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NAB LITTLE CREEK
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FINAL RECORD OF DECISION FOR SITE 11A BUILDING 3033 FORMER VEHICLE REPAIR FACILITY AND WASTE OIL TANK JEB LITTLE CREEK VA

08/01/2011

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Final

Record of Decision

Site 11a: Building 3033 Former Vehicle Repair Facility and Waste Oil Tank

Joint Expeditionary Base Little Creek

August 2011

1. Declaration

This Record of Decision (ROD) presents the selected remedy for Site 11a, Building 3033 Former Vehicle Repair Facility and Waste Oil Tank, at Joint Expeditionary Base (JEB) Little Creek, Virginia Beach, Virginia. Naval Amphibious Base (NAB) Little Creek (now referred to as JEB Little Creek) was placed on the United States Environmental Protection Agency (USEPA) National Priorities List (NPL) May 10, 1999 (USEPA ID: VA5170022482). This remedy was selected in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on information contained in the Administrative Record file for JEB Little Creek.

On October 1, 2009, Hampton Roads' first Joint Base was established. This new installation comprises the former NAB Little Creek and the Army post Fort Story; the new name is JEB Little Creek-Fort Story. With the forming of this new command, the Navy assumes responsibility for managing both properties and will now merge public meetings regarding the ongoing environmental restoration. 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 Environmental Restoration Program (ERP) documents, the bases will be referred to separately as JEB Little Creek and JEB Fort Story. This ROD contains information associated with the ERP at JEB Little Creek and does not discuss the ERP at JEB Fort Story.

The Department of the Navy (Navy) is the lead agency and provides funding for site cleanups at JEB Little Creek. The Navy and USEPA Region III, the lead regulatory agency, issue this ROD jointly. The Virginia Department of Environmental Quality (VDEQ), the supporting regulatory agency, concurs with the Selected Remedy.

1.1 Description of the Selected Remedy

The response action selected in this ROD is necessary to protect public health, welfare, and the environment from actual or threatened releases of contaminants from Site 11a. Under current and reasonably anticipated land use scenarios, groundwater is not anticipated to be used as a potable water supply. Previous investigations have identified the presence of volatile organic compounds (VOCs) tetrachloroethene (PCE) and trichloroethene (TCE) in shallow groundwater (Columbia aquifer) at concentrations that pose a potential threat to human health. The selected remedy for Site 11a is groundwater treatment through enhanced reductive dechlorination (ERD). Performance monitoring and long-term monitoring will be conducted throughout the active treatment period to

ensure: 1) effective and optimal conditions are established for the mitigation of VOCs; 2) the treatment process is performing effectively; and 3) the remedy remains protective of human health and the environment. Land use controls (LUCs) will be maintained on groundwater and associated property use within the boundaries of Site 11a until concentrations of hazardous substances in the groundwater have been reduced to levels that allow for unlimited use and unrestricted exposure.

The selected remedy is protective of human health and the environment, complies with federal and state regulations that are applicable or relevant and appropriate to the remedial action, is cost-effective, utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable, and satisfies the preference for treatment as a principal element of the remedy. Because the remedy will result in hazardous substances, pollutants or contaminants remaining onsite above levels that allow for unlimited use and unrestricted exposure, the Navy will conduct statutory reviews every 5 years after initiation of remedial action to ensure that the remedy is protective of human health and the environment. In accordance with current policy, the Naval Facilities Engineering Command (NAVFAC), Mid-Atlantic, will conduct the first statutory remedy review concurrent with the next scheduled review for JEB Little Creek in 2014.

1.2 Data Certification Checklist

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record file for JEB Little Creek, Site 11a.

- Chemicals of concern (COCs) and their respective maximum concentrations (Section 2.4)
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater (Section 2.5)
- Baseline risk represented by the COCs (Section 2.6)
- Cleanup levels established for COCs and the basis for these levels (Section 2.8)
- Estimated capital, annual operation and maintenance (O&M), and total present-worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (Section 2.9, Table 3)
- Key factor(s) that led to selecting the remedy (i.e., describe how the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (Section 2.10.1)
- Potential land and groundwater use that will be available at the site as a result of the selected remedy (Section 2.10.4, Table 5)

1.3 Authorizing Signatures

C. L. Stuppard
Captain, U.S. Navy
Commander, JEB Little Creek-Fort Story
Virginia Beach, Virginia

24 Aug 11
Date

Ronald J. Borsellino, Director
Hazardous Site Cleanup Division
USEPA (Region III)

September 7, 2011
Date

2 Decision Summary

2.1 Site Description and History

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

Site 11a is a former vehicle repair facility and associated underground storage tank in the central portion of JEB Little Creek (Figure 2). The Site 11a boundary encompasses approximately 7 acres. Site 11a was identified in 1998 when VOCs were detected in groundwater from an ERP Site 11 **upgradient monitoring well**[1][a] (LS11-MW16D) during the Site 11 Supplemental Remedial Investigation (RI). Groundwater samples were collected in 1999 in the Site 11a vicinity as part of Site 11 investigations to identify a potential upgradient source of VOCs. Consequently, the TCE groundwater contamination upgradient of Site 11 became identified in the Federal Facilities Agreement (FFA) in 2003 as Site 11a, an Appendix B Preliminary Screening Area, and was proposed for investigation under CERCLA.

Currently, surface features at Site 11a consist of Buildings 3606 and 3606A, their surrounding asphalt parking areas, and an open mown grass field (Figure 2). Building 3606 is a five-story barracks building used as a single residence lodging for active duty personnel. Building 3606A is a one-story building used primarily for administrative and recreational activities associated with the barracks. The open field south of Building 3606 is used primarily as a recreational area for building occupants.

Two former buildings, Buildings 3033 and 3034, were located at the site (Figure 2). Former Building 3033, used as a 12-bay vehicle repair facility, was immediately south of the current barracks building. Historical records indicate the presence of an underground waste oil tank associated with the vehicle repair activities. The tank was identified as **solid waste management unit (SWMU) 60**[2] in the SWMU/Installation Restoration (IR) Summary report. The contents of the tank were not documented, and there is no record of solvent disposal in the tank. The tank was reportedly excavated and removed in 1988 under the VDEQ Underground Storage Tank Program. Prior to JEB Little Creek's placement on the NPL in 1999, SWMU 60 was closed under CERCLA with no further action following a desktop audit. Subsequently, SWMU 60 was documented in the FFA as being closed with no further CERCLA action. Former Building 3034, used as a garden supply center, was in the grass-covered field. No releases associated with this building have been documented.

[a] **Bold blue text** identifies detailed site information available in the Administrative Record and listed in the References Table in the order in which they appear in this ROD.

FIGURE 1
Site Location

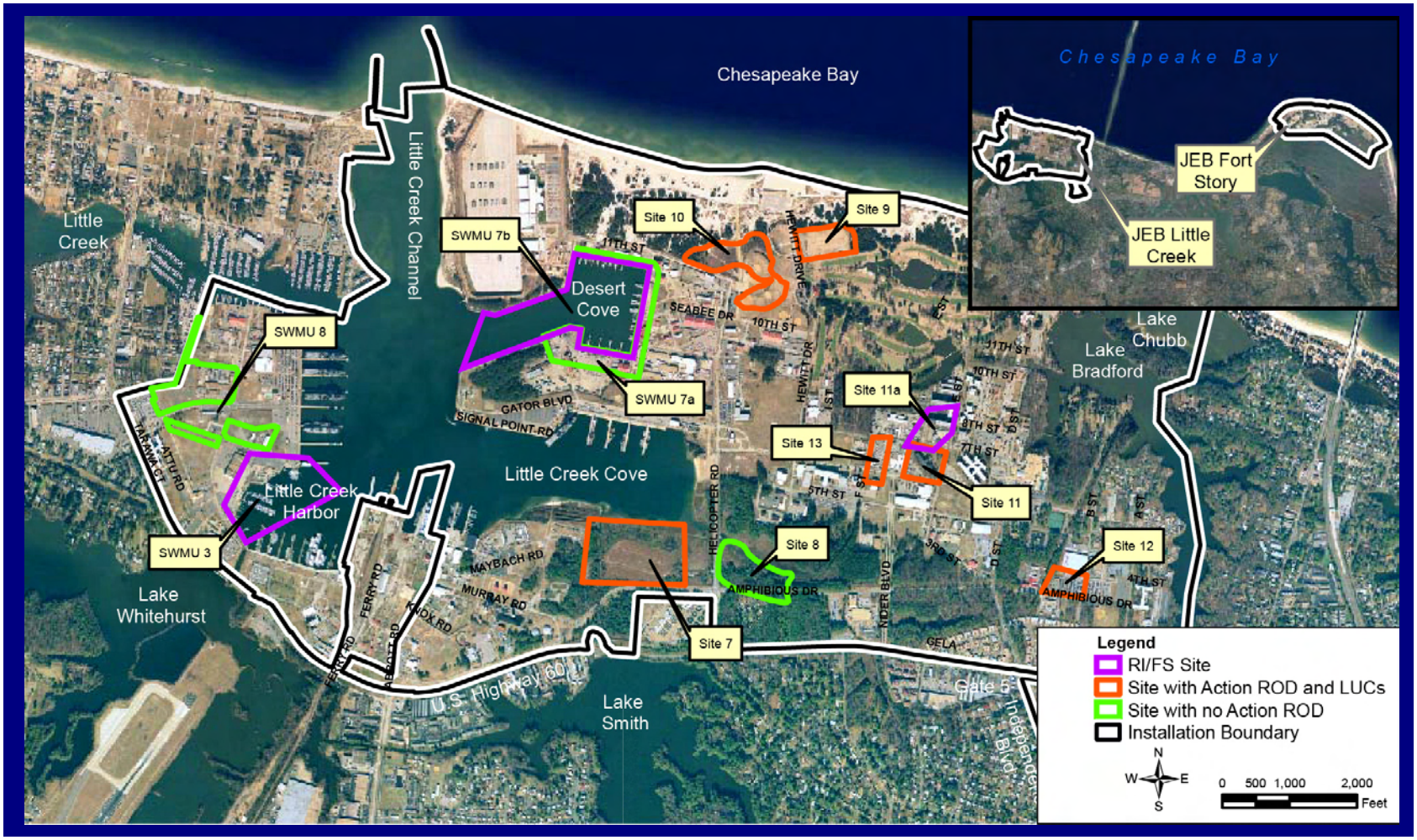


FIGURE 2
Site 11a Boundary and Vicinity

2.2 Previous Investigations

Site 11a was characterized under several investigations and studies between 2001 and 2011. Table 1 provides a chronological list and summary of previous investigations conducted at Site 11a. The respective investigations are a part of the Administrative Record file for JEB Little Creek and can be referenced for further details regarding specific sampling strategies, media investigations, and when and where the sampling was performed.

TABLE 1
Previous Studies and Investigations Summary

Previous Study / Investigation*	Date	Investigation Activities
Groundwater Investigation	2001	A groundwater investigation was conducted to investigate VOCs upgradient of Site 11 and define a potential source area. TCE was the only VOC detected above its maximum contaminant level (MCL). Investigation results confirmed VOCs were present in groundwater upgradient of Site 11; however, a source was not identified. As a result of this investigation, the Navy, USEPA, and VDEQ agreed to separate the upgradient area of Site 11 into a new site, Site 11a.
Supplemental Investigation	2002	Groundwater and soil sampling was conducted to delineate the nature and extent of contamination and identify a potential TCE source area within the soil at Site 11a. VOCs were not detected in the soil at concentrations likely contributing to VOC concentrations detected in groundwater. The supplemental investigation recommended additional investigation of VOCs in groundwater.
Membrane Interface Probe Investigation	2003	Soil and groundwater were investigated to further delineate the VOC plume. Results indicated VOCs were present throughout the shallow groundwater (Columbia aquifer) in the northern portion of the plume and limited to the deeper portion of the aquifer toward the southwest, indicating a potential source area located to the north. It was recommended that additional groundwater sampling be conducted to assess the horizontal and vertical extent of VOCs in groundwater.
Monitoring Well Installation and Groundwater Sampling	2004	Groundwater samples were collected to assess horizontal and vertical distribution of the VOC plume. PCE, TCE, and vinyl chloride (VC) were detected at concentrations exceeding their corresponding MCLs; however, no notable differences in VOC concentrations with respect to depth were observed. It was recommended that a **treatability study**[3] be conducted to evaluate potential treatment technologies for remediation of VOCs in groundwater.
Site 11a Treatability Study	2005	A treatability study was conducted to test the effectiveness of in situ chemical oxidation (ISCO) in treating VOCs in groundwater. A mixture of ferrous sulfate, hydrochloric acid, and sodium persulfate, followed by hydrogen peroxide, was injected into the shallow groundwater. Baseline (pre-injection) and 1, 3, and 6-month post-injection groundwater sampling was conducted to evaluate the effectiveness of the substrate at reducing VOC concentrations. The results of the treatability study indicated that **ISCO was not effective in reducing VOC concentrations**[4] consistently across the treatment area, likely a result of insufficient distribution of reagent in the aquifer.
Site 11a Remedial Investigation	2007	Groundwater and soil samples were collected to define the nature and extent of contamination and assess potential risks to human health and the environment. PCE, TCE, and pentachlorophenol (PCP) were detected at concentrations exceeding their corresponding MCLs. Although previously detected above the MCL, VC was not detected above the MCL during the RI. The RI concluded **PCE, TCE, PCP, and manganese in groundwater pose potential risks to human health**[5]. No risk associated with exposure to soil was identified. Additionally, the RI concluded there were **no unacceptable risks to ecological receptors**[6]. The RI recommended evaluation of the vapor intrusion pathway, further evaluation of PCP in groundwater, and development of a Feasibility Study (FS) to evaluate potential remedial alternatives to mitigate unacceptable human health risks associated with exposure to groundwater at Site 11a.
Site 11a Data Gap Investigation	2009	Groundwater sampling was conducted to confirm the presence of PCP in groundwater. PCP was not detected, so it was concluded that no PCP plume is present at the site and **no remedial action for PCP**[7] is required.

TABLE 1
Previous Studies and Investigations Summary

Previous Study / Investigation*	Date	Investigation Activities
Site 11a Remedial Investigation Addendum	2010	Subslab vapor and indoor air samples were collected to evaluate potential human health risks associated with exposure to groundwater emissions in indoor air via the vapor intrusion pathway. Results indicated there are no unacceptable risks to current or future occupants of Buildings 3606 and 3606A under existing building conditions and **no action is warranted for vapor intrusion**[8]. However, due to detections of VOCs in subslab vapor and the potential for concentrations of groundwater COCs to temporarily increase during implementation of a remedial action, future degradation of existing building conditions may increase the potential for unacceptable risks. Based on the presence of VOCs in shallow groundwater, it was assumed that vapor intrusion would pose potential risks to occupants of hypothetical future buildings constructed at the site. The RI Addendum recommended conducting vapor intrusion monitoring for Building 3606 and 3606A during implementation of the remedial action for groundwater and implementing LUCs to maintain current building use and prevent future building construction at the site without further investigation/evaluation of the vapor intrusion pathway.
Site 11a Feasibility Study	2011	Eleven **groundwater remediation technologies**[9] were screened for the development of remedial alternatives to mitigate potential human health risks associated with exposure to COCs in shallow groundwater. The technologies screened included institutional controls, long-term monitoring, in situ treatment [i.e. ISCO, ERD, air sparge/soil vapor extraction (AS/SVE), and pump and treat], and thermal treatment. Five remedial technologies were retained for further consideration based on their potential to most effectively reduce contaminant concentrations with minimal impacts to land use, have high implementability, and/or are cost-effective given the chemical concentrations at the site. These technologies were combined to develop four remedial alternatives for detailed comparative analysis. The remedial alternatives evaluated in the FS are: 1) No action, 2) ERD, 3) ISCO and ERD, and 4) AS/SVE.

Note:*The documents listed are available in the Administrative Record file for JEB little Creek and provide detailed information used to support remedy selection at Site 11a.

2.3 Scope and Role of Response Action

Site 11a is one of several ERP sites that are part of the comprehensive environmental investigation and cleanup currently being performed at JEB Little Creek under the CERCLA program. In addition to Site 11a, the following sites are currently in the RI/FS stage of the CERCLA process:

- SWMU 3 – Pier 10 Sandblast Yard
- SWMU 7b – Small Boats Sandblast Yard (Desert Cove)

The following sites have a Final ROD in place:

- SWMU 7a: No Action ROD
- SWMU 8: No Action ROD
- Site 7: Action ROD for maintenance of the existing soil cover, LUCs, and groundwater monitoring
- Site 8: No Action ROD
- Sites 9 and 10: Action ROD for LUCs and groundwater monitoring
- Site 11: Action ROD for enhanced anaerobic bioremediation with LUCs and post-treatment groundwater monitoring

- Site 12: Action ROD for enhanced anaerobic bioremediation with LUCs and post-treatment groundwater monitoring
- Site 13: Action ROD for enhanced anaerobic bioremediation with LUCs and post-treatment groundwater monitoring

Seventeen additional 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 2). Site 11a was recommended for further investigation. 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 no potential threat to public health, welfare, or the environment or the site is addressed by other environmental programs. Seven Military Munitions Response Program (MMRP) sites were identified for Preliminary Assessment. Of the seven sites, two were concluded to require no action under CERCLA following completion of the preliminary assessment (Table 2). 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. Details of these investigations can be found in the current version of the **Site Management Plan**[10], which is updated annually and is available in the Administrative Record file for JEB Little Creek. This ROD documents the final remedy for Site 11a and does not include the other sites at the facility.

2.4 Site Characteristics

A conceptual site model (Figure 3) has been developed to summarize the site conditions, contaminant distribution, transport pathways, potential receptors and exposure pathways, and land use data collected during site investigations. The Site 11a boundary encompasses approximately 7 acres. The topography is flat; unpaved areas have been landscaped with shrubs, bushes, grass, and several large trees surrounding Buildings 3606 and 3606A. There are no natural drainage features evident and no surface water bodies on or near the site; therefore, no sediment or surface water is associated with the site. Stormwater drop inlets at the site convey surface runoff to outfalls (covered under general VDEQ VPDES permit VAR05) that discharge to surface water bodies within JEB Little Creek.

Shallow groundwater (Columbia aquifer) at Site 11a is encountered from 5 to 10 feet below ground surface (bgs). The groundwater flow direction fluctuates based on weather events, but is predominantly to the southwest. Groundwater gradient underlying Site 11a is relatively flat and varies by less than 1 foot across the site. The average shallow groundwater flow velocity is estimated to be 2.4 feet per year. The Columbia aquifer 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 community by the City of Virginia Beach.

The subsurface geology at Site 11a consists of primarily medium- and fine-grained sands of the Columbia aquifer, underlain by the high-plasticity clay of the Yorktown confining unit. The Columbia aquifer extends to a depth of between 20 to 30 feet bgs where the Yorktown confining unit separates the Columbia aquifer from the underlying Yorktown aquifer. Yorktown aquifer groundwater samples have demonstrated the shallow groundwater contamination has not migrated through the Yorktown confining unit. Groundwater flow in the Yorktown aquifer is north toward the Chesapeake Bay. Groundwater wells at the Base golf course, approximately 1,900 feet northwest of Site 11a, provide water from the Yorktown aquifer for irrigation of the golf course.

The suspected sources of contamination at Site 11a are former Building 3033 and its associated former underground storage tank. Numerous investigations have been conducted to characterize potential impacts to site media. Sample locations are depicted on Figure 4. No contamination has been identified in site soil, and no sediment or surface water is present on or adjacent to the site.

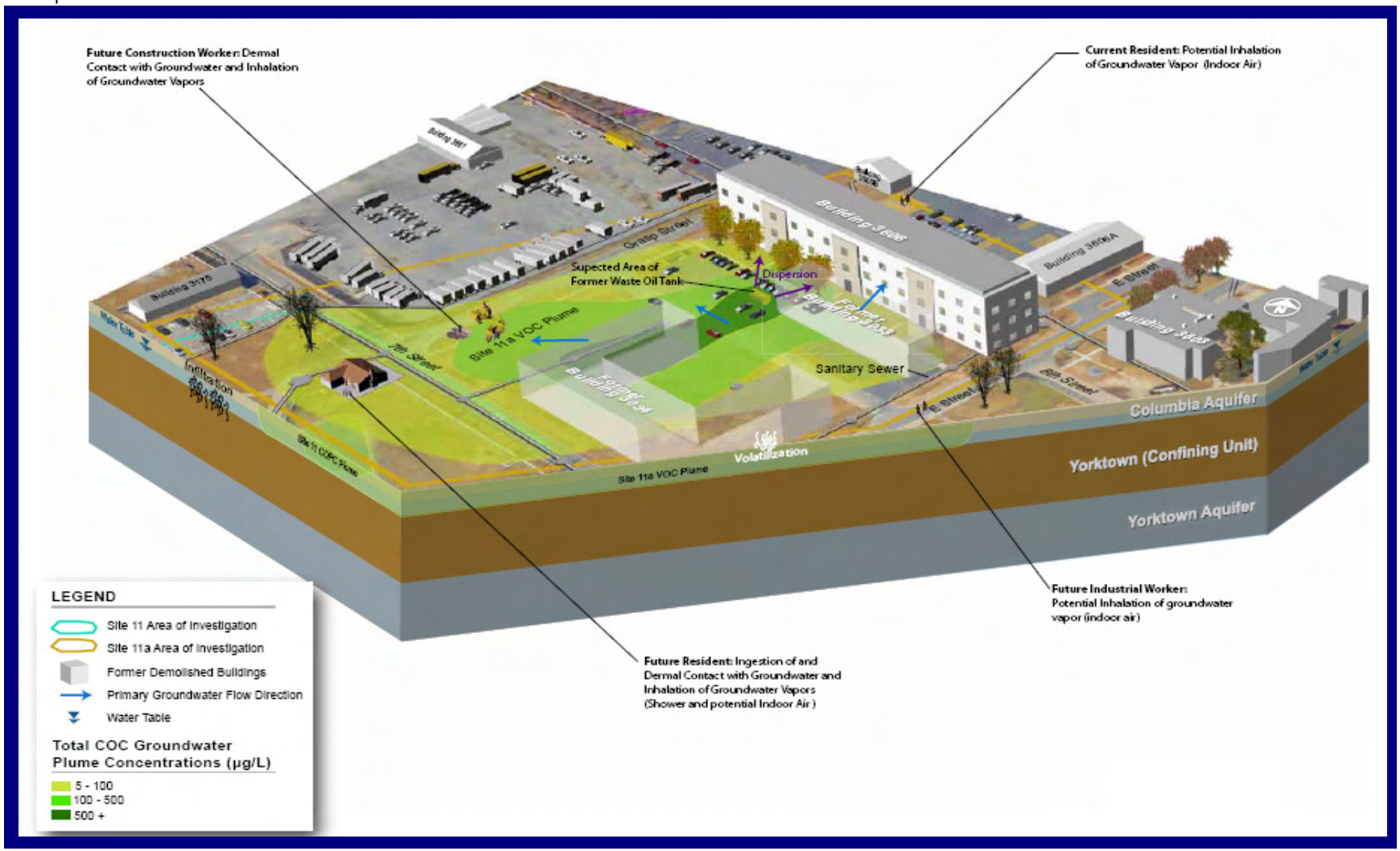
TABLE 2
Site and Preliminary Screening Area Closeout Summary

Site/Preliminary Screening Area	Investigation Activity	Determination	Closeout Documentation
Federal Facility Agreement Sites			
SWMU 30 – Leaking Above Ground Diesel Tank	Desktop evaluation and site visit.	Above ground storage tank (AST) and surrounding berm are in good condition. Further assessment will be conducted under Spill Prevention, Control, and Countermeasures (SPCC) Plan/AST Program.	Final June 2003 Tier I Partnering Team Meeting Minutes, Consensus Statement.
SWMU 96 – Scrap Metal Storage Area	Desktop evaluation and site visit.	Currently an active equipment storage area operated under facility protocols for maintaining best management practices (BMPs). No evidence of a CERCLA release. No further action required.	Final Closeout Report Appendix B Sites SWMUs 96, 97, 98, and 119, Naval Amphibious Base Little Creek, Virginia Beach, Virginia. September 2004.
SWMU 97 – Vehicle Maintenance Facility Storm Drain		Active storm drain operated under the facility VPDES 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.	
AOC H – Buildings 3109 and 3360 at Golf Course (Pesticide Mixing Area)	Soil samples collected.	Potential risks to human health and ecological receptors are minimal and no further action is required.	Final Close-Out Report Appendix B Sites Areas Of Concern – H, I, J, and Site 14, Naval Amphibious Base 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 IR Sites 9 and 10	Soil and groundwater samples collected.		
IS Site 14 – Old Pole Yard and Transformer Storage Area	Soil samples collected.		
SWMU 18 – PWC Trans. Garage Spent battery Shop, Collection Area	Desktop evaluation 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 (MWR) Boat Maintenance Facility			
AOC D – PCB Transformer Leak			

TABLE 2
Site and Preliminary Screening Area Closeout Summary

Site/Preliminary Screening Area	Investigation Activity	Determination	Closeout Documentation
Federal Facility Agreement Sites			
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, Naval Amphibious base Little Creek, Virginia Beach, Virginia. January 2006.
SWMU 6 – Seabee Area – CB124	Soil and groundwater samples collected.		
SWMU 13 – Former Pesticide Shop	Soil and groundwater samples collected.		
IR Site 6 – Special Boat Unit Battery Storage Yard	Soil and groundwater samples collected.		
Military Munitions Response Program Sites			
Chemical Defense Area	Desktop evaluation.	No evidence of a CERCLA release or potential unacceptable risks. No further action is required.	Final Preliminary Assessment, Naval Amphibious Base Little Creek. September 2007.
1942 Pistol Range	Desktop evaluation.	No evidence of a CERCLA release or potential unacceptable risks. No further action is required.	
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, Naval Amphibious Base Little Creek, Joint Expeditionary Base 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, Naval Amphibious Base Little Creek, Joint Expeditionary Base 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, Naval Amphibious Base Little Creek, Joint Expeditionary Base Little Creek-Fort Story, Virginia Beach, Virginia. January 2011.

FIGURE 3
Conceptual Site Model



Note: There is no complete pathway for ecological receptor exposure to groundwater at Site 11a.

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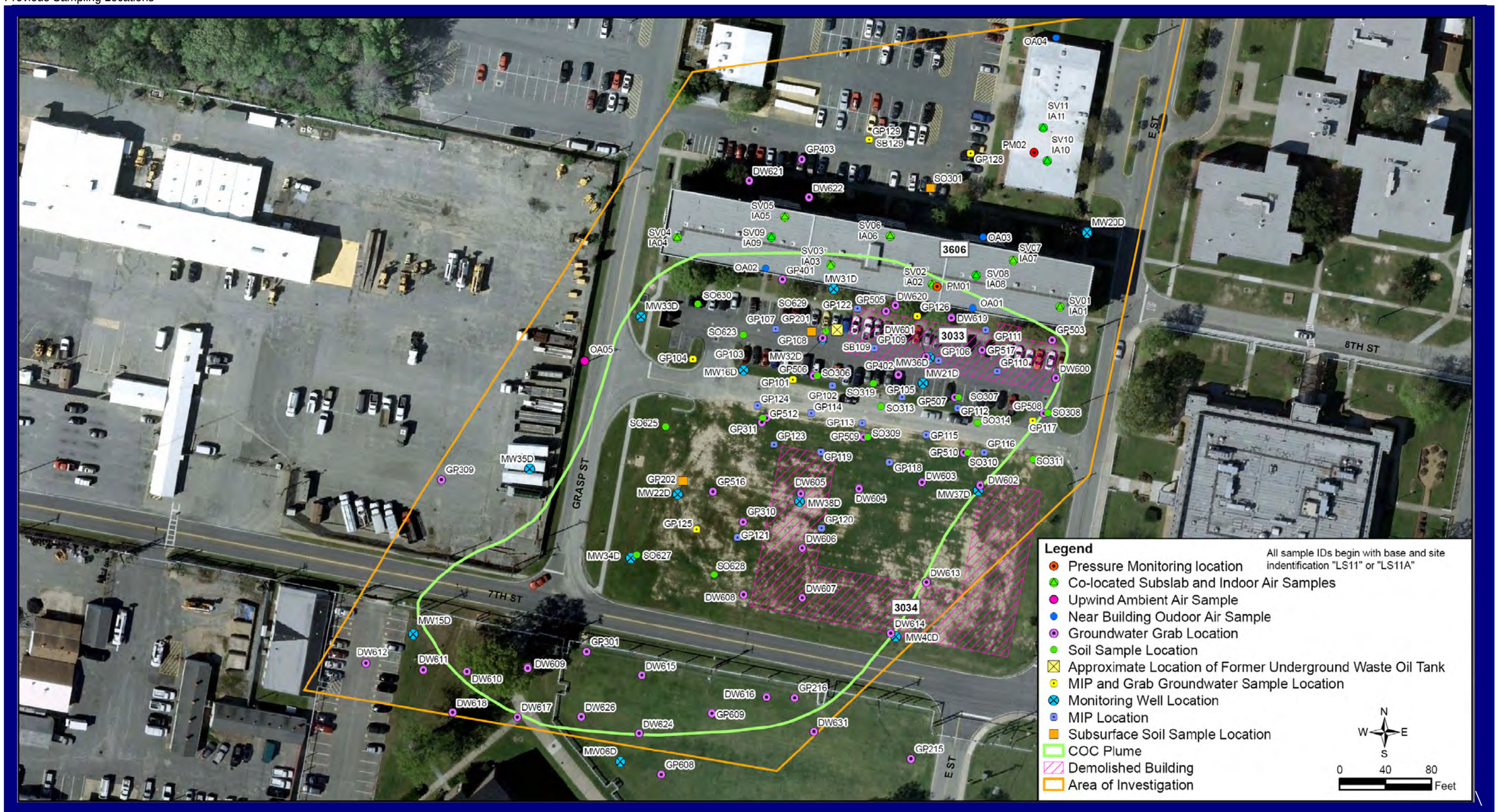
FIGURE 4
Previous Sampling Locations



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The COCs identified in shallow groundwater at Site 11a are the VOCs: PCE and TCE. The groundwater plume extends from the suspected source area south-southwest to 7th Street (Figure 2). Data also indicate VOCs are present beneath Building 3606, suggesting groundwater may also be dispersing from the source area due to the low groundwater gradient, in addition to migrating with the groundwater in the predominant groundwater flow direction. TCE is the most horizontally extensive COC, and PCE is concentrated in the source area and the area just south of the source. The southern portion of the plume appears to be commingled with a separate VOC plume at ERP Site 11. Therefore, the true extent of the southern boundary of the Site 11a groundwater plume is not clearly defined. Maximum concentrations of COCs are as follows:

- PCE: 1,800 micrograms per liter (µg/L)
- TCE: 1,100 µg/L

As depicted on the conceptual site model (Figure 3), the primary mechanism for constituent transport at Site 11a is migration of dissolved VOCs in groundwater by advection. A secondary, less-prominent transport mechanism for the COCs is dispersion from the source area due to the low groundwater gradient. The mechanisms responsible for the fate of contaminants are sorption of contaminants to soil surfaces (which affects the rate at which contaminants are carried by groundwater and how far they are spread); natural degradation through various pathways (which plays a significant role in the length of time the contaminants will exist in the subsurface); and volatilization of contaminants from groundwater into the gas phase (which results in a decrease of contaminant mass from the saturated zone). Some biodegradation of PCE to TCE may be occurring at Site 11a, but data collected to date shows limited transformation of TCE to cis-1,2-dichloroethene (DCE) and VC at the site.

2.5 Current and Potential Land and Water Uses

Site 11a currently consists of Buildings 3606 and 3606A, their surrounding asphalt parking areas, and an open, grass-covered field. Construction and excavation activities at the site are controlled through LUC notation in the Navy geographic information system database maintained by NAVFAC Mid-Atlantic and require approval through work permit protocols prior to initiation. Current land use (residential; non-institutional group quarters) is expected to continue at Site 11a, and there is no other planned future land use. However, future land uses, such as industrial, recreational, and operational activities, beyond what is currently being employed, may be implemented provided the activities are consistent with protection of human health and the environment. Groundwater is not currently used as a potable water supply at or near JEB Little Creek because of its general poor quality (naturally present iron and manganese above secondary drinking water standards) and low yield (generally less than 3 to 5 gallons per minute). Potable water is supplied to the base and surrounding community by the City of Virginia Beach. However, the Navy acknowledges the Commonwealth of Virginia's and USEPA's expectation to return usable groundwaters to their **beneficial uses**[11] wherever practicable.

2.6 Summary of Site Risks

Potential human health and ecological risks at Site 11a were evaluated and documented in the RI and RI Addendum reports. The following subsections and Table 3 summarize the findings of these risk assessments.

2.6.1 Human Health Risk Summary

A human health risk assessment (HHRA) was conducted to evaluate the **potential human health risks**[12] from **current receptor**[13] and **hypothetical future receptor**[14] exposure to soil and shallow groundwater at Site 11a using reasonable maximum exposure (RME) and central tendency exposure (CTE) point concentrations. The RME assumes the highest level (maximum concentrations) of

human exposure that could reasonably be expected to occur, whereas the CTE scenario reflects human exposure to average concentrations across the site.

The potential for non-cancer hazards, the hazard quotient (HQ), is evaluated by calculating the ratio of exposure to toxicity. An HQ greater than 1 indicates that a receptor's exposure to a particular constituent may present an unacceptable non-cancer hazard. In addition, hazard indices (HIs) are generated by adding the HQs for all constituents that affect the same target organ or cause adverse health effects within a medium or across all media to which an individual may reasonably be exposed. HI values greater than 1 indicate the potential for unacceptable non-cancer hazards due to site exposure.

For known or suspected carcinogens, the likelihood of any type of cancer resulting is generally expressed as an upper bound probability of 10^{-4} (a 1 in 10,000 chance of one extra cancer occurring because of exposure) using information on the relationship between dose and response. Acceptable exposure levels are generally considered as concentrations that represent a lifetime cancer risk to an individual of between 10^{-4} and 10^{-6} (a 1 in 1,000,000 chance of one extra cancer occurring because of exposure). The 10^{-6} risk level is used as the point of departure for developing performance standards for alternatives when applicable or relevant and appropriate requirements (ARARs) are not available or are not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure.

Current **exposure scenarios**[15] evaluated consisted of current adult resident exposure to soil and current adult resident and industrial worker exposure to indoor air. Hypothetical future exposure scenarios evaluated consisted of adult/child resident and construction worker exposure to soil and groundwater; industrial worker and adult/child trespasser/visitor exposure to soil; and adult resident and industrial worker exposure to indoor air. The exposure pathways evaluated were dermal contact, inhalation, and ingestion of surface soil, subsurface soil, shallow groundwater, and indoor air. A summary of the site COC non-cancer hazards and cancer risks exceeding USEPA threshold levels in shallow groundwater is provided in Table 3.

Soil

Under current land use, exposure to site soil by an adult resident would not result in any RME non-cancer hazards (cumulative HI = 0.01) or cancer risks (cumulative cancer risk = 1.0 x 10-6) above USEPA's acceptable levels. Under future land use, the child resident cumulative RME non-cancer hazard (HI=1.1) from exposure to combined surface and subsurface soil slightly exceeds USEPA's target threshold of 1. However, there are no individual compounds yielding an HQ greater than 1 and no target organ effect HIs greater than 1. Exposure to site soil by a future adult resident (cumulative HI = 0.12) and future lifetime (adult/child) resident (cumulative cancer risk = 9.7×10^{-6}) would not result in any RME non-cancer hazards or cancer risks above USEPA's acceptable levels. Therefore, there are no unacceptable risks associated with current/future resident exposure to soil.

Exposure to site soil by a future industrial worker (cumulative HI = 0.083, cancer risk = 2.5×10^{-6}); future construction worker (cumulative HI = 0.35, cancer risk = 4.0×10^{-7}); and future adult (cumulative HI = 0.018, cancer risk = 4.4×10^{-7}) or child (cumulative HI = 0.032, cancer risk = 3.2×10^{-7}) trespasser/visitor would not result in any RME non-cancer hazards or cancer risks above USEPA's acceptable levels. Therefore, the partnership of the Navy, USEPA, and VDEQ, agree there are no unacceptable risks associated with exposure to site soil, and no further action is necessary for soil at Site 11a.

Shallow Groundwater

Risk estimates were calculated for future residents based on potable use of groundwater and for future construction worker exposure to groundwater in an open excavation. Exposure to groundwater by an adult and child resident would result in RME non-cancer hazards (cumulative adult HI = 4.0, child HI = 9.1) above USEPA's acceptable levels. Child resident exposure to groundwater would also result in CTE non-cancer hazards (cumulative child HI = 2.3) above USEPA's acceptable levels. Future lifetime resident exposure to groundwater would result in RME cancer risks (cumulative cancer risk = 4.5×10^{-3}) and CTE cancer risks (cumulative cancer risk = 2.2×10^{-4}) above USEPA's acceptable levels. Future construction worker exposure to groundwater would result in RME cancer risks (cumulative cancer risk = 2.0×10^{-4}) and non-cancer hazards (cumulative HI = 8.1) and CTE cancer risks (cumulative cancer risk = 2.0×10^{-5}) and non-cancer hazards (cumulative HI = 3.6) above USEPA's acceptable levels. Unacceptable risks from exposure to groundwater are presented on Table 3.

In addition to PCE and TCE presented on Table 3, PCP and manganese concentrations in groundwater also resulted in cancer risks or non-cancer hazards above USEPA's acceptable levels based on RME calculations. However, the potential risks or hazards are considered acceptable, based on the following:

PCP

- There is no unacceptable risk based on CTE.
- PCP was detected in one sample during the 2007 RI/HHRA/ecological risk assessment (ERA) and was not detected in groundwater during one round of subsequent site-wide sampling.

Manganese

- There is no unacceptable risk based on CTE.
- Concentrations are below the background levels.

Therefore, the partnership of the Navy, USEPA, and VDEQ, agree that PCP and manganese in groundwater do not pose an unacceptable risk, and no further action is necessary for these constituents in shallow groundwater. Further action is required to mitigate human health risks to future adult/child residents and construction workers associated with PCE and TCE in shallow groundwater at Site 11a.

Indoor Air Vapor

Cancer risk estimates were calculated for current and future residents and industrial workers in Buildings 3606 and 3606A exposed to VOCs in indoor air. VOCs do not result in non-cancer effects; therefore these hazards were not evaluated. Current (maximum cancer risk = 5×10^{-6}) and future (maximum cancer risks = 5×10^{-5}) cancer risks to residents and industrial workers are within or below USEPA's acceptable risk range. Therefore, the partnership of the Navy, USEPA, and VDEQ, agree that there are no unacceptable risks associated with exposure to indoor air in existing occupied buildings under current building conditions. Future degradation of existing building conditions may increase the potential for unacceptable risks.

Because of uncertainties associated with quantifying the risks related to occupant exposure to indoor air in future hypothetical buildings (uncertainties with new construction such as future building size, air exchange systems, and foundations), risks associated with this pathway were not quantitatively evaluated in the HHRA. Based on the presence of VOCs in the shallow groundwater, it was assumed that vapor intrusion from the shallow groundwater into indoor air could pose unacceptable risks to future residents and industrial workers in future hypothetical buildings.

TABLE 3

Summary of Unacceptable Human Health Risks associated with site COCs in Groundwater

Receptor	Exposure Route	COC	RME EPC* ug/L	RME		CTE		Cancer Toxicity Factor (CSF) mg/kg-day-1	Non-Cancer Toxicity Factor (RfD) mg/kg-day
				Cancer Risk	Non-Cancer Hazard	Cancer Risk	Non-Cancer Hazard		
Future Resident Adult	Ingestion	PCE	3.2E+02	N/A	0.88	N/A	0.049	N/A	0.01
	Dermal				0.53		0.028		
	Inhalation				0.077		0.0026	2.0E-02	0.08
	Receptor Total (PCE only)		N/A	N/A	**1.5**	N/A	0.08	N/A	N/A
Future Resident Child	Ingestion	PCE	3.2E+02	N/A	**2.1**	N/A	0.16	N/A	0.01
		TCE	1.9E+02		**2.0**		0.76		0.006
	Dermal	PCE	3.2E+02		**1.2**		0.054		0.01
Future Lifetime Resident	Ingestion	PCE	3.2E+02	**2.6E-03**	N/A	**1.1E-04**	N/A	5.4E-01	N/A
	Dermal			**1.5E-03**		4.4E-05			
Future Construction Worker	Dermal	Exposure Route Total**	N/A	4.6E-05	**1.1**	2.7E-06	0.10	N/A	N/A
	Inhalation	PCE	3.2E+02	**1.2E-04**	**5.1**	6.9E-06	**2.5**	2.0E-02	0.08
		TCE	1.9E+02	2.7E-05	**1.6**	7.6E-06	0.79	7.0E-03	0.17

Notes:

EPC – exposure point concentration

CSF – cancer slope factor

RfD – reference dose

N/A-Not Applicable

*The RME EPC for groundwater were calculated as the 95% 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.

**Exposure route HI exceeds USEPA's target threshold of 1; however no individual constituents contribute a hazard quotient greater than 1.

Bold, highlighted values indicate a cancer risk outside of USEPA's acceptable range of 1x10-4 to 1x10-6 or a non-cancer hazard greater than 1.

Therefore, because of the potential for unacceptable risks resulting from existing building degradation or future hypothetical building construction, the partnership of the Navy, USEPA, and VDEQ, agree that monitoring the vapor intrusion pathway as part of the shallow groundwater remedy is warranted until potential human health risks associated with VOCs in shallow groundwater have been mitigated.

2.6.2 Ecological Risk Summary

A screening ERA (SERA) (Steps 1 and 2 of the ERA process) was completed to evaluate **potential risks**[16] to **ecological receptors**[17] through direct exposure to surface soil. There is no complete pathway for ecological receptor exposure to groundwater. Potential risks to terrestrial, aquatic, and wildlife receptors were evaluated. The Site 11a SERA concluded that the site provides little terrestrial habitat and no viable aquatic habitats for potential ecological receptors; therefore, potential ecological risks are negligible based on the lack of significant exposure pathways.

2.6.3 Basis for Response Action

Based on the HHRA, exposure to VOCs in shallow groundwater at Site 11a poses an unacceptable risk to human health from the presence of PCE and TCE (Table 3). Therefore, it is the current judgment of the Navy and USEPA, with the concurrence of VDEQ, that the selected remedy identified in this ROD is necessary to protect public health, welfare, or the environment from actual or threatened releases of hazardous substances into the environment.

2.7 Principal Threat Wastes

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 an exposure occur. Although no "threshold level" of risk has been established to identify principal threat wastes, a general guideline is to consider principal threats to be those source materials with toxicity and mobility characteristics that combine to pose a potential risk several orders of magnitude greater than the risk level acceptable for the current or reasonably anticipated future land use, given realistic exposure scenarios. The original source for potential principal threat waste was removed with the removal of the underground waste oil tank associated with the vehicle repair facility. Dissolved VOC concentrations are present in groundwater; however, contaminated groundwater is generally not considered a source material. The presence of dense non-aqueous phase liquids (DNAPLs) could represent a principal threat waste if present; however, DNAPLs have not been identified at Site 11a. Additionally, all available data suggest that mobility and migration of contaminated groundwater is limited at Site 11a. Based on the absence of identified DNAPLs, principal threat wastes are not present at Site 11a.

2.8 Remedial Action Objectives

The site-specific remedial action objectives (RAOs) for Site 11a are as follow:

- Reduce concentrations of COCs in the source area and the downgradient plume to cleanup levels (maximum contaminant levels [MCLs]) through treatment to the maximum extent practicable within a reasonable amount of time.
- Prevent exposure to Site 11a groundwater and groundwater emissions in indoor air until concentrations of COCs have been reduced to levels that allow for unlimited use and unrestricted exposure.

Cleanup levels have been established for constituents with concentrations contributing to unacceptable risks and hazards from exposure to shallow groundwater within Site 11a. The cleanup levels were developed from the **preliminary remediation goals**[18], which were established in the FS

as the MCLs after consideration of the total risks/hazards associated with their use. Cleanup levels for the Site 11a COCs are as follows:

- PCE: 5 µg/L
- TCE: 5 µg/L

The Navy acknowledges the Commonwealth of Virginia's and USEPA's expectation to return groundwaters to their beneficial uses wherever practicable. Therefore, although not identified as site-specific COCs requiring action, the degradation of PCE and TCE may result in temporary increases to the concentrations of daughter products cis-1,2-DCE and vinyl chloride (VC) above their respective MCLs. RAOs cannot be met if these constituents are above their MCLs. As a result, cis-1,2-DCE and VC 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
- VC: 2 µg/L

2.9 Description and Comparative Analysis of Remedial Alternatives

2.9.1 Description of Remedial Alternatives

Remedial alternatives to address VOCs in shallow groundwater were developed based on initial screening of technologies and are detailed in the FS. Four remedial alternatives were retained for detailed comparative analysis:

- Alternative 1 – No Action
- Alternative 2 – Enhanced Reductive Dechlorination (ERD)
- Alternative 3 –In situ Chemical Oxidation (ISCO) and ERD
- Alternative 4 –Air Sparge/Soil Vapor Extraction (AS/SVE)

With the exception of Alternative 1 (No Action), each of the remedial alternatives also includes monitoring and implementation of LUCs to prevent unacceptable risk exposure. Monitoring and LUCs would be maintained until the RAOs are achieved, with 5-year statutory reviews to ensure protection of human health and the environment. The components of each alternative are described briefly in Table 4. The No Action alternative does not protect human health and the environment, but is presented as a baseline for comparison.

2.9.2 Comparative Analysis of Remedial Alternatives

A comparative analysis of the four alternatives with respect to the **nine evaluation criteria**[19] was completed and is summarized below. Table 5 provides a comparison of the alternatives to the criteria to support ranking of the alternatives. Alternative 1 (No Action) does not achieve RAOs designed to protect human health and the environment; therefore, it fails the first threshold criterion and is not discussed further in this ROD.

Threshold Criteria

Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, and/or institutional controls.

TABLE 4
Remedial Alternatives Summary

Alternative	Components	Details	Cost
1-No Action	None	Allow the COCs to breakdown naturally over time.	No cost associated with this alternative Cost estimate timeframe: 0 yrs
2- ERD	• In-situ biological treatment to enhance natural biodegradation • LUCs • Performance monitoring and LTM	Electron donor source, which is generally the limiting factor, is provided to enhance naturally occurring reductive dechlorination process. Install two new monitoring wells . Implement LUCs to prevent exposure and control changes in site use . Regular monitoring performed to demonstrate that: • COC concentrations continue to decrease. • Potentially toxic transformation products are not created at levels that are a threat to human health. • Affected area is not expanding. • There are no changes in hydrogeologic, geochemical, or microbiological parameters that might reduce the effectiveness of the Remedial Action. • Temporary conditions do not result in COC concentrations in indoor air at levels that are a threat to building occupants.	Capital Cost = $401,200 O&M Present Value = $2,580,000 Total Present Value Cost = $2,980,000 -30%/+50%: $2,090,000 / $4,480,000 Cost estimate timeframe: 30 yrs
3- ISCO and ERD	•ISCO treatment in source area to oxidize COCs •In-situ biological treatment to enhance natural biodegradation •LUCs • Performance monitoring and LTM	Injection of oxidizing agent to promote abiotic in-situ oxidation of COCs through reaction of oxidants with the COCs to produce innocuous substances such as carbon dioxide, water, and chloride. Electron donor source, which is generally the limiting factor, is provided to enhance naturally occurring reductive dechlorination process. Install two new monitoring wells. Implement LUCs to prevent exposure and control changes in site use. Regular monitoring performed to demonstrate that: • COC concentrations continue to decrease. • Potentially toxic transformation products are not created at levels that are a threat to human health. • Affected area is not expanding. • There are no changes in hydrogeologic, geochemical, or microbiological parameters that might reduce the effectiveness of the Remedial Action. • Temporary conditions do not result in COC concentrations in indoor air at levels that are a threat to building occupants.	Capital Cost = $582,400 O&M Present Value = $2,840,000 Total Present Value Cost = $3,420,000 -30%/+50%: $2,380,000 / $5,090,000 Cost estimate timeframe: 30 yrs
4- AS/SVE	•In-situ biological treatment to induce volatilization of COCs and/or aerobic biological degradation •In-situ and ex-situ remedial technology used to withdraw and treat contaminant vapors from soil •LUCs • Performance monitoring and LTM	Installation of AS/SVE system in the source and downgradient edge of plume to inject air into the groundwater to induce volatilization of COCs in groundwater and enhance biodegradation. Pilot study in the source area followed by full-scale system installation in the source area and downgradient edges of the plume. Installation of two new monitoring wells. Implement LUCs to prevent exposure and control changes in site use. Regular monitoring performed to demonstrate that: • COC concentrations continue to decrease. • Potentially toxic transformation products are not created at levels that are a threat to human health. • Affected area is not expanding. • There are no changes in hydrogeologic conditions that might reduce the effectiveness of the Remedial Action. • Temporary conditions do not result in COC concentrations in indoor air at levels that are a threat to building occupants . • O&M of the AS/SVE system.	Capital Cost = $665,900 O&M Present Value = $2,970,000 Total Present Value Cost = $3,640,000 -30%/+50%: $2,550,000 / $5,460,000 Cost estimate timeframe: 30 yrs

TABLE 5
Relative Ranking of Alternatives

CERCLA Criteria	Alternatives			
	Alternative 1 No Action	Alternative 2 ERD	Alternative 3 ISCO & ERD	Alternative 4 AS/SVE
Threshold Criteria				
Protection of Human Health and the Environment	❍	●	●	●
Compliance with ARARs	❍	●	●	●
Primary Balancing Criteria				
Long-term Effectiveness and Permanence	❍	●	●	●
Reduction in Toxicity, Mobility, and Volume Through Treatment	❍	●	●	●
Short-term Effectiveness	❍	●	○	○
Implementability	●	●	●	○
Total Present-Worth Cost	$0	$2,980,000	$3,420,000	$3,640,000

Relative Ranking: ● High ○ Moderate ❍ Low

Note: The FS report provides the details for the **qualitative comparative analysis ratings**[21].

Alternatives 2, 3, and 4 are all protective of human health and the environment, based on current and reasonably anticipated future site conditions. Performance monitoring and long-term monitoring (LTM) will be conducted under these alternatives to confirm that the remedies are functioning and protective, and LUCs will be implemented and maintained to ensure adequate protection of human health and the environment by controlling exposure to shallow groundwater and maintaining existing current residential and industrial building uses until the RAOs are achieved.

Compliance with Applicable or Relevant and Appropriate Requirements

Compliance with applicable or relevant and appropriate requirements (ARARs) addresses whether a remedy will meet all of the ARARs of federal and state environmental laws, or whether there is a basis for invoking a waiver.

ARARs for the selected remedy are listed in Appendix A. Alternatives 2, 3, and 4 are expected to comply with the federal and state **ARARs**[20]. The applicability of most ARARs is the same for Alternatives 2, 3, and 4, with the following exceptions: Alternatives 2 and 3 require compliance with federal underground injection regulations due to the ERD and/or ISCO components of these alternatives; Alternative 4 requires compliance with regulations associated with air emissions because of the discharge of treated soil vapor to the atmosphere.

Primary Balancing Criteria

Long-term Effectiveness and Permanence

Long-term effectiveness and permanence refers to the magnitude and characteristics of the residual risk at the conclusion of remedial activities, and the ability of a remedy to maintain reliable protection of human health and the environment over time.

Each alternative is expected to achieve long-term effectiveness and permanence once RAOs are met; however when compared against one another Alternatives 2 and 3 are expected to be more effective than Alternative 4. Alternatives 2 and 3 rely on injection of reagents to condition the aquifer for continued degradation of COCs following termination of treatment activities and therefore reduce

the risk of rebound of contaminants. Although Alternative 4 does not provide continued support for the degradation of COCs following termination of treatment activities, the AS/SVE system can easily be restarted if rebound occurs following system shutdown. With proper engineering, planning, and implementation, controls can be put in place to monitor all of the alternatives effectively and verify continued compliance with RAOs. Each alternative will require LUCs until RAOs are achieved.

Reduction of Toxicity, Mobility, or Volume

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

Alternatives 2, 3, and 4 are each expected to reduce toxicity, mobility, and volume of hazardous substances through treatment. Each alternative has treatment components, which is the statutory preference.

Short-term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community, and the environment during construction and operation of the remedy until cleanup levels are achieved.

Alternatives 2, 3, and 4 are expected to perform (achieve RAOs) equally given the site conditions. Alternatives 2 and 3 have similar impacts on the community and risks to workers during implementation because both alternatives rely on direct injection methods; however, Alternative 3 ranks lower than Alternative 2 due to the handling of and potential exposure to oxidizing chemicals and the higher resource demand for production of the ISCO injectate. Alternative 4 has a slightly higher risk of affecting the community than Alternatives 2 and 3 because the technology will rely on an ex situ component to treat soil vapors. Alternatives 2 and 3 have a slightly higher risk of creating environmental impacts than Alternative 4 because they have the potential to temporarily mobilize naturally occurring metals (arsenic, iron, manganese), with Alternative 3 posing a slightly higher risk from its potential to also mobilize hexavalent chromium. All the alternatives have the potential to temporarily increase the concentrations of COCs in soil gas during active treatment.

Concerning sustainability, Alternative 4 has higher energy consumption, green house gas emissions, and resource consumption than Alternatives 2 and 3 because it requires permanent installation of equipment (mechanical treatment equipment, polyvinyl chloride, or other plastic or metal piping, electrical conduits, etc.) and ongoing electrical energy input throughout its effective life to power the AS/SVE treatment system. Alternative 2 ranks slightly higher than Alternative 3 since the reagent used is a naturally derived material; therefore resulting in lower resource consumption.

Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation.

Alternatives 2, 3, and 4 can each be implemented using standard and widely available technologies. Alternatives 2 and 3 can be constructed using similar technologies and both require similar levels of operation. Alternative 4 is less implementable because the technology is more difficult to construct and requires increased O&M of the treatment system. Additionally, because of the shallow water table, successful implementation of this alternative would require the system be operated under a low vacuum pressure to minimize water recovery into the SVE system, potentially resulting in additional maintenance. Consequently, the SVE wells would achieve a smaller radius of influence with some short circuiting to the surface, reducing the effectiveness of the treatment system.

Cost

The **estimated capital costs**[22], O&M present values, and **total present values**[23] associated with each of the alternatives are presented in Table 4. The cost for each alternative was calculated based on the assumption of a 30-year implementation period. The actual timeframe to achieve RAOs may vary by alternative; however, there is uncertainty associated with the timeframes, and costs beyond 30 years have minimal impact to the overall evaluation as a result of the present-worth adjustment. The estimated capital cost for implementation of Alternative 2 ($401,200) is less than Alternatives 3 ($582,400) and 4 ($665,900). The estimated present value cost, factoring in a 30-year O&M period for each alternative, for Alternative 2 ($3 million) is less than the estimated present value costs for Alternatives 3 ($3.4 million) and 4 ($3.6 million).

Modifying Criteria

State Acceptance

State involvement has been solicited throughout the CERCLA and remedy selection process. VDEQ, as the designated State support agency in Virginia, has reviewed this ROD and has given concurrence on the selected remedy. The selected remedy, Alternative 2 (ERD), is consistent with VDEQ's preference for active treatment of the shallow groundwater VOC plume.

Community Acceptance

The public meeting was held on July 18, 2011 to present the Proposed Plan and answer community questions regarding the proposed remedial action at Site 11a. Detailed information regarding the public meeting is provided in the Responsiveness Summary (Section 3) of this ROD.

2.10 Selected Remedy

Based on the comparative analysis, the selected remedy to address risk associated with shallow groundwater is Alternative 2, ERD with monitoring and LUCs.

2.10.1 Rationale for the Selected Remedy

Based on the evaluation of the data and information currently available, the Navy, in partnership with USEPA, has concluded the selected remedy meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria.

Alternative 2 was chosen over Alternatives 3 and 4 for the following reasons. Except for Alternative 1, each alternative is protective of human health and the environment, will achieve RAOs, comply with ARARs, achieve similar long-term effectiveness, and reduce toxicity, mobility, and volume through active treatment. However, Alternative 4 is more difficult to implement and poses a higher risk to the community during implementation and consumes more available resources. Alternative 2 was selected over Alternative 3 based on its lower risk to workers during implementation, lower resource consumption, and lower associated cost.

2.10.2 Description of the Selected Remedy

ERD

Biological reductive dechlorination is a naturally occurring, microbially mediated, anaerobic process in which chlorine atoms on a parent VOC molecule are sequentially replaced with hydrogen. In the ERD process, electrons are transferred from an electron donor source to the VOC compound, which functions as the electron acceptor. Therefore, an external electron donor source is required for the reaction to occur. Potential electron donor sources are biodegradable organic co-contaminants, native organic matter, or substrates intentionally added to the subsurface. Deeply anaerobic (reducing) conditions are required for reductive dechlorination of many VOCs, and competing

electron acceptors, such as dissolved oxygen, nitrate, nitrite, manganese(IV), ferrous iron, and sulfate, must be depleted. The COCs at Site 11a are PCE and TCE. The principal anaerobic biodegradation pathway for PCE and TCE is:

PCE → TCE → cis-1,2-DCE → VC → ethene→ ethane

The transformation rate for each step varies, but tends to become slower with progress along the breakdown sequence, which may result in accumulation of cis-1,2-DCE and VC. Further breakdown from cis-1,2-DCE and VC to ethene varies and is based on site-specific conditions.

ERD will be implemented in the source area, defined as where total COC concentrations are greater than 500 µg/L, and along the downgradient edge of the plume through direct injection of a suitable carbon substrate (e.g., emulsified soybean oil mixed with lactate, trace nutrients, and a slow-release pH buffer) into shallow groundwater. The introduced substrate will serve multiple purposes: depleting competing electron acceptors, creating strongly reducing conditions, and producing an electron donor source for reductive dechlorination. Before this alternative is implemented, groundwater samples will be collected to confirm assumptions made in the conceptual treatment design and to modify as necessary the application locations, substrate, and the corresponding monitoring locations. Based on current site conditions, conceptual design elements for implementation of ERD are presented in Figure 5. Substrate will be injected in the source area through 30 direct-push injection points arranged in seven lines perpendicular to groundwater flow. To treat the downgradient edge of the plume, substrate will be injected through 20 direct-push injection points arranged in two lines, one to the west and one to the south of the dissolved plume. For cost estimating purposes, it was assumed that two injections would be completed (one every 2 years). If necessary, as treatment progresses and the concentrations of COCs and their daughter products change, the type and quantity of substrate, frequency of injection, and the location of injection may be revised.

Performance Monitoring and Long-term Monitoring

Following substrate injection, initial effectiveness of the remedial technology (ERD) will be evaluated through periodic groundwater performance monitoring. Long-term reduction in COC concentrations will be monitored as part of a LTM plan designed to evaluate the achievement of RAOs over time, determine if additional injections are required, collect optimization data for future injections, assess the potential for vapor intrusion, and assess site exit strategies. Based on current site conditions, it is assumed that two new monitoring wells and 15 existing wells would be included in the performance and long-term monitoring plans. Because contaminants will remain onsite following remedy implementation, the need for additional action to achieve the cleanup levels will be evaluated and documented during CERCLA Five-Year Reviews.

Land Use Controls

Throughout implementation of the remedy, the Navy also will implement LUCs to prevent unacceptable risks to human receptors from exposure to COCs in shallow groundwater. LUCs will be implemented within the LUC boundary (Figure 5) until site conditions allow for unlimited use and unrestricted exposure.

The shallow groundwater LUCs will meet the following objectives:

- Prohibit activities that would result in contact with shallow groundwater except for environmental monitoring;
- Prohibit the withdrawal of shallow groundwater except for environmental monitoring;

- Prohibit construction of new buildings at the site without ensuring vapor intrusion mitigation measures are included in building design;
- Prohibit the use of the site for child care, elementary or secondary school, or playground facilities; and
- Maintain the integrity of any current or future remedial or monitoring system.

The Navy will develop and submit to USEPA and VDEQ, in accordance with the FFA, a Remedial Design and an LUC Remedial Design. The LUC Remedial Design will provide for implementation and maintenance actions, including periodic inspections and reporting. The Navy will implement, maintain, monitor, report on, and enforce the LUCs according to the LUC Remedial Design.

Although the Navy may transfer these responsibilities to another party by contract, property transfer agreement, or through other means, the Navy shall remain ultimately responsible for remedy integrity and shall: 1) perform CERCLA Section 121(c) Five-Year Reviews; 2) notify the appropriate regulators and/or local government representatives of any known LUC deficiencies or violations; 3) provide access to the property to conduct any necessary response; 4) retain the ability to change, modify, or terminate LUCs and any related deed or lease provisions; and, 5) ensure that the LUC objectives are met to maintain remedy protectiveness.

2.10.3 Summary of the Estimated Remedy Costs

Table 4 presents a cost estimate summary for implementation of the selected remedy. Detailed cost estimates are provided in the FS. The cost estimates were developed based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative.

2.10.4 Expected Outcomes of the Selected Remedy

Current land uses are expected to continue at Site 11a, and there are no other planned land uses in the foreseeable future. Cleanup levels (MCLs) for the selected remedy are based on unlimited use and unrestricted exposure. Exposure will be controlled through LUCs until COCs in shallow groundwater are reduced to the cleanup levels. Remedial activities at Site 11a will consist of ERD with periodic monitoring of natural degradation processes; however, the remedial technology is not guaranteed to reduce concentrations at or below MCLs across the site. Table 6 identifies the unacceptable human health risks for groundwater, the RAOs established to address the unacceptable risks, the remedy component that will be implemented to achieve the RAO, what metrics will be used to confirm the RAOs are met, and the expected outcome from implementation of the remedy components.

2.10.5 Statutory Determinations

In accordance with the NCP, the selected remedy, if implemented, meets the following statutory requirements:

Protection of Human Health and the Environment—The selected remedy will protect human health and the environment from known site risks to future receptors through groundwater treatment and monitoring to reduce COC concentrations, and through LUCs to restrict the use of and exposure to shallow groundwater and shallow groundwater emissions until concentrations are reduced to levels that allow for unrestricted use and unlimited exposure.

FIGURE 5
Conceptual Selected Remedy Layout

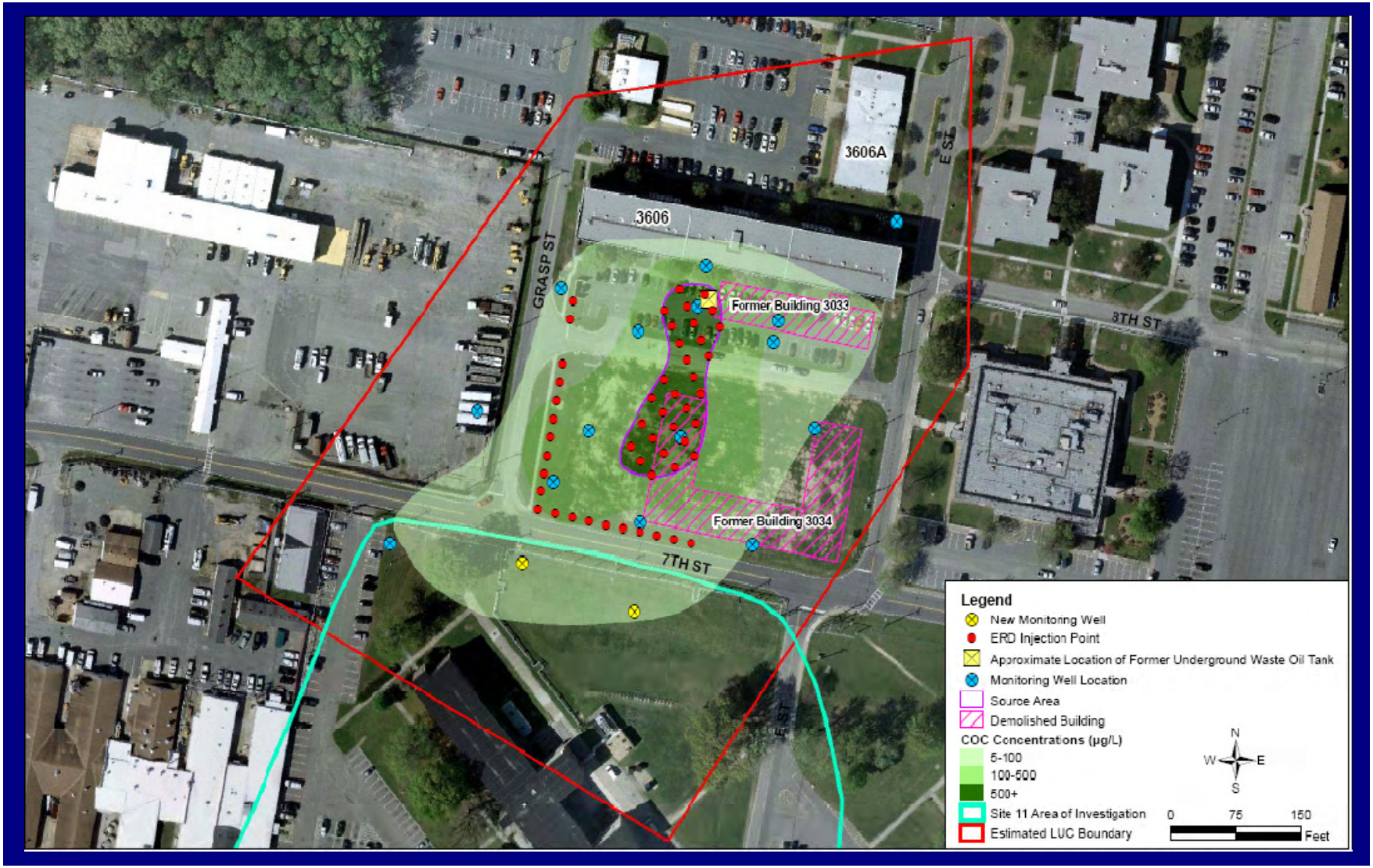

TABLE 6
Expected Outcomes

Risk		RAO	Remedy Component	Metric	Expected Outcomes	
Human Health	**Ecological**					
Shallow Groundwater						
Ingestion of and dermal contact with groundwater under future potable use scenario; inhalation of vapors in shallow groundwater in an open excavation for future construction workers	No exposure pathway	Reduce concentrations of COCs in the source area and the downgradient plume to remediation goals (MCLs) through treatment to the maximum extent practicable within a reasonable amount of time	ERD	Monitor shallow groundwater COC concentrations to confirm reduction of total COC concentrations to below 500 µg/L and plume stabilization	Elimination of source area and prevention of downgradient migration of plume	Removal of LUCs
			Performance Monitoring			
			LTM	Monitor shallow groundwater COC concentrations to confirm the natural degradation process until concentrations are at or below cleanup levels (MCLs)	Achieve unlimited use and unrestricted exposure	
		Prevent exposure to Site 11a groundwater and groundwater emissions until concentrations of COCs have been reduced to levels that allow for unlimited use and unrestricted exposure	LUCs	Periodic inspection of the site to confirm adherence to LUCs until shallow groundwater COCs are at or below their respective cleanup levels (MCLs)	Removal of LUCs	
			LTM	Monitor shallow groundwater COC concentrations to evaluate the potential for vapor intrusion until concentrations are at or below cleanup levels (MCLs)		

Compliance with ARARs—The selected remedy will meet all identified ARARs. Federal and state ARARs for Site 11a, summarized by classification, are presented in Appendix A. The classification of ARARs identified includes chemical-specific, location-specific, and action-specific requirements.

Cost-Effectiveness—The selected remedy provides the most reasonable value relative to the cost. The costs are proportional to overall effectiveness in comparison to other alternatives (e.g., similar benefit at lower cost).

Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable—The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a practicable manner at Site 11a. The selected remedy provides treatment through substrate injection that enhances dechlorination through natural microbial degradation processes to reduce contaminant mass. Because long-term effectiveness and permanence, as well as reduction of toxicity and volume, are achieved through the selected remedy, the Navy, USEPA, and VDEQ concur that the selected remedy provides the best balance of tradeoffs in terms of the balancing criteria, while also considering the statutory preference for treatment as a principal element and considering Commonwealth and community acceptance.

Preference for Treatment as a Principal Element—The selected remedy uses treatment as a principal element and therefore satisfies the statutory preference for treatment.

Five-Year Review Requirements— This remedy will result in hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for unlimited use and unrestricted exposure. The Navy will maintain LUCs and conduct a statutory remedy review every 5 years after initiating remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment. If the remedy is found not to be protective of human health and the environment because, for example, LUCs have failed or treatment is unsuccessful, the Navy, USEPA, and VDEQ would evaluate additional remedial actions and the Navy may be required to undertake additional remedial action.

2.11 Community Participation

The Navy and USEPA provide information regarding the cleanup of JEB Little Creek to the public through the community relations program, which includes a Restoration Advisory Board, public meetings, the Administrative Record file for Site 11a, and announcements published in the local newspaper. During the course of investigations at Site 11a, the Restoration Advisory Board has been apprised of all environmental activities related to the site.

In accordance with Sections 113 and 117(a) of CERCLA, the Navy provided a public comment period between June 29, 2011 and August 12, 2011, for the Site 11a Proposed Plan. A public meeting to present the Proposed Plan was held on July 18, 2011 at the Virginia Beach Central Library. Public notice of the meeting and availability of documents was placed in *The Virginian-Pilot* newspaper on June 28, 2011.

The Proposed Plan was available during the public comment period at the Virginia Beach Central Library. The final Proposed Plan and previous investigation reports for Site 11a are available to the public in the Administrative Record file for JEB Little Creek. Appointments to review the Administrative Record file for JEB Little Creek can be made by contacting:

Public Affairs Office, NAVFAC Mid-Atlantic
9742 Maryland Avenue, Building A-81
Norfolk, VA 23511-3095
Phone: (757) 341-1410

A copy of the Administrative Record file for JEB Little Creek is available online at: https://portal.navfac.navy.mil/portal/page/portal/navfac/navfac_ww_pp/navfac_hq_pp/navfac_env_pp/env_restoration_installations/lant/midlant/jeblcfs

3 Responsiveness Summary

The participants in the public meeting held on July 18, 2011 included representatives of the Navy, USEPA, and VDEQ. No written comments, concerns, or questions were received by the Navy, USEPA, or VDEQ during the public comment period. No one from the public attended the public meeting held on July 18, 2011. Navy, USEPA, and VDEQ representatives were available to present the Proposed Plan for Site 11a and answer any questions regarding the Proposed Plan as well as any other documents in the Administrative Record file for JEB Little Creek.

Appendix A
ARARs

TABLE A-1
Federal Chemical-Specific ARARs
Site 11a ROD
JEB Little Creek
Virginia Beach, Virginia

Media	Requirement	Prerequisite	Citation*	ARAR Determination	Comment
Safe Drinking Water Act (SDWA)					
Groundwater	SDWA standards serve to protect public water systems. Primary drinking water standards consist of federally enforceable Maximum Contaminant Levels (MCLs). MCLs are the highest level of a contaminant that is allowed in drinking water and are relevant and appropriate requirements for groundwater cleanup.	Groundwater contamination exceeds MCLs. CERCLA requires the return of usable waters to their beneficial use whenever practicable. Virginia's expectation for beneficial use of groundwater requires cleanup to MCLs for the contaminants presenting human health risk.	*40 CFR 141.61 (a) (5) and (15)*	Relevant and Appropriate	This remedial action is being implemented with a target goal of achieving MCLs. However, the aquifer is not currently, nor reasonably anticipated in the future to be used as a potable water supply. The MCLs for the COCs at Site 11a are: PCE – 5 ug/L TCE – 5 ug/L

*Federal chemical-specific ARARs are the substantive requirements found in the referenced citations.

TABLE A-2
Virginia Chemical-Specific ARARs
Site 11a ROD
JEB Little Creek
Virginia Beach, Virginia

Media	Requirement	Prerequisite	Citation*	ARAR Determination	Comment
No Virginia Chemical-Specific ARARs Apply					

TABLE A-3
Federal Location-Specific ARARs
Site 11a ROD
JEB Little Creek
Virginia Beach, Virginia

Location	Requirement	Prerequisite	Citation*	ARAR Determination	Comment
Migratory Bird Treaty Act					
Migratory bird area	Protects almost all species of native birds in the United States from unregulated taking.	Presence of migratory birds.	*Migratory Bird Treaty Act*, 16 USC 703	Applicable	JEBLC is located in the Atlantic Migratory Flyway.
Coastal Zone Management Act					
Coastal zone or area that will affect the coastal zone	Federal activities must be consistent with State coastal zone management programs to the maximum extent practicable.	Wetland, flood plain, estuary, beach, dune, barrier island, coral reef, and fish and wildlife and their habitat, within the coastal zone.	15 CFR 930.33(a)(1) and (c)	Applicable	JEBLC is located within the coastal zone. As a result, the substantive standards of the regulations apply to this remedy.

*Federal location-specific ARARs are the substantive requirements found in the referenced citations.

TABLE A-4
Virginia Location-Specific ARARs
Site 11a ROD
JEB Little Creek
Virginia Beach, Virginia

Location	Requirement	Prerequisite	Citation*	ARAR Determination	Comment
No Virginia Location-Specific ARARs Apply					

TABLE A-5
Federal Action-Specific ARARs
Site 11a ROD
JEB Little Creek
Virginia Beach, Virginia

Action	Requirement	Prerequisite	Citation*	ARAR Determination	Comment
SDWA					
Underground injection	Regulates the subsurface emplacement of fluids through the Underground Injection Control program, which governs the design and operation of five classes of injection wells in order to prevent contamination of underground sources of drinking water. The Underground Injection Control program regulates well construction, well operation, and monitoring.	Any dug hole or well that is deeper than its largest surface dimension, where the principal function of the hole is in subsurface emplacement of fluids.	40 CFR 144.12(a) and (c), 144.82(a)(1) and (b), 146.8(a) through (e), and 146.10(c)	Applicable	These remedial actions will include subsurface injections of fluids using Class V injection wells. Fluids include any material or substance which flows or moves whether in a semisolid, liquid, sludge, gas, or any other form or state. Permits are not applicable to onsite CERCLA injection wells; however, this remedial action will comply with the substantive requirements of the regulation.

*Federal action-specific ARARs are the substantive requirements found in the referenced citations.

TABLE A-6
Virginia Action-Specific ARARs
Site 11a ROD
JEB Little Creek
Virginia Beach, Virginia

Action	Requirement	Prerequisite	Citation*	ARAR Determination	Comment
Virginia Waste Management Act					
Management of solid waste generated on site.	Establishes criteria for the proper management of solid wastes.	Generation of solid waste associated with the selected remedy.	9 VAC 20-81-40(B), 45(B), and 90(A)(1)	Applicable	The on-site actions will be conducted in accordance with those substantive provisions of the chapter that are applicable to implementation of the remedy identified in the ROD, including those provisions identified herein. These remedial actions will generate wastes which will be characterized for offsite disposal. Based on site history, all wastes are expected to be characterized as non-hazardous.
State Board of Health					
Monitoring Well Installation and Abandonment	Establishes requirements for the installation and abandonment of observation and monitoring wells, governed jointly by the State Board of Health and Department of Environmental Quality.	Observation and monitoring wells must be properly installed and abandoned in accordance with Virginia regulations to prevent contamination from reaching groundwater resources via the well.	12 VAC 5-630-420(B),(C) and 450(C)(1),(2),(4),(5), and (7) to (9)	Applicable	Monitoring wells will be installed and abandoned in accordance with the substantive requirements of the Virginia regulations.
Air Pollution Control Board					
Generation of fugitive dust	Regulations regarding reasonable precautions to prevent particulate matter from becoming airborne.	Conducting any activity which may cause particulate matter to become airborne.	*Standard for Fugitive Dust Emissions*, 9 VAC 5-50-90	Applicable	Dust control measures will be implemented during activities at the site.
State Water Control Law					
Staging of chemicals onsite where stormwater conveyances are present.	Discharge of pollutants to state waters is prohibited.	Activities that result in discharging any pollutant into or adjacent to surface waters, or otherwise altering the physical, chemical or biological properties of surface waters.	9 VAC 25-210-50(A)	Applicable	Stormwater inlets are present at the site which drain directly to surface water bodies. These inlets will be protected to prevent accidental discharges of treatment chemicals to surface water.

*Virginia action-specific ARARs are the substantive requirements found in the referenced citations.

TABLE A-7
Acronyms and Abbreviations used in Appendix A
Site 11a ROD
JEB Little Creek
Virginia Beach, Virginia

ARAR	Applicable or relevant and appropriate requirement	VA	Virginia
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act	VAC	Virginia Administrative Code
CFR	Code of Federal Regulations		
JEBLC	Joint Expeditionary Base Little Creek		
MCL	Maximum Contaminant Level		
RCRA	Resource Conservation and Recovery Act		
SDWA	Safe Drinking Water Act		
USC	United States Code		
USEPA	United States Environmental Protection Agency		

References

Commonwealth of Virginia, 2004. Preliminary Identification, Applicable or Relevant and Appropriate Requirements.

USEPA, 1998. *CERCLA Compliance with Other Laws Manual: Interim Final*. Office of Emergency and Remedial Response. USEPA/540/G-89/006.

USEPA, 1998. *CERCLA Compliance with Other Laws Manual: Part II. Clean Air Act and Other Environmental Statutes.* Office of Emergency and Remedial Response. USEPA/540/G-89/009.

USEPA, 1998. RCRA, Superfund & EPCRA Hotline Training Manual. Introduction to Applicable or Relevant and Appropriate Requirements. USEPA540-R-98-020.

Appendix B
Acronyms and Abbreviations

Acronyms and Abbreviations

ARAR	applicable or relevant and appropriate requirement
AS/SVE	Air Sparge/Soil Vapor Extraction
AST	aboveground storage tank
bgs	below ground surface
BMP	Best Management Practice
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	chemical of concern
CSM	conceptual site model
CTE	central tendency exposure
DCE	dichloroethene
DNAPL	dense non-aqueous phase liquid
ERA	Ecological Risk Assessment
ERD	enhanced reductive dechlorination
ERP	Environmental Restoration Program
FFA	Federal Facilities Agreement
FS	Feasibility Study
HHRA	Human Health Risk Assessment
HI	hazard index
HQ	hazard quotient
IR	Installation Restoration
ISCO	in-situ chemical oxidation
JEB	Joint Expeditionary Base
LTM	Long-Term Monitoring
LUC	land use control
µg/L	micrograms per Liter
MCL	maximum contaminant level
MMRP	Military Munitions Response Program
MWR	Morale, Welfare, and Recreation
NAB	Naval Amphibious Base
Navy	Department of the Navy
NAVFAC	Naval Facilities Engineering Command
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	operation and maintenance
PCE	tetrachloroethene
PCP	pentachlorophenol
RAO	remedial action objective
RI	Remedial Investigation

RME	reasonable maximum exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SERA	Screening Ecological Risk Assessment
SPCC	Spill Prevention, Control, and Countermeasures
SWMU	solid waste management unit
TCE	trichloroethene
USEPA	United States Environmental Protection Agency
VC	vinyl chloride
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound

References

Item	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administrative Record
1	**upgradient monitoring well**	Section 2.1	CH2M HILL. 2004. *Final Supplemental Remedial Investigation for Site 11 – School of Music Plating Shop, Virginia Beach, Virginia*. June.
2	**solid waste management unit (SWMU) 60**	Section 2.1	Naval Amphibious Base (NAB) Little Creek. 2000. *SWMU/IR Summary for NAB Little Creek.* June.
3	**treatability study**	Table 1	CH2M HILL. 2004. *Field Activities and Explanation of Analytical Results for NAB Little Creek, Site 11a.*
4	**ISCO was not effective in reducing VOC concentrations**	Table 1	CH2M HILL. 2006. *Treatability Study, Site 11a, NAB Little Creek, Virginia Beach, Virginia.* July. Section 4
5	**PCE, TCE, and pentachlorophenol (PCP) in groundwater pose potential risks to human health**	Table 1	CH2M HILL. 2010. *Remedial Investigation Report for Site 11a – Former Building 3033 Former Vehicle Repair Facility and Waste Oil Tank, NAB Little Creek, Virginia Beach, Virginia.* July. Section 7.
6	**no unacceptable risks to ecological receptors**	Table 1	CH2M HILL. 2010. *Remedial Investigation Report for Site 11a – Former Building 3033 Former Vehicle Repair Facility and Waste Oil Tank, NAB Little Creek, Virginia Beach, Virginia.* July. Section 8.
7	**no remedial action for PCP**	Table 1	CH2M HILL. 2010. *Technical Memorandum Site 11a, Building 3033 Former Vehicle Repair Facility and Waste Oil Tank Data Gap Investigation Results, Joint Expeditionary Base (JEB) Little Creek-Fort Story Naval Amphibious Base (NAB) Little Creek.* October. Table 3.
8	**no action is warranted for vapor intrusion**	Table 1	CH2M HILL. 2011. *Remedial Investigation Addendum Report for Site 11a, JEB Little Creek, Virginia Beach, Virginia.* February. Section 6.
9	**groundwater remediation technologies**	Table 1	CH2M HILL. 2011. *Feasibility Study Site 11a Building 3033 Former Vehicle Repair Facility and Waste Oil Tank, JEB Little Creek, Virginia Beach, Virginia.* February. Section 3.1, Table 3-1.
10	**Site Management Plan**	Section 2.3	CH2M HILL. 2010. *Site Management Plan Fiscal Years 2011 through 2015. JEB Little Creek-Fort Story, NAB Little Creek, Virginia Beach, Virginia.*
11	**beneficial uses**	Section 2.5	USUSEPA. 1994. *National Oil and Hazardous Substances Pollution Contingency Plan.* 40 CFR 300.430 (a) (1)(iii)(f). VA. Code § 62.1-44.2.
12	**potential human health risks**	Section 2.6.1	CH2M HILL. 2010. *Remedial Investigation Report for Site 11a – Former Building 3033 Former Vehicle Repair Facility and Waste Oil Tank, NAB Little Creek, Virginia Beach, Virginia.* July. Appendix F CH2M HILL. 2011. *Remedial Investigation Addendum Report for Site 11a, JEB Little Creek, Virginia Beach, Virginia.* February. Section 4.3.2, Tables 4-8 to 4-11.

Item	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administrative Record
13	**current receptor**	Section 2.6.1	CH2M HILL. 2010. *Remedial Investigation Report for Site 11a – Former Building 3033 Former Vehicle Repair Facility and Waste Oil Tank, NAB Little Creek, Virginia Beach, Virginia.* July. Tables 7-4 and 7-5 CH2M HILL. 2011. *Remedial Investigation Addendum Report for Site 11a, JEB Little Creek, Virginia Beach, Virginia.* February. Section 4.3.2, Tables 4-8 to 4-11.
14	**hypothetical future receptor**	Section 2.6.1	CH2M HILL. 2010. *Remedial Investigation Report for Site 11a – Former Building 3033 Former Vehicle Repair Facility and Waste Oil Tank, NAB Little Creek, Virginia Beach, Virginia.* July. Tables 7-4 and 7-5 CH2M HILL. 2011. *Remedial Investigation Addendum Report for Site 11a, JEB Little Creek, Virginia Beach, Virginia.* February. Section 4.3.2, Tables 4-8 to 4-11.
15	**exposure scenarios**	Section 2.6.1	CH2M HILL. 2010. *Remedial Investigation Report for Site 11a – Former Building 3033 Former Vehicle Repair Facility and Waste Oil Tank, NAB Little Creek, Virginia Beach, Virginia.* July. Tables 7-4 and 7-5 CH2M HILL. 2011. *Remedial Investigation Addendum Report for Site 11a, JEB Little Creek, Virginia Beach, Virginia.* February. Section 4.3.2, Tables 4-8 to 4-11.
16	**potential risks**	Section 2.6.2	CH2M HILL. 2010. *Remedial Investigation Report for Site 11a – Former Building 3033 Former Vehicle Repair Facility and Waste Oil Tank, NAB Little Creek, Virginia Beach, Virginia.* July. Section 8.3, Table 8-1.
17	**ecological receptors**	Section 2.6.2	CH2M HILL. 2010. *Remedial Investigation Report for Site 11a – Former Building 3033 Former Vehicle Repair Facility and Waste Oil Tank, NAB Little Creek, Virginia Beach, Virginia.* July. Section 8.2.3, Figure 8-1.
18	**preliminary remediation goals**	Section 2.8	CH2M HILL. 2011. *Feasibility Study Site 11a Building 3033 Former Vehicle Repair Facility and Waste Oil Tank, JEB Little Creek, Virginia Beach, Virginia.* February. Section 2.2
19	**nine evaluation criteria**	Section 2.9.2	CH2M HILL. 2011. *Feasibility Study Site 11a Building 3033 Former Vehicle Repair Facility and Waste Oil Tank, JEB Little Creek, Virginia Beach, Virginia.* February. Section 4.3.
20	**ARARs**	Section 2.9.2	CH2M HILL. 2011. *Feasibility Study Site 11a Building 3033 Former Vehicle Repair Facility and Waste Oil Tank, JEB Little Creek, Virginia Beach, Virginia.* February. Appendix C
21	**qualitative comparative analysis ratings**	Table 5	CH2M HILL. 2011. *Feasibility Study Site 11a Building 3033 Former Vehicle Repair Facility and Waste Oil Tank, JEB Little Creek, Virginia Beach, Virginia.* February. Table 4-3.
22	**estimated capital costs**	Section 2.9.2	CH2M HILL. 2011. *Feasibility Study Site 11a Building 3033 Former Vehicle Repair Facility and Waste Oil Tank, JEB Little Creek, Virginia Beach, Virginia.* February. Appendix D.
23	**total present values**	Section 2.9.2	CH2M HILL. 2011. *Feasibility Study Site 11a Building 3033 Former Vehicle Repair Facility and Waste Oil Tank, JEB Little Creek, Virginia Beach, Virginia.* February. Appendix D.

Detailed site information referenced in this ROD in bold blue text is contained in the Administrative Record file for JEB Little Creek.

For access to information contained in the Administrative Record file for JEB Little Creek, please contact:

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