Section 8. Remedial Investigation Summary and Conclusions

According to EPA guidance, the goal of an RI/FS is to provide the information necessary to: 1) adequately characterize the site; 2) define site dynamics (by developing a conceptual site model); 3) define risks; and 4) develop the response action (EPA, 1991a). The information contained in Sections 1 through 7 of this report satisfy the first three of these goals, and the FS presented in the forthcoming sections will satisfy the fourth goal by developing the response action for Parcel E-2.

Subsection 8.1 presents an overview of the RI approach used to satisfy the first three goals. Subsections 8.2 through 8.7 summarize the RI findings for each of the media affected by site contamination:

- Solid waste and soil in the Landfill Area (Subsection 8.2)
- Landfill gas (Subsection 8.3)
- Soil and isolated solid waste in the adjacent areas (Subsection 8.4)
- Groundwater (Subsection 8.5)
- Surface water (Subsection 8.6)
- Shoreline sediment (Subsection 8.7)

Subsection 8.8 provides a summary of the affected media for which remedial option analysis in the FS is required.

8.1. REMEDIAL INVESTIGATION APPROACH

The Navy's overall approach in achieving the first three goals of the RI/FS process is summarized in the following subsections.

8.1.1. Site Characterization

The RI evaluated all characterization data collected during the past investigations, interim actions, and monitoring programs. The soil, soil gas, and groundwater data used in these evaluations were obtained from RI field activities (1988 to 1996), subsequent data gaps investigations (2000 to 2003), and ongoing monitoring programs (2003 to present). The 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 regulatory criteria; the evaluation criteria (referred to as RIECs) were selected to be adequately conservative to depict the extent of chemicals that may pose a risk to human health or the environment. The processes for selecting soil and groundwater RIECs were discussed in Subsections 4.1.3.2 and 5.6, respectively. Finally, potential data gaps were identified, and an assessment was made of the uncertainty resulting from these data gaps.

The site characterization data was presented and evaluated in the following portions of this document:

- The physical characteristics of Parcel E-2, including geology, hydrogeology, hydrology, and ecology, were discussed in Section 2. This information was derived from numerous soil and groundwater investigations and several specialized studies, including aquifer tests, tidal influence studies, and ecological assessments.
- A chronology and summary of past investigations, interim actions, and monitoring programs was presented in Section 3.
- The nature and extent of solid waste, landfill gas, and chemicals in soil within the three onshore study areas (the Landfill Area, East Adjacent Area, and Panhandle Area) were discussed in Section 4, and are summarized briefly in Subsections 8.2, 8.3, and 8.4.
- The nature of extent of chemicals in groundwater was discussed in Section 5, and is summarized briefly in Subsection 8.5.
- The nature and extent of chemicals in sediments within the Shoreline Area were defined during the SDGI, and this assessment was presented in the Shoreline Characterization Technical Memorandum (SulTech, 2005) (Appendix G).
- Characterization information for outdoor air and surface water runoff was presented in Subsections 3.7 and 3.9.3, respectively.

It should be noted that an evaluation of the nature and extent of radioactive materials at Parcel E-2 was not presented in this version of the RI/FS report. A brief summary of radiological investigations performed at Parcel E-2 (from 1988 to 2002) was provided in Subsection 3.6. The most recent radiological investigation at Parcel E-2 was completed in 2005, and will be summarized in a forthcoming addendum to this RI/FS report.

8.1.2. Conceptual Site Model

The conceptual site model is an understanding of the dynamics of the site's environmental concerns, and serves as the basis for the development of the RAOs. The conceptual site model is used to understand potential sources of contamination, migration pathways, and human and ecological receptors that the RAOs are intended to address. The conceptual site model was developed by incorporating site-specific landfill characteristics into EPA's generic site conceptual model for municipal landfills (EPA, 1991a).

The primary potential source of contamination at Parcel E-2 is solid waste in the Landfill Area. The landfill solid waste is defined by the physical presence of contiguous industrial or municipal-type wastes; however, the landfill solid waste also includes construction debris and soil fill. Another primary potential source of contamination is the industrial waste disposed of in the East Adjacent Area and Panhandle Area. Potentially affected media at Parcel E-2 consist of soil, subsurface air (emanating from the landfill), outdoor air, groundwater, surface water runoff, intertidal sediment, and wetlands (tidal and freshwater).

Based on this model, exposure pathways, exposure points, and potential receptors were identified for each contaminated medium (soil, subsurface air, groundwater, surface water, sediments, and wetlands). Outdoor air (referred to as air/dust on Figure 6-3) does not present a primary exposure pathway because, as discussed in Subsection 6.2.3, dust mitigation and removal actions are adequately controlling airborne dust contamination. However, the HHRA evaluates potential exposure to contaminated soil that may migrate to outdoor air through wind suspension and volatilization.

8.1.3. Site Risks

Potential risks to human and ecological receptors were evaluated for each of the contaminated media identified above. The risk evaluations performed for each media are listed below, and are discussed in Subsections 8.2 through 8.7.

Human Receptors

- A quantitative HHRA was performed for soil within the Landfill Area, Panhandle Area, and East Adjacent Area. The results were presented in Subsection 7.1, and are summarized briefly in Subsections 8.2 and 8.4.
- Human health risk to NMOCs in landfill gas was evaluated using the Johnson and Ettinger vapor intrusion model (EPA, 2003), and resulted in the development of an NMOC action level of 500 ppmv. These activities were discussed in Subsection 4.1.2.2, and are summarized briefly in Subsection 8.3.3.
- A quantitative HHRA was performed for groundwater throughout Parcel E-2. The results were presented in Subsection 7.1, and are summarized briefly in Subsection 8.5.

Ecological Receptors

- An onshore SLERA was performed for soil within the Landfill Area, Panhandle Area, and East Adjacent Area. The results were presented in Subsection 7.2 and Appendix L, and are summarized briefly in Subsections 8.2 and 8.4.
- An offshore SLERA was performed for intertidal sediment within the Shoreline Area. The results were presented in Subsection 7.2 and Appendix G, and are summarized briefly in Subsection 8.7.
- A preliminary evaluation of ecological risk to aquatic receptors in the Bay is provided in Appendix M, and is summarized briefly in Subsection 8.5. The identified chemicals in Appendix M are considered COPCs (that is, of potential concern) given the qualitative nature of the analysis. A quantitative analysis that would identify COCs and specify risk-based remediation goals cannot be prepared at this time.
- Potential exposure of ecological receptors to unacceptable chemical concentrations in surface water runoff is monitored in accordance with a SWDMP that was originally published in 2003 (TtEMI, 2003c). The results of the Parcel E-2 stormwater program were discussed in Subsection 3.9.3, and are summarized briefly in Subsection 8.6.
- Potential risks to ecological receptors from exposure to wetlands soil and sediment were evaluated in conjunction with the offshore and onshore SLERAs (Appendices G and L, respectively). However, very little soil and sediment data have been collected because of the

limited investigation activities conducted within wetland areas given their sensitive ecological nature. In the absence of such data, it is assumed that soil and sediment conditions in the wetland areas are similar to the adjoining areas.

8.2. SOLID WASTE AND SOIL IN THE LANDFILL AREA

The following subsections summarize the nature and extent of solid waste and chemicals in soil within the Landfill Area of Parcel E-2 (Subsection 8.2.1), the results of the risk assessments (Subsection 8.2.2), and the overall conclusions for the Landfill Area (Subsection 8.2.3).

8.2.1. Nature and Extent of Solid Waste and Chemicals in Soil

The nature and extent of contamination at the Parcel E-2 Landfill was evaluated based on information from the previous investigations and interim actions described in Section 3. The EPA's presumptive remedy guidance states that "characterization of a landfill's contents is not necessary or appropriate for selecting a response action for these sites except in limited cases; rather, existing data are used to determine whether the containment presumption is appropriate" (EPA, 1993a). EPA guidance provides a framework for determining whether the containment presumptive remedy applies to a specific military landfill (EPA, 1996). The first step is to evaluate the available information to determine the sources, types, and volumes of landfill wastes. The following subsections outline the available information for the Parcel E-2 Landfill to support this evaluation. The remaining steps in the decision framework will be discussed in Subsection 8.2.3.

8.2.1.1. Waste Types Encountered During Field Activities

Based on data from the 26 soil borings, 12 monitoring wells, and 25 test pits extended within the Landfill Area (Figures 3-1 and 3-2), the contiguous solid waste is composed primarily of municipal-type waste and construction debris. 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. Inert waste does not contain significant quantities of putrescible (i.e., decomposable) waste, and is not expected to generate leachate that would create potential risks to human health or the environment. The presence of construction debris, although typically considered an inert waste, was evaluated in conjunction with municipal-type waste because certain types of construction debris (most notably wood) and most municipal-type wastes readily biodegrade and may be considered putrescible.

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; NAVSEA, 2004). The presence of some of these industrial wastes has been confirmed during the ongoing remediation within the PCB Hot Spot, which extends into a small portion the Landfill Area (Figure 1-3). Small quantities of low-level radioactive wastes from the disposal of radioluminescent devices and potentially-radioactive sandblast grit have been encountered during implementation of the

PCB Hot Spot removal (BRAC PMO West, 2005b through 2005f). As of September 2006, approximately 324 cubic yards of soil and sediment were segregated as radiologically impacted (out of a total excavated volume of 44,500 cubic yards). Also, 41 radiological devices and 108 cubic yards of fire brick were identified within the removal area (BRAC PMO West, 2006c). In addition to this radiologically impacted debris, 110 drums and 537 assorted waste containers were recovered from the removal area (BRAC PMO West, 2006c). The waste characterization data for these drums and containers are not available for this Draft RI/FS, but this data will be provided in the removal action completion report. 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.

Additional information on subsurface conditions in the Landfill Area was obtained during the installation of the sheetpile wall in the southeast portion of Parcel E-2 (Figure 1-3). In September 1997, an obstruction was encountered at a depth of approximately 20 feet bgs, accompanied by a release of pressurized gas to the surface. The atmosphere in this area was monitored for health and safety purposes, specifically for explosive conditions (using an LEL meter) and various compounds including natural gas, chlorine, and hydrogen sulfide (using colorimetric indicator tubes). Sporadic detections of atmospheric conditions above 10 percent of the LEL and chlorine gas above 5 ppm were encountered during the health and safety monitoring. Approximately 80 feet of the sheetpile wall (as originally designed) was re-aligned to avoid the subsurface obstructions. The alternate alignment consisted of an approximate 50-foot-long section that was off-set approximately 20 feet from the design alignment, with the remaining portion gradually angling back to the design alignment. The remainder of the sheetpile wall was completed with no additional releases of subsurface gas (IT, 1999). These subsurface conditions may be indicative of solid waste at this location, and the sporadic detections of chlorine gas are a health and safety concern because they are above the permissible exposure limit (established by the Occupational Health and Safety Administration) of 1 ppm. However, no definitive conclusions regarding the nature of the potential waste at this depth can be drawn from the observed conditions.

8.2.1.2. Operating History

Overall, the operating history of the Parcel E-2 Landfill is not well documented (TtEMI, LFR, and Uribe, 1997). The following items summarize the available historic information:

- The IAS indicated that, between 1958 and 1974, the Navy created the Parcel E-2 Landfill by placement of a variety of shipyard wastes, including construction debris, municipal-type solid waste, and industrial waste (including sandblast waste, paint sludge, solvents, and waste oils) (NEESA, 1984).
- The HRA indicated that the Parcel E-2 Landfill, along with other areas within Parcels E and E-2, was a disposal area for radioluminescent devices (primarily containing radium-226), and that the landfill was a potential disposal area for wastes from decontamination of ships used in atomic testing (NAVSEA, 2004)

- An oily waste area was identified on the NAVFAC drawings along the western perimeter of the Landfill Area (NAVFAC Western Division, 1974). During preliminary closure activities in 1974, ponded liquid was removed and the top 6 inches of soil at the oily waste area was scarified before the soil cover was placed. Based on borings and exploratory trenches, this area also was partially filled with solid waste during closure; therefore, this area is included within the boundaries of solid waste at the Parcel E-2 Landfill (TtEMI, 2004f).
- Triple A allegedly disposed of industrial debris, sandblast waste, oily industrial sand, and asphalt over an area of approximately 5 acres along the shoreline of Parcel E-2. In addition, Triple A allegedly stored unlabeled, deteriorating, uncovered drums with their contents exposed to the elements in the southeast corner of Parcel E-2 (Figure 1-11) (San Francisco District Attorney, 1986).
- Waste fuel and waste oil containing PCBs were used at the Parcel E-2 Landfill as dust suppressants (TtEMI, LFR, and Uribe, 1997).

8.2.1.3. Nature and Extent of Chemicals in Soil

The soil data set within the Landfill Area was derived from 254 soil samples (26 soil borings, 12 monitoring wells, and 25 test pits) collected from the intermittent soil fill mixed within the solid waste. As discussed in Subsection 4.2.4, the soil characterization data is used to assess the approximate lateral and vertical extent (relative to the landfill waste volume) of hazardous substances above the RIECs, and to provide a basis for determining whether lesser quantities of hazardous wastes are present in the landfill as compared with municipal wastes. In addition, the characterization data are used to identify potential hot spots (defined as locations containing chemical concentrations 100 times greater than the corresponding RIEC) within the Landfill Area, and, based on criteria established by the EPA, to determine whether these hot spots require more extensive characterization and development of remedial alternatives.

Metals, PCBs, SVOCs, VOCs, and petroleum hydrocarbons were detected at concentrations exceeding the RIEC in soil samples collected at Landfill Area. These chemical detections above the RIECs are summarized as follows:

- Eight metals (antimony, arsenic, cadmium, chromium, copper, iron, lead, and vanadium) were detected at concentrations exceeding the RIECs at depths greater than 2 feet bgs.
- Total PCBs were detected at concentrations exceeding the RIEC at depths greater than 2 feet bgs, including six samples containing concentrations greater than 100 mg/kg. These concentrations were greater than 100 times the RIEC (0.74 mg/kg) and, as defined in Subsection 4.2.4, may be considered potential hot spots within the landfill.
- SVOCs were detected at concentrations exceeding the RIECs throughout the Landfill Area. The number of SVOC exceedances is highest in the 2- to 10-feet-bgs range.
- VOCs were detected at concentrations exceeding the RIECs at depths greater than 10 feet bgs in three different locations.
- Total TPH (TPH-g, TPH-d, and TPH-mo combined) was detected at concentrations exceeding the TPH source criterion (3,500 mg/kg) at depths greater than 2 feet bgs.

Based on the data presented in Table 4-23, soil contamination is less extensive within Landfill Area soil at depths of 0 to 2 feet bgs. This is attributed to the fact that the upper two feet of soil in the Landfill Area is comprised of relatively clean fill that was placed during closure activities in 1974. Residual SVOC contamination in this interval can be attributed to surface releases after 1974.

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. Several compounds, such as SVOCs, were detected throughout the Landfill Area at concentrations above RIECs but below that indicative of hot spots. These results demonstrate that lesser quantities of potentially hazardous industrial wastes are present in the landfill as compared with municipal-type waste and construction debris.

The potential PCB hot spots within the Landfill Area were localized relative to the overall waste volume and were relatively deep (8 to 17 feet bgs). In addition, these potential PCB hot spots do not appear to have migrated to groundwater within the landfill. In groundwater sampling performed since 2001 at the ten monitoring wells either co-located or in close proximity to the potential soil hot spots (Figure 5-26), PCB concentrations in groundwater were either not detected above laboratory reporting limits or detected sporadically (at well IR01MW38A in one out of six events since August 2002). Groundwater samples collected from these wells in 1991 and 1992 did contain elevated PCB concentrations above the typical solubility limit of PCB compounds (2.7 μg/L); however, as stated in Section 5.3.2.1, these results may not be representative of dissolved-phase PCB concentrations because sampling protocols used at the time did not employ techniques to minimize the amount of entrained sediment in water samples. This potential scenario is important because PCBs very readily adsorb to entrained sediment in an aqueous sample, but also readily desorb during the extraction process associated with analytical testing. Finally, these potential PCB hot spots are located 390 to 780 feet from the Parcel E-2 shoreline and, based on data presented on Figures 4-17, 4-35, and 5-26, show no connection with the PCB Hot Spot currently being remediated in the East Adjacent Area.

8.2.1.4. Lateral and Vertical Extent of Solid Waste

Determination of the extent of solid waste at the Parcel E-2 Landfill is based on the physical presence of contiguous industrial or municipal-type wastes. Overall, the lateral and vertical extent of solid waste at the Parcel E-2 Landfill has been adequately defined by the soil borings and test pits installed within, and adjacent to, the Landfill Area.

The lateral extent of waste at the Landfill Area is shown on Figure 3-1. The northern extent of waste was determined to be along the fence line separating Parcel E-2 from the UCSF compound (along the gas control system barrier wall). The eastern edge of the solid waste is located beneath the interim landfill cap. The southeastern edge of solid waste is located adjacent to the shoreline, and the southwestern edge is located adjacent to the freshwater wetlands within the Panhandle Area. The western edge of solid waste is located adjacent to the drainage channel along the western property boundary.

The waste interval is generally located between 21 feet above and 14 feet below msl, and varies in thickness from 10 to 25 feet. In most areas of the Parcel E-2 Landfill, waste is in direct contact with groundwater. The northwest corner of the landfill is the only area where waste is not in direct contact with groundwater.

8.2.1.5. Size/Volume

The physical extent of solid waste covers approximately 22 acres (TtEMI, 2004f). Based on a review of the geologic cross-sections presented in Section 2, 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). The estimated volume of the solid waste in the Landfill Area is approximately 473,000 cubic yards (including soil fill contained within the solid waste but excluding the overlying soil cover).

8.2.2. Risk Assessments for Landfill Area

The following subsections present the results of the human health and ecological risk assessment performed on soil data within the Landfill Area.

8.2.2.1. Human Health Risk Assessment

Although use of the landfill presumptive remedy typically allows for qualitative risk evaluations in lieu of more detailed quantitative evaluations, a quantitative HHRA was performed because the Panhandle and East Adjacent Areas do not meet the criteria for application of the containment presumptive remedy. The results of the HHRA helped determine whether risks attributed to the waste within the Landfill Area are "low-level" and therefore consistent with EPA's definition of municipal-type waste suitable for application of the containment presumption.

Methodology

The HHRA calculated cancer risks and noncancer hazards from exposure to COPCs in soil for adult and child recreational users and adult construction workers. Half-acre exposure grids were used to evaluate recreational and construction worker exposures. The evaluation of risks from exposure to soil at Parcel E-2 includes both a total risk assessment and an incremental risk assessment. The total risk evaluation estimated the risks posed by chemicals at the site, including those present at concentrations at or below ambient levels. The incremental risk evaluation also provides an estimate of the risks posed by chemicals at the site, but does not include the risks for those chemicals present at or below ambient levels. Preparation of the incremental HHRA is required by Navy policy.

The HHRA did not include radioactive compounds as COPCs because, as discussed in Subsection 8.1.1, the radiological characterization at Parcel E-2 was completed in 2005 and the results were not available for inclusion in this version of the RI/FS. Potential risks associated with human exposure to radioactive compounds at Parcel E-2 will be summarized in the draft final version of this RI/FS report.

Results

For the recreational exposure scenario (Figure 7-3), the results of the incremental risk evaluation indicated that the COCs were several SVOCs (primarily benzo[a]pyrene). Of the 60 exposure grid cells located either completely or partially within the Landfill Area, 14 grid cells had exposure point concentrations (for soil from 0 to 2 feet bgs) resulting in risk above one or more of the risk thresholds (1×10^{-6} for cancer risk; segregated HI of 1.0 for noncancer risk; and 155 mg/kg for lead exposure). Of the remaining 44 grid cells, 12 grid cells did not exceed any risk thresholds and 34 grid cells contained no data on which risk calculations could be based. For grid cells with risk above one or more of the risk thresholds (Table 7-3), cancer risks ranged from 3×10^{-6} to 3×10^{-5} total noncancer HIs were less than 1.0. The cited ranges exclude the risk from grid cell AD33 (total cancer risk of 2×10^{-4} and a total noncancer HI of 4.24) because all data within this grid cell were located in the Panhandle Area.

For the construction worker exposure scenario (Figure 7-4), the results of the incremental risk evaluation indicated that the COCs were antimony, arsenic, cadmium, copper, iron, lead, vanadium, several SVOCs (primarily benzo[a]pyrene), and several PCBs (primarily Aroclor-1260). Of the 60 exposure grid cells located either completely or partially within the Landfill Area, 23 grid cells had exposure point concentrations (for soil from 0 to 10 feet bgs) resulting in risk above one or more of the risk thresholds. Of the remaining 37 grid cells, 16 grid cells did not exceed any risk thresholds and 21 grid cells contained no data on which risk calculations could be based. For grid cells with risk above one or more of the risk thresholds (Table 7-7), cancer risks ranged from 2×10^{-6} to 1×10^{-4} and total noncancer HIs ranged from less than 1.0 to 182.

Conclusions

The results of the HHRA demonstrate that risk for the planned reuse scenario (recreational exposure) is lower than for the potential construction worker exposures. This finding is expected because potential recreational user exposure is limited to soil at 0 to 2 feet bgs, which consists of soil cover overlying the solid waste, while potential construction worker exposure is from 0 to 10 feet bgs (or into the solid waste). The risk for the recreational exposure scenario is associated entirely with SVOC concentrations that were attributed to surface releases following closure of the landfill in 1974. The results of the HHRA also indicate that, for both the recreational user and construction worker exposure scenarios, cancer risks are within the risk management range of 10^{-6} to 10^{-4}.

The data distribution within the Landfill Area is considered adequate to evaluate potential human health risks relative to the framework established in EPA guidance for CERCLA landfills. The purpose of the quantitative HHRA was not to characterize risk within each exposure area, and grid cells with no data may contain chemical concentrations that could result in risks of the same relative magnitude as found elsewhere in the Landfill Area. In addition, the quantitative HHRA was performed within the Landfill Area in order to be consistent with the HHRA in the adjacent areas (the Panhandle and East Adjacent Areas), and to verify that risks attributed to the waste within the Landfill Area are “low-level” and therefore consistent with EPA's definition of municipal-type waste suitable for application of the containment presumption.

8.2.2.2. Screening Level Ecological Risk Assessment

In order to update the previous ecological assessments with recent data collected during the SDGI, the Navy implemented the following steps: 1) evaluated the new data set to validate the COPC list used in the previous baseline ERA for terrestrial receptors; 2) identified additional chemicals as COPCs and calculated PSCs for these additional chemicals; and 3) updated the previous ecological assessments by performing a SLERA for onshore receptors (Appendix L) 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, vanadium, and zinc exceeded both PSCs and HPALs, and are considered a potential threat to birds and mammals exposed to soil in the Landfill Area. As shown on Figure 7-5, 4 out of 23 locations in the Landfill Area contained soil concentrations above the PSCs and HPALs. This finding is expected because potential risk at these locations was driven by samples collected either at 2 feet bgs (at the interface between the soil cover and underlying solid waste) or deeper than 2 feet bgs (into the solid waste). Similar to the HHRA conclusions, the data distribution within the Landfill Area is considered adequate to evaluate potential ecological risks, and areas with no data may contain chemical concentrations that would result in risks of the same relative magnitude as found elsewhere in the Landfill Area.

8.2.3. Conclusions for Solid Waste and Soil in Landfill Area

As discussed in Subsection 1.4, the EPA has developed a specialized RI/FS process for municipal landfill sites (EPA, 1991a; EPA, 1993a; EPA, 1993b; EPA, 1994) that allows the RI/FS to be streamlined, provided that certain conditions are met, so that a "presumptive remedy" may be implemented. Use of the streamlined process is intended to improve and accelerate the site characterization and remedy evaluation process, and to ensure consistent evaluation of remedial actions at similar sites. Use of this streamlined process is considered appropriate for the Landfill Area. Therefore, the following conclusions regarding the site characterization efforts (Subsections 8.2.3.1 and 8.2.3.2) and risk evaluations (Subsection 8.2.3.3) are discussed in the context of the presumptive remedy framework for CERCLA landfills. The validity of applying the presumptive remedy to the solid waste and soil in the Landfill Area is discussed in Subsection 8.2.3.4.

8.2.3.1. Conclusions for Overall Landfill Characterization

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). As discussed in Subsection 8.2.1, characterization of the solid waste is not necessary or appropriate for selecting a response action for the Landfill Area. Instead, existing data are used to answer two questions outlined in EPA guidance (EPA, 1996):

1. Do landfill contents meet municipal landfill-type waste definition?
2. Are military-specific wastes present?

Adequate data exists to answer these questions, as presented in the following paragraphs.

Do landfill contents meet municipal-type waste definition?

The landfill contents meet the municipal-type waste definition, as outlined in EPA guidance, based on the following lines of evidence:

- Risks are low-level (except for potential hot spots): The results of the HHRA also indicate that, for both the recreational user and construction worker exposure scenarios, cancer risks are within the risk management range of 10^{-6} to 10^{-4}.
- Treatment is impractical due to the volume and heterogeneity of the waste: The landfill covers 22 acres and has an estimated solid waste volume of 710,000 cubic yards (excluding the surrounding soil fill). The solid waste is a heterogeneous mixture of municipal-type waste, construction debris, and industrial waste.
- Waste types include household, commercial, non-hazardous sludge, and industrial solid waste: The predominant constituents of the solid waste are household/commercial refuse and construction debris. Other waste types, found in lower proportion, include industrial solid waste (such as sandblast waste) and waste oils, and may include asbestos-containing debris, paint sludge, and solvents.
- Lesser quantities of hazardous wastes are present as compared to municipal wastes: Based on an evaluation of 254 soil samples collected from the intermittent soil fill mixed within the solid waste, nearly all of the hazardous substances detected in Landfill Area soil were of a limited extent relative to the overall waste volume. Several compounds, such as SVOCs, were detected throughout the Landfill Area at concentrations above the RIEC but not indicative of hot spots.
- Land application units, surface impoundments, injection wells, and waste piles are not included: None of these features are present at the Parcel E-2 Landfill.

Are military-specific wastes present?

Based on the findings of the HRA (NAVSEA, 2004), low-level radioactive wastes may be present in and around the Parcel E-2 Landfill. These wastes consist primarily of buried radioluminescent devices (typically covered with paint containing radium-226), but may also include sandblast waste used to decontaminate ships used in atomic testing. Based on information from the ongoing PCB Hot Spot removal action (which extends partially into the Landfill Area), such low-level radioactive waste are found in low proportion relative to other waste types. According to EPA guidance, low-level radioactive wastes are considered “low-hazard military-specific wastes,” and “generally are no more hazardous than some wastes found in municipal landfills” (EPA, 1996).

Other types of "low-hazard" military-specific wastes include decontamination kits and munitions hardware. Although there is no information to indicate that such wastes were disposed of at the Parcel E-2 Landfill, these types of materials may have been used at the shipyard. The only reported munitions storage was at Building S-807 (located in the former Parcel A). This building was a bunker-like concrete structure approximately 10 feet wide, 3 feet deep, and 5 feet high that was reportedly used by the Navy to store small caliber munitions for hand-held weapons (AFA and Golder, 1996). Based on this information, decontamination kits and munitions hardware, if present at all, likely would only be found in low proportion relative to other waste types and would be no more hazardous than some wastes found in municipal landfills.

The "low-hazard" military-specific wastes discussed above are distinct from "high-hazard" military-specific wastes, which include chemical warfare agents, artillery, bombs, and other military chemicals. There is no anecdotal information, documentation, or physical evidence that such "high-hazard" military-specific wastes were ever used at HPS. Further, the shipyard's primary mission of fleet repair and maintenance did not include weapons storage.

8.2.3.2. Conclusions for Characterization of Potential Hot Spots

Existing data are also used to identify hot spots within a landfill, and to determine if additional characterization and/or treatment of these hot spots are warranted. EPA guidance poses four specific questions in regard to determining whether or not hot spots require characterization and/or treatment. If all of the questions can be answered in the affirmative, it is likely that characterization and/or treatment of hot spots is warranted (EPA, 1993a). The four questions outlined below include the Navy's answers regarding the potential PCB hot spots in the Landfill Area.

1. <u>Does evidence exist to indicate the presence and approximate location of waste?:</u> Yes. PCBs have been detected at concentrations greater than 100 mg/kg at several locations within the Landfill Area.

2. <u>Is the hot spot known to be a principal threat waste?:</u> No. According to the EPA guidance entitled "A Guide to Principal Threat and Low Level Threat Wastes" (EPA, 1991b), principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. The potential PCB hot spots identified within the Landfill Area were found to: 1) be located at relatively deep depths (8 to 17 feet bgs); 2) not have migrated to A- or B-aquifer groundwater; 3) be located far from the Parcel E-2 shoreline (390 to 780 feet); and 4) not be connected with the PCB Hot Spot currently being remediated in the East Adjacent Area. Based on this information, the potential PCB hot spots are not highly mobile and, given their depth and relative distance from the shoreline, can be reliably contained.

3. Is the waste in a discrete, accessible part of the landfill?: No. The potential PCB hot spots are located at relatively deep depths (8 to 17 feet bgs), and within the solid waste (rather than at the edge of the waste).

4. Is the hot spot known to be large enough that its remediation will reduce the threat posed by the overall site, but small enough to consider removal?: No. Based on the soil and groundwater data from surrounding areas, the potential PCB hot spots are not considered large enough that remediation will reduce the potential risk posed by the Landfill Area. Further, the potential PCB hot spots do not drive risk to human health or the environmental because of their depth and lack of migration to groundwater.

These findings demonstrate that characterization and/or treatment of the potential PCB hot spots within the Landfill Area is not warranted.

8.2.3.3. Conclusions for Risk Evaluations in Landfill Area

The quantitative HHRA and onshore SLERA determined that several locations in the Landfill Area contain chemical concentrations in soil that result in unacceptable levels of risk for human and ecological receptors. However, the majority of these areas (excluding the potential hot spots discussed in Subsection 8.2.3.2) contain chemical concentrations that are low relative to their corresponding risk-based thresholds (such as, human-health RBCs or ecological PSCs). In addition, areas with no data may contain chemical concentrations that would result in risks of the same relative magnitude as found elsewhere in the Landfill Area. Therefore, the solid waste and soil throughout the Landfill Area warrants analysis in the FS but this analysis can be focused consistent with procedures established for CERCLA municipal landfills.

8.2.3.4. Application of the Containment Presumptive Remedy

EPA's guidance for use of the containment presumptive remedy includes a decision framework for evaluating the applicability to military landfills (EPA, 1996). The six-step process includes the following considerations:

1. What information should be collected?
2. How may land reuse affect remedy selection?
3. Do landfill contents meet municipal landfill-type waste definition? (discussed in Subsection 8.2.3.1)
4. Are military-specific wastes present? (discussed in Subsection 8.2.3.1)
5. Is excavation of contents practical?
6. Can the presumptive remedy be used?

The following paragraphs present the Navy's evaluation of the applicability of the containment presumptive remedy relative to the above six steps. The results of the evaluation are presented graphically in Figure 8-1.

Step 1 – What information should be collected?

Available information on the waste types, operating history, and estimated size/volume of the Parcel E-2 Landfill were compiled and summarized in Subsection 8.2.1.

Step 2 – How may land reuse affect remedy selection?

According to the redevelopment plan, most of the planned reuse for Parcel E-2 is open space. Other planned reuses of areas within Parcel E-2 include industrial and research and development (SFRA, 1997). As discussed in Subsection 1.8 and presented in Figure 1-15, land uses other than open space are incompatible with the landfill area, and restrictive covenants will address this incompatibility. Therefore, the anticipated reuse of Parcel E-2 is compatible with the containment presumption.

Step 3 – Do landfill contents meet municipal-type waste definition?

The landfill contents meet the municipal-type waste definition, as summarized in Subsection 8.2.3.1. Although wastes within the Parcel E-2 Landfill meet the municipal-type waste definition outlined in EPA guidance, the presence of military-specific wastes warrant an additional evaluation step that is discussed below.

Step 4 – Are military-specific wastes present?

As discussed in Subsection 8.2.3.1, military-specific wastes present (or potentially present) in and around the Parcel E-2 Landfill are considered "low-hazard military-specific wastes," that is "generally are no more hazardous than some wastes found in municipal landfills" (EPA, 1996).

Step 5 – Is excavation of contents practical?

Excavation of the Parcel E-2 Landfill is not considered practical. This judgment is based primarily on the cost and technical difficulty of removing the estimated 1,008,250 cubic yards of solid waste and surrounding soil fill that extends as deep as 13 feet below msl. The ongoing removal actions in Parcels E and E-2 have provided useful information for evaluating potential waste excavation, including field production rates, types of wastes encountered, and the level of effort to implement site-specific requirements (such as, the requirement to screen all material excavated in Parcel E-2 for radioactivity). However, the volume of the Parcel E-2 Landfill is roughly 20 to 100 times the size of the current remediation areas at Parcel E-2. In addition, the depth of the excavation would require special procedures to ensure stability of the excavation, and likely would require treatment of large quantities of groundwater infiltrating into the excavation. Furthermore, excavation of the landfill would likely require multiple years of continuous construction to complete, and the resulting traffic, noise, and emissions from heavy equipment operation would impact the local population.

Step 6 – Can the presumptive remedy be used?

Based on the information outlined in the paragraphs above, the containment presumptive remedy meets all of the criteria specified in EPA guidance, and therefore is well-suited to prevent exposure to solid waste and soil in the Landfill Area. In addition, the containment presumption also can be applied to landfill gas and potentially-contaminated A-aquifer groundwater or leachate emanating from the landfill.

Some members of the local community have expressed a strong desire for the Navy to thoroughly evaluate excavation of the landfill. In order to provide information to support the community's review of potential remedial alternatives for Parcel E-2, the Navy has agreed to evaluate excavation of the landfill as part of this report. Accordingly, this report includes elements more typical of a standard RI/FS (such as quantitative risk assessments).

8.3. LANDFILL GAS

The following subsections summarize the nature and extent of landfill gas (Subsections 8.3.1 and 8.3.2), the results of the landfill gas risk evaluations (Subsection 8.3.3), and the overall RI conclusions for the landfill gas (Subsection 8.3.4).

8.3.1. Landfill Gas Characterization

The initial landfill gas characterization, consisting of temporary soil gas borings and 21 permanent GMPs, determined that methane was present at concentrations exceeding 25 percent of the LEL along the northern side of the Parcel E-2 Landfill. Methane was also detected on the UCSF compound, located north of the landfill, at concentrations exceeding the LEL. Methane was not detected at concentrations exceeding 25 percent of the LEL in locations along Crisp Avenue (north of the UCSF compound) or to the east, south, and west of the Landfill.

Several NMOCs were detected in both the temporary soil gas borings and the permanent GMPs, with the highest concentrations detected in GMPs around the northern perimeter of the landfill and within the UCSF compound. NMOC concentrations were detected in the GMPs located along Crisp Avenue, but at lower concentrations than detected at the GMPs along the northern perimeter of the landfill and within the UCSF compound.

Upon completion of the landfill gas characterization study, the extent of landfill gas was determined to be at the northern edge of the UCSF compound. To the east, west, and south, landfill gas had not migrated beyond the perimeter of the Parcel E-2 Landfill (TtEMI, 2003e) (Appendix A).

8.3.2. Landfill Gas Monitoring and Control Activities

Upon completion of the landfill gas characterization, the Navy conducted the landfill gas TCRA 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 TCRA consisted of active landfill gas extraction, post-extraction monitoring, and a response action to address potential methane migration pathways through the landfill gas control system (TtEMI, 2004a).

Ongoing landfill gas monitoring and gas control system operation is being conducted under the Interim Landfill Gas Monitoring and Control Plan (TtEMI and ITSI, 2004c). The landfill gas monitoring network, which includes perimeter GMPs and various surface and subsurface locations, was designed in accordance with 27 CCR, and ensures that any landfill gas migrating beyond the regulatory boundary will be detected. Monitoring is performed on a monthly basis and includes notification and response procedures in the event that hazardous concentrations of landfill gas (as discussed in Subsection 8.3.3) are detected beyond the fence line of the landfill and beneath the UCSF compound.

8.3.3. Landfill Gas Risk Evaluations

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 27 CCR. Performance standards for controlling gas emanating from closed landfills are provided in 27 CCR § 20921, and are summarized as follows:

- Concentrations of methane gas must not exceed 1.25 percent by volume in air (25 percent of the LEL) within on-site structures.
- Concentrations of methane gas migrating from the landfill must not exceed 5 percent by volume in air (the LEL) at the facility property boundary or an alternative boundary approved in accordance with 27 CCR §20925.
- Trace gases (that is, NMOCs) shall be controlled to prevent adverse acute and chronic exposure to toxic and carcinogenic compounds.

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 collected from permanent GMPs using the Johnson and Ettinger vapor intrusion model (EPA, 2003). A risk assessment was conducted prior to operation of the gas extraction system, to evaluate potential human health risks resulting from the low levels of NMOCs detected in GMPs along Crisp Avenue (TtEMI, 2003e) (Appendix A to this report). An additional risk assessment was performed on NMOC data from GMPs within the UCSF compound (TtEMI, 2004a) (Appendix F to this report). Cancer risk calculations for GMPs along Crisp Avenue, using the laboratory results, ranged from 6.4×10^{-7} to 2.0×10^{-8} for a residential exposure scenario. Cancer risk calculations for the GMPs on the UCSF compound ranged from 4.0×10^{-7} to 8.8×10^{-9} for an industrial exposure scenario.

Field measurements for NMOCs, collected during the same time frame as the laboratory analytical data, ranged from 0 ppmv to 51 ppmv. Recognizing that a 10-fold increase in the cancer risks would require a

10-fold increase in the NMOC measurements, 500 ppmv was selected as the action level for NMOCs detected at GMPs included in the monitoring network. If the concentration of total NMOCs increases from the 50-ppmv range to above 500 ppmv, additional sampling and analysis for NMOCs and further evaluation of risk to human health would be warranted (TtEMI and ITSI, 2004c). No concentrations of total NMOCs above 500 ppmv have been detected during monthly monitoring performed since January 2004.

For the ongoing landfill gas monitoring, the evaluation methodology for methane data involves comparing field data against the conservative action levels (1 percent for various surface and subsurface locations; 2.5 percent for all GMPs) selected to minimize the likelihood of exceeding the 27 CCR limits. The evaluation methodology for NMOCs involves comparing field data from surface and subsurface locations (not from GMPs) to a standard health and safety limit of 5 ppmv, and comparing field data from GMPs against the 500 ppmv action level discussed above.

8.3.4. Conclusions for Landfill Gas

The data collected as part of the landfill gas characterization study, the TCRA, and the ongoing landfill gas monitoring have adequately defined the nature and extent of landfill gas at Parcel E-2. However, the potential presence of subsurface utilities within the eastern portion of the Landfill Area (Figure 1-4) should be verified. Such utilities may serve as preferential pathways for gas migration; however, in previous soil gas measurements conducted in the vicinity (Figure 4-3), methane has not been detected above 25 percent of the LEL.

Based on an evaluation of the available data from January 2004 through January 2006, the control system is functioning to control 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. This determination supports the nature and extent of landfill gas as presented in this report.

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. Therefore, continued monitoring and control (through either passive or active methods) of landfill gas should be evaluated as part of any remedial alternative that leaves Landfill Area solid waste in place.

8.4. SOIL AND ISOLATED SOLID WASTE IN THE PANHANDLE AREA AND EAST ADJACENT AREA

The following subsections summarize the nature and extent of isolated solid waste locations (Subsection 8.4.1) and chemicals in soil (Subsection 8.4.2) found in the Panhandle and East Adjacent Areas. The risk assessments conducted in the adjacent areas are summarized in Subsection 8.4.3, and an overview of the RI conclusions for the adjacent areas is presented in Subsection 8.4.4.

8.4.1. Nature and Extent of Isolated Solid Waste Locations

The nature and extent of the solid waste in the adjacent areas 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. In addition, solid waste within the adjacent areas consists of inert construction debris with isolated locations of industrial wastes (e.g., sandblast waste, metal slag, radioluminescent devices, and oily waste) and putrescible construction debris (e.g., wood). Although these waste types are also found in the Landfill Area, the municipal-type waste found in the Landfill Area is not found in the adjacent areas.

The Navy reviewed aerial photographs and logs from more than 280 test pits, soil borings, monitoring wells, and GMPs from various investigations at Parcel E-2, to identify locations outside the landfill that contain industrial wastes, municipal-type wastes, or construction debris. The results of the evaluation are summarized in the table below and depicted on Figure 4-1.

Waste Type	Number of Waste Locations in Panhandle Area [a]	Number of Waste Locations in East Adjacent Area [a]
Non-putrescible construction debris	28	10
Putrescible construction debris	17	21
Sandblast waste	0	9
Sandblast waste and putrescible construction debris	0	3
Total:	45 (83 total borings and test pits)	43 (116 total borings and test pits)

a Includes borings in the Shoreline Area in close proximity to the adjacent areas, and also includes borings and test pits installed only to identify soil lithology (that is, no soil samples were collected for chemical analysis).

Construction debris encountered in both the Panhandle Area and the East Adjacent Area include concrete, brick, wood, and asphalt, with limited amounts of ceramic, glass, and metals (primarily as wire or rebar in concrete). With the exception of wood, the remaining types of construction debris are considered inert and are not expected to generate methane gas or leachate that would create potential risks to human health or the environment.

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) include metal slag and debris containing low-level radiological material and radioluminescent devices (BRAC PMO West, 2005b through 2005f). The industrial wastes encountered within the PCB Hot Spot (in the East Adjacent Area) include sandblast waste, radioluminescent devices, and oily wastes (BRAC PMO West, 2005b through 2005f). None of the industrial wastes encountered in either of the removal areas are considered putrescible.

The non-contiguous and heterogeneous nature of the fill material results in a high degree of uncertainty that this fill and the chemicals in soil can be delineated into discrete zones for remediation activities.

8.4.2. Nature and Extent of Chemicals in Soil

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. A summary of these chemical detections above the RIECs is as follows:

- Eight metals (antimony, arsenic, cadmium, chromium, iron, lead, vanadium, zinc) were detected at concentrations exceeding the RIECs at various depths. Arsenic and lead were the metals detected most frequently at concentrations exceeding RIECs. The majority of the metals exceedances were found in samples collected at depths of 0 to 10 feet bgs.
- Two pesticides (total DDE and dieldrin) were detected at concentrations exceeding the RIECs at depths of 0 to 2 feet bgs.
- Total PCBs were detected at concentrations exceeding the RIEC at depths of 0 to 10 feet bgs.
- One sample containing a detectable concentration of 2,3,4,7,8-PeCDF was found in the Panhandle Area at 10 feet bgs.
- SVOCs were detected at concentrations exceeding the RIECs in most depths ranges (except in East Adjacent Area soil greater than 10 feet bgs). SVOCs were detected most frequently at concentrations exceeding RIECs in the Panhandle Area from 0 to 2 feet bgs.
- Total TPH (the summation of TPH-g, TPH-d, and TPH-mo) was detected at concentrations exceeding the TPH source criterion (3,500 mg/kg) in most depths ranges (except in Panhandle Area soil from 2 to 10 feet bgs and East Adjacent Area soil greater than 10 feet bgs). Total TPH was detected most frequently at concentrations exceeding the TPH source criterion in adjacent area soil at depths of 0 to 2 feet bgs.

Based on the data presented in Table 4-24, soil contamination is less extensive within East Adjacent Area soils at depths greater than 10 feet bgs. This finding is attributed to the fact that the majority of fill material in these areas was not associated with shipyard operations. In addition, 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 contaminant distribution in these areas indicates that fill material placed at Parcel E-2 during shipyard operations may contain unacceptable levels of contamination. The heterogeneous contaminant distribution makes delineation of potential areas of concern problematic. This is evidenced by the findings of the SDGI which, as discussed in Subsection 4.5.3.1, was only partially successful in delineating known and potential soil contamination in the Panhandle and East Adjacent Areas. RIEC exceedances in the Panhandle and East Adjacent Areas that are not completely delineated are shown in red text on Table 4-24.

Despite the inherent difficulty in delineating potential point sources of soil contamination within heterogeneous fill material, the characterization efforts from the RI, NDGI, and SDGI 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).

8.4.3. Risk Assessment for the Adjacent Areas

The following subsections present the results of the human health and ecological risk assessment performed on soil data within the Panhandle Area and the East Adjacent Area.

8.4.3.1. Human Health Risk Assessment

The quantitative HHRA in the Panhandle and East Adjacent Areas was performed consistent with the methodology described in Subsection 8.2.2.1. The results of the HHRA were used to support the remedial alternative evaluation for the Panhandle and East Adjacent Areas.

Panhandle Area

For the recreational exposure scenario (Figure 7-3), the results of the incremental risk evaluation indicated that the COCs were antimony, arsenic, lead, several SVOCs (primarily benzo[a]pyrene), dieldrin, and several PCBs (primarily Aroclor-1260). Of the 44 exposure grid cells located either completely or partially within the Panhandle Area, 11 grid cells had exposure point concentrations (for soil at 0 to 2 feet bgs) resulting in risk above one or more of the risk thresholds (1×10^{-6} for cancer risk; segregated HI of 1.0 for noncancer risk; and 155 mg/kg for lead exposure). Of the remaining 33 grid cells, 12 grid cells did not exceed any risk thresholds and 21 grid cells contained no data on which risk calculations could be based. For grid cells with risk above one or more of the risk thresholds (Table 7-3), cancer risks ranged from 8×10^{-8} (for grid cell AB39 which did not exceed the cancer risk threshold of 1×10^{-6} but exceeded the lead exposure threshold) to 6×10^{-4} and noncancer HIs ranged from less than 1.0 to 6.32.

For the construction worker exposure scenario (Figure 7-5), the results of the incremental risk evaluation indicated that that the COCs were antimony, arsenic, iron, lead, vanadium, naphthalene, several SVOCs (primarily benzo[a]pyrene), dieldrin, several PCBs (primarily Aroclor-1260), and the 2,3,4,7,8-PeCDF. Of the 44 exposure grid cells located either completely or partially within the Panhandle Area, 12 grid cells had exposure point concentrations (for soil from 0 to 10 feet bgs) resulting in risk above one or more of the risk thresholds. Of the remaining 32 grid cells, 18 grid cells did not exceed any risk thresholds and 14 grid cells contained no data on which risk calculations could be based. For grid cells with risk above one or more of the risk thresholds (Table 7-7), cancer risks ranged from 3×10^{-6} to 2×10^{-4} and total noncancer HIs ranged from less than 1.0 to 17.6.

East Adjacent Area

For the recreational exposure scenario (Figure 7-3), the results of the incremental risk evaluation indicated that the COCs were arsenic, lead, several SVOCs (primarily benzo[a]pyrene), dieldrin, and Aroclor-1260. Of the 38 exposure grid cells located either completely or partially within the East Adjacent Area, 8 grid cells had exposure point concentrations (for soil at 0 to 2 feet bgs) resulting in risk above one or more of the risk thresholds. Of the remaining 30 grid cells, 8 grid cells did not exceed any risk thresholds and 22 grid cells contained no data on which risk calculations could be based. For grid cells with risk above one or more of the risk thresholds (Table 7-3), cancer risks ranged from 2×10^{-6} to 5×10^{-5} and noncancer HIs ranged from less than 1.0 to 9.55.

For the construction worker exposure scenario (Figure 7-5), the results of the incremental risk evaluation indicated that the COCs were antimony, arsenic, lead, several SVOCs (primarily benzo[a]pyrene), and Aroclor-1260. Of the 38 exposure grid cells located either completely or partially within the East Adjacent Area, 16 grid cells had exposure point concentrations (for soil at 0 to 10 feet bgs) resulting in risk above one or more of the risk thresholds. Of the remaining 22 grid cells, 4 grid cells did not exceed any risk thresholds and 18 grid cells contained no data on which risk calculations could be based. For grid cells with risk above one or more of the risk thresholds (Table 7-7), cancer risks ranged from 2×10^{-6} to 1×10^{-3} and total noncancer HIs ranged from less than 1.0 to 2,420. The highest cancer and noncancer risks were at grid cells AJ35 and AJ36, which are 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 completion of the remediation activities.

8.4.3.2. Screening Level Ecological Risk Assessment

Panhandle Area

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 the Panhandle Area. As shown on Figure 7-5, 13 out of 40 locations in the Panhandle Area contained soil concentrations above the PSCs and HPALs.

East Adjacent Area

Concentrations of cadmium, copper, lead, vanadium, and zinc exceeded both PSCs and HPALs, and are considered a potential threat to birds and mammals exposed to soil in the East Adjacent Area. As shown on Figure 7-5, 17 out of 41 locations in the East Adjacent Area contained soil concentrations above the PSCs and HPALs.

8.4.3.3. Adequacy of Risk Assessment Data Set

The data distribution within the Panhandle and East Adjacent Areas does not provide an exhaustive evaluation of potential human health and ecological risks throughout the areas. This is 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). While the resulting biased data set provides conservative estimates of potential chemical exposures, it also results in numerous areas having no data on which risk calculations can be based.

There are two potential solutions to this problem: 1) collect additional data to characterize risk in areas currently with no data, or 2) assume that grid cells with no data may contain chemical concentrations that could result in risks of the same relative magnitude as found elsewhere in the Panhandle and East Adjacent Areas. Given the heterogeneous contaminant distribution in the adjacent areas, the collection of additional data would not be the most expeditious or cost-effective means of protecting human health and the environment; rather, the assumption that areas with no data may cause unacceptable risk is considered the most prudent course of action.

8.4.4. Conclusions for Isolated Solid Waste, Soil, and Sediment in Adjacent Areas

As discussed in Subsection 1.4, the characteristics of the adjacent areas (specifically, areas of soil fill with isolated solid waste) require consideration more typical of a standard RI/FS. Accordingly, this report has included a detailed nature and extent evaluation and quantitative risk assessments for the adjacent areas.

The nature and extent evaluation determined that, despite collection of over 472 soil samples that targeted known or suspected areas of contamination, the site heterogeneities have led to a number of areas in the Panhandle and East Adjacent Areas where chemical detections in excess of RIECs are not completely delineated. These heterogeneous site conditions present severe challenges to completing a standard investigation and cleanup for a point source or sources. This fact was evidenced by the findings of the SDGI, which was designed specifically to delineate areas of known contamination (based on past chemical detections and a detailed review of aerial photographs), but was only partially successful in this effort. In light of this fact, additional effort spent further characterizing the adjacent areas would not expedite cleanup of Parcel E-2, nor would it enhance protection of human health and the environment.

The risk assessments found numerous areas in the East Adjacent Area and several, more localized areas in the Panhandle Area with surface soil concentrations that posed an unacceptable risk to human and ecological receptors. The combined results of the HHRA (for recreational users) and the SLERA (for terrestrial receptors) are shown on Figure 8-2. The depiction of SLERA results on Figure 8-2 shows all soil sample locations from 0 to 3 feet bgs. A study of this data distribution reveals that most HHRA grid cells that did not exceed any of the risk thresholds typically contained two or fewer data points. Given the known heterogeneity throughout Parcel E-2, a conclusion that soil concentrations throughout these grid cells do not pose unacceptable risk should be viewed with a high degree of uncertainty. This uncertainty coupled with the presumption that grid cells with no data may cause unacceptable risk, results in an overall conclusion that soil throughout the Panhandle and East Adjacent Areas should be considered for remedial action in the FS. In addition, these heterogeneous site conditions support the recommendation to develop a focused set of remedial alternatives in the FS and to evaluate their uniform implementation across the adjacent areas as the most expeditious and cost-effective means of protecting human health and the environment.

The isolated solid waste locations in the Panhandle and East Adjacent Areas were found to consist primarily of construction debris. With the exception of wood, the types of construction debris in the adjacent areas are considered inert and are not expected to generate methane gas or leachate that would create potential risks to human health or the environment. Therefore, remedial action to specifically remove these isolated solid waste locations is not required. However, the potential exists for the same types of industrial waste that were encountered in the Metal Slag Area and PCB Hot Spot (specifically, sandblast waste and radioluminescent devices) to be encountered elsewhere in the adjacent areas. The potential presence of these waste types should be considered in the remedial option analysis.

8.5. GROUNDWATER

The information derived from the field investigations and ongoing monitoring (through April 2005) was used to define the nature and extent of chemicals in groundwater at Parcel E-2. The complete nature and extent evaluation is included in Section 5, and the results of the HHRA are in Section 7. Summaries of the results of these evaluations are presented in the following subsections. Subsection 8.5.1 summarizes the results of the nature and extent evaluation, and a synopsis of the quantitative HHRA for Parcel E-2 groundwater is presented in Subsection 8.5.2. A summary of the RI conclusions is presented in Subsection 8.5.3.

8.5.1. Nature and Extent of Chemicals in 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 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 completion of the excavation activities. The following list briefly summarizes the main nature and extent evaluation findings and the major areas of concern with respect to chemicals in groundwater at Parcel E-2.

- Ammonia was detected at elevated concentrations throughout the A- and B-aquifers in the Landfill Area. These concentrations are indicative of the decomposition of organic waste material in the landfill. Elevated concentrations of un-ionized ammonia (exceeding the RIEC) are present in wells located along the Bay shoreline. Ammonia levels calculated as unionized ammonia exceed the RIEC and may be harmful to aquatic life.

- Persistent arsenic concentrations exceeding the RIEC (36 µg/L) exist in A-aquifer groundwater in the vicinity of IR04MW36A, located on the eastern boundary of the parcel, near the leaking sanitary sewer line. Arsenic concentrations exceeding the RIEC have persisted in this well for nearly 15 years; however, off-site, downgradient well data confirm that the elevated arsenic concentrations in this well are not migrating east/southeast toward Parcel E.
- Persistent barium concentrations exceeding the RIEC (1,000 µg/L) exist in A-aquifer groundwater in the southern portion of the Panhandle Area, and along the Landfill Area shoreline. Because the extent of barium beyond the Parcel E-2 shoreline is unknown, groundwater with barium concentrations exceeding the RIEC is potentially migrating toward the Bay. Concentrations of barium, as well as other dissolved metals, in groundwater may decrease in the Panhandle Area as a result of the Metal Slag Area removal action.
- In the case of metals in A-aquifer groundwater, concentrations slightly exceeding ambient levels were treated and delineated as RIEC exceedances in this evaluation, but they may be due to natural variations in background conditions.
- Concentrations of PCBs consistently exceed the RIEC in A-aquifer wells located near the sheet pile wall, along the shoreline in the Landfill and East Adjacent Areas. Historical data indicate that PCB concentrations generally decrease north and south from this area. In addition, the removal action currently being performed in the PCB Hot Spot along the Parcel E-2 shoreline will likely reduce soil source concentrations, and subsequently dissolved concentrations in the A-aquifer.
- In the northwestern corner of the site, where the A-aquifer is not separated from the B-aquifer by the Bay Mud aquitard, benzene is the only chemical with a concentration exceeding the RIEC in this area. Benzene was present in the A-aquifer in 2004 at a concentration of 1.3 µg/L in IR01MW403B, slightly exceeding the B-aquifer RIEC of 1 µg/L. Elevated concentrations of benzene have been detected in wells in the A- and B-aquifers within an area extending south and west from the landfill. Although benzene is present in groundwater in a large lateral area, concentrations across the site have been decreasing. Benzene is the most laterally and vertically extensive groundwater contaminant at Parcel E-2.
- Numerous chlorinated solvents (PCE, TCE, vinyl chloride, 1,1-DCE, 1,1-DCA, cis-1,2-DCE, and 1,2-DCA) were detected at concentrations exceeding RIECs in well IR04MW13A located southeast of the landfill. This contamination is not migrating downgradient, toward Parcel E, as confirmed by data from off-site downgradient wells (located at Parcel E).
- Historical total TPH concentrations in groundwater in wells IR01MWI-3, IR01MW43A, and IR01MW44A exceeded TPH criteria in samples collected between (1992 and 1996). Total TPH concentrations in IR01MWI-3 and IR01MW43A continued to exceed their respective RIECs (1,400 µg/L and 2,100 µg/L) through 2005. This area is located within the PCB Hot Spot, and the soil removal action will likely reduce soil source concentrations and subsequently dissolved concentrations in the A-aquifer.

The following data gaps were identified during the nature and extent evaluation:

- Data gaps exist for certain analytes (Table 5-14) along the Parcel E-2 shoreline, where chemical concentrations persistently or recently exceeded RIEC. However, the potential risks to aquatic receptors in the Bay from groundwater along the shoreline have not been quantified because a method for comparing groundwater data to aquatic criteria, in a manner that accounts for chemical attenuation and the near-shore mixing process, has not been agreed to with the Navy and regulatory agencies.
- Data gaps exist in areas where the effects on groundwater concentrations by recent soil removal actions or planned construction activities have yet to be evaluated (e.g., the PCB Hot Spot removal action, the Metal Slag Area removal action, and the sanitary sewer line removal). As confirmation sampling data and future groundwater monitoring data become available, they will be incorporated into the nature and extent analysis of future versions of this report.
- It is possible that some chemicals are present and may not have been identified as part of this nature and extent evaluation, as some of the sample reporting limits exceed the RIECs selected for this evaluation. After evaluating the data, however, generally, this issue does not diminish the usability of the data for the purpose of identifying the extent of the most prevalent, risk-driving chemicals in groundwater. The HHRA compensates for elevated reporting limits with conservative measures.
- The data are inadequate to evaluate the current effect of seasonal fluctuations on groundwater chemical concentrations, as the most recent data collected as part of the BGMP (TtEMI, 2004e) do not include more than one full year of data. As future groundwater monitoring data become available, they will be incorporated into the nature and extent analysis, allowing for analysis of seasonal groundwater fluctuations on chemical concentrations.

The ongoing basewide groundwater monitoring continues to contribute useful characterization data to the Parcel E-2 data set. The data set will be supplemented for future versions of this report, thereby reducing the number of data gaps and further strengthening the nature and extent evaluation.

8.5.2. Quantitative HHRA for Groundwater

For the evaluation of human exposure to groundwater, the HHRA used groundwater monitoring data from the 12 most recent sampling events (through April 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 (see Subsection K4.4 of Appendix K).

Similar to the soil HHRA, the groundwater HHRA did not include radioactive compounds as COPCs. Potential risks associated with human exposure to radioactive compounds at Parcel E-2 will be summarized in the draft final version of this RI/FS report. The following subsections summarize the risk evaluation results, by exposure scenario.

8.5.2.1. Construction Worker Trench Exposure Scenario

Table 7-8 summarizes the risk results from exposure to A-aquifer groundwater for a construction worker trench scenario. The total cancer risk was estimated at 2 x 10^{-4} and the total noncancer HI was 2.0. The primary risk drivers for the construction worker trench exposure scenario are PAHs, which account for more than 95 percent of the total cancer risk. The most significant cancer risk drivers are benzo(a)pyrene and dibenz(a,h)anthracene, as they account for almost 75 percent of the risk associated with the trench exposure scenario. 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 PAHs in Parcel E-2 groundwater has been limited to the shoreline area, and more specifically to the PCB Hot Spot removal area, in the vicinity of wells IR01MWI-3 and IR01MW43A.

The conservatism incorporated into the derivation of the exposure point concentration (i.e., using the past 12 quarters of monitoring data to develop exposure concentrations) may over-estimate the potential risk for the trench exposure scenario, relative to more recent analytical results. As additional groundwater data are incorporated for future versions of this report, exposure concentrations derived for future revisions to the HHRA will become more reflective of current conditions, as outdated analytical data (in many cases dating back to 1991) are replaced with more current and representative data. A summary of uncertainties for the HHRA is provided in Appendix K (Table K-17).

8.5.2.2. Domestic Use of Groundwater Exposure Scenario

Table 7-11 summarizes the risk results for the exposure to groundwater from domestic use of the B-aquifer. The total cancer risk was estimated at 9 x 10^{-3} and the total noncancer HI was 110.

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. Other risk drivers that contribute significantly to the total cancer risk include PCE, naphthalene, and benzo(a)pyrene, which cumulatively account for approximately 16 percent of the total cancer risk. 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. The risk assessment results for the domestic use scenario are considered conservative for the following reasons:

- The presence of elevated PCB concentrations (exceeding RIECs) in groundwater at Parcel E-2 is confined to the A-aquifer. PCBs have never been detected in B-aquifer samples. However, because the A- and B-aquifers are hydraulically connected in the northwestern part of the parcel, a conservative risk assessment approach was taken, and A-aquifer data were incorporated into the domestic use exposure risk calculations.
- The most significant area of known PCB contamination at the site (the PCB Hot Spot) is currently being remediated, and may lead to a reduction in PCB concentrations in the A-aquifer. As

additional groundwater data are incorporated for future versions of this report, exposure concentration derived for future revisions to the HHRA will become more reflective of current conditions.

- As discussed in Subsection 8.5.1, the only persistent arsenic detections exceeding RIECs in Parcel E-2 groundwater occur in well IR04MW36A, located in the East Adjacent Area. The extent of arsenic concentrations exceeding RIECs in Parcel E-2 groundwater is localized; however, due to the persistence of the elevated concentrations in IR04MW36A, the conservative methodology applied to the risk calculations causes arsenic to be one of the most significant risk drivers, potentially leading to biased, yet conservative risk assessment results.
- Metals concentrations in groundwater contribute significantly to non-cancer risk in the groundwater exposure from domestic use evaluation. Ambient concentrations of numerous metals in A-aquifer groundwater are known to exceed drinking water standards. Thus, the inclusion of the A-aquifer metals concentration data presumably contributes to the calculated risk associated with antimony, arsenic, copper, iron, and mercury. An incremental analysis was not performed; therefore, the incremental risk contribution of metals in A-aquifer groundwater potentially related to Parcel E-2 site activities is unknown.

A summary of uncertainties for the HHRA is provided in Appendix K (Table K-17).

8.5.2.3. Ecological Risk Assessment for Groundwater

As part of the nature and extent evaluation, wells along the Parcel E-2 shoreline, where chemical extent delineation below RIECs was inadequate, were identified (Table 5-14). This evaluation incorporated conservative evaluation criteria, including freshwater and saltwater aquatic habitat goals from RWQCB ESLs. Although this was a conservative approach for delineating extent of chemicals in Parcel E-2 groundwater, potential risk to aquatic receptors in the Bay is more accurately evaluated by using only promulgated criteria for saltwater aquatic life.

The results of the extent evaluation were reevaluated against promulgated saltwater aquatic criteria to qualitatively identify COPCs in A-aquifer groundwater that may pose an unacceptable risk to aquatic receptors. The results of this evaluation are provided in Appendix M. The identified chemicals in Appendix M are considered COPCs (that is, of <u>potential</u> concern) given the qualitative nature of the analysis. The qualitative evaluation of chemical extent results against saltwater aquatic criteria reveals that the following are the COPCs 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)

Table 8-1 lists the wells along the Parcel E-2 shoreline that contain concentrations of these COPCs greater than the corresponding saltwater aquatic criteria.

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..

8.5.3. Conclusions for Groundwater

The nature and extent evaluation identified several data gaps that will be resolved by continuing the groundwater monitoring program. Monitoring wells abandoned during the removal actions should be replaced and sampled to assess potential reductions in chemical concentrations.

The results of the risk evaluations showed potential risk to human receptors, for both construction worker trench exposure and domestic use exposure. An ecological risk assessment is required to quantify the potential risks to aquatic receptors, for the purpose of assigning remedial goals. However, such an assessment cannot be prepared until a method for comparing groundwater data to aquatic criteria, in a manner that accounts for chemical attenuation and the near-shore mixing process, is agreed to by the Navy and the regulatory agencies.

These findings demonstrate that both A- and B-aquifer groundwater throughout Parcel E-2 should undergo remedial option analysis. This analysis should include, at a minimum, long-term groundwater monitoring and institutional controls. Evaluation of active remedial options (such as containment) may also be prudent, if deemed necessary following consideration of the RAOs and analysis of ARARs.

8.6. SURFACE WATER

Potential exposure of ecological receptors to unacceptable chemical concentrations in surface water runoff is monitored in accordance with a SWDMP that was originally published in 2003 (TtEMI, 2003c). The results of the Parcel E-2 stormwater program are summarized on an annual basis and include a comparison of surface water data to aquatic water quality criteria. 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 BMPs serve to minimize erosion from surface water runoff and mitigate potential exposure to ecological receptors.

The potential exists for surface water runoff to be contaminated by leaching from contaminated soil or through surface erosion. Therefore, 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.

8.7. 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 SLERA prepared in conjunction with the Shoreline

Characterization Technical Memorandum (Appendix G). 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.

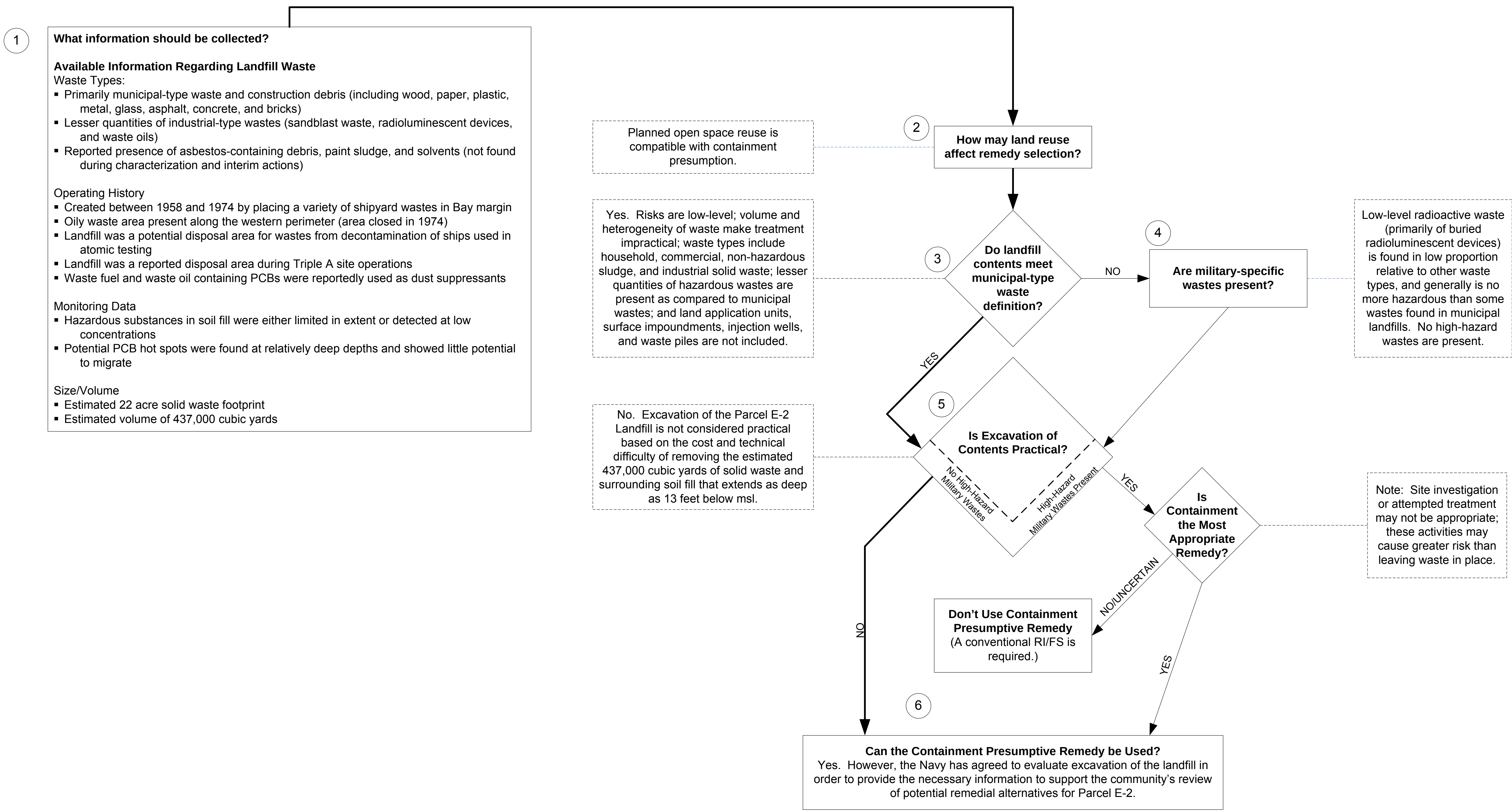
Source control measures are warranted along the Parcel E-2 shoreline, particularly in the metal slag area of the Panhandle Area and the Landfill Area, to control potential releases of copper and lead to Parcel F. In addition, ecological risk to invertebrates, birds, and mammals in the shoreline warrants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

8.8. SUMMARY OF 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) groundwater; 5) surface water runoff; and 6) shoreline sediment.

Figures



Notes:

msl	mean sea level
PCB	Polychlorinated Biphenyl
RI/FS	Remedial Investigation / Feasibility Study
⟶	Selected Decision Path

Source:
EPA. 1996. "Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills." OSWER Directive 9355.0-67FS. EPA/540/F-96/020. December.

ERRG Engineering/Remediation Resources Group, Inc.

Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 8-1
APPLICATION OF CONTAINMENT PRESUMPTIVE REMEDY

Remedial Investigation/Feasibility Study for Parcel E-2

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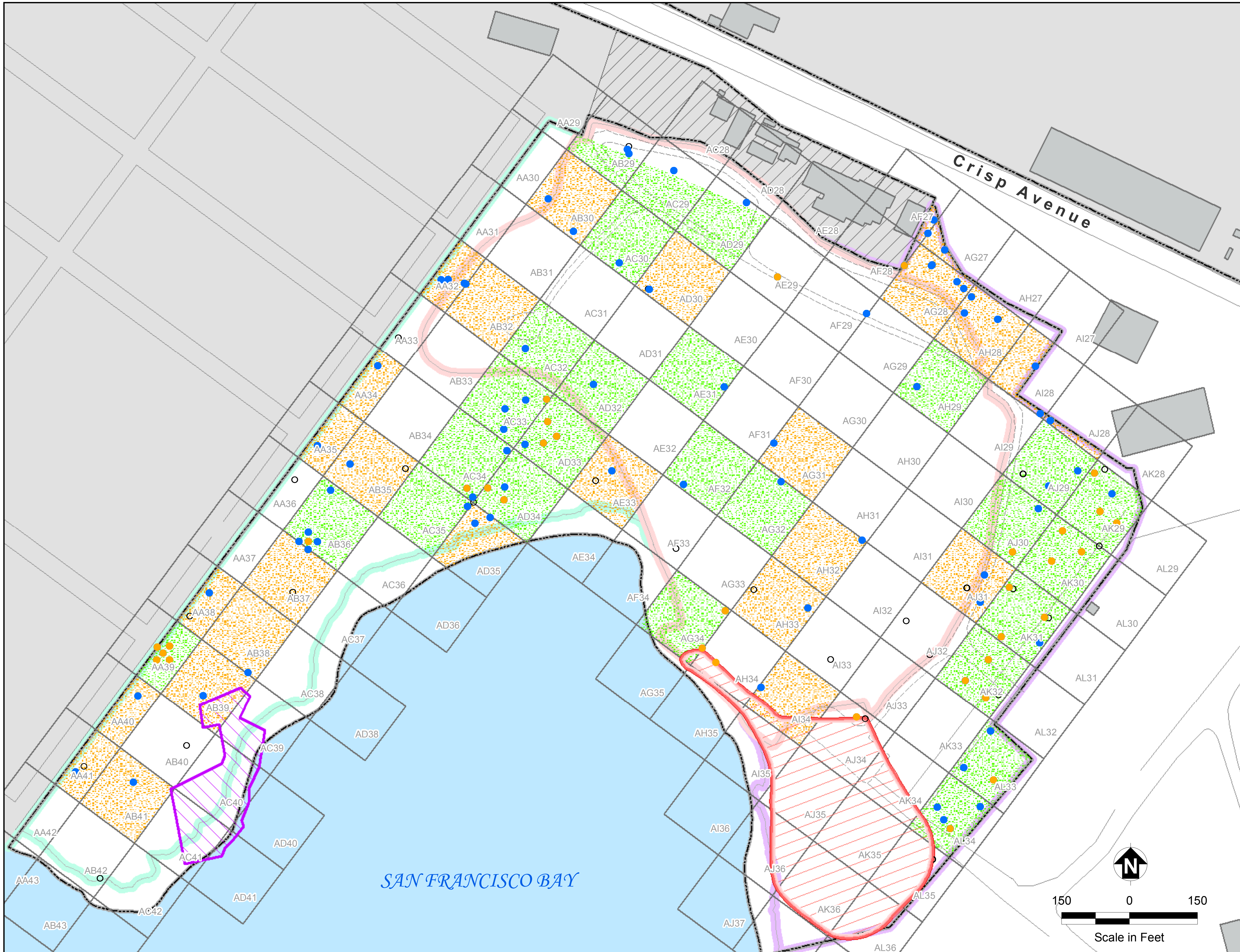

Human Health Evaluation

- Risk Exceeds One or More Threshold Criteria*
- Risk Does Not Exceed One or More Threshold Criteria*
- No Data

Ecological Evaluation

- Not Analyzed
- Analyte Not Detected
- Concentration ≤ PSC
- Concentration > PSC
- PCB Hotspot *
- Metal Slag Hotspot *
- Road
- Gravel Road
- Parcel Boundary
- Building
- UCSF Compound
- Landfill Area
- East Adjacent Area
- Panhandle Area
- Shoreline Area
- San Francisco Bay
- Non-Navy Property

Notes:

Results are only shown for locations where results have exceeded the PSC.
PSC = Protective Soil Concentration
mg/kg = milligrams per kilogram
ft bgs = feet below ground surface
PCB = polychlorinated byphenols

* Human health risk based on incremental risk for recreational use scenario; complete results and threshold criteria (for cancer/noncancer risk and lead exposure) are specified on Figure 7-3

** Results in PCB and Metal Slag hotspots are not shown since the areas are undergoing remediation. Post-excavation data will be presented in the draft final RI/FS.

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FIGURE 8-2

SOIL AREAS OF CONCERN

Remedial Investigation/Feasibility Study for Parcel E-2

Tables

Table 8-1 Groundwater COPCs for Aquatic Receptors
Hunters Point Shipyard Parcel E-2, Remedial Investigation/Feasibility Study

Chemical Group	Chemical of Potential Concern	Tidally Influenced Wells Recommended for Further Monitoring and Evaluation[a]	Surface Water Criteria Selected for Aquatic Evaluation (µg/L)[b]
Anions	Un-ionized Ammonia	IR01MW48A, IR01MWI-3, IR01MW43A	25
	Sulfide	IR01MW48A, IR01MWI-3, IR01MW43A, IR01MW44A	2
Metals	Copper	IR01MW44A	28.0 [c]
	Lead	IR01MW43A, IR01MW44A	14.4 [c]
	Mercury	IR01MW44A	0.60 [c]
	Zinc	IR01MW43A, IR01MW44A	81
Pesticides/PCBs	4,4-DDT	IR01MWI-3, IR01MW44A	0.001
	Endosulfan II	IR01MWI-3	0.0087
	Gamma-chlordane	IR01MWI-3, IR01MW43A	0.004
	Heptachlor	IR01MWI-3	0.0036
	Heptachlor epoxide	IR01MW44A	0.0036
	PCBs (Total)	IR01MWI-3, IR01MW43A, IR01MW44A	0.03
Petroleum Hydrocarbons	TPH (Total)	IR01MWI-3, IR01MW43A	1,400 - 20,000[d]

Notes:

µg/L = micrograms per liter

DDT = dichlorodiphenyltrichloroethane

COPC = Chemical of potential concern

HGAL = Hunters Point Groundwater Ambient Level

PCB = polychlorinated biphenyls

TPH = Total Petroleum Hydrocarbons

References:

(a) Tidally influenced wells are defined where the maximum tidal fluctuation exceeds 0.10 foot in the A aquifer based on data collected during the Phase III groundwater data gaps investigation (TtEMI, 2004b). Tidally influenced wells at Parcel E-2 consist of IR01MWI-8, IR01MW62A, IR01MW63A, IR01MWI-7, IR01MWI-9, IR01MW48A, IR01MWI-3, IR01MW43A, and IR01MW44A.

(b) References for the aquatic evaluation criteria shown below are included in Table M-1 of Appendix M

(c) Value shown has been HGAL adjusted and is applicable to the A-aquifer

(d) Range of values shown; total TPH aquatic criteria assigned as a function of distance from shoreline; the source of these criteria is the April 2004 "Draft Addendum to the Final Petroleum Hydrocarbon Corrective Action Plan, Parcel B, Hunters Point Shipyard, San Francisco, California" (TtEMI. 2004a)