Final Feasibility Study

Engineer School, Fort Totten
Queens, New York
Contract No.: W912DR-10-D-0003, Task Order No.: 003
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FUDS Project Name – Fort Totten Coast Guard Station
Formerly Used Defense Site
Queens, New York

Final Feasibility Study

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Prepared for:

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ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DERP-FUDS	Defense Environmental Restoration Program Formerly Used Defense Site
DoD	Department of Defense
FS	Feasibility Study
ft	feet
FUDS	Formerly Used Defense Site
GRA	General Response Actions
HHRA	Human Health Risk Assessment
HI	Hazard Index
µg/dL	micrograms per deciliter
mg/kg	milligram per kilogram
NCP	National Contingency Plan
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O&M	Operations and Maintenance
Pb	lead
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PPE	personal protective equipment
RAO	Remedial Action Objective
RG	remedial goal
RI	Remedial Investigation
RSL	Regional Screening Levels
SCO	soil cleanup objectives
SI	Site Investigation
sf	square feet
SLERA	Screening Level Ecological Risk Assessment
SRI	Supplemental Remedial Investigation
SRI2	Supplemental Remedial Investigation #2
SVOC	semi-volatile organic compound
TCLP	toxicity characteristic leaching procedure
TMV	toxicity, mobility, and volume
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USEPA	United States Environmental Protection Agency
Watermark	Watermark Environmental, Inc.

EXECUTIVE SUMMARY

This Feasibility Study (FS) addresses the soil impacts at Area 1 of the Fort Totten Coast Guard Station Formerly Used Defense Site (Fort Totten CGS FUDS) under the authority of the Defense Environmental Restoration Program – Formerly Used Defense Sites (DERP-FUDS). The Fort Totten CGS FUDS is listed in United States Army Corps of Engineers (USACE) records as Engineer School, Flushing, New York, FUDS site C02NY0057. The purpose of this FS is to develop and evaluate feasible alternatives for soils at Area 1 of the Fort Totten CGS FUDS which pose an unacceptable risk as documented in the Final Remedial Investigation Report, Engineer School, Fort Totten [(Final RI Report) (USACE, 2014)]. Area 1 would need to be addressed to complete closure of the site as an area of environmental concern.

The Fort Totten CGS FUDS is currently owned and operated by the U.S. Coast Guard (USCG) as a Coast Guard Station. Multiple investigations of the soil, groundwater, surface water, and sediment at Fort Totten CGS FUDS have been conducted. Two removal actions to address mercury in soils have also occurred. The most recent investigation, the Supplemental Remedial Investigation #2 (SRI2) presented in the Final RI Report, concluded that the only portion of Fort Totten CGS FUDS where Department of Defense (DoD) activities resulted in conditions that may pose a risk to future receptors is the lead-impacted soil in Area 1. Area 1 is currently used for recreation, but future residential use has been proposed for Fort Totten CGS FUDS. The US Coast Guard has an approved planning proposal to move back to Fort Totten. The location of the new facilities, which conceptually include family housing units, may be close to the ball field area. The ball field area is adjacent to Area 1. There are no conditions in Areas 2, 3, 4, and 5 that pose an unacceptable risk to current or future receptors; therefore, these areas will not be addressed in the FS and do not require follow-on actions in order to complete closure of the site as an area of environmental concern.

The following Remedial Action Objective (RAO) for Area 1 was developed as part of the Final RI Report:

- Prevent or reduce potential future residential human exposure to soil with lead concentrations above background concentrations.

The Remedial Goal (RG) for lead in Area 1 soil is background. The RG is to reduce lead (Pb) in surface and subsurface site soil so that the average Pb concentration does not exceed the average surface soil background concentration with 95 percent confidence.

The total surface area of lead concentrations greater than background in Area 1 is approximately 20,000 square feet (sf). For purposes of the FS, the lead concentrations in soil greater than background in the western half of the 20,000 sf area are estimated to extend to 1.5 ft below ground surface (bgs) and 3 ft bgs in the eastern half of the 20,000 sf area. The total volume of soil with lead concentrations greater than background is 45,000 cubic feet or 1,667 cubic yards.

Four alternatives were developed to address the lead in soil in Area 1: 1) no action, 2) land use controls, 3) soil cover cap and land use controls, and 4) removal, off-site disposal, and backfill. The alternatives were then evaluated with respect to nine criteria per the National Contingency Plan: 1) protection of human health and the environment, 2) compliance with applicable, relevant, and appropriate requirements (ARAR), 3) long-term reliability and effectiveness, 4) reduction of toxicity, mobility or volume through treatment, 5) short-term effectiveness, 6) implementability, 7) cost, 8) state acceptance, and 9) community acceptance.

Alternative 1 is not an acceptable alternative because it does not meet the threshold criteria of protectiveness. Alternative 2 is protective of human health, but does not provide the same degree of long-term effectiveness as the remaining alternatives. Alternatives 2, 3, and 4 are all permanent solutions; however, only Alternative 4 removes the lead in soils attributed to former DoD site use, thereby avoiding operation and maintenance (O&M) and long-term reporting requirements. None of the alternatives incorporates treatment to reduce toxicity, mobility, or volume. Alternatives 3 and 4 have virtually the same degree of short-term effectiveness and implementability. The cost of Alternative 2 is $206,130, Alternative 3 is $282,635, and Alternative 4 is $450,934. The alternatives will be evaluated with respect to state acceptance and community acceptance after the Proposed Plan is issued.

1.0 INTRODUCTION

This Feasibility Study (FS) for the Fort Totten Coast Guard Station Formerly Used Defense Site (Fort Totten CGS FUDS) was prepared by Watermark Environmental, Inc. (Watermark) for the U.S. Army Corps of Engineers (USACE), New England District under Contract No. W912DR-10-D-0003, Task Order No. 003. The FS was prepared to address the soil contamination at the Fort Totten CGS FUDS under the authority of the Defense Environmental Restoration Program (DERP) – Formerly Used Defense Sites (DERP-FUDS). The Fort Totten CGS FUDS is listed in USACE records as Engineer School, Flushing, New York, FUDS number C02NY0057. This FS was prepared in a manner consistent with United States Environmental Protection Agency's (USEPA) 1988 *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988).

The Fort Totten CGS is located in the northwest portion of Long Island in the Queens Borough of New York City, New York (Figure 1-1). The FUDS covers 7.8 acres and is located on Little Bay in Long Island Sound. The FUDS is currently owned and operated by the United States Coast Guard (USCG), although a large portion is currently not in use. The FUDS was formerly owned and operated by the Department of Defense (DoD). Investigations at the FUDS have been ongoing since the 1980s.

1.1 Purpose and Organization of Report

The purpose of this FS is to develop and evaluate remedial alternatives for the risk posed by soil at the Fort Totten CGS FUDS. The FS is organized into the following eleven sections. Section 1 presents pertinent background information, discusses nature and extent of contamination, and summarizes the risk assessment. Section 2 discusses applicable, relevant, and appropriate requirements (ARAR), describes how the Remedial Action Objective (RAO) was derived and how the Remedial Goal (RG) was specified in order to achieve the RAO. Section 3 presents the Identification and Screening of Technologies that summarizes the screening process utilized to reduce the list of potentially applicable technology types to the list of technologies carried over for detailed evaluation. Section 4 provides a description of the alternatives and the evaluation in accordance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (USEPA, 1988). Section 5 directly compares the various remedial alternatives to each other, based on the nine criteria identified in the CERCLA guidance (USEPA, 1988). Section 6 presents all of the documents referred to or relied on in the FS.

1.2 Background

A brief description and background are presented here. A more detailed description of the FUDS and site history are found in the Final RI Report (USACE, 2014).

1.2.1 Site Description

The Fort Totten CGS FUDS is located on the Willets Point peninsula in the northeastern region of Queens Borough, New York City (Figure 1-1). Fort Totten lies approximately ¾ mile due east of the southern reach of the Throgs Neck Bridge; it is bordered to the south and southwest by Little Bay Park and the Cross Island Parkway, to the west by Little Bay, and to the north and east by Little Neck Bay. Access to Fort Totten is via the Cross Island Parkway north on Bell Boulevard. The Fort Totten CGS FUDS property consists of 7.8 acres in the northwest region of this peninsula. It was formerly part of Fort Totten and is now bordered by Fort Totten property to the north, east, and south, and by Little Bay to the west (Figure 1-2).

1.2.2 Site History

The DoD acquired Fort Totten, a 146.75-acre property, between 1857 and 1943, for the coastal defense of Long Island Sound and the eastern entrance to the East River. Fort Totten also served as a post-Civil War hospital, an engineering school, and a training site for West Point Cadets. The US Army Reserve portion of Fort Totten is currently the Headquarters for the 77th Army Reserve Command. In 1968 the Department of the Army conveyed 9.6 acres of the property to the USCG, retaining ownership of the remaining 137.15 acres. This FUDS project is limited to the excess portion (7.8 acres) of Fort Totten presently owned by the USCG and excludes the 1.8 acre ball field area as described further in Section 1.2.3.

1.2.3 Previous Investigations at Fort Totten CGS FUDS

The Fort Totten CGS FUDS has been the subject of several previous investigations conducted both on the land portion of Fort Totten, referred to as the upland area, and on the surface water and sediment of Little Bay. USACE commissioned the first Site Investigation (SI) of Fort Totten CGS FUDS in 1988 (Metcalf & Eddy, 1988). The investigation consisted of collection of shallow soil and sediment samples and wipe tests; installation of groundwater monitoring wells and collection of groundwater samples; coring into bunker #619 to investigate a possible sealed room, and performance of an electro-magnetic survey. The report indicated that contamination in groundwater (lead and chromium), in soil (mercury), in sediment (mercury and petroleum hydrocarbons), and on building surfaces (pesticides) was encountered at concentrations that may require regulatory review. The contamination was suspected to have resulted from activities that took place during DoD control. The coring into bunker #619 indicated a sealed room was not present at the bunker. The electro-magnetic survey discovered subsurface anomalies at the ball field east of Area 4 (Figure 1-2). Based on the historic use of Fort Totten as a coastal defense battery, there was concern that the anomalies may be associated with ordnance. On December 12, 2012, an ordnance and explosives investigation team from the USACE (Baltimore District) excavated the areas where the anomalies were identified and discovered cultural debris that was not ordnance related (pipes, nails, wire, an antique roller skate, and reinforced concrete) (USACE, 2014). Based on these findings, no further actions are recommended for the ball field. The SI report recommended a risk assessment, at a minimum, or an RI/FS be performed. The report indicated the primary threat of concern to human health and the environment appeared to be mercury contamination of soil, marine sediments, and in the floor drainage system of Building 615 (later named Area 5, Figure 1-2). Building 615 was used as a torpedo and mine repair facility, where mercury was removed from guidance systems and disposed of through floor drains.

Separate from the recommended RI/FS, the USACE collected four surface soil samples in the general location of the Fill Area (later named Area 1, Figure 1-2) in 1992. The samples were analyzed for Total Recoverable Petroleum Hydrocarbons and mercury. The Fill Area was created when the Army placed soil excavated from the vicinity of Buildings 118, 119, and 121 (former vehicle maintenance shops located outside of the Fort Totten CGS FUDS boundary) in a low spot in a recreational field to eliminate periods of standing water. The excavated material included portions of the building's parking lots. Petroleum hydrocarbons were detected and mercury was not detected. The letter report containing the results indicated that the petroleum hydrocarbon concentrations should be of no concern as long as a drinking water supply is not in the immediate vicinity. At the time of sampling, New York State had not established an action level for total petroleum hydrocarbons and the report indicated the concentrations should decrease when the soil is exposed to air (USACE, 1992).

The USCG collected soil samples from the ball fields in 1996 (Figure 1-2). Fifteen samples were collected and analyzed for the USEPA Priority Pollutant List compounds (126 compounds). The samples were collected from five separate areas at three different depths within the ball fields. The New York State Department of Health (NYSDOH) reviewed the data and determined no contaminants were detected in the soil at levels that would pose a health concern for users of the ball field (NYDOH, 1996). Based on this information and findings from the SI, the ball field area of the Fort Totten CGS FUDS was not included in later investigations. At USACE's request, NYSDEC provided a letter dated March 18, 2014 confirming that the 1.8 acre ball field area is no longer considered a part of the Fort Totten Coast Guard Site and that the remaining portion of the site is now listed as approximately 7.8 acres in size. The letter notes that the reduction was handled internally as a "boundary modification", as opposed to a "delisting", but that the net outcome was the same. A copy of the letter is provided in Appendix Q of the Final RI Report (USACE, 2014).

In June 1996, New York State Department of Environmental Conservation (NYSDEC) completed a Registry Site Classification Decision form that identified the Fort Totten CGS FUDS as a "…Class 2 category, meaning that the hazardous waste disposed there represents a significant threat to public health and/or the environment and action is required". The justification for classification stated: "The mercury contamination is (sic) the Bay is most likely the result of improper disposal of mercury contaminated wastes used in the manufacture, repair or disposal of various weapons systems during the Army's use of the site. The mercury contamination in the Bay is extensive; Marine Resources has stated that these sediments would be considered impaired for benthic and fish life. Elevated levels of mercury contamination on site, and elevated levels of mercury and other heavy metals in sediments off-site represent a significant threat to public health and the environment. A determination of significant threat is warranted" (NYSDEC, 1996).

The USACE initiated a comprehensive RI in 1997 to determine the nature and extent of the contamination reported in earlier studies (USACE, 2005). The RI was conducted in two phases. Phase I was conducted from July of 1997 through August of 1998 and Phase II was conducted between November 1999 and August 2000. Six areas of concern were identified: 1) Fill Area (later named Area 1), 2) heavy metals in soils near previous soil borings and surface soil samples, 3) pesticide contamination around Buildings 619 and 624 (later named Area 2), 4) possible polychlorinated biphenyl (PCB) contamination around Buildings 609 and 625 (Building 625 is included in the area later designated as Area 4), 5) groundwater, and 6) mercury contamination in Little Bay marine sediments.

The RI report indicated:

- There were no significant levels of pesticides or PCB detected in the soil.
- Soil concentrations of four metals (arsenic, cadmium, chromium, and mercury) and some semi-volatile organic compounds (SVOCs) exceeded NYSDEC Soil Cleanup Objectives (SCO).
- Groundwater concentrations of four metals (aluminum, antimony, iron, and sodium) and some organic compounds exceeded NYSDEC's drinking water levels.
- Mercury was the principal contaminant of concern in the sediment, but the concentrations in Little Bay were not significantly higher than the concentrations of mercury in sediment in other portions of Long Island Sound and New York Harbor, suggesting that substantial quantities of mercury were not released from Building 615 into the Bay.

The human health risk assessment (HHRA) conducted as part of the RI indicated:

- Chemicals in the soil in the upland areas did not pose a significant cancer or non-cancer health risk.
- There was a high level of risk to future residential adults and children using groundwater as a water supply; however, the groundwater was not (and is not) currently used or planned for future use as a drinking water supply.
- Cumulative impacts from exposure to mercury in water, sediment, and fish from Little Bay may pose an adverse health risk. However, given the conservative nature of the risk assessment and its tendency to overestimate the hazard to the average person, the report concluded that the mercury in Little Bay did not pose a significant risk to human health.

The ecological risk assessment indicated that mercury posed no risk in the aquatic environment of Little Bay. Based on the results of the ecological risk screening in the upland area it was concluded that further refinement of the identified hazards was unnecessary.

Based on the human health and ecological risk assessments, no further action was required for soil in the Fill Area (Area 1) and other upland areas of the Fort Totten CGS FUDS. The USACE issued a No Further Action Record of Decision (ROD) for Little Bay (USACE, 2003) after additional fish and shellfish tissue sampling confirmed that mercury continues to pose no significant threat to human health and the environment.

The USACE conducted a SRI in summer 2004 to address data gaps and questions raised by the NYSDEC and NYSDOH regarding the nature and extent of SVOC and metals soils contamination in the Fill Area (Area 1) and other upland areas, SVOC concentrations in groundwater near MW-4 (Area 5), and mercury in the indoor air in Building 615 (Area 5). Soil samples were collected and a new monitoring well (MW-4R) was installed and sampled to replace the original MW-4 that had become unusable, air monitoring was performed, sediment samples were collected from a Building 615 drainpipe, and a dye test was performed on the drainpipe from Building 615.

The SRI report indicated:

- Metals and SVOCs were present in the soil at the Fill Area (Area 1) and other upland areas at concentrations that exceeded NYSDEC SCOs.
- There were detections of SVOCs in MW-4R indicating that the source of SVOCs in MW-4 was not only from parking lot runoff, as previously suspected.
- There were no detectable concentrations of mercury in the indoor air of Building 615 (Area 5) at concentrations greater than the screening level.
- The floor drain in the hallway of Building 615 (Area 5) was not connected to the discharge conduits protruding from the seawall.

The HHRA conducted as part of the SRI indicated:

- Soil in the Fill Area (Area 1) presents an unacceptable hazard under a residential reuse scenario due to lead.
- Soil in the other upland areas does not present an unacceptable risk.
- The groundwater may not be appropriate for use as a potable water source.
- The drainpipes in Building 615 (Area 5) do not contain mercury at concentration that would pose an inhalation health concern to workers.

The screening level risk assessment (SLERA) indicated there were no unacceptable threats to ecological receptors to chemicals in the soil in the upland areas of the Fort Totten CGS FUDS.

The SRI recommended a Focused Feasibility Study for the Fill Area (Area 1) soil. The SRI also recommended and that the structures (e.g., vault, drywell) at the end of the Building 615 (Area 5) drainpipe be investigated (and if necessary removed) and soil from that area be sampled and analyzed for mercury.

In May of 2006, EA Engineering Science and Technology and the USACE oversaw an exploratory excavation to determine the discharge point of a floor drain where mercury had been disposed of in Building 615. A septic tank was encountered during the excavation activities; however, the discharge point of the floor drain could not be located. On October 30 and 31, 2006, a second exploratory investigation was conducted to determine the discharge point of the floor drain and to conduct additional soil sampling activities. On March 22, 2007, excavation activities were conducted to remove these two hot spots of mercury identified during previous investigations (USACE, 2014).

In 2009 the USACE conducted an FS to evaluate remedial alternatives for the risk posed by metals and SVOCs in soil in the upland portion of the Fort Totten CGS FUDS (USACE, 2009). The Draft FS report presented remedial alternatives to address the areas with metals and SVOCs concentrations above NYSDEC SCOs and background concentrations developed in a background study. The alternatives presented in the draft document were inconsistent with the results of the SRI and the report was not finalized. USACE and NYSDEC agreed to re-evaluate the Fort Totten CGS FUDS, address data gaps, and update the HHRA for all areas in order to complete the RI Phase.

The SRI2 was conducted to further delineate and characterize environmental conditions in the upland portion of the Fort Totten CGS FUDS and to support an updated HHRA and SLERA. For the purposes of the SRI2, the Fort Totten CGS FUDS was divided into five investigation areas (Areas 1 through 5) based on current and former building locations and uses (Figure 1-2). Area 1 had previously been adequately characterized; however, the HHRA needed to be updated and was done so as part of the SRI2. Areas 2 through 5 were previously investigated, but underwent further characterization as part of SRI2.

The SRI2 was conducted in two phases. The first phase was completed in 2011 and consisted of redevelopment and sampling of the five monitoring wells, soil sampling in Areas 2, 3, 4, and 5 to determine the nature and extent of previously detected compounds and metals, and an updated HHRA and SLERA. The second phase was completed in 2012 and consisted of additional surface and shallow subsurface soil sampling in Area 3 in an attempt to confirm previously-detected elevated results for mercury, hand-digging of observation holes in Area 4 to look for potential sources of polynuclear aromatic hydrocarbons (PAHs) detected in previously-collected soil samples, and collection of filtered and unfiltered groundwater samples from monitoring wells MW-4R and MW-5 for PAHs. The results from the 2012 investigation were evaluated qualitatively to determine what impact, if any, they had on the risk assessment completed in 2011.

The Final Remedial Investigation Report concluded:

- PAHs were detected at concentrations greater than background in one or more samples in Areas 1 through 4. Using benzo(a)pyrene as an indicator of PAH concentrations, Areas 1 through 3 have slightly elevated concentrations with respect to background, and Area 4 has significantly higher concentrations with respect to background. Based on visual observations from soil borings and hand-dug holes, the elevated PAH concentrations in Area 4 are attributable to historic urban fill (coal, coal ash, and asphalt were observed at sample locations where elevated PAH concentrations were detected).
- Metals were detected in surface and subsurface soil samples in Areas 1 through 5. Some of these detections occurred at concentrations greater than background.
- A previously-detected elevated mercury concentration in Area 3 surface soil was not laterally or vertically extensive.
- In 2011, PAHs, sodium, and chloroform were the only analytes with reported concentrations above the New York State Class A groundwater guidance criteria. The 2012 groundwater sampling results indicated that the previous PAH concentrations were likely related to suspended solids in groundwater rather than dissolved PAHs (based on a comparison of analytical results from filtered versus unfiltered samples).

The HHRA conducted as part of the SRI2 indicated:

- There is unacceptable risk for exposure to lead in Area 1 soils. Specifically, the allowable blood lead concentration of 10 micrograms per deciliter (µg/dL) was exceeded for the Future Child Resident. Although PAHs and metals other than lead were detected in Area 1 soils at concentrations greater than background, only the lead concentrations resulted in unacceptable risk.
- There are no unacceptable risks for Areas 2 and 5.

- There is a non-cancer screening Hazard Index (HI) greater than 1 associated with a single elevated arsenic concentration in Area 3. This sample was collected adjacent to a deck constructed of pressure treated lumber. In the absence of that detection, the cancer risks and non-cancer HIs for future land use receptors at Area 3 would be within or below the acceptable risk range and below the threshold non-cancer HI value of 1. When the data from this sample point were excluded from the HHRA, the target organ-based segregated HI for all contaminants of potential concern, including arsenic, was below 1.
- There is unacceptable cancer risk in Area 4 for the Future Resident due to PAHs present in urban fill.
- There is a potential unacceptable risk for potential Future Residents from exposure to groundwater (potable use). Fort Totten CGS FUDS is currently supplied by municipal water and there is no foreseeable use of groundwater (potential salt water intrusion and low well yield would preclude future use of the groundwater for potable or non-potable purposes). A qualitative risk evaluation of 2012 groundwater sampling results indicated risk from exposure to groundwater is not a concern.

The SLERA determined that no further evaluation of potential adverse effects from chemical constituents of concern detected in surface soil in upland exposure areas to ecological receptors was necessary.

The Final RI Report recommended that the next steps include a FS to identify and evaluate appropriate remedial alternatives for addressing lead in Area 1 soils. No Further Action was recommended for soils in Areas 2, 3, 4, and 5 and for groundwater. The recommendations for each area and for groundwater are summarized below.

- An FS is recommended for lead in Area 1 soils because the blood lead level for future child exposure to soil is above the allowable blood lead concentration.
- No-action is recommended for Area 2 because the cancer risks and non-cancer HIs for current and potential future land use receptors are within or below the acceptable risk range (10^{-6} to 10^{-4}) and below the threshold non-cancer HI value of 1.
- No-action is recommended for Area 3 because the only risk greater than risk limits (arsenic-specific hazard quotient greater than one for a future residential land use scenario) is driven by a single elevated detection of arsenic associated with a pressure treated deck. In the absence of that detection, the cancer risks and non-cancer HIs for future land use receptors at Area 3 would be within or below the acceptable risk range (10^{-6} to 10^{-4}) and below the threshold non-cancer HI value of 1.
- No-action is recommended for Area 4 because the risk from PAHs is attributable to historic urban fill.
- No-action is recommended for Area 5 because the HHRA indicated there are no unacceptable risks or hazards from the remaining mercury contaminated soil in Area 5 and the SLERA indicated that concentrations of metals in Area 5 are not likely to result in actionable population level effects to ecological receptors. It is noted that previous remedial actions completed in 2006 and 2007 have resulted in the removal of mercury contaminated soil associated with an historical release at Building 615. Underground structures, including a buried electrical line, active sewer line, and former cesspools prevented complete removal of soils in this area. These structures are still in place and will limit or prevent future soil removal within the source area. Because Area 5 contains low-levels of residual mercury in the subsurface (albeit at concentrations that do not result in unacceptable risk), NYSDEC has requested that the USCG provide a written acknowledgement that mercury remains in the subsurface. Accordingly, the USACE has requested such a letter from the USCG.
- No-action is recommended for area groundwater because there is no current exposure and no potential for future exposure and a qualitative risk evaluation of 2012 groundwater sampling results indicates risk from exposure to groundwater is not of concern.

1.2.4 Nature and Extent of Contamination

This discussion is limited to lead concentrations in soil in Area 1 (Figure 1-3). Lead is the contaminant of concern, soil is the only media of concern, and Area 1 is the only portion of the Fort Totten CGS FUDS that requires an FS.

Lead was detected in all soil samples collected from Area 1. All of the shallow soil samples [0 to 1 feet below ground surface (ft bgs)] in the southern portion of Area 1 had concentrations greater than the USEPA residential regional screening level (RSL) of 400 mg/kg. The highest concentrations were detected in the southwestern portion of Area 1 at B-10 (1,540 mg/kg, 0 to 1 ft) and in the southeastern portion of Area 1 at B-11 (1,160 mg/kg, 0 to 1 ft). At locations where both surface and subsurface samples were collected, lead concentrations decreased with depth. Lead concentrations were less than 400 mg/kg in all subsurface soil samples collected below two feet bgs; however, the shallowest subsurface soil sample was collected from 14 to 15 ft bgs, resulting in uncertainty as to the depth where concentrations decrease below 400 mg/kg. This uncertainty will be addressed through pre-design characterization in the FS alternatives.

1.2.5 Fate and Transport

1.2.5.1 Contaminant Source

The source of lead-impacted soil in Area 1 is soil materials excavated from other Army-owned areas of Fort Totten that were placed in Area 1. Area 1, previously known as the Fill Area, was created when the Army placed soil excavated from other Army-owned areas at Fort Totten in a low spot of a recreation field to eliminate periods of standing water. The soil came from Buildings 118, 119, and 121, which were former and existing vehicle maintenance shops, on the Army-owned portion of Fort Totten. The excavated soil included a portion of those buildings' parking lots (USACE, 2005).

1.2.5.2 Migration Pathways

The potential migration pathways of the lead detected in soil includes the following:

- Migration of contaminants in surface soil via overland flow.
- Leaching to groundwater.

1.2.5.3 Environmental Fate and Transport

Lead in the surface soil is not migrating in significant quantities to surface water bodies. Surface water and sediment sampling in Little Bay did not detect concentrations of metals higher than those found in Little Neck Bay.

The mobility of metals in soil depends on many factors including soil type, oxidizing/reducing conditions, pH, and organic content. Of the metals detected, both in soil and groundwater, including lead, the maximum concentrations in groundwater are only 0.2 percent of the maximum concentrations detected in soil. These results indicate that metals, including lead, are not leaching in significant quantities to the groundwater.

1.2.6 Conclusions of the Risk Assessment

Human Health Risk Assessments and ecological risk assessments were performed for Fort Totten CGS FUDS as part of the RI (USACE, 2005), updated in the SRI (USACE, 2006), and conducted again as part of the Final Remedial Investigation Report (USACE, 2014). This section presents a summary of the risk assessment, which used data collected through May 2011. This summary focuses on the risk assessment results related to Area 1.

1.2.6.1 *Human Health Risks*

The HHRA was performed in a manner consistent with USEPA CERCLA guidance. Carcinogenic and non-carcinogenic risks were calculated for each exposure scenario. Consistent with standard practice, risks associated with exposure to lead were evaluated using USEPA blood lead models for both adults and children. The HHRA evaluated potential exposures to soil for Current Outdoor Workers, Current Trespasser, Future Outdoor Workers, Future Indoor Workers, Future Construction Workers, Future Recreational Receptors, and Future Residents.

The cancer risks and non-cancer HIs for current land use receptors are within or below the acceptable risk range (10^{-6} to 10^{-4}) and below the threshold non-cancer screening HI and/or the target organ-based segregated HI of 1. The cancer risks and non-cancer HIs for future land use receptors are within or below the acceptable risk range (10^{-6} to 10^{-4}) and below the threshold non-cancer screening HI and/or the target organ-based segregated HI of 1. The cancer risk and hazard indices are presented in Table 1-1.

Risks associated with exposure to lead were characterized using lead biokinetic uptake models for adults and children. The adult blood lead concentration from exposure to both surface and subsurface soil is below the allowable blood lead level 10 µg/dL. The probability percentage of fetal blood lead concentration greater than 10 µg/dL is below 5% for both surface soil and subsurface soil. The child blood lead model for Area 1 indicates that the blood lead level for children exposed to surface and subsurface soil is above the allowable blood lead level of 10 µg/dL. The probability percentage of the child blood lead concentration greater than 10 µg/dL for surface and subsurface soil are 13.2 percent and 11.1 percent, respectively.

1.2.6.2 *Ecological Risks*

A SLERA was performed in a manner consistent with USEPA, CERCLA, and NYSDEC guidance for the Fort Totten CGS FUDS to evaluate the potential for chemical constituents of concern detected in surface soil in upland exposure areas to adversely affect ecological receptors. The SLERA indicated that:

- Concentrations of SVOCs in Area 1 are not likely to result in actionable population level effects to ecological receptors.
- Concentrations of metals in Area 1 are not likely to result in actionable population level effects to ecological receptors.

2.0 DEVELOPMENT AND APPLICATION OF REMEDIAL GOALS

2.1 Identification of Potential Federal and State Regulations

The USACE must comply with the DERP statute (10 USC 2701 *et seq*.), the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 USC § 9601 *et seq*.) (CERCLA); Executive Orders 12580 and 13016, the National Contingency Plan (NCP) (40 CFR Part 300), and all applicable DoD and Army policies in managing and executing DERP-FUDS; however, Fort Totten CGS FUDS is not a National Priorities List (NPL) site. Because of the linkages between the DERP and CERCLA and the delegation of certain Presidential authorities under CERCLA to DoD, CERCLA is DoD's preferred framework for environmental restoration. The NCP specifies that on-site remedial actions must attain cleanup standards, standards of control, or other requirements related to the contaminant, the remedy, or the remedial location found in federal standards, requirements, criteria, limitations, or state standards if they are more stringent, determined to be legally applicable or relevant and appropriate requirements (ARARs) to the circumstances at a given site. Such ARARs are identified during the remedial investigation/feasibility study (RI/FS) and at other stages in the remedy selection process. To be applicable, a federal or state requirement must directly and fully address the hazardous substance, the action being taken, or other circumstance at a site. A requirement that is not applicable may be relevant and appropriate if it addresses problems or pertains to circumstances similar to those encountered at a site.

2.1.1 Scope of Federal ARARs

For on-site response activities, CERCLA does not require compliance with administrative requirements of permitting laws. CERCLA requires compliance with only the substantive elements of permitting laws, such as chemical concentration limits, monitoring requirements, or design and operating standards for waste management units for on-site activities. Administrative requirements, such as permits, reports, and records, along with substantive requirements, apply only to hazardous substances sent off-site for further management. The extent to which any type of requirement may apply also depends upon where response activities take place. Applicable requirements are universally applicable, while relevant and appropriate requirements only affect on-site response activities. Many federal statutes and their accompanying regulations contain standards that may be applicable or relevant and appropriate at various stages of a response action. Laws and requirements enforced by agencies other than the Environmental Protection Agency (EPA) may also be applicable or relevant and appropriate at a site. During on-site response actions, ARARs may be waived under certain circumstances. A state ARAR may be waived if evidence exists that the requirement has not been applied to other sites (NPL or non-NPL) or has been applied variably or inconsistently. This waiver is intended to prevent unjustified or unreasonable state restrictions from being imposed at CERCLA sites. In other cases, the response may incorporate environmental policies or proposals that are not applicable or relevant and appropriate, but do address site-specific concerns. Such to-be-considered (TBC) standards may be used in determining the cleanup levels, in the absence of an ARAR, necessary for protection of human health and the environment. ARARs must be identified on a site-by-site basis. Features such as the chemicals present, the location, the physical features, and the actions being considered as remedies at a given site will determine which standards will be ARARs for the site. The lead and support agencies (i.e., USACE and NYSDEC for this project) are responsible for the identification of ARARs.

ARARs are used in conjunction with risk-based goals to govern response activities and to establish cleanup goals. ARARs are often used as the starting point for determining protectiveness. When ARARs are absent or are not sufficiently protective, USACE uses data collected from the baseline risk assessment to determine cleanup levels. ARARs thus lend structure to the response process, but do not supplant USACE's responsibility to reduce the risk posed to an acceptable level.

CERCLA, in addition to incorporating applicable environmental laws and regulations into the response process, requires compliance with other relevant and appropriate standards which serve to further reduce the risk posed by hazardous material at a site. Relevant requirements are those cleanup standards, standards of control, or other substantive environmental provisions that do not directly and fully address site conditions, but address similar situations or problems to those encountered at the site. Resource Conservation and Recovery Act (RCRA) landfill design standards could, for example, be relevant to a landfill used at a site, if the wastes being disposed of were similar to RCRA hazardous wastes. Whether or not a requirement is appropriate (in addition to being relevant) will vary depending on various factors. These factors include the duration of the response action, the form or concentration of the chemicals present, the nature of the release, the availability of other standards that more directly match the circumstances at the site, and other factors [40 CFR 300.400(g)(2)]. In some cases only a portion of the requirement may be relevant and appropriate. The identification of relevant and appropriate requirements is a two-step process; only those requirements that are considered both relevant and appropriate must be addressed at CERCLA sites.

Environmental laws and regulations generally fit into three categories: 1) those that pertain to the management of certain chemicals; 2) those that restrict activities at a given location; and 3) those that control specific actions. Therefore, there are three primary types of ARARs.

- **Chemical specific** ARARs are usually health or risk-based restrictions on the amount or concentration of a chemical that may be found in, or discharged to, the environment.
- **Location-specific** ARARs. Location-specific ARARs prevent damage to unique or sensitive areas, such as floodplains, historic places, wetlands, and fragile ecosystems, and restrict other activities that are potentially harmful because of where they take place.
- **Action-specific** ARARs control remedial activities involving the design or use of certain equipment, or regulate discrete actions.

The types of legal requirements applying to responses will differ to some extent depending upon whether the activity in question takes place on site or off site. The term "on-site" includes not only the contaminated area at the site, but also all areas in close proximity to the contamination necessary for implementation of the response action. Remedial actions must comply with all substantive requirements that are "applicable" or "relevant and appropriate." For remedial actions conducted off-site, compliance is required only with applicable requirements, but both substantive and administrative compliance are necessary. Thus, compliance on-site is broader in some respects, and narrower in others, than would be required where similar actions were conducted outside the CERCLA context (e.g., if a private party was doing an entirely voluntary cleanup on its own property). On-site compliance is broadened by the need to comply with "relevant and appropriate" as well as "applicable" requirements. Activities conducted on-site would have to comply with all ARARs; those conducted off-site would have to comply only with applicable requirements. Congress limited the scope of the obligation to attain administrative ARARs through CERCLA Section 121(e), which states that no federal, state, or local permits are required for on-site CERCLA response actions. The lack of permitting authority does not impede implementation of an environmentally protective remedy, since CERCLA and the NCP already provide a procedural blueprint for responding to the release or threatened release of a hazardous substance into the environment. Only the substantive elements of other laws affect on-site responses.

Applicable requirements are those cleanup standards, controls, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, or contaminant, remedial action, location, or other circumstance at a response site [40 CFR Part 300.400(g)]. Basically, to be applicable, a requirement must directly and fully address a CERCLA activity. Determining which standards will be applicable to a remedial action response is similar to determining the applicability of any law or regulation to any chemical, action, or location.

2.1.2 State ARARs

Many states implement environmental regulations that differ from federal standards.

CERCLA 121(d)(2) requires compliance with applicable or relevant and appropriate state requirements when they are more stringent than federal rules and have been promulgated at the state level. To serve as an ARAR at a CERCLA response site, a state requirement must be legally enforceable, based on specific enforcement provisions or the state's general legal authority, and must be generally applicable, meaning that it applies to a broader universe than CERCLA sites. State rules must also be identified by the state in a timely manner (i.e., soon enough to be considered at the appropriate stage of the response process) in order to function as ARARs. State ARARs may be waived under certain circumstances. Of the six waivers set forth in CERCLA Part 121(d)(4), one applies exclusively to state ARARs: the inconsistent application of a state standard waiver. In addition, many state regulations have their own waivers or exceptions that may be invoked at a CERCLA response site. The New York state regulations in Subchapter B, Solid Wastes, Part 360-1.7 are considered ARARs.

2.2 To-Be-Considered Guidelines and Other Controls

Conditions vary widely from site to site, thus ARARs alone may not adequately protect human health and the environment. When ARARs are not fully protective, the lead agency (i.e., USACE for this project) may implement other federal or state policies, guidelines, or proposed rules capable of reducing the risks posed by a site. Such TBC guidelines, while not legally binding (since they may or may not have been promulgated), may be used in conjunction with ARARs to achieve an acceptable level of risk. To-be considered guidance is evaluated along with ARARs, in the RI/FS conducted for each site, to set protective cleanup levels and goals. Because TBCs are not potential ARARs, their identification is not mandatory.

2.3 Identification of Potential ARARs

ARAR identification is a critical element of the DERP-FUDS response process that depends upon cooperation and communication among the USACE and NYSDEC project offices. The ARAR identification process began during the scoping phase of the RI, and will continue through the creation of the Decision Document. During the scoping of the RI and development of the FS the following steps were completed for the ARARs and TBC item identification.

- A list of all chemicals present were considered to be contaminants of potential concern (COPC).
- Potential chemical-specific ARARs and TBCs for the COPCs were identified and analyzed.
- The applicability and relevance and appropriateness of potential chemical-specific ARARs were determined.
- A description of land location characteristics was developed.

Only chemical-specific soil standards (not sediment or groundwater regulations), were examined as potential ARARs and TBC guidance. The human health risk assessment (Section 1.2.6.1) shows that the only risk above acceptable risk levels is to a residential child, from lead in the soil. The ecological risk assessment (Section 1.2.6.2) concluded that the likelihood of an actual risk to ecological receptors in the Area 1 is small enough to warrant no remedial action. Therefore, examination of potential chemical-specific ARARs were limited to those that address lead in soil. There were no federal chemical-specific ARARs identified.

The NYSDEC Unrestricted Use Soil Cleanup Objective (SCO) for lead in soil (63 mg/kg) is considered to be relevant, but not appropriate. This most stringent SCO is based on rural background levels determined by NYSDEC. It assumes that child and adult residents have the same exposures scenarios used for the Residential Use SCO, with the addition of consumption of home based animal products, such as meat, eggs, and milk. However, this is an urban rather than a rural property, and local background concentrations are consistently greater than 63 mg/kg. Also, animal husbandry for the purposes of human consumption is considered overly conservative and is not a reasonable expected site use in a historically developed urban setting. For these reasons, the Unrestricted Use SCO was not identified as an ARAR.

The Residential Use SCO is considered to be relevant but not appropriate. The Residential Use SCO is relevant because the current and future use of Area 1 is consistent with residential land use. The Residential Use SCO is based on a “Residential Use” land use category that allows a site to be used for any use other than raising livestock or producing animal products for human consumption. Per New York State regulation, this is the land use category which will be considered for single family housing (NYSDEC & NYDOH, 2006). The regulation also identifies a separate land use category designated as “Restricted-Residential Use” which only applies when there is common ownership/managing entity of the site. The restricted-residential use category includes restrictions on vegetable gardens and single family housing, but specifically allows active recreational use, defined as “…public uses with a reasonable potential for soil contact.” Such recreational use is also allowable under the residential use land use category and is considered appropriate for Area 1 given its proximity to the adjacent ball field. The current use of the ball field as an active playing field results in a high likelihood that members of the public will come into contact with Area 1 soil while retrieving stray balls or engaging in other recreational activities.

It is noted that the SCO for lead in soil of 400 mg/kg is the same for both the residential use and restricted-residential use land use categories. The SCO is based on an assumption that children residing at the site will be exposed to soil contaminants via direct ingestion, inhalation, and dermal contact, and indirectly through ingestion of indoor dust derived from outdoor soil and consumption of vegetables from a home garden. Adults residing at the site have similar exposures, except that they are not assumed to be exposed to ingestion of indoor dust derived from outdoor soil (NYSDEC & NYDOH, 2006).

The Residential Use SCO is not appropriate because the SCO for lead in soil (400 mg/kg) is less than background (449 mg/kg in shallow soils and 522 mg/kg in deep soils).

There are no location-specific ARARs (Table 2-1). There is a wetland in Area 1; however, it is not regulated under the New York State Freshwater Wetlands Act. There are no known endangered species at the Fort Totten CGS FUDS. The Fort Totten CGS FUDS is within an area designated by the NYDEC as potentially containing rare animals (NYSDEC, 2014). Fort Totten CGS FUDS is within the Fort Totten Historic District (New York City Landmarks Preservation Commission, 1999). Portions of the Fort Totten Historic District have been designated as an archaeological resource (New York City Landmarks Preservation Commission, 2013).

The action-specific ARARs (Table 2-1) are related to cap design, maintenance, monitoring, and inspection. The action-specific ARARs are specific to the individual alternative because each alternative employs different actions.

2.4 Remedial Action Objective

The major objective of any remedial action is the overall protection of human health and the environment. As discussed in the NCP, RAOs are to be stated with specific reference to particular contaminants, the media of concern, the potential exposure pathways, and remedial goals (RGs). The RAO should be fairly well defined, but not so specific that the range of alternatives that can be developed is unduly limited.

The following RAO was developed for Area 1.

- Prevent or reduce potential future residential human exposure to soil with lead concentrations significantly above background concentrations.

2.5 Remedial Goals

Remedial goals establish acceptable exposure levels that are protective of human health and the environment. For lead in Area 1 soils, the RG is background. The RG is to reduce lead (Pb) contamination in surface and subsurface site soil so that the average Pb concentration does not exceed the average surface soil background concentration with 95 percent confidence.

Because the average Pb concentration for the background surface soil may be greater than the NYSDEC Residential Use SCO of 400 mg/kg for Pb in soil, 6 NYCRR Part 375-6.8(a) and (b) is not selected as an ARAR.[1]

The selection of this RG was based on the following:

- The RG is feasible.
- The RG ensures the average Pb concentration in soil at the site will not be significantly greater than the average Pb background concentration with 95 percent confidence.

2.6 Area to be Addressed by the FS

In order to develop remedial alternatives, it was necessary to identify the soils that will be addressed by the FS alternatives. As shown in Figure 2-1, the estimated extent of lead concentrations in excess of background [522 mg/kg for shallow soils (0 to 3 inches) or 449 mg/kg for deep soils (greater than three inches)] is limited to the southern half of Area 1. The total surface area of lead concentrations greater than background that will be addressed in the FS is approximately 20,000 sf. The depth of lead concentrations greater than background is between 1 and 2 ft below ground surface (bgs) in the southwestern portion of Area 1 and is greater than 2 ft bgs, but less than 16 ft bgs in the southeastern portion of Area 1. The depth of soil with lead concentrations that exceed background is assumed to be fairly shallow based on the source of the contamination (i.e., fill material was deposited in the southern portion of Area 1 to fill in low areas of the topography). For purposes of the FS, the lead concentrations in soil greater than background are estimated to extend to 1.5 ft bgs in the western half of the area and are estimated to extend to 3 ft bgs in the eastern half of the entire 20,000 sf area. The total volume of soil with lead concentrations greater than background is estimated to be 45,000 cubic feet or 1,667 cubic yards. The uncertainty in the extent of the lead concentrations greater than background will be addressed through pre-design characterization included as part of FS alternatives 2, 3, and 4.

[1] The average lead background concentration is not statistically different with 95 percent confidence from the NYSDEC Residential SCO of 400 mg/kg.

3.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

3.1 General Response Actions

This section describes the identification and initial screening of applicable technologies. The discussion starts with the identification of general response actions (GRA) and technologies associated with the GRAs; a brief description of each technology, and an initial screening of technologies based on effectiveness, implementability, and cost. GRAs are broad classes of responses or remedial actions that can potentially achieve the RAO. Typically, in developing remedial alternatives, combinations of GRAs may be identified to fully address the RAO.

The GRAs are media-specific actions that may encompass many remedial technologies and remedial technology process options. For example, ex situ treatment is a general response action, ex situ solidification/stabilization is a remedial technology, and ex situ stabilization with pozzolan/Portland cement is a remedial technology process option. Technologies that pass the preliminary screening process are then used in the development of alternatives at the end of this section.

A summary of GRAs for the Area 1 soils is presented in Table 3-1. The GRAs identified as applicable for achieving the RAOs include the following:

- Land Use Controls (LUC);
- Containment;
- Excavation;
- Treatment, and
- Disposal.

3.2 Identification of Remediation Technologies

A list of potentially applicable technologies was developed and organized in terms of the GRA categories (Table 3-2). Initial screening of the identified technologies was based primarily on technical implementability considerations. Each technology in Table 3-2 was evaluated based on contaminant types and concentrations and site conditions. Specific criteria employed in the screening process were:

- Comparability with Site and Constituent Characteristics – A technology must be compatible with the specific site and constituent characteristics.
- Ability to Achieve the RAO – A technology must be capable of achieving the RAO, either alone or as a component of a technology combination.
- Cost – A technology should not be an order of magnitude more costly than other technologies providing comparable performance.

3.2.1 Eliminated Technologies

As shown in Table 3-2, several of the treatment alternatives were eliminated as potential solutions due to their inability to address the contaminant of concern, lead in soil. Most in situ and ex situ treatment technologies were not retained because of contaminant/technology incompatibility or because the technology was excessive for the level of contamination. Three of the four containment technologies were eliminated due to the type of site (shallow contamination) and low risk based analysis of the contaminants present.

3.2.2 Retained Technologies

As shown in Table 3-2, several of the technology types were retained as potential solutions due to their ability to address lead in Area 1 soil. Limited action technologies (including use restrictions, access restrictions, and signs), soil cover cap, and excavation and disposal were retained as potentially appropriate technologies for the Area 1 soils.

3.3 Remedial Alternatives

In assembling alternatives, the technologies that were retained were combined to form four remedial alternatives to address the Area 1 soil. Using the retained technologies and process options, the following remedial alternatives were developed:

- Alternative 1: No Action;
- Alternative 2: Land Use Controls;
- Alternative 3: Soil Cover Cap with LUCs; and
- Alternative 4: Removal, Off-Site Disposal, and Backfill

These four alternatives are summarized in Table 3-3 and evaluated in detail in Section 4.0.

4.0 DETAILED ANALYSIS OF ALTERNATIVES

4.1 Description of Evaluation Criteria

As discussed in Section 3.0, the alternatives retained for further consideration are: 1) no action, 2) LUCs, 3) soil cover cap and LUCs, and 4) removal, off-site disposal, and backfill. Those four alternatives will be analyzed further in this section. Section 300.430(e)(9)(iii) of the NCP lists nine criteria against which each alternative must be assessed. The acceptability or performance of each alternative against the criteria is evaluated individually so that relative strengths and weaknesses may be identified. The detailed criteria are: 1) protection of human health and the environment; 2) compliance with ARARs; 3) long-term reliability and effectiveness; 4) reduction of toxicity, mobility, or volume through treatment; 5) short-term effectiveness; 6) implementability; 7) cost; 8) state acceptance; and 9) community acceptance.

The first two criteria, protection of human health and the environment and compliance with ARARs, are "threshold criteria" which must be met by the selected remedial action unless a waiver is granted under Section 121(d)(4) of CERCLA. Criteria 3 through 7 are "primary balancing criteria" and the trade-offs within this group must be balanced. The preferred alternative will be the alternative which is protective of human health and the environment, is ARAR-compliant, and provides the best combination of primary balancing attributes. The final two criteria, state and community acceptance, are "modifying criteria" which are evaluated after the FS has been presented to the regulators and the community, allowing for their input. The nine criteria are explained further below.

4.1.1 Protection of Human Health and the Environment

A determination and declaration that this criterion will be met by the proposed remedial action must be made in the Decision Document; therefore, the selected remedy must meet this threshold criterion. The criterion can be satisfied if the risks/exposures at the site are eliminated, reduced, or controlled to levels established during development of remediation goals. Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

4.1.2 Compliance with ARARs

Compliance with ARARs is a threshold criterion that must be met by the proposed remedial action. The remedial alternative will meet this criterion if all chemical-specific, action-specific, and location-specific ARARs are met by the alternative. For those ARARs that are not met, a determination will be made as to whether a waiver is appropriate. The ARARs identified for this project are discussed in Section 2.3 and are summarized in Table 2-1.

4.1.3 Long-Term Effectiveness and Permanence

This criterion examines the protection of human health and the environment after implementation of the remedial alternative. This criterion addresses the long-term adequacy, reliability, and permanence of the alternative. Components of this analysis include:

- The expected long-term reduction in risk posed by the site.
- The magnitude of residual risk remaining from untreated waste or treatment residuals at the conclusion of the remedial activities.
- The level of effort needed to maintain the remedy and monitor the area for changes in site conditions.
- Compatibility of the remedy with the planned future use of the site.

4.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The statutory preference for remedial technologies that significantly and permanently reduce the toxicity, mobility, or volume (TMV) through treatment of the waste is addressed by this criterion. The following factors will be considered:

- The amount of hazardous materials that will be destroyed or treated.
- The degree of expected reduction in toxicity, mobility, or volume.
- The degree to which the treatment will be irreversible.
- The type and quantity of treatment residuals that will remain following treatment.

4.1.5 Short-Term Effectiveness

Evaluation of the alternatives with respect to short-term effectiveness takes into account protection of workers and community during the remedial action, environmental impacts from implementing the action, and the time required to achieve remedial action objectives. The short-term impacts of alternatives shall be assessed considering the following:

- Protection of the community during the remedial action, including the effects of dust from excavation, transportation of contaminated materials, and air-quality impacts from on-site treatment.
- Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures.
- Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation.
- Time required to achieve remedial response objectives.

4.1.6 Implementability

The technical and administrative feasibility of implementing the remedial action will be addressed. The technical feasibility will be evaluated on the basis of ease of construction and maintenance, and the reliability of the selected technology. The ease or difficulty of implementing the alternatives is assessed by considering the following types of factors as appropriate.

- Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy.
- Administrative feasibility, including activities needed to coordinate with other offices and agencies and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions).
- Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment, specialists, and provisions to ensure any necessary additional resources; the availability of services, materials, and availability of prospective technologies.

4.1.7 Cost

The cost estimates presented in this report were prepared in accordance with USEPA guidance (USEPA, 2000) and represent programming-level and order of magnitude estimates. These costs are based on conventional cost estimating guides, prior experience, and vendor quotes and were prepared in accordance with the information available at the time of the estimate. The cost estimates are on a common, present-worth basis in terms of 2013 dollars. The actual costs of the project will depend on true labor and material costs, actual site conditions, competitive market conditions, final project scope, the implementation schedule, and other variable factors.

The cost estimate details are presented in Appendix A and include both capital cost and operations and maintenance (O&M) costs as detailed below.

- Capital costs, including both direct and indirect costs: Capital costs include those expenditures required to implement a remedial action. Both direct and indirect costs are considered in the development of capital cost estimates. Direct costs include construction costs for equipment, labor, and materials required to implement the remedial action. Indirect costs include those associated with engineering, permitting, construction management, and other services necessary to carry out a remedial action.
- Annual operation and maintenance costs: Annual operations and maintenance costs, which include operation labor, maintenance manuals, energy, and purchased services have also been determined. The estimates include those operation and maintenance costs that may be incurred even after the initial remedial activity is complete.

A significant uncertainty that may affect the costs is the actual area and volume of contaminated soil. The area and/or volume of contaminated soil will be determined during additional pre-design investigation. The cost of the additional pre-design investigation is included in each of the alternatives, except the No Action alternative.

4.1.8 State Acceptance

Since NYSDEC has not been provided with a formal opportunity to review the detailed analysis of the remedial actions, no formal comments are available for evaluation of the "State Acceptance" criterion. It is anticipated that formal comments from NYSDEC will be provided during the public comment period on the Proposed Plan for the preferred alternative. These comments will then be addressed in the Decision Document responsiveness summary.

4.1.9 Community acceptance

Since the community has not been provided with a formal opportunity to review the detailed analysis of the remedial actions, no formal comments are available for evaluation of the "Community Acceptance" criterion. It is anticipated that formal comments from the community will be provided during the public comment period on the Proposed Plan for the preferred alternative. These comments will then be addressed in the Decision Document responsiveness summary.

4.2 Alternative 1 – No Action (Baseline Alternative)

Although not a remedial technology, the NCP requires the evaluation of a No Action alternative as a baseline for comparison with other remedial technologies.

4.2.1 Protection of Human Health and the Environment

The “No Action” alternative does not decrease the potential risks to humans or the environment in any way, because no remedial activities would be implemented at the site under this alternative. The “No Action” alternative does not include a monitoring system to determine if further remedial action is necessary. Future residential use is proposed for Fort Totten CGS FUDS near the ball field area, which is adjacent to Area 1. Future residents may experience soil exposures causing unacceptable risks.

4.2.2 Compliance with ARARs

Action-specific ARARs are not considered because no remedial activities would be implemented. There are no chemical-specific or location-specific ARARs.

4.2.3 Long-Term Effectiveness and Permanence

Since the no-action baseline alternative does not make any changes, either administrative or by remediation, it does not stop or retard further environmental degradation by controlling or eliminating source area releases.

4.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Since the no-action baseline alternative does not implement any treatment technologies, there are no expected reductions in toxicity, mobility, or volume of contaminants through treatment.

4.2.5 Short-Term Effectiveness

Short-term effectiveness does not apply to the "No Action" alternative because no additional remedial activities would be implemented.

4.2.6 Implementability

There are no implementability concerns associated with the "No Action" alternative because no remediation activities would be conducted.

4.2.7 Cost

The No Action alternative does not have any capital or O&M costs associated with it, since it does not require any activities to be initiated.

4.3 Alternative 2 – Land Use Controls

LUCs in the form of access and land use restrictions and a security fence are proposed for this alternative. Aspects of this alternative are discussed below.

Access and Land-Use Restrictions: Administratively, use of the property would be limited and restricted through changes to the site management plan. If the property is sold, the ownership transfer documents would need to describe the contamination at the site. To prevent contact with the lead-impacted soil by children, a physical land use control, consisting of a six foot tall chain link fence, would be erected to surround the area where lead concentrations in soil exceed background. It is estimated that 580 ft of fence would be required. The security fence would have warning signs posted upon it, restricting entry to authorized personnel only. The fence would have at least one gate to allow for monitoring and maintenance activities. USACE would be responsible for maintenance of the fence.

Pre-design investigation: A pre-design investigation would be conducted to determine the extent of the surface soil with lead concentrations above background. The investigation results would be used to determine the exact location of the security fence.

Monitoring and Maintenance: Monitoring and maintenance of the fence would be conducted. Monitoring of the fence would be conducted annually and maintenance of the fence would be conducted as needed.

Five-Year Review: Five-year reviews would be conducted to monitor the protectiveness of the remedy.

4.3.1 Protection of Human Health and the Environment

Access and land-use restrictions are a proven method of preventing unnecessary human exposure to contaminants, provided they are properly and consistently enforced. Land use controls at Area 1 would prevent human exposure to contaminants in soil through the ingestion and dermal contact pathways.

4.3.2 Compliance with ARARs

There are no applicable action-specific ARARs. There are no chemical-specific or location-specific ARARs.

4.3.3 Long-Term Effectiveness and Permanence

Land use controls would be effective in the long term if appropriate use and access restrictions were properly established and maintained. Installation of a fence to restrict access to soil with lead concentrations above background would eliminate human exposure to contaminated soil through dermal contact and ingestion, as long as the fencing is maintained. It is recognized that there can be difficulties associated with the maintenance of LUCs and a fence for perpetuity, especially as property ownership changes, and given the anticipated use of the property for open space and its location adjacent to established ball fields. Land use controls do not stop or retard further environmental degradation by controlling or eliminating source area releases.

4.3.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Land use controls would not involve treatment, so they would not reduce the toxicity, mobility, or volume of contaminants through treatment.

4.3.5 Short-Term Effectiveness

Design and construction plans would be developed to minimize potential exposures to site workers from dermal absorption, inhalation, or incidental ingestion of contaminated soil during installation of the fence. Potential exposure would be minimized by using appropriate personal protective equipment (PPE).

4.3.6 Implementability

Administrative implementation of this alternative would require coordination between USACE, the current site owners (USCG), NYSDEC, and various departments of New York City administration such as the land records office or local zoning authorities, to ensure continuity of the long-term management and monitoring of the site. The physical characteristics of Area 1 present no obstacles to the erection of a fence and signs. Building the security fence would be easily implemented with readily available resources. Uncertainty regarding the lateral extent of lead-impacted soils with concentrations greater than background would be addressed during pre-design investigation. Implementation of this alternative would require approximately six months for the design phase, and six months for the bidding and construction phase.

4.3.7 Cost

The total cost of Alternative 2 is estimated at $206,130. The total capital cost of Alternative 2 is estimated at $73,435, while the 30-year O&M costs are estimated at $132,695. Costs for Alternative 2 were prepared for 30 years, but the remedy would be implemented for as long as needed to verify the protectiveness of the remedy. The costs include pre-design investigation, construction, monitoring, maintenance, and 5-Year Reviews. Details of the cost estimate are presented in Appendix A.

4.4 Alternative 3 – Soil Cover Cap with LUCs

This alternative would involve placing a soil cover cap over the area where lead concentrations exceed the RG. The primary objective of the soil cover cap is to eliminate human contact with the contaminated soils.

The cover would include a geomembrane, placed on the grubbed soil. The geomembrane would be covered by 12 inches of fill and 6 inches of topsoil. The topsoil would be seeded with grass. The soil cover cap would include a storm water management system to prevent runoff into the adjacent wetland. The total surface area of lead concentrations greater than background is approximately 20,000 sf. The estimated volume of fill needed would be 741 cy and the topsoil volume needed would be 370 cy. Conventional earthmoving equipment such as excavators, front-end loaders, or other earthmoving equipment would be used for applying the soil cover cap. Signage and barriers such as the fence (wood, split-rail) and the gate, would be installed to prohibit activities that would disturb or interfere with the integrity or function of the cap, such as construction on, excavation of, or drilling through the soil cover cap. Construction equipment during installation would impose the maximum lifetime loads on the cover. Gas venting is not planned due to the low level of organic contamination and because the soil cover cap design does not include an impermeable layer. The following paragraphs present a summary of activities anticipated under this alternative.

Pre-Design Investigation/Work Plans/Reporting: A pre-design investigation would be conducted to determine the extent of the surface soil with lead concentrations above background. The investigation results would be used to determine the exact dimensions of the cap. Site-specific work plans would be prepared prior to construction activities that will include a quality assurance planning component, health and safety component (including air monitoring specifications), work plan, and field procedures. In addition, a full-scale Remedial Design would be completed that would detail the design of the cover, including specifications on materials to be used for the different layers of the cap, types of grass seed to sown, method and degree of compaction, and other design requirements. The plans would be reviewed and approved by USACE and NYSDEC prior to remedial activities. After the remedial action has been completed and the final inspection approved by the USACE and NYSDEC, a Remedial Action Report would be prepared. The report would include site drawings, sample data, and a detailed narrative of the remedial action. The report would be submitted to USACE and regulatory agencies for review and comment. Comments would be incorporated into the Final Remedial Action Report.

Site Set-Up: Site set-up for the soil cover installation at Area 1 would consist of setting up of a decontamination station and equipment/materials staging areas. The only water needs of the remedial activities would be for decontamination and dust suppression. Therefore, water would be trucked to the site and stored in a 550-gallon tank. Electrical power during construction would be supplied by portable generators. Construction activities would be conducted during daylight hours, so lighting would not be required.

Clearing and Grubbing: Trees present in the area to be covered would be removed prior to construction activities. Clearing and grubbing would be performed using conventional equipment.

Soil Cover Construction: The soil cover would consist of a geomembrane, a fill layer, and a topsoil layer. Confirmation samples would be collected from the fill and topsoil prior to placement to verify that they are suitable for use at the site. The geomembrane is the first layer of the cap. The area would be cleared, grubbed, and graded prior to installation of the geomembrane. The geomembrane would be permeable, eliminating the need for a gas venting system.

The fill layer is the second layer of the cap, and would be varied in thickness to achieve the final surface gradient of the cap. The minimum thickness of fill planned would be 12 inches, and it is estimated that approximately 577 cy of fill would be required. The gradient of the top of the foundation layer would conform to the final gradient planned for the completed cap, allowing uniform placement of the upper topsoil layer.

The upper soil layer would the final layer to be installed. This layer would consist of six inches of topsoil, and grass or other durable vegetation. The purpose of this upper soil/vegetation layer would be to protect the underlying cover components, to prevent surface erosion of the cap with minimum maintenance. The 6-inch topsoil layer would be seeded with grass.

Land-Use Restrictions: Administratively, use of the property would be limited and restricted through changes to the site management plan. If the property is sold, the ownership transfer documents would need to describe the contamination at the site and prohibit residential use of the area where lead concentrations are greater than the RG.

Monitoring and Maintenance: Monitoring and maintenance of the soil cover cap, signage, and fence would be conducted. Monitoring of the soil cover cap, signage, and fence would be conducted quarterly for the first two years and semiannually thereafter. Monitoring would be documented through inspection reports, including photographs. The soil cover cap would be mowed semiannually and woody growth (shrubs and trees) would be removed. Other maintenance of the soil cover cap (e.g., filling animal burrows and repairing subsidence caused by settlement or erosion) and the fence would be conducted as needed.

Five-Year Review: Five-year reviews would be conducted to monitor the protectiveness of the remedy.

4.4.1 Protection of Human Health and the Environment

This alternative is protective of human health and the environment. It is unlikely that recreational users of the park could penetrate the topsoil, fill, and geomembrane (2 ft total depth). Wind erosion of contaminated soil, surface runoff, plant uptake, and animal burrowing and ingestion would also be eliminated. Land use controls prohibiting excavation in the area would be an additional part of the remedy. These measures would provide protection for human and ecological receptors by preventing contact with contaminated soil.

4.4.2 Compliance with ARARs

Applicable action-specific ARARs would be followed. There are no chemical-specific or location-specific ARARs.

4.4.3 Long-Term Effectiveness and Permanence

The soil cover cap prevents contact with contaminated media, thereby eliminating the risk from exposure and providing long-term effectiveness. The soil cover cap would also prevent release of the contaminants through erosion by wind or water. These factors would control the source of contamination and its release. If properly maintained, this option would provide long-term soil stabilization and reduction of contaminant mobility. Maintenance of the soil cover cap and associate fence would be performed as needed. Human exposure via direct contact and incidental ingestion would be eliminated. This alternative also includes LUCs and a fence surrounding the cap. It is recognized that there can be difficulties associated with the maintenance of LUCs and a fence for perpetuity, especially as property ownership changes, and given the anticipated use of the property for open space and its location adjacent to established ball fields. These issues would be identified and a mitigation plan developed as part of the remedy implementation process.

4.4.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The soil cover alternative is not a treatment method, so it would not reduce the toxicity, mobility, or volume of contaminants, through treatment.

4.4.5 Short-Term Effectiveness

During clearing and grubbing and the placement of soil cover cap, contaminated particulates may be generated and dispersed into the atmosphere resulting in potential exposure from dermal absorption, inhalation, or incidental ingestion of contaminated soil. Design and construction plans along with monitoring and appropriate use of PPE would be implemented to minimize potential exposures. Windblown emissions of contaminated dusts and transport of contamination in surface runoff would be controlled using a water spray or plastic sheeting. Silt fences, trenches, or other structures would be constructed to prevent surface runoff and erosion of contaminated soil. Air monitoring during remedial actions would be conducted to measure releases of contaminated particulates. An air monitoring program, including the regular use of a particulate counter, would provide a means of determining when additional dust control measures are required. Appropriate levels of PPE would be used to minimize worker exposure to airborne contaminants. It is assumed that Level D PPE would be sufficient to protect workers during the remedial action activities.

There would be short term impacts associated with noise generation to workers and nearby residents. Appropriate hearing protection would be used to minimize worker exposure. Efforts would be made to minimize the potential impact to the local community by working during regular business hours and coordinating with the nearby residents.

Other impacts to nearby residents would include an increase in heavy vehicle traffic into and out of Fort Totten via Totten Avenue. Traffic controls would be implemented, as appropriate, to minimize inconveniences and to avoid roadway accidents. The time required to implement Alternative 3 is estimated at 15 to 18 months.

4.4.6 Implementability

Soil cover is a proven technology and construction is normally a simple process. Materials (e.g., geomembrane, fill, and topsoil) could be easily obtained from vendors near Fort Totten. Parts of Area 1 are wooded; the trees would be removed, thus presenting no obstacles to the construction of a soil cover. All required equipment for earthwork is available locally. Other materials, such as erosion control netting, seeding material, and piping, are also widely available. Additional actions, including maintaining erosion control, and periodic maintenance of the vegetative cover, are not difficult to implement, although repairing the layers may be difficult if the cover is breached by subsidence. Periodic monitoring and maintenance would include visual inspection of the entire cover to ensure it is intact, and that erosion controls are functioning properly. Administrative implementation of this alternative would require coordination between USACE, the current site owners (USCG), NYSDEC, and various departments of New York City administration such as the land records office or local zoning authorities, to ensure continuity of the long-term management and monitoring of the site. Uncertainty regarding the lateral extent of lead-impacted soils with concentrations greater than background would be addressed during pre-design investigation. Implementation of this option would require six to nine months for the design phase, and nine months for the bidding and construction phase. These time estimates include regulatory review of the design.

4.4.7 Cost

The total cost of Alternative 3 is estimated at $282,635. The total capital cost of Alternative 3 is estimated at $156,527, while the 30-year O&M costs are estimated at $126,107. Costs for Alternative 3 were prepared for 30 years, but the remedy would be implemented for as long as needed to verify the protectiveness of the remedy. The costs include pre-design investigation, construction, monitoring, maintenance, and 5-Year Reviews. Details of the cost estimate are presented in Appendix A.

4.5 Alternative 4 – Removal, Off-Site Disposal, and Backfill

This alternative involves removal of soil with lead concentrations greater than background. The soil would be removed by excavation to a depth of 1.5 ft in the western portion of the area to be addressed and to a depth 3 feet in the eastern portion of the area to be addressed. Excavation confirmation sampling would be conducted. Then the area would be backfilled with fill and topsoil, and finally seeded with grass. The contaminated soil volume is approximately 1,667 cy. Assuming a 20 percent increase in volume from fluffing (assuming a combination of sand, gravel and loam) and an additional 30 percent increase for conversion to tons (Department of Army, 2000) the total mass of waste material to be excavated would be approximately 2,600 tons. Conventional earthmoving equipment such as excavators, loaders, and dump trucks would be used for excavation of the soil. A summary of the site activities is presented below.

Pre-Design Investigation/Work Plans/Reporting: A pre-design investigation would be conducted to determine the extent of the surface soil with lead concentrations above background. The investigation results would be used to determine the planned extent of the excavation. Site-specific work plans would be prepared prior to excavation activities that would include a quality assurance planning component, health and safety component, work plan, and field procedures. A minimal Remedial Design would be completed. The plans would be reviewed and approved by USACE and NYSDEC prior to remedial activities. The estimated time for completion of these plans would be three months. This includes incorporation of review comments and revisions. After the remedial action has been completed and the final inspection approved by USACE and NYSDEC, a Remedial Action Report would be completed. The report would include site drawings, sample data, copies of all manifests, and a detailed narrative of the remedial action. The report would be submitted to USACE and regulatory agencies for review and comment. Comments would be incorporated into the Final Remedial Action Report.

Site Set-Up: Site set-up for the excavation, off-site disposal, and backfilling at Area 1 would consist of setting up of a decontamination station and equipment/materials staging areas. The only water needs of the remedial activities would be for decontamination and dust suppression. Therefore, water would be trucked to the site and stored in a 550-gallon tank. Electrical power during construction would be supplied by portable generators. Construction activities would be conducted during daylight hours, so lighting would not be required.

Excavation: For cost estimating purposes, it was assumed that one excavator and one loader would be used to excavate and load the soil into dump trucks. The soil would then be transported to a permitted disposal facility. It is assumed that the excavation would proceed at the rate of approximately 400 cy per day, assuming that the disposal facility can receive wastes at this rate. A water truck would be required on site during excavation activities for decontamination and dust suppression purposes. Air monitoring for dust generation would be performed. The decontamination liquids generated from equipment cleaning would be stored in a 550-gallon storage tank for disposal.

Confirmational Sampling: Soil screening using X-ray fluorescence would be conducted concurrently with excavation. The screening would be used to determine the limits of excavation based on the soil RG. Confirmation samples for total lead would then be collected using an incremental sampling approach and analyzed at an off-site analytical laboratory. The confirmation sample data would document that the arithmetic average lead concentration of soil remaining for exposure was not greater than background.

Waste Characterization: Characterization of the soil prior to excavation would be used to determine if it would be disposed as a hazardous or non-hazardous waste. The soil would be sampled prior to disposal for RCRA waste characteristics. For the purposes of this FS, analysis for lead toxicity characteristic leaching procedure (TCLP) would be completed on soil samples collected from the area planned for excavation during the pre-design investigation. It is assumed that one composite sample per 500 tons, for a total of 6 samples, would be necessary. An off-site laboratory would conduct this analysis of the soils.

Waste Transportation and Disposal: For cost estimating purposes in this FS, it was assumed that 100 percent of the soil removed from Area 1 would be non-hazardous and would be disposed as such. In addition, it was assumed that the decontamination water would be non-hazardous, so it would be disposed in the New York City Sanitary Sewer System.

Site Restoration: Clean soil fill would be obtained and used to replace the excavated soil to match the surrounding grade. Samples of the topsoil and fill would be analyzed at an off-site laboratory prior to placement to verify that the fill is suitable for use at the site. The fill soil would be compacted in 6-inch lifts to minimize the formation of depressions. Finally, 6 inches of topsoil would be placed over the backfill and the area would be vegetated with grass for erosion control. Erosion mats or temporary barriers would be used as necessary to prevent erosion.

4.5.1 Protection of Human Health and the Environment

This alternative would leave the Area 1 soil below the RG, thereby protecting human receptors and achieving the RAO. Therefore, overall protection of human health and the environment would be enhanced by this alternative.

4.5.2 Compliance with ARARs

There are no applicable action-specific ARARs. There are no chemical-specific or location-specific ARARs.

4.5.3 Long-Term Effectiveness and Permanence

Alternative 4 would remove soil contaminated above the RG, thus providing long term effectiveness and permanence.

4.5.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The excavation, off-site disposal, and backfill alternative is not a treatment method, so it would not reduce the toxicity or mobility of contaminants, through treatment.

4.5.5 Short-Term Effectiveness

During excavation and backfill, contaminated particulates may be generated and dispersed into the atmosphere resulting in potential exposure from dermal absorption, inhalation, or incidental ingestion of contaminated soil. Design and construction plans along with monitoring and appropriate use of PPE would be implemented to minimize potential exposures. Windblown emissions of contaminated dusts and transport of contamination in surface runoff would be controlled using a water spray or plastic sheeting. Silt fences, trenches, or other structures would be constructed to prevent surface runoff and erosion of contaminated soil. Air monitoring during remedial actions would be conducted to measure releases of contaminated particulates. An air monitoring program, including the regular use of a particulate counter, would provide a means of determining when additional dust control measures are required. Appropriate levels of PPE would be used to minimize worker exposure to airborne contaminants. It is assumed that Level D PPE would be sufficient to protect workers during the remedial action activities.

There would be short term impacts associated with noise generation to workers and nearby residents. Appropriate hearing protection would be used to minimize worker exposure. Efforts would be made to minimize the potential impact to the local community by working during regular business hours and coordinating with the nearby residents.

Other impacts to nearby residents would include an increase in heavy vehicle traffic into and out of Fort Totten via Totten Avenue. Traffic controls would be implemented, as appropriate, to minimize inconveniences and to avoid roadway accidents. All vehicles that would be transporting soil to the off-site disposal facility would be operated in accordance with federal and state regulations. The haul routes would be identified and agreed to prior to commencement of remedial activities. The time required to implement Alternative 4 is estimated to need from 6 to 12 months to implement.

4.5.6 Implementability

Excavation and off-site disposal of lead-impacted soil is a common remedial activity and the required personnel and equipment are readily available. Materials (i.e., clean fill, topsoil, erosion control netting, and seeding material) are easily obtained from local vendors. Administrative implementation of this alternative would require coordination between USACE, the current site owners (U.S. Coast Guard) and NYSDEC. Uncertainty regarding the lateral extent of lead-impacted soils with concentrations greater than background would be addressed during pre-design investigation. Implementation of this alternative would require approximately six months for the design phase, and three months for the construction phase.

4.5.7 Cost

The total capital cost of this alternative is estimated at $450,935. No O&M is involved in this alternative. The costs include pre-design investigation, excavation, transportation, and disposal of soil, backfill, and site restoration. Details of the cost estimate are presented in Appendix A.

A summary of the evaluations in Sections 4.2 through 4.5 is provided in Table 4-1.

5.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

5.1 Comparative Analysis of Alternatives

In the following analysis, the alternatives are evaluated in relation to one another for each of the first seven evaluation criteria. State and community acceptance will be addressed in the Decision Document following comments on the FS report and the Proposed Remedial Action Plan. The purpose of this analysis is to identify relative advantages and disadvantages of each alternative. This analysis is summarized in Table 5-1. The alternatives are evaluated in Section 4.0, and are as follows:

- Alternative 1: No Action
- Alternative 2: Land Use Controls
- Alternative 3: Soil Cover Cap with LUCs
- Alternative 4: Removal, Off-Site Disposal, and Backfill

5.1.1 Overall Protection of Human Health and the Environment

Alternative 1 is the only alternative where there would be no activity. Therefore, this is the only alternative that would not satisfy the “overall protection of human health and the environment” criterion. Alternatives 2, 3 and 4 would satisfy this criterion. Alternative 2 would prevent or reduce direct contact with the contaminated soil through LUCs and a security fence. Alternative 3 would protect human health and the environment by preventing direct contact or incidental ingestion of contaminated soil. Alternative 4 would protect human health and the environment through the removal of the contaminated soil.

5.1.2 Compliance with ARARS

There are no chemical- or location-specific ARARs. Alternative 3 would comply with the action-specific ARARs. Alternatives 2 and 4 do not have any action-specific ARARs.

5.1.3 Long-Term Effectiveness and Permanence

Alternative 1 will not provide a permanent solution or long-term effectiveness. Alternative 2 would provide long-term protection for only as long as the LUCs and the fence remained in place and effective. Alternatives 2 and 3 would have similar issues associated with maintenance of LUCs and the fence for perpetuity; however, Alternative 3 has the significant added benefit of the presence of the soil cap in the event that LUCs or the fence become compromised. Alternatives 3 and 4 provide long-term effectiveness. Alternative 4 provides a more permanent solution than Alternative 3, because Alternative 4 would remove the contaminated soil from the site.

5.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternatives 1, 2, 3, and 4 would not reduce the TMV of the contaminants through treatment because they do not include treatment as part of the design.

5.1.5 Short-Term Effectiveness

Alternative 1, the No Action alternative, would have no short-term impacts on human health and the environment. Alternatives 3 and 4 would likely have impacts on workers and also possibly visitors and nearby residents during remedial action from the generation of fugitive dust. The amount of dust generated under Alternative 4 is likely to be greater than the amount generated under Alternative 3; however, this impact can be minimized by using water to control the dust. In terms of noise generation during construction activities, Alternatives 3 and 4 may have some impact on the workers and the residents. Efforts would be made to minimize the potential impact to the local community by working during regular business hours and coordinating with the nearby residents. Additionally, during the invasive remediation activities, as would occur for Alternatives 3 and 4, ambient air would be monitored for airborne dust at the perimeter of Area 1. For Alternatives 3 and 4, an increase in heavy vehicle traffic into and out of Fort Totten would occur via Totten Avenue. Traffic controls would be implemented, as appropriate, to minimize inconveniences. For Alternative 4, all vehicles that would be transporting soil to the off-site disposal facility would be operated in accordance with federal and state regulations. The haul routes would be identified and agreed to prior to commencement of remedial activities. Because no action would occur under Alternative 1, no time would be required to implement it. The time required to implement Alternative 2 is estimated at three to nine months. The time required to implement Alternative 3 is estimated at 15 to 18 months. Alternative 4 is estimated to need from 6 to 12 months to implement.

5.1.6 Implementability

All the alternatives can easily be implemented using commonly employed methods, equipment, materials, and personnel. Alternative 1 is the easiest to implement because no action is taken. Alternatives 3 and 4 would require the most experienced personnel to implement because of the skill required in surveying, sampling, soil cover cap construction, excavation, and backfilling.

5.1.7 Cost

The estimated cost of each alternative is detailed in Appendix A and summarized in Table 4-1. The assumptions for the cost estimates also are presented in Appendix A. Capital cost, periodic costs (where appropriate), and total project costs for a period of 30 years have been evaluated. Five- year reviews over a period of 30 years is included for Alternatives 2 and 3. In accordance with USEPA guidelines, these cost estimates are anticipated to provide an accuracy of +50 percent to –30 percent (USEPA, 1988).

5.1.8 State Acceptance

The NYSDEC will review the Proposed Plan. Final state acceptance of the selected remedial alternative will be addressed in the Decision Document following the public comment on the Proposed Plan.

5.1.9 Community Acceptance

Final public acceptance of the selected remedial alternative will be addressed in the Decision Document following the public comment period on the Proposed Plan.

5.2 Summary

Alternative 1 is not an acceptable alternative because it does not meet the threshold criteria of protectiveness. Alternative 2 is acceptable but does not provide the same degree of long-term effectiveness as the remaining alternatives. Alternatives 2, 3, and 4 are all permanent solutions; however, only Alternative 4 removes the contaminated soil, thereby avoiding future O&M and long-term reporting requirements. None of the alternatives incorporates treatment to reduce toxicity, mobility, or volume. Alternatives 3 and 4 have virtually the same degree of short-term effectiveness and implementability. The cost of Alternative 2 is $206,130, Alternative 3 is $282,635, and Alternative 4 is $450,934.

It is noted that only Alternative 4 provides a means of effectively “closing out” the property under the FUDS program. Because Area 5 contains low-levels of residual mercury in the subsurface (albeit at concentrations that do not result in unacceptable risk), NYSDEC has requested that the USCG provide a written acknowledgement of same. Accordingly, the USACE has requested such a letter from the USCG as part of the overall “closure” of the property.

6.0 REFERENCES

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TABLES

Table 1-1
Summary of Estimated Life Time Cancer Risks and Hazard Indices from Area 1
Feasibility Study
Engineer School, Fort Totten
Queens, New York

Exposure Scenario	Current Exposure		Future Exposure	
	Excess Lifetime Cancer Risk	Hazard Index	Excess Lifetime Cancer Risk	Hazard Index
Outdoor Workers (surface soil)	1.00E-06	0.02	7.00E-06	0.1
Outdoor Workers (subsurface soil)	1.00E-06	0.02	8.00E-06	0.1
Trespasser (surface soil)	3.00E-06	0.05	NA	NA
Indoor Workers (surface soil)	NA	NA	5.00E-06	0.06
Indoor Workers (subsurface soil)	NA	NA	6.00E-06	0.08
Construction Workers (surface soil)	NA	NA	1.00E-06	0.9
Construction Workers (subsurface soil)	NA	NA	1.00E-06	1
Residents (surface soil)	NA	NA	6.00E-05	1
Residents (subsurface soil)	NA	NA	7.00E-05	2*
Recreational (surface)	NA	NA	9.00E-06	0.2
Recreational (subsurface)	NA	NA	1.00E-05	0.3

* The largest contributors to the screening HI is the ingestion of cobalt (Endocrine HI = 0.4) and arsenic (Skin HI = 0.4). Each of the segregated, target organ-based HIs is below 1, indicating it is not an unacceptable risk.

NA = Not Applicable

Table 2-1
ARARs and To-Be-Considered Guidance
Feasibility Study
Engineer School, Fort Totten
Queens, New York

Standard, Requirement, or Criteria	Citation	ARAR and Description of Requirement	Type	Comment
Determination of Soil Cleanup Objectives and Cleanup Levels	6 NYCRR Part 375-6.8(a) (Remedial Program Soil Cleanup objectives).	Not an ARAR.	Relevant but not Appropriate	The Unrestricted Use Soil Cleanup Objective (SCO) is not an ARAR because it is not appropriate. The Unrestricted Use SCO for lead in soil (63 mg/kg) is considered to be relevant, but not appropriate. This most stringent SCO is based on rural background levels determined by NYSDEC. However, this is an urban rather than a rural property, and local background concentrations are consistently greater than 63 mg/kg.
	6 NYCRR Part 375-6.8(b) (Remedial Program Soil Cleanup objectives).	Not an ARAR.	Relevant but not Appropriate	The Residential Use Soil Cleanup Objective (SCO) is not an ARAR because it is not appropriate, since background concentrations exceed 400 mg/kg (Residential Use SCO).

Standard, Requirement, or Criteria	Citation	ARAR and Description of Requirement	Type	Comment
Capping	40 CFR 264.310(a, b), Hazardous waste landfills. 40 CFR 258.60 Non-hazardous waste landfill. 6NYCRR 360-1.7(a)(3)(viii) Solid Waste Management Facilities	Action-Specific ARAR. Standards for owners and operators of hazardous waste treatment, storage, disposal facilities closure, and post-closure care. Standards for municipal solid waste landfills closure and post-closure care.	Applicable	Cap design, monitoring and inspection, closure and post-closure care. (Alternative 3)

Table 3-1
General Response Actions
Feasibility Study
Engineer School, Fort Totten
Queens, New York

General Response Action/Technology	Applicability to Remedial Action Objective
Land Use Controls (LUC)	Implementation of administrative action controlling future site use or placement of fencing and warning signs to restrict use. LUC may be used in conjunction with other technologies.
Containment	Isolation of contaminated media from the environment and potential receptors by blocking the exposure/transport mechanism.
Excavation	Use of mechanical force to dislodge contaminated soil from the site. Easy to implement and traditional technology that has been used at other sites. Required prior to implementation of ex-situ treatment or disposal options.
Treatment	Treatment of contaminated soil may reduce the toxicity, mobility, or volume of contaminants, thereby eliminating the risks. Treatment of contaminated materials may be performed in situ, or ex situ, at an off-site location following a removal action by excavation.
Disposal	Disposal of treated or untreated soil at an offsite location would reduce the potential for exposure. Disposal involves placement of waste materials in designated facilities that have been designed and are operated for such purpose.

Table 3-2
Identification and Screening of Technology Types and Process Options
Feasibility Study
Engineer School, Fort Totten
Queens, New York

Technology Type	Description	Comments
Land Use Controls		
Access Restriction – Fencing and/or Signs and Enforcement	Placement of fencing and posting of warning signs to inform the public of use restrictions and to deter access.	Retained. Access restrictions may also be used in conjunction with other technologies.
Containment		
Slurry Wall	Construction of a subsurface wall – a baseline barrier technology. Typical slurry wall construction involves soil-bentonite or cement-bentonite mixtures.	Eliminated. Most of the exposure is from surface and shallow subsurface soil.
Sheet Pile Wall	Construction of subsurface cutoff wall by driving vertical strips of steel or precast concrete. A continuous wall can be constructed by joining these sheets together.	Eliminated. Most of the exposure is from surface and shallow subsurface soil.
Soil Cover Cap	Remove trees, lay down geomembrane, top with 18 inches fill, top with 6 inches top soil and seed with grass.	Retained. A Soil Cover Cap prevents direct contact with waste and controls surface water run-off.
Landfill Cap	Landfill caps typically consist of regrading the site, and installing drains, vents, and a clay layer, a geosynthetic clay liner and a topsoil layer.	Eliminated. Soil Cover Cap is equally effective and has a lower cost.
Excavation		
Excavation	Soil is excavated and properly disposed of. Excavated area is filled in with clean soil and seeded with grass.	Retained. Removes soil and restores the excavated area.

Technology Type	Description	Comments
Treatment		
Solidification/ Stabilization (S/S) – Ex Situ or In Situ	Ex Situ or in situ mixing of the soil so that contaminants are physically bound or enclosed within a stabilized mass (solidification), or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility (stabilization).	Eliminated. For in-situ stabilization, it is difficult to assess the uniformity of treatment and long-term reliability. The chemical composition of the COC matrix, the amount of water present, and ambient temperature can affect the application of solidification/stabilization. These factors can interfere with the S/S process by inhibiting bonding of the waste binding material, retarding the setting of mixtures, decreasing the stability of the matrix, or reducing the strength of the solidified area. Additionally, chemicals used for lead stabilization could adversely affect the surrounding ecological setting.
Biological Treatment, Aerobic/Anaerobic, Ex situ or in situ	Enhance the activity of aerobes or anaerobes by injecting the required nutrients. Biodegradation process is likely to convert toxics into non-toxics.	Eliminated. Biological treatments are not especially effective against lead in soil.
Phytoremediation	Contaminants are bioaccumulated, degraded or rendered harmless by plants.	Eliminated. The depth of effectiveness is limited by the depth occupied by the roots. The lead concentrations greater than the remedial goal are present at depths greater than 2 feet.
Soil Washing, ex situ	Contaminants sorbed onto fine soil particles are separated from bulk soil in an aqueous-based system based on particle size. The wash water may be augmented with a basic leaching agent, surfactant, pH adjustment, or chelating agent to help remove organics and heavy metals.	Eliminated. Due to the heterogeneous site conditions, consisting of organic silts and silty sand/gravel, the soils may be difficult to treat because of varied permeabilities. Further reduction of soil porosity can occur when the surfactants used to mobilize the contaminant adhere to the soil particles. The aqueous stream will require treatment at demobilization.

Technology Type	Description	Comments
Treatment (Cont'd)		
Chemical Reduction/ Oxidation, ex situ	Reduction/oxidation chemically converts hazardous contaminants to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. The oxidizing agents most commonly used are ozone, hydrogen peroxide, hypochlorites, chlorine, and chlorine dioxide.	Eliminated. Limited applicability for remediating lead in soil.
Thermal Desorption, ex-situ	Soil heating sufficient to volatilize the contaminants which are transported to a gas treatment system for remediation. (In contrast to incineration, HTTD is a physical separation process that is not designed to destroy organics.)	Eliminated. Heavy metals such as lead are volatilized and must be captured and treated. An expensive technology.
Disposal		
Off-Site Disposal	Transport and disposal of excavated soil at off-site permitted disposal facility	Retained. Off-site disposal is necessary for the excavation alternative.

Table 3-3
Summary of Retained Remedial Alternatives
Feasibility Study
Engineer School, Fort Totten
Queens, New York

Alternatives		Description	Comments
Number	**Name**		
1	No Action	No activities conducted to address Contamination	While the No Action alternative does not address risk/hazard or reduce the toxicity, mobility, or volume of contamination through treatment, it is retained for consideration in the alternatives assembly to measure the effectiveness of the other alternatives.
2	Land Use Controls	Installation of a fence, signs, and use restrictions.	This alternative is the minimum alternative that would be prudent.
3	Soil Cover Cap	This alternative would install a soil cover cap the soils with lead concentrations above the RG and reduce infiltration into the soil and direct contact with the same.	A soil cover cap prevents direct contact with contaminated soil and controls surface water run-off.
4	Removal, Off-Site Disposal, and Backfill	Soils with lead concentrations above the RG would be excavated. Laboratory confirmatory samples will be collected. The excavated area would be backfilled, top soil added and seeded. The excavated soil will be disposed at an off-site permitted disposal facility.	This alternative removes selected soil and replaces it with clean fill. After remediation is complete direct exposure risks/hazards are eliminated.

Table 4-1
Evaluation of Retained Alternatives
Feasibility Study
Engineer School, Fort Totten
Queens, New York

	Alternative 1 No Action	**Alternative 2 Land Use Controls**	**Alternative 3 Soil Cover Cap and Land Use Controls**	**Alternative 4 Removal, Off-Site Disposal, Backfill**
Protection of Human Health and the Environment	This alternative would not satisfy this criterion, because the contaminants continue to persist in the environment.	Implementation of this alternative would reduce the potential human health risks from direct contact and incidental ingestion.	The soil cover cap would reduce the potential human health risks from direct contact, incidental ingestion, or inhalation of lead in soil.	Implementation of this alternative would remove the contaminants to a disposal facility. It would reduce the potential human health risks from direct contact, incidental ingestion, or inhalation of soils exceeding the RG.
Compliance with ARARs	There are no ARARs.	There are no ARARs.	This alternative would comply with the ARARs.	There are no ARARs.
Long-Term Effectiveness and Permanence	This alternative would not be an effective, long-term solution.	This alternative would provide long-term protection only as long as the LUCs and the security fence remained in place.	This alternative would reduce the direct exposure to lead in soil, minimizing future risks to human health. Since this remedy is likely to provide a permanent solution, this alternative would be effective in the long term.	Since this remedy is likely to provide a permanent solution, this alternative would be effective over the long term.
Reduction of Toxicity, Mobility, or Volume (TMV) Through Treatment	This alternative does not include treatment; therefore, it will not reduce the TMV of lead in soil through treatment.	This alternative would not reduce the TMV of lead in soil through treatment.	This alternative would not reduce the TMV of lead in soil through treatment.	This alternative would not reduce the TMV of lead in soil through treatment.

	Alternative 1 No Action	Alternative 2 Land Use Controls	Alternative 3 Soil Cover Cap and Land Use Controls	Alternative 4 Removal, Off-Site Disposal, Backfill
Short-Term Effectiveness	Because no action would occur, there would be no impact to the local community beyond the potential impacts to human health identified in the SRI2.	No significant risks are posed to the local community or to workers. During fence construction, engineering controls would be instituted to minimize noise and fugitive dust concerns. Workers would be protected from risks from being exposed to lead and other contaminants in the soil through the use of appropriate personal protective equipment (PPE) and implementation of proper safety practices.	No significant risks are posed to the local community or to workers. During soil cover cap construction and site restoration activities, engineering controls would be instituted to minimize noise and fugitive dust concerns. Workers would be protected from risks from being exposed to lead and other contaminants in the soil through the use of appropriate personal PPE and implementation of proper safety practices.	No significant risks are posed to the local community or to workers. During excavation and site restoration activities, engineering controls, and PPE would be used to minimize noise and fugitive dust concerns. There would be perimeter air and dust monitoring. The waste would be transported to a permitted disposal facility.
Implementability	There would not be any implementability concern.	This alternative is implementable. No technical difficulties are anticipated in fencing and deed restrictions. Uncertainty regarding the lateral extent of lead-impacted soil greater than 400 mg/kg would be addressed during pre-design investigation.	This alternative is implementable. No technical difficulties are anticipated in constructing the soil cover cap or restoring the area. Uncertainty regarding the lateral extent of lead-impacted soil greater than 400 mg/kg would be addressed during pre-design investigation.	This alternative is implementable. No technical difficulties are anticipated in sampling, excavating, transporting, backfilling, or restoring Area 1 to its pre-existing surface condition. Uncertainty regarding the lateral and vertical extent of lead-impacted soil greater than 400 mg/kg would be addressed during pre-design investigation.
Cost	Total Cost: $0 Capital Cost: $0 30-year O & M Cost: $0	Total Cost: $206,130 Capital Cost: $73,435 30-year O & M Cost: $132,695	Total Cost: $282,635 Capital Cost: $156,527 30-year O & M Cost: $126,107	Total Cost: $450,934 Capital Cost: $450,934 30-year O & M Cost: $0

Table 5-1
Summary of the Evaluation of the Retained Alternatives
Feasibility Study
Engineer School, Fort Totten
Queens, New York

Alternative		Protects Human Health and Environment?	Complies with ARARs?	Effective/ Permanent for Long-Term?	Reduces Toxicity, Mobility, or Volume through Treatment?	Effective Short-Term?	Implementability?	Cost?
#	Name							
1	No Action	No	NA	No	No	NA	Yes	$0
2	Land Use Controls	Yes	NA	Yes	No	Yes	Yes	$206,130
3	Soil Cover Cap	Yes	Yes	Yes	No	Yes	Yes	$282,635
4	Removal, Off-Site Disposal and Backfill	Yes	NA	Yes	No	Yes	Yes	$450,934

NA = not applicable, Alternatives 1, 2, and 4 do not have any ARARs.

Figures

J:\01 Projects\10404 - Balt HTRW03 - Fort Totten\11.0 Drawings\GIS\Feasibility Study 6-19-2013\Figure 1-1 Site Locus Map.mxd

PROJECT NO: 10404-03	
PREPARED FOR: USACE	
DATE: 06/19/2013	
DRAWN BY: SDP	
CHK'D BY: KT	
APP'D BY: LJP	

NOTES AND SOURCES:

SITE LOCUS MAP

Feasibility Study
Fort Totten Coast Guard Station
Formerly Used Defense Site
Queens, New York

FIGURE 1-1

Watermark
175 Cabot Street • Lowell • MA • 01854
Ph. 978-452-9696 Fax 978-453-9988

J:\01 Projects\10404 - Balt HTRW03 - Fort Totten\11.0 Drawings\GIS\Feasibility Study 6-19-2013\Figure 1-2 Site Map CGS FUDS.mxd

PROJECT NO: 10404-03 PREPARED FOR: USACE DATE: 04/02/2014 DRAWN BY: SDP CHK'D BY: KT APP'D BY: LJP	NOTES AND SOURCES:	Site Map of Fort Totten CGS FUDS Feasibility Study Fort Totten Coast Guard Station Formerly Used Defense Site Queens, New York	FIGURE 1-2 Watermark 175 Cabot Street • Lowell • MA • 01854 Ph. 978-452-9696 Fax 978-453-9988

N

0 20 40 80 Feet

Scale: 1" = 40'

Watermark
175 Cabot Street • Lowell • MA • 01854
Ph. 978-452-9696 Fax 978-453-9988

Feasibility Study
Fort Totten Coast Guard Station
Formerly Used Defense Site
Queens, New York

NOTES AND SOURCES:.

1. All concentrations are reported in milligrams per kilogram (mg/kg).

2. J - Reported concentration is estimated.

PROJECT NO: 10404-03

PREPARED FOR: USACE

DATE: 06/19/2013

DRAWN BY: SDP

CHK'D BY: KT

APP'D BY: LJP

AREA 1 LEAD
CONCENTRATIONS IN SOIL

FIGURE 1-3

J:\01 Projects\10404 - Balt HTRW\03 - Fort Totten\11.0 Drawings\GIS\Feasibility Study 6-19-2013\Figure 1-3 Area 1 Lead Concentrations.mxd

Scale: 1" = 40'

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Feasibility Study
Fort Totten Coast Guard Station
Formerly Used Defense Site
Queens, New York

NOTES AND SOURCES:.

1. All concentrations are reported in milligrams per kilograms (mg/kg)

2. J - Reported concentration is estimated.

PROJECT NO: 10404-03

PREPARED FOR: USACE

DATE: 06/19/2013

DRAWN BY: SDP

CHK'D BY: KT

APP'D BY: LJP

AREA TO BE ADDRESSED BY ALTERNATIVES

FIGURE 2-1

J:\01 Projects\10404 - Balt HTRW\03 - Fort Totten\11.0 Drawings\GIS\Feasibility Study 6-19-2013\Figure 2-1 Area to Be Addressed by Alternatives.mxd

APPENDIX A

Cost Estimates and Assumptions

Appendix A
Assumptions for Cost Estimating

GENERAL

1. The cost estimates are based on the best available information regarding the anticipated scope of the remedial alternative at this time. Changes in the cost elements are likely to occur as a result of new information and any data collected after the supplemental remedial investigation #2 was conducted. This is an order-of-magnitude cost estimate that is expected to be within –30 percent to +50 percent of the actual project cost.
2. General & Administrative costs (2 percent) as well as profit (10 percent) were applied to the itemized cost estimates.
3. Life-cycle costs are calculated as project duration. The duration of Alternatives 2 and 3 is unknown. Costs for these alternatives were only estimated for 30 years, but Alternatives 2 and 3 will likely continue for a significantly longer time period as lead-contaminated soil, at concentrations above the Remedial Goal, will remain in place.
4. A discount rate of 1.1 percent was used for present value calculations for Alternatives 2 and 3, which have a life cycle greater than 30 years. The rate was chosen per U.S. Environmental Protection Agency guidance (July 2000) and Office of Management and Budget Circular A-94, revised January 2013.

CONSTRUCTION COSTS

1. It is assumed that all capital costs occur in Year 0. Some of these activities may extend beyond Year 0; however, the effect on the overall cost will be insignificant.
2. It is assumed that analytical soil studies would be needed for all of the alternatives, except for Alternative 1 No Action. For Alternatives 2 and 3, the investigation will be focused on the lateral extent of soil with lead concentrations greater than 400 milligrams per kilogram. For Alternative 4, the lateral extent and the depth of the lead-impacted soil must be determined, therefore, it is assumed that soil cores from 0 to 10 feet below ground surface would be collected. The analytical soil studies will consist of soil sample collection, analysis, and data management. All of the data would be interpreted and used to determine an optimum remedial design.
3. Excavation confirmation samples would only be analyzed for total lead (SW6010) with a five-day turn-around-time.
4. Composite samples would be collected specifically for waste characterization. Samples would be collected at a rate of 1 sample per every 500 tons of soil planned for disposal. The samples will be collected and analyzed during the pre-design investigation. It is assumed the samples will only be analyzed for toxicity characteristic leaching procedure lead.
5. A 20 percent increase in volume of soil due to fluffing during excavation was assumed. The conversion factor of 1.3 tons to 1 cubic yard of soil was used.

PERIODIC COSTS

1. The five-year CERCLA reviews were included as periodic costs for the lifetime of Alternatives 2 and 3.

APPENDIX A

Tables

Table A-1
Cost Analysis – Alternative 2 Land Use Controls
Feasibility Study
Engineer School, Fort Totten
Queens, New York

Item	Rate	Unit	Quantity	Total	Present Worth Cost	Comments
Capital Costs						
Pre-Design Investigation						
Data and sample collection and analysis	$ 13,310	LS	1	$ 13,310	$ 13,310	Vendor estimates and Watermark project experience. Includes workplan, 15 surface soil samples, sample analysis, and data validation and management.
Report	$ 10,000	LS	1	$ 10,000	$ 10,000	Watermark project experience.
Pre-Design Investigation Costs Total					**$ 23,310**	
Development of Monitoring Plan	$ 10,000	LS	1	$ 10,000	**$ 10,000**	Watermark project experience.
Construction Costs						
Utility Locating Services	$ 2,016	LS	1	$ 2,016	$ 2,016	Watermark project experience.
Signage	$ 2,800	LS	1	$ 2,800	$ 2,800	Watermark project experience.
Fence Installation	$ 13,642	LS	1	$ 13,642	$ 13,642	Watermark project experience.
Remedial Action Report	$ 10,000	LS	1	$ 10,000	$ 10,000	Watermark project experience.
Construction Costs Total					**$ 28,458**	
Construction Management/Engineering Fees						
Engineering	8%	%	$ 28,458	$ 2,277	$ 2,277	Percentage of Construction/Capital Costs. Based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002.
Contingency	15%	%	$ 28,458	$ 4,269	$ 4,269	Percentage of Construction/Capital Costs. Based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002.
Oversight/Construction Management	10%	%	$ 28,458	$ 2,846	$ 2,846	Percentage of Construction/Capital Costs. Based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002.
Project Management	8%	%	$ 28,458	$ 2,277	$ 2,277	Percentage of Construction/Capital Costs. Based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002.
Construction Management/Engineering Fees Total					**$ 11,668**	
Total Capital Costs					**$ 73,435**	

Table A-1
Cost Analysis – Alternative 2 Land Use Controls
Feasibility Study
Engineer School, Fort Totten
Queens, New York

Watermark

Periodic Costs						
Discount Rate	1.1%					
Monitoring Costs						
Visual survey	$ 825	yr	30	$ 24,750	$ 24,750	Watermark project experience. Conducted annually.
Reporting	$ 750	yr	30	$ 22,500	$ 19,286	Watermark project experience. Conducted annually.
Maintenance	$ 2,448	yr	30	$ 73,435	$ 62,945	Watermark Project Experience. Signs and fence replaced once. Price annualized for PV analysis.
Five Year Review	$ 1,000	yr	30	$ 30,000	$ 25,714	Watermark Project Experience. Price annualized for PV analysis.
Total of Periodic Costs					**$ 132,695**	
Total Cost for Alternative					**$ 206,130**	

Table A-2
Cost Analysis – Alternative 3 Soil Cover Cap and Land Use Controls
Feasibility Study
Engineer School, Fort Totten
Queens, New York

Item	Rate	Unit	Quantity	Total	Present Worth Cost	Comments
Capital Costs						
Pre-Design Investigation						
Data and sample collection and analysis	$ 13,310	LS	1	$ 13,310	$ 13,310	Vendor estimates and Watermark project experience. Includes workplan, 15 soil samples, sample analysis, and data validation and management.
Report	$ 10,000	LS	1	$ 10,000	$ 10,000	Watermark project experience.
Pre-Design Investigation Costs Total					**$ 23,310**	
Development of Monitoring Plan	$ 10,000	LS	1	$ 10,000	**$ 10,000**	Watermark project experience.
Construction Costs						
Mobilization	$ 5,600	LS	1	$ 5,600	$ 5,600	Watermark project experience.
Site Services (portable toilets, Administrative)	$ 560	mo	1	$ 560	$ 560	Watermark project experience.
Utility Locating Services	$ 2,016	LS	1	$ 2,016	$ 2,016	Watermark project experience.
Erosion and Sediment Control	$ 7	LF	500	$ 3,360	$ 3,360	Watermark project experience.
Site Preparation	$ 12,318	LS	1	$ 12,318	$ 12,318	Watermark project experience.
Stormwater Management	$ 4,159	LS	1	$ 4,159	$ 4,159	Watermark project experience.
Cap Installation						
Grade and Geomembrane	$ 7,840	LS	1	$ 7,840	$ 7,840	Watermark project experience.
Backfill	$ 17	ton	385	$ 6,465	$ 6,465	Watermark project experience.
Topsoil	$ 30	ton	578	$ 17,333	$ 17,333	Watermark project experience.
Fence	$ 3,265	LS	1	$ 3,265	$ 3,265	Watermark project experience.
Air Monitoring	$ 504	week	1	$ 504	$ 504	Vendor estimate.
Surveyor	$ 3,136	day	1	$ 3,136	$ 3,136	Watermark project experience. Final post-construction survey. Assumes a two man survey crew.
Site Restoration and Demob	$ 5,040	LS	1	$ 5,040	$ 5,040	Watermark project experience. Includes materials and labor for riverbank restoration, construction support area pad removal, and field restoration.
Signage	$ 2,800	LS	1	$ 2,800	$ 2,800	Watermark project experience.
Remedial Action Report	$ 10,000	LS	1	$ 10,000	$ 10,000	Watermark project experience.
Construction Costs Total					**$ 84,395**	

Table A-2
Cost Analysis – Alternative 3 Soil Cover Cap and Land Use Controls
Feasibility Study
Engineer School, Fort Totten
Queens, New York

Item	Rate	Unit	Quantity	Total	Present Worth Cost	Comments
Construction Management/Engineering Fees						
Engineering	8%	%	$ 84,395	$ 6,752	$ 6,752	Percentage of Construction/Capital Costs. Based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002.
Contingency	20%	%	$ 84,395	$ 16,879	$ 16,879	Percentage of Construction/Capital Costs. Based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002.
Oversight/Construction Management	10%	%	$ 84,395	$ 8,440	$ 8,440	Percentage of Construction/Capital Costs. Based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002.
Project Management	8%	%	$ 84,395	$ 6,752	$ 6,752	Percentage of Construction/Capital Costs. Based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002.
Construction Management/Engineering Fees Total					**$ 38,822**	
Total Capital Costs					**$ 156,527**	
Periodic Costs						
Discount Rate	1.1%					
Monitoring Costs						
Visual survey	$ 1,760	yr	30	$ 52,800	$ 45,257	Watermark Project Experience. Price annualized for PV analysis.
Reporting	$ 1,067	yr	30	$ 32,000	$ 27,429	Watermark Project Experience. Price annualized for PV analysis.
Soil Cover Cap and Sign Maintenance	$ 1,078	yr	30	$ 32,325	$ 27,707	Watermark Project Experience. Price annualized for PV analysis.
Five Year Review	$ 1,000	yr	30	$ 30,000	$ 25,714	Watermark Project Experience. Price annualized for PV analysis.
Total Periodic Costs					**$ 126,107**	
Total Cost for Alternative					**$ 282,635**	

Table A-3
Cost Analysis – Alternative 4 Removal, Off-Site Disposal, Backfill
Feasibility Study
Engineer School, Fort Totten
Queens, New York

Item	Rate	Unit	Quantity	Total	Present Worth Cost	Comments
Capital Costs						
Pre-Design Investigation						
Data and sample collection and analysis	$ 16,182	LS	1	$ 16,182	$ 16,182	Vendor estimates and Watermark project experience. Includes workplan, 10 cores 10 ft deep, 30 soil samples, sample analysis, and data validation and management.
Report	$ 15,000	LS	1	$ 15,000	$ 15,000	Watermark project experience.
Pre-Design Investigation Costs Total					**$ 31,182**	
Construction Costs						
Mobilization	$ 5,600	LS	1	$ 5,600	$ 5,600	Watermark project experience.
Site Services (portable toilets, Administrative)	$ 560	mo	1	$ 560	$ 560	Vendor Estimates.
Utility Locating Services	$ 2,016	LS	1	$ 3,000	$ 3,000	Watermark project experience.
Erosion and Sediment Control	$ 7	LF	500	$ 3,360	$ 3,360	Watermark project experience.
Site Preparation	$ 12,318	LS	1	$ 12,318	$ 12,318	Watermark project experience.
Excavation	$ 13,440	LS	1	$ 13,440	$ 13,440	Watermark project experience.
Air Monitoring	$ 336	week	1	$ 336	$ 336	Vendor estimate.
Confirmation Sampling	$ 10,040	LS	1	$ 10,040	$ 10,040	Watermark project experience.
Waste Disposal Characterization	$ 567	LS	1	$ 567	$ 567	Watermark project experience.
Transportation and Disposal of Soil	$ 58	ton	2600	$ 151,424	$ 151,424	Vendor estimate.
Backfill	$ 17	ton	2,022	$ 33,973	$ 33,973	Watermark project experience.
Topsoil	$ 34	ton	578	$ 19,413	$ 19,413	Watermark project experience.
Site Restoration and Demob	$ 5,040	LS	1	$ 5,040	$ 5,040	Watermark project experience.
Remedial Action Report	$ 10,000	LS	1	$ 10,000	$ 10,000	Watermark project experience.
Construction Costs Total					**$ 269,072**	

Table A-3
Cost Analysis – Alternative 4 Removal, Off-Site Disposal, Backfill
Feasibility Study
Engineer School, Fort Totten
Queens, New York

Item	Rate	Unit	Quantity	Total	Present Worth Cost	Comments
Construction Management/Engineering Fees						
Engineering	8%	%	$ 269,072	$ 21,526	$ 21,526	Percentage of Construction/Capital Costs. Based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002.
Contingency	30%	%	$ 269,072	$ 80,722	$ 80,722	Percentage of Construction/Capital Costs. Based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002.
Oversight/Construction Management	10%	%	$ 269,072	$ 26,907	$ 26,907	Percentage of Construction/Capital Costs. Based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002.
Project Management	8%	%	$ 269,072	$ 21,526	$ 21,526	Percentage of Construction/Capital Costs. Based on "A Guidance to Developing and Documenting Cost Estimates During Feasibility Study" EPA 540-R-00-002.
Construction Management/Engineering Fees Total					**$ 150,680**	
Total Capital Costs					**$ 450,934**	
Total Cost for Alternative					**$ 450,934**	