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FINAL ENGINEERING EVALUATION/COST ANALYSIS FOR SOLID WASTE MANAGEMENT UNIT 3 (SWMU3) PIER 10 SANDBLAST YARD JEB LITTLE CREEK VA
12/1/2012
CH2MHILL

Final

Engineering Evaluation/Cost Analysis for Solid Waste Management Unit 3 Pier 10 Sandblast Yard

Joint Expeditionary Base Little Creek
Virginia Beach, Virginia

NAVFAC
Naval Facilities Engineering Command

Prepared for

Department of the Navy

Naval Facilities Engineering Command
Mid-Atlantic

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Executive Summary

This report presents an Engineering Evaluation/Cost Analysis (EE/CA) for a non-time-critical removal action (NTCRA) for sediment at Solid Waste Management Unit (SWMU) 3, Pier 10 Sandblast Yard, at Joint Expeditionary Base (JEB) Little Creek in Virginia Beach, Virginia.

SWMU 3 is located in a developed area on Little Creek Harbor's western side. The site was used for sandblasting boats, anchors, and chains between 1962 and 1995. Paint chips and blast grit covered the unpaved ground south of the pad to the water's edge and the near-shore bottom of Little Creek Harbor. Historical releases from SWMU 3 likely occurred when sandblasting residue was lying directly on the ground surface or contaminants were transported via sheet flow through a catch basin connected to a Virginia Pollution Discharge Elimination System-permitted outfall discharging to Little Creek Harbor. Currently, residual abrasive blast material is present on the unpaved ground surface to the water's edge and in Little Creek Harbor sediment. Previous site investigations identified potentially unacceptable risk to ecological receptors associated with exposure to metals in sediment.

The objective of this NTCRA is to reduce concentrations of copper, lead, nickel, tin, and zinc in surface sediment surrounding the dry dock and anchoring system such that concentrations do not pose unacceptable risk to ecological receptors. The four removal action alternatives evaluated are:

- Alternative 1: No action
- Alternative 2: Mechanical dredging, upland disposal, and replacement with clean fill
- Alternative 3: Mechanical dredging, onsite solidification, upland disposal, and replacement with clean fill
- Alternative 4: Mechanical dredging, onsite passive dewatering via geotube, upland disposal, and replacement with clean fill

Alternative 1 does not meet the objectives of the NTCRA to eliminate the potential for exposure to metals in sediment that may pose potential ecological risk. However, this alternative is provided as a basis for comparison.

Alternative 2 is effective in eliminating the potential for exposure to metals in sediment surrounding the dry dock and anchoring system that may pose potential ecological risk. No further action (NFA) would be required in the removal action area following completion of this alternative. Implementation of this alternative is moderately difficult using common construction practices. Costs associated with Alternative 2 are moderate, similar to Alternative 3, and less expensive than Alternative 4. Alternative 2 is the recommended alternative.

Alternative 3 is effective in eliminating the potential for exposure to metals in sediment surrounding the dry dock and anchoring system that may pose potential ecological risk. NFA would be required in the removal action area following completion of this alternative. Implementation of the alternative is moderately difficult using common construction practices. Unlike Alternative 2, Alternative 3 also requires some level of onsite solidification making is slightly more difficult to implement. Additionally, the transport of waste from the site has the potential to interfere with facility activities. Costs associated with Alternative 3 are moderate, similar to Alternative 2, and less expensive than Alternative 4. Alternative 3 is not recommended.

Alternative 4 is effective in eliminating the potential for exposure to metals in sediment surrounding the dry dock and anchoring system that may pose potential ecological risk. NFA would be required in the removal action area following completion of this alternative. Implementation of this alternative is moderately difficult using common construction practices. Unlike Alternative 2, Alternative 4 also requires some level of onsite solidification making is slightly more difficult to implement. Additionally, the transport of waste from the site has the potential to interfere with facility activities. Costs associated with Alternative 4 are moderately high and Alternative 4 is the most expensive alternative. Alternative 4 is not recommended.

In accordance with the National Oil and Hazardous Substance Pollution Contingency Plan, this EE/CA will be placed in the Administrative Record and notice of its availability for public review, along with a brief summary, will be published in the local newspaper. The EE/CA will then be available for review during a 45-day public comment period. The public comment period will be held from November 1, 2012 through December 15, 2012. A public information session may be held during or immediately following the public comment period, if requested. Following the public comment period, if comments are received, a Responsiveness Summary summarizing responses to significant comments will be prepared and included in the Action Memorandum describing the proposed removal action and placed in the Administrative Record.

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Acronyms and Abbreviations

ABM	abrasive blast material
ARAR	applicable or relevant and appropriate requirement
BERA	Baseline Ecological Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	contaminant of concern
COPC	contaminant of potential concern
EE/CA	Engineering Evaluation/Cost Analysis
ERA	Ecological Risk Assessment
ER-L	effects range–low
ER-M	effects range–medium
FAA	Federal Aviation Administration
HHRA	Human Health Risk Assessment
JEB	Joint Expeditionary Base
MILCON	military construction
mlw	mean low water
NAB	Naval Amphibious Base
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NFA	no further action
NTCRA	non-time-critical removal action
PAH	polycyclic aromatic hydrocarbon
PEL	probable effects level
PRG	preliminary remediation goal
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RQ	remediation quotient
SARA	Superfund Amendments and Reauthorization Act
SERA	Screening Ecological Risk Assessment
SI	Site Investigation
SRI	Supplemental Remedial Investigation
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TBC	to-be-considered
TEL	threshold effects level
USEPA	U.S. Environmental Protection Agency
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound
VPDES	Virginia Pollution Discharge Elimination System

SECTION 1

Introduction

This report presents an Engineering Evaluation/Cost Analysis (EE/CA) for a non-time- critical removal action (NTCRA) for Solid Waste Management Unit (SWMU) 3, Pier 10 Sandblast Yard, Joint Expeditionary Base (JEB) Little Creek, Virginia Beach, Virginia. The EE/CA is prepared under the Naval Facilities Engineering Command Mid-Atlantic Comprehensive Long-Term Environmental Action Navy Contract Number N62470-08-D-1000, Contract Task Order WE07.

The investigation activities for SWMU 3 were conducted in response to recommendations for further evaluation made in the Site Investigation (SI) report (CH2M HILL, 1999). The SI report identified human health contaminants of potential concern (COPCs) in soil, groundwater, and sediment. A Baseline Ecological Risk Assessment (BERA) (CH2M HILL, 2001) conducted using data collected as part of the SI identified several ecological COPCs in soil and sediment. The human health and ecological COPCs were further evaluated during the Remedial Investigation/ Human Health Risk Assessment/Ecological Risk Assessment (RI/HHRA/ERA) (CH2M HILL, 2005), Supplemental RI (SRI)/HHRA/ERA (CH2M HILL, 2009), and Risk Assessment Update (CH2M HILL, 2012). The investigations identified five metals (copper, lead, nickel, tin, and zinc) in sediment as ecological contaminants of concern (COCs). No potentially unacceptable ecological risk was identified from exposure to soil or surface water. Although no potentially unacceptable risks to human health from exposure to soil, groundwater, sediment or surface water were identified; detections of volatile organic compounds (VOCs) in groundwater and lead in soils above standards warrant further action. This EE/CA will address the ecological COCs in sediment surrounding the dry dock and anchoring system. Remaining sediment in other areas as well as soil and groundwater will be addressed under a separate action.

The following information is presented within this EE/CA:

- Site description
- Identification of the removal action objective
- Description of response action elements
- Identification of the removal action alternatives and technologies
- Recommendation of a preferred removal alternative
- Schedule for the selected removal alternative

1.1 Regulatory Background

This document is issued by the Navy, the lead agency responsible for remediation of SWMU 3, in partnership with the U.S. Environmental Protection Agency (USEPA) Region 3 and the Virginia Department of Environmental Quality (VDEQ), under Section 104 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Superfund Amendments and Reauthorization Act (SARA) of 1986.

Section 104 of CERCLA and SARA allows an authorized agency to remove, or arrange for removal of, and to provide for remedial action relating to hazardous substances, pollutants, or contaminants at any time, or to take any other response measures consistent with the National Oil and Hazardous Substance Pollution Contingency Plan (NCP) as deemed necessary to protect public health or welfare and the environment.

The NCP, 40 Code of Federal Regulations (CFR) 300, provides regulations for implementing CERCLA and SARA, and regulations specific to removal actions. The NCP defines a removal action as the

> *cleanup or removal of released hazardous substances from the environment, such actions as may be necessary to monitor, assess, and evaluate the threat of release of hazardous substances; the disposal of removed material; or the taking of such other actions as may be necessary to prevent, minimize, or mitigate damage to the public health or welfare or to the environment, which may otherwise result from a release or threat of release.*

A removal action is being considered for the work element. The removal action is non-time-critical. NTCRAs are defined in 40 CFR Section 300.415(b)(4) as “actions pertaining to an imminent threat to human health and the environment and that have planning periods of 6 months or more.” Under 40 CFR Section 300.415, the lead agency is required to conduct an EE/CA when an NTCRA is planned for a site. The goals of an EE/CA are to identify the objectives of the removal action and to analyze the effectiveness, implementability, and cost of various alternatives that may satisfy these objectives. An EE/CA documents the removal action alternatives and selection process. Where the extent of the contamination is well defined and limited in extent, NTCRAs also allow for the expedited cleanup of sites in comparison to the remedial action process under CERCLA.

Community involvement requirements for NTCRAs include preparing an EE/CA and making it available for public review and comment for a period of 45 days. An announcement of the 45-day public comment period for the EE/CA is required in a local newspaper. Written responses to significant comments will be summarized in an Action Memorandum and included in the Administrative Record.

1.2 Purpose and Objectives

Submittal of this document fulfills the requirements for NTCRAs defined by CERCLA, SARA, and the NCP. This EE/CA has been prepared in accordance with USEPA’s guidance document, *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (USEPA, 1993).

The EE/CA compares four remedial alternatives based on their technical feasibility/implementability, effectiveness (i.e., ability to protect human health and the environment and ability to prevent the potential release of hazardous constituents), and cost. Individual goals of this EE/CA are to: (1) satisfy environmental review and public information requirements for removal actions, (2) satisfy Administrative Record requirements for documenting the removal action selection, and (3) provide a framework for evaluating and selecting alternative technologies.

The objectives of this NTCRA are to reduce or eliminate compounds determined to pose potential unacceptable risk to ecological receptors in SWMU 3 sediment and to achieve long-term site remediation to be protective of human health and the environment. The following alternatives were evaluated:

1. No action
2. Mechanical dredging, offsite solidification, upland disposal, and replacement with clean fill
3. Mechanical dredging, onsite solidification, upland disposal, and replacement with clean fill
4. Mechanical dredging, onsite passive dewatering via geotube, upland disposal, and replacement with clean fill

SECTION 2
Site Characterization

2.1 JEB Little Creek Description and History

On October 1, 2009, Hampton Roads' first Department of Defense Joint Base was established. This new installation comprises the former Naval Amphibious Base (NAB) Little Creek and the former Army Post Fort Story; the new name is JEB Little Creek-Fort Story. With the formation of this new command, the Navy assumes responsibility for management of both properties and will now merge public meetings regarding the ongoing environmental restoration programs. However, separate records will be maintained to ensure the integrity of ongoing efforts at both properties. When required for public notices and distributions, the former bases are identified jointly as JEB Little Creek-Fort Story. For Environmental Restoration Program documents, the bases are referred to separately as JEB Little Creek or JEB Fort Story.

JEB Little Creek covers approximately 2,215 acres in the northwest portion of Virginia Beach, Virginia, adjacent to the Chesapeake Bay (**Figure 2-1**). The former NAB Little Creek began operations as a permanent base in 1946. The base's mission was the training of landing craft personnel for operational assignments. JEB Little Creek has expanded in both area and complexity of its mission over the past 65 years. Base personnel provide logistic facilities and support services for local commands, organizations, home-ported ships, and other U.S. and allied units to meet amphibious warfare–training requirements of the U.S. armed forces. Past and present operations at JEB Little Creek include vehicle and boat maintenance, boat painting and sandblasting, construction and repair of buildings and piers, mixing and application of pesticides, electroplating of musical instruments, laundry and dry cleaning, medical and dental treatment, and the generation of steam for heat. Land development surrounding the base is residential, commercial, and industrial.

2.2 SWMU 3 Description and History

SWMU 3, the Pier 10 Sandblast Yard, is located in a developed area on Little Creek Harbor's western side (**Figure 2-2**). SWMU 3 was used for sandblasting boats between 1962 and 1984 (Rogers, Golden and Halpern, 1984). Sandblasting activities took place on a 0.04-acre concrete pad located to the west of Building 1263. After 1984, anchors and chains were sandblasted on the concrete pad. The used sandblast material was periodically sampled using extraction procedure toxicity testing protocols and removed from the site for disposal. Results of these toxicity tests indicated the sandblast residue was not hazardous. Paint chips and blast grit covered the unpaved ground south of the pad to the water's edge and the near-shore bottom of Little Creek Harbor. In 1982, a fence was installed around the sandblasting area to limit access to the site and prevent windblown sandblast materials from migrating outside the fenced area. In 1995, the concrete pad was taken out of service, and a new sandblasting area was constructed in the northwestern corner of the site. The new sandblasting area consisted of a 0.4-acre concrete pad surrounded by a 4- to 5-foot -high concrete wall. All sandblasting operations at SWMU 3 ceased in 1996 when the new indoor sandblasting facility, CB125, was completed adjacent to SWMU 7b.

Historical releases from SWMU 3 likely occurred when sandblasting residue was lying directly on the ground surface. Prior to 1993, runoff from sandblasting operations occurred as sheet flow to Little Creek Harbor. In 1993, a catch basin connected to a Virginia Pollution Discharge Elimination System (VPDES)-permitted outfall was constructed to receive runoff from various areas. Following construction of the new concrete pad surrounding the catch basin, surface water drainage from the more recent sandblasting area flowed to this catch basin and emptied into Little Creek Harbor via VPDES-permitted Outfall 008 (Permit Number VA0079928), located under Pier 10, about 35 ft from its easternmost edge (**Figure 2-2**). Under the current VPDES permit, VA0079928, Outfall 008 is defined as a stormwater outfall and has no monitoring requirements. Some runoff from other areas of SWMU 3 may continue to flow directly into Little Creek Harbor. Currently, residual abrasive blast material (ABM) is present on the unpaved ground surface south of the concrete pad to the water's edge and in Little Creek Harbor sediment in the vicinity of Pier 10, the recreational marina, and south to Pier 8.

Most of the aquatic activities within the SWMU 3 study boundary are associated with the Pier 10 dry dock and the recreational marina. The Pier 10 dry dock area of Little Creek Harbor is used for dive team training and boat maintenance. Boats are brought, with the assistance of a tug boat, to the Pier 10 dry dock for maintenance. Once boats are secured, water is removed from the dry dock at approximately 2,000 gallons per minute using ballast pumps. Process wastewater from the dry dock is discharged to Little Creek Harbor under the same VPDES permit via monitored Outfall 006. During dry dock activities, sediment is disturbed; therefore, vertical mixing of the sediment in this area is likely. The recreational marina is used by military dependents and former active-duty service members. Personal watercraft docked at the marina may cause minimal vertical mixing in the sediment. Substantial mixing is unlikely since the marina area is a “no wake” zone for boaters. A fueling station and fish-cleaning station are located south of the boats slips. For security purposes, recreational swimming, fishing, and crabbing are not permitted in Little Creek Harbor.

Dredging maintenance activities vary within the vicinity of SWMU 3. Little Creek Channel (not including the near-shore sediments that make up part of SWMU 3) is maintained by the U.S. Army Corps of Engineers and has been regularly dredged since 1928 to maintain a depth of approximately 27 feet below mean low water (mlw) (**Figure 2-2**). Little Creek Channel was most recently dredged in 2010. The surrounding area is maintained by JEB Little Creek to depths ranging from approximately 18 to 31 feet below mlw plus 1-foot over-dredge. In 1965, the areas around Piers 1 through 8, south of the marina (just southwest of the Pier 10 dry dock), were dredged to 18 feet below mlw, plus a 2-foot over-dredge. In 1999, 2 to 5 ft of sediment were removed from beneath the Pier 10 dry dock, to a depth of approximately 31 feet below mlw plus a 1-foot over-dredge. Some minor sediment removal also occurred in the vicinity of the floating dry dock at Pier 10 just prior to the start of the Remedial Investigation (RI) sampling (fall 2002). The recreational marina area is permitted for a dredge depth of approximately 10 feet below mlw plus a 1-foot over-dredge; however, this area has not been dredged since 1965.

2.3 Previous Site Investigations

JEB Little Creek initiated environmental investigation efforts under the Navy Assessment and Control of Installation Pollutants Program in 1984. The former NAB Little Creek was placed on the National Priorities List in May 1999 (USEPA ID #VA5170022482) and investigations have since been conducted under CERCLA authority. The Federal Facility Agreement for JEB Little Creek was signed in November 2003 (Navy, 2003).

SWMU 3 has been characterized under several investigations and studies between 1989 and 2010. **Table 2-1** provides a chronological list and summary of previous investigations conducted at SWMU 3. Sediment sample locations are depicted on **Figure 2-3.** The conceptual site model is shown on **Figure 2-4**. The respective investigations are a part of the Administrative Record file for JEB Little Creek and can be referenced for further details regarding specific sampling strategies, media investigations, and when and where the sampling was performed.

TABLE 2-1
Previous Studies and Investigations Summary

Previous Study / Investigation	Date	Investigation Activities
Site Investigation (SI) (CH2M HILL, 1999)	1998	Groundwater, surface soil, subsurface soil, and sediment samples were collected to verify the presence or absence of contamination and to conduct a human health risk screening. VOCs, metals, and/or polycyclic aromatic hydrocarbons (PAHs) were detected in groundwater, soil, and sediment above human health screening criteria and COPCs were identified for each media. Additionally, ABM was observed on the ground surface and in near-shore sediment. The SI recommended a Screening ERA (SERA) to identify potentially complete exposure pathways for ecological receptors and an RI to define the nature and extent of contamination in site media.

TABLE 2-1
Previous Studies and Investigations Summary

Previous Study / Investigation	Date	Investigation Activities
SERA (CH2M HILL, 2000)	2000	A SERA, constituting Steps 1 and 2 of the ERA process, was completed using data collected as part of the SI. Based upon a comparison of groundwater, surface soil, and sediment concentrations to screening values, inorganic and organic COPCs were identified for each medium. The SERA concluded that the potential for ecological risk is moderate to high based upon the potential exposure to metals in sediment and soil; an additional evaluation of potential ecological risk (Step 3) was recommended.
Baseline ERA (BERA) (CH2M HILL, 2001)	2001	A BERA, constituting Step 3 of the ERA process, was completed using data collected as part of the SI. The BERA concluded that, although terrestrial habitat size and quality are limited at SWMU 3, detected concentrations of select metals and one semivolatile organic compound (SVOC) in soil exceeded ecological screening values and/or basewide background concentrations, and may pose potentially unacceptable risks to lower-trophic-level receptors in soil. Only zinc was identified as posing a potential unacceptable risk to upper-trophic-level terrestrial receptors. Potentially unacceptable risks to lower-trophic level receptors were identified associated with exposure to select metals, PAHs, and one SVOC in sediment; however, potential risks to upper-trophic-level aquatic receptors were negligible.
Remedial Investigation (RI)/HHRA/ERA (CH2M HILL, 2005)	2002	Soil, groundwater, sediment, and surface water samples were collected to define the nature and extent of contamination and to evaluate potential human health and ecological risks. No potentially unacceptable human health or ecological risks associated with exposure to site soil were identified; however, individual detections of lead in soil exceeded the child residential screening value and will require further action. Potentially unacceptable risks associated with future potable use of groundwater were identified as a result of VOCs, SVOCs, and metals. SVOCs and metals were detected in surface water but the concentrations did not pose potentially unacceptable risk to human health or the environment. No potentially unacceptable human health risk was identified from exposure to sediment; however, potentially unacceptable ecological risks to lower- trophic-level receptors exposed to metals and PAHs in sediment were identified. Additionally, evidence of petroleum impacts to subsurface sediment was noted. The RI recommended additional investigation of groundwater and sediment to identify contaminant sources, delineate the nature and extent of contamination, and further assess potential human health and ecological risks. Additionally, the RI concluded that ABM residues in soil are a potential continuing source of contaminants to Little Creek Harbor and recommended that the residues be removed to eliminate this transport pathway.

TABLE 2-1
Previous Studies and Investigations Summary

Previous Study / Investigation	Date	Investigation Activities
Supplemental RI/ HHRA/ ERA (CH2M HILL, 2009a)	2007/2008	Soil, groundwater and sediment samples were collected to identify the source and extent of VOCs in groundwater and associated human health risks, define the extent of ABM in sediment, and assess the correlation between ABM content and metals concentrations in sediment. PAHs in sediment were determined to not be site-related and therefore were not investigated as part of the SRI. Additional surface sediment samples were collected from Little Creek Cove for establishment of urban background sediment values for comparison to site-specific sediment samples. No source for VOCs in groundwater was identified. Potentially unacceptable risks to human health associated with exposure to PCE, vinyl chloride, dibenzofuran, arsenic, iron, manganese, and thallium in groundwater were identified. Based upon additional groundwater data collected as part of the SRI and a comparison of constituent concentrations to background concentrations, the RI recommended a risk management decision of no further action (NFA) for PCE, dibenzofuran, arsenic, iron, manganese, and thallium. As a result of the presence of VOCs in groundwater, it was assumed that vapor intrusion from groundwater into indoor air would pose potentially unacceptable risk to future building occupants. The eastern extent of ABM in sediment was defined; however, uncertainty in the extent to the north and along the bulkhead by the marina was identified. Additionally, the presence of petroleum in subsurface sediment was noted. The SRI concluded that ABM content is significantly correlated with metals concentrations and is a good indicator of impacts from historic sandblasting activities. The SRI recommended an evaluation of remedial alternatives to address COCs in groundwater (vinyl chloride) and sediment (copper, lead, nickel, tin, and zinc). Additionally, ABM and lead in soil will be addressed during remedial action at the site. No further action for surface water is warranted.
Pre-FS Sediment Investigation (Remediation Boundary Delineation) (CH2M HILL, 2009b)	2009	Surface and subsurface sediment sampling was conducted to delineate a remediation area boundary and define sediment dewatering and disposal characteristics for evaluation of remedial alternatives in an FS. The lateral and vertical extent of CERCLA remediation was adequately delineated per the preliminary remediation goals (PRGs) established. In addition, the extent of the petroleum impacted sediment within the remediation area was delineated for consideration during alternative development. Sediment dewatering and disposal characterization testing indicated sediment is non-hazardous and that both passive (i.e., geotextile tube) and mechanical (i.e., belt filter) dewatering technologies would be effective.
Pre-FS Sediment Investigation (Benthic Invertebrate Evaluation) (CH2M HILL, 2012a)	2010	Surface sediment sampling was conducted to evaluate the current condition of the benthic invertebrate community within the remediation boundary and determine if the condition of the benthic community is correlated with the concentration of COCs and ABM content in sediment. Data indicated that the condition of the benthic community was positively correlated to COC concentrations and ABM content, with the portion of the site with the highest concentrations of metals and ABM content (Near Shore Area and portions of the Marina) typically having the most developed benthic invertebrate community relative to other areas of the site (Dry Dock and Offshore Areas), where metals concentrations and ABM content are typically lower. Additionally, data indicated low bioavailability of metals in sediment. Non-CERCLA-related physical conditions at the site (i.e., low dissolved oxygen, high percentage of fine-grained sediment) were generally better predictors of the condition of the benthic community, indicating that these non-CERCLA-related conditions may have a stronger impact on the survival of the benthic invertebrate community. The evaluation concluded that although other non-CERCLA-related factors may be having more of an impact on the condition of the benthic invertebrate community, the magnitude of metals concentrations may potentially result in unacceptable risks to ecological receptors should these physical characteristics change over time; therefore, remedial action at SWMU 3 is warranted. The evaluation recommended that, given the current physical characteristics in the Dry Dock and Offshore Areas (primarily low bottom DO concentrations), it is unlikely that a benthic invertebrate community that would approach that in a similar urban reference area would be established following remedial action; therefore, the remedial action objective established for the site should focus on the reduction of metals concentrations and not the establishment of a benthic invertebrate community.

TABLE 2-1
Previous Studies and Investigations Summary

Previous Study / Investigation	Date	Investigation Activities
Risk Assessment Update (CH2M HILL, 2012b)	2011	As a result of updates made to the conceptual site model, the viability of the future potable use scenario as an applicable human health exposure pathway for groundwater at the site and the human health and ecological risks associated with groundwater discharge to surface water were evaluated. Based upon aquifer characteristics, the lack of potential downgradient users, and USEPA restriction against potable use of groundwater characterized as having a high-to-intermediate degree of interconnection with an adjacent surface water body, the Navy, in partnership with USEPA and VDEQ, agreed that potable use of groundwater is not a viable exposure scenario for human health risk evaluation at SWMU 3. Revision to the human health and ecological risk evaluations did not identify potentially unacceptable risk associated with the discharge of groundwater to surface water. Therefore, the Navy, in partnership with USEPA and VDEQ, agreed that no further evaluation of the groundwater to surface water transport pathway at SWMU 3 was warranted.

2.4 Risk Assessment Summary and Basis for Action

2.4.1 Risk Assessment Summary

No potentially unacceptable risks to human health from exposure to soil, groundwater, sediment or surface water were identified. However, VDEQ's anti-degradation policy (9 VAC 25-280-30), considers all groundwater a potential potable resource and requires that all groundwater be restored to beneficial use or that present and potential future uses of groundwater be preserved and protected. Therefore, because concentrations of VOCs above groundwater standards were detected, land use restrictions prohibiting the potable use of shallow groundwater at SWMU 3 may be necessary for the protection of human health until it is demonstrated that concentrations of contaminants are below the maximum contaminant levels. Additionally, due to the uncertainty in evaluating the potential future risk from vapor intrusion associated with detections of VOCs in groundwater, land use restrictions prohibiting changes in existing building use and new building construction without further evaluation of potential risk from vapor intrusion may be necessary. Although no potentially unacceptable risk was identified from exposure to soil, individual lead concentrations detected in soil were above the child residential screening value and will be addressed under a separate action.

There are no potentially unacceptable ecological risks from exposure to soil, groundwater, or surface water at SWMU 3. Potentially unacceptable risks to lower-trophic-level receptors from exposure to copper, lead, nickel, tin, and zinc in sediment were identified.

2.4.2 Basis for Removal Action

It is expected that the removal action will be completed prior to the implementation of the final remedial action for SWMU 3. The NTCRA will be coordinated with the removal of the dry dock and anchoring system, which is scheduled for February 2013. Impacts to/movement of the dry dock anchoring system while in place would result in the need for full recertification of the dry dock. Removal of the dry dock anchoring system to complete the sediment remedy would significantly increase overall site remedy costs and require coordination with the Federal Aviation Administration (FAA) to temporarily halt flights at Norfolk International Airport. Therefore, as a result of the scheduled temporary removal of the dry dock and anchoring system in February 2013, the Navy, in partnership with USEPA and VDEQ, agree that an NTCRA is warranted to allow for the remediation of sediment in areas otherwise inaccessible without significant disruption to regular boat maintenance activities conducted at the dry dock and to avoid significant increases in remedy cost.

2.5 Development of Cleanup Goals

As part of the Supplemental RI, a simple linear regression analysis was used to investigate potential correlations between the metals COC concentrations in surface sediments and the amount of ABM present. All surface sediment samples from 2002 and 2007 for which ABM content was quantified were used in the analysis. The 2002 and 2007 surface sediment data indicated a statistically significant positive correlation between the ABM content in surface sediment samples and the concentrations of copper, lead, nickel, tin, and zinc. The resulting regression equations were used to calculate associated sediment concentrations using 1 percent ABM (the lowest possible integer; also, percent ABM in sediment was only estimated to the nearest integer during the 2007 SRI sampling). These values, along with consideration of site-specific background concentrations and literature-based sediment effect levels (effects range-low [ER-L], effects range-median [ER-M], threshold effects level [TEL], and probable effects level [PEL]), were used to define the sediment PRGs for the five primary COCs (**Table 2-2**) as discussed during the November 2008 Tier I Partnering Team meeting and initially documented in the *Final Technical Memorandum Work Plan for Pre-Feasibility Study Sediment Sampling* (CH2M HILL, 2009). The PRGs for copper, lead, and tin were based upon the regression equations (at 1 percent ABM); none of these PRGs exceeded the ER-M (where available) and all were comparable to the maximum background concentration. The PRG for nickel was set at the maximum background concentration because maximum background exceeded the regression-derived value and was below the ER-M. For zinc, the ER-M was selected as the PRG because the regression-derived value exceeded all effects-based criteria. It should be noted, however, that the maximum background value for zinc also exceeded the ER-M.

TABLE 2-2
Sediment PRGs

Copper		Lead		Nickel		Tin		Zinc	
TEL	18.7	TEL	30.2	TEL	15.9	TEL	NA	TEL	124
ER-L	34.0	ER-L	46.7	ER-L	20.9	ER-L	NA	ER-L	150
PEL	108	PEL	112	PEL	42.8	PEL	NA	PEL	271
Mean Background	155	Mean Background	45.2	Mean Background	23.2	Mean Background	8.61	Mean Background	290
Max Background	184	Max Background	67.6	Max Background	26.5	Max Background	9.80	Max Background	421
1% ABM	232	1% ABM	107	1% ABM	26.2	1% ABM	11.2	1% ABM	454
ER-M	270	ER-M	218	ER-M	51.6	ER-M	NA	ER-M	410

Shaded cells indicate the selected PRG. All values in milligrams per kilogram.

2.6 Determination of Removal Area

To define the area requiring action under CERCLA, a "remediation quotient," or RQ, was calculated. As discussed during the November 2008 Tier I Partnering Team meeting and agreed upon initially documented in the *Final Technical Memorandum Work Plan for Pre-Feasibility Study Sediment Sampling* (CH2M HILL, 2009), the RQ is defined as the ratio of the PRG to the sediment concentration. The lateral remediation area boundary was determined by calculating the RQ for each of the five COCs using the most recent, and most complete, round of surface sediment data available, collected in 2010 as part of the benthic invertebrate evaluation (CH2M HILL, 2012c). The site was broken down into 100x100 foot grids. As discussed during the April 2012 Tier I Partnering Team meeting and documented herein, a grid is defined as being "impacted" if the RQ for one or more individual COC exceeds 1.5 and the average RQ for the five COCs exceeds one. The RQ calculations for those grids with exceedances of both individual or average RQ criteria and the area proposed for CERCLA sediment remediation is depicted on **Figure 2-5**. Although Grids 509, 551, and 558 have exceedances of either the individual or average RQ, they do not have exceedances of both criteria and are therefore not included in the remediation area.

In establishing the area to be addressed as part of this NTCRA, the following logistical and engineering challenges were identified:

- Per facility direction, sediment cannot be dredged within 50 feet of bulk-head shoreline, 10 feet of piers, and 20 feet of shoreline revetment without the potential for structural impacts to the surrounding area.
- The current elevation of the harbor floor cannot be raised.
- Recreational marina piers are in poor condition and would likely require replacement if action is taken in close proximity.

Based upon these considerations, the removal area to be addressed as part of this NTCRA is depicted on **Figure 2-6**. Removal of impacted sediment in this area will eliminate the exposure pathway and mitigate potentially unacceptable ecological risks within approximately 57 percent of the site requiring remedial action under CERCLA. The remaining sediment, groundwater, and soil will be addressed as part of the final remedy for the site to be determined in the forthcoming Record of Decision.

DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\LITTLECREEK\MAPFILES\375057_SWMU3_EECA\FIGURE 2-1 - BASE LOCATION MAP.MXD CBOWMAN 7/3/2012 10:23:08 AM

Legend
Installation Boundary
SWMU 3 Study Area Boundary

N W E S

0 1,500 3,000 Feet

Figure 2-1
SWMU 3 Location Map
SWMU 3 Engineering Evaluation/Cost Analysis
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL

Legend

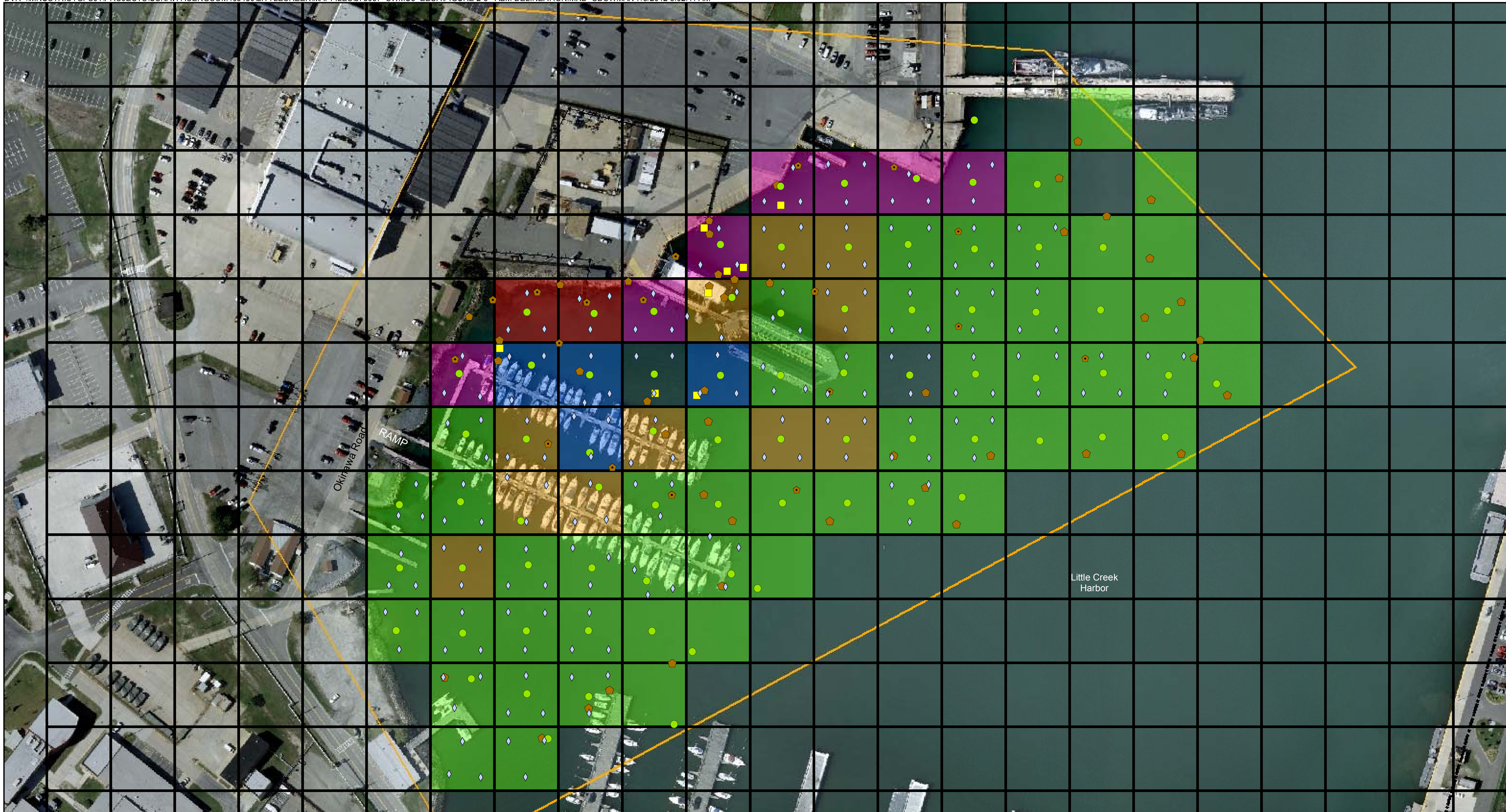
- Outfall Locations
- Underground Drain Pipe
- 1999 Dredging Limits
- Fenced Area
- Picnic Area
- SWMU 3 Study Area Boundary
- Former Sandblasting Area (1962-1995)
- More Recent Sandblasting Area (1995-1996)
- NAB Little Creek Dredge Maintenance to -18' mean low water (mlw)
- NAB Little Creek Dredge Maintenance to -20' mlw
- NAB Little Creek Dredge Maintenance to -25' mlw
- USACE Dredge Maintenance to -27' mlw
- Area Dredged in 2010

N
W E
S

0 200 400
Feet

Figure 2-2
SWMU 3 Boundary and Immediate Vicinity
SWMU 3 Engineering Evaluation/Cost Analysis
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL



Legend

- Subsurface Sediment Sample Location
- Surface/Subsurface Sediment Sample Location
- Surface Sediment Sample Location
- Composite Surface Sediment Sample Location
- Vertical Delineation Sampling Location

2010 Surface Sediment ABM Content

- ≤ 1%
- 1-5%
- 5-10%
- 10-30%
- >30%

N / W / E / S

0 150 300 Feet

Figure 2-3
Previous Sample Locations and ABM Delineation
SWMU 3 Engineering Evaluation/Cost Analysis
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL

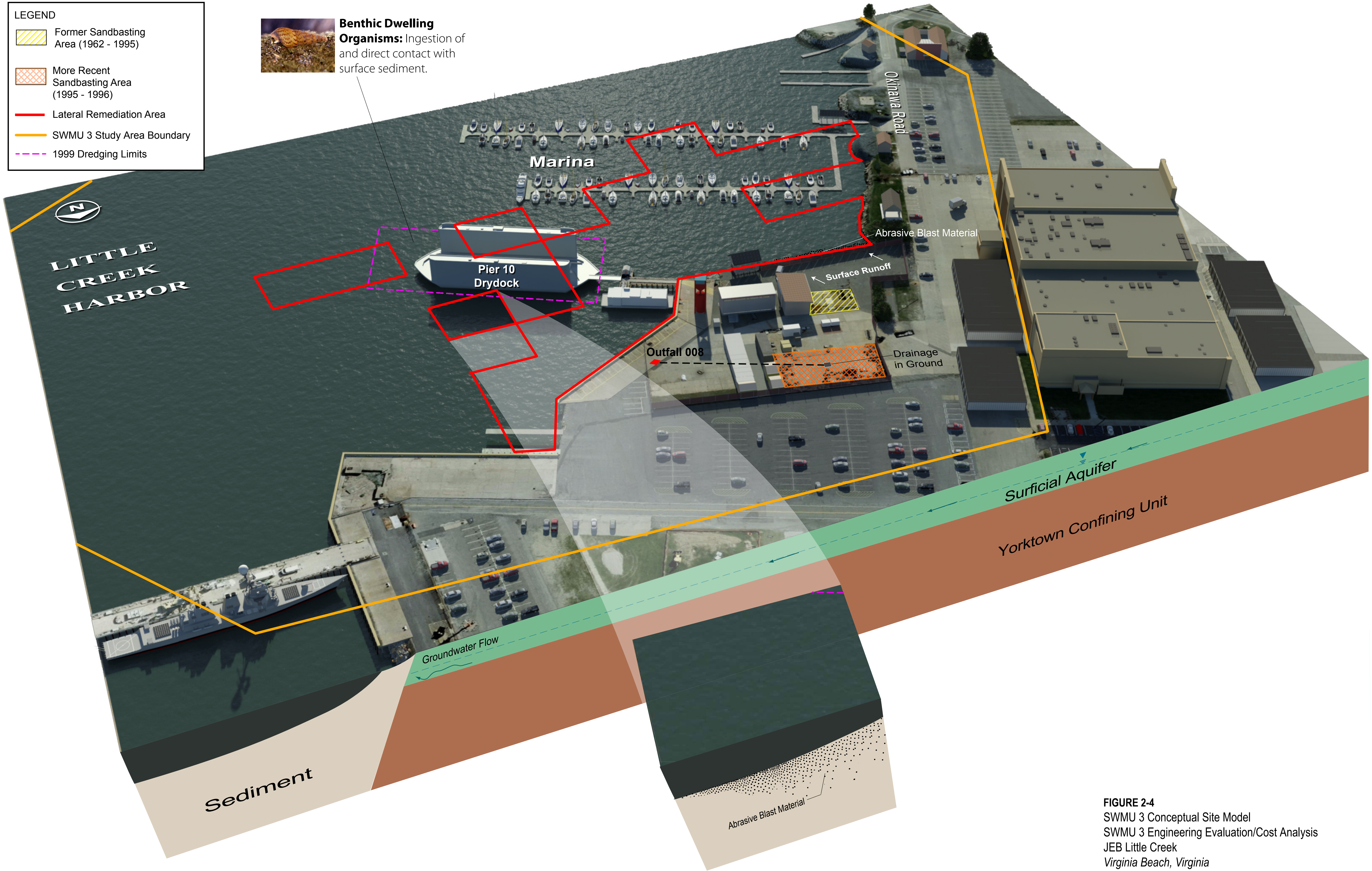
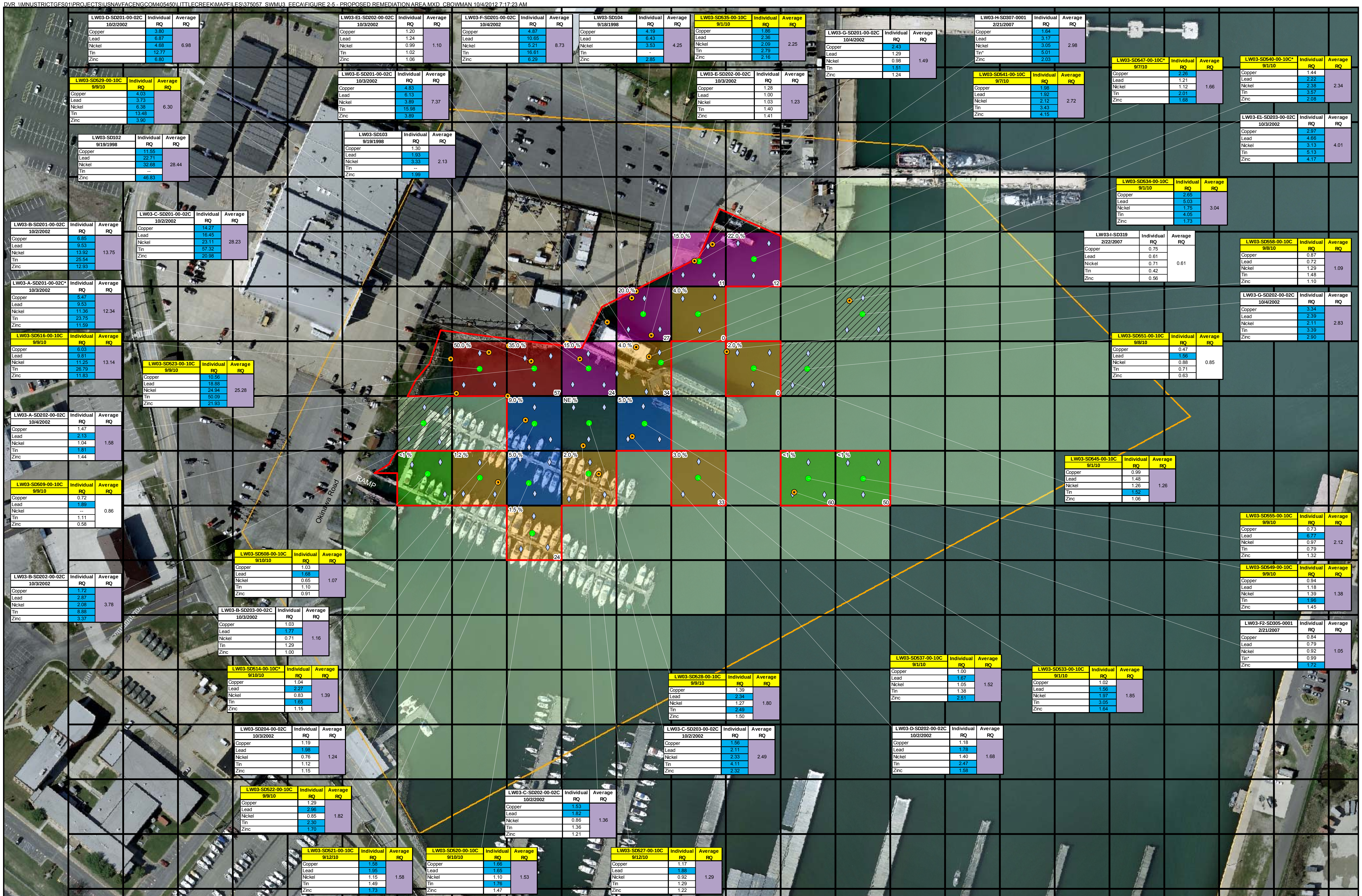


FIGURE 2-4
SWMU 3 Conceptual Site Model
SWMU 3 Engineering Evaluation/Cost Analysis
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL.

DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\LITTLECREEK\MAPFILES\375057_SWMU3_EECA\FIGURE 2-5 - PROPOSED REMEDIATION AREA.MXD CBOWMAN 10/4/2012 7:17:23 AM



Legend

- Surface Sediment Sample Locations
- 2010 Composite Surface Sediment Sample Locations
- 2010 Surface Water Quality Sample Locations
- Grids with exceedances of only one RQ criteria, not included in remediation area
- Proposed Remediation Area
- SWMU 3 Study Area Boundary
- Grid determined to require no CERCLA remedial action per 2002, 2007, 2009, and 2010 data

2010 Surface Sediment ABM Content

- ≤ 1%
- 1-5%
- 5-10%
- 10-30%
- >30%

N W E S

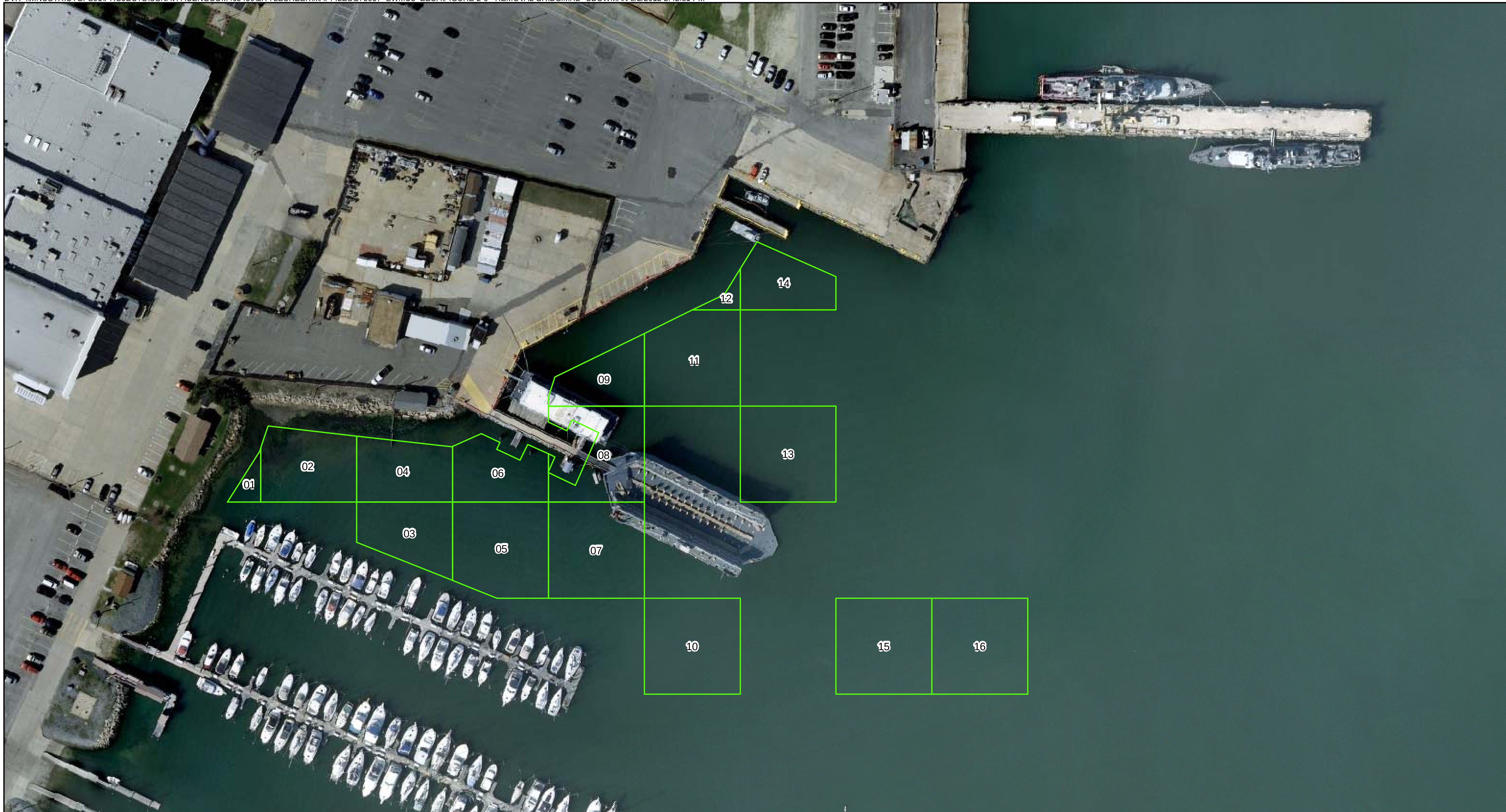
0 60 120 240 360 Feet

Notes:
- * - Duplicate sample collected. Most conservative result reported.
- Depth (in inches) of POL noted in bottom right corner of grid, where applicable.
- Surface sediment ABM content (per August/September 2010 sampling) noted in % in top of grid
- Blue shading indicates individual RQ >1.5
- Purple shading indicates average RQ >1.0
- Yellow shading in text box headers indicates data collected in 2010

Figure 2-5
Proposed Remediation Area
SWMU 3 Engineering Evaluation/Cost Analysis
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL.

DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\LITTLECREEK\MAPFILES\375057_SWMU3_EECA\FIGURE 2-6 - REMOVAL GRIDS.MXD CBOWMAN 8/2/2012 2:42:51 PM



Legend

Removal Action Area

Note: Petroleum impacted sediment is anticipated
to be exposed in grids 6, 8, 9, 10, 11, 12, and 13
if dredging is completed to 2 ft bss with 1 ft of overdredge.

N W E S

0 50 100 200 Feet

Figure 2-6
Removal Action Area
SWMU 3 Engineering Evaluation/Cost Analysis
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL.

SECTION 3
Identification of Objective

3.1 Statutory Limits on Removal Action

The NCP 40 CFR Part 300.415 dictates statutory limits of $2 million and 12 months of USEPA fund-financed removal actions, with statutory exemptions for emergencies and actions consistent with the remedial action to be taken. This removal action will not be USEPA fund-financed. The Navy/Marine Corps installation restoration manual does not limit the cost or duration of the removal action; however, cost-effectiveness is a recommended criterion for the evaluation of removal action alternatives.

3.2 Removal Action Objective and Scope

3.2.1 Removal Action Objective

The removal action objective in this EE/CA will only address the SWMU 3 sediment surrounding the dry dock and anchoring system as shown on **Figure 2-6**. There are no potentially unacceptable human health risks associated with current or future exposure to SWMU 3 sediment and, therefore, no action is required for this medium for the protection of human health. The removal action objective for the protection of the environment is:

- Reduce concentrations of copper, lead, nickel, tin, and zinc in sediment surrounding the dry dock and anchoring system such that concentrations do not pose unacceptable risk to ecological receptors.

3.2.2 Removal Action Scope

In the preparation of this EE/CA, removal action alternatives were scoped and developed to meet the objective listed above. The scope of the engineering measures for each removal alternative is defined in this section.

1. No action: The no action alternative means that no removal work will be done at this site.
2. Mechanical dredging, upland disposal, and replacement with clean fill: The sediment removal area would be dredged and backfilled with a clean sand layer. This option would mitigate potentially unacceptable risk within the removal area and would incorporate actions for erosion and sediment control and upland disposal.
3. Mechanical dredging, onsite solidification, upland disposal, and replacement with clean fill: The sediment removal area would be dredged and backfilled with a clean sand layer. This option would mitigate potentially unacceptable risk within the removal area and would incorporate actions for erosion and sediment control, onsite dredge spoil solidification, and upland disposal.
4. Mechanical dredging, onsite passive dewatering via geotube, upland disposal, and replacement with clean fill: The sediment removal area would be dredged and backfilled with a clean sand layer. This option would mitigate potentially unacceptable risk within the removal area and would incorporate actions for erosion and sediment control, onsite passive dewatering via geotube, and upland disposal.

3.3 Determination of Removal Schedule

The EE/CA will be placed in the Administrative Record, and notice of its availability for public review along with a brief summary will be published in the local newspaper. The EE/CA will be available for a 45-day public comment period. The public comment period is scheduled to be from November 1, 2012 through December 15, 2012. A public information session will be held during or immediately following the public comment period, if requested. If public comments are received during the public comment period, a Responsiveness Summary summarizing responses to significant comments will be prepared and included in the Administrative Record. Since this removal action has been designated non-time-critical, the main factor controlling the start date of the NTCRA is the removal and maintenance of the dry dock and anchoring system scheduled to be begin in February 2013 and take approximately 90 days to complete.

The total project period is anticipated to last 9.5 months from the beginning of the public comment period to completion of the associated construction completion documentation. Mobilization for completion of the NTCRA will correspond with removal of the dry dock and anchoring system. Critical milestone periods related to the EE/CA are summarized below:

- EE/CA Public Comment Period—45 days
- Subcontracting, Work Plan, and Mobilization—3 months
- Removal Action—1 month
- CERCLA Documentation—4 months

3.4 Applicable or Relevant and Appropriate Requirements

As required by Section 121 of CERCLA, remedial actions carried out under Section 104 or secured under Section 106 must attain the levels of standards of control for hazardous substances, pollutants, or contaminants specified by the applicable or relevant and appropriate requirements (ARARs) of federal and state environmental laws and state facility-siting laws, unless waivers are obtained. However, as required by USEPA's policy 40 CFR Section 300.415(j), ARARs will be identified and attained for removal actions to the extent practicable. Two factors will be applied to determine whether the identification and attainment of ARARs is practicable in a particular removal situation: (1) the urgency of the situation; and (2) the scope of the removal action to be conducted.

ARARs are identified by the USEPA as either being applicable to a situation or relevant and appropriate to it. These distinctions are critical to understanding the constraints imposed on response alternatives by environmental regulations other than CERCLA. The definitions of ARARs below are from the USEPA guidance (USEPA, 1998).

- "Applicable" requirements are standards and other environmental protection requirements of federal or state law dealing with a hazardous substance, pollutant, contaminant, action being taken, location, or other circumstance at a CERCLA site.
- "Relevant and appropriate" requirements are standards and environmental protection criteria of federal or state law that, although not "applicable" to a hazardous substance, pollutant, contaminant, action being taken, location, or other circumstance, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. The procedure to determine if a requirement is relevant and appropriate is a two-step process. A requirement is "relevant" if it addresses problems or situations sufficiently similar to the circumstances of the proposed response action. A requirement is "appropriate" if it would also be well suited to the conditions of the site.

A requirement may be "relevant" to a particular situation but not "appropriate," given site-specific circumstances; such a requirement would not be an ARAR for the site. A requirement that is relevant and appropriate must be met as if it were applicable.

"To-be-considered" (TBC) criteria are non-promulgated advisories or guidance issued by federal or state government that are not legally binding, and do not have the status of potential ARARs. TBCs are evaluated along with ARARs and may be implemented when ARARs are not fully protective of human health and the environment.

Another factor in determining which response requirement must be met is whether the requirement is substantive or administrative. Onsite CERCLA response actions must meet substantive requirements but not administrative requirements. Substantive requirements are those dealing directly with actions or with conditions in the environment. Administrative requirements implement the substantive requirements by prescribing procedures such as fees, permitting, and inspection that make substantive requirements effective. This distinction applies to onsite actions only; offsite response actions are subject to all applicable standards and regulations, including administrative requirements such as permits.

Three classifications of requirements are defined by USEPA in the ARAR determination process: chemical-specific, location-specific, and action-specific.

Chemical-specific ARARs are health or risk management-based numbers or methodologies that result in the establishment of numerical values for a given medium that would meet the NCP "threshold criterion" of overall protection of human health and the environment. These requirements generally set protective cleanup concentrations for the COCs in the designated media, or set safe concentrations of discharge for response activity. Chemical-specific requirements are generally set for a single chemical or closely related group of chemicals and do not typically consider mixtures of chemicals. When chemical-specific requirements do not adequately protect human health or the environment, cleanup goals may be set by the TBC value. Federal and Commonwealth of Virginia chemical-specific regulations that have been reviewed are summarized in **Appendix A**.

Location-specific ARARs restrict response activities and media concentrations based on the characteristics of the surrounding environments. Location-specific ARARs may include restrictions on response actions within wetlands or floodplains, near locations of known endangered species, or on protected waterways. Federal and Commonwealth of Virginia location-specific regulations that have been reviewed are summarized in **Appendix A**.

Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous substances. Federal and Commonwealth of Virginia action-specific ARARs that may affect the development and conceptual arrangement of response alternatives are summarized in **Appendix A**.

3.5 General Disposal Requirements

Waste disposal procedures implemented for the removal action will be in accordance with applicable laws and regulations. For the purposes of this EE/CA, the cost estimates were based on the assumption that excavated sediment will be non-hazardous. Waste characterization testing will be conducted in accordance with the requirements of the disposal facility. Any materials classified as hazardous will be appropriately transported and disposed of in accordance with applicable requirements. All materials shall be disposed of in a state-permitted disposal facility that is approved by the Navy and is permitted to accept CERCLA waste.

SECTION 4

Description and Analysis of Removal Action Alternatives

A sediment removal action is planned for SWMU 3 based upon the removal area identification presented in Section 2.6. The alternatives for this NTCRA were developed using professional judgment and information from previous investigations. Alternatives were evaluated based on effectiveness, implementability, and cost. The no action alternative was evaluated for comparative purposes.

4.1 Description of Removal Action Alternatives

4.1.1 Alternative 1—No Action

With the no action alternative, no removal work will be done, no controls will be implemented, and the site will remain in its current condition, leaving the impacted sediment in place. This alternative does not represent the final action for the site. The need for additional action will be evaluated as part of a forthcoming ROD. It is assumed that the current level of maintenance will be sustained.

4.1.2 Alternative 2—Mechanical dredging, offsite solidification, upland disposal, and replacement with clean fill

Alternative 2 includes the removal and offsite disposal of impacted sediment surrounding the dry dock and its anchoring system followed by placement of a clean sand layer to facilitate replacement with clean fill of the area. The elements of this removal are discussed in this section. This alternative does not represent the final action for the site. The need for additional action will be evaluated as part of a forthcoming ROD.

Pre-Delineation Sampling

Prior to completion of the work planning phase, pre-delineation subsurface sediment sampling will be conducted to determine the required final dredging depths. As a result of the equipment being utilized (mechanical dredge), a minimum of 1 foot of sediment will be removed, plus an allowance for an additional 1 foot of overdredge (2 feet total). For the purposes of this EE/CA, it is assumed that removal of 2 feet of impacted sediment is required, plus an allowance for an additional 1 foot of overdredge (3 feet total).

Mobilization

Prior to removal activities, utility locating will be performed to identify any underground and overhead utilities that may impact the removal action. A military construction (MILCON) maintenance dredging is scheduled to take place north of SWMU 3 during the timeframe of this NTCRA; therefore, it is assumed the same dredging subcontractor will be utilized and no mobilization costs will be associated with the dredge equipment or personnel. A temporary water treatment system will be constructed onsite. A pre-removal bathymetric survey will be completed to confirm the pre-excavation surface elevations and identify any large anomalies within the removal area. If any large debris is identified, a debris sweep will be performed prior to dredging.

Dredging

Removal of sediment will be performed using a mechanical dredge outfitted with an environmental clamshell bucket. The dredge will be positioned on scows to allow for easier movement around Little Creek Harbor and prevent disturbance to upland activities. Turbidity and sheens in the dredging area will be reduced through use of the environmental clamshell bucket and controlled with silt curtains and oil booms. Dredged sediment will be loaded onto water-tight scows and moved to an onsite staging area for dewatering. Up to six intermediate bathymetric surveys will be performed during dredging activities. Following completion of dredging, a post-removal bathymetric survey will be completed to confirm contract dredging depths were achieved.

Dewatering and Solidification

Dredged sediment will undergo passive dewatering within water-tight scows. The dredged material will sit in water-tight scows for a period of time to allow for the solids to settle to the bottom of the scows. The overlying water will be pumped through a filter system located on the barge and discharged to Little Creek Harbor.

The dewatered sediment will then be transported, via scow, to Port Weanack in Charles City, Virginia for solidification. For the purposes of this EE/CA, it is assumed that Portland cement will be used for solidification. Solidification would be performed to the degree needed for the dredged sediment to pass the paint filter test. Solidification within the scow will be accomplished by a rotary mixing head attached to an extended reach excavator or similar equipment. After solidification and waste classification, the material will be off-loaded directly from the scow and trucked to a CERCLA-approved Resource Conservation and Recovery Act (RCRA) Subtitle D Landfill (Charles City Landfill in Charles City, Virginia) for disposal.

Barge Decontamination

Following completion of all dredging and sediment solidification, each scow will be decontaminated at Port Weanack in Charles City, Virginia. Decontamination fluids will be containerized for waste characterization and transported to a CERCLA-approved facility (Soilex Facility in Suffolk, Virginia) for disposal.

Site Restoration

Following completion of the post-removal bathymetric survey, the site will be restored through placement of a clean sand layer. Prior to placement, sand will be sampled to determine its suitability for use as clean fill. Sampling requirements and clean fill criteria will be determined during the work-planning phase. Six inches of clean, medium-grained sand will be placed in those areas where petroleum-impacted sediment is not exposed (**Figure 2-6**). Where petroleum-impacted sediment is exposed, 2 feet of clean sand will be placed. Based on the pre-FS vertical delineation sampling, petroleum impacted sediment is anticipated to be exposed in removal grids 6, 8, 9, 10, 11, 12, and 13. The final areas where petroleum-impacted sediment will be exposed will be determined during the pre-delineation subsurface sediment sampling event. Sand placement will be verified by collecting sediment cores allowing for visual confirmation of thickness.

Short-Term Monitoring

Short-term monitoring would be required during the construction phase to protect human health and the environment. Monitoring requirements may include turbidity and water quality monitoring and noise monitoring. Monitoring requirements will be defined during the work planning phase.

4.1.3 Alternative 3—Mechanical dredging, onsite solidification, upland disposal, and replacement with clean fill

Alternative 3 includes the removal and offsite disposal of impacted sediment surrounding the dry dock and its anchoring system followed by placement of a clean sand layer to facilitate replacement with clean fill of the area. The elements of this removal are discussed in this section. This alternative does not represent the final action for the site. The need for additional action will be evaluated as part of a forthcoming ROD.

Pre-Delineation Sampling

Prior to completion of the work planning phase, pre-delineation subsurface sediment sampling will be conducted to determine the required final dredging depths. As a result of the equipment being utilized (mechanical dredge), a minimum of 1 foot of sediment will be removed, plus an allowance for an additional 1 foot of overdredge (2 feet total). For the purposes of this EE/CA, it is assumed that removal of 2 feet of impacted sediment is required, plus an allowance for an additional 1 foot of overdredge (3 feet total).

Mobilization

Prior to removal activities, utility locating will be performed to identify any underground and overhead utilities that may impact the removal action. A MILCON maintenance dredging is scheduled to take place north of SWMU 3 during the timeframe of this NTCRA; therefore, it is assumed the same dredging subcontractor will be utilized and no mobilization costs will be associated with the dredge equipment or personnel. A material staging area for onsite solidification operations and a temporary water treatment system will be constructed onsite. A pre-removal bathymetric survey will be completed to confirm the pre-excavation surface elevations and identify any large anomalies within the removal area. If any large debris is identified, a debris sweep will be performed prior to dredging.

Dredging

Removal of sediment will be performed using a mechanical dredge outfitted with an environmental clamshell bucket. The dredge will be positioned on scows to allow for easier movement around Little Creek Harbor and to prevent disturbance to upland activities. Turbidity and sheens in the dredging area will be reduced through use of the environmental clamshell bucket and controlled with silt curtains and oil booms. Dredged sediment will be loaded onto water-tight scows and moved to an onsite staging area for dewatering. Up to six intermediate bathymetric surveys will be performed during dredging activities. Following completion of dredging, a post-removal bathymetric survey will be completed to confirm contract dredging depths were achieved.

Dewatering and Solidification

Dredged sediment will undergo passive dewatering within water-tight scows. The dredged material will sit in water-tight scows for a period of time to allow for the solids to settle to the bottom of the scows. The overlying water will be pumped through a filter system located on the barge and discharged to Little Creek Harbor.

The dewatered sediment will then be stabilized onsite. For the purposes of this EE/CA, it is assumed that Portland cement will be used for solidification. Solidification will be performed to the degree needed for the dredged sediment to pass the paint filter test. Solidification within the scow will be accomplished by a rotary mixing head attached to an extended reach excavator or similar equipment. After solidification and waste classification, the material will be off-loaded directly from the scow and trucked to a CERCLA-approved RCRA Subtitle D Landfill (Bethel Landfill in Hampton, Virginia) for disposal.

Barge Decontamination

Following completion of all dredging and sediment solidification, each scow will be decontaminated onsite. Decontamination fluids will be containerized for waste characterization and transported to a CERCLA-approved facility (Soilex Facility in Suffolk, Virginia) for disposal.

Site Restoration

Following completion of the post-removal bathymetric survey, the site will be restored through placement of a clean sand layer. Prior to placement, sand will be sampled to determine its suitability for use as clean fill. Sampling requirements and clean fill criteria will be determined during the work-planning phase. Six inches of clean, medium-grained sand will be placed in those areas where petroleum-impacted sediment is not exposed (**Figure 2-6**). Where petroleum-impacted sediment is exposed, 2 feet of clean sand will be placed. Based on the pre-FS vertical delineation sampling, petroleum impacted sediment is anticipated to be exposed in removal grids 6, 8, 9, 10, 11, 12, and 13. The final areas where petroleum-impacted sediment will be exposed will be determined during the pre-delineation subsurface sediment sampling event. Sand placement will be verified by collecting sediment cores allowing for visual confirmation of thickness.

Short-Term Monitoring

Short-term monitoring would be required during the construction phase to protect human health and the environment. Monitoring requirements may include turbidity and water quality monitoring, dust and air quality monitoring, and noise monitoring. Monitoring requirements will be defined during the work planning phase.

4.1.4 Alternative 4—Mechanical dredging, onsite passive dewatering via geotube, upland disposal, and replacement with clean fill

Alternative 4 includes the removal and offsite disposal of impacted sediment surrounding the dry dock and its anchoring system followed by placement of a clean sand layer to facilitate replacement with clean fill of the area.

The elements of this removal are discussed in this section. This alternative does not represent the final action for the site. The need for additional action will be evaluated as part of a forthcoming ROD.

Pre-Delineation Sampling

Prior to completion of the work planning phase, pre-delineation subsurface sediment sampling will be conducted to determine required final dredging depths. As a result of the equipment being utilized (mechanical dredge), a minimum of 1 foot of sediment will be removed, plus an allowance for an additional 1 foot of overdredge (2 feet total). For the purposes of this EE/CA, it is assumed that removal of 2 feet of impacted sediment is required, plus an allowance for an additional 1 foot of overdredge (3 feet total).

Mobilization

Prior to removal activities, utility locating will be performed to identify any underground and overhead utilities that may impact the removal action. A MILCON maintenance dredging is scheduled to take place north of SWMU 3 during the timeframe of this NTCRA; therefore, it is assumed the same dredging subcontractor will be utilized and no mobilization costs will be associated with the dredge equipment or personnel. A material staging area for the onsite geotube dewatering operations and a temporary water treatment system will be constructed onsite. A pre-removal bathymetric survey will be completed to confirm the pre-excavation surface elevations and identify any large anomalies within the removal area. If any large debris is identified, a debris sweep will be performed prior to dredging.

Dredging

Removal of sediment will be performed using a mechanical dredge outfitted with an environmental clamshell bucket. The dredge will be positioned on scows to allow for easier movement around Little Creek Harbor and to prevent disturbance to upland activities. Turbidity and sheens in the dredging area will be reduced through use of the environmental clamshell bucket and controlled with silt curtains and oil booms. Dredged sediment will be loaded onto water-tight scows and moved to an onsite staging area for dewatering. Up to six intermediate bathymetric surveys will be performed during dredging activities. Following completion of dredging, a post-removal bathymetric survey will be completed to confirm contract dredging depths were achieved.

Dewatering and Solidification

Dredged sediment will undergo passive dewatering via geotube at an onsite staging area. Dredged materials will be pumped from the scow into geotubes staged upland. During pumping, it is assumed that a cationic polymer will need to be added to enhance dewatering of dredged sediment to pass the paint filter test. Weep water from the geotubes will be collected in a secondary containment system and subsequently pumped through an onsite temporary water treatment system prior to point source discharge to Little Creek Harbor.

The dewatered sediment will then be stabilized onsite. For the purposes of this EE/CA, it is assumed that Portland cement will be used for solidification. Solidification will be performed to the degree needed for the dewatered sediment to pass the paint filter test. Solidification within the material staging area will be accomplished using an extended reach excavator or similar equipment. After dewatering and waste classification, the material will be off-loaded directly from the staging area and trucked to a CERCLA-approved RCRA Subtitle D Landfill (Bethel Landfill in Hampton, Virginia) for disposal.

Barge Decontamination

Following completion of all dredging and sediment solidification, each scow will be decontaminated onsite. Decontamination fluids will be containerized for waste characterization and transported to a CERCLA-approved facility (Soilex Facility in Suffolk, Virginia) for disposal.

Site Restoration

Following completion of the post-removal bathymetric survey, the site will be restored through placement of a clean sand layer. Prior to placement, sand will be sampled to determine its suitability for use as clean fill. Sampling requirements and clean fill criteria will be determined during the work-planning phase. Six inches of clean, medium-grained sand will be placed in those areas where petroleum-impacted sediment is not exposed (**Figure 2-6**). Where petroleum-impacted sediment is exposed, 2 feet of clean sand will be placed. Based on the pre-FS vertical delineation sampling, petroleum impacted sediment is anticipated to be exposed in removal grids 6, 8, 9, 10, 11, 12, and 13. The final areas where petroleum impacted sediment will be exposed will be determined during the pre-delineation subsurface sediment sampling event. Sand placement will be verified by collecting sediment cores, allowing for visual confirmation of thickness.

Short-Term Monitoring

Short-term monitoring would be required during the construction phase to protect human health and the environment. Monitoring requirements may include turbidity and water quality monitoring, dust and air quality monitoring, and noise monitoring. Monitoring requirements will be defined during the work planning phase.

4.2 Evaluation Criteria

The evaluation criteria are based on *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA*, PB93-963402 (USEPA, 1993).

4.2.1 Effectiveness

The *effectiveness* criterion addresses the expected results of the removal alternatives. It includes two major subcategories: protectiveness and ability to achieve the removal objectives.

- Protectiveness
  - Protective of public health and community;
  - Protective of workers during implementation;
  - Protective of the environment; and
  - Compliant with ARARs.
- Ability to Achieve Removal Objectives
  - Ability to meet the expected level of treatment or containment;
  - Have no residual effect concerns; and
  - Maintain long-term control.

In addition to the protectiveness and ability to achieve the removal objective subcategories, a sustainability assessment was conducted using SiteWise, a stand-alone tool that assesses the environmental footprint of a remedial alternative to compare the overall life-cycle environmental impacts of each remedy (Battelle, 2010). The sustainability assessment provides an additional comparison criterion that may allow options with a smaller environmental impact to be selected when all other criterion are met.

4.2.2 Implementability

The *implementability* criterion encompasses the technical and administrative feasibility of the removal action. It includes three subcategories: technical feasibility, availability of resources, and administrative feasibility.

- Technical Feasibility
  - Construction and operational consideration;
  - Demonstrated performance and useful life;
  - Adaptability to environmental conditions;
  - Contribution to performance of long-term removal actions; and
  - Implementation within the allotted time.

- Availability of Resources
  - Availability of equipment;
  - Availability of personnel and services;
  - Laboratory testing capacity;
  - Offsite treatment and disposal capacity; and
  - Post-removal site control.
- Administrative Feasibility
  - Required permits and/or easement or rights-of-way;
  - Impacts on adjoining property;
  - Ability to impose institutional controls; and
  - Likelihood of obtaining exemptions from statutory limits (if needed).

4.2.3 Cost

The cost criterion encompasses the life-cycle costs of a project, including the projected implementation costs and the long-term operational and maintenance costs of the remedial action. For the detailed cost analysis, the expenditures required to complete each alternative were estimated in terms of capital costs, including direct and indirect costs, to complete initial construction activities. Direct costs include the cost of construction, equipment, land and site development, treatment, transportation, and disposal. Indirect costs include engineering expenses and contingency allowances. No annual operations and maintenance costs are associated with either alternative.

The costs estimated are provided to an expected accuracy of +50 percent and –30 percent. The alternative cost estimate is in 2012 dollars and the unit pricing is based on costs from similar projects, vendor quotes, or engineering estimates. The enclosed Engineer's Estimate (**Appendix B**) is only an estimate of possible construction costs for budgeting purposes.

4.3 Analysis of Removal Action Alternatives

Table 4-1 provides a summary of the alternative analysis with respect to effectiveness, ease of implementation, and cost. **Appendix B** provides cost estimate details pertaining to each alternative discussed in the following sections. The results using the sustainability analysis tool SiteWise for each alternative is included in **Appendix C**.

TABLE 4-1
Evaluation of Remedial Alternatives

Alternative	Description	Effectiveness	Ease of Implementation	Cost
Alternative 1—No Action	No removal work performed. Site left "as is".	*Protectiveness* Potentially unacceptable ecological risk will remain onsite. *Compliance with ARARs* This alternative does not comply with chemical-specific ARARs. Location- and Action-specific ARARs do not apply. *Ability to Achieve Removal Action Objective* This alternative does not meet the removal action objective. *Sustainability* No short-term sustainability impacts because no action is implemented.	*Technical Feasibility* No action to implement. *Availability of Resources* No resources required. *Administrative Feasibility* No action to implement.	$0.00
Alternative 2— Mechanical dredging, offsite solidification, upland disposal, and replacement with clean fill	- Removal of impacted sediment surrounding the dry dock and its anchoring system - On scow dewatering and upland disposal in a RCRA Subtitle D Landfill via scow transport - Site restoration through placement of clean sand layer	*Protectiveness* Very effective in eliminating potentially unacceptable risk to ecological receptors. *Compliance with ARARs* This alternative achieves the chemical-, location-, and action-specific ARARs. *Ability to Achieve Removal Action Objective* This alternative meets the remedial action objective to reduce concentrations of site COCs in sediment surrounding the dry dock and anchoring system such that remaining concentrations do not pose unacceptable risk to ecological receptors. Removal of contaminated sediment would permanently eliminate the potential threat to the environment through removal of the exposure pathway. An immediate reduction in the contaminant levels, toxicity, and volume in the sediment would be anticipated. Because the excavated materials will be disposed of at a landfill, the alternative would not meet the NCP preference of onsite treatment and site reuse over land disposal. *Sustainability* This alternative poses a potential environmental impact due to transportation of equipment, operation of equipment, and residual handling.	*Technical Feasibility* The implementation of this alternative would require common construction activities and the use of standard dredging, materials handling, and hauling equipment. This alternative would require a contractor experienced in environmental dredging who would be required to develop a Dredging Work Plan. *Availability of Resources* Site access and resources will be readily available during the proposed timeframe of the removal action for the type of equipment necessary to execute this work. *Administrative Feasibility* Scheduling completion of the removal action with removal of the dry dock and anchoring system allows for easier access to the removal area and eliminates the need for coordination with dry dock and FAA personnel for completion of the removal action.	$3,533,200
Alternative 3— Mechanical dredging, onsite solidification, upland disposal, and replacement with clean fill	- Removal of impacted sediment surrounding the dry dock and its anchoring system - On scow dewatering, onsite solidification of sediment via on scow mixing, and sediment offload for upland disposal in a RCRA Subtitle D Landfill via trucking - Site restoration through placement of clean sand layer	*Protectiveness* Very effective in eliminating potentially unacceptable risk to ecological receptors. *Compliance with ARARs* This alternative achieves the chemical-, location-, and action-specific ARARs. *Ability to Achieve Removal Action Objective* This alternative meets the remedial action objective to reduce concentrations of site COCs in sediment surrounding the dry dock and anchoring system such that remaining concentrations do not pose unacceptable risk to ecological receptors. Removal of contaminated sediment would permanently eliminate the potential threat to the environment through removal of the exposure pathway. An immediate reduction in the contaminant levels, toxicity, and volume in the sediment would be anticipated. Because the excavated materials will be disposed of at a landfill, the alternative would not meet the NCP preference of onsite treatment and site reuse over land disposal. *Sustainability* This alternative poses a potential environmental impact due to transportation of equipment, operation of equipment, and residual handling.	*Technical Feasibility* The implementation of this alternative would require common construction activities and the use of standard dredging, sediment solidification, materials handling, and hauling equipment. This alternative would require a contractor experienced in environmental dredging who would be required to develop a Dredging Work Plan. *Availability of Resources* Site access and resources will be readily available during the proposed timeframe of the removal action for the type of equipment necessary to execute this work. This alternative would require available property for construction of a materials staging area and use of facility roadways for waste hauling. *Administrative Feasibility* Scheduling completion of the removal action with removal of the dry dock and anchoring system allows for easier access to the removal area and eliminates the need for coordination with dry dock and FAA personnel for completion of the removal action.	$3,512,100

TABLE 4-1
Evaluation of Remedial Alternatives

Alternative	Description	Effectiveness	Ease of Implementation	Cost
Alternative 4— Mechanical dredging, onsite passive dewatering via geotube, upland disposal, and replacement with clean fill	- Removal of impacted sediment surrounding the dry dock and its anchoring system - Onsite passive dewatering via geotube of sediment for upland disposal in a RCRA Subtitle D Landfill via trucking - Site restoration through placement of clean sand layer	*Protectiveness* Very effective in eliminating potentially unacceptable risk to ecological receptors. *Compliance with ARARs* This alternative achieves the chemical-, location-, and action-specific ARARs. *Ability to Achieve Removal Action Objective* This alternative meets the remedial action objective to reduce concentrations of site COCs in sediment surrounding the dry dock and anchoring system such that remaining concentrations do not pose unacceptable risk to ecological receptors. Removal of contaminated sediment would permanently eliminate the potential threat to the environment through removal of the exposure pathway. An immediate reduction in the contaminant levels, toxicity, and volume in the sediment would be anticipated. Because the excavated materials will be disposed of at a landfill, the alternative would not meet the NCP preference of onsite treatment and site reuse over land disposal. *Sustainability* This alternative poses a potential environmental impact due to transportation of equipment, operation of equipment, and residual handling.	*Technical Feasibility* The implementation of this alternative would require common construction activities and the use of standard dredging, sediment dewatering, materials handling, and hauling equipment. This alternative would require a contractor experienced in environmental dredging who would be required to develop a Dredging Work Plan. *Availability of Resources* Site access and resources will be readily available during the proposed timeframe of the removal action for the type of equipment necessary to execute this work. This alternative would require available property for construction of a materials staging area and use of facility roadways for waste hauling. *Administrative Feasibility* Scheduling completion of the removal action with removal of the dry dock and anchoring system allows for easier access to the removal area and eliminates the need for coordination with dry dock and FAA personnel for completion of the removal action.	$4,142,900

SECTION 5

Comparative Analysis

Section 5 provides a comparative analysis of the removal alternatives to assist in the decision-making process by which an alternative will be selected. In previous sections, the removal alternatives were independently screened according to their effectiveness, ease of implementability, and cost. In this section, the alternatives are compared to each other for their relative metrics. From this analysis, it should become clear which alternative is preferable in each category and, consequently, which will be selected for implementation at SWMU 3. **Table 5-1** summarizes the results of the alternative comparison.

TABLE 5-1
Remedial Alternatives Comparison

Alternative	Effectiveness	Implementation	Cost
Alternative 1—No Action	Not Effective	Easy	No cost
Alternative 2— Mechanical dredging, upland disposal, and replacement with clean fill	Effective	Moderate	Moderate
Alternative 3— Mechanical dredging, onsite solidification, upland disposal, and replacement with clean fill	Effective	Moderate	Moderate
Alternative 4— Mechanical dredging, onsite passive dewatering via geotube, upland disposal, an replacement with clean fill	Effective	Moderate	Moderate to High

5.1 Effectiveness

Alternative 1 is not effective. It is not protective of human health and the environment, does not comply with ARARs, and does not achieve the removal action objective of this EE/CA. Since Alternative 1 is not protective of human health and the environment, ARARs were not considered. Alternative 1 involves no action and therefore has no short-term sustainability impacts.

Alternatives 2, 3 and 4 are effective in meeting the removal action objective and providing for long-term protection because each will result in removal of contaminated sediment within the removal area boundary, eliminating the pathway for ecological receptor exposure to COCs in sediment. Each alternative includes the removal and disposal of contaminated sediment offsite. Given the appropriate training and personal protective equipment, each alternative is protective to workers during construction. Because excavated sediment from each alternative would require transportation and offsite disposal, there is a potential for exposing surrounding communities to the contaminants during transport and disposal. Each alternative poses a potential environmental impact due to transportation of equipment, operation of equipment, and residual handling. Alternative 2 poses a slightly greater potential environmental impact due to transporting the sediment up the James River to Port Weanack. None of the three removal alternatives meets the NCP’s preference for onsite treatment and site reuse over land disposal. Each removal alternative achieves the chemical-, location-, and action-specific ARARs and the compliance with ARARs during implementation of the alternatives is summarized in **Appendix A.**

5.2 Implementability

Alternative 1 involves no action and therefore is easy to implement.

Alternatives 2, 3, and 4 are technically and administratively feasible, and resources for implementing the alternatives are readily available. Alternatives 2, 3, and 4 will follow all applicable federal and state regulations for offsite transportation and disposal activities. Alternatives 2, 3, and 4 can be accomplished utilizing standard construction methods and readily available resources. Alternatives 2, 3, and 4 each require some level of onsite dewatering. Alternatives 3 and 4 also require some level of onsite sediment solidification. Sediment solidification, dewatering, and construction of a material staging area are standard dredging processes and the equipment, materials, and labor force would be readily available. However, Alternatives 3 and 4 are slightly more difficult to implement than Alternative 2 as they require construction of onsite material staging areas and would require haul truck access to and from SWMU 3. The material staging areas and large volume of haul trucks required for Alternatives 3 and 4 have the potential to interfere with facility activities. Scheduling completion of the removal action with removal of the dry dock and anchoring system allows for easier access to the removal area and eliminates the need for coordination with dry dock and FAA personnel for completion of the removal action.

5.3 Cost

Alternative 1 has no cost and is therefore the least expensive. The cost estimate for Alternatives 2, 3, and 4 are provided in **Appendix B** and summarized in **Table 4-1**. Alternative 2 is estimated at $3,533,200 (-30% = 2,473,300; +50% = 5,299,800), Alternative 3 is estimated at $3,512,100 (-30% = 2,458,500; +50% = 5,268,200), and Alternative 4 is estimated at $4,142,900 (-30% = 2,900,100; +50% = 6,214,400). Alternative 4 is the most expensive alternative. Costs associated with Alternatives 2 and 3 are essentially the same.

SECTION 6
Recommended Alternative

Based on the comparative analysis of the removal alternatives completed in Section 5 and the scheduled MILCON maintenance dredge, the recommended removal alternative is mechanical dredging, offsite solidification, upland disposal, and replacement with clean fill, as described in Alternative 2. Alternative 2 is in line with the current scope of the MILCON maintenance dredge, consisting of mechanical dredging with an environmental clamshell bucket and upland disposal via scow transport to Port Weanack; requires only the addition of sand placement to the existing MILCON scope of work; and is not more difficult to implement or more expensive than the other alternatives evaluated.

Alternative 2 will require removal of contaminated sediment and site restoration through placement of a clean sand layer to facilitate replacement with clean fill of the area. The sediment will be treated and disposed of offsite. Upon completion of the removal action, potential risk to ecological receptors will be mitigated and NFA will be required for the removal area. Remaining impacted sediment outside the removal area, as well as site soil and groundwater, will be addressed under a separate action, as necessary.

SECTION 7

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Appendix A
ARARs

Acronyms and Abbreviations

ARAR	Applicable or relevant and appropriate requirement
BTAG	Biological Technical Assistance Group
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFC	Chlorofluorocarbon
CFR	Code of Federal Regulations
DCR	Virginia Department of Conservation and Recreation
DNH	Division of Natural Heritage
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
NAAQS	National Ambient Air Quality Standards
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
NSDWRs	National Secondary Drinking Water Regulations
NSPS	New Source Performance Standards
PCB	Polychlorinated biphenyls
PMCL	Primary Maximum Contaminant Level
POTW	Publicly Owned Treatment Works
ppm	Parts per Million
RBC	Risk-Based Concentrations
RCRA	Resource Conservation and Recovery Act
SDWA	Safe Drinking Water Act
SMCL	Secondary Maximum Contaminant Level
TBC	To Be considered
TCLP	Toxicity Characteristic Leaching Procedure
TSCA	Toxic Substance Control Act
USACE	US Army Corps of Engineers
USC	United States Code
USEPA	United States Environmental Protection Agency
VA	Virginia
VAC	Virginia Administrative Code
VMRC	Virginia Marine Resource Commission
VPA	Virginia Pollutant Abatement
VPDES	Virginia Pollutant Discharge Elimination System

References

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USEPA, 1998. RCRA, Superfund & EPCRA Hotline Training Manual. Introduction to Applicable or Relevant and Appropriate Requirements. EPA540-R-98-020.

TABLE A-1
Federal Chemical-Specific ARARs
SWMU 3
JEB Little Creek, Virginia

Media	Requirement	Prerequisite	Citation	Alternative	ARAR/TBC Determination	Comment
Project Remediation Goals						
Sediment	Guidance document regarding how to conduct a technically defensible ecological risk assessment	Assessment of potential ecological risks.	Interim Final Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (EPA, June 1997). Copper (inorganic/metal) CAS #7440-50-8, Lead (inorganic/metal) CAS #7439-92-1, Nickel (inorganic/metal) CAS #7440-02-0, Tin (inorganic/metal) CAS #7440-31-5, and Zinc (inorganic/metal) CAS #7440-66-6	2, 3, 4	TBC	The objective of the removal action at SWMU 3 is to reduce or eliminate risks to ecological receptors from copper, lead, nickel, tin, and zinc in sediment. Project remediation goals (PRGs) for each contaminant of concern (COC) are below: Copper - 232 mg/kg Lead - 107 mg/kg Nickel - 26.5 mg/kg Tin - 11.2 mg/kg Zinc - 410 mg/kg

TABLE A-2

Virginia Chemical-Specific ARARs

SWMU 3

JEB Little Creek, Virginia

Media	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Wastewater Treatment						
Surface Water	Contains minimum standards for surface water quality. No discharge to surface water may cause these criteria to be violated.	Applicable to any discharge of industrial wastewater to state waters.	9 VAC 25-260-140A, 9 VAC 25-260-140B only as it pertains to Copper (CAS #7440-50-8), Lead (CAS #7439-92-1), Nickel (CAS #7440-02-0), Zinc (CAS #7440-66-6), pH, and Temperature	4	Applicable	Alternative 4 includes treatment of the dredge slurry by filtration and the addition of a cationic polymer. Based on that process, the COCs with specific limits, pH, temperature, and toxicity have criteria listed that will be controled as part of the discharge. There are no standards specified for Tin. The final set of standards that will need to be monitored will be set after the design of the treatment system is completed.

TABLE A-3
Federal Location-Specific ARARs
SWMU 3
JEB Little Creek, Virginia

Location	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Migratory Flyway						
Migratory bird area	Protects almost all species of native birds in the United States from unregulated taking.	Presence of migratory birds.	*Migratory Bird Treaty Act;* 16 USC 703	2, 3, 4	Applicable	SWMU 3 is located in the Atlantic Migratory Flyway. If migratory birds, or their nests or eggs, are identified at Site 3, operations will not destroy the birds, nests or eggs.
Coastal Zone						
Coastal zone or area that will affect the coastal zone	Federal activities must be consistent with, to the maximum extent practicable, State coastal zone management programs.Federal agencies must comply with the consistency requirements of 15 CFR § 930.	Actions that may affect identified coastal zone resources or uses	15 CFR 930.33(a)(1), (a)(2), (b); .35(a), (b); .36(a)	2, 3, 4	Applicable	Activities at SWMU 3 that will affect Virginia’s coastal zone will be consistent to the maximum extent practicable with Virginia’s enforceable policies. Activites performed on-site and in compliance with CERCLA are not subject to adminsitrative review; however the substantive requirements of making a consistency determination will be met.

TABLE A-4
Virginia Location-Specific ARARs
SWMU 3
JEB Little Creek, Virginia

Location	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Wetlands						
Wetlands	Mitigate or minimize the loss of wetlands and the adverse ecological effects of all permitted activities. To preserve the wetlands as much as possible in their natural state and to consider appropriate requirements for compensation only after it has been proven that the loss of the natural resource is unavoidable and that the project will have the highest public and private benefit. Commitments to preserve other existing wetlands shall not ordinarily be an acceptable form of compensation.	If a wetlands zoning ordinance has been adopted by local government, in accordance with the *General Provisions Relating to Marine Resources Commission*, and the response action is not exempt from its provisions, the project must comply with the requirements of the ordinance. In the case of absence of an ordinance, or of an exemption to it, VMRC can exercise jurisdiction over tidal wetlands.	4 VAC 20-390-40, 50	2, 3, 4	Relevant and Appropriate	It is not anticipated that onsite activities will disturb the existing wetland areas. The dredging operation will not result in a net loss of wetland area.
Presence of Threatened and Endangered Species or Habitat						
Area where endangered species are present	Identified federal and state threatened and endangered species are protected from unlawful taking. This requirement includes prohibition of activities that adversely affect critical habitat. The list of federal threatened and endangered species is incorporated into state law along with additions.	Activity in an area where listed threatened or endangered species are present or in an area that is designated as their critical habitat.	4VAC 15-20-130 (c), 2 VAC 5-320-10 (as it references §3.2-1003)	2, 3, 4	TBC	Per Navy policy, state-listed species are protected through the implementation of an Integrated Natural Resource Management Plan (INRMP). Compliance with the INRMP will constitute compliance with all substantive requirements in the regulations for this action.

TABLE A-5

Federal Action-Specific ARARs

SWMU 3

JEB Little Creek, Virginia

Action	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Dredge and Fill						
Discharge of dredge-and-fill	No discharge of dredged or fill material will be allowed unless appropriate and practicable steps are taken that minimize potential adverse impacts of the discharge on the aquatic ecosystem.	Discharges of dredged or fill material to surface waters, including wetlands.	40 CFR 230.10(d); 33 CFR 320.4(a), (b), (d), (p), (r)	2, 3, 4	Applicable	Onsite actions may include removal or replacement of sediments as well as dewatering removed sediment. These actions will be taken in accordance with the substantive provisions of Nationwide Permit 38. Steps will be taken to minimize the impacts to the ecosystem.
Storage of Petroleum and Non-petroleum Oils						
Storage of fuels and oils (petroleum and non-petroleum) onsite	If storage capacity limits are exceeded a Spill, Prevention, Control, and Countermeasures Plan must be prepared and implemented with procedures, methods, equipment, and other requirements to prevent the discharge of into or upon the navigable waters of the United States.	Total onsite storage capacity exceeding 1,320 gallons in containers that are 55 gallons or larger in size.	40 CFR 112.3(a)(1); 112.5; 112.6(a)(1), (a)(3)*; 112.7(a)(3)(i), (a)(3)(iv), (a) (3)(vi),(a)(4), (a)(5), (c), (e), (f),(g),(k); 112.8(b)(1), (b)(2), (c)(1), (c)(3), (c)(6), (c)(10), and (d)(4) *the provisions incorporated by reference here are not ARARs unless they are also listed in this table.	2, 3, 4	Applicable	It is anticipated that fuels or other treatment chemicals will be stored onsite. If the storage capacity in containers that are 55 gallons or greater is equal to or exceeds 1,320 gallons a Spill Prevention, Control, and Countermeasure (SPCC) Plan must be prepared and implemented. Containers include oil and fuel reservoirs in equipment. Onsite CERCLA actions are not subject to administrative requirements such as administrative reviews and endorsements.

TABLE A-6
Virginia Action-Specific ARARs
SWMU 3
JEB Little Creek, Virginia

Action	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Dredge and Fill						
Dredging, filling, and/or discharging pollutants into, or adjacent to, surface waters (including wetlands)	Regulations for activities undertaken in State surface waters	Activities such as dredging, filling, or discharging any pollutant into or adjacent to surface waters, or otherwise altering the physical, chemical, or biological properties of surface waters; excavating in wetlands; or conducting the following activities in a wetland: 1. New activities to cause draining that significantly alters or degrades existing wetland acreage or functions. 2. Filling or dumping. 3. Permanent flooding or impounding. 4. New activities that cause significant alteration or degradation of existing wetland acreage or functions.	9 VAC 25-210-90(F)(1), (2), (3); 115(C)(1); 116(A), (B), (C), (F);	2, 3, 4	Relevant and Appropriate	The removal area at SMWU 3 will be dredged to remove the impacted sediment and place a clean sand layer over the dredged areas. The clean sand layer will provide a layer of clean fill over the dredged area which will eliminate the need for post-dredging confirmation sampling. Relevant and appropriate because the action will not result in a net loss of wetland area.
Erosion and deposits of soil/sediment caused by land disturbing activities	Regulations for the effective control of soil erosion, sediment deposition and nonagricultural runoff which must be met in any control program to prevent the unreasonable degradation of properties, stream channels, waters and other natural resources.	Construction activities that will disturb more than 10,000 square feet of land.	Erosion and Sediment Control Regulations, 4 VAC 50-30-40-2; 12; 14; 15; 16(c); and 19(k)	2, 3, 4	Relevant and Appropriate	Since the response action occurs in a live watercourse and along its beds and banks, the only requirements in 4 VAC 50-30-40 that are relevant and appropriate to the response action itself are 12, 13, and 15. However, additional site work will be required to facilitate the response action including the construction of temporary access roads, material and equipment staging areas, and support facilities.
Waste Management						
Handling and storage of solid waste onsite in waste piles	Establishes standards and procedures pertaining to the management of solid wastes in stockpiles.	On-site management of wastes that meet the definition of solid waste in piles.	9 VAC 20-81-330(F)(1); 330(F)(2)(a)(1), (e),(f); 330(F)(4)	3	Applicable	Dredged sediment may be staged onsite in piles during the response action. In the event that staging piles are used they will be managed in accordance with these requirements.
Staging of solid waste onsite in containers	Establishes criteria for the proper management of solid wastes.	Management of solid wastes onsite in containers	9 VAC 20-81-95(D)(10)(b)	2, 3, 4	Applicable	It is anticipated that some wastes (such as decontamination fluids and sediment) may be generated and managed onsite in containers. Based on the analytical results from previous investigations, it is expected that these wastes will be non-hazardous solid waste. Wastes will be characterized prior to offsite disposal.

TABLE A-6

Virginia Action-Specific ARARs

SWMU 3

JEB Little Creek, Virginia

Action	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Accumulation of hazardous waste in containers onsite for less than 90 days	Hazardous waste may be accumulated on site in containers for up to 90 days so long as the containers are in good condition, compatible with the waste being stored, and labeled with the words "Hazardous Waste" and the date that accumulation began. The containers must also be kept closed unless adding or removing waste and inspected weekly.	Accumulation of hazardous waste in containers onsite.	9 VAC 20-60-262 only as it incorporates 40 CFR 262.34 (a) (1)(i), (2), (3), and 40 CFR 265.171 through 174	2, 3, 4	Applicable	It is possible that hazardous waste will be generated and staged onsite in containers for less than 90 days
Accumulation and/or treatment of hazardous waste in staging piles onsite	A staging pile must me designed constructed and maintained to prevent the migration of hazardous constituents other media. The design must consider location, hydrogeology, and any other factors that may reasonably influence the migration of hazardous constituents. Closure requirements are also included.	Accumulation or treatment of hazardous wastes in staging piles onsite	9 VAC 20-60-264 only as it incorporates 40 CFR 264.554(d)(1)(ii), (d)(2),	3, 4	Relevant and Appropriate	These requirements are applicable to operating a staging pile for treatment or staging of hazardous wastes in piles during this action. However, since it is not anticipated that hazardous wastes will be generated, these requirements are relevant and appropriate for this action. Staging piles will be designed and operated in accordance with these standards; however, since this is a CERCLA action no permit will be required. These requriements are applicable only if hazardous waste is generated and treated or staged in piles.
Treatment of hazardous waste in containers	Containers used for treatment must be in good condition and compatible with the waste being treated. The containers must also be kept closed unless adding or removing waste, handled to minimize the possibility of failure, and inspected weekly. The containers must also be protected from contact with precipitation.	Treatment of hazardous wastes in containers onsite	9 VAC 20-60-264 only as it incorporates 40 CFR 264.171 through 174, and 175(c)	3	Applicable	Applicable if hazardous waste will be treated ex situ in containers.
Wastewater Treatment						
Discharge to state waters	The Virginia Pollutant Discharge Elimination System (VPDES) regulates point source discharges to state waters.	Treatment of wastewater prior to discharge	9 VAC 25-31-190(D), (E), (J)(1), J(3), J(4); 200(A)(2)(a) and (A)(2)(b).	4	Applicable	The water treatment system will be designed and operated to meet the substantive requirements of the VDPES system. Onsite CERCLA actions are not subject to administrative requirements such as administrative reviews or permitting.

TABLE A-6
Virginia Action-Specific ARARs
SWMU 3
JEB Little Creek, Virginia

Action	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Dust Control						
Generation of fugitive dust	Regulations regarding reasonable precautions to prevent particulate matter from becoming airborne.	Conducting any activity which may cause particulate matter to become airborne.	9 VAC 5-50-90	3, 4	Applicable	Dust control measures will be implemented during activities at the site.

Appendix B
Cost Estimate

Table B-1
Engineer's Cost Estimate for Alternative 2: Mechanical dredging, upland disposal, and replacement with clean fill
SWMU 3 Pier 10 Sandblast Yard
JEB Little Creek
Virginia Beach, Virginia

Description: Alternative 2 (Mechanical dredging, upland disposal, and replacement with clean fill) includes removal of contaminated sediment surrounding the dry dock and anchoring system. The total removal area is 114,552 ft^2. Assumed dredge depth is 2 feet with an additional 1 foot of ovedredge. The total removal volume is estimated to be 12,728 yd^3.

Cost Item	Unit	Quantity	Unit Cost	Cost	Cost Estimate Reference	Assumptions and Notes
Pre-Dredge Sampling						
In-situ Waste Characterization Sampling						
Sediment Sampling	LS	0	$ 54,020.00	$ 54,020.00	Recent similar projects	- Includes all sampling labor and expenses - Includes vibracore and IDW subcontractor costs
Sample Analysis	EA	17	$ 1,710.63	$ 29,080.71	Navy CLEAN Laboratory BOA Rates	- Includes analysis of full TCLP (VOCs, SVOCs, metals, herbicides, and pesticides), BTEX, PCBs, TPH, EOX, dioxins, reactivity, ignitability, and corrosivity.
Site Preparation Activities						
Dredging						
Dredge Equipment Mobilization	Lump Sum	0	$ 150,000.00	$ -	Recent similar projects	- Assumes MILCON Contractor already onsite
Dredge Personnel Mobilization	Lump Sum	0	$ 29,180.00	$ -	Recent similar projects	- Assumes MILCON Contractor already onsite
Utility Locate	Lump Sum	1	$ 975.00	$ 975.00	Recent similar projects	- Includes mobilization, demobilization, and all labor, equipment, and materials.
Bathymetric Survey Mobilization/Demobilization	Lump Sum	1	$ 2,000.00	$ 2,000.00	Recent similar projects	- Assumes mobilization/demobilation of two-man survey crew and all associated supplies and equipment.
Pre-Removal Bathymetric Survey	Day	1	$ 4,025.00	$ 4,025.00	Recent similar projects	Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day
Debris Sweep	Day	3	$ 12,000.00	$ 36,000.00	Recent similar projects	- Assumes equipment rented locally as needed when large debris is located
Turbidity Curtain	Linear Feet	1,700	$ 28.75	$ 48,875.00	Recent similar projects	Assumes: - 25 ft deep - 200 x 200 ft dredge area - 300 x 150 ft scow dewatering area
Turbidity Curtain Installation/Removal	Lump Sum	1	$ 11,730.00	$ 11,730.00	Recent similar projects	- Includes labor and boat for installation and removal of system
Dredging and Disposal						
Dredging						
Dredging	Cubic Yard	12,728	$ 27.25	$ 346,838.00	Recent similar projects	- Assumes dredging 5 days per week M-F 12 hr/day. - Includes labor, mechanical dredge use, and fuel
Work-in-Progess Bathymetric Survey	Day	6	$ 4,025.00	$ 24,150.00	Recent similar projects	Bathymetric surveys will be completed following completion of each removal grid to identify need for additional dredging prior to dredge equipement downtime or demobilzation. Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day
Post-Removal Bathymetric Survey	Day	1	$ 4,025.00	$ 4,025.00	Recent similar projects	Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day
Scow Free Water Removal						
Scow Free Water Removal	Day	26	$ 2,300.00	$ 59,800.00	Recent similar projects	- Includes 20 ton crane for pump manuevering, sump pump, and labor
Sediment Transportation and Disposal						
Waste Characterization Sampling	Each	14	$ 76.70	$ 1,073.80	Navy CLEAN Laboratory BOA Rates	- Assumes 1 sample per barge (approx. 1000 yds^3) for analysis of TPH and paint filter test. - Includes volume of sediment and portland cement.
Offsite Disposal Waste Management	Ton	21,001	$ 45.25	$ 950,304.30	Per quotes from Port Weanack and Waste Management Charles City Landfill	-Assumes 10% by weight stabilization agent mix ratio - Includes sediment stabilization, loading sediment from scow to truck, and transporting sediment to the landfill
Disposal @ Subtitle D Landfill	Ton	21,001	$ 25.00	$ 525,030.00	Per quote from Waste Management Charles City Landfill	- Tonnage includes portland cement
Disposal @ Subtitle D Landfill (debris)	Ton	12	$ 50.00	$ 600.00	Per quote from Waste Management Charles City Landfill	- Tonnage based on recent similar projects
Decontamination Water Transportation and Disposal						
Scow travel for Decontamination	Each	7	$ 3,600.00	$ 25,200.00	Recent similar projects	-Assumes decontamination will occur at SWMU 3
Barge Survey and Report	Lump Sum	1	$ 20,000.00	$ 20,000.00	Recent similar projects	- Includes equipment surveys after each scow offload to document damage.
Waste Characterization Sampling	Each	1	$ 864.04	$ 864.04	Navy CLEAN Laboratory BOA Rates	- Assumes 1 sample per load for analysis of full TCLP, Ignitability, Corrosivity (pH), TPH, and Reactivity (cyanide and sulfide).
Transport to Disposal Facility	Load	1	$ 665.00	$ 665.00	Per quote from Summit Environmental	- Includes 5,000 gallon vacuum tanker and transferring water from scow to vacuum tanker.
Disposal @ Soilex Facility, Suffolk, VA	Gallon	5,000	$ 0.25	$ 1,250.00	Per quote from Summit Environmental.	- Includes water for barge cleaning performed after dredging is complete
Solids Surcharge	Gallon	250	$ 0.70	$ 175.00	Per quote from Summit Environmental	- Assume 5% of decon water volume.
Site Restoration/Demoboilization						
Sand Layer Placement						
Mobilization/Demobilization	Lump Sum	1	$ 20,000.00	$ 20,000.00	Recent similar projects	- Includes mobilization and demobilization of sand spreader (barge and long reach excavator)
Well Graded Sand (Washed Sand 100+)	Ton	7,995	$ 20.00	$ 159,900.00	Recent similar projects	- Includes cost for purchase/delivery and 15% loss
Placement of Well Graded Sand	Cubic Yard	4,854	$ 12.00	$ 58,248.00	Recent similar projects	- Includes use of sand spreader (barge and long reach excavator), fuel, and labor.
Site Survey						
Final Bathymetric Survey	Day	1	$ 4,025.00	$ 4,025.00	Recent similar projects	Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day
Subtotal				**$2,388,854**		
Contingency (15%)				$358,328		
General Conditions (10%)				$238,885		
Subtotal				**$2,986,067**		
Performance Bond (2%)				$59,721		Industry Average
Subtotal				**$3,045,789**		
Design Costs (8%)				$243,663		Includes Closeout Reports
Construction Oversight (8%)				$243,663		
TOTAL CAPITAL COST				**$3,533,200**	**+50%** **$5,299,800**	
					-30% **$2,473,300**	

Notes

1. Base costs used are 2012 dollars.

2. For the bathymetric survey the dredge subcontractor will be responsible for coordinating with the surveyor to insure schedule efficiency. Navy will not be responsible for dredging delay due to surveyor. Survey will occur immediately after dredging is complete. Dredger will not leave dredging area until survey is confirmed.

3. Assumes that 90% of the free dredge water from the scows will be removed before turnover of the scows to the offloading contractor.

4. The enclosed Engineer's Estimate is only an estimate of possible construction costs for budgeting purposes. This estimate is limited to the conditions existing at its issuance and is not a guarantee of actual price or cost. Uncertain market conditions such as, but not limited to: local labor or contractor availability, wages, other work, material market fluctuations, price escalations, force majeure events, and developing bidding conditions etc may affect the accuracy of this estimate. CH2M Hill is not responsible for any variance from this estimate or actual prices and conditions obtained.

Table B-2
Engineer's Cost Estimate for Alternative 3: Mechanical dredging, onsite solidification, upland disposal, and replacement with clean fill
SWMU 3 Pier 10 Sandblast Yard
JEB Little Creek
Virginia Beach, Virginia

Description: Alternative 3 (Mechanical dredging, onsite stabilization, upland disposal, and replacement with clean fill) includes removal of contaminated sediment surrounding the dry dock and anchoring system. The total removal area is 114,552 ft^2. Assumed dredge depth is 2 feet with an additional 1 foot of ovedredge. The total removal volume is estimated to be 12,728 yd^3.

Cost Item	Unit	Quantity	Unit Cost	Cost	Cost Estimate Reference	Assumptions and Notes
Pre-Dredge Sampling						
In-situ Waste Characterization Sampling						
Sediment Sampling	LS	0	$ 54,020.00	$ 54,020.00	Recent similar projects	- Includes all sampling labor and expenses - Includes vibracore and IDW subcontractor costs
Sample Analysis	EA	17	$ 1,710.63	$ 29,080.71	Navy CLEAN Laboratory BOA Rates	- Includes analysis of full TCLP (VOCs, SVOCs, metals, herbicides, and pesticides), BTEX, PCBs, TPH, EOX, dioxins, reactivity, ignitability, and corrosivity.
Site Preparation Activities						
Dredging						
Dredge Equipment Mobilization	Lump Sum	0	$ 150,000.00	$ -	Recent similar projects.	- Assumes MILCON Contractor already onsite
Dredge Personnel Mobilization	Lump Sum	0	$ 29,180.00	$ -	Recent similar projects.	- Assumes MILCON Contractor already onsite
Utility Locate	Lump Sum	1	$ 975.00	$ 975.00	Recent similar projects.	- Includes mobilization, demobilization, and all labor, equipment, and materials.
Bathymetric Survey Mobilization/Demobilization	Lump Sum	1	$ 2,000.00	$ 2,000.00	Recent similar projects.	- Assumes mobilization/demobilation of two-man survey crew and all associated supplies and equipment.
Pre-Removal Bathymetric Survey	Day	1	$ 4,025.00	$ 4,025.00	Recent similar projects.	Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day
Debris Sweep	Day	3	$ 12,000.00	$ 36,000.00	Recent similar projects.	- Assumes equipment rented locally as needed when large debris is located
Turbidity Curtain	Linear Feet	1,700	$ 28.75	$ 48,875.00	Recent similar projects.	Assumes: - 25 ft deep - 200 x 200 ft dredge area - 300 x 150 ft scow dewatering area
Turbidity Curtain Installation/Removal	Lump Sum	1	$ 11,730.00	$ 11,730.00	Recent similar projects.	- Includes labor and boat for installation and removal of system
Material Staging Area Civil Construction	Lump Sum	1	$ 130,000.00	$ 130,000.00	Recent similar projects.	Assumes 140 x 25 ft area. Includes sump installation, stone underlayment, asphalt surface, sump pumps, water collection piping (1in), dust control, and SWPP controls
Dredging and Disposal						
Dredging						
Dredging	Cubic Yard	12,728	$ 27.25	$ 346,838.00	Recent similar projects.	- Assumes dredging 5 days per week M-F 12 hr/day. - Includes labor, mechanical dredge use, and fuel
Work-in-Progess Bathymetric Survey	Day	6	$ 4,025.00	$ 24,150.00	Recent similar projects.	Bathymetric surveys will be completed following completion of each removal grid to identify need for additional dredging prior to dredge equipement downtime or demobilzation. Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day
Post-Removal Bathymetric Survey	Day	1	$ 4,025.00	$ 4,025.00	Recent similar projects.	Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day
Scow Free Water Removal						
Scow Free Water Removal	Day	26	$ 2,300.00	$ 59,800.00	Recent similar projects.	- Includes 20 ton crane for pump manuevering, sump pump, and labor
Solidification						
Sediment Solidification	Ton	2,272	$ 275.00	$ 624,800.00	Recent similar projects.	- Assumes 10% by weight portland cement. Includes purchase/delivery of portland cement, equipment mobilization/demobilization, labor, and equipment
Sediment Transportation and Disposal						
Loading	Ton	21,001	$ 4.50	$ 94,504.50	Recent similar projects.	- Tonnage includes portland cement. Includes front end loader and excavator.
Waste Characterization Sampling	Each	14	$ 76.70	$ 1,073.80	Navy CLEAN Laboratory BOA Rates	- Assumes 1 sample per barge (approx. 1000 yds^3) for analysis of TPH and paint filter test. - Includes volume of sediment and portland cement.
Transport to Landfill	Ton	21,001	$ 9.00	$ 189,010.80	Per quote from Waste Management Bethel Landfill	- Tonnage includes portland cement
Disposal @ Subtitle D Landfill	Ton	21,001	$ 20.00	$ 420,024.00	Per quote from Waste Management Bethel Landfill	- Tonnage includes portland cement
Disposal @ Subtitle D Landfill (debris)	Ton	12	$ 50.00	$ 600.00	Per quote from Waste Management Bethel Landfill	- Tonnage based on recent similar projects
Decontamination Water Transportation and Disposal						
Dredge, Scows, & Equipment Decontamination	Lump Sum	1	$ 10,000.00	$ 10,000.00	Recent similar projects.	- Assumes decontamination will be performed onsite within a scow and water will be containerized and sampled for offsite transportation and disposal. Includes decontamination of all dredging and solidification equipment including scows.
Waste Characterization Sampling	Each	2	$ 864.04	$ 1,728.08	Navy CLEAN Laboratory BOA Rates	- Assumes 1 sample per load for analysis of full TCLP, Ignitability, Corrosivity (pH), TPH, Reactivity (cyanide and sulfide).
Transport to Disposal Facility	Load	2	$ 665.00	$ 1,330.00	Per quote from Summit Environmental.	- Includes 5,000 gallon vacuum tanker and transferring water from scow to vacuum tanker.
Disposal @ Soilex Facility, Suffolk, VA	Gallon	10,000	$ 0.25	$ 2,500.00	Per quote from Summit Environmental.	- Includes water for barge/dredge and scow cleaning performed after dredging is complete
Solids Surcharge	Gallon	500	$ 0.70	$ 350.00	Per quote from Summit Environmental	- Assume 5% of decon water volume.
Site Restoration/Demoboilization						
Material Staging Area						
Demobilization	Lump Sum	1	$ 35,000.00	$ 35,000.00	Recent similar projects.	- Includes grading/seeding the material staging area, removal of sump pumps and water collection piping, removal/disposal of stone and asphalt.
Sand Layer Placement						
Mobilization/Demobilization	Lump Sum	1	$ 20,000.00	$ 20,000.00	Recent similar projects.	- Includes mobilization and demobilization of sand spreader (barge and long reach excavator)
Well Graded Sand (Washed Sand 100+)	Ton	7,995	$ 20.00	$ 159,900.00	Recent similar projects.	- Includes cost for purchase/delivery and 15% loss
Placement of Well Graded Sand	Cubic Yard	4,854	$ 12.00	$ 58,248.00	Recent similar projects.	- Includes use of sand spreader (barge and long reach excavator), fuel, and labor
Site Survey						
Final Bathymetric Survey	Day	1	$ 4,025.00	$ 4,025.00	Recent similar projects.	Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day
Subtotal				***$2,374,613***		
Contingency (15%)				$356,192		
General Conditions (10%)				$237,461		
Subtotal				***$2,968,266***		
Performance Bond (2%)				$59,365		Industry Average
Subtotal				***$3,027,631***		
Design Costs (8%)				$242,211		Includes Closeout Reports
Construction Oversight (8%)				$242,211		
TOTAL CAPITAL COST				**$3,512,100**	**+50% $5,268,200** **-30% $2,458,500**	

Notes

1. Base costs used are 2012 dollars.

2. For the bathymetric survey the dredge subcontractor will be responsible for coordinating with the surveyor to insure schedule efficiency. Navy will not be responsible for dredging delay due to surveyor. Survey will occur immediately after dredging is complete. Dredger will not leave dredging area until survey is confirmed.

3. Assumes that 90% of the free dredge water from the scows will be removed before turnover of the scows to the offloading contractor.

4. The enclosed Engineer's Estimate is only an estimate of possible construction costs for budgeting purposes. This estimate is limited to the conditions existing at its issuance and is not a guarantee of actual price or cost. Uncertain market conditions such as, but not limited to: local labor or contractor availability, wages, other work, material market fluctuations, price escalations, force majeure events, and developing bidding conditions etc may affect the accuracy of this estimate. CH2M Hill is not responsible for any variance from this estimate or actual prices and conditions obtained.

Table B-3
Engineer's Cost Estimate for Alternative 4: Mechanical dredging, onsite passive dewatering via geotube, upland disposal, an replacement with clean fill
SWMU 3 Pier 10 Sandblast Yard
JEB Little Creek
Virginia Beach, Virginia

Description: Alternative 4 (Mechanical dredging, onsite passive dewatering via geotube, upland disposal, and replacement with clean fill) includes removal of contaminated sediment surrounding the dry dock and anchoring system. The total removal area is 114,552 ft^2. Assumed dredge depth is 2 feet with an additional 1 foot of ovedredge. The total removal volume is estimated to be 12,728 yd^3.

Cost Item	Unit	Quantity	Unit Cost	Cost	Cost Estimate Reference	Assumptions and Notes
Pre-Dredge Sampling						
In-situ Waste Characterization Sampling						
Sediment Sampling	LS	0	$ 54,020.00	$ 54,020.00	Recent similar projects	- Includes all sampling labor and expenses - Includes vibracore and IDW subcontractor costs
Sample Analysis	EA	17	$ 1,710.63	$ 29,080.71	Navy CLEAN Laboratory BOA Rates	- Includes analysis of full TCLP (VOCs, SVOCs, metals, herbicides, and pesticides), BTEX, PCBs, TPH, EOX, dioxins, reactivity, ignitability, and corrosivity.
Site Preparation Activities						
Dredging						
Dredge Equipment Mobilization	Lump Sum	0	$ 150,000.00	$ -	Recent similar projects.	- Assumes MILCON Contractor already onsite
Dredge Personnel Mobilization	Lump Sum	0	$ 29,180.00	$ -	Recent similar projects.	- Assumes MILCON Contractor already onsite
Utility Locate	Lump Sum	1	$ 975.00	$ 975.00	Recent similar projects.	- Includes mobilization, demobilization, and all labor, equipment, and materials.
Bathymetric Survey Mobilization/Demobilization	Lump Sum	1	$ 2,000.00	$ 2,000.00	Recent similar projects.	Assumes mobilization/demobilization of two-man survey crew and all associated supplies and equipment.
Pre-Removal Bathymetric Survey	Day	1	$ 4,025.00	$ 4,025.00	Recent similar projects.	Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day
Debris Sweep	Day	3	$ 12,000.00	$ 36,000.00	Recent similar projects.	- Assumes equipment rented locally as needed when large debris is located
Turbidity Curtain	Linear Feet	1,700	$ 28.75	$ 48,875.00	Recent similar projects.	Assumes: - 25 ft deep - 200 x 200 ft dredge area - 300 x 150 ft scow dewatering area
Turbidity Curtain Installation/Removal	Lump Sum	1	$ 11,730.00	$ 11,730.00	Recent similar projects.	- Includes labor and boat for installation and removal of system
Material Staging Area Civil Construction	Lump Sum	1	$ 175,000.00	$ 175,000.00	Recent similar projects.	- Assumes 250 x 350 ft area. - Includes geotextile fabric, 60 mil HDPE liner, geonet, sump, berm fill (clay), water collection piping (16in), dust control, and SWPP controls.
Sediment Offload and Screening Installation	Lump Sum	1	$ 16,000.00	$ 16,000.00	Recent similar projects.	- Includes screening plant, slurry pump, electrical connections, open top mix tank and all labor and equipment to install.
Dredging and Disposal						
Dredging						
Dredging	Cubic Yard	12,728	$ 27.25	$ 346,838.00	Recent similar projects.	- Assumes dredging 5 days per week M-F 12 hr/day. - Includes labor, mechanical dredge use, and fuel
Work-in-Progess Bathymetric Survey	Day	6	$ 4,025.00	$ 24,150.00	Recent similar projects.	Bathymetric surveys will be completed following completion of each removal grid to identify need for additional dredging prior to dredge equipement downtime or demobilzation. Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day
Post-Removal Bathymetric Survey	Day	1	$ 4,025.00	$ 4,025.00	Recent similar projects.	Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day
Dewatering						
Scow Slurry Pump Operation	Day	26	$ 12,000.00	$ 312,000.00	Recent similar projects.	- Includes long reach excavator w/root rake and all labor, equipment and materials.
Sediment Screening Operation	Day	26	$ 2,800.00	$ 72,800.00	Recent similar projects.	- Includes screening plant, slurry pump, electrical connections, open top mix tank and all labor and equipment to operate.
Polymer Injections and Geotube Operations	Day	26	$ 6,700.00	$ 174,200.00	Recent similar projects.	- Includes polymer injection equipment, electrical connections and labor
Geotubes	Linear Feet	2,489	$ 75.00	$ 186,675.00	Recent similar projects.	- Includes cost for purchase/delivery and 15% loss of 75 ft circumference geotubes
Polymer	Pound	29,497	$ 2.00	$ 58,994.00	Recent similar projects.	- Includes cost for purchase/delivery and 15% loss of polymer at 3lb/dry ton
Solidification						
Sediment Solidification	Ton	955	$ 275.00	$ 262,515.00	Recent similar projects.	- Assumes 5% by weight portland cement. Includes purchase/delivery of portland cement, equipment mobilization/demobilization, labor, and equipment
Sediment Transportation and Disposal						
Loading	Ton	20,047	$ 4.50	$ 90,209.70	Recent similar projects.	- Includes front end loader and excavator.
Waste Characterization Sampling	Each	13	$ 76.70	$ 997.10	Navy CLEAN Laboratory BOA Rates	- Assumes 1 sample per barge (approx. 1000 yds^3) for analysis of TPH and paint filter test. - Includes volume of sediment and portland cement.
Transport to Landfill	Ton	20,047	$ 9.00	$ 180,419.40	Per quote from Waste Management Bethel Landfill	- Tonnage includes portland cement
Disposal @ Subtitle D Landfill	Ton	20,047	$ 20.00	$ 400,932.00	Per quote from Waste Management Bethel Landfill	- Tonnage includes portland cement
Disposal @ Subtitle D Landfill (debris)	Ton	12	$ 50.00	$ 600.00	Per quote from Waste Management Bethel Landfill	- Tonnage based on recent similar projects
Decontamination Water Transportation and Disposal						
Dredge, Scows, & Equipment Decontamination	Lump Sum	1	$ 10,000.00	$ 10,000.00	Recent similar projects.	- Assumes decontamination will be performed onsite within a scow and water will be containerized and sampled for offsite transportation and disposal. Includes decontamination of all dredging and solidification equipment including scows.
Waste Characterization Sampling	Each	2	$ 864.04	$ 1,728.08	Navy CLEAN Laboratory BOA Rates	- Assumes 1 sample per load for analysis of full TCLP, Ignitability, Corrosivity (pH), TPH, Reactivity (cyanide and sulfide).
Transport to Disposal Facility	Load	2	$ 665.00	$ 1,330.00	Per quote from Summit Environmental.	- Includes 5,000 gallon vacuum tanker and transferring water from scow to vacuum tanker.
Disposal @ Soilex Facility, Suffolk, VA	Gallon	10,000	$ 0.25	$ 2,500.00	Per quote from Summit Environmental.	- Includes water for barge cleaning performed after dredging is complete
Solids Surcharge	Gallon	500	$ 0.70	$ 350.00	Per quote from Summit Environmental	- Assume 5% of decon water volume.
Site Restoration/Demoboilization						
Geotube Dewatering System						
Demobilization	Lump Sum	1	$ 50,000.00	$ 50,000.00	Recent similar projects.	Includes: - Grading/seeding of dewatering area - Decontamination of the screening plant, polymer injection, and modutank - Dismantling/demobilization of modutank
Sand Layer Placement						
Mobilization/Demobilization	Lump Sum	1	$ 20,000.00	$ 20,000.00	Recent similar projects.	- Includes mobilization and demobilization of sand spreader (barge and long reach excavator)
Well Graded Sand (Washed Sand 100+)	Ton	7,995	$ 20.00	$ 159,900.00	Recent similar projects.	- Includes cost for purchase/delivery and 15% loss
Placement of Well Graded Sand	Cubic Yard	4,854	$ 12.00	$ 58,248.00	Recent similar projects.	- Includes use of sand spreader (barge and long reach excavator)
Site Survey						
Final Bathymetric Survey	Day	1	$ 4,025.00	$ 4,025.00	Recent similar projects.	Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day
Subtotal				***$2,801,142***		
Contingency (15%)				$420,171		
General Conditions (10%)				$280,114		
Subtotal				***$3,501,427***		
Performance Bond (2%)				$70,029		Industry Average
Subtotal				***$3,571,456***		
Design Costs (8%)				$285,716		Includes Closeout Reports
Construction Oversight (8%)				$285,716		
TOTAL CAPITAL COST				**$4,142,900**	**+50% $6,214,400** **-30% $2,900,100**	

Notes

1. Base costs used are 2012 dollars.

2. For the bathymetric survey the dredge subcontractor will be responsible for coordinating with the surveyor to insure schedule efficiency. Navy will not be responsible for dredging delay due to surveyor. Survey will occur immediately after dredging is complete. Dredger will not leave dredging area until survey is confirmed.

3. Assumes that 90% of the free dredge water from the scows will be removed before turnover of the scows to the offloading contractor.

4. The enclosed Engineer's Estimate is only an estimate of possible construction costs for budgeting purposes. This estimate is limited to the conditions existing at its issuance and is not a guarantee of actual price or cost. Uncertain market conditions such as, but not limited to: local labor or contractor availability, wages, other work, material market fluctuations, price escalations, force majeure events, and developing bidding conditions etc may affect the accuracy of this estimate. CH2M Hill is not responsible for any variance from this estimate or actual prices and conditions obtained.

Appendix C
SiteWise Evaluation

APPENDIX C

Sustainability Analysis for Solid Waste Management Unit 3 Pier 10 Sandblast Yard

Introduction

This appendix presents the approach taken and results obtained from a sustainability analysis that was completed for Solid Waste Management Unit (SWMU) 3 Pier 10 Sandblast Yard at Joint Expeditionary Base Little Creek in Virginia Beach, Virginia.

Alternatives are presented to address SWMU 3 contaminants of concern (COCs) in sediment surrounding the dry dock and anchoring system at the Pier 10 Sandblast Yard. A detailed summary of the removal action alternatives is provided in Section 4 of the SWMU 3 Evaluation/Cost Analysis (EE/CA). A sustainability analysis was performed by CH2M HILL using SiteWise™ Version 2.0 (Battelle, 2011) for the following remedial alternatives:

- Alternative 1 - No Action; and
- Alternative 2 – Mechanical dredging, offsite solidification, upland disposal, and enhanced natural recovery
- Alternative 3 – Mechanical dredging, onsite solidification, upland disposal, and enhanced natural recovery
- Alternative 4 – Mechanical dredging, onsite passive dewatering via geotube, upland disposal, and enhanced natural recovery

Method and Assumptions

The SiteWise™ tool (Battelle, 2011) consists of a series of Excel-based spreadsheets used to conduct a baseline assessment of sustainability metrics. The assessment is carried out using a spreadsheet-based building block approach, where every removal action alternative is first broken down into modules that mirror the phases of remedial action work, specifically: remedial investigation (RI), remedial action construction (RAC), remedial action operation (RAO), and long-term monitoring (LTM).

SiteWise™ uses various emission factors from governmental or non-governmental research sources to determine the environmental impact of each activity. The quantitative metrics calculated by the tool include:

1) Greenhouse gases (GHGs) reported as carbon dioxide equivalents (CO_2e), consisting of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O)
2) Energy usage (expressed as British Thermal Units [BTU])
3) Water usage (gallons of water)
4) Air emissions of criteria pollutants consisting of nitrogen oxides (NO_x), sulfur oxides (SO_x), and particulate matter (PM_{10})
5) Accident risk (risk of injury and risk of fatality)

For the purpose of this discussion the term footprint will be used to describe the quantified emissions or quantities for each metric. To estimate the sustainability footprint for each removal action alternative, only those elements of the RI, RAC, RAO, and LTM possessing important sustainability elements were included in the assessment. The No Action alternative (Alternative 1) is not analyzed because there are no impacts to environmental and social metrics. SiteWise™ uses a “cradle to grave” approach to quantify footprints. As a result some activities, such as material production, incorporate environmental burdens that do not directly occur onsite, but contribute to the overall footprints of the remedial alternative. This is particularly true in the case of GHGs which contribute on a global, long-term scale.

The major conclusions of this sustainability analysis are incorporated into the effectiveness criteria evaluation of the EE/CA report.

Detailed assumptions for removal action alternatives are provided in **Table C-1**. The following is a description of the major activities for Alternative 2. All activities for this alternative are covered under the RAC.

- RI: No actions for any alternatives.
- RAC:
  - Alternative 2 involves the dredging of 2 feet, with an additional 1-foot over-dredge, from a 2.6 acre area to 3 feet (12,728 cubic yard [cy]) and placement of a 6- to 12-inch clean sand layer. Dredge sediment will be stabilized using Portland cement for offsite disposal. This alternative includes the handling of backfill material and the transportation of personnel, materials, and equipment to site. Equipment use, labor hours onsite, water use, and offsite disposal of residual waste are also included.
  - Alternative 3 involves the dredging of 2 feet, with an additional 1-foot over-dredge, from a 2.6 acre area to 3 feet (12,728 cy) and placement of a 6- to 12-inch clean sand layer. Dredge sediment will be stabilized onsite using Portland cement for offsite disposal. This alternative includes the handling of backfill material and the transportation of personnel, materials, and equipment to site. Equipment use, labor hours onsite, water use, and offsite disposal of residual waste are also included.
  - Alternative 4 involves the dredging of 2 feet, with an additional 1-foot over-dredge, from a 2.6 acre area to 3 feet (12,728 cy) and placement of a 6- to 12-inch clean sand layer. Dredged sediment will be placed in geotextile tubes onsite for passive dewatering and stabilized onsite using Portland cement for offsite disposal. This alternative includes the handling of backfill material and the transportation of personnel, materials, and equipment to site. Equipment use, labor hours onsite, water use, and offsite disposal of residual waste are also included.
- RAO: No actions for any alternatives.
- LTM: No actions for any alternatives.

General Assumptions

The specific assumptions made for the individual remedies are presented in **Tables C-1** through **C-3**. The following overall assumptions are used for the SiteWise™ tool evaluation:

- The distances per trip for materials shipped onsite and investigate-derived waste (IDW) shipped offsite were included at full weight going one way and empty weight going one way.
- The complete environmental footprint for production of equipment used, or production of the vehicles used for transportation, is not considered in this analysis. This equipment is reusable and the burden of these removal actions in the duration of the equipments life is negligible.
- The transportation of the Portland cement, sand, and Geotube materials was captured using the EQUIPMENT TRANSPORTATION section.
- The following average distances traveled were used unless specific distances were known:
  - Oversight– 100 miles roundtrip (local workers)
  - Surveying – 100 miles roundtrip (local contractor)
  - Operators/Laborers –100 miles roundtrip (local workers)
  - Portland cement – 50 miles roundtrip
  - Sand - 50 miles roundtrip
  - Earthmoving Equipment – 50 miles roundtrip (by land)
- Sand weighs approximately 1.4 tons/cy
- Sediment weighs approximately 1.5 tons/cy

Results and Conclusions

It should be noted that while this analysis quantifies the overall footprint of the alternatives, the alternatives provide different end-uses. Therefore, a comparison of the results of the alternatives needs to be made in the context of the benefits (e.g., applicable or relevant and appropriate requirement [ARAR] compliance, contaminant reduction, cost effectiveness, etc.) of each of the alternatives. The overall comparison of alternatives is shown on **Figure C-1** and in **Table C-4**. Alternatives 2 and 3 had similarly high GHG and total energy footprints, primarily from production of Portland cement used for solidification. The footprints for the remaining impact categories (NO_X, SO_X, water, PM_{10} and accident risks) were similar between the three active alternatives. Alternative 4 had a slightly lower PM_{10} footprint and Alternative 2 had a slightly lower accident risk fatality footprint. Alternative 4 had the highest water and SO_X footprints from operating the compressor for the turbidity curtain longer than Alternatives 2 and 3. Alternative 4 also had the highest accident risk footprints primarily due to the higher number of onsite labor hours.

- Alternative 1— No Action

  This Alternative has no sustainability impacts because no action occurs; however, this alternative does not meet removal goals.

- Alternative 2 – Mechanical dredging, offsite solidification, upland disposal, and sand layer placement

  The production of the Portland cement accounted for the majority of the GHG and total energy-use footprints. Transportation of equipment and residual handling also contributed to these footprints. The water consumption footprint is primarily from electricity used to power the compressor for the turbidity curtain (cooling water at the power plant). SO_X, NO_X, and PM_{10} footprints were also primarily from electricity to power the compressor. Personnel, equipment, and waste transportation and onsite labor hours contributed to the accident risk fatality and injury footprints. Results are provided in **Table C-5** and **Figure C-2**.

- Alternative 3 – Mechanical dredging, onsite solidification, upland disposal, and enhanced natural recovery

  Like Alternative 2, the majority of GHG and total energy use footprints were from production of Portland cement. Also like Alternative 2, electricity use to power the turbidity curtain accounted for the majority of the water, NO_X, SO_x, and PM_{10} footprints. Transportation of waste contributed to a larger portion of the accident risk fatality than Alternative 2 because of the longer distance to the landfill than Alternative 2. Results are provided in **Table C-6** and **Figure C-3**.

- Alternative 4 – Mechanical dredging, onsite passive dewatering via geotube, upland disposal, and enhanced natural recovery

  Since 50 percent less Portland cement is used in Alternative 4, the GHG and total energy footprints are significantly lower even when accounting for the production of geotubes. Alternative 4 also had lower NO_X and PM_{10} footprints than the other active alternatives. The water, SO_X, and accident risk footprints are highest for Alternative 4 primarily because of the longer duration of the field work (running the compressor longer and more hours worked). Water, NO_X, SO_X, and PM_{10} impacts are primarily from electricity powering the compressor. Transportation of waste and equipment, and onsite labor hours accounted for the accident risk footprints. Results are provided in **Table C-7** and **Figure C-4**.

Uncertainty Assessment

The SiteWise™ tool estimates environmental and risk footprints based on industry averages, published emissions factors, and generalized data sources. The footprint results are not representative of actual emissions and should be used for comparative purposes only.

High density polyethylene (HDPE) liner was used as a proxy for the geotextile material used for the Geotubes.

Recommendations

The estimates from the SiteWise™ tool were used to estimate the environmental footprint of the alternatives. Once the alternative is selected, it is recommended the footprint of the selected alternative be further evaluated in the design/work planning phase of the project to explore opportunities to optimize the environmental footprint of the project and integrate sustainable remediation best practices in the design, construction, and operation of the alternative.

References

Battelle. 2011. *SiteWise™ Version 2 User Guide*. NAVFAC Engineering Service Center, UG-2092-ENV. June.

TABLE C-1

Alternative 2 - Mechanical Dredging, Offsite Stabilization, Upland Disposal, and Enhanced Natural Recovery

SWMU 3 EE/CA

JEB Little Creek, Virginia

Assumptions:

Sand weighs 1.4 tons/cy

Sediment weighs 1.5 tons/cy

Total volume of sediment removed is 12,728 cy

SITEWISE TAB	Assumptions
Remedial Investigation	No Actions
Remedial Action Construction	mechanical dredging, upland disposal, and clean sand layer placement
Material Production	Sand, 4,854 cy x 1.4 ton/cy = 6,800 tons (13,600,000 lbs)
	Portland Cement, 2,272 tons (4,544,000 lbs)
Personnel Transportation - Road	Oversight (PM, QA/QC, and H&S),100 miles r/t, 3 people
	1 operator,100 miles r/t
	3 laborers, 100 miles r/t
	Surveyors, 2 people, 1 truck,100 miles r/t
Equipment Transportation - Road	(2) Excavators, 50 miles r/t, 30 tons
	Transport 2,272 tons of portland cement, 25 miles empty, 25 miles full, 57 trips (1,425 miles full/empty), 40 tons full load
	Transport 6,800 tons of sand, local supplier, 25 miles empty, 25 miles full, 170 trips (4,250 miles full/empty) with 40 tons full
Equipment Transportation - Water	Transport 19,100 tons dredged/dewatered soil 80 miles, full only
Equipment Use	Excavator moving sediment from scow to trucks for disposal, 12,728 cy
	Excavator mixing portland cement into dredged sediment, 12,728 cy
	Excavator moving sand from truck to water, 4,854 cy
Equipment use - Pump	Turbidity curtain: 275 hp compressor running 5 hrs/day for 35 days (175 hrs)
Residual Handling/Fill Material Transport	21,001 tons of sediment (includes portland cement) transported by truck, 12 miles full and 12 miles empty, (525 trips of 40 tons full)
	5,000 gallons of rinse water, transported by truck, 90 miles full and 90 miles empty, 1 trips of 21 tons full
Labor Hours Onsite	3,156 hrs (4 laborers/operators, 3 Oversight crew, 12 hrs/day, 35 days=2,940 hours) (2 surveyors, 12 hrs/day, 9 days = 216 hours)
Water Consumption	5,000 gallons for decon
Remedial Action Operations	No Actions
Longterm Monitoring	No Actions

Notes:

r/t = round trip

ft = feet

hrs = hours

cy = cubic yards

TABLE C-2

Alternative 3 - Mechanical Dredging, Onsite Solidification, Upland Disposal, and Enhanced Natural Recovery

SWMU 3 EE/CA

JEB Little Creek, Virginia

Assumptions:

Sand weighs 1.4 tons/cy | Sediment weighs 1.5 tons/cy

Total volume of sediment removed is 12,728 cy

SITEWISE TAB	Assumptions
Remedial Investigation	No Actions
Remedial Action Construction	mechanical dredging, onsite solidification, upland disposal, and clean sand placement
Material Production	Sand, 4,854 cy x 1.4 ton/cy = 6,800 tons (13,600,000 lbs)
	Portland Cement, 2,272 tons (4,544,000 lbs)
Personnel Transportation - Road	Oversight (PM, QA/QC, and H&S),100 miles r/t, 3 people
	1 operator,100 miles r/t
	3 laborers, 100 miles r/t
	Surveyors, 2 people, 1 truck,100 miles r/t
Equipment Transportation - Road	(2) Excavators, 50 miles r/t, 30 tons
	Transport 2,272 tons of portland cement, 25 miles empty, 25 miles full, 57 trips (1,425 miles full/empty), 40 tons full load
	Transport 6,800 tons of sand, local supplier, 25 miles empty, 25 miles full, 170 trips (4,250 miles full/empty) with 40 tons full
Equipment Use	Excavator moving sediment from scow to trucks for disposal, 12,728 cy
	Excavator mixing portland cement into dredged sediment, 12,728 cy
	Excavator moving sand to water, 4,854 cy
Equipment use - Pump	Turbidity curtain: 275 hp compressor running 5 hrs/day for 35 days (175 hrs)
Residual Handling/Fill Material Transport	21,001 tons of sediment (includes portland cement) transported by truck, 30 miles full and 30 miles empty, (525 trips of 40 tons full)
Labor Hours Onsite	3,156 hrs (4 laborers/operators, 3 Oversight crew, 12 hrs/day, 35 days=2,940 hours) (2 surveyors, 12 hrs/day, 9 days = 216 hours)
Resource Consumption - Water use	5,000 gallons for decon, disposed of onsite
Remedial Action Operations	No Actions
Longterm Monitoring	No Actions

Notes:

r/t = round trip | ft = feet

hrs = hours | cy = cubic yards

TABLE C-3

Alternative 4 - Mechanical Dredging, Onsite Passive Dewatering, Upland Disposal, and Enhanced Natural Recovery

SWMU 3 EE/CA

JEB Little Creek, Virginia

Assumptions:

Sand weighs 1.4 tons/cy — Sediment weighs 1.5 tons/cy

Total volume of sediment removed is 12,728 cy

SITEWISE TAB	Assumptions
Remedial Investigation	No Actions
Remedial Action Construction	mechanical dredging, onsite passive dewatering, upland disposal, and clean sand layer placement
Material Production	Sand, 4,854 cy x 1.4 ton/cy = 6,800 tons (13,600,000 lbs)
	Portland Cement, 955 tons (1,910,000 lbs)
	Geotube material (proxy 10 mil HDPE liner for the geotextile material) area of material = 20,542 square yards (185,000 square ft) (2,465 ft of 75 ft circumference geotubes)
Personnel Transportation - Road	Oversight (PM, QA/QC, and H&S),100 miles r/t, 3 people
	1 operator,100 miles r/t
	3 laborers, 100 miles r/t
	Surveyors, 2 people, 1 truck,100 miles r/t
Equipment Transportation - Road	(2) Excavators, 50 miles r/t, 30 tons
	Geotube materials = weight approximately 33 ounce per square yard (manufacturer specifications) = 20,542 x 33 oz /16 oz/lb = 38,500 lb or 19.25 tons, transported 500 miles from GA
	Transport 955 tons of portland cement, 25 miles empty, 25 miles full, 24 trips (1,425 miles full/empty), 40 tons full load
	Transport 6,800 tons of sand, local supplier, 25 miles empty, 25 miles full, 170 trips (4,250 miles full/empty) with 40 tons full
Equipment Use	Excavator moving sediment from geotube to trucks for disposal, 12,728 cy
	Excavator mixing portland cement into dredged sediment, 12,728 cy
	Excavator moving sand to water, 4,854 cy
Equipment use - Pump	275 hp compressor running 5 hs/day for 50 days (250 hrs)
Residual Handling/Fill Material Transport	20,047 tons of sediment (includes portland cement) transported by truck, 30 miles full and 30 miles empty, (478 trips of 40 tons full)
Labor Hours Onsite	4,416 hrs (4 laborers/operators, 3 Oversight crew, 12 hrs/day, 50 days=4,200 hours) (2 surveyors, 12 hrs/day, 9 days = 216 hours)
Resource Consumption - Water use	5,000 gallons for decon, disposed of onsite
Remedial Action Operations	No Actions
Longterm Monitoring	No Actions

Notes:

r/t = round trip — ft = feet

hrs = hours — cy = cubic yards

TABLE C-4

Relative Impact of Alternatives

SWMU 3 EE/CA

JEB Little Creek, Virginia

Remedial Alternatives	GHG Emissions	Total energy Used	Water Used	NO_x emissions	SO_x Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
	metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Alternative 1- No Action	0	0	0	0	0	0	0	0
Alternative 2 - Mechanical dredging, offsite solidification, upland disposal, and enhanced natural recovery	1.91E+03	1.16E+04	2.33E+04	1.81E-01	1.30E-01	1.13E-02	4.89E-04	9.09E-02
Alternative 3 - Mechanical dredging, onsite solidification, upland disposal, and enhanced natural recovery	1.88E+03	1.15E+04	2.33E+04	1.94E-01	1.30E-01	1.24E-02	6.22E-04	1.02E-01
Alternative 4 - Mechanical dredging, onsite passive dewatering via Geotube, upland disposal, and enhanced natural recovery	1.71E+02	2.87E+03	3.11E+04	1.42E-01	1.57E-01	8.01E-03	7.18E-04	1.28E-01

Remedial Alternatives	GHG Emissions	Total energy Used	Water Used	NO_x emissions	SO_x Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
	metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Alternative 1- No Action	Low	Low	Low	Low	Low	Low	Low	Low
Alternative 2 - Mechanical dredging, offsite solidification, upland disposal, and enhanced natural recovery	High	High	High	High	High	High	Medium	High
Alternative 3 - Mechanical dredging, onsite solidification, upland disposal, and enhanced natural recovery	High	High	High	High	High	High	High	High
Alternative 4 - Mechanical dredging, onsite passive dewatering via Geotube, upland disposal, and enhanced natural recovery	Low	Low	High	High	High	Medium	High	High

The relative impact is a qualitative assessment of the relative footprint of each alternative, a rating of High for an alternative is assigned if it is at least 70 percent of the maximum footprint, a rating of Medium is assigned if it is between 30 and 70 percent of the maximum footprint, and a rating of Low is assigned if it is less than 30 percent of the maximum footprint.

Notes:

MMBTU - million British Thermal Unit

NOx - Nitrogen Oxides

SOx - Sulfur Oxides

PM10 - Particulate Matter

GHG - Greenhouse Gases

TABLE C-5

SiteWise Results Alternative 2 - Mechanical Dredging, Offsite Stabilization, Upland Disposal, and Clean Layer Placement

SWMU 3 EE/CA

JEB Little Creek, Virginia

Phase	Activities	GHG Emissions	Total Energy Used	Water Used	NO_x Emissions	SO_x Emissions	PM_{10} Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Action Construction	Consumables	1.74E+03	9.57E+03	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	2.29E-01	2.88E+00	NA	8.46E-05	2.98E-06	1.72E-05	7.02E-06	5.65E-04
	Transportation-Equipment	1.00E+02	9.79E+02	NA	8.20E-03	1.45E-04	7.29E-04	8.93E-05	7.19E-03
	Equipment Use and Misc	4.20E+01	7.43E+02	2.33E+04	1.65E-01	1.30E-01	9.82E-03	3.02E-04	7.59E-02
	Residual Handling	2.64E+01	3.45E+02	NA	8.31E-03	1.47E-04	7.39E-04	9.09E-05	7.31E-03
	Sub-Total	1.91E+03	1.16E+04	2.33E+04	1.81E-01	1.30E-01	1.13E-02	4.89E-04	9.09E-02
Total		**1.91E+03**	**1.16E+04**	**2.33E+04**	**1.81E-01**	**1.30E-01**	**1.13E-02**	**4.89E-04**	**9.09E-02**

Notes:

MMBTU - million British Thermal Unit

NOx - Nitrogen Oxides

SOx - Sulfur Oxides

PM10 - Particulate Matter

NA - Not Applicable

GHG - Greenhouse Gases

TABLE C-6

SiteWise Results Alternative 3 - Mechanical Dredging, Onsite Solidification, Upland Disposal, and Enhanced Natural Recovery

SWMU 3 EE/CA

JEB Little Creek, Virginia

Phase	Activities	GHG Emissions	Total Energy Used	Water Used	NO_x Emissions	SO_x Emissions	PM_{10} Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Action Construction	Consumables	1.74E+03	9.57E+03	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	2.29E-01	2.88E+00	NA	8.46E-05	2.98E-06	1.72E-05	7.02E-06	5.65E-04
	Transportation-Equipment	2.61E+01	3.41E+02	NA	8.20E-03	1.45E-04	7.29E-04	8.93E-05	7.19E-03
	Equipment Use and Misc	4.20E+01	7.43E+02	2.33E+04	1.65E-01	1.30E-01	9.82E-03	3.02E-04	7.59E-02
	Residual Handling	6.53E+01	8.53E+02	NA	2.05E-02	3.63E-04	1.83E-03	2.24E-04	1.80E-02
	Sub-Total	1.88E+03	1.15E+04	2.33E+04	1.94E-01	1.30E-01	1.24E-02	6.22E-04	1.02E-01
Total		**1.88E+03**	**1.15E+04**	**2.33E+04**	**1.94E-01**	**1.30E-01**	**1.24E-02**	**6.22E-04**	**1.02E-01**

Notes:

MMBTU - million British Thermal Unit

NOx - Nitrogen Oxides

SOx - Sulfur Oxides

PM10 - Particulate Matter

NA - Not Applicable

GHG - Greenhouse Gases

TABLE C-7

SiteWise Results Alternative 4 - Mechanical Dredging, Onsite Passive Dewatering, Upland Disposal, and Enhanced Natural Recovery

SWMU 3 EE/CA

JEB Little Creek, Virginia

Phase	Activities	GHG Emissions	Total Energy Used	Water Used	NO_x Emissions	SO_x Emissions	PM_{10} Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Action Construction	Consumables	4.35E+01	9.99E+02	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	2.29E-01	2.88E+00	NA	8.46E-05	2.98E-06	1.72E-05	7.02E-06	5.65E-04
	Transportation-Equipment	2.13E+01	2.78E+02	NA	6.68E-03	1.18E-04	5.94E-04	7.49E-05	6.03E-03
	Equipment Use and Misc	4.08E+01	7.38E+02	3.11E+04	1.15E-01	1.56E-01	5.58E-03	4.12E-04	1.04E-01
	Residual Handling	6.53E+01	8.53E+02	NA	2.05E-02	3.63E-04	1.83E-03	2.24E-04	1.80E-02
	Sub-Total	1.71E+02	2.87E+03	3.11E+04	1.42E-01	1.57E-01	8.01E-03	7.18E-04	1.28E-01
Total		**1.71E+02**	**2.87E+03**	**3.11E+04**	**1.42E-01**	**1.57E-01**	**8.01E-03**	**7.18E-04**	**1.28E-01**

Notes:

MMBTU - million British Thermal Unit

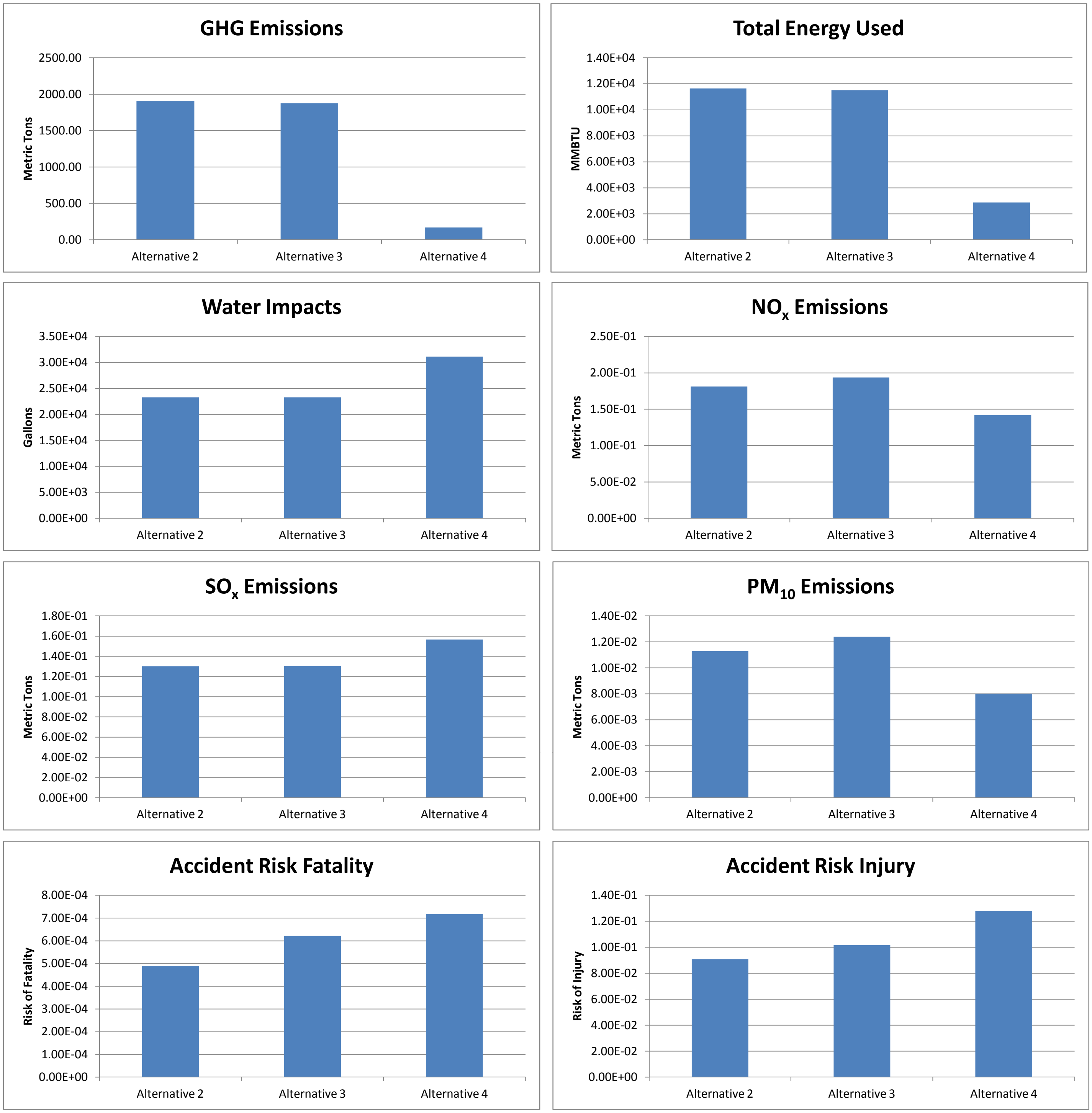
NOx - Nitrogen Oxides

SOx - Sulfur Oxides

PM10 - Particulate Matter

NA - Not Applicable

GHG - Greenhouse Gases



Notes:

Alternative 2 - Mechanical dredging, offsite solidification, upland disposal, and enhanced natural recovery

Alternative 3 - Mechanical dredging, onsite solidification, upland disposal, and enhanced natural recovery

Alternative 4 - Mechanical dredging, onsite passive dewatering via geotube, upland disposal, and enhanced natural recovery

Figure C-1
Overall Summary
SWMU 3 EE/CA
JEB Little Creek
Virginia Beach, Virginia

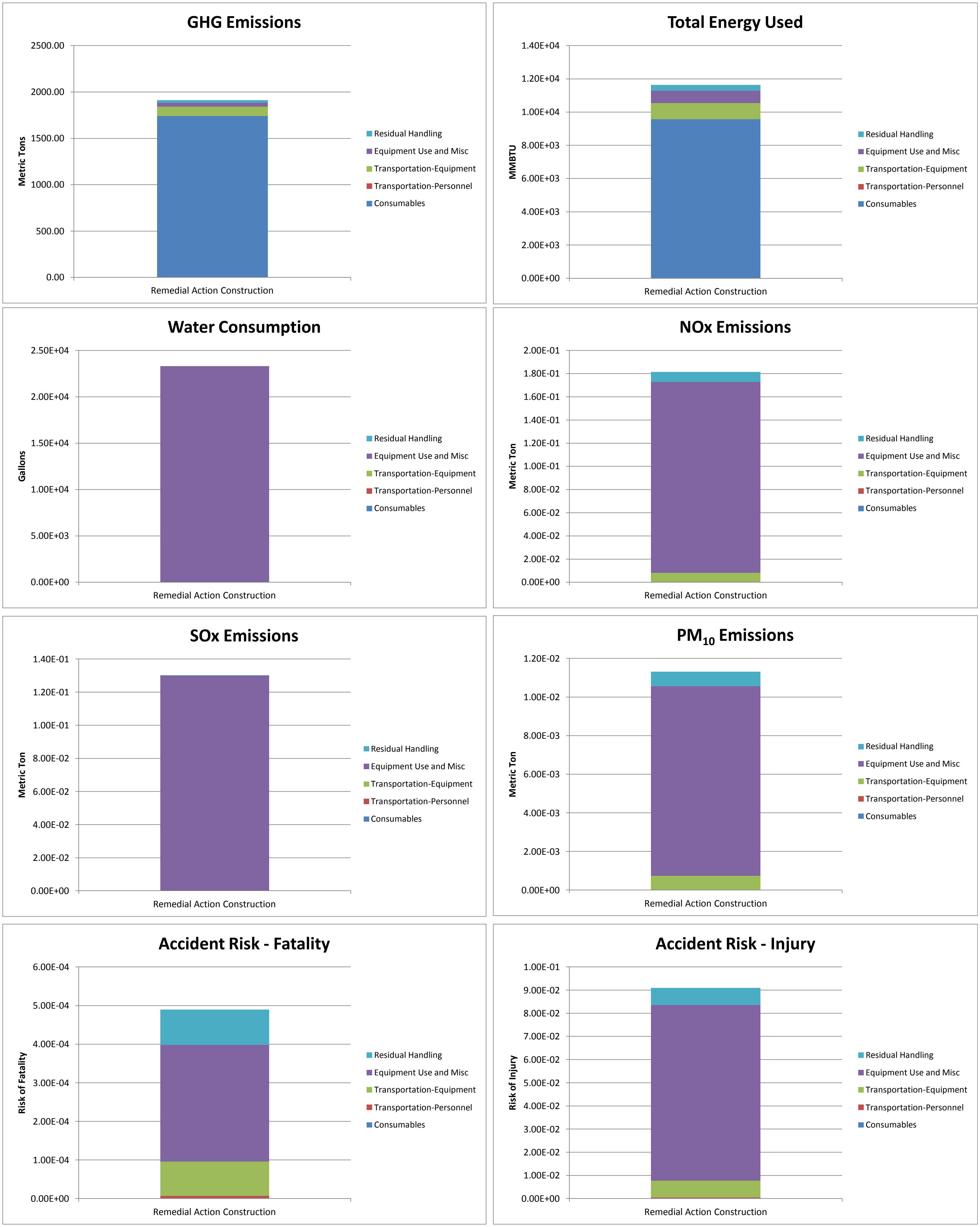


Figure C-2
Alternative 2 - Mechanical dredging, offsite stabilization, upland disposal, and enhanced natural recovery
SWMU 3 EE/CA
JEB Little Creek
Virginia Beach, Virginia

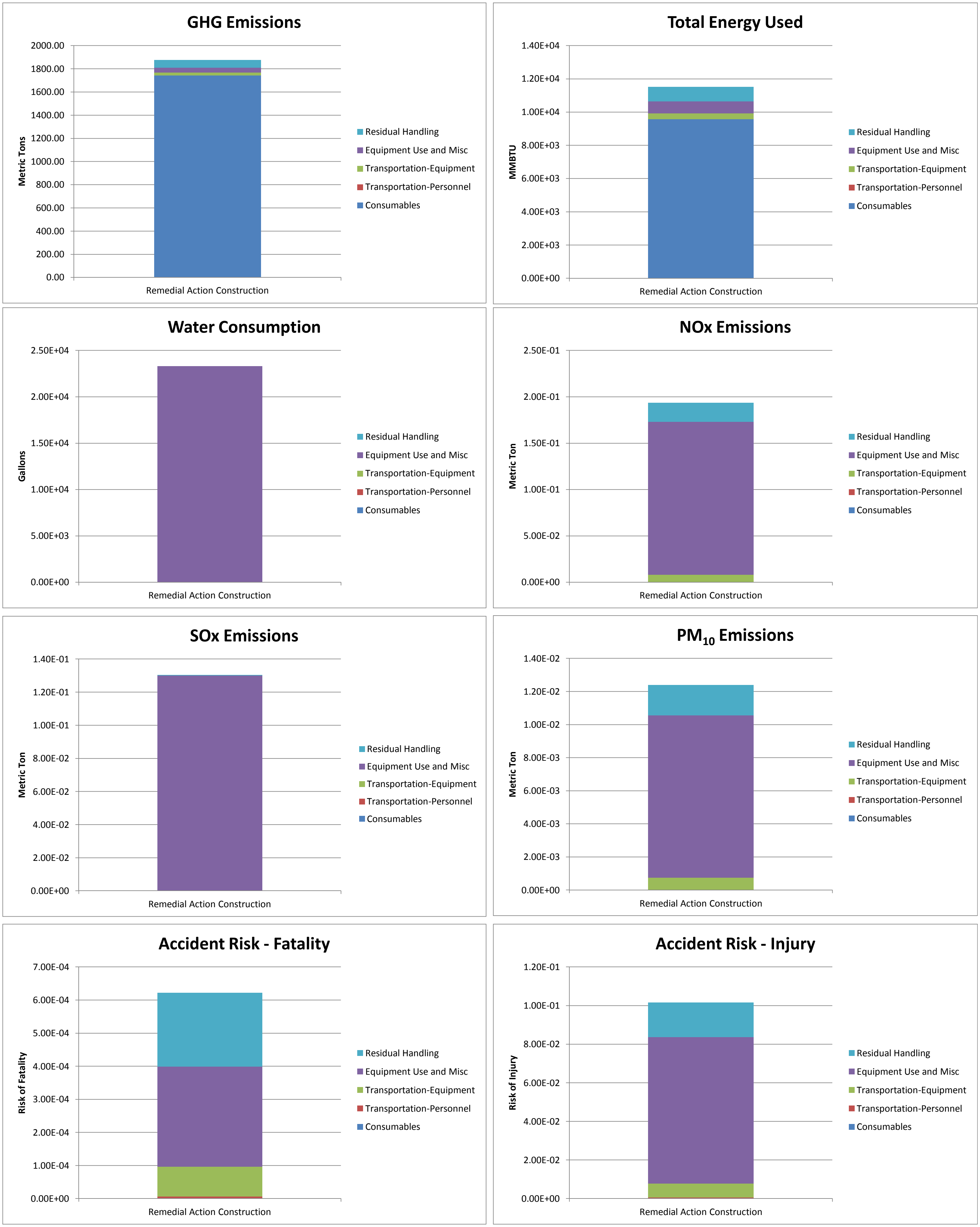


Figure C-3
Alternative 3 - Mechanical dredging, onsite solidification, upland disposal, and enhanced natural recovery
SWMU 3 EE/CA
JEB Little Creek
Virginia Beach, Virginia