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JEB LITTLE CREEK
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PROPOSED PLAN SOLID WASTE MANAGEMENT UNIT 3 (SWMU 3) PIER 10 SANDBLAST YARD JEB LITTLE CREEK VIRGINIA BEACH VA
10/01/2014
CH2M HILL

Proposed Plan

Solid Waste Management Unit 3 – Pier 10 Sandblast Yard

Joint Expeditionary Base Little Creek-Fort Story
Joint Expeditionary Base Little Creek
Virginia Beach, Virginia

October 2014

1 Introduction

This **Proposed Plan** identifies the Preferred Remedial Alternative for addressing contaminated **groundwater** at **Solid Waste Management Unit (SWMU)** 3, Pier 10 Sandblast Yard, at Joint Expeditionary Base (JEB) Little Creek, Virginia Beach, Virginia, herein referred to as SWMU 3. Previous removal actions have reduced risk from exposure to soil and sediment to acceptable levels; therefore, no further action to address these media is warranted. This Plan summarizes the remedial alternatives evaluated and provides the rationale for the selection of **Monitored Natural Attenuation** and **Land Use Controls** as the Preferred Alternative to effectively protect against potential future human exposure to groundwater at SWMU 3.

This Proposed Plan is issued jointly by the Navy, the lead agency for environmental restoration activities at JEB Little Creek-Fort Story, and the **United States Environmental Protection Agency (USEPA)** Region 3. The Navy and the USEPA, in consultation with the **Virginia Department of Environmental Quality (VDEQ),** the support agency, will select the final remedy for this site after reviewing and considering all information submitted during the 45-day **public comment period**. The Navy and USEPA, in consultation with VDEQ, may modify this Proposed Plan based on new information or public comments. Therefore, the public is encouraged to review and comment on this Proposed Plan.

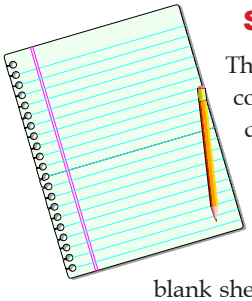
The Navy is issuing this Proposed Plan as part of its public participation responsibilities under Sections 113 (k)(2)(B), 117(a), 120(f), and 121 (f)(1)(G) of the **Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA**, also known as Superfund), as amended and Sections 300.430(f)(2) and 300.430(f)(3) of the **National Oil and Hazardous Substances Pollution Contingency Plan (NCP)** and in accordance with the **Federal Facility Agreement**, outlining the process by which the **Environmental Restoration Program (ERP)** is to be implemented at JEB Little Creek. This Proposed Plan summarizes information that can be found in greater detail in the reports of investigations that have been conducted at SWMU 3, including the **Remedial Investigation (RI)/Human Health Risk Assessment (HHRA)/Ecological Risk Assessment (ERA)** (CH2M HILL, 2005), the Supplemental Remedial Investigation (SRI) (CH2M HILL, 2009a), and the **Engineering Evaluation/Cost Analysis (EE/CA)** (CH2M HILL, 2012c), as well as other reports listed in Table 1. These reports are contained in the **Administrative Record (AR)** file for JEB Little Creek-Fort Story. A glossary of key terms, which are identified in bold print the first time they appear, is provided at the end of this Proposed Plan.

Please Mark Your Calendar for the Public Comment Period

Public Comment Period

October 25, 2014 – December 8, 2014

Submit Written Comments

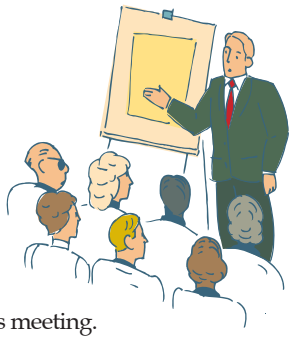


The Navy will accept written comments on this Proposed Plan during the public comment period. To submit comments or obtain further information, please refer to the names and contact information included at the end of Section 7. A blank sheet has been added at the end of the document to be used for writing comments.

Attend the Public Meeting

November 18, 2014
7:00 — 7:30 pm

Virginia Beach Central Library
Folio Conference Room
4100 Virginia Beach Boulevard
Virginia Beach, Virginia 23452



The Navy will hold a public meeting to explain the Proposed Plan. Verbal and written comments will be accepted at this meeting.

Administrative Record can be viewed here:

http://www.navfac.navy.mil/products_and_services/ev/products_and_services/env_restoration.html

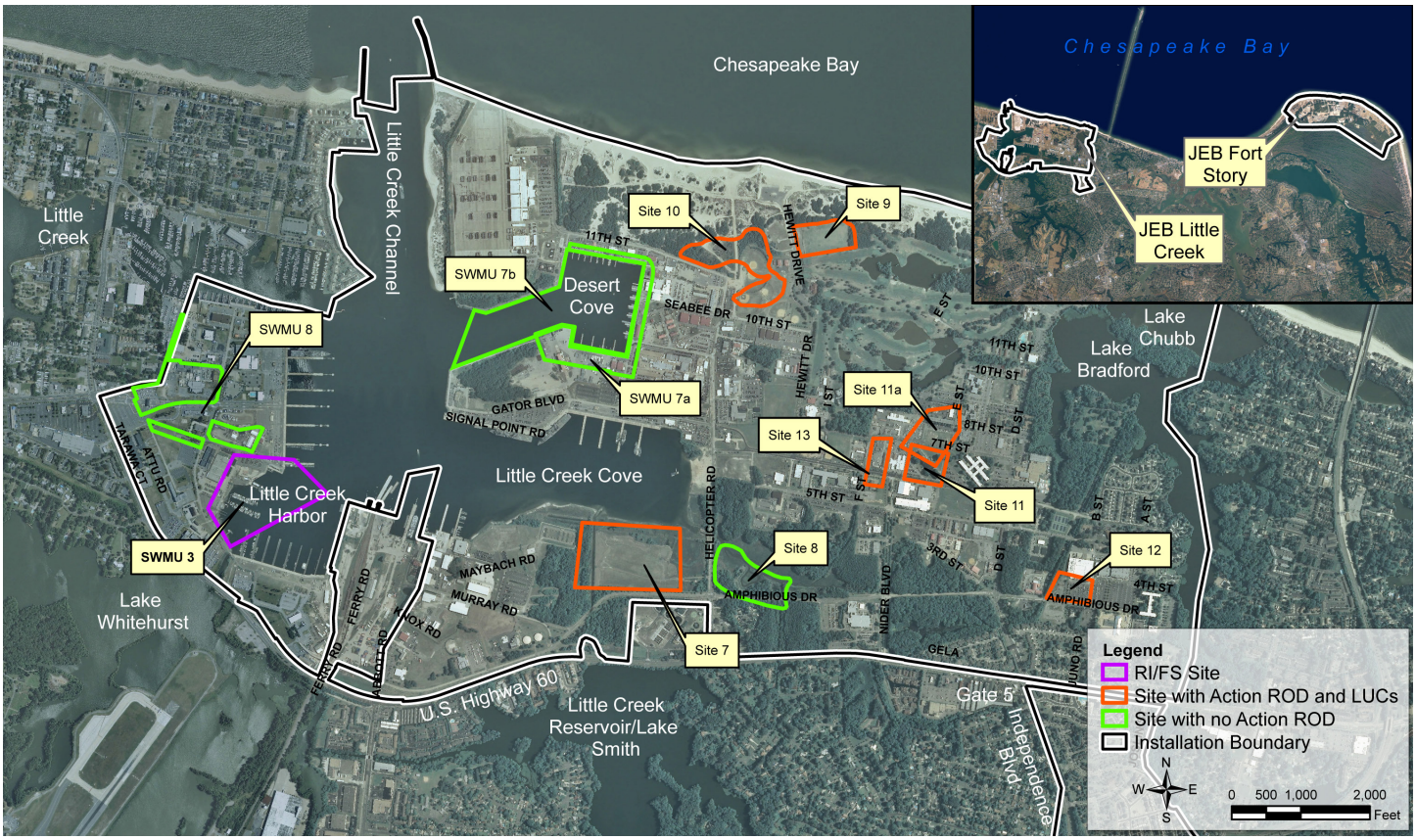


Figure 1 – SWMU 3 Location Map

2 Site Background

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 for the combined installation 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 ERPs. 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 as JEB Little Creek-Fort Story. For ERP documents, the Bases will be referred to separately as JEB Little Creek or JEB Fort Story. This Proposed Plan contains information associated with the ERP at JEB Little Creek.

The former NAB Little Creek was commissioned in 1945 to train landing-craft personnel for operational assignments. During the last 60 years, the facility has expanded in both area and the complexity of its mission.

JEB Little Creek consists of 2,215 acres located in the northwest corner of Virginia Beach, Virginia, adjacent to the Chesapeake Bay (Figure 1). The western boundary of JEB Little Creek borders the City of Norfolk, Virginia. JEB Little Creek is primarily an industrial facility that provides logistics and support services to 18 home-ported ships and 155 shore-based resident commands. The area surrounding the facility is low-lying and relatively flat. JEB Little Creek is bounded on the north by the Chesapeake Bay, on the west by residential communities and several marinas, on the south by Shore Drive, Lake Whitehurst, Little Creek Reservoir/Lake Smith, Norfolk International Airport, and residential development, and on the east by Lake Bradford.

2.1 Site Description and Background

SWMU 3, Pier 10 Sandblast Yard, is located in a developed area on Little Creek Harbor's western side (Figure 2). SWMU 3 was used for sandblasting boats between 1962 and 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 residual, used **abrasive blast material (ABM)** was periodically sampled, determined to be non-hazardous, and removed from the site. However, some residual ABM, consisting of 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 minimize 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

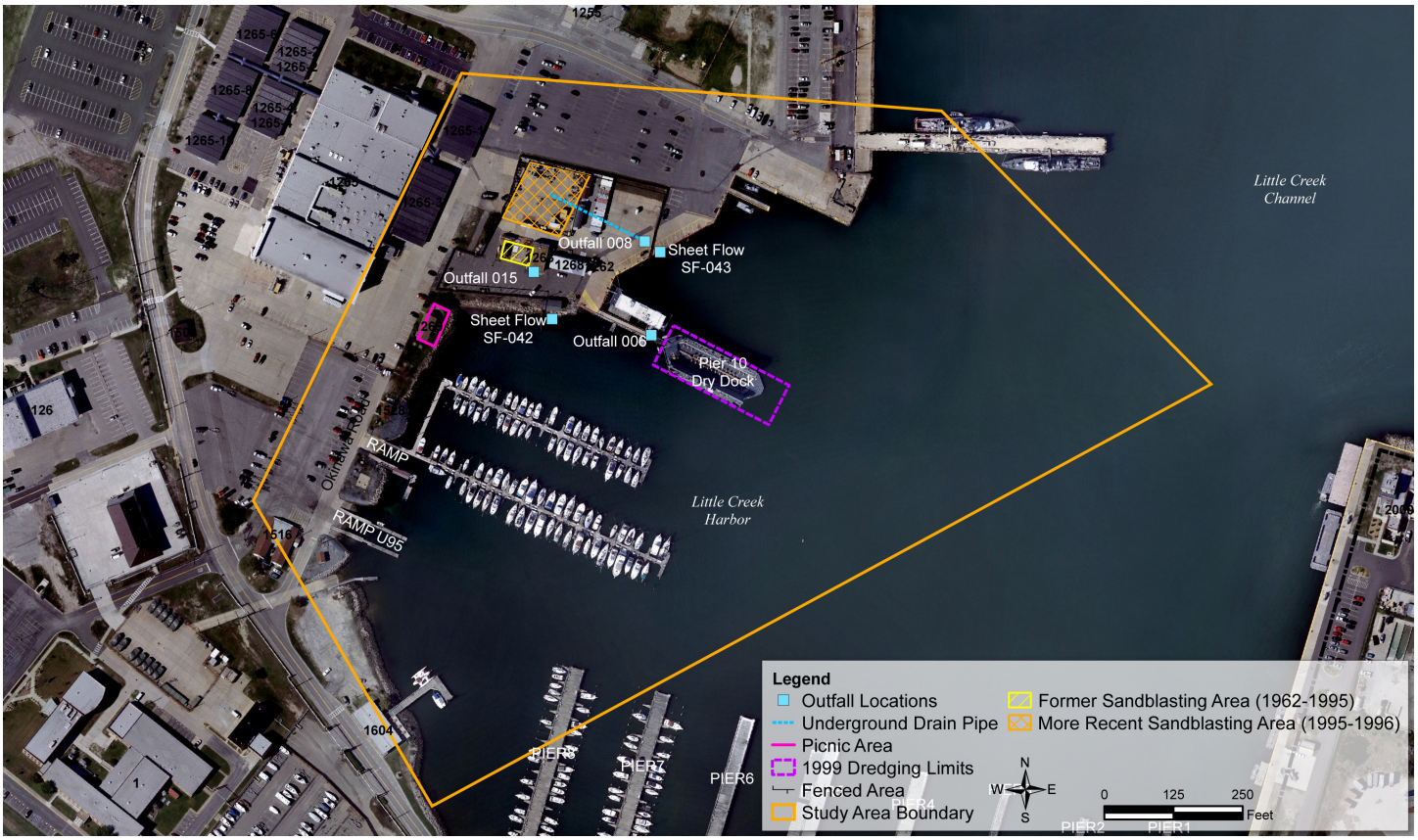


Figure 2 – SWMU 3 Boundary and Immediate Vicinity

by a 4- to 5-foot-high concrete wall. All sandblasting operations at SWMU 3 ceased in 1996 when a new indoor sandblasting facility, building CB125, was completed adjacent to SWMU 7b.

Historical releases from SWMU 3 likely occurred from the accumulation of sandblasting residue 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 Pollutant 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.

2.2 Summary of Investigations and Actions

Environmental investigation efforts were initiated at JEB Little Creek (former NAB Little Creek) under the Navy Assessment and Control of Installation Pollutants Program in 1984. SWMU 3 has been characterized under several investigations and studies between 1989 and 2014. Table 1 summarizes site-specific investigations, studies, actions and public participation activities.

Detailed information from previous investigations conducted at SWMU 3 is available in the AR file for JEB Little Creek. A complete list of the documents included in the AR files can be obtained from the JEB Little Creek Environmental Restoration web site (**http://www.navfac.navy.mil/products_and_services/ev/products_and_services/env_restoration.html**) or by contacting the **Naval Facilities Engineering Command (NAVFAC)** Mid-Atlantic Public Affairs Office at (757) 341-1410.

3 Site Characteristics

The SWMU 3 characteristics are depicted on Figure 3 as a **conceptual site model**. The terrestrial portion of SWMU 3 includes a fenced area containing Buildings 1263 and 1268, used as a repair shop and wood storage area, and two concrete pads formerly used for sandblasting operations. Within the fenced area, the ground surface is generally covered in concrete, asphalt, or gravel. Little to no vegetation covers unpaved areas. A small, grassy area is located outside the fence. The topography at SWMU 3 is relatively flat and gently slopes east/southeast towards Little Creek Harbor. A catch basin connected to VPDES-permitted Outfall 008 (Permit Number VA0079928), located under Pier 10 approximately 35 feet from its easternmost edge, conveys surface runoff from the site into Little Creek Harbor. Under the current VPDES permit, Outfall 008 is defined as a stormwater outfall and has no monitoring requirements. In addition to what is conveyed by the catch basin and outfall, a portion of the stormwater runoff from SWMU 3 flows directly into Little Creek Harbor as sheet flow.

Table 1 - Studies, Investigations, and Acivities Summary

Previous Study / Investigation	AR Document Number	Investigation Activities
Site Investigation (SI) (CH2M HILL, December 1999)	000355	**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. **Volatile organic compounds (VOCs)**, semivolatile organic compounds (SVOCs), and metals were detected in groundwater above human health **screening criteria**. **Polycyclic aromatic hydrocarbons (PAHs)** and metals were detected in soil and sediment above human health screening criteria. **Contaminants of potential concern (COPCs)** were identified for each medium. Additionally, abrasive blast material (ABM) was observed on the ground surface and in near-shore sediment. The SI recommended a Screening **Ecological Risk Assessment (ERA)** to identify potentially complete **exposure pathways** for **ecological receptors** and an RI to define the nature and extent of contamination.
Screening ERA (CH2M HILL, June 2000)	000417	A Screening ERA, 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 ecological screening criteria and the results of aquatic and terrestrial food web modeling, inorganic and organic COPCs were identified for each **medium**. The Screening ERA concluded that the potential for unacceptable ecological risk was 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 (CH2M HILL, January 2001)	001031	A Baseline ERA, constituting Step 3 of the ERA process, was completed using data collected as part of the SI. The Baseline ERA concluded that, although terrestrial habitat size and quality are limited at SWMU 3, concentrations of seven metals and one SVOC in surface soil exceeded ecological screening criteria and/or basewide **background** concentrations. These chemicals in soil may pose potentially unacceptable risks to plants or animals that are on the low end of the food chain (**lower-trophic-level receptors**). Only zinc was identified as posing a potential unacceptable risk to animals higher on the food chain (**upper-trophic-level receptors**) exposed to site soil. Potentially unacceptable risks to lower-trophic-level receptors were identified associated with exposure to eight metals, five PAHs, and one SVOC in sediment; however, potential risks to upper-trophic-level aquatic receptors were low.
Remedial Investigation (RI)/ HHRA/ERA (CH2M HILL, August 2005)	000911	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 residential risk screening criteria and were determined to require further action. Potentially unacceptable risks associated with future potable use of groundwater were identified as a result of VOCs and metals. SVOCs and metals were detected in surface water, but the concentrations did not pose potentially unacceptable risks 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.
Supplemental RI (SRI)/ HHRA/ ERA (CH2M HILL, August 2009a)	000222	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 not to be related to former sandblasting activities at SWMU 3 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 soil source for VOCs in groundwater was identified. The HHRA identified potentially unacceptable risks to human health associated with exposure to tetrachloroethene (PCE), trichloroethene (TCE), vinyl chloride, benzene, cis-1,2-dichloroethene (cis-1,2-DCE), 1,2-dichloroethane (1,2-DCA), dibenzofuran, antimony, arsenic, iron, manganese, and thallium in groundwater. However, based upon risk management considerations, the Navy and USEPA, in consultation with VDEQ, agree the risks and/or hazards associated with dibenzofuran, antimony, arsenic, iron, manganese, and thallium are considered acceptable; therefore **no further action** to address these constituents in groundwater is warranted. The HHRA indicated currently there is no route for human exposure to vapors in building indoor air resulting from the volatilization of VOCs in groundwater (vapor intrusion). However, due to the presence of VOCs in groundwater, and the uncertainties associated with quantifying risks associated with potential vapor intrusion, it was assumed that vapor intrusion from shallow groundwater into indoor air could pose unacceptable risks to future building occupants.

Table 1 - Studies, Investigations, and Acivities Summary

Previous Study / Investigation	AR Document Number	Investigation Activities
Supplemental RI (SRI)/ HHRA/ ERA (CH2M HILL, August 2009a) (Cont'd)	000222	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 tends to be present in sediment where elevated metal concentrations are detected and is a good indicator of impacts from former sandblasting. The SRI recommended an evaluation of remedial alternatives to address **contaminants of concern (COCs)** in groundwater (vinyl chloride) and sediment (copper, lead, nickel, tin, and zinc). Additionally, it recommended addressing ABM and lead in soil. The SRI concluded no further action for surface water was warranted.
Pre-Feasibility Study Groundwater Sampling (CH2M HILL, 2007)	Work Plan (001384)	In January and September 2008, groundwater samples were collected to support risk management considerations and identification of COCs at SWMU 3. Samples were analyzed for VOCs, dibenzofuran, and total/ and dissolved thallium. Concentrations of VOCs were similar to those detected during the SRI in 2007. TCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride were detected above federal MCLs. Dibenzofuran and total and dissolved thallium were not detected in groundwater. Results of this investigation are documented in 2014 Focused Feasibility Study.
Pre-Feasibility Study (FS) Sediment Investigations (Remediation Boundary Delineation) (CH2M HILL, February 2009b and CH2M HILL, December 2009c)	001517 (Pre-FS Sampling Work Plan) 001074 (Vertical Delineation SAP)	Surface and subsurface sediment sampling was conducted to define the boundaries of the area requiring cleanup and define sediment dewatering and disposal characteristics. The correlations between the ABM content in sediment and the concentrations of copper, lead, nickel, tin, and zinc were used to calculate associated sediment concentrations for each metal using 1 percent ABM (the lowest possible integer). These calculated concentrations, along with consideration of site-specific background concentrations and literature-based sediment ecological screening criteria (**effects range-low, effects range-median, threshold effects level, and probable effects level**), were used to define the sediment preliminary remediation goals (PRGs) (Table 6). To define the area requiring **remedial action** under CERCLA, the site was broken down into 100-by-100-foot grid cells. A grid cell was identified as requiring remedial action through the calculation of the ratio of the individual sediment COC concentration in surface sediment to its chemical-specific PRG. If surface sediment in a grid cell contained greater than 1 percent ABM, individual COC ratios greater than 1.5, or an average ratio for the COCs greater than 1, it was included in the area requiring remedial action. This approach was selected giving consideration to the size of the grid cells, the spatial distribution of the surface sediment data, and the recognition of the combined impacts caused by multiple contaminants. The lateral and vertical extent of sediment requiring remedial action was defined using the PRGs. In addition, the extent of the petroleum-contaminated sediment within the remediation area was delineated. Sediment dewatering and disposal characterization testing indicated sediment is non-hazardous and that both passive (geotextile tube) and mechanical (belt filter) dewatering technologies would be effective.
Risk Assessment Update (Groundwater to Surface Water) (CH2M HILL, July 2012a)	001542	As a result of updates made to the **conceptual site model**, the future use of groundwater at the site as a potable water source and the human health and ecological risks associated with groundwater discharge to surface water were evaluated as part of the risk assessment update. Based on site-specific determinations on aquifer characteristics (groundwater is located within land made through the placement of dredge spoils and mixes with the adjacent surface water) and the inability to install a potable well between the waste mass (VOCs in groundwater) and the adjacent surface water body (Little Creek Harbor), the Navy and USEPA, in consultation with VDEQ, agreed that future potable use of groundwater is not a viable exposure pathway for human health risk evaluation at SWMU 3. Although potable use of groundwater is not considered an applicable exposure pathway at SWMU 3, VDEQ considers all groundwater a potential potable resource and requires that all groundwater be restored to beneficial (potable) use. Revisions to the human health and ecological risk evaluations for human and ecological exposure to surface water (and ecological exposure to sediment pore water) did not identify potentially unacceptable risks resulting from the discharge of groundwater to Little Creek Harbor. Therefore, the Navy and USEPA, in consultation with VDEQ, agreed that no further evaluation of risks associated with groundwater discharging to Little Creek Harbor was warranted.
Benthic Invertebrate Evaluation (CH2M HILL, December 2012b)	001662	Surface sediment sampling was conducted to evaluate the current health of the **benthic invertebrate** community within the area requiring remedial action and assess the relationship of the health of the benthic community with concentrations of COCs and ABM in sediment. Data indicated that a larger benthic community was present in areas of higher COC and ABM concentrations. Additionally, data indicated that physical conditions at the site unrelated to former sandblasting (such as low dissolved oxygen in the surface water column just above the sediment surface, water depth, and a high percentage of fine-grained sediment) may have a greater negative impact on the health of the benthic invertebrate community than concentrations of COCs and ABM in sediment. The evaluation concluded that although factors unrelated to former sandblasting may be working in combination with site-related contamination to impact the health of the benthic invertebrate community, the magnitude of metals concentrations in sediment may potentially result in unacceptable risks to ecological receptors should these factors change over time; therefore, remedial action at SWMU 3 was determined to be warranted. The evaluation recommended that **remedial action objectives (RAOs)** to reduce the concentrations of metals in sediment be established for the site.

Table 1 - Studies, Investigations, and Acivities Summary

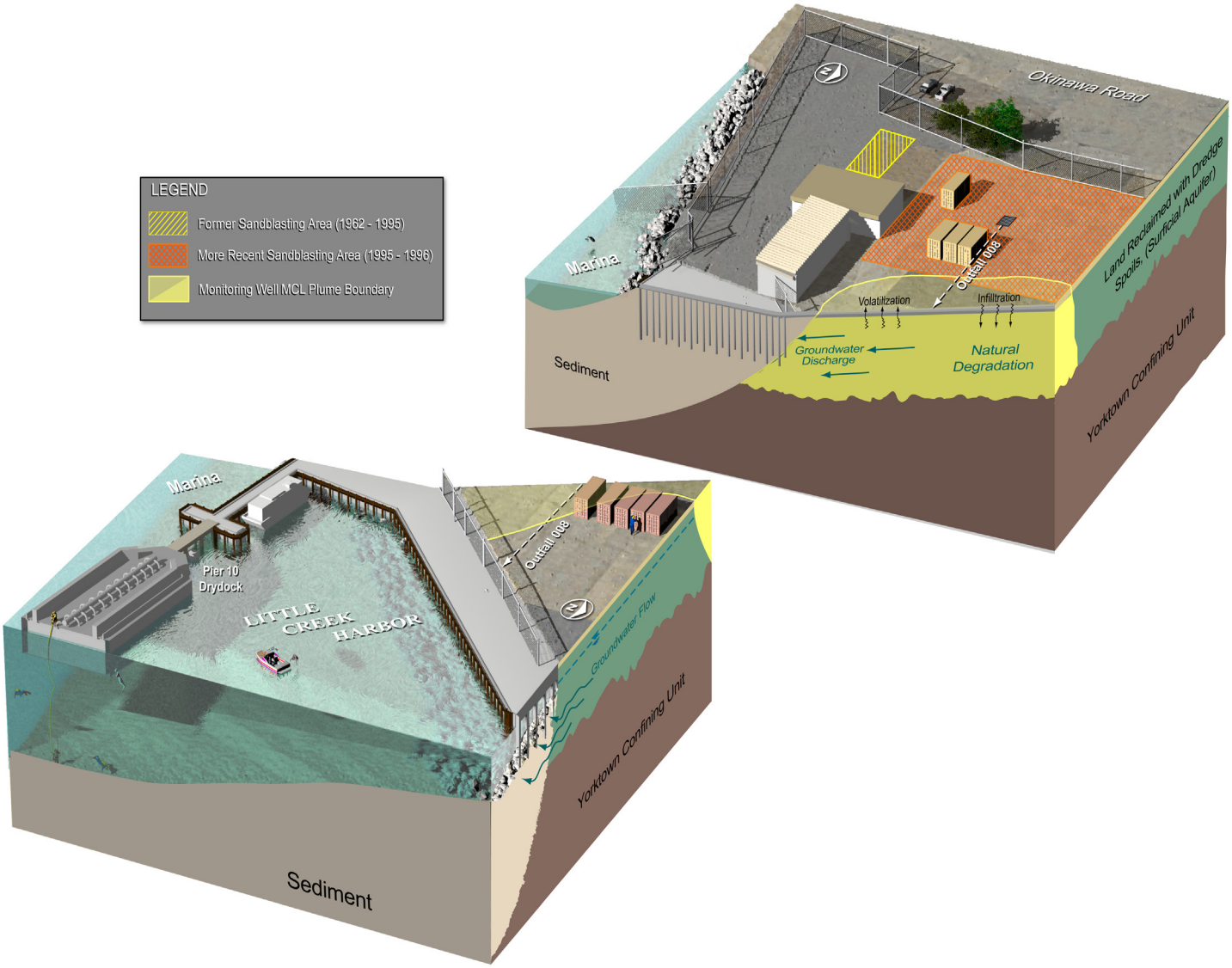
Previous Study / Investigation	AR Document Number	Investigation Activities
Non-time-critical Removal Action (NTCRA) (CH2M HILL, December 2012c, CH2M HILL, December 2012d, and CH2M HILL, June 2013a)	001723 (EE/CA) 001716 (AM) 001786 (Summary Memorandum)	In December 2012, an **Engineering Evaluation/Cost Analysis (EE/CA)** was finalized to evaluate **Non-time-critical Removal Action (NTCRA)** alternatives to reduce potential unacceptable ecological risks from sediment surrounding the dry dock and its anchoring system. The alternative selected included dredging of contaminated sediment, disposal of dredge materials, and replacement with clean fill. A public notice was issued in *The Virginian Pilot* on November 1, 2012, and the EE/CA was made available to the public from November 1, 2012, to December 15, 2012. No comments were received and an Action Memorandum (AM) was signed by the Navy on December 17, 2012, to implement the recommended alternative presented in the EE/CA. As previously discussed, site-specific sediment PRGs were established for the site COCs (copper, lead, nickel, tin, and zinc) by considering metals concentrations, ABM content, and urban background values (Table 6). Because ABM was classified as non-hazardous, the Navy and USEPA, in consultation with VDEQ, agreed that the presence of ABM in sediment does not drive the need for action at SWMU 3. The Navy and USEPA, in consultation with VDEQ, agreed that a grid cell required remedial action if the calculated ratio (as previously described) for one or more individual COC exceeded 1.5 and the average ratio for the five COCs exceeded 1. All available surface sediment data were used to define the revised lateral area requiring remedial action as depicted on Figure 6. In December 2012, prior to implementation of the NTCRA, delineation sampling was conducted to determine the vertical extent of the area requiring CERCLA remedial action and the depth of removal required to reduce ecological risk from sediment surrounding the dry dock and its anchoring system (Figure 6). Sediment samples were collected from each grid cell located within the area requiring remedial action, in 1 foot intervals to determine the depth at which COC concentrations met ratio requirements as discussed above. With the exception of grid SD609A, the vertical extent of sediment requiring remedial action was defined. For grid SD609A, ratio requirements were not met within the deepest sample collected from 5 to 5.5 feet below the sediment surface. Beginning in February 2013, 12,600 cubic yards of sediment was dredged from within a portion of the area requiring remedial action in Little Creek Harbor (Figure 7). As a result of engineering constraints, sediment within 50 feet of the bulkhead shoreline, 10 feet of piers, and 20 feet of the shoreline revetment were inaccessible via dredging and left in place. Additionally, the dredge barge could not reach removal grid cell 01; therefore, this grid cell was not dredged. Dredged materials were transported via barge to Port Weanack located in James City County, Virginia, where they were solidified and offloaded for transport and disposal. Following dredging activities, the site was restored by placing a clean sand layer. Grid cells where previous subsurface sediment sampling results indicated petroleum-like material may have been exposed during dredging activities received approximately 2 feet of sand; the remaining portion of the site received a minimum of 6 inches of sand. In September 2013, a Construction Summary Memorandum was prepared to document completion of removal activities and mitigation of ecological risks associated with SWMU 3 sediment within the NTCRA area, with the exception of removal grid cell 01.
Risk Assessment Update (Vapor Intrusion) (CH2M HILL, June 2013b)	001750	Currently at SWMU 3 there is no route for human exposure to vapors in building indoor air resulting from the volatilization of VOCs in groundwater (vapor intrusion); therefore risk associated with vapor intrusion was not evaluated as part of the HHRAs in the RI and SRI. However, due to the presence of VOCs in groundwater, and the uncertainties associated with quantifying risks from potential future building occupant exposure to vapors in indoor air, it was assumed that vapor intrusion from shallow groundwater into indoor air could pose unacceptable risks to future buildings occupants. As part of a risk assessment update, potential risks associated with future exposure to indoor air were quantified for potential future residents at SWMU 3 using groundwater VOC data collected in January and September 2007 during the SRI. Potentially unacceptable risks associated with trichloroethene (TCE) and vinyl chloride were identified based on maximum detected concentrations of VOCs in groundwater. However, calculated risks are representative of site conditions in 2007. Based upon natural processes working to reduce chemical concentrations in groundwater (**natural degradation**), and proximity of elevated TCE and vinyl chloride concentrations to the adjacent shoreline, concentrations of these chemicals are expected to be lower or to have migrated with groundwater flow and discharged to Little Creek Harbor. As a result, calculated risks are likely an overestimation of actual potential risks; therefore, the Navy and USEPA, in consultation with VDEQ, agreed that no current or future action is warranted to address vapor intrusion at SWMU 3.

Table 1 - Studies, Investigations, and Acivities Summary

Previous Study / Investigation	AR Document Number	Investigation Activities
Time-critical Removal Action (TCRA) (CH2M HILL, June 2013c, CH2M HILL, December 2013d, and Tetra Tech, September 2014)	001748 (AM) 001900 (Scope Change AM) 001913 (Lead Sampling Work Plan) 001724 (TCRA Work Plan) Pending (CCR)	An AM was signed by the Navy on June 17, 2013, for completion of a **Time-Critical Removal Action (TCRA)** at SWMU 3 to prevent remaining sediment from re-contaminating areas cleaned up during the NTCRA, address localized areas of elevated lead concentrations (greater than 400 milligrams per kilogram [mg/kg]) in soil, and reduce potential ecological risks associated with exposure to site COCs in remaining sediment. Performing an action other than a TCRA would have required a planning period of at least 6 months, which could have allowed storm events to move contaminated sediment into areas dredged and backfilled during the NTCRA. A second AM to document a partial change in scope of the response action was signed on December 16, 2013. The final scope of the TCRA included sediment dredging where feasible, soil excavation, and offsite disposal of soil and sediment, followed by site restoration including backfill and construction of a stormwater management retention feature. In those areas inaccessible for dredging, TCRA scope included the placement of powdered activated carbon on the sediment surface to reduce benthic invertebrate exposure to metals in sediment. A public notice was issued in *The Virginian Pilot* on November 30, 2013, and the TCRA was made available for public comment from November 30, 2013, to December 31, 2013. No comments were received. Areas addressed as part of the TCRA are depicted on Figures 5 and 7. Beginning in November 2013, approximately 1,300 cubic yards of sediment and 320 cubic yards of soil were removed, transported, and disposed of offsite. Sediment was removed from the area depicted on Figure 7. The vertical depth of sediment removal required to reduce potential ecological risks associated with site COCs in sediment was previously delineated as part of the NTCRA delineation sampling event conducted in December 2012. Successful removal of elevated concentrations of lead in soil (greater than 400 mg/kg) was confirmed through pre-excavation confirmation soil sampling and post-excavation confirmation sampling. Soil was removed from the area depicted on Figure 5. Following completion of removal activities, a minimum of 6 inches of clean sand were placed in the sediment removal area; a stormwater retention feature was constructed to retain and filter runoff from the adjacent parking lot and remaining areas were backfilled with clean fill to match surrounding grade. In remaining areas, as depicted on Figure 7, 2 inches of powdered activated carbon delivered as part of a pebble-like aggregate (also known as a "reactive amendment") was distributed across the sediment surface. Sediment cores were collected to verify successful achievement of desired amendment thickness and no post-action monitoring of sediment was required. In September 2014, a Construction Completion Report (CCR) was finalized to document TCRA activities.
Focused FS (CH2M HILL, 2014)	002184 (Sampling and Analysis Plan) Pending (Focused FS)	Although potable use was previously concluded to not be an applicable exposure pathway at SWMU 3, VDEQ considers all groundwater a potential potable resource and requires that all groundwater be restored to beneficial (potable) use. Therefore, a **Focused Feasibility Study (FS)** was completed to develop and evaluate remedial alternatives to prevent unacceptable risk from future exposure through potable use of groundwater. As part of the Focused FS, groundwater sampling was conducted in August 2014 to evaluate current site conditions and collect groundwater geochemistry data to aid in the evaluation of remedial alternatives to address VOCs in groundwater. Samples were collected from existing site monitoring wells and analyzed for COPCs identified in the HHRA conducted as part of the SRI as well as those VOCs detected above federal drinking water standards. Data indicated that COPC concentrations in groundwater have decreased as a result of naturally occurring physical and chemical processes since completion of the RI and SRI (Table 2). A revised HHRA was completed to assess potential risks posed by the COPCs under current site conditions. Results identified potentially unacceptable risks to future residents from potable use of groundwater still remain; however risks are limited to exposure to vinyl chloride and TCE in groundwater. As part of the Focused FS, two remedial alternatives were selected for detailed comparative analysis: (1) no action and (2) monitored natural attenuation and land use controls.
Notes: *The documents listed are available in the AR and provide detailed information used to support remedy selection at SWMU 3.		

The land where SWMU 3 is located and the surrounding area were created from the placement of dredge material between 1937 and 1954; thus, the underlying groundwater is not contained within the natural fine sand and silt deposits of the Columbia **aquifer**. Beneath this dredged fill material, the low-permeability silt, clay, and sandy clay deposits of the Yorktown confining unit are present at the site. The saturated **soil** underlying SWMU 3 is referred to as the surficial aquifer, which is generally encountered between 4 and 6 feet below ground surface. The elevation of the water table underlying SWMU 3 varies between high and low tide cycles with elevation differences of between 1 and 2 feet at low tide and less than half a foot at high tide. Groundwater flows south/southeast towards Little Creek Harbor with some localized reversal in flow direction observed during high tide. The average shallow groundwater flow velocity is estimated to be 10.3 feet per year. The groundwater in the surficial aquifer beneath SWMU 3 is generally brackish, and is within a transition zone where upgradient fresh water mixes with seawater. The shallow groundwater is not currently used, and is not expected to be used, as a potable water supply. **Potable** water is provided to the base and surrounding communities by the City of Virginia Beach or City of Norfolk.

Figure 3 – SWMU 3 Conceptual Site Model



The aquatic portion of the site, located in Little Creek Harbor, consists of the Pier 10 floating dry dock and its associated anchoring system, as well as a recreational marina used by military dependents and former active duty service members. In addition to floating dry dock activities, Little Creek Harbor is currently used for dive team training. A public health restriction on shellfish consumption in Virginia Beach and Norfolk and a fish consumption advisory for the entire Chesapeake Bay are currently in place; JEB Little Creek falls under those advisories. For security purposes, recreational swimming is not permitted in Little Creek Harbor; however, the facility currently allows recreational fishing from the pier located behind Building 1604.

3.1 Nature and Extent of Contamination

The chlorinated **volatile organic compound (VOC)** tetrachloroethene (PCE) and several "breakdown product" compounds formed from the biological and chemical degradation of PCE – namely trichloroethene (TCE), cis-1,2-dichloroethene (DCE), and vinyl chloride – have historically been detected in groundwater above federal maximum contaminant levels (MCLs); however, based upon groundwater sampling conducted in August 2014, TCE and vinyl chloride are the only chlorinated VOCs remaining in groundwater above MCLs (Table 2). The groundwater plume extends from east of the more recent (1995 to 1996) sandblasting area south to Little Creek Harbor (Figure 4). No release of chlorinated solvents to soil has been documented at the site. Additionally, detected concentrations of VOCs in soil do not indicate that any continuing source of contamination is present in soil.

3.2 Fate and Transport of Contamination

The primary mechanism for transport of dissolved VOCs in groundwater at SWMU 3 is downgradient migration with groundwater flow discharging to Little Creek Harbor. Secondary, less prominent fate and transport mechanisms are volatilization from groundwater to soil gas and indoor air; and natural degradation of VOCs (PCE to TCE, cis-1,2-DCE, and vinyl chloride).

Figure 4 — Groundwater COC Plume Boundary

Table 2 – Maximum Concentrations of COPCs

COPC	MCL	Maximum Concentration		
		2002	2007	2014
Benzene	5	1.3	ND	ND
1,1-DCA	--	87	9	3.01
1,2-DCA	5	1.5	ND	ND
PCE	5	210	0.1	ND
TCE	5	180	17	6.01
cis-1,2-DCE	70	47	260	28
trans-1,2-DCE	100	14	79	12.2
Vinyl chloride	2	21	56	15.9

Concentrations reported in micrograms per liter (µg/L).
DCA – dichloroethane
ND – not detected

4 Scope and Role of Response Action

The former NAB Little Creek, now referred to as JEB Little Creek, was placed on the **National Priorities List (NPL)** in May 1999. The Navy, USEPA, and VDEQ entered into a Federal Facility Agreement (FFA) in 2003. The FFA identified 10 sites for RI/FS activities requiring closure through a **Record of Decision (ROD)**. SWMU 7, identified in the FFA for investigation under an RI/FS, was later divided into SWMU 7a and SWMU 7b. Seventeen sites were identified in the FFA as requiring further evaluation through **desktop audits** or site screening process investigations. Sixteen of the sites were evaluated and closeout documentation was prepared (Table 3). Site 11a was recommended for further investigation under RI/FS activities and closure through a ROD.

SWMU 3 is one of 12 ERP sites being addressed under CERCLA at JEB Little Creek. No sites are currently in the RI/FS stage of the CERCLA process. The following sites have a Final ROD in place:

- SWMU 7a: No Action ROD
- SWMU 7b: No Action ROD
- SWMU 8: No Action ROD
- Site 7: Action ROD for maintenance of the existing soil cover, land use controls, and groundwater monitoring
- Site 8: No Action ROD
- Sites 9 and 10: Action ROD for **land use controls** and groundwater monitoring
- Site 11: Action ROD for groundwater treatment through **enhanced reductive dechlorination** with land use controls and post-treatment groundwater monitoring
- Site 11a: Action ROD for groundwater treatment through enhanced reductive dechlorination with land use controls and post-treatment groundwater monitoring
- Site 12: Action ROD for groundwater treatment through **bio-augmentation** with land use controls and post-treatment groundwater monitoring

Table 3 – Site and Preliminary Screening Area Closeout Summary

Site/Preliminary Screening Area	Investigation Activity	Determination	Closeout Documentation
Federal Facility Agreement Sites			
SWMU 30 – Leaking Above Ground Diesel Tank	Desktop audit and site visit.	Aboveground storage tank (AST) and surrounding berm is in good condition. Further assessment will be conducted under Spill Prevention, Control, and Countermeasures Plan/AST Program.	Final June 2003 Tier I Partnering Team Meeting Minutes, Consensus Statement.
SWMU 96 – Scrap Metal Storage Area	Desktop audit and site visit.	Currently an active equipment storage area operated under facility protocols for maintaining best management practices. No evidence of a CERCLA release. No further action required.	Final Closeout Report Appendix B Sites SWMUs 96, 97, 98, and 119, NAB Little Creek, Virginia Beach, Virginia. September 2004.
SWMU 97 – Vehicle Maintenance Facility Storm Drain		Active storm drain operated under the facility Virginia Pollutant Discharge Elimination System permit. No evidence of a CERCLA release. No further action required.	
SWMU 98 – Elevated Causeways Mechanic Shop Material Dispensing Area		No evidence of a CERCLA release. No further action required.	
SWMU 119 – Former Special Warfare Group 2 Electronics Shop	Groundwater samples collected.	No evidence of a CERCLA release or potential unacceptable risks. No further action is required.	
Area of Concern (AOC) H – Buildings 3109 and 3360 at Golf Course (Pesticide Mixing Area)	Soil samples collected.	Potential risks to human health and ecological receptors minimal and no further action is required.	Final Close-Out Report Appendix B Sites AOCs – H, I, J, and Site 14, NAB Little Creek, Virginia Beach, Virginia. March 2004
AOC I – Eagle Haven Golf Course Pond	Soil and sediment samples collected.		
AOC J – Former "Burn Area" between IF Sites 9 and 10	Soil and groundwater samples collected.		
Installation Restoration Site 14 – Old Pole Yard and Transformer Storage Area	Soil samples collected.		
SWMU 18 – Personal Watercraft Transmission Garage Spent Battery Shop, Collection Area	Desktop audit and site visit.	No evidence of a CERCLA release. No further action required.	Final April 2005 Tier I Partnering Team Meeting Minutes, Consensus Statement.
SWMU 116 – Morale, Welfare, and Recreation Boat Maintenance Facility			
AOC D – Polychlorinated Biphenyl (PCB) Transformer Leak			
SWMU 5 – Port Ops Boat Painting Area	Soil and groundwater samples collected.	No evidence of a CERCLA release or potential unacceptable risks. No further action is required.	Final Site Screening Assessment Closeout Report SWMUs 5, 6, 13, and Site 6, NAB Little Creek, Virginia Beach, Virginia. January 2006.
SWMU 6 – Seabee Area – CB-124	Soil and groundwater samples collected.		
SWMU 13 – Former Pesticide Shop	Soil and groundwater samples collected.		
Installation Restoration Site 6 – Special Boat Unit Battery Storage Yard	Soil and groundwater samples collected.		

Table 3 – Site and Preliminary Screening Area Closeout Summary

Site/Preliminary Screening Area	Investigation Activity	Determination	Closeout Documentation
Military Munitions Response Program Sites			
Chemical Defense Area	Desktop evaluation.	No evidence of a CERCLA release or potential unacceptable risks were identified during the archive search. Additionally, significant redevelopment and fill of the area has occurred. Area removed from further study.	Final Preliminary Assessment, NAB Little Creek. September 2007.
1942 Pistol Range	Desktop evaluation.	No evidence of a CERCLA release or potential unacceptable risks. The site is currently under several feet of concrete that makes up the landing craft air cushion pad. Area removed from further study.	
Anti-Aircraft Target Rifle Range	Desktop evaluation and site visit.	Site screening area does not pose a threat or potential threat to public health, welfare, or the environment. Area removed from further study.	Final Site Screening Process Closeout Report, Anti-Aircraft Target Rifle Range, 1944 Pistol Range, and 1953 Pistol Range, NAB Little Creek, JEB Little Creek-Fort Story, Virginia Beach, Virginia. September 2010.
1944 Pistol Range			
1953 Pistol Range			
Depth Charge Testing Area	Desktop evaluation.	Site screening area does not pose a threat or potential threat to public health, welfare, or the environment. Area removed from further study.	Final Site Screening Process Closeout Report, Depth Charge Testing Area, NAB Little Creek, JEB Little Creek-Fort Story, Virginia Beach, Virginia. September 2010.
Former Morale, Welfare, and Recreation Skeet Range	Soil and groundwater samples collected.	Site screening area does not pose a threat or potential threat to public health, welfare, or the environment. Area removed from further study.	Final Site Screening Process Report, Former Morale, Welfare, and Recreation Skeet Range, NAB Little Creek, JEB Little Creek-Fort Story, Virginia Beach, Virginia. January 2011.

- Site 13: Action ROD for groundwater treatment through **enhanced anaerobic bioremediation** with land use controls and post-treatment groundwater monitoring

The FFA also identified 105 sites for which no action under CERCLA is required due to the determination that the site poses no threat, or potential threat, to public health, welfare, or the environment or the site is addressed by other environmental programs.

Seven Military Munitions Response Program sites were identified for Preliminary Assessment. Of the seven sites, two were determined to require no action under CERCLA following completion of the Preliminary Assessment (Table 3). The five remaining sites were identified for further evaluation through desktop audits or site screening process investigations. Each site was evaluated and closeout documentation was prepared (Table 3). Details of these investigations are presented in the **Site Management Plan** for JEB Little Creek, which is updated annually and available in the AR file.

"**Principal threat wastes**" are source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should they be exposed. There is no principal threat waste at SWMU 3. Dissolved VOC concentrations are present in groundwater; however, contaminated groundwater is generally not considered principal threat waste. **Dense non-aqueous phase liquids (DNAPLs)** have not been identified at SWMU 3. Additionally, no soil source of VOCs to groundwater has been identified at the site. Currently groundwater is not used as a public drinking water supply. Exposure to groundwater from construction activities does not pose potentially unacceptable risk to human health. Based upon the absence of identified DNAPL and a lack of exposure, principal threat wastes are not present at SWMU 3. Previous removal actions removed low-level threat waste from soil and sediment.

5 Summary of Site Risks

Detailed results of the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) conducted at SWMU 3 are presented in the Remedial Investigation (RI) Report (CH2M HILL, 2005), Supplemental Remedial Investigation (SRI) Report (CH2M HILL, 2009a), Groundwater to Surface Water Risk Assessment Update (CH2M HILL, 2012a), Benthic Invertebrate Evaluation (CH2M HILL, 2012b), and Vapor Intrusion Risk Assessment Update (CH2M HILL, 2013b) available in the AR file. Short descriptions of the risk calculation process are provided in the information boxes that accompany the following site-specific risk summaries.

5.1 Human Health Risk Summary

An HHRA was completed as part of the RI and SRI to evaluate potential human health risks from current and future human exposure to **soil**, **groundwater**, **sediment**, and **surface water** at SWMU 3. The current exposure scenarios evaluated were the other worker (such as scuba diver) and adult/adolescent recreational user exposure to sediment and surface water, and maintenance worker and adult/adolescent trespasser exposure to soil. Hypothetical future exposure scenarios were evaluated for the other worker, adult/adolescent recreational user, and maintenance worker exposure to sediment and surface water, and construction worker, adult/child resident, and industrial worker exposure to soil and groundwater. The exposure pathways evaluated were dermal contact with, inhalation of emissions from, and ingestion of surface soil, subsurface soil, and shallow groundwater, and dermal contact with and ingestion of sediment and surface water. Health risks are based on a conservative estimate of the potential cancer risk or the potential to cause other health effects not related to cancer (non-cancer hazard or hazard index [HI]). USEPA identifies acceptable non-cancer hazard as an HI less than 1 or a cancer risk range of 10^{-4} (1 in 10,000 chance) to 10^{-6} (1 in 1,000,000 chance).

Surface Water and Sediment

No unacceptable risks were associated with exposure to sediment or surface water. Additionally, an evaluation of human health risks associated with groundwater discharge to Little Creek Harbor concluded that discharge of groundwater to surface water does not pose an unacceptable incremental increase in risks from exposure to surface water in Little Creek Harbor. Therefore, the Navy and USEPA, in consultation with VDEQ, agree **no further action** is required for surface water and sediment to ensure the protection of human health.

What is Human Health Risk and How is it Calculated?

An HHRA, which estimates the likelihood of health problems occurring if no cleanup action were taken, consists of the following four-step process:

Step 1: Analyze Contamination

Step 2: Estimate Exposure

Step 3: Assess Potential Health Dangers

Step 4: Characterize Site Risk

In **Step 1**, comparisons of the concentrations of site chemicals to human health risk-based concentrations help identify which chemicals pose the greatest threat to human health. Human health risk-based concentrations are developed based on scientific studies of the effects chemicals have on people

In **Step 2**, the Navy considers different ways people might be exposed to chemicals, the concentrations, how often, and how long they may be exposed in order to assess a "reasonable maximum exposure" (RME) scenario that portrays the highest level of human exposure that could reasonably be expected to occur. The Navy may also assess a central tendency exposure (CTE) scenario that evaluates exposure to individuals who have average or typical intake of environmental media if the RME scenario demonstrates the potential for unacceptable risks in Step 4.

In **Step 3**, the Navy uses the information from Step 2, combined with toxicity information, to assess potential health risks. The Navy considers two types of risk: (1) cancer risk and (2) non-cancer hazard. The likelihood of any type of cancer resulting from a contaminated site is generally expressed as a probability: "1 in 10,000 chance" (for every 10,000 people that could be exposed, one extra cancer may occur as a result of exposure). For non-cancer health effects, the Navy calculates a "hazard index" (HI), which is the ratio between the "reference dose," (the dosage at which no adverse health effects are expected), and the RME. A "threshold level" (HI less than 1) exists below which non-cancer health effects are not expected.

In **Step 4**, the Navy assesses whether site risks are high enough to cause health problems for people at or near the site. The results of the three previous steps are combined, evaluated, and summarized. The Navy adds up the potential risks from the individual contaminants and exposure pathways and calculates a total site risk. The USEPA considers risks unacceptable if the total non-carcinogenic HI for an individual target organ (such as the kidney) exceeds 1 or the total cancer risk exceeds 1 in 10,000.

Soil

No potentially unacceptable risk resulting from current maintenance worker or adult/adolescent trespasser exposure to soil was identified. The cumulative **reasonable maximum exposure (RME)** non-cancer hazard is 3.0 for child resident exposure to soil; however, there are no target organ effect/hazard HIs greater than 1 and the **central tendency exposure (CTE)** cumulative non-cancer hazard is below 1. The Integrated Exposure Uptake Biokinetic Model (IEUBK) model was used to evaluate future child resident exposure to lead in surface and subsurface soil across the site and the Adult Lead Methodology (ALM) Model was used to evaluate current maintenance worker and future industrial worker exposure to lead in soil across the site. Although concentrations of lead detected in soil at individual sample locations exceeded the child residential **screening criteria**, the IUEBK and ALM models demonstrated that

exposures to lead in soil across the site would not be a potential health concern. While there are no potentially unacceptable human health risks from exposure to lead in soil, the Navy proactively addressed localized areas of elevated levels of lead concentrations (greater than 400 mg/kg) as part of the **Time-Critical Removal Action (TCRA)**. Pre-excavation confirmation soil samples were collected as part of TCRA activities to define the extent of removal (Figure 5). Following excavation activities, a field survey was conducted to ensure required excavation depths were achieved.

Because pre-removal confirmation soil samples defined the area requiring removal and the post-excavation field survey confirmed successful excavation of soil, no post-excavation confirmation sampling was required. Successful removal of soil is documented in the TCRA CCR (Tetra Tech, 2014).

Based on the results of the HHRA and completion of the 2013 TCRA which removed localized areas of lead contamination attributable to SWMU 3, the Navy and USEPA, in consultation with VDEQ, agree no further action is required for soil to ensure the protection of human health.

Groundwater

No potentially unacceptable risks resulting from future construction worker exposure to groundwater were identified. Results of the HHRA performed as part of the 2007 SRI indicated calculated risk estimates for potable use of groundwater by hypothetical future residents and industrial workers may result in unacceptable RME and CTE **cancer risks** and **non-cancer hazards** due to VOCs, one SVOC (dibenzofuran), and metals in groundwater (Table 4).

Dibenzofuran and metals concentrations in groundwater resulted in cancer risks or non-cancer hazards above USEPA's acceptable levels based on RME calculations. However, based upon the risk management considerations presented in Table 5, the Navy and USEPA, in consultation with VDEQ agree dibenzofuran, antimony, arsenic, iron, manganese, and thallium in groundwater do not pose an unacceptable risk, and no further action is warranted to address these constituents in groundwater.

As part of development of the Focused FS, groundwater data collected during the SI, RI, and SRI were reviewed against updated risk-based screening values, MCLs, and toxicity values to identify any potentially new COPCs, in addition to those previously identified in the 2007 HHRA, in groundwater. As a result, 1,1-dichloroethane (DCA), chromium, and cobalt were identified as new COPCs that may potentially contribute to an unacceptable risk or hazard in groundwater and may potentially be identified as site-specific COCs. However, based upon the risk management considerations presented in Table 5 the Navy and USEPA, in consultation with VDEQ agree the potential risks and hazards associated with chromium and cobalt are acceptable and no further action is warranted to address these constituents in groundwater.

Figure 5 – TCRA Soil Removal Area

In August 2014 additional groundwater sampling was conducted to evaluate current concentrations of the VOC COPCs (PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, VC, benzene, 1,1-DCA, and 1,2-DCA) and assess potential risks associated with potable use of groundwater under current site conditions. No unacceptable risks were associated with industrial worker exposure to VOCs in groundwater. Calculated cumulative risk estimates for hypothetical future resident exposure to groundwater resulted in RME cancer risks above USEPA's acceptable risk range. Cumulative risk estimates are associated with vinyl chloride and TCE (Table 4). CTE cumulative risk estimates are within USEPA's acceptable risk range.

Indoor Air

Risks associated with future resident exposure to indoor air via vapor intrusion from groundwater were calculated using groundwater data collected as part of the SRI in 2007. Calculated cumulative risk estimates were above USEPA's acceptable carcinogenic risk range of 10^{-4} to 10^{-6} and non-carcinogenic hazard level of 1 based upon maximum detected concentrations of VOCs in groundwater, primarily TCE and vinyl chloride (Table 4). However, calculated cumulative risks based upon the 95 percent upper confidence limit (UCL) of the mean concentrations were below USEPA's acceptable thresholds. Additionally, maximum detected chemical concentrations and calculated 95 percent UCL of the mean concentrations were representative of site conditions in 2007. Based upon groundwater VOC data collected in August 2014, maximum detected concentrations of TCE and vinyl chloride (Table 2) have decreased to concentrations generally similar to the calculated 95 percent UCL values (TCE = 3.8 µg/L; vinyl chloride = 11 µg/L) used in the risk assessment.

5.2 Ecological Risk Summary

No unacceptable **ecological** risks associated with exposure to groundwater (discharged to surface water), soil, or surface water were identified. The ERA concluded that metals concentrations in sediment posed potentially unacceptable ecological risks to **lower-trophic-level receptors** (such as **benthic invertebrates**). However, potentially unacceptable risks from exposure to sediment were reduced as a result of the 2013 **Non-Time-Critical Removal Action (NTCRA)** and TCRA.

Site-specific PRGs for the site **contaminants of concern (COCs)** (copper, lead, nickel, tin, and zinc) in sediment were established as detailed in Table 1 and presented in Table 6. Because ABM was classified as non-hazardous and any contribution to potential risk to the environment is captured as part of sediment analytical results, the Navy and USEPA, in consultation with VDEQ, agreed that the presence of ABM in sediment does not drive the need for action at SWMU 3. Therefore no clean-up goal for ABM was established. Prior to conducting the NTCRA and TCRA, pre-removal action sediment sampling was conducted to define the final vertical extent of sediment dredging required to reduce potentially unacceptable ecological risks at SWMU 3 and identify the depth of non-CERCLA-related petroleum impacted sediment. Sediment data were compared to site-specific PRGs and the removal action area was defined as described in Table 1 and presented on Figure 6.

As part of the NTCRA, sediments were dredged from areas surrounding the dry dock and its anchoring system (Figure 7). Prior to and immediately following dredging, elevation surveys of the sediment surface were conducted to confirm that required dredging depths were achieved. Following successful completion of dredging, the site was restored by placing a clean sand layer. Areas where previous subsurface sediment sampling results indicated

What is Ecological Risk and How is it Calculated?

An ERA evaluates the potential risks to plants, animals, habitats, and communities and is conducted using a step-wise process (as outlined in Navy and USEPA ERA policy and/or guidance), which includes decision points where agreement among stakeholders is reached to assess whether the process should be continued or terminated. The process continues until a final decision has been reached (that is, remedial action if unacceptable risks are identified or no further action if risks are acceptable). The process can also be iterative if data needs are identified at any step; the needed data are collected and the process re-starts at the point appropriate to the type of data collected. An ERA has three principal components:

1. Problem Formulation establishes the goals, scope, and focus of the ERA and includes:

- Compiling and reviewing existing information on the habitats, plants, and animals that are present on or near the site
- Identifying and evaluating area(s) where site-related chemicals may be found (source areas) and at what concentrations
- Evaluating potential movement (transport) of chemicals in the environment
- Identifying possible exposure media (soil, air, water, sediment)
- Evaluating if/how the plants and animals may be exposed (exposure pathways)
- Evaluating routes of exposure (for example, ingestion)
- Identifying specific **receptors** (plants and animals) that could be exposed
- Specifying how the risk will be measured (**assessment and measurement endpoints**) for all complete exposure pathways

2. Risk Analysis includes:

- Exposure Assessment - An estimate of exposure concentrations. These include direct exposures to lower-trophic-level receptors (organisms low on the food chain, such as plants and insects), upper-trophic-level receptors (organisms higher on the food chain, such as birds and mammals), and indirect exposures (exposures via the food chain) for upper-trophic-level receptors.
- Effects Assessment - An assessment of the concentrations of chemicals at which an adverse effect may occur.

3. Risk Calculation or Characterization:

- The first two components are used to estimate potential risk to plants and/or animals by comparing the exposure estimates with the effects thresholds.
- Also included is an evaluation of the uncertainties (that is, potential degree of error) associated with the predicted risk estimate and their effects on ERA conclusions.

Table 4 – Summary of Unacceptable Human Health Risks

Receptor	COPC	RME EPC[1]	Total RME		Total CTE		Cancer Toxicity Factor (CSF)[2]	Non-Cancer Toxicity Factor (RfD)[2]
			Cancer Risk	Non-Cancer Hazard	Cancer Risk	Non-Cancer Hazard		
Groundwater								
2009 SRI HHRA								
Future Resident Adult	PCE	34 µg/L	N/A	0.16	N/A	0.016	N/A	1×10^{-2}
	TCE	30 µg/L	N/A	0.16	N/A	0.018	N/A	6×10^{-3}
	VC	12 µg/L	N/A	0.13	N/A	0.022	N/A	3×10^{-3}
	cis-1,2-DCE	60 µg/L	N/A	0.18	N/A	0.019	N/A	1×10^{-2}
	Dibenzofuran	28 µg/L	N/A	1.7	N/A	0.27	N/A	1×10^{-3}
	Antimony	2.2 µg/L	N/A	0.15	N/A	0.047	N/A	4×10^{-4}
	Thallium	5.0 µg/L	N/A	2.0	N/A	0.33	N/A	7×10^{-5}
	Receptor Total	*N/A*	*N/A*	*6.6*	*N/A*	*1.3*	*N/A*	*N/A*
Future Resident Child	PCE	34 µg/L	N/A	0.34	N/A	0.043	N/A	1×10^{-2}
	TCE	30 µg/L	N/A	0.37	N/A	0.058	N/A	6×10^{-3}
	VC	12 µg/L	N/A	0.27	N/A	0.068	N/A	3×10^{-3}
	cis-1,2-DCE	60 µg/L	N/A	0.42	N/A	0.06	N/A	1×10^{-2}
	Dibenzofuran	28 µg/L	N/A	4.0	N/A	0.69	N/A	1×10^{-3}
	Antimony	2.2 µg/L	N/A	0.36	N/A	0.16	N/A	4×10^{-4}
	Arsenic	7.1 µg/L	N/A	1.5	N/A	0.69	N/A	3×10^{-4}
	Iron	15,000 µg/L	N/A	1.4	N/A	0.33	N/A	7×10^{-1}
	Manganese	460 µg/L	N/A	1.7	N/A	0.69	N/A	2×10^{-2}
	Thallium	5.0 µg/L	N/A	4.6	N/A	1.1	N/A	7×10^{-5}
	Receptor Total	*N/A*	*N/A*	*15*	*N/A*	*4.0*	*N/A*	*N/A*
Future Resident Adult/Child	1,2-DCA	1.5 µg/L	3.1×10^{-6}	N/A	8.5×10^{-7}	N/A	9.1×10^{-2}	N/A
	Benzene	1.3 µg/L	1.5×10^{-6}	N/A	4.6×10^{-7}	N/A	5.5×10^{-2}	N/A
	PCE	34 µg/L	4.4×10^{-4}	N/A	3.1×10^{-5}	N/A	5.4×10^{-1}	N/A
	TCE	30 µg/L	6.9×10^{-6}	N/A	5.2×10^{-7}	N/A	1.1×10^{-2}	N/A
	VC	12 µg/L	2.6×10^{-4}	N/A	3.6×10^{-5}	N/A	1.4	N/A
	Arsenic	7.1 µg/L	1.6×10^{-4}	N/A	3.9×10^{-5}	N/A	1.5	N/A
	Receptor Total	*N/A*	*8.6×10^{-4}*	*N/A*	*1.1×10^{-4}*	*N/A*	*N/A*	*N/A*
Future Industrial Worker	PCE	34 µg/L	6.3×10^{-5}	0.033	3.3×10^{-6}	0.0065	5.4×10^{-1}	1×10^{-2}
	TCE	30 µg/L	1.2×10^{-6}	0.049	6.6×10^{-8}	0.011	1.1×10^{-2}	6×10^{-3}
	VC	12 µg/L	3.0×10^{-5}	0.039	2.7×10^{-6}	0.013	7.2×10^{-1}	3×10^{-3}
	Arsenic	7.1 µg/L	3.7×10^{-5}	0.23	5.9×10^{-6}	0.14	1.5	3×10^{-4}
	Receptor Total	*N/A*	*1.3×10^{-4}*	*1.9*	*1.2×10^{-5}*	*0.73*	*N/A*	*N/A*

Table 4 – Summary of Unacceptable Human Health Risks

Receptor	COPC	RME EPC[1]	Total RME		Total CTE		Cancer Toxicity Factor (CSF)[2]	Non-Cancer Toxicity Factor (RfD)[2]
			Cancer Risk	Non-Cancer Hazard	Cancer Risk	Non-Cancer Hazard		
August 2014 HHRA Update								
Future Resident Adult/Child	TCE[3]	6.0	6.5×10^{-6}	N/A	1.7×10^{-6}	N/A	9.3×10^{-3}/ 3.7×10^{-2}	N/A
	VC	16	2.1×10^{-4}	N/A	6.4×10^{-5}	N/A	1.5	N/A
	Receptor Total	*N/A*	*2.2 x 10-[4]*	*N/A*	*6.5×10^{-5}*	*N/A*	*N/A*	*N/A*
Indoor Air								
Future Resident	TCE[4]	5.61 µg/m3	1.0×10^{-5}	2.7	3.0×10^{-6}	0.6	1.0×10^{-6}/ 3.1×10^{-6}	2.0×10^{-3}
	VC	142 µg/m3	9.0×10^{-4}	1.4	7.0×10^{-5}	0.11	4.4×10^{-6}	1.0×10^{-1}
	Receptor Total	*N/A*	*9.0×10^{-4}*	*5.0*	*7.5×10^{-5}*	*0.9*	*N/A*	*N/A*

µg/L – microgram per liter

µg/m3 – microgram per cubic meter

COPC – constituent of potential concern

CSF – cancer slope factor; expressed in mg/kg-day-1 for groundwater.

CTE – central tendency exposure

DCA – dichlorothane

DCE – dichloroethene

EPC – exposure point concentration

IUR – inhalation unit risk factor; expressed in units of µm/m3-1 for indoor air.

N/A – not applicable

PCE – tetrachloroethene

RfD – reference dose; expressed in mg/kg-day for groundwater.

RfC – reference concentration; expressed in mg/m3 for indoor air.

RME – reasonable maximum exposure

TCE – trichloroethene

VC – vinyl chloride

Notes:

[1] For completion of the SRI HHRA the RME EPC for groundwater was calculated as the 95% upper confidence limit (UCL) of the arithmetic mean. In cases where there were less than five samples in the data set, or the recommended UCL exceeded the maximum detected concentration, the maximum concentration was used as the RME EPC. The arithmetic mean concentration was used as the CTE EPC for groundwater. For completion of the August 2014 HHRA update the RME and CTE EPC was the maximum detected concentration. The RME EPC for indoor air was calculated using the maximum detected concentration in groundwater. The CTE EPC for indoor was calculated using the 95% UCL of the mean concentration in groundwater.

[2] Sources: Integrated Risk Information system (IRIS), Health Effects Assessment Summary Tables (HEAST), National Center for Environmental Assessment (NCEA), California Environmental Protection Agency (CalEPA), current at time SRI conducted (2008) for the SRI HHRA and current at the time the 2014 HHRA Update was performed for the 2014 HHRA Update calculations.

[3] Risk estimates for TCE take into account mutagenic mode of action on the kidney (CSF = 9.3×10^{-3}) and are added to the risk estimates for liver and non-Hodgkin's Lymphoma (CSF = 3.7×10^{-2}).

[4] Risk estimates for TCE take into account mutagenic mode of action on the kidney (IUR = 1.110^{-6}) and are added to the risk estimates for liver and non-Hodgkin's Lymphoma (IUR = 3.1×10^{-6}).

Potential unacceptable risks or hazards are shaded yellow. Although the cancer risk from an individual constituent may be within USEPA acceptable risk range of 10^{-4} to 10^{-6}, the constituent contributes a cancer risk greater than 10^{-6} to a cumulative cancer risk above 10^{-4}. Although the HI from an individual constituent may not exceed 1, the constituent contributes a HI >0.1 to a target organ HI above 1.

Table 5 – Risk Management Considerations

Risk Driver	Risk Management Consideration		Detection[1]			MCL	Frequency of Exceedance	Background			
			Frequency	Min	Max			UTL	Frequency of Exceedance	Min	Max
Dibenzofuran	– No CTE risks or hazards above USEPA's acceptable levels (Table 4). – Dibenzofuran was detected in one of five samples collected during the 1998 SI. – Dibenzofuran was not analyzed for during the RI and SRI; however was not detected in 62 groundwater samples collected in January and September 2008.		1/5	28	28	NE	--	NE	--	--	--
Antimony	– RME and CTE HIs for antimony are below 1 (Table 4). Although antimony contributes a CTE HI slightly above 0.1 (HI = 0.16) to a target organ effect above 1 (blood HI = 1.3); thallium contributes an individual HI above 1 (HI = 1.1) to the total target organ effect. – Concentrations of total and dissolved antimony are below the MCL. – Concentrations of dissolved antimony are below background.	Total	5/36	4.9	5.1	6	0/5	ND	5/5	ND	ND
		Dissolved	1/36	4.9	4.9	6	0/1	49	0/1	2.7	31.6
Arsenic	– No discernable plume of arsenic concentrations above the MCL. – Concentrations are within range of detected background concentrations. – Reducing conditions indicated by low DO and negative ORP may have increased the mobility of naturally occurring arsenic.	Total	23/36	1.4 K	27.6	10	6/23	4	12/23	3.9	105
		Dissolved	27/36	1.4 J	25.2	10	4/27	4	11/27	5.4	78
Chromium[2]	– Concentrations are generally similar to or below background. – Concentrations of total and dissolved chromium are below the MCL. – Chromium identified as a potential COC based on comparison of measured total chromium concentrations to hexavalent chromium, the more toxic form of chromium, screening levels. – When calculated, carcinogenic risks for chromium assume all of the detected chromium (measured as total chromium) is in the more toxic hexavalent form of chromium.	Total	9/36	0.7 J	29.9	100	0/9	4.1	3/9	1.1	18.9
		Dissolved	12/36	0.47 J	11.7	100	0/12	2.1	3/12	1.3	2.2
Cobalt[2]	– Concentrations are generally similar to or below background. – The non-cancer hazard and risk-based screening level for cobalt is based on a 2008 non-cancer reference dose (RfD) from the Provisional Peer Reviewed Toxicity Value (PPRTV) database. Confidence in the study used to drive the PPRTV RfD was low to medium, and confidence in the provisional RfD was low (Provisional Peer Reviewed Toxicity Values for Cobalt, Superfund Health Risk Technical Support Center, National Center for Environmental Assessment, Office of Research and Development, USEPA, August 25, 2008).	Total	23/36	0.19 J	23.1	NE	--	2.6	5/23	0.95	21.5
		Dissolved	22/36	0.14 J	22.8	NE	--	1.9	6/21	1.2	55.9

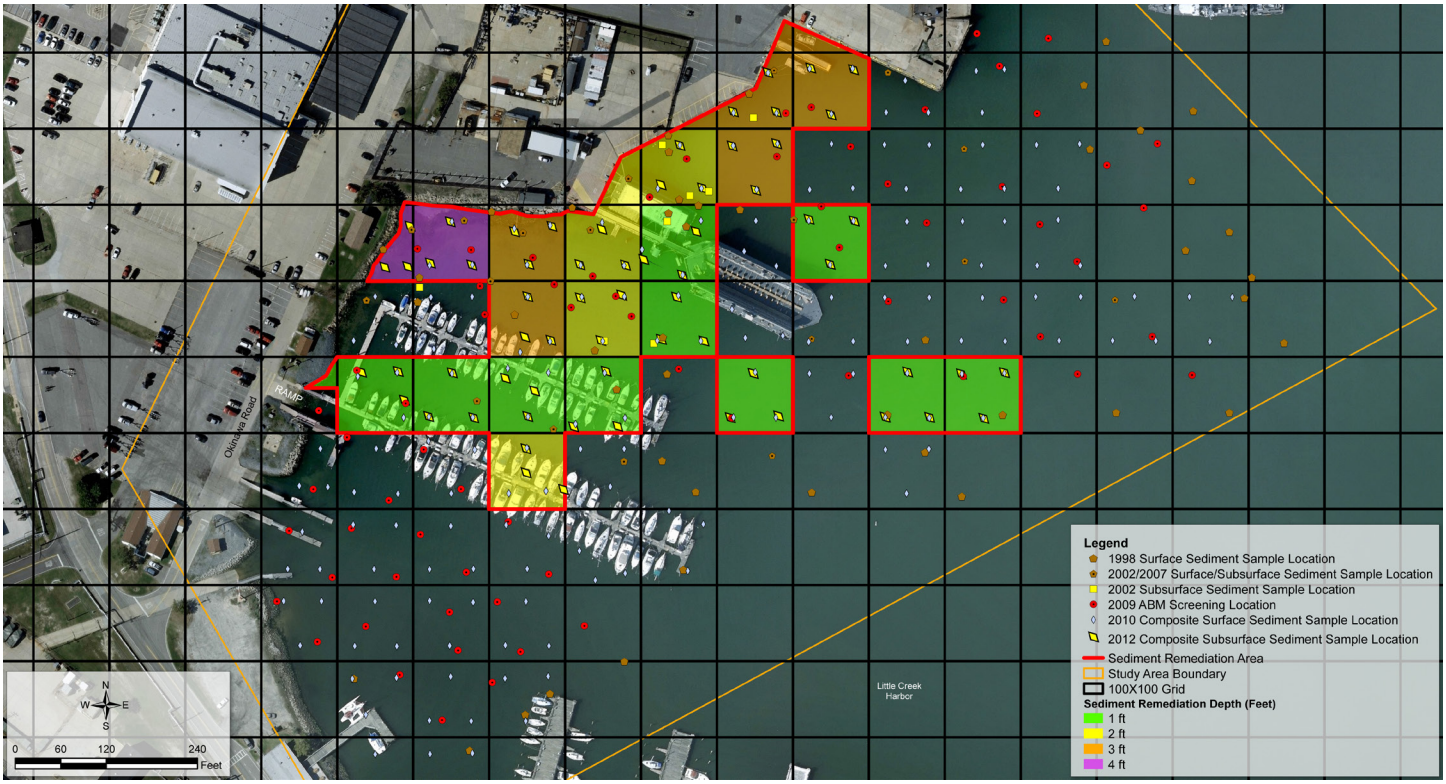
Table 5 – Risk Management Considerations

Risk Driver	Risk Management Consideration		Detection[1]			MCL	Frequency of Exceedance	Background			
			Frequency	Min	Max			UTL	Frequency of Exceedance	Min	Max
Iron	– No CTE risks or hazards above USEPA's acceptable levels (Table 4). – Concentrations are generally similar to background. – Iron is an essential human nutrient. – The estimated RME intake of iron via incidental ingestion of groundwater (0.98 milligrams per kilogram-day) falls within the recommended daily allowance (RDA) range for children ages 6 months to 10 years (0.36–1.11 mg/kg-day) (USEPA, 1999).	Total	34/36	248	35,500	NE	--	11,200	5/34	303	70,800
		Dissolved	30/36	120 J	30,400	NE	--	17,100	3/30	24.9	43,600
Manganese	– No CTE risks or hazards above USEPA's acceptable levels (Table 4). – Concentrations are below background. – Manganese is an essential human nutrient. – The estimated RME child resident daily intake rate is 0.029 mg/kg-day, which corresponds to an intake of 0.44 mg/day lower than the recommended daily allowance for a child 1 to 3 years [1.2 mg/day (Institute of Medicine, 2005)].	Total	31/36	26	1,020	NE	--	1,500	0/31	16.3	1,910
		Dissolved	32/36	23 J	1,200 J	NE	--	1,510	0/32	17.2	1,930
Thallium	– The RME non-cancer HIs are 1.9 and 4.5 for ingestion by future adult and child residents, respectively. There are no CTE hazards for future adult residents. The CTE non-cancer HI of 1.1 for the future child resident is only slightly above USEPA's target HI of 1. – Thallium has not been detected in 46 groundwater samples collected in January 2007, September 2007, January 2008, and September 2008.	Total	6/36	2.5 J	5.5 J	2	6/6	2.5	3/6	4.4	18.4
		Dissolved	6/36	2.5	9 J	2	6/6	4	3/6	3	9.7

Notes:

All concentrations shown in µg/L.
J – Analyte prewsent. Reported value is estimated.
K – Analyte present. Reported value may be biased high.
ND – not detected
NE – not established
[1] Samples collected as part of SI, RI, and SRI.
[2] Constituents identified as COPCs based upon comparison of maximum detected concentrations from SI, RI, and SRI groundwater samples to May 2014 tap-water RSLs. Associated risks were not calculated.

Figure 6 – Sediment Remediation Area



petroleum-like material may have been exposed during dredging activities received approximately 2 feet of sand; the remaining portion of the site received a minimum of 6 inches of sand. Post-sand placement sediment cores were collected to ensure adequate sand placement. Because pre-removal action sampling defined the area requiring dredging and pre- and post-dredge elevation surveys of the sediment surface confirmed successful removal of all contaminated sediment within the NTCRA action area, no post-dredging confirmation sampling was required in this area.

Table 6 – Sediment Preliminary Remediation Goals

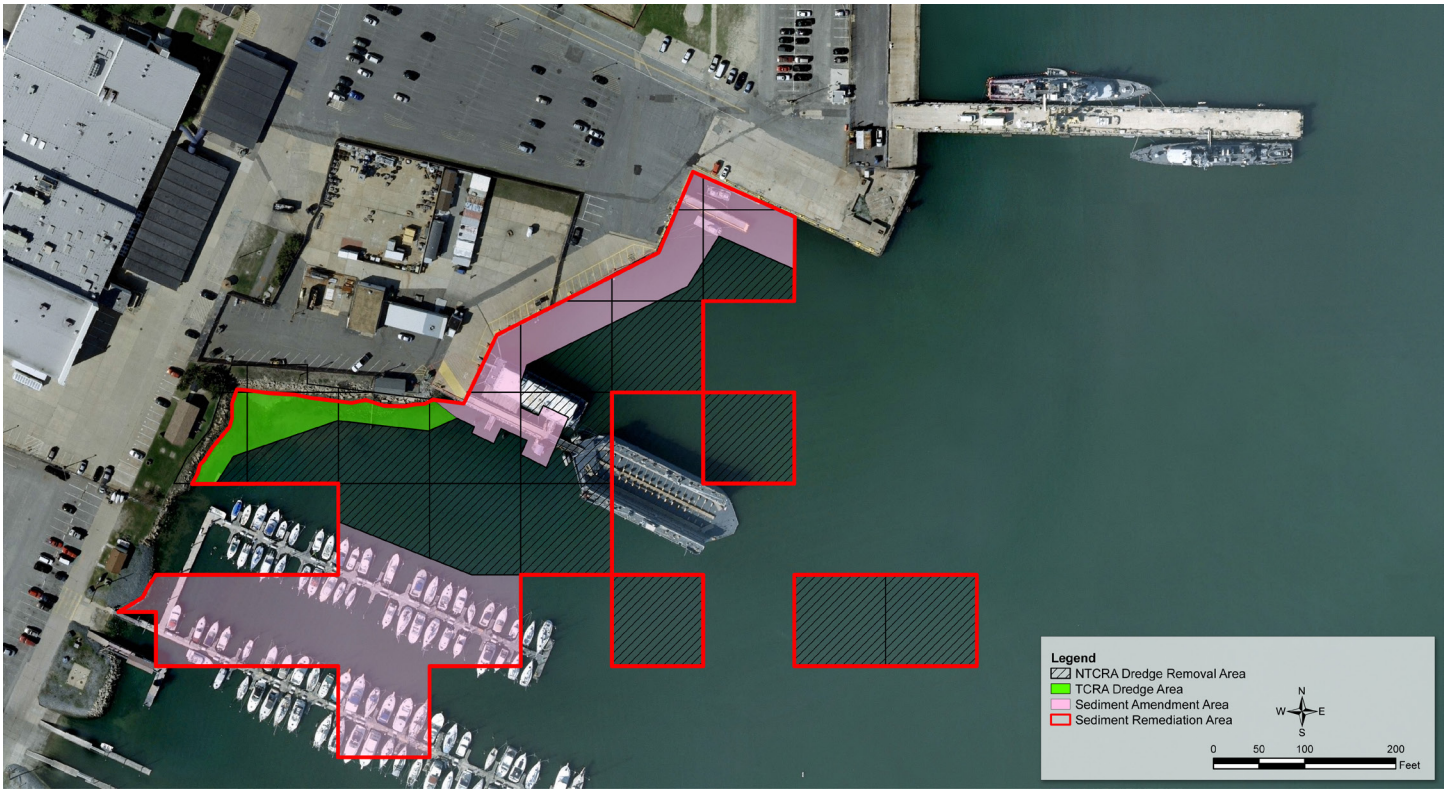
	Copper	Lead	Nickel	Tin	Zinc
Threshold Effects Level	18.7	30.2	15.9	N/A	124
Effects Range-Low	34.0	46.7	20.9	N/A	150
Probable Effects Level	108	112	42.8	N/A	271
Mean Background	155	45.2	23.2	8.61	290
Max Background	184	67.6	26.5	9.80	421
1% ABM	232	107	26.2	11.2	454
Effects Range-Median	270	218	51.6	N/A	410

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

As part of the TCRA, sediments near the rip-rap shoreline were dredged (Figure 7). Prior to and immediately following dredging, elevation surveys of the sediment surface were completed to confirm that the required dredging depths were achieved. Following successful completion of excavation, the site was restored through placement of a minimum of 2 feet of clean imported sand and reconstruction of the shoreline embankment. Post-sand placement elevation surveys of the sediment surface were completed to ensure adequate sand placement. Because pre-removal action sampling defined the area requiring dredging and pre- and post- dredge sediment surface elevation surveys confirmed successful removal of all contaminated sediment within the TCRA excavation area, no post-dredging confirmation sampling was required in this area.

Within the remaining sediment remedial action area, 2 inches of powdered activated carbon was placed on the sediment surface as part of a pebble-like aggregate (also known as a "reactive amendment") to address potential risks associated with metal COCs in sediment. Sediment cores were collected to ensure adequate placement. The Navy and USEPA, in consultation with VDEQ, agreed that the benefits associated with excavation of contaminated sediment to the extent feasible coupled with placement of the reactive amendment, compensate for and effectively reduce any potential ecological risks remaining at the site. Therefore, no post-amendment monitoring is required. Successful removal of contaminated sediment, placement of the reactive amendment, and risk mitigation

Figure 7 – Sediment Removal Action Areas



is documented in the NTCRA Construction Summary Technical Memorandum (CH2M HILL, 2013a) and TCRA CCR (Tetra Tech, 2014).

Based on the results of the ERA and completion of the NTCRA and TCRA, which reduced potentially unacceptable ecological risks attributable to SWMU 3, the Navy and USEPA, in consultation with VDEQ agree no further remedial action is required for sediment to ensure protection of the environment.

6 Remedial Action Objectives

The Navy and USEPA, in consultation with VDEQ, determined that remedial action is necessary to protect public health, welfare, and the environment from actual or threatened releases of VOCs in groundwater. The site-specific **Remedial Action Objectives (RAOs)** are:

- Prevent potable use of groundwater and exposure to groundwater emissions until concentrations of COCs allow for unlimited use and unrestricted exposure.
- Monitor the natural attenuation of groundwater COCs until concentrations allow for unlimited use and unlimited exposure.

Preliminary remediation goals (PRGs) were developed for chemicals with concentrations contributing to unacceptable risks and hazards from exposure to groundwater at SWMU 3. COCs are identified as those site-related chemicals that contribute cancer risks exceeding 1 in 1,000,000 or HIs exceeding 0.1 to cumulative cancer risks exceeding 1 in 10,000 or cumulative target organ HIs exceeding 1 (Table 4). Based on the results of the revised risk assessment conducted in August 2014 as part of the Focused FS and risk management considerations agreed upon by the Navy and USEPA, in consultation with VDEQ, the COCs for SWMU 3 groundwater are TCE and vinyl chloride. To achieve RAOs for unlimited use and unrestricted exposure, PRGs were established as the federal MCLs. PRGs are identified in Table 7.

Table 7 – Preliminary Remediation Goals

COC	PRG	Maximum Concentration
TCE	5	6.01
Vinyl Chloride	2	15.9
Concentrations shown in µg/L.		

Although not identified as site-specific COCs requiring PRGs, the degradation of TCE may result in temporary increases to the concentrations of daughter products cis-1,2-DCE and trans-1,2-DCE. Even if the site-specific COC concentrations reach cleanup levels (MCLs), SWMU 3 cannot reach unlimited use and unrestricted exposure until cis-1,2-DCE and trans-1,2-DCE are below the MCL. As a result, these constituents will be monitored during remedy implementation to ensure concentrations remain below their respective MCLs. The daughter product MCLs are as follows:

- cis-1,2-DCE: 70 µg/L
- trans-1,2-DCE: 100 µg/L

7 Remedial Alternatives Analysis

The Focused FS details the development and evaluation of the following remedial alternatives for SWMU 3:

- Alternative 1: No Action
- Alternative 2: Monitored Natural Attenuation and Land Use Controls

Alternative 1 is the No Action alternative and serves as the baseline for comparison of other alternatives. Under this alternative, no additional effort or resources would be utilized at SWMU 3. Alternative 2 consists of monitored **natural attenuation** of COCs in groundwater and the implementation of land use controls to prevent potable use of groundwater until concentrations of hazardous substances in groundwater have been reduced to levels that allow for unlimited use and unrestricted exposure. The major components of Alternative 2 include:

- Development of a groundwater monitoring plan and periodic groundwater sampling to evaluate continued natural attenuation of COCs in groundwater;
- Implementing land use controls that (a)prohibit potable use of groundwater and prevent exposure to groundwater emissions until groundwater is suitable for unlimited use and unrestricted exposure and (b) maintaining the integrity of groundwater monitoring systems;
- Performing periodic site inspections and associated reporting to ensure continued compliance with land use controls; and
- Conducting 5-year site reviews and preparing reports as required under CERCLA to evaluate the continued effectiveness of the remedy and ensure protection of human health and the environment.

The NCP identifies nine evaluation criteria for use in a comparative analysis of the remedial alternatives.Each remedial alternative for SWMU 3 was evaluated against these criteria in the Focused FS. Definition of the nine evaluation criteria and a comparative analysis of each alternative is summarized in Table 8.

8 Preferred Alternative

Based on the comparative analysis, the preferred alternative is Alternative 2, consisting of monitored natural attenuation and land use controls (Figure 8). Reduction in COC concentrations will be monitored as part of a long-term monitoring plan designed to evaluate the achievement of the RAOs over time, the need for additional action, and site exit strategies. Land use controls will effectively limit site use and protect against future human exposure to groundwater and groundwater emissions that may result in unacceptable risks while natural attenuation processes reduce COCs to concentrations that allow for unlimited use and unrestricted exposure. Implementation of Alternative 2 has minimal associated costs, is straightforward, protective in both the short- and long-term, and meets all federal and state regulations deemed applicable or relevant and appropriate requirements (ARARs). As required by

Figure 8 — Preliminary Remedy Layout

Table 8 – Risk Management Considerations

NCP Criteria	Definition	Comparative Analysis	
		Alternative 1 – No Action	Alternative 2 – Monitored Natural Attenuation and Land Use Controls
Military Munitions Response Program Sites			
Protection of Human Health and the Environment	Addresses whether a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through mitigation, engineering controls, or institutional controls.	Does not meet the RAOs and does not provide protection against future human exposure to VOCs in groundwater.	Meets the RAOs and is protective of human health and the environment. Site COCs naturally attenuate over time from natural processes and LUCs prevent unacceptable risk from exposure to groundwater until concentrations allow for unlimited use and unrestricted exposure.
Compliance with ARARs	Addresses whether a remedy will meet all of the ARARs of Federal and State environmental or facility siting laws and/or justifies a waiver of the requirements.	Does not comply with ARARs. No monitoring will be conducted to evaluate whether PRGs are met.	Complies with ARARs. Site COCs will naturally attenuate to below chemical-specific ARARs; LUCs will be in place in the RAO is achieved, and periodic monitoring will be conducted to evaluate whether PRGs have been met.
Primary Balancing Criteria			
Long-Term Effectiveness and Permanence	Addresses the expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up goals have been met.	All future risks would remain.	Prevents unacceptable exposures over the long-term through site use restrictions and achieves long-term effectiveness and permanence through the natural attenuation of site COCs.
Reduction in Toxicity, Mobility, and Volume Through Treatment	Discusses the anticipated performance of the treatment technologies a remedy may employ.	No Reduction in toxicity, mobility, or volume through treatment because no treatment technologies would be employed.	No Reduction in toxicity, mobility, or volume through treatment because no treatment technologies would be employed, relying instead on natural attenuation processes to remediate groundwater.
Short-Term Effectiveness	Considers the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until clean-up goals are achieved.	No short-term risks to the community or to workers would occur as a result of implementing the action.	Limited short-term risks to the community or to workers resulting from travel to and from the site to conduct periodic groundwater monitoring.
Implementability	Evaluates the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement an option.	Implementable but agency and community acceptance are unlikely.	Readily implementable; requires implementation, monitoring and communication of land use controls.
Cost	Compares the estimated initial, operations and maintenance, and present-worth costs.	$0	$370,000 (-30 percent = $259,000; +50 percent = $555,000)
Modifying Criteria			
State Acceptance	Considers the State support agency comments on the Proposed Plan.	State involvement has been solicited throughout the CERCLA and remedy selection process. VDEQ, as the designated State support agency in Virginia, has reviewed this Proposed Plan and has given concurrence on the preferred alternative.	
Community Acceptance	Provides the public's general response to the alternatives described in the Proposed Plan, RI report, and FS report. The specific responses to the public comments are addressed in the "Responsiveness Summary" section of the ROD.	Public comment period will be held between October 25, 2014 and December 8, 2014. A public meeting will be held on November 18, 2014 at 7:00 pm to present the Proposed Plan and answer community questions regarding the proposed remedial action at SWMU 3. Public acceptance will be evaluated following completion of the public comment period.	

CERCLA, Five-year Reviews will be conducted to evaluate the continued effectiveness of the remedy and ensure to protection of human health and the environment.

The Navy may reconsider the preferred alternative or select another alternative if public comments or additional data indicate that another alternative warrants consideration.

9 Community Participation

The Navy and USEPA provide information regarding the environmental cleanups at JEB Little Creek to the public through the Restoration Advisory Board (RAB), public meetings, the AR file for SWMU 3, and announcements published in *The Virginian-Pilot* newspaper. The public is encouraged to gain a more comprehensive understanding of SWMU 3 and the ERP at JEB Little Creek. To date, public participation activities for SWMU 3 have included annual RAB meetings, as well as public comment periods associated with completion of the NTCRA and TCRA. The public comment period for this Proposed Plan runs from October 25, 2014, to December 8, 2014, and a public meeting will be held November 18, 2014, at 7:00 PM (see page 1 of this report for details). Minutes for the public meeting will be included in the AR file. The Navy will summarize and respond to all comments submitted during the public comment period in a responsiveness summary, which will become a part of the ROD, and will also be included in the AR file for JEB Little Creek.

During the comment period, interested parties may request additional information or submit written comments to the following individual:

Mr. Matthew Stepien
NAVFAC MIDLANT, Code OPHE3
9742 Maryland Avenue
Building N-26, Room 3300
Norfolk, VA 23511-3095
Phone: (757) 341-0380
E-mail: matthew.stepien@navy.mil

Additional information may also be obtained by contacting the following individuals:

Mr. Jeffery Boylan, Code 3HS11
USEPA Region 3
1650 Arch Street
Philadelphia, PA 19103-2029
Phone: (215) 814-2094
E-mail: Boylan.Jeffrey@epamail.epa.gov

Mr. Paul Herman
Virginia Deptartment of Environmental Quality
629 East Main Street
Richmond, VA 23219
Phone: (804) 698-4464
E-mail: paul.herman@deq.virginia.gov

Glossary

This glossary defines in non-technical language the more commonly used environmental terms appearing in this Proposed Plan. The definitions do not constitute the Navy's, USEPA's, or VDEQ's official use of terms and phrases for regulatory purposes, and nothing in this glossary should be construed to alter or supplant any other federal or Commonwealth document. Official terminology may be found in the laws and related regulations as published in such sources as the Congressional Record, Federal Register, and elsewhere.

Abrasive blast material (ABM): Material used under high pressure to smooth a rough surface, roughen a smooth surface, shape a surface, or remove surface contaminants. ABM can be manufactured using minerals, metals, agricultural material, or synthetic material.

Administrative Record (AR): A compilation of site-related information reviewed or relied upon by the Navy and regulatory agencies to make decisions about the site and its cleanup, which is available for public review.

Aquifer: Underground bed of soil or rock from which groundwater can be usefully extracted.

Assessment and measurement endpoint: Measures that focus the risk assessment on particular components of the ecosystem that could be adversely affected by contaminants.

Background: Chemicals or locations that are not influenced by the releases from a site, and usually described as either naturally occurring or anthropogenic. Naturally occurring substances are substances present in the environment that have not been influenced by human activity. Anthropogenic substances are natural- and human-made substances present in the environment as a result of human activities (not specifically related to the CERCLA release in question).

Benthic Invertebrate: Organisms without a backbone living on the floor of a water body.

Bio-augmentation: The addition of necessary nutrients and/or degrading bacteria required to speed up the rate of degradation of a contaminant.

Carcinogenic risk: Carcinogenic risks are expressed as a number reflecting the increased chance that a person will develop cancer if exposed to specific chemicals or substances. For example, USEPA's acceptable risk range for Superfund sites is 1×10^{-6} to 1×10^{-4}, meaning there is 1 additional chance in 1 million (1×10^{-6}) to 1 additional

chance in 10,000 (1×10^{-4}) that a person will develop cancer if exposed to a site that is not remediated.

Central tendency exposure (CTE): The mean concentration of site data, used as an exposure concentration in the risk assessment.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA): A federal law, commonly referred to as the "Superfund" Program, passed in 1980 and was amended by the Superfund Amendments and Reauthorization Act of 1986. CERCLA provides for cleanup and emergency response in connection with existing inactive hazardous waste disposal sites that endanger public health and safety or the environment.

Conceptual site model: A description of a site and its environment that is based on existing knowledge and that assists in planning, interpreting data, and communicating. It describes sources of contamination (such as spills) and receptors (such as humans) and the interactions that link the two.

Contaminant of concern (COC): A contaminant which has been shown through analysis to be likely to cause risk to humans, plants or animals at a site.

Contaminant of potential concern (COPC): A contaminant present in site media (soil, groundwater, surface water, or sediment) at a concentration that exceeds risk screening criteria but has not yet been determined to pose risk; further evaluation is completed to evaluate site-specific risk in quantitative risk assessment.

Desktop audit: Site evaluation conducted through review of all existing documentation/information, including the assessment of information concerning the handling of hazardous wastes, actions taken, or actions that may be occurring under other regulatory programs. Evaluation results are used to determine if the site should be eliminated from further consideration (that is, no further action), identified for a removal action to address actual or imminent threats to human health or the environment, or if further site investigation is warranted.

Ecological: Refers to plants and animals in the environment.

Ecological Risk Assessment (ERA): An evaluation of the potential risk posed to the environment by a contaminant source.

Effects Range-Low: A sediment quality guideline representative of concentrations below which toxicological effects in marine ecological environments are rarely observed or predicted.

Effects Range-Median: A sediment quality guideline representative of concentrations above which toxicological effects in marine ecological environments are generally observed or predicted.

Engineering Evaluation and Cost Analysis (EE/CA): EE/CAs are written for removal actions where a planning period of at least 6 months exists before on-site activities must be initiated. An EE/CA identifies the objectives of the removal action and analyzes the effectiveness, implementability, and cost of various alternatives that may satisfy these objectives.

Enhanced anaerobic bioremediation: Practice of adding hydrogen to groundwater and/or soil to increase the number and vitality of anaerobic (that is, not in the presence of oxygen) microorganisms performing the removal and /or neutralization of contaminants in groundwater and/or soil.

Enhanced reductive dechlorination: An anaerobic (that is, without oxygen) process in which an electron donor source is injected into the subsurface to allow chlorine atoms on a chlorinated VOC molecule to be sequentially replaced with hydrogen in order to break down COCs.

Environmental Restoration Program (ERP): The Navy, as the lead agency, acts in partnership with USEPA Region 3 and VDEQ to address environmental investigations at the facility through the ERP. The current ERP is consistent with CERCLA and applicable state environmental laws.

Exposure pathway: The means by which a person or animal comes into contact with a substance through inhalation, ingestion, or direct contact with the skin, either acute or chronic.

Federal Facility Agreement: A written agreement between the Navy, USEPA, and VDEQ to identify sites of potential historical contamination and implement corrective actions based on public health and environmental considerations. The FFA outlines the roles and responsibilities of each party, and sets timetables for cleanup actions. Among other requirements, the agreement outlines a process to insure regulatory authority and oversight.

Groundwater: Subsurface water that occurs in soil and geologic formations that are fully saturated.

Human Health Risk Assessment (HHRA): An evaluation of the risk posed to human health if remedial activities are not implemented.

Land use controls: Physical, legal, or administrative methods that restrict the use of or limit access to property to reduce risks to human health and the environment.

Lower-trophic-level receptors: Animals or plants that are at the lower end of the food chain and are consumed by upper-trophic-level receptors. Lower-trophic-level receptors may be exposed to contaminants at a given site through direct contact and/or ingestion.

Media (singular, medium): Soil, groundwater, surface water, or sediment at the site.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP): Provides the organizational structure and procedures needed to prepare for and respond to discharges of oil and releases of hazardous substances, pollutants, and contaminants.

National Priorities List (NPL): A list developed by the USEPA of uncontrolled hazardous substance release sites in the United States that are considered priorities for long-term remedial evaluation and response.

Natural attenuation/degradation: Reduction in mass or concentration of a chemical over time or distance from the source due to naturally occurring physical, chemical, and biological processes.

Naval Facilities Engineering Command (NAVFAC): Global organization that provides planning, design, and construction of shore facilities for Navy activities around the world.

No Further Action: A determination that site characterization is complete and that, if applicable, removal and/or remedial actions have achieved their objectives, and that no additional investigation or action is required for a site.

Non-Carcinogenic Hazard: Adverse human health effects other than cancer which are caused by contaminants present at a site. Non-carcinogenic hazards are expressed as a quotient that compares the existing level of exposure to the acceptable level of exposure. There is a level of exposure (the reference dose) below which it is unlikely for even a sensitive population to experience adverse health effects. USEPA's threshold level for non-cancer hazard at Superfund sites is 1, meaning that if the exposure exceeds the threshold; there may be a concern for potential non-carcinogenic effects.

Non-time-critical removal action (NTCRA): A removal action conducted at a Superfund site where a planning period of at least 6 months exists before on-site activities must be initiated.

Polycyclic aromatic hydrocarbon (PAH): Any of a class of carcinogenic organic molecules that consist of three or more benzene rings that are commonly produced by fossil fuel combustion.

Polychlorinated biphenyl (PCB): A type of industrial compound, such as lubricants, heat-transfer fluids, and plasticizers, that accumulates in animal tissue and results in adverse health conditions. The manufacture and use of PCBs has been regulated since the 1970s because they are very harmful to the environment.

Potable: Suitable for use as a source of water for human consumption.

Preliminary remediation goals (PRG): Chemical specific concentration goals for specific media and land use combinations that serve as a target to use during the initial development, analysis, and selection of cleanup alternatives. These goals should both be protective of human health and the environment and comply with all ARARs for all exposure pathways being addressed.

Principal threat wastes: Source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur.

Probable Effects Level: A sediment quality guideline representative of concentrations that will likely cause toxicological effects in marine ecological environments.

Proposed Plan: A Proposed Plan is a document that presents a proposed cleanup alternative and requests public input.

Public comment period: The time allowed for the members of an affected community to express views and concerns regarding an action proposed to be taken by the Navy and USEPA, such as a rulemaking, permit, or Superfund-remedy selection.

Reasonable maximum exposure (RME): The highest level of site chemical concentrations a human can reasonably be expected to be exposed to under different exposure scenarios.

Receptors: Humans, animals, or plants that may be exposed to contaminants related to a given site.

Record of Decision (ROD): A legal document that describes the cleanup action or remedy selected for a site, the basis for choosing that remedy, and public comments on alternative remedies.

Remedial action objectives: Cleanup objectives for a site that are developed based on contaminated media, COCs, potential receptors and exposure scenarios, HHRA and ERA results, and attainment of regulatory cleanup levels, if any exist.

Remedial action: Those actions consistent with a permanent remedy taken instead of, or in addition to, removal action in the event of a release or threatened release of a hazardous substance into the environment

Remedial Investigation (RI): A study that supports the selection of a remedy where hazardous substances have been disposed of or released. The RI identifies the nature and extent of contamination at the facility.

Remedial Investigation/Human Health Risk Assessment/Ecological Risk Assessment (RI/HHRA/ERA): See "Remedial Investigation," "Human Health Risk Assessment," and "Ecological Risk Assessment."

Restoration Advisory Board (RAB): An advisory group for the restoration process with members from the public, the Navy, and the regulatory agencies.

The purpose of the RAB is to gain effective input from stakeholders on cleanup activities and increase installation responsiveness to the community's environmental restoration concerns.

Screening criteria: Screening criteria are numerical values used in environmental site assessments to identify potential human health and/or ecological hazards in site media (groundwater, soil, sediment, and surface water).

Sediment: Particulate matter that can be transported by fluid flow and that is found submerged underwater in surface water systems.

Site: The area where a hazardous substance, hazardous waste, hazardous chemical, pollutant, or contaminant from the facility has been deposited, stored, disposed of, or placed; has migrated; or otherwise come to be located.

Site Management Plan (SMP): An annual report that provides a management tool for NAVFAC, VDEQ, USEPA, and contractors for use in planning, scheduling, and setting priorities for environmental remedial response activities to be conducted at a base. The SMP establishes schedules and conceptual approaches for continued CERCLA activities.

Soil: A mixture of organic and inorganic solids, air, water, and biota that exists on the earth's surface above bedrock, including materials of anthropogenic sources, such as slag and sludge.

Solid Waste Management Unit (SWMU): Any discernible unit in which wastes have been placed at any time, regardless of whether the unit was designed to accept solid waste or hazardous waste, and from which contaminants may migrate. Units include, but are not limited to, old landfills, wastewater treatment tanks, container storage areas, surface impoundments, waste piles, land treatment units, incinerators, injection wells, recycling operations, leaking process or waste collection sewers, and transfer stations. SWMUs include any area at a facility at which solid wastes have been routinely and systematically released. Only past releases from SWMUs that also meet the definition of a CERCLA release are eligible for remediation through the ERP.

Surface water: All water naturally open to the atmosphere (for example, rivers, lakes, reservoirs, ponds, streams, impoundments, seas, and estuaries).

Threshold Effects Level: A sediment quality guideline representative of concentrations above which toxicological effects in marine ecological environments will be produced and below which will not be produced.

Time-critical removal action (TCRA): A removal action conducted at a Superfund site where a planning period of at least 6 months does not exists before on-site activities must be initiated.

United States Environmental Protection Agency (USEPA): The federal agency responsible for administration and enforcement of CERCLA (and other federal environmental statutes and regulations), and with final approval authority for the selected remedy.

Upper-trophic-level receptors: Humans or animals that are at the upper end of the food chain and consume lower-trophic-level receptors. Upper-trophic-level receptors may be exposed to contaminants at a given site through direct exposure or via the food web.

Virginia Department of Environmental Quality (VDEQ): The Commonwealth of Virginia agency responsible for administration and enforcement of environmental regulations.

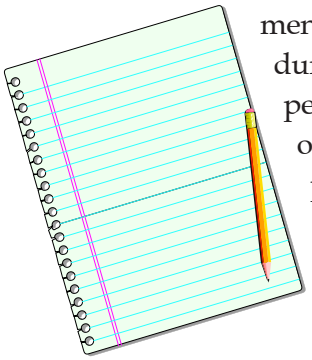
Volatile organic compound (VOC): A compound that easily vaporizes and has low water solubility. Many VOCs are manufactured chemicals that are associated with paint, solvents, and petroleum.

Please print or type your comments below.

Mark Your Calendar for the Public Comment Period

Public Comment Period

October 25, 2014 – December 8, 2014

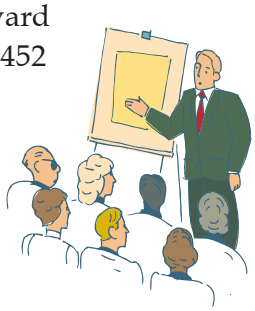


The Navy will accept written comments on this Proposed Plan during the public comment period. To submit comments or obtain further information, please refer to the names and contact information included at the end of Section 9. A blank sheet has been added at the end of the document to be used for writing comments.

Attend the Public Meeting

November 18, 2014
7:00 — 7:30 pm

Virginia Beach Central Library
Folio Conference Room
4100 Virginia Beach Boulevard
Virginia Beach, Virginia 23452



The Navy will hold a public meeting to explain the Proposed Plan. Verbal and written comments will be accepted at this meeting.

Administrative Record can be viewed here:
http://www.navfac.navy.mil/products_and_services/ev/products_and_services/env_restoration.html

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Place stamp here

Mr. Matthew Stepien
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