Executive Summary

The U.S. Department of the Navy (Navy) has prepared this combined Remedial Investigation (RI)/Feasibility Study (FS) for the contiguous area consisting of the closed industrial landfill (hereafter identified as the "Parcel E-2 Landfill") and the surrounding adjacent areas that contain isolated or non-contiguous pockets of buried solid waste at Parcel E-2, Hunters Point Shipyard (HPS) in San Francisco, California. This RI/FS is part of ongoing efforts by the Navy to address contamination at Parcel E-2 in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (Title 42 *United States Code* [USC] Sections [§§] 9601-9675).

Because past shipyard operations left hazardous materials on site, HPS property was placed on the National Priorities List in 1989 as a Superfund site pursuant to the CERCLA as amended by the Superfund Amendments and Reauthorization Act of 1986. In 1991, HPS was designated for closure pursuant to the Defense Base Closure and Realignment Act (BRAC) of 1990. Closure activities at HPS involve conducting environmental remediation and making the property available for nondefense use. As a management tool to accelerate site investigation, cleanup, and reuse, HPS was divided into parcels. Sites within each parcel are evaluated concurrently. In September 2004, the Navy divided Parcel E into two parcels (Parcels E and E-2) to facilitate the closure of the Parcel E-2 Landfill and its adjacent areas.

This RI/FS summarizes and evaluates the nature and extent of contamination using all available data, including information from interim removal actions that have removed potential contamination sources at Parcel E-2. The data was used to update risk assessments for human and ecological receptors at Parcel E-2. The results from the nature and extent evaluation and risk assessments were used to identify remedial action objectives (RAOs), and to develop remedial alternatives consistent with U.S. Environmental Protection Agency (EPA) RI/FS guidance for landfills (EPA, 1991a; EPA, 1993a; EPA, 1993b; EPA, 1996). Each remedial alternative was evaluated in accordance with criteria established in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (Title 40 of the *Code of Federal Regulations* [40 CFR], Part 300). This RI/FS addresses CERCLA hazardous substances with the exception of radionuclides. Potential radiological contamination will be addressed in a radiological addendum to the RI/FS. Both chemical and radiological contaminants will then be addressed together in the proposed plan and the record of decision (ROD).

ES.1. SITE HISTORY AND PLANNED REUSE

Parcel E-2 consists of 47.4 acres of shoreline and lowland coast along the southwestern portion of HPS, and contains four distinct but contiguous areas, which were designated to streamline the information presentation in the RI/FS (Figure ES-1):

1. The "Landfill Area," which comprises the entire Parcel E-2 Landfill and its immediate perimeter
2. The "East Adjacent Area," located to the east of the Landfill Area
3. The "Panhandle Area," located west/southwest of the Landfill Area
4. The "Shoreline Area" located adjacent to the Bay

Based on the City and County of San Francisco's Hunters Point Naval Shipyard Redevelopment Plan, Parcel E-2 is designated for open space reuse except for a small area in the East Adjacent Area, which is designated for industrial and research and development (R&D) reuse (San Francisco Redevelopment Agency, 1997). At time of transfer, restrictive covenants will be incorporated to prohibit certain construction activities within a specified distance from the Parcel E-2 boundary. These restrictions will impact this small area of industrial and R&D uses, but will be consistent with the intentions of the Redevelopment Plan.

ES.1.1. Operational History

Parcel E-2 is part of an area created in the 1940s, 1950s, and 1960s by filling in the Bay margin with a variety of material, including soil, crushed bedrock, dredged sediments, and debris. The overall composition of the fill material, on which the Parcel E-2 Landfill was created, is primarily sand and clay with intermixed construction debris (Tetra Tech EMI [TtEMI], 2004f). Almost all the land at HPS was created by filling activities conducted between the early 1940s and the late 1960s.

Between 1958 and 1974, the Navy created the Parcel E-2 Landfill by placing a variety of shipyard wastes, including construction debris, municipal-type solid waste, and industrial waste (including sandblast waste, paint sludge, solvents, and waste oils) (Naval Energy and Environmental Support Activity [NEESA], 1984). As a result, the landfill has a heterogeneous composition ranging from solid waste material to solid waste intermixed with soil fill. The physical extent of solid waste covers approximately 22 acres (TtEMI, 2004f). Shortly after landfill operations ceased in 1974, the Navy implemented several preliminary landfill closure measures, including placing a minimum of two feet of compacted, imported fill on top of the landfill.

Between 1976 and 1986, industrial operations conducted by a lessee of the property (Triple A Machine Shop, Inc.) allegedly resulted in the disposal of industrial debris, sandblast waste, oily industrial sand, and asphalt over an area of approximately 5 acres along the shoreline in Parcel E-2, and in a portion of the Landfill Area. The lessee also allegedly stored unlabeled, deteriorating, uncovered drums with their contents exposed to the elements in the southeast portion of Parcel E-2 (San Francisco District Attorney, 1986).

ES.1.2. Investigation Activities

Environmental investigations performed through from 1984 to 1996 were evaluated in RI and FS reports for Parcel E, which encompassed the area later subdivided as Parcel E-2. During preparation of these reports, the Navy and regulatory agencies decided that additional data gaps investigations were needed to better define the nature and extent of chemicals in soil and groundwater at Parcel E-2, and to better evaluate site conditions in and around the Parcel E-2 Landfill. Previous environmental investigations at Parcel E-2 are listed below.

ENVIRONMENTAL INVESTIGATION ACTIVITIES AT PARCEL E-2

- 1984 Initial Assessment Study
- 1987 Confirmation Study/Verification Step, Area Study for Asbestos-Containing Material and Organic and Inorganic Soil Contamination
- 1986-1988 Triple A Investigation, Remedial Action Order and RI/FS Scoping Document
- 1988-1989 Solid Waste Air Quality Assessment Test
- 1988-1992 Operable Unit I Remedial Investigation
- 1991-1992 Intertidal Sediment Study
- 1991, 1993 Radiological Investigation (Phases I and II)
- 1994-1996 Ecological Risk Assessment (Phases 1A and 1B)
- 1995-1998 Parcel E Remedial Investigation and Feasibility Study
- 1999-2000 Ecological Risk Assessment Validation Study
- 2000-2002 Groundwater Data Gaps Investigations (Phases I, II, and III)
- 2001-2002 Landfill and Soil Data Gaps Investigations, Wetlands Delineation
- 2001-2003 Radiological Investigations, Phase V (and other interim investigations)
- 2002-2005 Shoreline Sediment Characterization

ES.1.3. Interim Removal Actions

The Navy has performed several interim removal actions at Parcel E-2 to mitigate potential exposure of hazardous substances and to expedite the cleanup process. Interim removal actions include:

REMOVAL ACTIONS AT PARCEL E-2 (FIGURE ES-1)

- Groundwater Extraction System, 1997-1998: a groundwater containment and extraction system was installed at the southeast portion of Parcel E-2 to reduce the potential for release of landfill constituents into the San Francisco Bay
- Landfill Cap Construction, 2000-2001: a multilayer interim cap was constructed on a portion of the Parcel E-2 Landfill to prevent oxygen intrusion and extinguish smoldering subsurface areas following a brush fire
- Landfill Gas Removal Action, 2002-2003: a landfill gas control and monitoring system was installed along the northern Parcel E-2 boundary to control gas migration from the landfill
- Metal Slag Area Removal Action, 2005-2006: 8,560 cubic yards of contaminated soil and sediment, including 98 cubic yards of radiologically impacted material, were excavated and disposed of off-site from this area in the southwest portion of Parcel E-2
- Polychlorinated Biphenyl Hot Spot Removal Action, 2005–2006: 44,500 cubic yards of contaminated soil, including 432 cubic yards of radiologically impacted material, were excavated and disposed of off-site from this area in the southeast portion of Parcel E-2

ES.1.4. Ongoing Monitoring Programs

The Navy has implemented several environmental monitoring programs to satisfy regulatory requirements for Parcel E-2 until a final remedy is selected. The ongoing monitoring programs at Parcel E-2 are summarized below.

ONGOING MONITORING PROGRAMS IMPLEMENTED AT PARCEL E-2

- 2003-Present Storm Water Discharge Management Program
- 2003-Present Landfill Cover Inspection and Maintenance Program
- 2004-Present Basewide Groundwater Monitoring Program
- 2004-Present Landfill Gas Control and Monitoring Program

ES.2. NATURE AND EXTENT OF CONTAMINATION

The nature and extent evaluation was performed for the following potentially contaminated media: 1) solid waste and soil in the Landfill Area; 2) landfill gas; 3) soil and isolated solid waste in the adjacent areas; 4) groundwater; 5) surface water; and 6) shoreline sediment. Data were initially evaluated to identify chemicals whose presence may be attributed to the Navy's past site operations. The evaluation was then focused by comparing the site data against remedial investigation evaluation criteria (RIEC). The RIEC were selected based on regulatory criteria and are adequately conservative to depict the extent of chemicals that may pose a risk to human health or the environment.

ES.2.1. Solid Waste and Soil in the Landfill Area

The contiguous solid waste in the Landfill Area is composed primarily of municipal-type waste and construction debris. The waste was observed in 26 soil borings, 12 monitoring wells, and 25 test pits extended within the Landfill Area. The solid waste includes wood, paper, plastic, metal, glass, asphalt, concrete, and bricks, that are mixed with sand, clay, and gravel fill. Construction debris (such as asphalt, concrete, and brick) is typically inert, and is not expected to generate leachate that would create potential risks to human health or the environment.

In addition to municipal-type waste and construction debris, historic information indicates that industrial wastes were also disposed of in or around the Landfill Area, including sandblast waste, radioluminescent devices, asbestos-containing debris, paint sludge, solvents, and waste oils (NEESA, 1984; Naval Sea Systems Command, 2004). The presence of some of these industrial wastes has been confirmed during the remediation within the polychlorinated biphenyl (PCB) Hot Spot, which extended into a small portion the Landfill Area (BRAC Program Management Office West, 2005b through 2005f). The available characterization data suggest that the quantity of industrial waste within the Landfill Area is less than the quantity of municipal-type waste and construction debris.

The areal extent of solid waste covers approximately 22 acres, and the estimated volume of the solid waste is 473,000 cubic yards. Waste thickness across the Landfill Area varies from less than 10 feet to

greater than 25 feet (with an average thickness of about 13 feet). In most areas of the Parcel E-2 Landfill, waste is in direct contact with groundwater.

The soil data set within the Landfill Area was derived from 254 soil samples collected from the intermittent soil fill mixed within the solid waste. Metals, polychlorinated biphenyls (PCBs), semi-volatile organic compounds (SVOCs), volatile organic compounds (VOCs), and petroleum hydrocarbons were detected at concentrations exceeding the RIEC in soil samples collected at Landfill Area. Nearly all of the chemicals detected in Landfill Area soil at concentrations above RIECs were of a limited extent relative to the overall waste volume. These results indicate that lesser quantities of potentially hazardous industrial wastes are present in the landfill as compared with municipal-type waste and construction debris.

The nature and extent of solid waste and chemicals in soil within the Landfill Area is adequately characterized in order to evaluate a focused set of remedial alternatives in the FS. This determination is based in large part on EPA presumptive remedy guidance for CERCLA landfills (EPA, 1994; EPA, 1996). Consistent with EPA guidance, characterization of the solid waste is not necessary or appropriate for selecting a response action for the Landfill Area.

ES.2.2. Landfill Gas

Landfill gas characterization, consisted of installation of temporary soil gas borings and 21 permanent gas monitoring probes (GMPs). It was determined that methane was present at concentrations exceeding 25 percent of the lower explosive limit (LEL), equivalent to 1.25 percent methane by volume, north of the Parcel E-2 Landfill (including property owned by the University of California San Francisco [UCSF]). Methane was not detected at concentrations exceeding 25 percent of the LEL in locations along Crisp Avenue (approximately 200 feet north of the landfill) or to the east, south, and west of the landfill. Non-methane organic compounds (NMOCs) were detected in both the temporary soil gas borings and the permanent GMPs, with the highest concentrations immediately north of the landfill.

Upon completion of the landfill gas characterization, the Navy conducted an interim removal action to: 1) remove landfill gas and reduce subsurface methane concentrations at the UCSF compound to below the LEL (5 percent methane by volume in air); and 2) control future landfill gas migration to off-site areas. The removal action involved the installation and operation of a gas control, extraction, and treatment system. Monitoring is performed on a monthly basis and includes notification and response procedures in the event that hazardous concentrations of landfill gas (either methane or NMOCs) are detected beyond the fence line of the landfill and beneath the UCSF compound. The data collected as part of the landfill gas characterization study, the time-critical removal action, and the ongoing landfill gas monitoring have adequately defined the nature and extent of landfill gas at Parcel E-2.

ES.2.3. Soil and Isolated Solid Waste in the Adjacent Areas

The nature and extent of the solid waste in the adjacent areas, which consist of the Panhandle Area and East Adjacent Area, is distinct from the solid waste defined in the Landfill Area. Specifically, fill

material in the adjacent areas consists primarily of soil and rock with isolated solid waste locations that are not contiguous with the solid waste in the Landfill Area. Solid waste within the adjacent areas consists of a heterogeneous distribution of construction debris (primarily concrete, brick, wood, and asphalt) and isolated locations of industrial wastes (e.g., sandblast waste, metal slag, radioluminescent devices, and oily waste). Industrial wastes have been encountered in the two Parcel E-2 areas that are being actively remediated. The industrial wastes encountered within the Metal Slag Area (in the Panhandle Area) and the PCB Hot Spot (in the East Adjacent Area) have been removed and disposed off-site.

The soil data set within the adjacent areas was derived from 472 soil samples (113 soil borings and 14 test pits) collected within the Panhandle and East Adjacent Areas. Metals, pesticides, PCBs, furans, SVOCs, and petroleum hydrocarbons were detected at concentrations exceeding RIECs in soil samples collected in the Panhandle and East Adjacent Areas. Soil contamination is less extensive within East Adjacent Area soils at depths greater than 10 feet below ground surface (bgs). This finding is attributed to the fact that the deep soil within the East Adjacent Area consists of either natural sediments or fill material placed during expansion of the shipyard in the early 1940s. Soil contamination is more widely distributed in the Panhandle Area and the shallow zones (0 to 10 feet bgs) of the East Adjacent Area.

The heterogeneous distribution of solid waste and soil contamination makes delineation of potential areas of concern problematic; however, past characterization efforts have provided sufficient data to evaluate potential human health and ecological risk at Parcel E-2 because past sampling locations have focused, to the extent practical, on the most likely contaminant sources (based on a comprehensive review of historic aerial photographs and any visual evidence of contamination).

ES.2.4. Groundwater

Groundwater contamination has been confirmed through sampling across Parcel E-2 in both the A-aquifer and uppermost B-aquifer. The lateral and vertical extent of chemicals in groundwater has been defined across most of Parcel E-2 through a series of investigations and the ongoing groundwater monitoring program. The groundwater chemical extent, however, is not completely defined along the Parcel E-2 shoreline. This uncertainty is highest at the PCB Hot Spot where concentrations of PCB, SVOCs, and total petroleum hydrocarbons (TPH) consistently exceeded RIECs prior to initiating the interim removal action. It is unknown how effective the excavation activities, which have been extended below the groundwater table, will be at reducing groundwater chemical concentrations in this area. Groundwater monitoring will resume in 2007, following replacement of wells that were decommissioned prior to the soil excavation activities.

The major groundwater contaminant groups at Parcel E-2 include VOCs, SVOCs, metals, petroleum hydrocarbons, pesticides, PCBs, and anions (such as ammonia and cyanide). Groundwater sampling results indicate that the concentration and extent of contamination in the uppermost B-aquifer is less than observed in the A-aquifer due to the hydrogeologic and geologic characteristics (presence of Bay Mud)

across most of Parcel E-2. Overall, the number of detected chemicals and the magnitude of the concentrations detected in both aquifers have declined between 1990 and 2005.

ES.2.5. Surface Water

Potential exposure of ecological receptors to unacceptable chemical concentrations in surface water runoff is monitored in accordance with a Storm Water Discharge Management Program (TtEMI, 2003c). Results to date indicate that surface water discharges from the Parcel E-2 Landfill do not pose an unacceptable risk to aquatic receptors in the Bay (TtEMI, 2004d; AFA and EEC, 2005a). The ongoing maintenance of the interim cap and implementation of best management practices (BMPs) serve to minimize erosion from surface water runoff and mitigate potential exposure to ecological receptors. Continued management (through implementation of BMPs) and monitoring of surface water runoff should be evaluated as part of any remedial alternative that leaves contaminated soil in place.

ES.2.6. Shoreline Sediment

Potential risks to ecological receptors, specifically benthic invertebrates, birds and mammals, exposed to intertidal sediments at Parcel E-2 were evaluated in a screening-level ecological risk assessment (SLERA) prepared in conjunction with the Shoreline Characterization Technical Memorandum (included as Appendix G in the RI/FS document). Concentrations of chemical contaminants in surface and subsurface sediment samples collected from the Shoreline Area were screened against toxicological benchmarks for invertebrates, birds, and mammals.

The shoreline SLERA determined 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.

Source control measures are warranted along the Parcel E-2 shoreline, particularly in the metal slag area of the Panhandle Area and the Landfill Area, to control potential releases of copper and lead to Parcel F. In addition, ecological risk to invertebrates, birds, and mammals in the shoreline warrants the evaluation of remedial alternatives for the intertidal sediments along the entire Parcel E-2 shoreline.

ES.3. RISK ASSESSMENTS

Potential risks to human and ecological receptors were evaluated for the following contaminated media: 1) soil; 2) landfill gas; 3) groundwater; and 4) shoreline sediment. The human health risk assessment (HHRA) was performed in accordance with the protocols and procedures for conducting HHRAs at HPS established by the BRAC Cleanup Team. SLERAs for soil and sediment were performed in accordance with Navy policy and EPA guidance.

ES.3.1. Soil

Human Health Risk Assessment

The HHRA calculated cancer risks and noncancer hazards from exposure to chemicals of potential concern (COPCs) in soil for recreational users and construction workers. Both total and incremental risks were evaluated for exposure to soil at Parcel E-2. The total risk evaluation provides an estimate of the risks posed by all chemicals at the site, including those present at concentrations at or below Hunters Point Ambient Levels (HPALs). The incremental risk evaluation provides an estimate of risks posed by all chemicals at the site, except those that do not exceed HPALs. A risk characterization analysis, of both total and incremental risk, identified the following chemicals of concern (COCs) which contribute to cancer risks exceeding 1 x 10^{-6} or noncancer hazard indices exceeding 1.0:

Chemicals of Concern

Recreational User Exposure [a] to Surface Soil (0 to 2 feet bgs)	Construction Worker Exposure [b] to Subsurface Soil (0 to 10 feet bgs)	
Antimony	2,3,4,7,8-PECDF	Cadmium
Aroclor-1248	Antimony	Copper
Aroclor-1260	Aroclor-1016	Dibenz(a,h)anthracene
Arsenic	Aroclor-1242	Dieldrin
Benzo(a)anthracene	Aroclor-1248	Indeno(1,2,3-cd)pyrene
Benzo(a)pyrene	Aroclor-1254	Iron
Benzo(b)fluoranthene	Aroclor-1260	Lead
Benzo(k)fluoranthene	Arsenic	Naphthalene
Dieldrin	Benzo(a)anthracene	Vanadium
Lead	Benzo(a)pyrene	
Indeno(1,2,3-cd)pyrene	Benzo(b)fluoranthene	
PCB-156	Benzo(k)fluoranthene	

Note:

COCs for total risk and incremental risk are identical

[a]COCs identified for this exposure scenario are based on the planned reuse for Parcel E-2 as open space.

[b]The construction worker exposure scenario is not associated with a specific planned reuse for Parcel E-2.

PeCDF = pentachlorodibenzofuran

The highest cancer and noncancer risks were at grid cells located in the PCB Hot Spot. PCBs detected below 3 feet bgs (the initial remediation depth within the PCB Hot Spot) contribute to the elevated risks at these locations; however, remediation depths in many areas of the PCB Hot Spot have been extended to 10 feet bgs (or greater). Risk in these areas is anticipated to be significantly reduced following the removal action.

Screening Level Ecological Risk Assessment

In order to update the previous ecological assessments with recent data collected during the soil data gaps investigation, the Navy implemented the following steps: 1) evaluated the new data set to validate the COPC list used in the previous baseline ecological risk assessment for terrestrial receptors; 2) identified additional chemicals as COPCs and calculated protective soil concentrations (PSCs) for these additional chemicals; and 3) updated the previous ecological assessments by performing a SLERA for onshore receptors using the updated PSCs and surface soil data set. The onshore SLERA evaluated all soil data within the Landfill Area, Panhandle Area, and East Adjacent Area, including data collected within wetland areas. Concentrations of cadmium, copper, lead, manganese, vanadium, and zinc exceeded both PSCs and HPALs, and are considered a potential threat to birds and mammals exposed to soil in Parcel E-2.

ES.3.2. Landfill Gas

Human exposure to subsurface air emanating from the landfill (referred to as landfill gas) can pose a potential risk in two ways: 1) explosive conditions due to concentrations of methane at or above the LEL; and 2) inhalation of NMOCs that, above certain concentrations, have associated cancer and noncancer health effects. Evaluation of these potential risks was performed consistent with regulations outlined in Title 27 of the California Code of Regulations (27 CCR).

For the landfill gas characterization, the evaluation methodology for methane data involved comparing field and laboratory data collected from the monitoring network against the numeric 27 CCR limits. The evaluation methodology for NMOCs involved performing risk assessments on soil-gas data using the Johnson and Ettinger vapor intrusion model (EPA, 2003). Cancer risk calculations for GMPs along Crisp Avenue and within the UCSF compound were less than the NCP point of departure of 1×10^{-6}; therefore, exposure to soil-gas along Crisp Avenue and within the UCSF compound levels do not pose an unacceptable risk to human health.

Based on an evaluation of the available data from January 2004 through January 2006, the control system is controlling the migration of hazardous levels of landfill gas beyond the fence line of the Parcel E-2 Landfill. In January 2006, hazardous levels of landfill gas were detected at the fence line of the landfill. The Navy promptly performed active extraction to control the migration of hazardous levels of landfill gas beyond the fence line of the landfill. The potential exists for landfill gas, if not properly controlled, to migrate beyond the Parcel E-2 Landfill boundary at concentrations that may be hazardous to human health.

ES.3.3. Groundwater

Human Health Risk Assessment

For the evaluation of human exposure to groundwater, the HHRA used groundwater monitoring data from the 12 most recent sampling events (through March 2005) from all Parcel E-2 wells to develop a

conservative exposure concentration for each potentially complete pathway (based on the 95 percent upper confidence limit). The HHRA evaluated B-aquifer groundwater for domestic use; because of the potential for vertical hydraulic communication between the A- and B-aquifers in some areas at Parcel E-2, the evaluation used both B-aquifer and A-aquifer data. In addition, construction workers were also assumed to be exposed to groundwater in the A-aquifer during trenching activities. For groundwater exposures, risks are the same for the total risk and incremental risk evaluations because a comparison to ambient levels was not conducted for groundwater.

The primary risk drivers for the construction worker trench exposure scenario are SVOCs, primarily benzo(a)pyrene and dibenz(a,h)anthracene, which account for more than 95 percent of the total cancer risk exceeding 1×10^{-6}. However, benzo(a)pyrene and dibenz(a,h)anthracene, among other chemicals listed above, have not been detected in Parcel E-2 groundwater since August 2002. In addition, the extent of most SVOCs in Parcel E-2 groundwater has been limited to the PCB Hot Spot removal area.

The primary risk drivers for the domestic use of groundwater exposure scenario are arsenic and PCBs, accounting for over 70 percent of the total cancer risk exceeding 1×10^{-6}. Other risk drivers that contribute significantly to the total cancer risk include tetrachloroethene (PCE), naphthalene, and benzo(a)pyrene, which cumulatively account for approximately 16 percent of the total cancer risk exceeding 1×10^{-6}. The risk evaluation also indicated that the primary non-cancer risk drivers include PCBs, metals (antimony, arsenic, copper, iron, and mercury), and PCE, which account for over 85 percent of the non-cancer risk exceeding a hazard index of 1.0.

Ecological Risk Assessment

Potential risk to aquatic receptors in the Bay was qualitatively evaluated by using promulgated criteria for saltwater aquatic life to identify the following COPCs in groundwater that may pose an unacceptable risk to aquatic receptors:

- Unionized Ammonia
- Cyanide
- Sulfide
- Copper
- Lead
- Mercury
- Zinc
- 4,4'-DDT
- Endosulfan II
- Gamma chlordane
- Heptachlor
- Heptachlor epoxide
- PCBs (Total)
- TPH (Total)

This screening level evaluation is considered preliminary because groundwater near the shore mixes with Bay water prior to discharging into the Bay. A method for comparing groundwater data to aquatic criteria, in a manner that accounts for chemical attenuation and the near-shore mixing process, is required to assess the downgradient impact of shoreline groundwater contamination on the Bay; however, such a method has not been agreed to by the Navy and the regulatory agencies.

ES.4. REMEDIAL INVESTIGATION CONCLUSIONS

Parcel E-2 has been adequately characterized to support the development of a focused set of remedial alternatives. The conclusion that adequate data exist, despite the known data gaps at the site, is consistent with EPA RI/FS guidance. Specifically, EPA RI/FS guidance states that "the objective of the RI/FS process is not the unattainable goal of removing all uncertainty, but rather to gather information sufficient to support an informed risk management decision regarding which remedy appears to be most appropriate for a given site" (EPA, 1988a).

Based on the nature and extent evaluation, the identified exposure pathways based on the conceptual site model, and the risk assessment results, the following media and affected areas pose potential threats to human health and the environment and will undergo remedial option analysis in the FS: 1) solid waste and soil in the Landfill Area; 2) landfill gas; 3) soil and isolated solid waste in the Panhandle and East Adjacent Areas; 4) A-aquifer and B-aquifer groundwater; 5) surface water runoff; and 6) shoreline sediment.

ES.5. FEASIBILITY STUDY

The approach used to conduct the FS consisted of the following steps: develop remediation goals, develop remedial action objectives, identify general response actions, identify areas requiring remediation, and evaluate alternatives based on the nine NCP evaluation criteria. Each of these steps is discussed in the following paragraphs.

ES.5.1. Remediation Goals

Human Receptors

Remediation goals for human receptors were derived for each COC identified in the risk assessments by comparing the highest concentrations of acceptable incremental risk with both the laboratory's reporting limit and the ambient level for the COC, if one was established. The greatest value from this comparison was selected as the remediation goal for that COC. For landfill gas, remediation goals were derived using the numeric 27 CCR limits for methane and by identifying screening levels for NMOCs that are considered protective of human health.

Ecological Receptors

Remediation goals for ecological receptors were derived for COCs identified from the nature and extent evaluation and the risk assessments. For surface soil and shoreline sediment, remediation goals were derived using the corresponding protective soil concentrations (for soil) and effects range-median values (for shoreline sediment) developed as part of the risk assessment process. For surface water runoff, remediation goals were derived using promulgated criteria for saltwater aquatic life. Saltwater aquatic criteria were used in a preliminary evaluation of groundwater discharges; however, a method for comparing groundwater data to aquatic criteria, in a manner that accounts for the near-shore mixing process, is required to establish remediation goals for groundwater discharges into the Bay.

In addition, remediation goals were established for TPH that are commingled with CERCLA-regulated chemicals. The TPH remediation goals were based on criteria established for Hunters Point petroleum program, and were developed for protection of aquatic receptors in the Bay. The TPH criteria sum all TPH categories (gasoline-range, diesel-range, and motor-oil range). The total TPH groundwater criterion ranges from 1,400 to 20,000 micrograms per liter (µg/L), depending on the distance from the shoreline (TtEMI, 2004b). The total TPH soil source criterion is 3,500 mg/kg, and is applied to potential soil sources between 0 and 10 feet bgs (TtEMI, 2002f).

ES.5.2. Remedial Action Objectives

RAOs for Parcel E are medium-specific goals that were developed to protect human health and the environment. Each remedial action objective specifies: 1) the chemical of concern(s); 2) the exposure route and receptor(s); and 3) an acceptable contaminant concentration or range of concentrations for media of concern. The following table summarizes the RAOs developed for Parcel E-2:

Media / Receptor	Remedial Action Objective
Waste, Soil, and Sediment / Human Receptors	Prevent exposure to organic and inorganic compounds greater than the remediation goals in: a) solid waste, soil, or sediment from 0 to 2 feet bgs by recreational users; or b) solid waste, soil, or sediment from 0 to 10 feet bgs by construction workers.
Waste, Soil, and Sediment / Ecological Receptors	Prevent ecological exposure to organic and inorganic compounds in solid waste or soil greater than the remediation goals from 0 to 3 feet bgs by terrestrial receptors throughout Parcel E-2. Prevent ecological exposure to organic and inorganic compounds in intertidal sediment greater than the remediation goals from 0 to 2.5 feet bgs by aquatic receptors throughout the Shoreline Area.
Landfill Gas	Control methane concentrations to: a) 5 percent (by volume in air) or less at the subsurface points of compliance; and b) 1.25 percent (by volume in air) or less in on-site structures. Prevent exposure to NMOCs at concentrations: a) greater than 500 ppmv at the subsurface points of compliance; and b) greater than 5 ppmv above background levels in the breathing zone of on-site workers and visitors.
Groundwater / Human Receptors	Prevent direct exposure to groundwater that may contain COCs greater than the remediation goals through the domestic use pathway. Prevent or minimize migration of B-aquifer groundwater that may contain COCs greater than the remediation goals beyond the compliance boundary. Prevent direct exposure to groundwater that may contain COCs greater than the remediation goals from existing and future groundwater monitoring wells. Prevent or minimize dermal contact and inhalation of volatilized compounds emitted from A-aquifer groundwater containing COCs greater than remediation goals by construction workers.

Media / Receptor	Remedial Action Objective
Groundwater / Ecological Receptors	Prevent or minimize migration of A-aquifer and B-aquifer groundwater into San Francisco Bay that would result in surface water concentrations of COPCs greater than aquatic water quality criteria. Prevent or minimize migration of A-aquifer and B-aquifer groundwater containing total TPH concentrations greater than the remediation goal (where commingled with CERCLA substances) into San Francisco Bay. Monitor potential groundwater migration in areas with total TPH soil concentrations greater than the source criterion of 3,500 milligrams per kilogram (applicable to soil from 0 to 10 feet bgs),
Surface Water / Ecological Receptors	Prevent or minimize migration of surface water that may contain COCs greater than aquatic water quality criteria into San Francisco Bay.

ES.5.3. General Response Actions, Remedial Technologies, and Process Options

General response actions (GRAs) are responses or remedies intended to meet RAOs. The following GRAs were selected for Parcel E-2:

1. No action – which is required by the NCP and is used as a baseline for comparison
2. Institutional actions – includes institutional controls, engineering controls, and site monitoring
3. Containment actions (with or without collection, treatment, and/or disposal) – includes technologies that isolate media to reduce or eliminate exposure to, and off-site migration of, surface and subsurface contaminants
4. Removal actions – includes removal of contaminated media for treatment and/or disposal off site; exposure risk and migration potential are diminished by eliminating or reducing the contaminant source

The technologies and associated process options identified for each GRA were screened using three criteria: 1) effectiveness; 2) implementability; and 3) cost. Screening of the technologies and process options for each GRA are summarized in Figure ES-2. The Parcel E-2 Landfill meets all of the criteria specified in EPA guidance for application of the containment presumptive remedy. However, in light of feedback from members of the local community, the Navy has agreed to fully evaluate excavation of the landfill as part of the FS to provide information to support the community's review of potential remedial alternatives for Parcel E-2. Therefore, removal by excavation and off-site disposal was retained as a potentially viable process option.

In addition, several groundwater containment and alternative landfill gas treatment/destruction process options were retained as viable options that may be appropriate to implement in the future; however, these were not included in any of the proposed remedial alternatives because the need for their implementation cannot be supported by existing data. In the case of groundwater containment, a method for translating contaminant concentrations in groundwater to surface water releases into the Bay, in a manner that accounts for the near-shore mixing process, must be established to determine if groundwater containment

is required to meet RAOs established for Bay protection. In the case of landfill gas, additional data are needed regarding the volume and concentrations of gas within the landfill to determine what type of gas treatment or destruction would be most implementable and cost-effective.

Implementation of any containment or removal action that would alter existing site conditions will impact Parcel E-2 wetlands. Compliance with regulations for wetlands protection (in accordance with the Clean Water Act [Section 404] and the San Francisco Bay Plan [14 CCR, Sections 10110 through 11990]) will require that such impacts be addressed through the established wetlands mitigation process. The following mitigation approaches have been identified: 1) wetlands banking; 2) wetlands restoration within HPS at areas not impacted by chemicals of concern; and 3) wetlands restoration in the Panhandle Area of Parcel E-2 on top of a constructed cap.

ES.5.4. Development of Remedial Alternatives

The following remedial alternatives were developed for Parcel E-2 from the technologies and process options retained for each GRA:

Alternative 1 – No Action: For this alternative, no remedial action would take place. Solid waste, soil, sediment, surface water, and groundwater would be left in place without any response actions (e.g., monitoring, institutional controls, containment, removal, treatment). The no action alternative is included throughout the FS process as required by the NCP to provide a baseline for comparison to and evaluation of other alternatives.

Alternative 2 – Excavate and Dispose of Solid Waste, Soil, and Sediment (including monitoring and institutional controls): This alternative would involve excavation and off-site disposal of all solid waste, debris, and soil in the Landfill Area. Isolated solid waste locations, soil, and sediment in the adjacent areas (which consists of the Panhandle Area, East Adjacent Area, and Shoreline Area) would also be excavated and disposed of off site. Groundwater monitoring would also be included under this alternative to evaluate chemical concentrations in groundwater while the aquifers naturally recover. Additionally, groundwater monitoring would be used to confirm site conditions and to ensure that, over time, the potential exposure pathways would remain incomplete. This alternative would also include institutional controls (including covenants to restrict use of property) that would be implemented across the entire parcel to prevent exposure to COCs in soil and groundwater. In the adjacent areas, wetlands disturbed during the excavation activities would be restored on top of the clean fill.

Alternative 3 – Contain Solid Waste, Soil, and Sediment (including monitoring and institutional controls): This alternative would involve containment of solid waste and soil in the Landfill Area as well as soil and sediment in the adjacent areas. The portions of the Landfill Area not already covered by the existing multilayer cap would be capped with a similarly designed multilayer cap. The isolated solid waste locations and soil in the Panhandle and East Adjacent Areas, as well as sediment within the Shoreline Area, would also be capped with a geosynthetic cap. The cap within the Shoreline Area would also be protected with a revetment wall. In addition, this alternative would include installation, operation, and maintenance of an active landfill gas control system. Monitoring of landfill gas, stormwater, and groundwater would be included under this alternative. This alternative would also include institutional controls (including covenants to restrict use of property) that would be implemented across the entire parcel to prevent exposure to COCs in soil and groundwater. Wetlands disturbed during the construction of the containment systems would be restored on top of the cap in the Panhandle Area.

ES.5.5. Detailed Evaluation of Remedial Alternatives

Each remedial alternative was evaluated in comparison to the two threshold and five balancing evaluation criteria established in the NCP. The two modifying criteria, state and community acceptance, will be assessed in the ROD following comment on the RI/FS and the proposed plan. A comparative analysis was then conducted to evaluate the relative performance of the three remedial alternatives developed for Parcel E-2.

NCP EVALUATION CRITERIA

Threshold Criteria
- Overall protection of human health and the environment
- Compliance with applicable or relevant and appropriate requirements

Balancing Criteria
- Long-term effectiveness and permanence
- Reduction of mobility, toxicity, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost

Modifying Criteria
- State acceptance
- Community acceptance

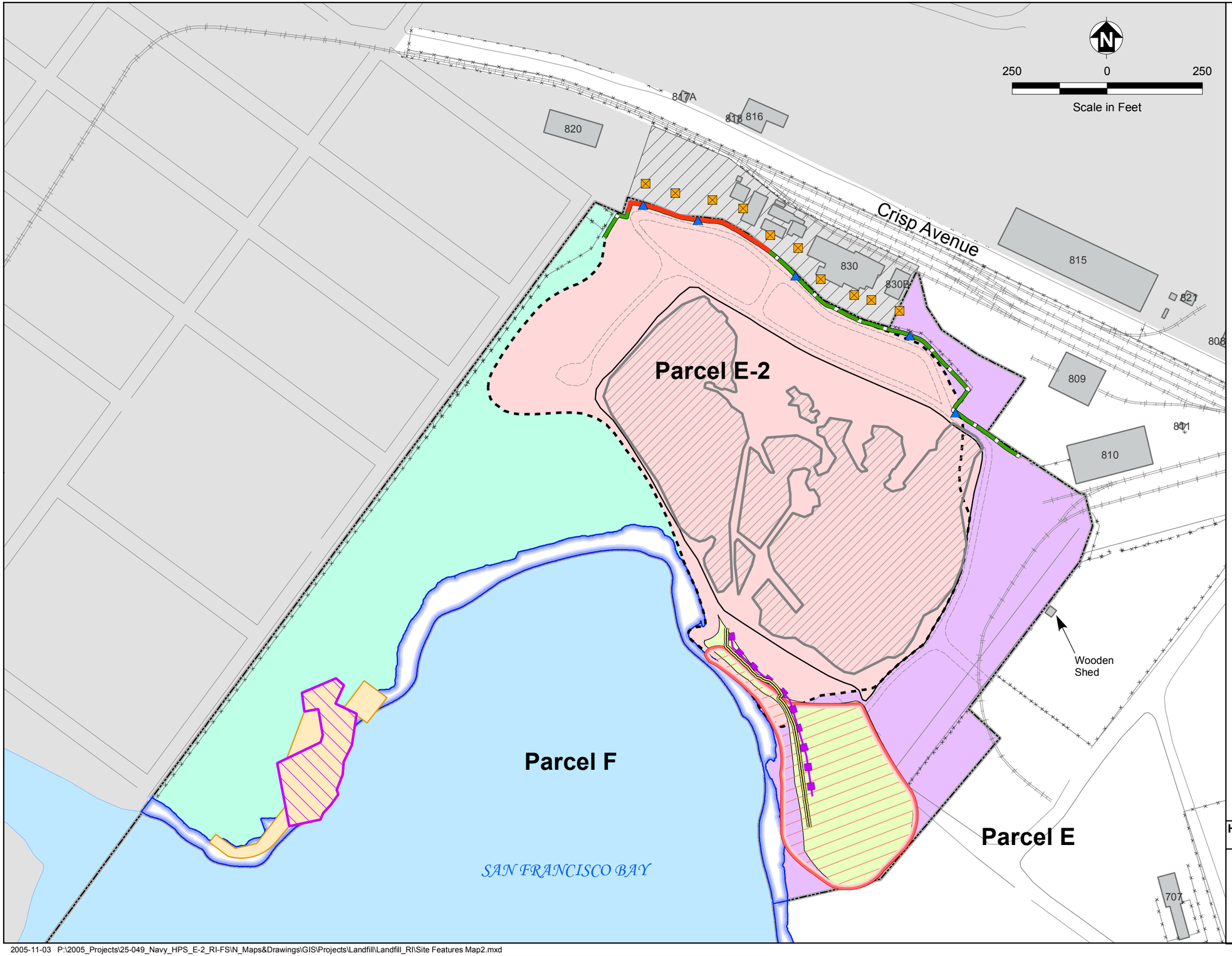
ES.5.6. Comparative Analysis of Remedial Alternatives

The table below summarizes the comparative analysis; showing each alternative's rating under the three threshold criteria and five balancing criteria. The no action alternative (Alternative 1) would not be effective in protecting human health and the environment. Alternatives 2 and 3 would be effective remedial alternatives for Parcel E-2. Based on a comparative analysis, Alternative 3 appears to be the most feasible, predictable, cost effective, time effective and implementable remedy for Parcel E-2. The remedy for Parcel E-2 will be selected in the ROD following comment on the RI/FS and the proposed plan.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP) Criteria	1 No Action	2 Excavate and Dispose Monitor / IC	3 Containment Monitor / IC
Protective Overall?	No	Yes	Yes
Compliant with Applicable or Relevant and Appropriate Requirements?	No	Yes	Yes
Long-term Effectiveness and Permanence	○	●	◕
Reduction of Toxicity, Mobility, or Volume via Treatment	○	◑	◑
Short-term Effectiveness	●	○	◕
Implementability	●	○	◑
Cost ($ Millions)	0	330	74
State Acceptance	To be evaluated after comment on RI/FS		
Community Acceptance	To be evaluated after the Public Comment Period		

Notes:
IC = institutional controls
RI/FS =remedial investigation/feasibility study
○ = low
◑ = moderate
◕ = moderate high
● = high

Figures



Previous Removal Actions

- Interim Landfill Cap

Groundwater Extraction System

- Sheet-Pile Wall
- Extraction Trench

Interim Landfill Gas Control System

- Extraction Wells
- Passive Vents
- HDPE Barrier Wall
- Grouted Section of HDPE Barrier Wall That Can Be Used For Extraction

Recent Removal Actions

- Proposed Metal Slag TCRA
- Actual Metal Slag TCRA*
- Proposed PCB Hot Spot TCRA
- Actual PCB Hot Spot TCRA*

- Burn Area
- Parcel Boundary
- Estimate of Soild Waste Extent
- Landfill Area
- Adjacent Area
- Panhandle Area
- Shoreline Area
- Non-Navy Property
- UCSF Compound
- Building
- San Francisco Bay
- Fence Line
- Road
- Gravel Road
- Railroad

Notes:
HDPE High Density Polyethylene
PCB Polychlorinated Biphenyls
TCRA Time-Critical Removal Action
* Actual boundaries of removal action excavation areas as of September 2006.

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FIGURE ES-1

PARCEL E-2 LOCATIONS AND REMOVAL ACTION AREAS

Remedial Investigation/Feasibility Study for Parcel E-2

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Medium	General Response Action	Remedial Technology	Process Options	Description	Comments	Effectiveness	Implementability	Cost	Retained for Analysis?
Solid Waste and Soil in Landfill, Panhandle, and East Adjacent Areas; Sediment in Shoreline Area	No Action	None	None	No additional action would be taken to address solid waste and soil in the Landfill Area, Panhandle Area or East Adjacent Area.	Required by the NCP and is used as a baseline against which other response actions are compared - would not meet RAOs.	Low	High	No Cost	Yes
	Institutional Actions	Institutional Controls	Legal Mechanisms (Restrictive Covenants, Negative Easements, Deed Notifications); Administrative Mechanisms (Land Use Plans, Soil & Groundwater Procedures & Policies, Construction Permitting, Public Notices & Educational Materials)	Legal and administrative mechanisms used in combination to enforce various land use restrictions such as: • Restrict the use of the parcel to open space • Require maintenance of control systems • Maintain the integrity of covers (or access restrictions where covers are not present) • Require development of a soil and groundwater management plan to be implemented during all intrusive site activities (such as, subsurface construction)	Institutional controls would be integral to and highly effective at maintaining the integrity of any final remedy, and are likely to be included as a part of any alternative that leaves landfill solid waste or other hazardous substances in place.	High	High	Low	Yes
		Engineering Controls (i.e. to limit/restrict access)	Signs (Warning & No Trespassing); Traffic Barriers & Perimeter Fencing	Engineering controls are physical mechanisms that serve to restrict access and potential exposure to contaminated media. Process options include warning and no trespassing signs, engineered barriers to vehicular traffic and perimeter fencing to reduce the potential for direct human contact with contaminated media.	Access restrictions conflict with future open space reuse; to be used during implementation of other remedial technologies.	Low (if used as part of a permanent remedy) High (if used during implementation of an active remediation technology)	Low (if used as part of a permanent remedy) High (if used during implementation of an active remediation technology)	Low	No (to be used in conjunction with other remediation technologies)
		Site Monitoring	Short-Term Monitoring; Long-Term Monitoring	Short-term monitoring involves outdoor air monitoring during construction that may disturb contaminated solid waste, soil, or sediment. Long-term monitoring includes operation and maintenance of control systems (such as, inspection and maintenance of caps/covers).	Short-term and long-term monitoring would be integral components in any remedial alternative implemented at Parcel E-2.	High	High	Low	Yes
	Containment	Caps/Covers	Low-Permeability Soil Cap	The low-permeability soil cap system (Title 27 cover, prescriptive standard) includes a low-permeability soil layer (such as clay) at least 12 inches thick with a maximum permeability of $1x10^{-6}$ cm/sec or equal to the hydraulic conductivity of the base liner system.	No local source of low-permeability soil; costly to purchase and import suitable low-permeability soils.	High	Moderate-High	Moderate-High	No
			Geosynthetic Cap	The geosynthetic cap system (Title 27 cover, engineered alternative) would include a 60-mil-thick HDPE geomembrane in place of the low-permeability soil layer (typical permeability is $1x10^{-13}$ cm/sec)	Highly effective and implementable with proper QA/QC, skilled labor, and appropriate supplies and equipment.	High	High	Moderate	Yes
			Multilayer Geosynthetic Cap	The multilayer geosynthetic cap system includes a composite low-permeability layer consisting of an HDPE geomembrane at least 60 mils thick over a GCL (typical permeability of GCL is $5x10^{-9}$ cm/sec)	Already installed over a portion of the waste area; highly effective and implementable with proper QA/QC, skilled labor, and appropriate supplies and equipment.	High	High	Moderate-High	Yes
			Evapotranspiration Cap	An evapotranspiration cap is typically a 4- to 6-foot-thick soil layer over a soil foundation layer; it acts to store moisture within the cap thickness, while minimizing infiltration, until the moisture is removed through vegetative uptake or evaporation.	Diminished effectiveness in temperate climates; ideal in arid or semi-arid climates; would require importation of a significant amount of cover soil and may encroach on neighboring property.	Moderate	Low	Moderate to High	No
		Shoreline Protection *	Armoring	Armoring includes seawalls, bulkheads, and protective revetments.	Armoring would protect the containment systems from erosion, provide a termination point for the cap, and allow wetlands to be established in the Panhandle Area.	High	High	High	Yes
			Beach Stabilization Structures	Beach stabilization structures, such as headland and nearshore breakwaters, groins, sills and reefs, and wetlands; moderate the coastal sediment transport processes to reduce the local erosion rate.	Beach stabilization structures would not prevent erosion during greater than average storm events.	Low to Moderate	High	Moderate to High	No
			Beach Nourishment	Beach nourishment can include berms, dunes, feeder beach, nearshore berm, dune stabilization, or structural stabilization.	Inadequate area for proper implementation; would not prevent erosion.	Low	High	Moderate	No
	Removal Actions	Excavation and Off-Site Disposal	RCRA Facility; Non-RCRA Facility; LLRW Facility	Includes the excavation and off-site disposal of all solid waste and impacted soil.	Multiple issues associated with excavation and transport of such a large volume of landfill solid waste and soil.	Moderate-High	Low-Moderate	Very High	Yes (to support community review of potential remedies)
		Excavation and On-Site Disposal	Consolidation in Parcel E-2 Landfill	Eliminated from consideration due to volume of material considered for removal from adjacent areas.		N/A	N/A	N/A	N/A
			Consolidation in other site landfill	Eliminated from consideration because no other landfills are located on site.		N/A	N/A	N/A	N/A

Legend

- Retained for use in Remedial Alternatives
- Retained for possible future incorporation (based on future site data)
- Eliminated from consideration

Notes:

* Required in Shoreline Area

Acronyms defined on page 4

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FIGURE ES-2
Results of Remedial Technologies and Process Options Evaluation

Remedial Investigation/Feasibility Study for Parcel E-2

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