E-18	-	**2.14E-18**
Bi-215	0.00E+00	0.00E+00	0.00E+00	-	0.00E+00	0.00E+00	8.08E-24	-	**8.08E-24**
Po-215	0.00E+00	0.00E+00	0.00E+00	-	0.00E+00	0.00E+00	6.83E-21	-	**6.83E-21**
Pb-211	0.00E+00	0.00E+00	0.00E+00	-	1.13E-21	1.68E-24	2.65E-18	-	**2.65E-18**
Bi-211	0.00E+00	0.00E+00	0.00E+00	-	0.00E+00	0.00E+00	1.74E-18	-	**1.74E-18**
Po-211	0.00E+00	0.00E+00	0.00E+00	-	0.00E+00	0.00E+00	9.46E-22	-	**9.46E-22**
Tl-207	0.00E+00	0.00E+00	0.00E+00	-	0.00E+00	0.00E+00	1.44E-19	-	**1.44E-19**
Total Risk	***-***	***-***	***-***	***-***	***6.61E-07***	***5.67E-09***	***4.68E-09***	***-***	***6.71E-07***

Table F-23. Soil PRG Ra-226

Resident Parent Risk and CDI at Time=T_0 Soil (no decay)

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Half-life (yr)
Ra-226	S	2.82E-08	2.50E-08	5.14E-10	6.77E-10	4.33E-04	1.60E+03

1000000 m^2 Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor	Infinite Soil Volume Concentration (pCi/g)	Ingestion CDI (pCi)	Inhalation CDI (pCi)	External Exposure CDI (pCi-year/g)	Produce Consumption CDI (pCi)
1.00E+00	1.00E+00	1.00E+00	1.12E+03	3.95E-02	8.64E+00	-

Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
7.58E-07	1.11E-09	2.16E-07	-	**9.75E-07**

Table F-24. Soil Peak Times Ra-226

Resident Peak Risk Start Times (by route)

Soil

Peak Risk Start Time Ingestion (yrs)	Peak Risk Start Time Inhalation (yrs)	Peak Risk Start Time External Exposure (yrs)
1.23E+02	1.06E+02	6.82E-02

Table F-25. Soil Peak Risk Ra-226

Resident Peak Risks

Soil (complete chain decay)

using the peak risk time intervals from PRG calculations (by route)

Isotope	Ingestion Concentration (pCi/g)	Inhalation Concentration (pCi/g)	External Exposure Concentration (pCi/g)	Produce Ingestion Concentration (pCi/g)	Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
Ra-226	9.48E-01	9.55E-01	1.00E+00	-	7.15E-07	1.06E-09	2.15E-07	-	**9.31E-07**
Rn-222	9.48E-01	9.55E-01	9.89E-01	-	0.00E+00	8.55E-14	1.45E-08	-	**1.45E-08**
Po-218	9.48E-01	9.55E-01	9.89E-01	-	0.00E+00	5.21E-13	5.29E-14	-	**5.74E-13**
At-218	1.90E-04	1.91E-04	1.98E-04	-	0.00E+00	0.00E+00	4.24E-14	-	**4.24E-14**
Rn-218	1.90E-07	1.91E-07	1.98E-07	-	0.00E+00	0.00E+00	5.82E-15	-	**5.82E-15**
Pb-214	9.48E-01	9.55E-01	9.89E-01	-	8.36E-10	2.91E-12	8.54E-06	-	**8.54E-06**
Bi-214	9.48E-01	9.55E-01	9.89E-01	-	4.26E-10	2.32E-12	6.31E-05	-	**6.31E-05**
Po-214	9.48E-01	9.55E-01	9.89E-01	-	0.00E+00	0.00E+00	3.31E-09	-	**3.31E-09**
Tl-210	1.99E-04	2.01E-04	2.08E-04	-	0.00E+00	0.00E+00	2.42E-08	-	**2.42E-08**
Pb-210	9.40E-01	9.32E-01	1.66E-03	-	1.81E-06	5.87E-10	4.04E-09	-	**1.81E-06**
Bi-210	9.40E-01	9.32E-01	1.10E-03	-	2.53E-08	1.68E-11	7.52E-09	-	**3.28E-08**
Po-210	9.40E-01	9.31E-01	4.50E-05	-	3.45E-06	5.37E-10	1.18E-10	-	**3.45E-06**
Hg-206	1.79E-08	1.77E-08	3.14E-11	-	0.00E+00	0.00E+00	2.50E-14	-	**2.50E-14**
Tl-206	1.26E-06	1.25E-06	1.48E-09	-	0.00E+00	0.00E+00	2.22E-14	-	**2.22E-14**
Total Risk	***-***	***-***	***-***	***-***	***6.00E-06***	***2.20E-09***	***7.19E-05***	***-***	***7.79E-05***

Table F-26. Soil PRG Sr-90

Resident Parent Risk and CDI at Time=T_0 Soil (no decay)

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Half-life (yr)
Sr-90	S	4.26E-10	4.83E-10	6.88E-11	8.62E-11	2.41E-02	2.88E+01

1000000 m^2 Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor	Infinite Soil Volume Concentration (pCi/g)	Ingestion CDI (pCi)	Inhalation CDI (pCi)	External Exposure CDI (pCi-year/g)	Produce Consumption CDI (pCi)
9.00E-01	1.00E+00	3.31E-01	3.71E+02	1.31E-02	2.57E+00	-

Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
3.20E-08	5.56E-12	1.24E-09	-	**3.32E-08**

Table F-27. Soil Peak Times Sr-90

Resident Peak Risk Start Times (by route)
Soil

Peak Risk Start Time Ingestion (yrs)	Peak Risk Start Time Inhalation (yrs)	Peak Risk Start Time External Exposure (yrs)
1.00E-08	1.00E-08	1.00E-08

Table F-28. Soil Peak Risk Sr-90

Resident Peak Risks
Soil (complete chain decay)
using the peak risk time intervals from PRG calculations (by route)

Isotope	Ingestion Concentration (pCi/g)	Inhalation Concentration (pCi/g)	External Exposure Concentration (pCi/g)	Produce Ingestion Concentration (pCi/g)	Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
Sr-90	3.31E-01	3.31E-01	3.31E-01	-	2.38E-08	4.13E-12	9.25E-10	-	**2.47E-08**
Y-90	0.00E+00	0.00E+00	0.00E+00	-	1.36E-08	8.15E-14	4.05E-08	-	**5.40E-08**
Total Risk	***-***	***-***	***-***	***-***	***3.73E-08***	***4.21E-12***	***4.14E-08***	***-***	***7.87E-08***

Table F-29. Soil PRG Th-232

Resident Parent Risk and CDI at Time=T_0 Soil (no decay)

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Half-life (yr)
Th-232	S	4.33E-08	3.58E-10	1.33E-10	1.84E-10	4.93E-11	1.41E+10

1000000 m^2 Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor	Infinite Soil Volume Concentration (pCi/g)	Ingestion CDI (pCi)	Inhalation CDI (pCi)	External Exposure CDI (pCi-year/g)	Produce Consumption CDI (pCi)
1.00E+00	1.00E+00	1.69E+00	1.89E+03	6.67E-02	1.46E+01	-

Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
3.48E-07	2.89E-09	5.23E-09	-	**3.56E-07**

Table F-30. Soil Peak Times Th-232

Resident Peak Risk Start Times (by route)

Soil

Peak Risk Start Time Ingestion (yrs)	Peak Risk Start Time Inhalation (yrs)	Peak Risk Start Time External Exposure (yrs)
1.69E+02	1.69E+02	1.70E+02

Table F-31. Soil Peak Risk Th-232

Resident Peak Risks

Soil (complete chain decay)

using the peak risk time intervals from PRG calculations (by route)

Isotope	Ingestion Concentration (pCi/g)	Inhalation Concentration (pCi/g)	External Exposure Concentration (pCi/g)	Produce Ingestion Concentration (pCi/g)	Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
Th-232	1.69E+00	1.69E+00	1.69E+00	-	3.48E-07	2.89E-09	5.23E-09	-	**3.56E-07**
Ra-228	1.69E+00	1.69E+00	1.69E+00	-	3.75E-06	2.91E-09	5.01E-10	-	**3.75E-06**
Ac-228	1.69E+00	1.69E+00	1.69E+00	-	9.31E-09	3.28E-12	5.90E-05	-	**5.90E-05**
Th-228	1.69E+00	1.69E+00	1.69E+00	-	4.60E-07	8.84E-09	8.24E-08	-	**5.51E-07**
Ra-224	1.69E+00	1.69E+00	1.69E+00	-	8.05E-07	7.55E-10	5.71E-07	-	**1.38E-06**
Rn-220	1.69E+00	1.69E+00	1.69E+00	-	0.00E+00	7.67E-14	4.04E-08	-	**4.04E-08**
Po-216	1.69E+00	1.69E+00	1.69E+00	-	0.00E+00	0.00E+00	1.04E-09	-	**1.04E-09**
Pb-212	1.69E+00	1.69E+00	1.69E+00	-	1.20E-07	4.20E-11	7.25E-06	-	**7.37E-06**
Bi-212	1.69E+00	1.69E+00	1.69E+00	-	3.18E-09	7.54E-12	7.25E-06	-	**7.25E-06**
Po-212	1.08E+00	1.08E+00	1.08E+00	-	0.00E+00	0.00E+00	0.00E+00	-	**0.00E+00**
Tl-208	6.07E-01	6.07E-01	6.07E-01	-	0.00E+00	0.00E+00	9.19E-05	-	**9.19E-05**
Total Risk	***-***	***-***	***-***	***-***	***5.49E-06***	***1.54E-08***	***1.66E-04***	***-***	***1.72E-04***

Table F-32. Soil PRG U-235

Resident Parent Risk and CDI at Time=T_0 Soil (no decay)

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Half-life (yr)
U-235	S	2.50E-08	5.51E-07	9.44E-11	1.48E-10	9.84E-10	7.04E+08

1000000 m^2 Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor	Infinite Soil Volume Concentration (pCi/g)	Ingestion CDI (pCi)	Inhalation CDI (pCi)	External Exposure CDI (pCi-year/g)	Produce Consumption CDI (pCi)
1.00E+00	1.00E+00	1.95E-01	2.18E+02	7.70E-03	1.69E+00	-

Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
3.22E-08	1.93E-10	9.29E-07	-	**9.61E-07**

Table F-33. Soil Peak Times U-235

Resident Peak Risk Start Times (by route)

Soil

Peak Risk Start Time Ingestion (yrs)	Peak Risk Start Time Inhalation (yrs)	Peak Risk Start Time External Exposure (yrs)
9.74E+02	9.74E+02	9.74E+02

Table F-34. Soil Peak Risk U-235

Resident Peak Risks
Soil (complete chain decay)
using the peak risk time intervals from PRG calculations (by route)

Isotope	Ingestion Concentration (pCi/g)	Inhalation Concentration (pCi/g)	External Exposure Concentration (pCi/g)	Produce Ingestion Concentration (pCi/g)	Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
U-235	1.95E-01	1.95E-01	1.95E-01	-	3.22E-08	1.93E-10	9.29E-07	-	**9.61E-07**
Th-231	1.95E-01	1.95E-01	1.95E-01	-	1.30E-09	1.16E-14	4.19E-08	-	**4.32E-08**
Pa-231	3.98E-03	3.98E-03	3.98E-03	-	1.34E-09	1.21E-11	4.43E-09	-	**5.79E-09**
Ac-227	3.85E-03	3.85E-03	3.85E-03	-	1.27E-09	2.30E-11	6.69E-12	-	**1.30E-09**
Th-227	3.80E-03	3.80E-03	3.80E-03	-	5.55E-10	5.32E-12	1.48E-08	-	**1.54E-08**
Fr-223	5.31E-05	5.31E-05	5.31E-05	-	1.02E-12	8.65E-17	6.30E-11	-	**6.40E-11**
Ra-223	3.85E-03	3.85E-03	3.85E-03	-	2.62E-09	4.50E-12	1.54E-08	-	**1.80E-08**
At-219	3.19E-09	3.19E-09	3.19E-09	-	0.00E+00	0.00E+00	0.00E+00	-	**0.00E+00**
Rn-219	3.85E-03	3.85E-03	3.85E-03	-	0.00E+00	0.00E+00	7.91E-09	-	**7.91E-09**
Bi-215	3.09E-09	3.09E-09	3.09E-09	-	0.00E+00	0.00E+00	2.93E-14	-	**2.93E-14**
Po-215	3.85E-03	3.85E-03	3.85E-03	-	0.00E+00	0.00E+00	2.52E-11	-	**2.52E-11**
Pb-211	3.85E-03	3.85E-03	3.85E-03	-	4.17E-12	6.21E-15	9.80E-09	-	**9.81E-09**
Bi-211	3.85E-03	3.85E-03	3.85E-03	-	0.00E+00	0.00E+00	6.42E-09	-	**6.42E-09**
Po-211	1.06E-05	1.06E-05	1.06E-05	-	0.00E+00	0.00E+00	3.50E-12	-	**3.50E-12**
Tl-207	3.84E-03	3.84E-03	3.84E-03	-	0.00E+00	0.00E+00	5.34E-10	-	**5.34E-10**
Total Risk	***-***	***-***	***-***	***-***	***3.93E-08***	***2.37E-10***	***1.03E-06***	***-***	***1.07E-06***