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NAB LITTLE CREEK
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Final

Five-Year Review

Naval Amphibious Base Little Creek,
Virginia Beach, Virginia



Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Contract No. N62470-02-D-3052
CTO-0157

March 2009

Prepared by
CH2MHILL

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**Naval Amphibious Base Little Creek
Virginia Beach, Virginia**

Contract Task Order 157

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**Department of the Navy
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Under the

**NAVFAC CLEAN III Program
Contract N62470-02-D-3052**

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Naval Amphibious Base Little Creek Virginia Beach, Virginia

March 2009

This report documents the Five-Year Review for Sites 9, 10, 11, 12, and 13, at Naval Amphibious Base Little Creek as required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in accordance with CERCLA §121(c), as amended, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Part 300.430(f)(4)(ii) of the Code of Federal Regulations (CFR).

Approved by:



19 MAR 09

W. W. Crow, CAPT, USN
By direction of the Commander
Navy Region Mid-Atlantic

Date

Executive Summary

The United States Navy (Navy) conducted this Five-Year Review for Naval Amphibious Base (NAB) Little Creek in Virginia Beach, Virginia, as required by the Comprehensive Environmental Response, Compensation, and Liability Act in accordance with CERCLA §121(c), as amended, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Part 300.430(f)(4)(ii) of the Code of Federal Regulations (CFR). The Report has been prepared in accordance with the United States Environmental Protection Agency (USEPA) *Comprehensive Five-Year Review Guidance* (2001), and summarizes the evaluation of remedies and remedial actions that resulted in hazardous substances, pollutants, or contaminants remaining at sites above levels that allow for unlimited use and unrestricted exposure, and for which there is a Final Record of Decision (ROD). A ROD requiring a Five-Year Review has been finalized for the following NAB Little Creek sites:

- Site 9 – Driving Range Landfill, December 2003
- Site 10 – Sewage Treatment Plant Landfill, December 2003
- Site 11 – School of Music Plating Shop, July 2007
- Site 12 – Former Exchange Laundry/Dry Cleaning Facility, September 2005
- Site 13 – Former Public Works Pentachlorophenol (PCP) Dip Tank and Wash Rack, September 2007

The objective of this Five-Year Review is to evaluate the selected remedies at these sites and determine whether the remedies remain protective of human health and the environment in accordance with the requirements set forth in the ROD. The principal method used to evaluate the protectiveness of the remedies was a review of various documents pertaining to site activities, analytical data, and findings. The methods, findings, and conclusions from the document reviews are presented in this Five-Year Review report. In addition, this report identifies issues that may prevent a particular remedy from functioning as designed or appropriately, which could endanger the protection of human health and the environment. The overall evaluations of the effectiveness of each remedy are presented as protectiveness statements in the Five Year Review Summary Form provided below.

Five-Year Review Summary Form

Site Identification

Site Name: Naval Amphibious Base Little Creek USEPA ID: VA5170022482
 Region: 03 State: Virginia City/County: Virginia Beach

Activity Status

National Priorities List (NPL) Status: Final
 Remediation Status: Ongoing Operation
 Multiple Sites: Yes
 Construction Completion Date: Not applicable (N/A)
 Has the site(s) been put into reuse? Sites 9 is currently used as a driving range; a portion of Site 10 is used for range practice, while the other portion is used as baseball fields; Sites 11, 12, and 13 source areas have been removed, however land use remains the same.

Review Status

Lead Agency: United States Navy
 Who conducted the review? (USEPA Region, State, Federal Agency): Federal Facility
 Author Name: CH2M HILL
 Author Title: Navy CLEAN Contractor
 Author Affiliation: CH2M HILL, Inc.
 Review Period: From: 2003 To: 2008
 Date(s) of Site Inspection: September 17, 2008
 Type of Review: Statutory Review Number: 1
 Triggering Action: Signature of Sites 9 and 10 ROD
 Trigger Action Date: December 2003
 Due Date: January 2009

Five-Year Review Summary Form (continued)**1. Sites 9, Driving Range Landfill, and Site 10, Sewage Treatment Plant Landfill****A. Issues:**

- Bare areas have been noted on the Site 9 driving range during quarterly ER site inspections.
- September 2008 site inspection, a low spot, likely the result of vehicle traffic, was present at Site 10. Additionally, an empty 55-gallon drum was observed along the range fenceline.
- Site monitoring wells are not clearly labeled outside the casing.
- Annual groundwater monitoring sampling and analysis plan is not adequate to fully evaluate potential degradation in groundwater quality, indicative of a release and offsite migration from the landfill.

B. Recommendations and Follow-up Actions:

- The Navy is currently evaluating the most cost effective method to repair the bare areas.
- The low-lying area is backfilled with clean fill and the drum is removed from the site.
- Permanent identification is applied to all well casings.
- Modifications are made to the sampling analysis plan for fiscal years 2009 through 2013.

C. Protectiveness Statement:

The selected remedy is protective of human health and the environment. Exposure pathways that could result in unacceptable risk are controlled through quarterly ER site inspections and annual groundwater LTM. As detailed in Section 3.7, modifications to the groundwater LTM plan are suggested to evaluate potential future releases and offsite migration of contaminants. Risk management decisions, analytical parameters, and site-specific monitoring well networks will be defined during development of future LTM plans. Additionally, corrective action is warranted to repair the bare and the low-lying areas observed at Sites 9 and 10.

2. Site 11, School of Music Plating Shop**A. Issues:**

- Changes to the methodology for evaluating the potential for vapor intrusion risk.
- Although the LUC RD has been finalized, LUCs are not fully implemented until the Interim Remedial Action Completion Report (I-RACR) is finalized.
- Site monitoring wells are not clearly labeled outside the casing.

B. Recommendations and Follow-up Actions:

- Following resolution of risk evaluation methodology, re-evaluation of the potential for vapor intrusion at Site 11 is recommended.
- Implement LUCs in accordance with the LUC RD and document in the I-RACR for the site.
- Permanent identification is applied to all well casings.

Five-Year Review Summary Form (continued)

C. Protectiveness Statement:

The remedy has not been implemented at Site 11, however, it is expected to be protective of human health and environment. In the interim, exposure pathways that could result in unacceptable risk are controlled through quarterly ER site inspections. Remedy construction began in January 2009 and is expected to be completed in March 2009. Full implementation of the LUCs and the groundwater LTM plan will be documented in the I-RACR. Based upon a review of the Site 12 remedy performance (Section 5), there is no evidence at this time to expect the Site 11 remedy will not be successful. Further evaluation of the vapor intrusion pathway is recommended following resolution of risk evaluation methodology.

3. Site 12, Former Exchange Laundry/Dry Cleaning Facility**A. Issues:**

- Although the LUC RD has been finalized, LUCs are not fully implemented until the Interim Remedial Action Completion Report (I-RACR) is finalized.
- Site monitoring wells are not clearly labeled outside the casing.

B. Recommendations and Follow-up Actions:

- Implement LUCs in accordance with the LUC RD and document in the I-RACR for the site.
- Permanent identification is applied to all well casings.

C. Protectiveness Statement:

The groundwater portion of the remedy for Site 12 has been implemented, is currently functioning as designed and is expected to be protective of human health and environment. In order for the remedy to be protective in the long-term, an I-RACR must be in place to document the implementation of the LUCs and the groundwater LTM plan. In the interim, exposure pathways that could result in unacceptable risk are controlled through quarterly ER site inspections. The remedy is successfully reducing concentrations of VOCs in groundwater, however, since VOC concentrations remain above their respective MCLs in some areas, additional action is warranted at Site 12. Additional injection of substrate to prolong the effectiveness of the remedy was conducted in January/February 2009. Continued monitoring of plume configuration and migration will be conducted through post-remedial action groundwater monitoring to ensure long-term effectiveness of the remedy.

4. Site 13, Former Public Works Pentachlorophenol Dip Tank and Wash Rack**A. Issues:**

- Changes to the methodology for evaluating the potential for vapor intrusion risk.
- Although the LUC RD has been finalized, LUCs are not fully implemented until the Interim Remedial Action Completion Report (I-RACR) is finalized.
- Site monitoring wells are not clearly labeled outside the casing.

B. Recommendations and Follow-up Actions:

- Following resolution of risk evaluation methodology, re-evaluation of the potential for vapor intrusion at Site 13 is recommended.
- Implement LUCs in accordance with the LUC RD and document in the I-RACR for the site.
- Permanent identification is applied to all well casings.

Five-Year Review Summary Form (continued)

C. Protectiveness Statement:

The remedy has not been implemented at Site 13, however, it is expected to be protective of human health and environment. In the interim, exposure pathways that could result in unacceptable risk are controlled through quarterly ER site inspections. Remedy construction is expected to begin in April 2009. Full implementation of the LUCs and the groundwater LTM plan will be documented in the I-RACR. Based upon a review of the Site 12 remedy performance (Section 5), there is no evidence at this time to expect the Site 13 remedy will not be successful. Further evaluation of the vapor intrusion pathway is recommended following resolution of risk evaluation methodology.

Other Comments:

None.

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Acronyms and Abbreviations

ABM	abrasive blast material
AR	Administrative Record
ARAR	applicable or relevant and appropriate requirements
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
BTAG	Biological Technical Assistance Group
CD	cyclodextrin
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-term Environmental Action – Navy
COC	chemical of concern
CTE	central tendency exposure
CTO	Contract Task Order
DCA	dichloroethane
DCE	dichloroethene
DD	Decision Document
DDD	4,4'-dichlorodiphenyldichloroethane
DNAPL	dense non-aqueous phase liquid
DO	dissolved oxygen
DoD	Department of Defense
EE/CA	Engineering Evaluation/Cost Analysis
EPC	exposure point concentration
ER	Environmental Restoration
ERA	Ecological Risk Assessment
ERD	enhanced reductive dechlorination
ERP	Environmental Restoration Program
ESD	Explanation of Significant Difference
FFA	Federal Facilities Agreement
FS	Feasibility Study
ft	feet
ft/day	feet per day
ft/ft	feet per foot
ft/year	feet per year
GMP	Groundwater Monitoring Program
HHRA	Human Health Risk Assessment
HI	hazard index
HQ	hazard quotient
HRS	Hazard Ranking System

IAS	Initial Assessment Study
IR	Installation Restoration
IRA	Interim Removal Action
I-RACR	Interim Remedial Action Completion Report
IRP	Installation Restoration Program
ISCO	<i>in situ</i> chemical oxidation
J&E	Johnson & Ettinger
kg	kilogram
LTM	long-term monitoring
LUC	land use control
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
MCL	maximum contaminant level
mg/L	milligrams per liter
MIP	Membrane Interface Probe
mS/cm	milliSiemens per centimeter
msl	mean sea level
MTBE	methyl-tert-butyl-ether
MWR	Little Creek Morale, Welfare, and Recreation
NAB	Naval Amphibious Base
NACIP	Navy Assessment and Control of Installation Pollutants
NAPL	non-aqueous phase liquid
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NCP	National Contingency Plan
NFA	no further action
NPL	National Priorities List
ORC	Oxygen Releasing Compound
ORP	oxidation-reduction potential
OWS	oil-water separator
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene
PCP	pentachlorophenol
PRAP	Proposed Remedial Action Plan
PWC	Public Works Center
RAB	Restoration Advisory Board
RAO	Remedial Action Objective
RAWP	Remedial Action Work Plan
RBC	risk-based screening criteria
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design

RFA	RCRA Facility Assessment
RI	Remedial Investigation
RME	reasonable maximum exposure
ROD	Record of Decision
RVS	Round 1 Verification Study
SARA	Superfund Amendments and Reauthorization Act
SERA	Streamlined Ecological Risk Assessment
SMP	Site Management Plan
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TCA	1,1,1-trichloroethane
TOC	total organic carbon
TOD	total oxidant demand
TOX	total organic halogen
TPH	total petroleum hydrocarbon
USEPA	United States Environmental Protection Agency
UTL	upper tolerance limit
UU/UE	unrestricted use and unlimited exposure
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound
yd ³	cubic yard

SECTION 1

Introduction

This document presents the results of the Five-Year Review for Naval Amphibious Base (NAB) Little Creek, Virginia Beach, Virginia. This Five-Year Review Report was prepared by CH2M HILL under the Naval Facilities Engineering Command Mid-Atlantic Division (NAVFAC), Comprehensive Long-term Environmental Action—Navy (CLEAN) III Program, Contract N62470-02-D-3052, Contract Task Order (CTO) 0157, for submittal to NAVFAC Mid-Atlantic, United States Environmental Protection Agency (USEPA), and the Virginia Department of Environmental Quality (VDEQ).

NAB Little Creek is a federal facility at which Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) activities are funded and implemented by the Department of the Navy (Navy) under the Navy Environmental Restoration Program (ERP). The Navy implements CERCLA at NAB Little Creek in partnership with the USEPA and the VDEQ.

The purpose of this 5-year review is to evaluate the effectiveness of remedies and remedial actions for sites with a Record of Decision (ROD) leaving hazardous substances, pollutants, or contaminants on site above levels that allow for unrestricted use and unlimited exposure (UU/UE). The 5-year review was conducted in accordance with the *Comprehensive Five-Year Review Guidance* (USEPA, 2001) and Section 120 of CERCLA as amended by the Superfund Amendments and Reauthorization Act (SARA). The NAB Little Creek sites included in this Five-Year Review Report are listed below and shown on [Figure 1-1](#).

- Site 9—Driving Range Landfill
- Site 10—Sewage Treatment Plant Landfill
- Site 11—Former School of Music Plate Shop
- Site 12—Former Exchange Laundry
- Site 13—Former Public Works Center Dip Tank and Wash Rack

No Action RODs were signed for: Solid Waste Management Unit (SWMU) 7a (DON, 2005a), SWMU 8 (DON, 2005b), and Site 8 (DON, 2008). A total of 17 sites requiring further evaluation through desktop audits or site screening process investigations were identified in the NAB Little Creek Federal Facilities Agreement (FFA). Each site was evaluated and close-out documentation was prepared. Additionally, the FFA identified 105 sites for which no further action (NFA) under CERCLA is required. Land use is unrestricted at these sites and a 5-year review is not required. Sites requiring NFA are shown on [Figure 1-2](#). Sites currently in the Remedial Investigation (RI)/Feasibility Study (FS) phase of the CERCLA process include SWMU 3, SWMU 7b, Site 7, and Site 11a. The status of all the Environmental Restoration Program (ERP) sites at NAB Little Creek is presented in [Table 1-1](#) and may be found in the current version of the Site Management Plan (SMP) (CH2M HILL, 2008a) in the Administrative Record (AR).

NAB Little Creek has elected to follow Navy recommendations of conducting an installation-wide 5-year review which includes all sites with remedies in place. A 5-year

review is required 5 years from the initiation of the first remedial action where hazardous substances, pollutants, or contaminants remain onsite above levels that allow for UU/UE. If a site contains multiple remedies, all are subject to a 5-year review when at least one remedy is initiated.

This Five-Year Review Report was prepared pursuant to CERCLA §121(c) and the National Oil and Hazardous Substances Pollution Contingency Plan, or National Contingency Plan (NCP). CERCLA §121(c) states:

If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each 5 years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106] the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.

USEPA interpreted this requirement further in the NCP at 40 CFR §300.430 (f)(4)(ii), which states:

If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for [UU/UE], the lead agency shall review such action no less often than every five years after initiation of the selected remedial action.

The triggering action of the statutory review process is signature of the Sites 9 and 10 ROD in December 2003 by the Navy (DON, 2003). This first Five-Year Review Report for NAB Little Creek was accomplished through a review of various reports and documents pertaining to pre- and post-remedy-implementation activities, analytical data, and findings, and through site inspections and interviews.

1.1 Community Involvement

NAB Little Creek established a Restoration Advisory Board (RAB) for NAB Little Creek, comprised of community members as well as representatives of the VDEQ and USEPA. The community was informed of the initiation of the 5-year review at a RAB meeting on October 23, 2007. Prior to this meeting, a public notice was placed in the *Virginian Pilot* informing the public of the RAB meeting. Additionally, a public notice was placed in the *Virginian Pilot* on January 5, 2008 to inform the community of the initiation of the 5-year review and the sites to be included. Community relations activities are documented in the AR. The AR is maintained by a NAVFAC Public Affairs Officer, Robin Willis, 757/445-8732 extension 3096. A public website has been established to enhance information exchange between the Navy and community (<http://public.lantops-ir.org/sites/public/nablc>).

**Table 1-1
Site Status Summary Table
Five Year Review
NAB Little Creek, Virginia Beach, Virginia**

Site ID	Other ID	Name/Description	Location	Env. Program	Status	Status	Comments/Notes
New SWMU 3	Formerly SWMU 111, was part of IR Site 2, IR Site 2 (sandblast areas) no longer used as each sandblast area now identified as separate SWMUs	Pier 10 Sandblasting Yard	West of Little Creek Channel	CERCLA / IRP	IR Site (RI / Phase II RI / EE/CA / PRAP / ROD / RD / RA)	RI/FS	A RI/HHRA/ERA was finalized in September 2005. Supplemental investigation for VOCs/metals in GW and abrasive blast material (ABM) delineation in sediment was conducted in FY07 and the draft SRI/HHRA/ERA report was submitted in May 2008. A FS/PP/ROD are scheduled for FY09.
New SWMU 7	SWMU 137, formerly part of IR Site 2, IR Site 2 (sandblast areas) no longer used as each sandblast area now identified as separate SWMUs	Small Boats Sandblast Yard - Piers 51-59. In June 2004, The Tier I Partnering Team agreed to separate the terrestrial portion of SWMU 7 from the aquatic portion (Desert Cove). SWMU 7a includes the soil and groundwater of SWMU 7, and SWMU 7b includes the sediment and surface water of desert cove.	Piers 51-59	CERCLA / IRP	IR Site (RI / EE/CA / PRAP / ROD / RD / RA)	RI/FS	IRA for lead in surface soil was completed in September 2004. Final RI/HHRA/ERA submitted in December 2004. Conclusions and Recommendations indicated that there is no overall human health or ecological risk in GW or Soil (SWMU 7a). Further investigations are necessary to further assess Ecological risk in Desert Cove (SWMU 7b) sediment. SWMU 7a NFA ROD was Signed in June 2005. Additional investigations are scheduled for FY09.
IR Site 7	SWMUs 123-126	Amphibious Base Landfill	NW corner of the intersection of Helicopter Road and Amphibious Drive	CERCLA IRP	IR Site (FFS)	RI/FS	A Final RI/HHRA/ERA was completed under the CERCLA IR Program. Eleven rounds of long-term monitoring of groundwater, sediment, and surface water was completed. LTM was discontinued in 2004 until a ROD is signed. Following signature of the ROD LTM will continue in accordance with a Post ROD LTM Plan. An IRA for canal sediment was completed in January -April 2007. A draft FFS outlining LUCs with groundwater LTM as the presumptive remedy was submitted in October 2007. In response to comments received additional subsurface debris investigation was conducted on the western "ear" of the landfill. The final FFS is scheduled for submittal in FY08. A PP/ROD are scheduled for FY09.
IR Site 11a		Building 3033 Former Waste Oil Tank	North of Site 11	CERCLA IRP	IR Site (RI)	RI/FS	Upgradient groundwater results at Site 11 indicated chlorinated VOC contamination. ISCO was used to treat chlorinated VOCs in groundwater in March 2004, and was not successful in reducing VOC concentrations below the MCL. A RI was conducted in FY08 and the draft RI/HHRA/ERA report is scheduled for submittal in May 2008. A FS/PP/ROD are scheduled for FY09.
IR Site 9	SWMU 24	Driving Range Landfill	Near Bldg 3699, NNE Portion of Base, East of Desert Cove	CERCLA IRP	IR Site (ROD)	ROD with LUCs (RIP)	Final ROD is in place. Selected Remedy is Land Use Restrictions (LUCs) and continued Long-term monitoring of groundwater. A Five Year Review is scheduled for FY08/09.
IR Site 10	SWMU 25 and SWMU 26	Sewage Treatment Plant Landfill - Desert Cove Landfill (SWMU 25); Sewage Treatment Plant Landfill - South of Desert Cove Landfill (SWMU 26)	Desert Cove Area, just west of former base sewage treatment plant	CERCLA IRP	IR Site (ROD)	ROD with LUCs (RIP)	Final ROD is in place. Selected Remedy is Land Use Restrictions (LUCs) and continued Long-term monitoring of groundwater. A Five Year Review is scheduled for FY08/09.
IR Site 11	SWMU 27 and SWMU 28	Former School of Music Plating Shop (SWMU 27); Former School of Music Neutralization Tank (SWMU 28);	School of Music Area, East Central Portion of Base	CERCLA IRP	IR Site (FS / PRAP / ROD)	ROD with LUCs	A final SRI, SRI addendum for HHRA, FS, and Proposed Plan have been completed under the CERCLA IR Program. A ROD was signed in July 2007 and the selected remedy is bio-remediation with LTM and LUCs. The draft RAWP was submitted in May 2008 and completion of the RA is scheduled for FY08/09.
IR Site 12	SWMU 77	NEX Laundry Disposal Area	Bldg 3323 in SE corner of base	CERCLA IRP	IR Site (FS / PRAP / ROD)	ROD with LUCs (RIP)	A Final RI/HHRA/ERA and a Final FS has been completed. A ROD was finalized in September 2005. An ESD to the ROD was signed in October 2006 and the remedy is bio-remediation with LTM. RA was completed in FY07. The draft RA CCR is scheduled for submittal in May 2008 and an IRACR is scheduled for FY09.
IR Site 13	SWMU 14 and SWMU 15	PWC Wash Rack (SWMU 14); PWC PCP Dip Tank (SWMU 15)	Bldg 3165, in the vicinity of the Public Works Compound; Paved Yard in the Public Works Center compound west of Bldg 3175, East-Central Portion of Base	CERCLA IRP	IR Site (FS / PRAP / ROD)	ROD with LUCs	A Final RI/HHRA/ERA and a Final FS have been completed. A TS was conducted in November 2004; injection of ISCO and anaerobic bio-remediation was completed and documented in Nov 06 TS report. A ROD was signed in September 2007 and the selected remedy is bio-remediation with LTM and LUCs. Completion of the RA is scheduled for FY09.
New SWMU 8	SWMU 144, formerly part of IR Site 2, IR Site 2 (sandblast areas) no longer used as each sandblast area now identified as separate SWMUs	West Annex Sandblasting Area	Vacant Lot west of the ACU 2 Area in the West Annex	CERCLA / IRP	IR Site (RI / EE/CA / PRAP / ROD)	Response Complete (NFA)	An IRA was completed in September 2004 to removal Outfall sediment posing potential unacceptable ecological risk. Final RI/HHRA/ERA submitted in December 2004. Conclusions and recommendations indicated that there was no overall human health or ecological risk in soil, groundwater, surface water, and sediment, and recommended no further action for the site. NFA PP/ROD Signed in June 2005.
IR Site 6	SWMU 117/ 4	Special Boat Unit 2 Battery Storage Area / Battery Acid Disposal Area	On the SE corner of Bldg 103, in the SW Area of the Base	CERCLA IRP	IR Site (SSA)	Response Complete (NFA)	On January 27, 1999, EPA, DEQ, and the Navy discussed this site. It was agreed that further investigation was required. Existing information suggests potential problem. One GW sample was collected for lead during 2005 SSA. NFA Closeout report was signed in January 2006.
IR Site 8	SWMU 84	Demolition Debris Landfill	NE corner of the intersection of Amphibious Drive and Helicopter Road	CERCLA IRP	IR Site (RI / EE/CA / PRAP / ROD)	Response Complete (NFA)	A final RI/HHRA/ERA was completed under the CERCLA IR Program. An IRA and wetlands creation was completed in FY06 and is the final remedy for the Site. A NFA ROD was signed in July 2008.
SWMU 13		Former Pesticide Shop	Building 3170 near Building 3166 and intersection of 6th and F Streets (Off Gator Blvd)	CERCLA	SSA	Response Complete (NFA)	On January 27, 1999, EPA, DEQ, and the Navy discussed this site. It was agreed that further investigation was required. Existing information suggests potential problem. Soil and GW samples collected in 2005 SSA did not pose risk. NFA Close out report was signed in January 2006

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Site ID	Other ID	Name/Description	Location	Env. Program	Status	Status	Comments/Notes
New SWMU 5	SWMU 130	Port Ops Boat Painting Area	Port Ops Building 3896, west of piers 56-59	CERCLA	SSA	Response Complete (NFA)	On May 10, 1999, EPA, DEQ, and the Navy discussed the demolition of all buildings in this area. After comparing sampling results to industrial soil RBCs, it was concluded that no special precautions needed to be taken for demolition. One monitoring well GW sample collected in 2005 SSA. No unacceptable risk, and NFA Closeout report was signed in January 2006.
New SWMU 6	SWMUs 131-133	Seabee Area - CB124	East of Pier 47: South of Desert Cove	CERCLA, SI Process	SSA	Response Complete (NFA)	EPA, DEQ, and the Navy discussed this site on April 19 and May 10, 1999. Based on comparison of the chemical concentrations found in the soil to Industrial RBCs, EPA and DEQ agreed that NFA was required for the soil. However, due to elevated metals in groundwater recommend the collection of three filtered groundwater samples near the previous locations W1, S2, and W4 using geoprobe or other direct push technology. SSA was conducted in 2005. There was no unacceptable risk, and NFA close out report was signed in January 2006.
SWMU 18		PWC Trans. Garage Spent Battery Shop, Collection Area	North of Public Works Facility Area in Building 3661	CERCLA	Preliminary Screening	Response Complete (NFA)	Two grab samples will be collected in the grassy area behind the old batteries, composited, and tested for lead and zinc. A picture from '93 indicated another battery storage area. Desktop audit indicated no potential risk. NFA consensus in May 2005.
SWMU 116		MWR Recreation Boat Maintenance Facility	Bldg 3021 in the northeast corner of the base	CERCLA	Preliminary Screening	Response Complete (NFA)	Site was sampled during the Relative Risk Ranking, soil samples were collected along the fence line in 1995 and analyzed for VOCs and Metals. SSA will be conducted in FY05. EPA has considered analysis for SVOCs may be required. Sample results show lead was not found to be significant, and no significant volatiles were found. Desktop audit was conducted in 2005 and indicated site did not pose risk. NFA consensus signed in May 2005.
AOC D		PCB Transformer Leak	Bldg 3530 Between 5th and 3rd Streets in the SE Corner of the Base	CERCLA	Preliminary Screening	Response Complete (NFA)	Desktop audit conducted in May 2005 did not indicate potential release, therefore NFA consensus was signed in May 2005.
SWMU 30		Leaking Above Ground Diesel Tank	Bldg 3400, in the SE portion of the Base	SPCC/AST	NFA	Response Complete (NFA)	The 150 gallon diesel tank rests on four steel legs atop an asphalt surface. A concrete berm has been placed around the tank. The tank and the berm are currently in good condition. Any further assessment or remediation will be covered under the SPCC Plan/AST Program. SPCC/AST Site. In June 2003, the team agrees to closeout SWMU 30 with NFA. The CNRMA IR staff will inform CNRMA UST/AST staff of responsibility for any "needed" action.
SWMU 96		CB301 Seabee Vehicle Maintenance Facility Scrap Storage Area	Bldg CB301, South of Desert Cove	CERCLA	Preliminary Screening	Response Complete (NFA)	Desk top audit was completed in April 2004. NFA due to Seabee activity. This area is an active industrial facility and will be covered under RCRA. A close out report was signed in September 2004.
SWMU 97		CB301 Seabee Vehicle Maintenance Facility Storm Drain	Bldg CB301, South of Desert Cove	VPDES	Preliminary Screening	Response Complete (NFA)	Drain located immediately west of the northwest corner of CB301. Further assessment and remediation will be covered under the VPDES Program. Desk top audit was completed in April 2004. NFA due to Seabee activity. This area is an active industrial facility and will be covered under RCRA. A close out report was signed in September 2004.
SWMU 98		CB210 Elevated Causeways Mechanic Shop Material Dispensing Area	Bldg CB210, South of Desert Cove	CERCLA	Preliminary Screening	Response Complete (NFA)	Desk top audit was completed in April 2004. NFA due to Seabee activity. This area is an active industrial facility and will be covered under RCRA. A close out report was signed in September 2004.
SWMU 119		Former Special Warfare Group 2 Electronics Shop	South of Little Creek Channel, Bldg W112	CERCLA	Preliminary Screening	Response Complete (NFA)	In March 2004, the Navy, DEQ, and USEPA joint scoped the collection of three groundwater samples from 10-15' bgs for the analysis of TCL VOCs, and TCL SVOCs. Results showed no unacceptable human health or ecological risk. Closeout report was signed in September 2004.
IR Site 14	SWMU 16 and SWMU 17/1	Transformer Storage Area - Old Pole Yard (SWMU 16); Small Transformer Storage Area (SWMU 17/1)	Bldg 3664 across 7th Street from the Public Works Compound, East-Central Portion of Base	CERCLA IRP	IR Site / Preliminary Screening/NFA	Response Complete (NFA)	NFA was recommended in IAS; consensus August 1999 Partnering for desktop audit of site and review of historical data and clarification of regulatory standards or action levels for PCBs; some additional sampling may be required in the drum storage area. In March 2000, EPA, DEQ, and the Navy agreed this SWMU would be addressed in Appendix B of the FFA. Preliminary Site Screening was conducted in August 2003. Surface and subsurface soil samples were collected in the former drum storage area. Results indicated no human health or ecological risk and the site was recommended for NFA. A Final Close-Out Report was issued and signed in March 2004.
AOC H		Pesticide Mixing Area	Buildings 3109 and 3630, near golf course	CERCLA	Preliminary Screening/NFA	Response Complete (NFA)	On January 27, 1999, EPA, DEQ, and the Navy discussed the site. It was agreed that further action was required, although no specific priority or timeline was assigned. Limited soil sampling for pesticides was recommended. In March 2000, EPA, DEQ, and the Navy agreed this site would be addressed in Appendix A of the FFA. Preliminary Screening was conducted in August 2004. Soil (surface and subsurface) samples were collected. Results indicated no human health or ecological risks at the AOC. USEPA, DEQ, and Navy agreed that NFA was required at the Site. A Final Close-Out report was issued and signed in March 2004. Land use is unrestricted at the site.

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AOC I		Golf Course Pond Area	Golf course Hole 9	CERCLA	Preliminary Screening/NFA	Response Complete (NFA)	During the December 2000 partnering meeting, EPA, DEQ and the Navy discussed this site. It was agreed that further action was required, although no specific priority or timeline was assigned. Preliminary Screening was conducted in August 2004. Soil (surface and subsurface) samples were collected and analyzed for Site 9 COCs and results indicated no human health or ecological risk at the site. Additionally one sediment sample was collected in the golf course pond for Site 9 COCs to assess the potential for ecological risk at the site. Results indicated no ecological risk from site runoff in sediment. The Navy, USEPA, and DEQ agreed that NFA was required and a Final Close-Out Report was issued and signed in March 2004. Land use is unrestricted at the site.
AOC J		Burn Area	Across Hewitt Drive from driving range	CERCLA	Preliminary Screening/NFA	Response Complete (NFA)	During the December 2000 partnering meeting, EPA, DEQ and the Navy discussed this site. It was agreed that further action was required, although no specific priority or timeline was assigned. Preliminary Screening was conducted in August 2004. Soil (surface and subsurface) samples and one groundwater sample were collected. The results indicated no human health or ecological risk at the site. The USEPA, Navy, and DEQ agreed NFA was required for the site and a Final Close-Out Report was issued and signed in March 2004. Land use is unrestricted at the site.
SWMU 31		Pier 10 Leaking Above Ground Fuel Tanks	On Pier 10 near Bldg 1263	SPCC/AST	NFA	Response Complete (NFA)	The three fuel tanks holding JP-5, gasoline, and diesel, were removed in 1995. Drums containing waste oil are still present at the site. However, the drums are resting on a steel platform above a concrete pad in good repair. The pad is bermed by a 4-inch high concrete curb containing a valve that allows release to outside of the bermed area. The area is in compliance with the SPCC Plan, and on June 30, 1999, the site was approved for NFA by the EPA, DEQ, and the Navy. Any further assessment or remediation will be covered under the SPCC Plan/AST Program.
SWMU 32		NEX (East Annex) Gas Station - Battery Storage Area	East end of Base	CERCLA	NFA	Response Complete (NFA)	On March 10, 1999, EPA, DEQ, and the Navy visited the site. Due to the lack of release or stains reported in the RFA, the very small area potentially affected, and the lack of significant contamination detected in 1995, EPA and DEQ agreed that NFA was required for this SWMU.
SWMU 33		NEX (East Annex) Gas Station - Satellite Accumulation Area	East end of Base	CERCLA	NFA	Response Complete (NFA)	On March 10, 1999, EPA, DEQ, and the Navy visited the site. Due to the lack of release or stains reported in the RFA, the very small area potentially affected, and the lack of significant contamination detected in 1995, EPA and DEQ agreed that NFA was required for this SWMU.
SWMU 34		NEX Vending Office Used Oil UST	Bldg 3319, Southeast Corner of the Base	UST	NFA	Response Complete (NFA)	The tank was removed in 1990. A Site Characterization was submitted to the DEQ. The Navy received notification from DEQ on August 27, 1991 that no further assessment or remedial action was necessary at the site. In June 1999, consensus for NFA since site is under UST program.
SWMU 35		PWC Transportation Garage Used Oil UST	Bldg 3661 in East/Central Portion of Site, north of Public Works Facility	UST	NFA	Response Complete (NFA)	The tank was removed in 1989. Site Characterization was submitted to the DEQ. No closure letter was received by the Navy. However, per telephone conversation with Tom Madigan on April 13, 1999, the unit is defined as closed in the DEQ database. The draft RFA stated that the stained soils surrounding the tank fill pipes were removed and disposed. Consensus at June 1999 Partnering NFA since site is under UST program
SWMU 36		Auto Hobby Shop Used Oil UST	Bldg 3530 Between 5th and 3rd Streets in the SE Corner of the Base	UST	NFA	Response Complete (NFA)	The tank was closed in place in 1991. Two Site Characterization Reports have been submitted to DEQ. A Corrective Action Plan was also submitted and approved by the DEQ. Implementation of the CAP began March 1998. Free product is being recovered at the site. The site is monitored weekly Quarterly progress reports are submitted to DEQ. In June 1999, consensus for NFA since site is under UST program.
SWMU 37		CB301-3 Seabee Maintenance Used Oil Tank	CB301-3 South of Desert Cove	UST	NFA	Response Complete (NFA)	The tank was removed under Phase IV of the UST Program. It was replaced with double wall Fiberglass tanks and piping with interstitial monitoring on the tanks and piping. The Navy received notification from the DEQ on September 20, 1994 that no further assessment or remedial action was necessary at the site. In June 1999, consensus for NFA since site is under UST program.
SWMU 38		ACU-4 Used Oil Tanks	Bldg 3817, slightly west of Desert Cove Area in the north/central portion of the base	UST	NFA	Response Complete (NFA)	Two 2550 gallon USTs were removed in 1992. Navy had no closure letter on file. Status in DEQ database identified tanks as "currently in use." Navy will continue to coordinate with DEQ on these tanks. In June 1999, consensus for NFA since site is under UST program.
SWMU 39		East Annex Gas Station Used Oil Tank	Bldg 3615 in the far eastern portion of the base	UST	NFA	Response Complete (NFA)	The 550 gallon UST installed in 1961 was removed in 1991. The Site Characterization was submitted to the DEQ. The Navy received notification from the DEQ on August 17, 1994 that no further assessment or remedial action was necessary at the site. In June 1999, consensus for NFA since site is under UST program.
SWMU 40		BMU-2 Used Oil Tank	Bldg 3142, south of the baseball fields in the North/Central portion of the Base	UST	NFA	Response Complete (NFA)	The 550 gallon UST constructed of fiberglass reinforced plastic was installed in 1985 and removed in 1991. A Site Characterization was sent to the DEQ. The Navy received notification from the DEQ on August 16, 1994 that no further assessment or remedial action was necessary at the site.

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SWMU 41		MWR Equipment Rental Used Oil Tank	Bldg 3108, NW of the Public Work Facility	UST	NFA	Response Complete (NFA)	The 550 gallon UST constructed of fiberglass reinforced plastic was installed in 1985 and removed in 1990. A Site Characterization was sent to the DEQ. The Navy received notification from the DEQ on October 18, 1991 that no further assessment or remedial action was necessary at the site. In June 1999, consensus for NFA since site is under UST program.
SWMU 42		ACU-2 Used Oil Tank 3	Bldg 1231 west of the Little Creek Channel	UST	NFA	Response Complete (NFA)	The 550 gallon UST constructed of fiberglass reinforced plastic was installed in 1981 and removed in 1991. A Site Characterization was sent to the DEQ. The Navy received notification from the DEQ on August 16, 1994 that no further assessment or remedial action was necessary at the site. In June 1999, consensus for NFA since site is under UST program.
SWMU 43		ACU-2 Used Oil Tank 4	Bldg 1231 west of the Little Creek Channel	UST	NFA	Response Complete (NFA)	The 550 gallon UST constructed of fiberglass reinforced plastic was installed in 1981 and removed in 1991. A Site Characterization was sent to the DEQ. The Navy received notification from the DEQ on August 16, 1994 that no further assessment or remedial action was necessary at the site. In June 1999, consensus for NFA since site is under UST program.
SWMU 44		NSWG-2 Used Oil Tank	Between Buildings T-9 and T-11 in the SW Area of the Base	UST	NFA	Response Complete (NFA)	The 550 gallon UST constructed of fiberglass reinforced plastic was installed in 1985 and removed in 1991. A Site Characterization was sent to the DEQ. The Navy received notification from the DEQ on August 16, 1994 that no further assessment or remedial action was necessary at the site. In June 1999, consensus for NFA since site is under UST program.
SWMU 45	cross-reference with SWMU 139 and 142	Naval Special Warfare Group 2 Solvent Tank	Bldg 3806 in the central region of the base, just north of Pier 59	UST	NFA	Response Complete (NFA)	Within the NSWG command are the SEAL Teams. NAB Little Creek is resident command to four SEAL Teams. All four occupy one large compound, of which Bldg 3806 is a part. Only one solvent tank existed in this compound, although three different SWMU numbers were assigned. This is a duplicate of SWMU 139. In June 1999, consensus for NFA since site is under UST program.
SWMU 46		NAMS Used Oil Tank 4	Bldg 3872, in the proximity of Desert Cove	UST	NFA	Response Complete (NFA)	The 500 gallon UST was constructed of stainless steel and installed in 1985. The tank was removed by 1994. The Navy received notification from the DEQ on June 8, 1994 that no further assessment or remediation was necessary at the site. In June 1999, consensus for NFA since site is under UST program.
SWMU 47		SURTASS-3 Used Oil Tank	Bldg 1558 west of Little Creek Channel	UST	NFA	Response Complete (NFA)	The 4000 gallon UST constructed of fiberglass reinforced plastic was installed in 1985 and used for storage of NORPAR 12. The tank was removed in 1995. The Navy received notification from DEQ on August 15, 1995 that no further assessment or remedial action was necessary at the site. In June 1999, consensus for NFA since site is under UST program.
SWMU 48		Oil/Water Separator	Bldg 3896, Port Ops, west of piers 56-59	HRSD	NFA	Response Complete (NFA)	All of the Base Oil/Water Separators discharge to the sanitary sewer system and are therefore covered under the HRSD Permit. The Oil/Water Separators are inspected and cleaned as necessary to prevent releases to the sanitary sewer system. The EPA, DEQ, and Navy discussed these SWMUs on June 30, 1999 and NFA was recommended for these SWMUs.
SWMU 49		Used Oil Tank 1	Bldg 3860, west of Desert Cove in the North/Central portion of the base	UST	NFA	Response Complete (NFA)	The 10,000 gallon UST constructed of fiberglass reinforced plastic and installed in 1976 was removed in 1992. It was replaced with a new double walled 10,000 gallon tank. If additional contamination is discovered, it will be investigated through the UST Program.
SWMU 50		Used Oil Tank 2	Bldg 3860, west of Desert Cove in the North/Central portion of the base	UST	NFA	Response Complete (NFA)	The 500 gallon UST, constructed of steel was removed in 1989. A closure letter was not sent to the Navy and could not be located. The site is listed as "closed" in the DEQ database. It was reiterated by Tom Madigan on April 1, 1999 that the tanks are closed therefore NFA. In June 1999, consensus for NFA since site is under UST program.
SWMU 51		Used Oil Tank 6	Bldg 3530, south of Desert Cove	UST	NFA	Response Complete (NFA)	The 500 gallon UST constructed of stainless steel was installed in 1954 and removed in 1990. A closure letter was not sent to the Navy and could not be located. The site is listed as "closed" in the DEQ database. It was reiterated by Tom Madigan on April 1, 1999 that the tanks are closed therefore NFA was recommended. Consensus at June 1999 Partnering NFA since site is under UST program.
SWMU 52		CB208 Used Oil Tank	South of Building CB-210, slightly south of Desert Cove	UST	NFA	Response Complete (NFA)	The 550 gallon UST constructed of fiberglass reinforced plastic and installed in 1983 was removed in 1994. The Navy received notification from DEQ on May 27, 1994 that no further assessment or remedial action was necessary at the site. If additional contamination is discovered, it will be investigated through the UST Program.
SWMU 53		CB214 Used Oil Tank	Bldg CB214, directly south of Desert Cove	UST	NFA	Response Complete (NFA)	The 550 gallon UST constructed of fiberglass reinforced plastic and installed in 1983 was removed in 1994. The Navy received notification from DEQ on May 27, 1994 that no further assessment or remedial action was necessary at the site. Consensus at June 1999 Partnering NFA since site is under UST program.

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SWMU 54		CB301-4 Seabee Maintenance Used Oil Tank	Bldg CB301-4	UST	NFA	Response Complete (NFA)	The tank was removed under Phase IV of the UST Program. It was replaced with double wall Fiberglass tanks and piping with interstitial monitoring on the tanks and piping. The Navy received notification from the DEQ on September 20, 1994 that no further assessment or remedial action was necessary at the site. In June 1999, consensus for NFA since site is under UST program.
SWMU 55		CB315 Used Oil Tank	South of Desert Cove Area	UST	NFA	Response Complete (NFA)	The 550 gallon UST constructed of fiberglass and reinforced plastic was installed in 1983 and removed in 1991. The Navy received notification from DEQ on August 16, 1994 that no further assessment or remedial action was necessary at the site. Consensus at June 1999 Partnering NFA since site is under UST program.
SWMUs 56-58		SIMA Used Oil Tanks 2-4	Building 1265 west of Little Creek Channel	UST	NFA	Response Complete (NFA)	All three tanks were 1000 gallon USTs constructed of steel and installed in 1984. SWMU 56 was removed by 1994. SWMUs 57 and 58 were removed in 1991 and replaced with oil/water separators. A Site Characterization was sent to DEQ. The Navy received notification from DEQ on August 16, 1994 that no further assessment or remedial action was necessary. In June 1999, consensus for NFA since site is under UST program.
SWMU 59		Naval/Marine Reserve Center Used Oil Tank 1	SW portion of the base, west of Little Creek Channel	UST	NFA	Response Complete (NFA)	The 550 gallon UST constructed of fiberglass reinforced plastic and installed in 1983 was removed in 1991. The Navy received notification from DEQ on October 18, 1991 that no further assessment or remedial action was necessary at the site. In June 1999, consensus for NFA since site is under UST program.
SWMU 60		Used Oil Tank	Bldg 3033, north of the Music School	UST	NFA	Response Complete (NFA)	The Navy has closure letter on file. Tom Madigan of TRO-DEQ identified this unit as "closed" in the DEQ database and reiterated that the tanks are closed and NFA is required. In June 1999, consensus for NFA since site is under UST program. If additional contamination is discovered, it will be investigated through the UST Program.
SWMU 61		Harbormaster's Office Above Ground Used Oil Tanks	Building 3894, East/Central Portion of Base	CERCLA	NFA	Response Complete (NFA)	Tank has been drained and removed (Draft RFA Navy comment). Because the unit is in good condition and is located in a contained area, the Revised RFA recommended NFA. Consensus for NFA (June 30, 1999).
SWMU 62		CB210 ELCS Mechanic Shop Above Ground Used Oil Tank	CB210 ELCS	CERCLA	NFA	Response Complete (NFA)	Because the unit is in good condition and is located in a contained area, the Revised RFA recommended NFA (June 30, 1999). No releases identified, SWMU managed under SPCC Plan as AST, tank no longer in service.
SWMU 63		Fuel Farm Platform Above Ground Waste Oil Tanks	Bldg 3867, West of Desert Cove	SPCC/AST	NFA	Response Complete (NFA)	These tanks will be replaced with convault tanks as part of the SPCC upgrade. The EPA, DEQ, and Navy discussed this SWMU on June 30, 1999. EPA and DEQ agreed that as long as the tanks are registered, NFA was required for this SWMU. All tanks over 660 gal are registered at Little Creek. If additional contamination is discovered, it will be investigated through the SPCC Program.
SWMU 64		BMU-2 Maintenance Above Ground Waste Oil Tank	Bldg 3142	CERCLA	NFA	Response Complete (NFA)	Tank replaced with convault AST 10/98, soil sampling during replacement, managed under SPCC Program. Because the unit is in good condition and is located in a contained area, the revised RFA recommended NFA (June 30, 1999).
SWMUs 65-75		Facility Oil/Water Separators	Facility Wide	HRSD	NFA	Response Complete (NFA)	The EPA, DEQ, and Navy discussed these SWMUs on June 30, 1999 and NFA was recommended for these SWMUs. All of the Base Oil/Water Separators discharge to the sanitary sewer system and are therefore covered under the HRSD Permit. The Oil/Water Separator are inspected and cleaned as necessary to prevent releases to the sanitary sewer system.
SWMU 76		Hazardous Waste Storage Pad	North of Gates 4 and 5 in the Southeast corner of the Base	CERCLA	NFA	Response Complete (NFA)	Clean closure DEQ letter April 1997. Consensus for NFA.
SWMU 78		Navy Exchange Vending Office Drum Area	Exact location could not be determined after visit to building 3319	CERCLA	NFA	Response Complete (NFA)	Sept, '93, the site was visited, and no drums were present. As part of the UST Program, a Site Characterization has been performed near the SWMU. No contamination was detected. The Navy, EPA, and DEQ visited the site on March 10, 1999 and could not find the drums, or any staining. Consensus for NFA.
SWMU 79		Navy Exchange Vending Office Scrap Yard	SE Portion of Base, Bldg 3319	CERCLA	NFA	Response Complete (NFA)	Site has been vending office since 1954, all items removed, no longer scrap yard. No release noted during VSI, since there is no hazardous waste or hazardous constituents managed, the RFA recommended NFA for this SWMU (June 30, 1999).
SWMU 80		MWR Auto Hobby Shop Paint Booth Filters	Bldg 3530 Between 5th and 3rd Streets	CERCLA	NFA	Response Complete (NFA)	The revised RFA stated that this site is recommended for NFA because it is located inside a building or under a roof with a concrete floor (June 30, 1999). Painting operations ceased 1996.
SWMU 81		MWR Auto Hobby Shop Stain in Parking Lot Area	Southeast portion of base between 5th and 3rd Streets	CERCLA	NFA	Response Complete (NFA)	On March 10, 1999, EPA, DEQ, and the Navy visited the site. The oil stains and stressed vegetation around the edges of the parking lot could not be located. The locations of the dumpsters and stains on the picture from the VSI were located. A Site Characterization has been performed near this site as part of the UST Program. No soil or groundwater contamination was detected at the site with the exception of the area immediately surrounding the UST.

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SWMU 82		Boone Clinic Medical X-Ray Silver Recovery Unit	Bldg 3505, Medical Clinic Building	CERCLA	NFA	Response Complete (NFA)	No release identified during VSI, the revised RFA stated that this site is recommended for NFA because it is located inside a building or under a roof with a concrete floor (June 30, 1999).
SWMU 83		Boone Clinic Dental Clinic	Bldg 3505, Medical Clinic Building	CERCLA	NFA	Response Complete (NFA)	No release identified during VSI, the revised RFA stated that this site is recommended for NFA because it is located inside a building or under a roof with a concrete floor (June 30, 1999).
SWMU 85		SIMA Machine Shop	Bldg 1265	CERCLA	NFA	Response Complete (NFA)	In 1998, SIMA vacated the building. No release identified during VSI, the revised RFA stated that this site is recommended for NFA because it is located inside a building or under a roof with a concrete floor (June 30, 1999).
SWMU 86		SIMA Grind Shop	Bldg 1265	CERCLA	NFA	Response Complete (NFA)	In 1998, SIMA vacated the building. No release identified during VSI, the revised RFA stated that this site is recommended for NFA because it is located inside a building or under a roof with a concrete floor (June 30, 1999).
SWMU 87		SIMA Rewind Shop	Bldg 1265	CERCLA	NFA	Response Complete (NFA)	No release identified during VSI, the revised RFA stated that this site is recommended for NFA because it is located inside a building or under a roof with a concrete floor (June 30, 1999). In 1998, SIMA vacated the building.
SWMU 88		SIMA Mechanical Calibration Laboratory	Bldg 1265	CERCLA	NFA	Response Complete (NFA)	No release identified during VSI, the revised RFA stated that this site is recommended for NFA because it is located inside a building or under a roof with a concrete floor (June 30, 1999). In 1998, SIMA vacated the building.
SWMU 89		SIMA Carpentry Shop	Bldg 1265	CERCLA	NFA	Response Complete (NFA)	No release identified during VSI, the revised RFA stated that this site is recommended for NFA because it is located inside a building or under a roof with a concrete floor (June 30, 1999). In 1998, SIMA vacated the building.
SWMU 90		SIMA Boat Shop Storage Yard Satellite Accumulation Area	Exact location could not be determined after visit to building 1265	CERCLA	NFA	Response Complete (NFA)	The revised RFA stated that this site is recommended for NFA because it is located inside a building or under a roof with a concrete floor. In June 1999, consensus for NFA (June 30, 1999).
SWMU 91		SIMA Cable Rigger Shop Storage Satellite Accumulation Area	Bldg 1265	CERCLA	NFA	Response Complete (NFA)	No release identified during VSI, the revised RFA stated that this site is recommended for NFA because it is located inside a building or under a roof with a concrete floor (June 30, 1999). In 1998, SIMA vacated the building.
SWMUs 92-95		CB301 Seabee Vehicle Maintenance Facility	Bldg CB301, South of Desert Cove	CERCLA	NFA	Response Complete (NFA)	No release identified during VSI, the revised RFA stated that this site is recommended for NFA because it is located inside a building or under a roof with a concrete floor (June 30, 1999).
SWMU 99		Solid Waste Incinerator Site	Bounded by Helicopter Road to the west, 10th Street to the South, and Hewitt Drive to the East	CERCLA	NFA	Response Complete (NFA)	Operation of unit ended in 1957. The revised RFA recommended NFA for this site because the unit has been removed and there is no evidence of release (June 30, 1999).
SWMU 100		Fuel Farm Loading Platform Underground Storage Tank	Adjacent to Desert Cove near Bldg 3867	CERCLA/UST	NFA	Response Complete (NFA)	Above ground oil tanks (SWMU 63) are associated with this SWMU, this SWMU is also managed under the UST program.
SWMU 101		Beachmaster Unit 2 Satellite Accumulation Area	Southeast of Site 10	CERCLA	NFA	Response Complete (NFA)	On May 11, 1999, the EPA, DEQ, and the Navy visited the site and could not determine its exact location. They resolved that NFA was required.
SWMU 103		Stationary Crane Area	Between Piers 10 and 11 located along Little Creek Cove	CERCLA	NFA	Response Complete (NFA)	Unit removed and no evidence of release and was subsequently recommended for NFA in the revised RFA (June 30, 1999).
SWMU 104		Steam Plant Baghouses	In Building 757 between Murray Road and Amphibious Drive	CERCLA	NFA	Response Complete (NFA)	The unit is in good condition and was recommended for NFA by the revised RFA (June 30, 1999).
SWMU 106		Steam Plant French Drain	In Building 757 between Murray Road and Amphibious Drive	CERCLA	NFA	Response Complete (NFA)	Associated with SWMU 105 and 107, operation began 1956, SWMU also covered under HRSD Permit. The unit is in good condition and was recommended for NFA by the revised RFA (June 30, 1999).
SWMU 107		Steam Plant Coal Pile Leachate Collection System	In Building 757 between Murray Road and Amphibious Drive	CERCLA	NFA	Response Complete (NFA)	Associated with SWMU 105 and 106, operation began 1956, SWMU also covered under HRSD Permit. The unit is in good condition and was recommended for NFA by the revised RFA (June 30, 1999).
SWMU 108		Steam Plant Fuel Tanks and Associated Pipes	In Building 757 between Murray Road and Amphibious Drive	SPCC/AST	NFA	Response Complete (NFA)	The steam plant fuel tanks were inspected in 1995, and no evidence of leaks was detected. Monitoring was also completed and no evidence of contamination or free product was found. The EPA, DEQ, and the Navy discussed this SWMU on June 30, 1999 and agreed that as long as the tanks were registered, NFA was necessary for this SWMU. Any further assessment or remediation will be covered under the SPCC/AST Program
SWMU 109		Steam Plant Floor Drains	In Building 757 between Murray Road and Amphibious Drive	HRSD	NFA	Response Complete (NFA)	Drains from the steam plant enter the sanitary sewer system and are covered by the HRSD Permit. Therefore, NFA has been recommended for this SWMU. Status pending verification drains off-line (3/00). It was confirmed back drains have been sealed, front drains uncertain (3/00).
SWMU 110		90-Day Accumulation Area	Two bays in Bldg 106 and an outdoor storage yard adjacent to Bldg 106	CERCLA	NFA	Response Complete (NFA)	Because the unit is in good condition and is located in a contained area, the Revised RFA recommended NFA (June 30, 1999).
SWMU 112		Pier 10 Sandblasting Area Satellite Accumulation Area	Location cannot be determined	CERCLA	NFA	Response Complete (NFA)	On March 10, 1999, EPA, DEQ, and the Navy visited this SWMU. The best estimate of its former location was determined to be in the middle of the parking lot. Since it is covered, it poses no likely risk to health, EPA and DEQ agreed NFA was required.

**Table 1-1
Site Status Summary Table
Five Year Review
NAB Little Creek, Virginia Beach, Virginia**

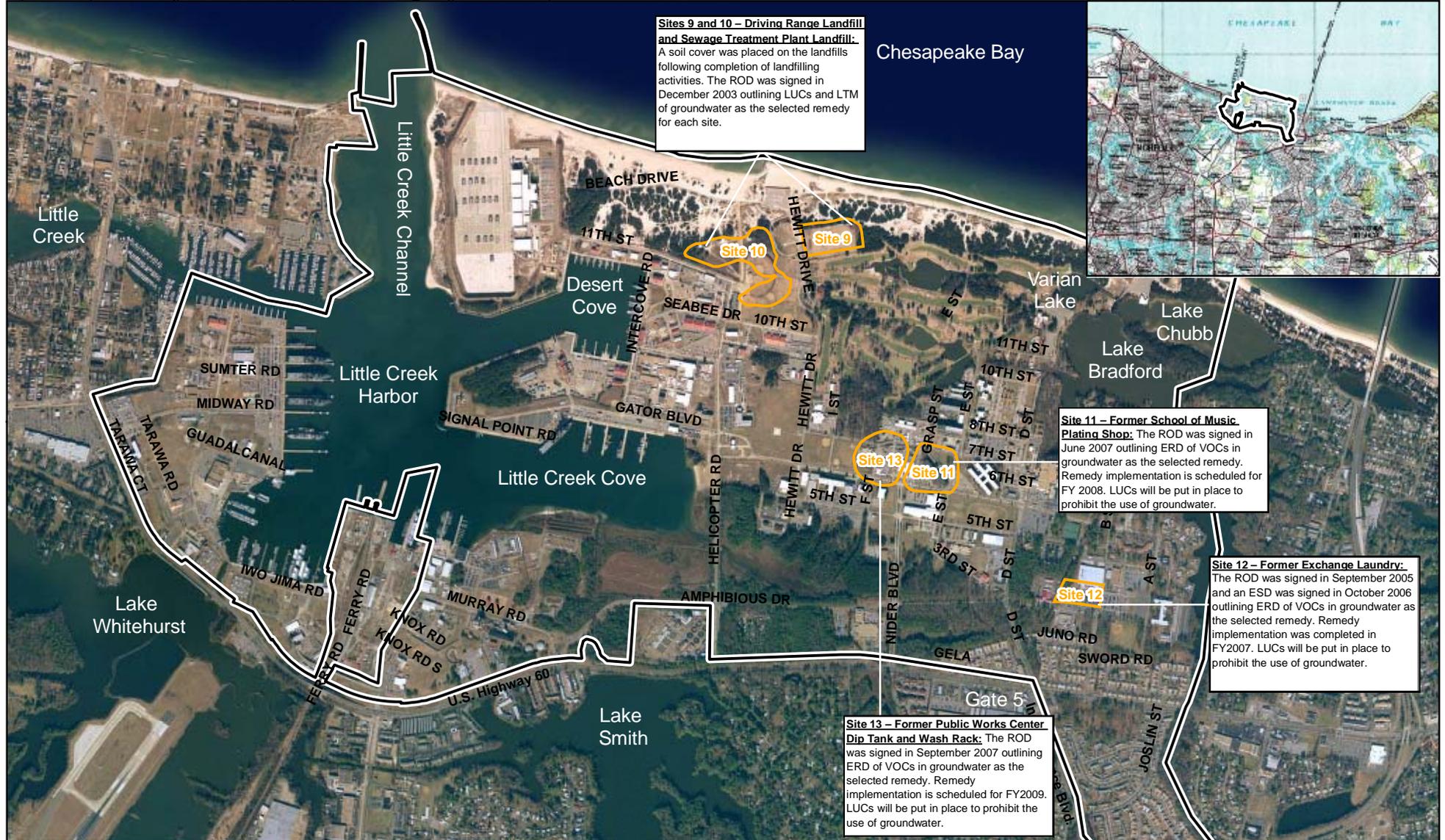
Site ID	Other ID	Name/Description	Location	Env. Program	Status	Status	Comments/Notes
SWMU 114		ACU-2 Drum Rack and Tank Area	Building 1522, west of Little Creek Channel	SPCC/AST	NFA	Response Complete (NFA)	SPCC/AST Site. The ACU 2 drum rack and tank area consists of 100 square foot concrete area surrounded by a berm. The berm will be demolished and removed as part of the SPCC upgrades. All stained soil will be excavated. TPH soil samples to be collected under SPCC and results provided to EPA/DEQ. PWC to provide information.
SWMU 115		ACU-2 Fuel Dispensing Area	Building 1522, west of Little Creek Channel	SPCC/AST	NFA	Response Complete (NFA)	SPCC/AST Site. Two metal tanks rest on a concrete slab surrounded by a 6-inch concrete berm. This area will be addressed as part of the SPCC upgrades. The existing tanks will be replaced with convaults. The berm will be partially demolished and the rest filled in to form a raised platform for the new tanks. PWC will collect 3 grab samples into one composite for TPH on each log side of berm, 2 grab samples into one composite for TPH; total of 4 composite samples to be collected. PWC to provide information. DEQ close out letter March 15, 2000 received. One composite sample comprised of 7 grabs from the bottom of the excavation Sept 99 for TPH diesel with a result of 422 mg/Kg, excavation backfilled and prefab slab and convault.
SWMU 120		VC-6 Satellite Accumulation Area	Directly South of Pier 6, Bldg 2074	CERCLA	NFA	Response Complete (NFA)	On October 4, 1993, the site was visited, and there was no evidence of stains or releases. On April 19, 1999, EPA and DEQ agreed that NFA was required for this SWMU.
SWMU 121		Landing Force Training Command Satellite Accumulation Area	Bldg 3532	CERCLA	NFA	Response Complete (NFA)	No releases identified during the VSI, the revised RFA stated that this site is recommended for NFA because it is located inside a building or under a roof with a concrete floor (June 30, 1999).
IR Site 1		Building 1231 Oil Disposal Area	West of Little Creek Channel	CERCLA IRP	NFA/ IR Site	Response Complete (NFA)	This site was investigated within the UST program. Because the unit is in good condition and is located in a contained area, the Revised RFA recommended NFA. DEQ approved closure of the site in August 1994.
IR Site 3	SWMU 102	West Annex Fuel Leak - Piers 11-19	Piers 11-19 along the west side of Little Creek Channel	CERCLA IRP	NFA/ UST/VPDES	Response Complete (NFA)	This SWMU was included in the IR Program (Site 3). However, NFA was recommended because the site will be monitored and regulated under the UST and VPDES Programs and permits. On August 10, 1999, EPA and DEQ recommended NFA due to coverage under other programs.
IR Site 4		Reserve Center Motor Oil Disposal Area	Naval Marine Reserve Center West of Little Creek Channel	CERCLA IRP	NFA/ UST	Response Complete (NFA)	This site was investigated through the UST and IR Program (SWMU 59). DEQ has granted closure of the Site in October 1991. The Navy does not own this land, and did not own it during disposal activities. The Naval Marine Reserve Center is responsible for this area. Site was sampled under IR program as PSI, NFA was recommended. in PSI report; April 2003 Consensus for NFA based on UST site.
IR Site 5	SWMU 118	Motor Oil Disposal Area Special Boat Unit Yard	Between Buildings T-9 and T-11 in the SW Area of the Base	CERCLA IRP	NFA/ IR Site	Response Complete (NFA)	On August 10, 1999, the EPA and DEQ agreed that NFA for site screening was required for this SWMU based on its status as a CERCLA IR Site. DD preparation under CTO 25 in 99 and a risk and FS was needed (March 00). In June 2002, two groundwater samples were collected and no human health risk identified and low to negligible ecological impacts and NFA was recommended. Closeout of Site in September 2002.
IR Site 15	AOC A	PCB Capacitor Spill - Fire Station Number 1	Electric Utility Pole on E Street	CERCLA IRP	NFA/ IR Site	Response Complete (NFA)	In June 2002, four soil samples were collected and no human health or ecological risks were identified, NFA was recommended. Closeout of Site in September 2002.
IR Site 16	AOC B	PCB Capacitor Spill - Pole Number 425	PCB Capacitor Pole located 300 ft east of the intersection of Amphibious Dr. and Helicopter Rd.	CERCLA IRP	NFA/ IR Site	Response Complete (NFA)	In June 2002, six soil samples were collected and no human health or ecological risks were identified, NFA was recommended. Closeout of Site in September 2002.
IR Site 17	SWMU 113	Motor Disposal Area	Bldg 1256, between piers 11 and 12	CERCLA IRP	NFA/ IR Site	Response Complete (NFA)	Oil stained soil removed in 1986; PSI sampling lead range 7 to 57 parts per million; one TPH 2750 in oil stained area. Four surface soil and four subsurface soil samples were collected in 2002 and no stained soil evident. NFA by DEQ in April 2003.
Old SWMU 1		Paint Shop Waterwall-Building 3165	Along Gator Blvd in Bldg 3165 D, two blocks from the baseball diamond	CERCLA	NFA	Response Complete (NFA)	No releases identified 1988 VSI. The revised RFA stated that this site is recommended for NFA because it is located inside a building or under a roof with a concrete floor. (June 30, 1999)
Old SWMUs 2-5		Wood dust/chip collection bins	Buildings 3165, 3227, 3334, and 3530	CERCLA	NFA	Response Complete (NFA)	Old SWMU 2 - PWC Carpentry Shop; Old SWMU 3 - Training Service Carpentry Shop; SWMU 4 - Maintenance Carpentry Shop; SWMU 5 - MWR Carpentry Shop. No releases identified 1988 VSI. Since there are no hazardous waste or hazardous constituents managed, the revised RFA recommended NFA (June 30, 1999)
New SWMU 2	SWMU 105	Steam Plant Flyash Silo	In Building 757 between Murray Road and Amphibious Drive	CERCLA	NFA	Response Complete (NFA)	In June 2002, two soil samples and one groundwater sample were collected and no human health or ecological risks were identified, NFA was recommended. Closeout of Site in September 2002.
Old SWMU 6		NEX Maintenance Shop Spent Battery AA	Building 3334, NW of the 5th and B St intersection	CERCLA	NFA	Response Complete (NFA)	No releases identified 1988 VSI. The revised RFA stated that this site is recommended for NFA because it is located inside a building or under a roof with a concrete floor (June 30, 1999).
Old SWMU 7		NEX Maintenance Shop Satellite Accumulation Area	Building 3334, NW of the 5th and B St intersection	CERCLA	NFA	Response Complete (NFA)	No releases identified 1988 VSI. The revised RFA stated that this site is recommended for NFA because it is located inside a building or under a roof with a concrete floor (June 30, 1999).

**Table 1-1
Site Status Summary Table
Five Year Review
NAB Little Creek, Virginia Beach, Virginia**

Site ID	Other ID	Name/Description	Location	Env. Program	Status	Status	Comments/Notes
Old SWMU 8		Base Exchange (East Annex) Gas Station Dumpster	Building 3615 in the eastern portion of the base	CERCLA	NFA	Response Complete (NFA)	Oily stains were present on the dumpster, the concrete surface, and over the curbed surface and into a grassy area during the VSI. However, On September 20, 1993, photos were taken to compare with the VSI photo. The dumpster was not present. No stains were observed on the grass area behind the curb. On March 9, 1999 EPA and DEQ agreed that NFA was required for this SWMU.
SWMU 9		PWC Training Center Scrap Metal Dumpster	Adjacent to Building 3614	CERCLA	NFA	Response Complete (NFA)	Since there are no hazardous waste or hazardous constituents managed, the revised RFA recommended NFA (June 30, 1999).
SWMU 10		PWC Sheet Metal Shop Scrap Metal Dumpster	Adjacent to Building 3165	CERCLA	NFA	Response Complete (NFA)	Since there are no hazardous waste or hazardous constituents managed, the revised RFA recommended NFA (June 30, 1999).
SWMU 11		Harbormaster Shop Scrap Metal Dumpster	Building 3894 near Port Ops, west of piers 56-59	CERCLA	NFA	Response Complete (NFA)	In the Navy's comments on the draft RFA in August, 1988, it was reported that the dumpster had been removed, oil contaminated soil had been removed, and the area had been covered with asphalt. On March 9, 1999, EPA and DEQ agreed that NFA was required at this site.
SWMU 12		The Former Wharf Building Shop	Near Building 3165 in the proximity of the Public Works Facility	CERCLA	NFA	Response Complete (NFA)	Recommended for NFA for the following reasons: 1) No releases or staining were identified during the VSI. 2) There is no evidence that PCP was ever used in this area. 3) As part of the IRP, sampling has been completed in the area and no PCP contamination was detected in the soil. 4) The area is part of CERCLA IR Site 13. It was determined through the IRP that NFA was required in this area due to lack of contamination. On March 9, 1999, EPA and DEQ agreed to NFA for this site.
SWMU 19		PWC Transportation Garage - Paint Booth Filters	Near Bldg 3661 in East/Central Portion of Base	CERCLA	NFA	Response Complete (NFA)	The revised RFA stated that this site is recommended for NFA because it is located inside a building or under a roof with a concrete floor (June 30, 1999).
SWMU 20		PWC Transportation Garage - Salvage Parts Storage Area	Building 3661 North of the Public Works Facility	CERCLA	NFA	Response Complete (NFA)	The revised RFA suggested that soil sampling be conducted in order to determine if hazardous constituents have been released. Two surface soil and one groundwater sample were taken in 1995. They were analyzed for VOCs, SVOCs, and TAL Metals. Due to lack of contamination detected in this study, and lack of staining observed in subsequent visits, on March 10, 1999, the Navy, EPA, and DEQ recommended NFA for this site.
SWMU 21		PWC Transportation Garage - Lubricating Oil Storage Area	Building 3661 North of the Public Works Facility	CERCLA	NFA	Response Complete (NFA)	The Revised RFA suggested that soil sampling be conducted and that samples be analyzed for SVOCs, metals, and PCBs. However, on March 10, 1999, when the Navy, EPA, and DEQ visited the site, it was confirmed that the 3-inch high curb did have a concrete base. The area the drums were stored in was a berm. Due to the integrity of the berm, release to the environment was unlikely. EPA and DEQ agreed NFA was required.
SWMU 22		PWC Transportation Garage - Wash Rack	Bldg 3661 in East/Central Portion of Base	CERCLA	NFA	Response Complete (NFA)	Because the unit is in good condition, the revised RFA recommended NFA (June 30, 1999).
SWMU 23		Rifle Range	NE Corner of Base	CERCLA	NFA	Response Complete (NFA)	NFA recommended for this SWMU due to the approved closure of the Lead Waste Pile by DEQ in July 1995, the EPA definition that munitions are not solid wastes as described above, and the closure requirements under the range rule, independent of RCRA and CERCLA. Consensus during May 1999 partnering meeting the site is regulated under the Munitions Rule. TBD status (3/00) for further consideration of Rule on active ranges, Navy policy is no action on active range.
SWMU 29		Harbormaster's Office Area Paint/Thinner Residue Tank	Bldg 3894; East/Central Portion of base	CERCLA	NFA	Response Complete (NFA)	The draft RFA stated the tank had been drained and removed. Because the unit is in good condition, the revised RFA recommended NFA (June 30, 1999).
SWMU 122		Gymnasium Emergency Generator	Bldg 3147, Southeast of the Public Works Facility	CERCLA	NFA	Response Complete (NFA)	On May 6, 1999, the location of the generator was identified. No staining or evidence of release was present. EPA, DEQ, and Navy, visited the site on May 11, 1999 and agreed NFA was warranted.
SWMU 127		Amphibious Base Landfill Transfer Station	South of the intersection of Amphibious Drive and Murray Rd.	CERCLA	NFA	Response Complete (NFA)	On April 19, 1999 EPA and DEQ agreed NFA was required for this site.
SWMU 128		Port Ops Lube Oil Dispensing Area Storm Water Drain	Building 3896, near port ops, west of piers 56-59	VPDES	NFA	Response Complete (NFA)	VPDES Site, Sediment samples directly under the outfall may be required (detailed in August 1999 minutes), but the EPA, DEQ, and the Navy have agreed that NFA is necessary for the soil or groundwater near the site.
SWMU 129		Port Ops Satellite Accumulation Area	Port Ops Building 3896, west of piers 56-59	CERCLA	NFA	Response Complete (NFA)	On March 10, 1999, EPA, DEQ, and the navy visited this SWMU. The compound was in good condition, and there was no evidence that releases could have occurred to soil in the area. EPA and DEQ agreed that NFA was required for the soil or groundwater near the site. However, due to reported releases to the storm drain, sediment samples were proposed but due to Navy policy they were not collected.
SWMU 134		Portable Waste Oil Tanks Piers 51-59	Piers 51-59	SPCC/AST	NFA	Response Complete (NFA)	New portable waste oil tanks with the proper secondary containment are now in use at the piers. In June 1999, consensus for NFA. Any further assessment or remediation will be covered under the SPCC Plan/AST Program

**Table 1-1
Site Status Summary Table
Five Year Review
NAB Little Creek, Virginia Beach, Virginia**

Site ID	Other ID	Name/Description	Location	Env. Program	Status	Status	Comments/Notes
SWMU 135		Hydraulic Fuel Leak	Piers 51-59; dog leg of the pier near building 3882	CERCLA	NFA	Response Complete (NFA)	The leak described in the Revised RFA cannot be located. No evidence of staining or release was present at the estimated location of the site. On May 11, 1999, the EPA and DEQ visited the site and determined that NFA was necessary.
SWMU 136		Mobile Diving Salvage Unit II Salvage Area - Piers 51-59	Piers 51-59	CERCLA	NFA	Response Complete (NFA)	On May 11, 1999, EPA, DEQ, and the Navy visited the area described. No staining was found. A new building has been built on top of the site. Thus, the EPA and DEQ determined that NFA was necessary.
SWMU 138		SEAL Team 4 Satellite Accumulation Area	Building 3806 South of Desert Cove	CERCLA	NFA	Response Complete (NFA)	On April 19, 1999, EPA, DEQ, and the Navy visited this SWMU. EPA and DEQ agreed that NFA was required for the soil and groundwater near the site. However, due to reported releases to the storm drain, sediment samples under the outfall NR-26A, 33, and 34 were recommended. A sediment sample was collected adjacent to the storm drains as part of the SWMU 7b RI. Additionally the area was dredged as part of the 2008 Military Construction project in Desert Cove.
SWMU 139	Cross-referenced with SWMU 45	SEAL Team 4 Waste PD 680 Tank	Bldg 3806 South of Desert Cove	UST	NFA	Response Complete (NFA)	The 200 gallon tank constructed of fiberglass reinforced plastic and installed in 1983 was removed in 1990. The Navy received notification from the DEQ on October 18, 1991 that no further assessment or remedial action was necessary at the site. In June 1999, consensus for NFA since site is under UST program.
SWMU 140		SEAL Team 4 Spent Battery Staging Area	Bldg 3806 South of Desert Cove	CERCLA	NFA	Response Complete (NFA)	The revised RFA stated that this site is recommended for NFA because it is located inside a building or under a roof with a concrete floor (June 30, 1999).
SWMU 141		SEAL Delivery Vehicle 4 Satellite Accumulation Area	Building 3806 South of Desert Cove	CERCLA	NFA	Response Complete (NFA)	On April 19, 1999, EPA, DEQ, and the Navy visited this SWMU. EPA and DEQ agreed that NFA was required for the soil or groundwater near the site. However, due to reported releases to the storm drain, sediment samples under the outfall NR-26A, 33, and 34 were recommended. A sediment sample was collected adjacent to the storm drains as part of the SWMU 7b RI. Additionally the area was dredged as part of the 2008 Military Construction project in Desert Cove.
SWMU 142	Cross-referenced with SWMU 139 and SWMU 45	SEAL Delivery Vehicle 4 Waste PD 680 Tank	Bldg 3806 South of Desert Cove	UST	NFA	Response Complete (NFA)	Within the NSWG command are the SEAL Teams. NAB Little Creek is resident command to four SEAL Teams. All four occupy one large compound, of which Bldg 3806 is a part. Only one solvent tank existed in this compound, although three different SWMU numbers were assigned. This is a duplicate of SWMU 139.
SWMU 143		Former Seabee Vehicle Maintenance Facility - CB201	Bldg CB201: South of Desert Cove	CERCLA	NFA	Response Complete (NFA)	EPA and DEQ agreed that NFA was required for soil or groundwater near the site as long as it could be confirmed that the tanks for the gas station had been properly closed. Since there is no storm sewer or catch basin to sample sediments, EPA and DEQ decided on NFA for this site on June 30, 1999.
SWMU 145		Fuel Oil Tank	Bldg 3029, Fire Station 1, near the golf course	SPCC/AST	NFA	Response Complete (NFA)	This SWMU no longer exists. The area where Bldg 3029 (Fire Station #1) was located is now an open field. The tank has been removed, and there is no evidence of oil staining. NFA consensus at June 1999 Partnering pending a site visit. Any further assessment or remediation will be covered under the SPCC Plan/AST Program.
SWMU 146		SEAL Team 2 Material Storage Area	Bldg 3813: North of Pier 59	CERCLA	NFA	Response Complete (NFA)	On April 19, 1999, EPA, DEQ, and the Navy visited this SWMU. EPA and DEQ agreed that NFA was required for the soil or groundwater near the site. However, due to reported releases to the storm drain, sediment samples under the outfall NR-26A, 33, and 34 were recommended. A sediment sample was collected adjacent to the storm drains as part of the SWMU 7b RI. Additionally the area was dredged as part of the 2008 Military Construction project in Desert Cove.
SWMU 147		Facility Storm Sewers/Drains	Throughout Facility	VPDES	NFA	Response Complete (NFA)	The storm water system is covered by a VPDES permit. Both the draft Subpart S and the RFA guidance state that it is not the EPA's position to include releases permitted under other environmental laws in the corrective action program. Therefore, NFA is recommended (June 1999).
AOC C		Non-PCB Transformer Leak	Building 366, north of Public Works Facility	CERCLA	NFA	Response Complete (NFA)	After confirming that the transformer did not contain PCBs, the DEQ, EPA, and Navy discussed this AOC and agreed that NFA was required on May 11, 1999.
AOC E		Non-PCB Transformer Leak	Adjacent to Port Ops, Building 3896	CERCLA	NFA	Response Complete (NFA)	After confirming that the transformer did not contain PCBs, the DEQ, EPA, and Navy discussed this AOC and agreed that NFA was required on May 11, 1999.
AOC F		Emergency Generator Leak - Pier 59	Pier 59	CERCLA	NFA	Response Complete (NFA)	On April 19, 1999, EPA and DEQ agree that NFA is required for the AOC.
AOC G		Emergency Generator Leak - Fire Station Number 1	Fire Station #1; Building 3029	CERCLA	NFA	Response Complete (NFA)	The area where Bldg 3029 (Fire Station #1) was located is now an open field. The generator has been removed and there is no evidence of any oil staining. On April 19, 1999, EPA and DEQ agreed that NFA was required for this AOC.



Legend

- IR Site Boundary
- Installation Boundary

- ERD - Enhanced Reductive Dechlorination
- ESD - Explanation of Significant Differences
- FY - Fiscal Year
- LTM - Long-Term Monitoring
- LUC - Land Use Controls
- ROD - Record of Decision
- VOC - Volatile Organic Compound



Figure 1-1
Base Map and Five-Year Review Sites
2008 Five-Year Review
NAB Little Creek
Virginia Beach, VA

Facility Background and History

2.1 Facility Description

NAB Little Creek is primarily an industrial facility located in the northwest corner of Virginia Beach, Virginia. The western boundary of NAB Little Creek borders the City of Norfolk, Virginia ([Figure 1-1](#)). The area surrounding this 2,215-acre base is low lying and relatively flat with several freshwater lakes (Chubb Lake, Lake Bradford, Little Creek Reservoir/Lake Smith, and Lake Whitehurst) located on or adjacent to the base. NAB Little Creek centers around four saltwater bodies: Little Creek Harbor, Little Creek Cove, Desert Cove, and Little Creek Channel that connects the coves and harbor with the Chesapeake Bay.

In addition to industrial land use, NAB Little Creek is used for recreational, commercial, and residential purposes. Specifically, the southeast corner of the base has been developed for residential use. Land development surrounding the base is residential, commercial, and industrial. Little Creek Reservoir/Lake Smith, located north of the base, serves as a secondary drinking water supply for parts of the City of Norfolk.

NAB Little Creek grew out of four bases constructed during World War II – the Amphibious Training Base, the Naval Frontier Base, and Camps Bradford and Shelton. It consisted of three annexes named for the former owners of the property – Shelton on the east, Bradford in the center, and Whitehurst to the west. A letter from the Secretary of the Navy (1945) disestablished the separate bases and established NAB Little Creek on August 10, 1945. In 1946, NAB Little Creek was designated a permanent base. The base's mission was the training of landing craft personnel for operational assignments.

During the last 50 years, NAB Little Creek has expanded in both area and the complexity of its mission. NAB Little Creek personnel provide logistic facilities and support services to 27 homeported ships and more than 80 tenant commands. The combination of operational support and training facilities is geared predominantly to meet the amphibious warfare training requirements of the Armed Forces of the United States. Operations that have occurred at the NAB 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.

2.1.1 Physical Characteristics

NAB Little Creek is situated on the outer part of the Atlantic Coastal Plain, which is characterized by unconsolidated sediments several thousand feet in thickness (Rogers, Golden, and Halpern, 1984). The upper most geologic formations consist of alluvial, colluvial, and marsh deposits which are composed of silt, sand, and pebbles with some clay. The aquifers and confining/semi-confining units relevant to CERCLA investigations at NAB Little Creek are, from youngest to oldest: the Columbia aquifer, Yorktown confining

unit, and the Yorktown-Eastover aquifer. Groundwater flow directions for the aquifers are controlled by topography and surface water bodies with the primary discharge direction being north toward the Chesapeake Bay. A basewide potentiometric map is presented in [Figure 2-1](#).

2.1.2 Land and Resource Use

NAB Little Creek supports industrial activities, management, and storage associated with the mission, but also supports some residential and recreational land uses. Current land use throughout much of the facility is restricted to Navy personnel and residents. A majority of the facility is developed with few wooded areas remaining onsite. Site-specific land use is discussed in the following sections of the report.

The main surface water drainage receptors for NAB Little Creek are Chubb Lake, Lake Bradford, Little Creek, Lake Whitehurst, Little Creek Harbor, Little Creek Cove, Desert Cove, and Little Creek Channel; which are used for commercial, industrial, and recreational purposes. All of these surface water bodies discharge to the Chesapeake Bay, also used for commercial, industrial, and recreational purposes.

Groundwater is not used as a potable resource at NAB Little Creek; however shallow groundwater wells receiving water from the Yorktown Aquifer are used for irrigation of the recreational golf course. Public water is supplied to NAB Little Creek and the surrounding area by the City of Virginia Beach Waterworks. Although no onsite lakes serve as a water supply to the surrounding areas, the Little Creek Reservoir/Lake Smith, located north (upgradient) of the base, serves as a secondary drinking-water supply for parts of the City of Norfolk.

The NAB Little Creek mission and current land and resource use at the facility is not expected to change in the foreseeable future.

2.2 Environmental History

Comprehensive environmental restoration activities at NAB Little Creek began in 1984 under the Navy Assessment and Control of Installation Pollutants (NACIP) Program, termed the Installation Restoration (IR) Program (IRP) in 1986 when changed to reflect the requirements of CERCLA as amended by SARA. The purpose of the NACIP Program and IRP was to identify, assess, characterize, and cleanup or control contamination from past waste management activities at Navy and Marine Corps facilities.

Given the nature and extent of its operations, the Navy has been involved with toxic and hazardous materials for several decades. The Department of Defense (DoD), as well as general industry, has realized that previously acceptable methods of disposal are no longer sufficient, and actions are being taken, through these programs, to clean up Navy sites that pose a threat to human health or the environment. Current Navy waste management operations are expected to comply with all federal, state, and Navy regulations to ensure safe operation and disposal of hazardous substances.

NAB Little Creek initiated its environmental investigation efforts by conducting an Initial Assessment Study (IAS) in 1984 (Rogers, Golden, and Halpern, 1984) followed by a Round 1

Verification Study (RVS) in 1986 (CH2M HILL, 1986) and Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) in 1989 (A. T Kearney, 1989). A total of 132 potential contaminated sites, areas, or SWMUs at NAB Little Creek were identified for evaluation in the IAS, RVS, RFA, and other NAB Little Creek assessments. A detailed discussion of each of these investigations can be found in the most recent SMP and results will be discussed in the following sections as they pertain to each site evaluated during the 5-year review.

On July 28, 1998, the USEPA proposed that NAB Little Creek be added to the National Priorities List (NPL). The USEPA evaluates industrial sites using the Hazard Ranking System (HRS), and those facilities with HRS scores exceeding 28.5 are proposed for the NPL. A HRS score of 50 was assigned by the USEPA to NAB Little Creek. The proposed listing was followed by a 60-day review and comment period prior to NAB Little Creek's inclusion on the NPL on May 10, 1999.

The FFA, negotiated between the Navy, USEPA, and VDEQ, was finalized in November 2003. In accordance with the FFA, all investigation activities and remedial action activities at IR sites and SWMUs is reviewed, and a course of action for future work requirements at each site is developed.

Background soil and groundwater chemical concentrations were addressed for NAB Little Creek as part of the basewide *Final Background Investigation* (CH2M HILL, 2000c) and *Final Background Investigation Addendum for Summer Groundwater Sampling Event* (CH2M HILL, 2003b). The investigation's objective was to establish background concentrations of metals, pesticides, and polynuclear aromatic hydrocarbons (PAHs) in surface and subsurface soil and groundwater for use in comparison to IRP site data to better identify release-related chemical of concern. Background levels are due to naturally occurring (those chemicals expected at a site in the absence of human influence) or anthropogenic (chemicals present in the environment due to manmade, non-site-related) sources.



- Legend**
- Monitoring Well
 - Groundwater Contour
 - - - Inferred Groundwater Contour
 - ▭ MRP Site
 - ▭ Site with a Final ROD and LUC
 - ▭ Site in the CERCLA RI/FS Process
 - ▭ Site with a NFA ROD
 - ▭ Installation Boundary
 - Groundwater Flow Direction

CERCLA - Comprehensive Environment Response, Compensation, and Liability Act
 LUC - Land Use Controls
 MRP - Munitions Response Program
 NAB - Naval Amphibious Base
 NFA - No Further Action
 RI/FS - Remedial Investigation/Feasibility Study
 ROD - Record of Decision

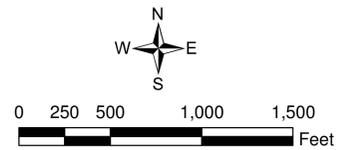


Figure 2-1
 Basewide Potentiometric Surface Map
 2008 Five-Year Review
 NAB Little Creek
 Virginia Beach, VA

SECTION 3

Site 9—Driving Range Landfill, Site 10—Sewage Treatment Plant Landfill

3.1 Site Chronology

Date	Event
Dec. 1984	IAS
Oct. 1986	RVS
Mar. 1989	RFA
Nov. 1991	Interim RI
Nov. 1994	RI/FS for Sites 7 and 9–13
Nov. 1996	Project Plans for Groundwater Monitoring at Sites 5, 9, 10, and 11
Jan. 1997	Proposed Plan
Jan. 1997	Decision Document (DD) for Soil Cover Maintenance and Groundwater Long-term Monitoring (LTM)
May 1999	NAB Little Creek on NPL
Jul. 1999	Three-Year Groundwater Monitoring Report, Sites 9 and 10
Jan. 2000	Initiated Annual Groundwater Monitoring Program
Feb. 2000	Soil Cover Survey
Feb. 2000	Screening Ecological Risk Assessment
Feb. 2001	Revised RI/Human Health Risk Assessment (HHRA)/FS
Feb. 2001	Ecological Risk Assessment (ERA)
Mar. 2001	Proposed Remedial Action Plan (PRAP)
Oct. 2003	FFA
Dec. 2003	ROD
Jun. 2004	Remedial Design (RD)
Aug. 2004	Quarterly Site Inspection Survey Plat Filed
Sep. 2004	Project Plans for the Post-ROD LTM Program
Sep. 2004	Initiated Quarterly Inspections and Annual LTM Reporting
Jan. 2005	Final Site Inspection of Remedial Action Components

3.2 Site Background

3.2.1 Site 9 Description

Site 9, the Driving Range Landfill, is located in the northeast portion of the installation, northwest of the golf course, directly east of the Sewage Treatment Plant Landfill (Site 10) and Hewitt Drive, and approximately 500 feet (ft) south of the Chesapeake Bay shoreline (**Figure 3-1**). The northern perimeter of the landfill is bounded by a fence and a network of sand dunes that parallel the Bay shoreline. Before landfilling operations began, the area was a marsh environment adjoining the eastern arm of Little Creek Cove (Ebasco, 1991).

Site 9 is comprised of approximately 6 acres and operated from 1952 through 1956. Landfilling methods entailed the excavation of trenches with a dragline or other heavy equipment. Trench depth was likely limited by the water table located approximately 5 ft below ground surface (bgs). Following excavation, the trenches were filled with waste and backfilled. An incinerator, located on Hewitt Drive opposite the western perimeter of Site 9, was active during the landfill operating period and reportedly burned combustible materials generated by NAB Little Creek. The resulting ash and bypassed materials were disposed of in the landfill. After the incinerator was decommissioned, solid waste from the base was disposed of directly in the landfill. The estimated land disposal volume was 40,000 cubic yards (yd³) of waste.

Following landfill activities, a soil cover was placed over the landfill, and the installation converted the area into a driving range. A berm was constructed using clean fill along the east side of Hewitt Drive, and sewage sludge was placed along the southern site boundary to enhance growth of the grass. A soil survey, conducted in February 2000, indicated a 2 to 5 ft soil cover across the landfill (CH2M HILL, 2000a).

Site 9 is currently the facility driving range. The site is grass covered, with topography ranging from approximately 6 to 12 ft above mean sea level (msl) gently sloping to the south/southeast. Generally, surface runoff in the area is lost through infiltration or evaporation; however some runoff drains to the golf course lakes located southeast of the driving range.

3.2.2 Site 10 Description

Site 10, the Sewage Treatment Plant Landfill, is located in the northeast portion of the installation, west of Site 9 – Driving Range Landfill, and approximately 500 ft south of the Chesapeake Bay shoreline (**Figure 3-1**). Site 10 is bounded on the north and the west by sand dunes, on the south by 11th Street and recreational facilities that extend onto the landfill area, and on the east by Hewitt Drive.

Site 10 is comprised of approximately 18 acres and operated from 1941 until 1968. Landfilling operations began in the southern portion of the site, which included an extension of Desert Cove, and then moved northward to the associated marsh lowlands. Between 1941 and 1952, Site 10 – Sewage Treatment Plant Landfill was the only operational landfill on the base, and received household and industrial wastes, and demolition debris until the Driving Range Landfill (Site 9) was opened in 1952 (RGH, 1984). Sewage sludge from the onsite sewage treatment plant was also disposed of in the landfill until the

treatment plant was closed in 1968. The bulk of the sewage sludge was disposed of along the northwest perimeter of the landfill, near the base of the sand dunes. The estimated disposal volume was 46,500 yd³ of waste.

Following landfill activities, a soil cover was placed over the landfill. A portion of the landfill area was designated for mission training. The remaining portion of the landfill area was developed for recreational use (baseball fields). A soil cover survey completed in February 2000 indicated a 2 to 6 ft soil cover across the landfill (CH2M HILL, 2000a).

Site 10 is primarily used as a recreational area with a portion designated as an active range. The site is grass covered, with topography ranging from approximately 7 ft above msl at the baseball fields to 15 ft above msl along the east side of the site near the location of the former incinerator. Generally, surface runoff in the area is lost through infiltration or evaporation; however some runoff drains towards the Chesapeake Bay to the north and Desert Cove to the southwest.

3.2.3 Sites 9 and 10 Geology and Hydrogeology

The surface geology at Sites 9 and 10 consists of the 10 to 15 ft thick Columbia Formation, which contains the 7 to 12 ft thick unconfined Columbia Aquifer. The Columbia Aquifer overlies the Yorktown Confining Unit. The Yorktown Confining Unit is continuous across the sites and impedes the downward migration of Columbia Aquifer groundwater to the Yorktown Aquifer. Shallow groundwater at Sites 9 and 10 is locally influenced by nearby surface water bodies (golf course lakes and Desert Cove) and generally flows in a radial pattern with elevations ranging from 3 to 5 ft above msl (Figure 3-1). The horizontal hydraulic gradient of the shallow groundwater at Sites 9 and 10 is approximately 2.0×10^{-3} feet per foot (ft/ft). Utilizing slug test data collected in October 2007, the groundwater flow velocities for Sites 9 and 10 were calculated to be approximately 83.4 feet per year (ft/year) and 114.7 ft/year, respectively (CH2M HILL, 2008b). Groundwater in the Columbia Aquifer underlying Sites 9 and 10 discharges into the Chesapeake Bay, Desert Cove, and surrounding golf course lakes. Due to the proximity of the sites to the Chesapeake Bay, groundwater in the Yorktown Aquifer beneath the sites is assumed to flow north and discharge into the Chesapeake Bay.

3.3 Land and Resource Use

Sites 9 and 10 were historically used for the disposal of NAB Little Creek household and industrial wastes, construction debris, and/or sewage sludge. Site 9 is currently used as the golf course driving range and is managed by Little Creek Morale, Welfare, and Recreation (MWR). The existing driving range generally coincides with the landfill boundary. The southeastern portion of Site 10 is currently used for baseball fields and is also managed by Little Creek MWR. The vegetated dune area to the north of Site 9, as well as the vegetated dune area located in the northeastern portion of Site 10, is currently used for military combat exercises.

There are no potable groundwater supply wells located within the boundaries of Sites 9 and 10. Non-potable groundwater supply wells located on the Little Creek Golf Course, withdraw groundwater from the Yorktown Aquifer for irrigation and storage pond maintenance. There are no surface water bodies within the boundaries of Sites 9 and 10.

Site 9 is located approximately 375 feet northwest of the golf course ponds; Site 10 is located approximately 750 ft west of Desert Cove; and Sites 9 and 10 are approximately 500 ft south of the Chesapeake Bay.

Land use controls (LUCs) are currently maintained at Sites 9 and 10 to restrict land use, prohibit the use of Columbia Aquifer groundwater, and prevent or minimize direct contact with landfill contents. Current and future land use of the sites is not expected to change.

3.4 History of Contamination

Surface soil and groundwater samples were collected during previous investigation activities for analysis of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls (PCBs), metals, cyanide, and/or total petroleum hydrocarbons (TPHs). Soil analytical results were screened against risk-based screening criteria (RBCs). Groundwater data were screened against background upper tolerance limits (UTLs) and Federal Maximum Contaminant Levels (MCLs).

VOCs, SVOCs, pesticides, PCBs, and TPHs were detected in surface soil at Sites 9 and 10; however, with the exception of Aroclor®-1260 at Site 9, concentrations did not exceed residential RBCs. Several metals were detected in surface soil above the residential soil RBCs at Sites 9 and 10. PCBs were not detected in groundwater at Sites 9 and 10. One SVOC, a common laboratory contaminant bis(2-ethylhexyl)phthalate, and several VOCs were detected in groundwater; however concentrations were below the MCLs. Although total and dissolved metals were detected in groundwater at both sites at concentrations above the MCLs and background UTLs, no definable plume of contamination has been identified at either site. Potential migration of groundwater contamination has been monitored regularly (biannually and annually) since 1996.

3.4.1 Site Risks

A revised RI/HHRA/FFS was completed in February 2001 to evaluate the risks to human health from exposure to surface soil and groundwater at Sites 9 and 10 (CH2M HILL, 2001a). Additionally, potential ecological risks associated with the sites were evaluated in a Baseline Ecological Risk Assessment (BERA) in 2001 (CH2M HILL, 2001b). The summary of site risks presented in the subsections below was documented in the ROD (DON, 2003).

Human Health Risk

With the exception of waste in place, no risks to human health associated with exposure to soil at either site were above USEPA's target levels. Reasonable maximum exposure (RME) risks identified for all current receptors and future construction workers exposed to site groundwater were below USEPA's target levels. Potable use of the groundwater by hypothetical future residents and industrial workers may present a human health risk above USEPA's target levels based on RME calculations due to exposure to antimony, iron, and manganese in groundwater at Site 9 and arsenic, cadmium, iron, manganese, thallium, and zinc in groundwater at Site 10. In addition, future child resident exposure to iron in groundwater at Site 10 may present a human health risk above USEPA's target level based upon central tendency exposure (CTE) calculations. Groundwater concentrations of arsenic, iron and manganese detected at Sites 9 and/or 10 are similar to background and therefore

do not pose an unacceptable risk. Chemicals of concern (COCs) identified in the ROD for each site are:

- **Site 9:** antimony
- **Site 10:** cadmium, manganese, thallium, and zinc

Ecological Risk

Metals were detected in surface soil and groundwater above ecological screening criteria. Detected concentrations in surface soil were similar to background UTLs and associated risks are considered low to negligible. Metals detected in groundwater are expected to have no adverse effects on aquatic organisms in the Chesapeake Bay due to dilution. The BERA concluded no unacceptable ecological risks were present at Sites 9 and 10.

3.4.2 Initial Response

Sites 9 and 10 were identified in the IAS (RGH, 1984). A biannual groundwater monitoring program (GMP) was initiated in 1996 (**Table 3-1**) (FWES, 1997) prior to completion of the 1997 DD (Baker, 1997b) and signature of the ROD in 2003 (DON, 2003). Biannual sampling continued until 2001 when the groundwater monitoring program was reduced to annual sampling (CH2M HILL, 2001c).

3.4.3 Basis for Remedial Action

Based on the results of previous investigations, remedial action is warranted to prevent human exposure to waste in place.

3.5 Remedial Actions

3.5.1 Remedy Selection

A ROD for Sites 9 and 10 was signed in December 2003. This report summarized the risks to human health and ecological receptors, established Remedial Action Objectives (RAOs), and defined the selected remedy. The selected remedy for Sites 9 and 10 was defined as LUCs and LTM of groundwater to meet the following RAOs:

- Prevent or minimize direct contact of human and ecological receptors with landfill contents
- Prevent unacceptable risks to potential receptors for groundwater
- Control surface water runoff and erosion

The following LUC objectives for Sites 9 and 10 were selected in the ROD:

- Prohibit digging into or disturbing the existing soil covers or contents of the landfills
- Prohibit residential development on the sites
- Prohibit the use of the shallow aquifer groundwater beneath the sites other than for environmental monitoring and testing

LUCs restrictions have been implemented with the actions detailed in the Sites 9 and 10 LUC RD (DON, 2004). The LUCs shall be maintained on all land and groundwater within the boundaries of Sites 9 and 10 until the concentrations of hazardous substances in the landfills and groundwater have been reduced to levels that allow for UU/UE. Groundwater LTM is conducted to identify off-site migration of COCs and any potential degradation of groundwater quality associated with a release from the landfill posing potential risk to human health and the environment.

3.5.2 Remedy Implementation

A soil cover was placed on Sites 9 and 10 following landfill closure. In February 2000, the integrity of the existing soil cover at both Sites 9 and 10 was evaluated; adequate cover material was present at both sites. The LUC RD documented the LUC objectives and implementation and maintenance actions necessary. Signs were placed around the perimeter of Sites 9 and 10 to notify individuals of buried debris, prevent unauthorized digging, and provide a point of contact for further implementation. Survey plats were filed with the Virginia Beach Circuit Court in the Commonwealth of Virginia to provide public notice of the environmental conditions and limitations on the use of the property. In April 2005, an Interim Remedial Action Completion Report (I-RACR) for Sites 9 and 10 was signed to document the remedy is in place, is operating and functioning as intended, and is protective of human health and the environment (CH2M HILL, 2005a).

In accordance with the Project Plans for post-ROD LTM, quarterly site inspections and annual groundwater sampling activities were implemented in October 2004 (CH2M HILL, 2004c). Since 2004 quarterly site inspections have been conducted to verify the integrity of the soil cover; ensure appropriate surface water runoff and erosion control measures are in place; ensure adequate vegetation is maintained; and verify site signage and monitoring wells are intact. The findings from the site inspections have been documented in quarterly letter reports submitted to the Navy and regulatory stakeholders. Annual groundwater monitoring included the collection of groundwater samples from six shallow monitoring wells at Site 9 and six shallow monitoring wells at Site 10 (**Figure 3-1**). As outlined in the Project Plans and summarized in **Table 3-2**, groundwater samples collected during each LTM event have been analyzed for site COCs (Site 9: antimony; Site 10: cadmium, manganese, thallium, and zinc). To ensure additional landfill releases had not occurred, groundwater samples collected during the October 2006 LTM sampling event were also analyzed for VOCs, SVOCs, pesticides/PCBs, and total and dissolved metals. Additionally, to evaluate potential releases to groundwater as part of the 5-year review process, groundwater samples collected in October 2007 were analyzed for groundwater quality indicator parameters (specific conductance, pH, total organic halogens [TOX], and total organic carbon [TOC]) (CH2M HILL, 2007b).

3.6 Five-Year Review Process

3.6.1 Site Inspections

Quarterly inspections have been conducted by the Navy at Sites 9 and 10 since October 2004. In addition, the Navy, USEPA, and VDEQ conducted a site inspection to support the Five-Year Review in September 2008. A summary of the quarterly site inspections and the

Five-Year Review site inspection is presented below. Inspection results are provided in [Appendix A](#).

Site 9

In February 2006, standing water was visible in low lying areas in the northeast corner of the driving range and was attributed to the removal of stockpiled dirt from the winter of 2004. According to golf course staff, this low lying area was present prior to the placement of the dirt stockpile, and was unlikely a result of heavy equipment use during removal. Standing water was not observed in this area during subsequent inspections. A lack of vegetative growth has been noted on the driving range since October 2006. Maintenance actions to establish vegetative cover in these areas are scheduled for the spring of 2009. Other minor corrective measures, such as lock replacements on monitoring wells and repair to signage for restrictive activities, have been conducted regularly during the inspection process.

During the September 2008 site inspection, the bare spots scheduled for maintenance were observed on driving range.

Site 10

In April 2004, prior to finalization of the LUC RD and implementation of quarterly landfill inspections, an open pit excavation was discovered at Site 10. The excavation was used as a part of a recreational race held at NAB Little Creek. Soil samples were collected from the open pit and a risk assessment was conducted to evaluate the potential human health risk to race participants and construction workers from exposure to the soil in the excavation pit. The assessment concluded there were no unacceptable risks to the recreational runner or construction worker from exposure to soil (CH2M HILL, 2004b).

During the April 2006 inspection, construction of a new golf course practice area within the Site 10 boundary was observed. A 25 ft wide by 60 ft long mound of fill material had been placed on the southeast corner of Site 10. USEPA and VDEQ were notified of the presence of the fill material and its intended use. The soil was sampled and screened against established soil background UTLs to ensure it was appropriate for use as clean fill. The results of the soil sampling and screening were provided to USEPA and VDEQ and documented as part of the Fiscal Year 2006 LTM report (CH2M HILL, 2007c).

Other minor corrective measures, such as lock replacements on monitoring wells and repair to signage for restrictive activities, have been conducted regularly during the inspection process.

During the September 2008 site inspection, a low spot, likely the result of vehicle traffic, was present at Site 10. Additionally, an empty 55-gallon drum was observed along the range fenceline. It was recommended the drum be removed from the site and the low-lying area backfilled with clean fill.

3.6.2 Site Interviews

Site Interviews were conducted on October 6, 2008 with Al Gregg of NAB Little Creek Base Environmental and Richard Howard of NAB Little Creek Base Planning. Interview summaries are provided in [Appendix B](#).

3.6.3 Long-term Monitoring Data Summary

Groundwater LTM has been conducted annually at Sites 9 and 10 since October 2004. Chemicals analyzed during each round are presented on [Table 3-2](#). Results of the groundwater LTM activities have been documented in annual reports and are summarized below.

Site 9

Antimony (total and dissolved) was detected above the MCL and/or background UTLs in groundwater from at least one monitoring well during each of the LTM sampling events ([Figure 3-2](#)). As discussed above, LTM sampling parameters were expanded in 2006 and 2007. In October 2006, several total and dissolved metals were detected above background UTLs and/or their respective MCLs. One VOC (methyl-tert-butyl-ether [MTBE]), two SVOCs (4-methylphenol and bis[2-ethylhexyl]phthalate), and four pesticides (4,4'-dichlorodiphenyldichloroethane [DDD], endosulfan I, alpha-chlordane, and gamma-chlordane) were detected in groundwater. Of those chemicals, bis(2-ethylhexyl)phthalate, a common laboratory contaminant, was the only organic chemical detected at a concentration exceeding the MCL. No PCBs were detected.

In October 2007, groundwater quality indicator parameters (specific conductance, pH, TOX, and TOC) were analyzed. Groundwater specific conductance ranged from 0.0036 to 0.700 milliSiemens per centimeter (mS/cm); pH ranged from 5.2 to 6.8 ([Figure 3-2](#)). Detected concentrations of TOX and TOC ranged from 0.0197J to 0.0483 milligrams per liter (mg/L) and 1.8J to 13.4 mg/L, respectively.

Site 10

Total and dissolved manganese and zinc and dissolved cadmium were detected above their respective background UTLs in groundwater once during all LTM events ([Figure 3-3](#)). Thallium was detected above the MCL in the most recent round of sampling (October 2007) at LS10-MW02. As discussed above, LTM sampling parameters were expanded in 2006 and 2007. In October 2006, several total and dissolved metals were detected above background UTLs; however concentrations were below the MCLs. Two VOCs (cyclohexane and MTBE) were detected in groundwater at concentrations below the MCLs. SVOCs, pesticides, and PCBs were not detected.

In October 2007, groundwater quality indicator parameters (specific conductance, pH, TOX, and TOC) were analyzed. Groundwater specific conductance ranged from 0.314 to 0.872 mS/cm; pH ranged from 6.0 to 7.0 ([Figure 3-3](#)). Detected concentrations of TOX and TOC ranged from 0.111J to 0.133 mg/L and 1.5J to 20.1 mg/L, respectively.

Long-Term Monitoring Data Evaluation

Statistical analysis of pre-ROD GMP (May 1996–July 2003) and post-ROD (October 2004–October 2007) LTM data was performed to evaluate data trends and identify if a release of contaminants from the landfill to groundwater has occurred. [Table 3-3](#) provides a list of the monitoring wells and analytes included in the statistical analysis.

Groundwater Data Trend Analysis

A Mann-Kendall trend analysis was conducted for the site-specific COCs (Site 9—antimony; Site 10—cadmium, manganese, thallium, and zinc) to identify significantly increasing or decreasing chemical trends in each site monitoring well. The Mann-Kendall test is a nonparametric method; there are no distributional assumptions, missing data values (non-detects) are easily handled, and irregularly spaced sampling intervals are permitted. The test does require that independent data be used (i.e., duplicate data is not considered independent since one can use one duplicate value to predict the other).

Uniform values (i.e., detection limit) used to represent a non-detected concentration will not change the outcome of the Mann-Kendall test as long as the uniform value is below the minimum detected concentration for that chemical. The data set for Sites 9 and 10 had multiple detection limits for each given COC, which sometimes exceeded the minimum detected concentration. To avoid having this non-detect “noise” influence the evaluation, each non-detect concentration was assigned a uniform value of half the minimum detected concentration for that chemical.

Per recommendation (Gilbert, 1987; Gibbons, 1994; USEPA, 2006) the evaluation was performed as a one-sided test. The null hypothesis ($P_i = P_j$) was defined as no temporal trend existing in the data. The alternative hypothesis ($P_i > P_j$ or $P_i < P_j$) was defined as the data follow an increasing or decreasing trend over time. In order to test the null hypothesis, a Mann-Kendall statistic (S) was calculated using the following equation:

$$S = \sum_{i=1}^{n-1} \sum_{j=i+1}^{j=n} \text{sgn}(P_i - P_j)$$

Where: S = Mann-Kendall statistic
 n = number of data values
 P_j = next data value
 P_i = current data value

$$\text{sgn}(P_i - P_j) = \begin{cases} 1 & \text{if } P_i > P_j \\ 0 & \text{if } P_i = P_j \\ -1 & \text{if } P_i < P_j \end{cases}$$

A positive value of S indicated an upward trend in which the values increase with time; likewise a negative S indicated a decreasing trend. In order to determine if a trend was significantly different than zero, the variance (var) of the data set was calculated based on the assumption the null hypothesis is true by the following equation:

$$\text{var}(S) = \frac{n(n-1)(2n+5)}{18}$$

Where: var(S) = Variance
 n = number of years data was collected

Once the variance had been calculated, a probability to determine if the trend was statistically significant was calculated as well. For this evaluation, a common significance level of 0.05 was used; therefore, results with a positive slope were tested to be significantly increasing at a 0.05 or less level and those with a negative slope were tested to be significantly decreasing at a 0.05 or less level. The statistical significant probability was calculated using the following equation:

$$Z = \begin{cases} \frac{S - 1}{\sqrt{\text{var}(S)}} & \text{if } S > 0 \\ 0 & \text{if } S = 0 \\ \frac{S + 1}{\sqrt{\text{var}(S)}} & \text{if } S < 0 \end{cases}$$

Where: S = Calculated Mann-Kendall Statistic
 var(S) = Variance
 Z = Statistical significant probability

If the calculated probability from the Mann-Kendall test was less than the 0.05 significance level, the null hypothesis was rejected (no trend) and the alternative hypothesis (increasing or decreasing trend) was accepted as true. The calculations presented above were applied to each chemical detected in each well to determine individual trends.

Trend Analysis Conclusion

If a chemical was detected at least once over time in an associated well, this data set was considered a "case." There were a total of 45 cases for Sites 9 and 10 COCs; 8 of the 45 cases had significantly increasing (1) or decreasing (7) trends. The results for the Mann-Kendall test for intra-well increasing and decreasing data trends are presented in [Table 3-4](#) and illustrated in [Tables 3-5a](#) through [3-5e](#). A statistically significant increase in dissolved antimony was identified in groundwater from monitoring well LS09-MW08 ([Figure 3-4](#)). The maximum detected concentration of dissolved antimony detected in groundwater from LS09-MW08 (7.8 micrograms per Liter [$\mu\text{g}/\text{L}$]) exceeded the background UTL (non-detect) and the MCL (6 $\mu\text{g}/\text{L}$). No statistically significant increasing trends were exhibited by Site 10 COCs.

Trend Analysis Uncertainties

For total and dissolved COCs, approximately 2.2 percent of the cases (1 of 45) studied were significantly increasing. Randomly generated data is expected to demonstrate a significant increase or decrease in about 5 percent of the total cases studied. Therefore, the percentage of significantly increasing trends identified in this evaluation may be a representation of typical data distribution and not a true increase in concentrations.

3.7 Technical Assessment

Question A: Is the remedy functioning as intended by the decision document?

Remedial Action Performance: Based on the review of documents, LTM results, applicable or relevant and appropriate requirements (ARARs), risk assumptions, and site inspection reports, the Sites 9 and 10 remedy is functioning as intended by the ROD.

Implementation of LUCs: With the exception of the Site 10 landfill breach noted in Section 3.6.1, implementation of LUCs and quarterly site inspections has ensured soil cover integrity is maintained and exposure to landfill contents is prevented. Landfill signs restricting intrusive activities at the site have remained intact. Monitoring well LS10-MW01 was abandoned and monitoring well LS10-MW07 was converted to a flush mount monitoring well during a base-wide well repair event in June 2006.

LTM Activities: Groundwater LTM has been conducted annually in accordance with the ROD and Project Plans since October 2004. LTM activities have verified that offsite migration of site specific COCs has not occurred. In addition, modified sampling was conducted in October 2006 to evaluate additional landfill releases and potential offsite migration of chemicals.

Opportunities for Optimization: Following a review of site characteristics, historical data, LTM data, and the statistical trend analysis, risk management of site specific COCs and modification of the groundwater LTM plan is suggested based upon the following rationale:

- **Site 9 – Antimony**
 - Although the RME hazard to the future child resident due to antimony (hazard quotient [HQ] = 1.6) was above USEPA’s target level of 1 in the 2001 revised HHRA, the potential CTE hazard was below USEPA’s target level.
 - The maximum concentration of antimony detected during LTM activities is 9.4 µg/L (dissolved) from LS09-MW05. The concentration is below the May 2008 regional screening levels issued by the USEPA (15 µg/L), based on an HQ of 1. Because antimony is the only COC identified for Site 9, and the preliminary remediation goal (or cleanup level) would be based on a HQ of 1, the current detected concentrations of antimony would likely be below the calculated preliminary remediation goal.
 - Although dissolved antimony was identified as having a significantly increasing trend in monitoring well LS09-MW08 (minimum – non-detect (August 2002); maximum – 7.8 µg/L [October 2005]), the individual probability of the trend (4.8 percent) is not greater than the probability the trend would be found in randomly generated data (5.0 percent).
- **Site 10 – Cadmium**
 - Although the RME hazard to the future child resident due to cadmium (HQ=1.6) were above USEPA’s target level of 1 in the 2001 revised HHRA, the potential CTE hazard was below USEPA’s target level.

- The exposure point concentration (EPC) (maximum concentration detected) used to evaluate risk in 2001 was 8.6J µg/L; however the maximum concentration detected during LTM activities is 1.7 µg/L (total cadmium) from LS10-MW07, located within the landfill boundary. This concentration is below the adjusted USEPA regional screening level for cadmium (1.8 µg/L).
- Total cadmium has not been detected above the background UTL (2.1 µg/L) during LTM activities. Dissolved cadmium has been detected once at 0.42J µg/L (LS10-MW06) which is above the background UTL for dissolved cadmium (non-detect).
- No significantly increasing trends were identified for total and dissolved cadmium in any of the monitoring wells.
- **Site 10 – Manganese**
 - Although RME hazards to the future adult (HQ = 3.4) and child (HQ = 7.8) resident were above USEPA’s target level of 1 in the 2001 revised HHRA, potential CTE hazards were below USEPA’s target level.
 - Total and dissolved manganese were detected above their respective background UTLs (1,500 µg/L and 1,510 µg/L) only once (October 2006) during LTM activities from LS10-MW09 at 2,050 µg/L and 1,990 µg/L, respectively. Detected concentrations are not likely the result of landfilling activities.
 - No significantly increasing trends were identified for total and dissolved manganese; significantly decreasing trends in LS10-MW03 and LS10-MW05 were identified.
- **Site 10 – Thallium**
 - Although the RME hazard to the future child resident (HQ = 2.4) was above USEPA’s target level of 1 in the 2001 revised HHRA, the potential CTE hazard was below USEPA’s target level.
 - Although dissolved thallium was detected once above the MCL (2 µg/L) during LTM activities at a concentration of 4 µg/L (LS10-MW02), the concentration is equivalent to the background UTL and is not likely a result of historical activities.
 - No significantly increasing trends were identified for total and dissolved thallium.
- **Site 10 – Zinc**
 - Although the RME hazard to the future child resident (HQ = 1.9) was above USEPA’s target level of 1 in the 2001 revised HHRA, the potential CTE hazard was below USEPA’s target level.
 - The exposure point concentration (maximum concentration detected) used to evaluate risk in 2001 was 8,870 µg/L; however the maximum concentration detected during LTM activities is 936 µg/L (total zinc) from LS10-MW07 located within the landfill boundary. This current maximum concentration is below the adjusted USEPA regional screening level for zinc (1,100 µg/L).

- No significantly increasing trends were identified for total and dissolved zinc; significantly decreasing trends in LS10-MW03 (total and dissolved) and LS10-MW02 (dissolved) were identified.

Based on the risk management considerations presented above, modifications to the sampling analysis plan to better evaluate potential degradation in groundwater quality, indicative of a release and offsite migration from the landfill, are suggested as follows:

- Eliminate site-specific COCs from LTM sampling based upon risk management information presented above.
- Include groundwater quality indicator parameters such as specific conductance, pH, TOX, and TOC for future LTM sampling events. The October 2007 indicator parameter results can be used as a baseline for future comparison in evaluating groundwater quality.
- Expand groundwater monitoring network to include upgradient monitoring wells for offsite migration comparison. The existing monitoring well network receives downgradient groundwater flow; currently no upgradient monitoring wells are sampled during LTM activities.
- Exclude LS09-UST3 and LS10-MW07 from the monitoring network as these wells are located within the boundary of waste.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

Changes in Exposure Pathways: No changes in the site conditions that would affect exposure pathways have been identified during the 5-year review. No new contaminants, sources, or routes of exposure have been identified as part of this 5-year review. There is no indication that hydrologic or hydrogeologic conditions have changed in a way to affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: Although there have been some changes in toxicity values, regulatory levels, and risk characteristics of some contaminants detected in Sites 9 and 10 media, these changes would not affect the protectiveness of the selected remedy as it would not substantially change the results of the risk assessment. The remedy is soil cover and LUCs. The soil cover eliminates exposure to the waste and LUCs restrict unauthorized activities which may result in exposure to landfill waste and/or contaminated groundwater. Therefore, any changes in toxicity would not affect the protectiveness of the remedy.

Changes in Risk Assessment Methodologies: Although there have been some procedural changes to how human health risk assessments are conducted, including how exposure point concentrations are calculated and the parameter values for the inputs to the dermal exposure estimates from groundwater, none of these changes affect the protectiveness of the remedy.

There have been some minor changes in ecological toxicity reference values since the BERA was issued (March 2001) for some of the chemicals detected in soil and groundwater at Sites 9 and 10. However, these changes would not affect the protectiveness of the remedy nor substantially change the results of the risk assessment.

Question C: Has any other information come to light that could question the protectiveness of the remedy?

No new information has come to light that would question the current protectiveness of the remedy. Modification to groundwater LTM is recommended to evaluate a future potential release and offsite migration of contaminants.

3.8 Sites 9 and 10 Issues and Associated Recommendations, and Follow Up Actions

The following issues have been identified for Sites 9 and 10 based on this five-year review:

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
Bare areas have been noted on the Site 9 driving range during quarterly ER site inspections.	The Navy is currently evaluating the most cost effective method to repair the bare areas.	Navy	State/USEPA	May 2009	N	Y
During the September 2008 site inspection, a low spot, likely the result of vehicle traffic, was present at Site 10. Additionally, an empty 55-gallon drum was observed along the range fenceline.	Backfill the low-lying area with clean fill and remove the drum from the site.	Navy	State/USEPA	March 2009	N	Y
Site monitoring wells are not clearly labeled outside the casing.	Apply permanent identification to all well casings.	Navy	State/USEPA	January 2013	N	N
Annual groundwater monitoring sampling and analysis plan is not adequate to fully evaluate potential degradation in groundwater quality, indicative of a release and offsite migration from the landfill.	Modify the sampling analysis plan for fiscal years 2009 through 2013.	Navy	State/USEPA	Sept. 2009	N	Y

3.9 Protectiveness Summary

The selected remedy is protective of human health and the environment. Exposure pathways that could result in unacceptable risk are controlled through quarterly ER site inspections and annual groundwater LTM. As detailed in Section 3.7, modifications to the groundwater LTM plan are suggested to evaluate potential future releases and offsite migration of contaminants. Risk management decisions, analytical parameters, and site-

specific monitoring well networks will be defined during development of future LTM plans. Additionally, corrective action is warranted to repair the bare and the low-lying areas observed at Sites 9 and 10.

3.10 Next Review

The next Five-Year Review for Sites 9 and 10 will be in 2013.

**Table 3-1
Grounwater Monitoring Program Summary
Sites 9 and 10
Five Year Review
NAB Little Creek
Virginia Beach, Virginia**

Sampling Date	Monitoring Wells Sampled	Sampling Frequency	Analysis
05/1996	Site 9: LS09-MW02, LS09-MW04, LS09-MW05, LS09-MW06, LS09-UST1, LS09-UST3 Site 10: LS10-MW01, LS10-MW02, LS10-MW03, LS10-MW04, LS10-MW05, LS10-MW06, LS10-MW07, LS10-MW08	semiannual	TCL VOCs, TAL total and dissolved metals
12/1996 - 12/1997			TCL VOCs, TAL total and dissolved metals, cyanide, and anions (sulfate, bicarbonate, and chloride)
6/1998 and 11/1998			TCL VOCs, TCL SVOCs, PCBs, TAL total and dissolved metals, cyanide, and anions (sulfate, bicarbonate, and chloride)
6/1999			TCL VOCs, pesticides, PCBs, TAL total and dissolved metals, cyanide, and anions (sulfate, bicarbonate, and chloride)
1/2000			
6/2000	Site 9: LS09-MW02, LS09-MW04, LS09-MW05, LS09-MW06, LS09-UST1, LS09-UST3 Site 10: LS10-MW01, LS10-MW02, LS10-MW03, LS10-MW05, LS10-MW06, LS10-MW07		All wells: TCL SVOCs, TAL total and dissolved metals LS09-MW04, LS09-MW05, LS09-MW06 also analyzed for pesticides, PCBs, dioxins, and furans LS09-UST3 also analyzed for pesticides and PCBs
9/2001	Site 9: LS09-MW04, LS09-MW05, LS09-MW06, LS09-MW07, LS09-UST3 Site 10: LS10-MW03, LS10-MW05, LS10-MW06, LS10-MW07, LS10-MW09	annual	TCL SVOCs, pesticides, PCBs, and TAL total and dissolved metals
07/2002 and 07/2003	Site 9: LS09-MW04, LS09-MW05, LS09-MW06, LS09-MW07, LS08-MW08, LS09-UST3 Site 10: LS10-MW02, LS10-MW03, LS10-MW05, LS10-MW06, LS10-MW07, LS10-MW09		TCL SVOCs, pesticides, PCBs, and TAL total and dissolved metals, and cyanide

**Table 3-2
Long-Term Monitoring Summary
Sites 9 and 10
Five Year Review
NAB Little Creek
Virginia Beach, Virginia**

Site	Monitoring Wells Sampled	Sampling Dates	Sampling Frequency	Analysis	
Site 9	LS09-MW04, LS09-MW05, LS09-MW06, LS09-MW07, LS08-MW08, and LS09-UST3	10/2004	annual	Total and dissolved antimony	
		10/2005		TCL VOCs, SVOCs, pesticides/PCBs, and total and dissolved metals	
		10/2006		Total and dissolved antimony, specific conductance, pH, TOX, and TOC	
		10/2007		Total and dissolved cadmium, manganese, thallium, and zinc	
Site 10	LS10-MW02, LS10-MW03, LS10-MW05, LS10-MW06, LS10-MW07, and LS10-MW11	10/2004		annual	TCL VOCs, SVOCs, pesticides/PCBs, and total and dissolved metals
		10/2005			Total and dissolved cadmium, manganese, thallium, and zinc, specific conductance, pH, TOX, and TOC
		10/2006			Total and dissolved cadmium, manganese, thallium, and zinc
		10/2007			

Table 3-3
Statistical Analysis Data Summary
Sites 9 and 10
Five Year Review
NAB Little Creek
Virginia Beach, Virginia

Sampling Dates	Monitoring Wells¹	Analytes
GMP: semi-annual sampling 05/1996 to 06/2000 and annual sampling 09/2001 to 07/2003	Site 9: LS09-MW04, LS09-MW05, LS09-MW06, LS09-MW07, LS08-MW08, and LS09-UST3 Site 10: LS10-MW02, LS10-MW03, LS10-MW05, LS10-MW06, LS10-MW07, and LS10-MW12	Site 9: antimony Site 10: cadmium, manganese, thallium, and zinc
LTM: annual sampling 10/2004 to 10/2007	Site 9: LS09-MW04, LS09-MW05, LS09-MW06, LS09-MW07, LS08-MW08, and LS09-UST3 Site 10: LS10-MW02, LS10-MW03, LS10-MW05, LS10-MW06, LS10-MW07, and LS10-MW12	Site 9: antimony Site 10: cadmium, manganese, thallium, and zinc

¹ Refer to Table 3-1 for a more detailed presentation of monitoring wells sampled during each event.

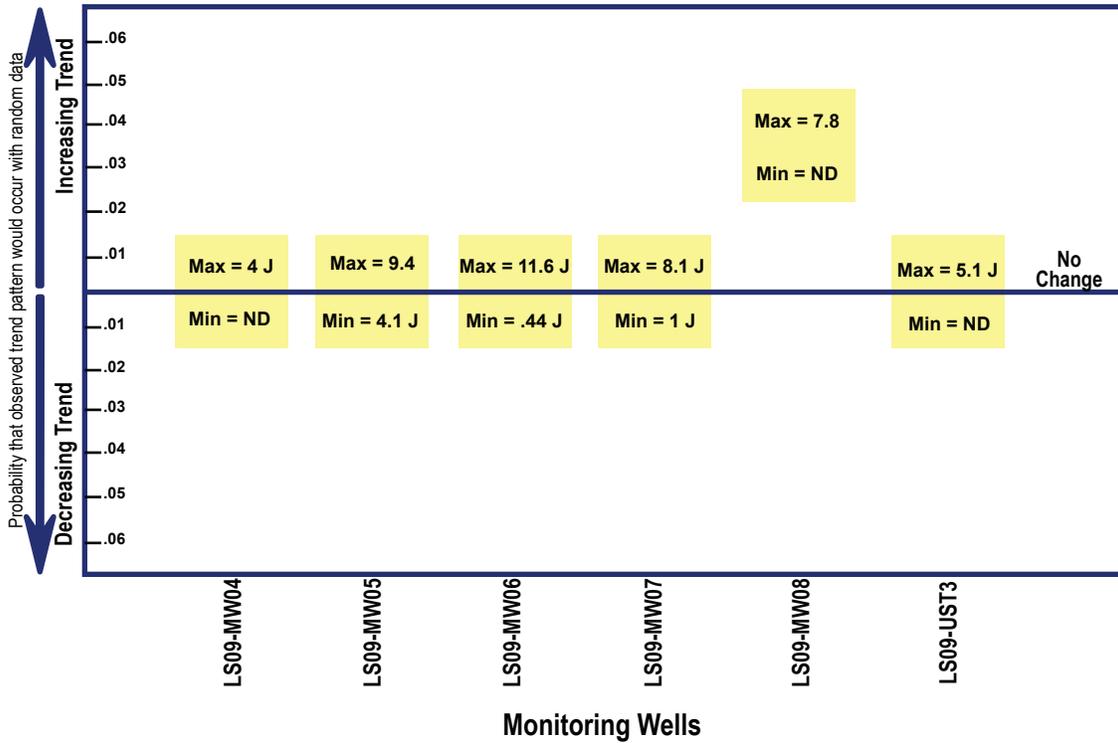
Table 3-4
Statistically Significant LTM Trends
Sites 9 and 10
Five Year Review
NAB Little Creek
Virginia Beach, Virginia

Chemical Group	Constituent	Location	Percent Detects	Sample Size	Trend Observed	Probability Observed Trend Pattern Would Occur with Random Data*
Site 9						
Dissolved Metals	Antimony	LS09-MW08	67	6	Increasing	0.048
Site 10						
Total Metals	Manganese	LS10-MW03	100	14	Decreasing	0.003
Total Metals	Manganese	LS10-MW05	100	16	Decreasing	0.021
Dissolved Metals	Manganese	LS10-MW03	100	14	Decreasing	0.001
Dissolved Metals	Manganese	LS10-MW05	100	16	Decreasing	0.014
Total Metals	Zinc	LS10-MW03	21	14	Decreasing	0.004
Dissolved Metals	Zinc	LS10-MW02	36	14	Decreasing	0.047
Dissolved Metals	Zinc	LS10-MW03	29	14	Decreasing	0.011

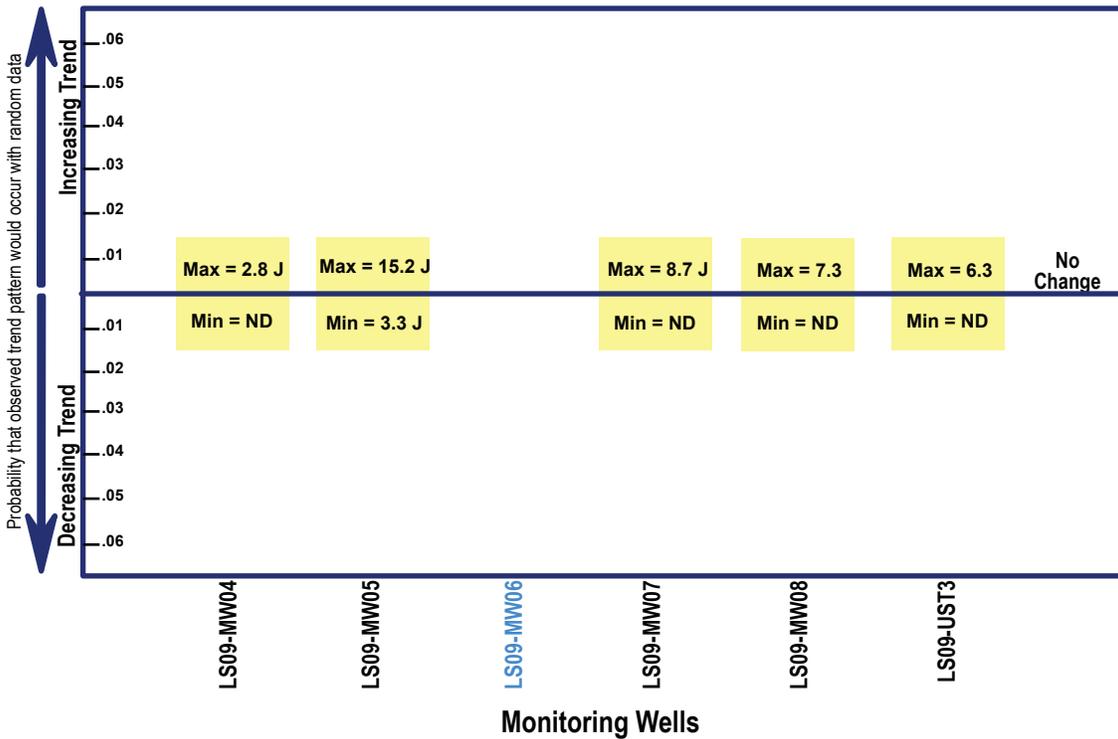
Notes:

*The calculated probability provided represents the probability that any observed trend would occur purely by chance (given the variability and sample size of the data set). A significance level of 0.05 was used for comparisons with this probability and the resulting decision is reported. If a significance level of 0.05 is achieved, the increasing or decreasing trend is considered a false positive and a no significant trend is accepted as true.

Site 9 Dissolved Antimony Trends



Site 9 Total Antimony Trends



Footnotes:

J - Reported value is estimated
 K - Reported value may be biased high
 Min = Minimum Concentration
 Max = Maximum Concentration
 ND = Not detected

All concentrations are expressed in micrograms per Liter

Half of the minimum detected value for a constituent in a given well used in the statistical analysis

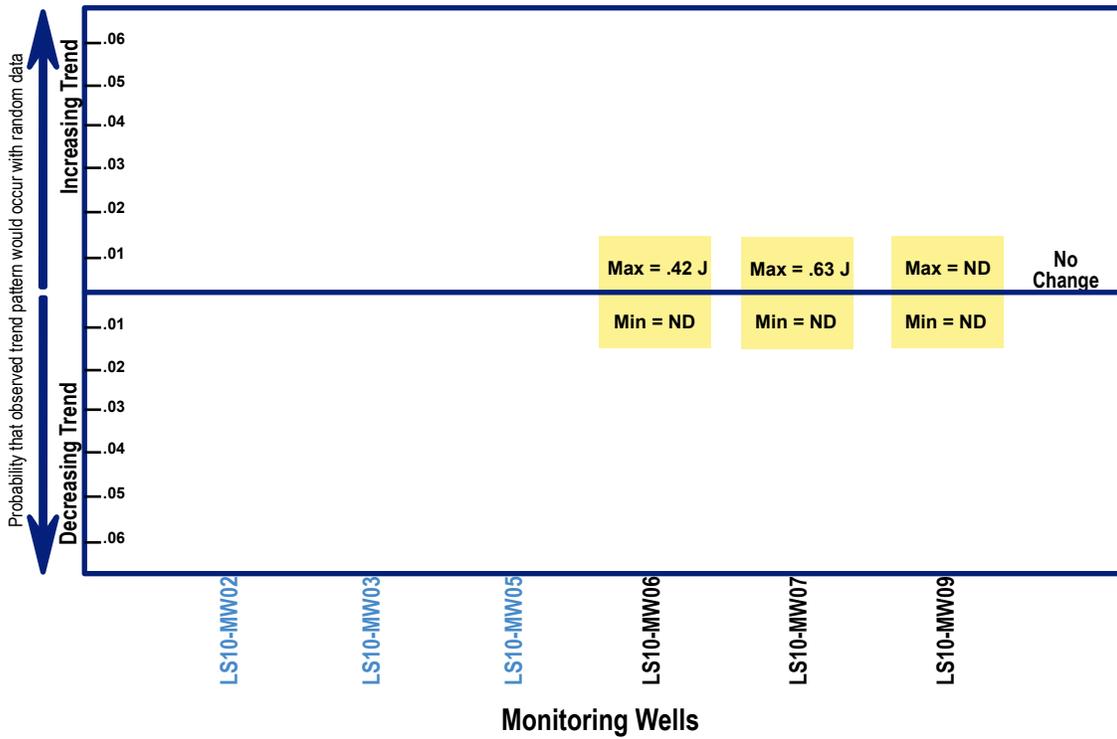
If the probability that an observed trend pattern would occur with random data is greater than 0.05, the increasing or decreasing trend is found to be a false positive and a no change trend is accepted.

Monitoring wells in blue indicate no detected values during long term monitoring, therefore no case is present

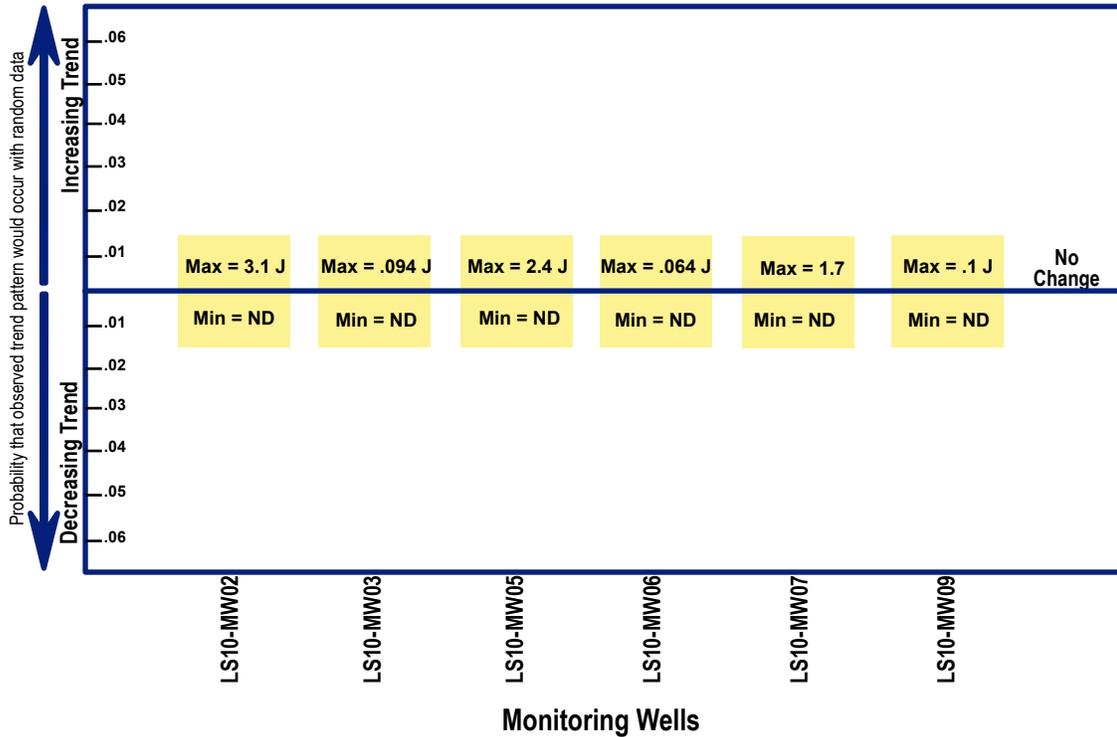
Table 3-5a

Site 9 Antimony Statistical Trends
 2008 Five Year Review
 NAB Little Creek
 Virginia Beach, Virginia

Site 10 Dissolved Cadmium Trends



Site 10 Total Cadmium Trends



Footnotes:

- J - Reported value is estimated
- K - Reported value may be biased high
- Min = Minimum Concentration
- Max = Maximum Concentration
- ND = Not detected

All concentrations are expressed in micrograms per Liter

Half of the minimum detected value for a constituent in a given well used in the statistical analysis

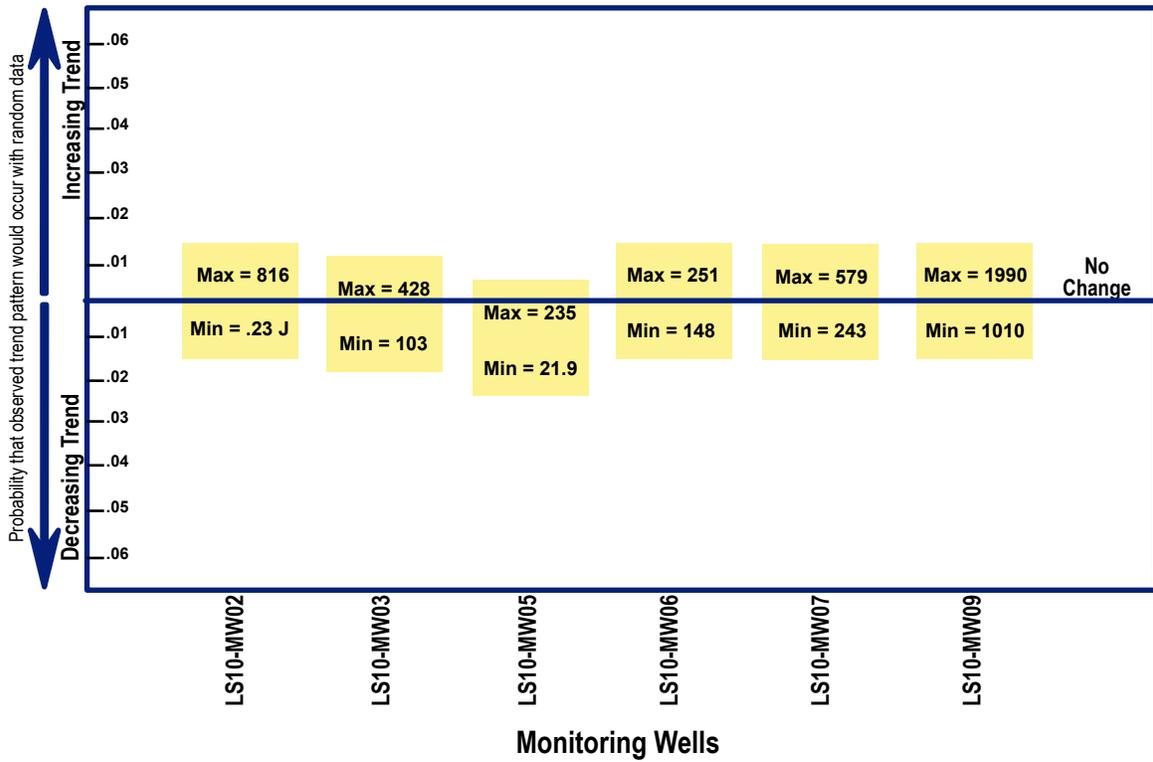
If the probability that an observed trend pattern would occur with random data is greater than 0.05, the increasing or decreasing trend is found to be a false positive and a no change trend is accepted.

Monitoring wells in blue indicate no detected values during long term monitoring, therefore no case is present

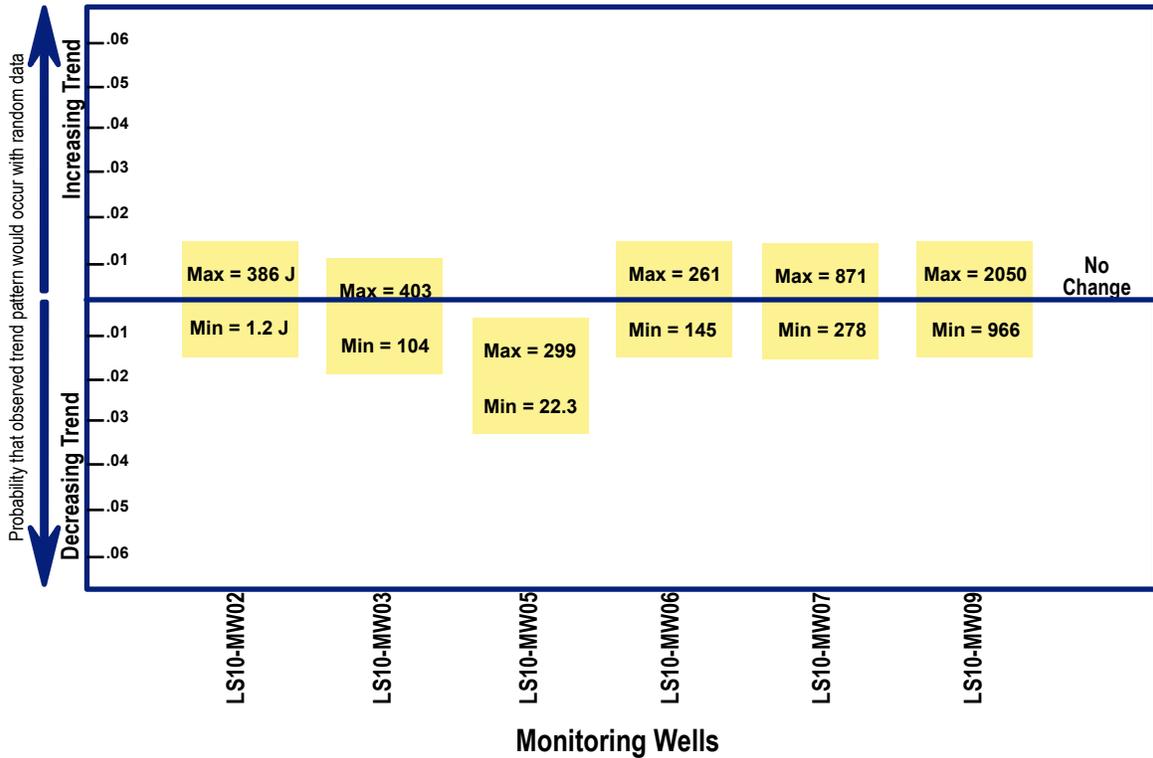
Table 3-5b

Site 10 Cadmium Statistical Trends
2008 Five Year Review
NAB Little Creek
Virginia Beach, Virginia

Site 10 Dissolved Manganese Trends



Site 10 Total Manganese Trends



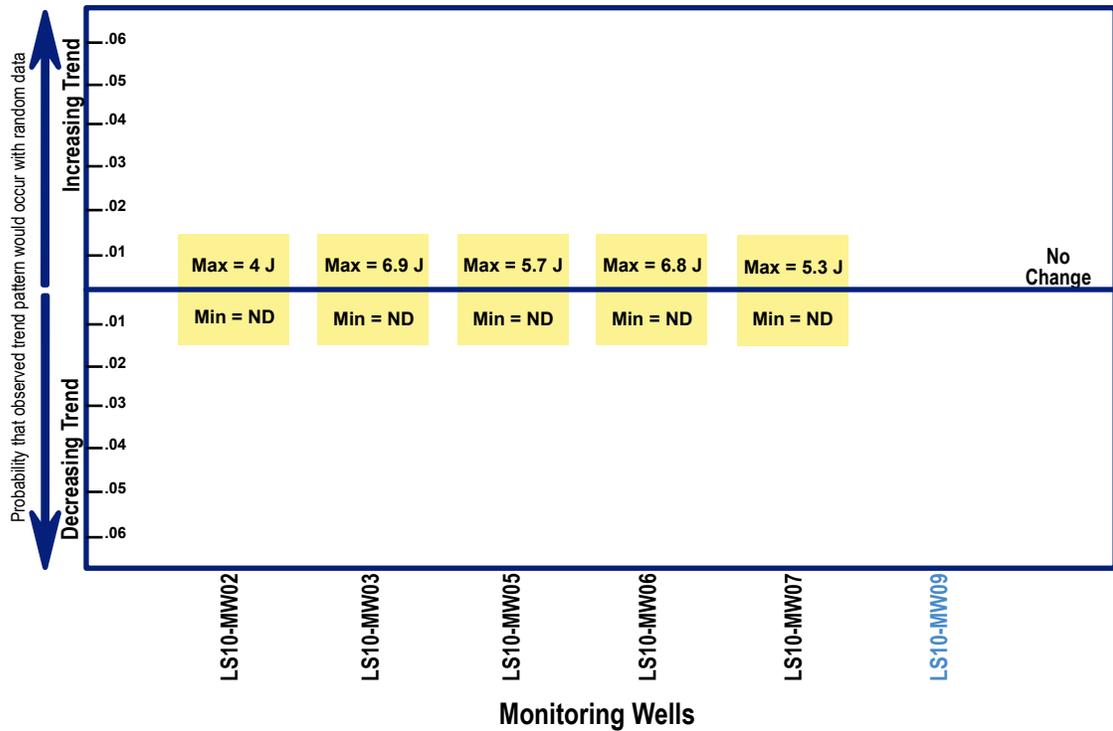
Footnotes:

- J - Reported value is estimated
- K - Reported value may be biased high
- Min = Minimum Concentration
- Max = Maximum Concentration
- ND = Not detected

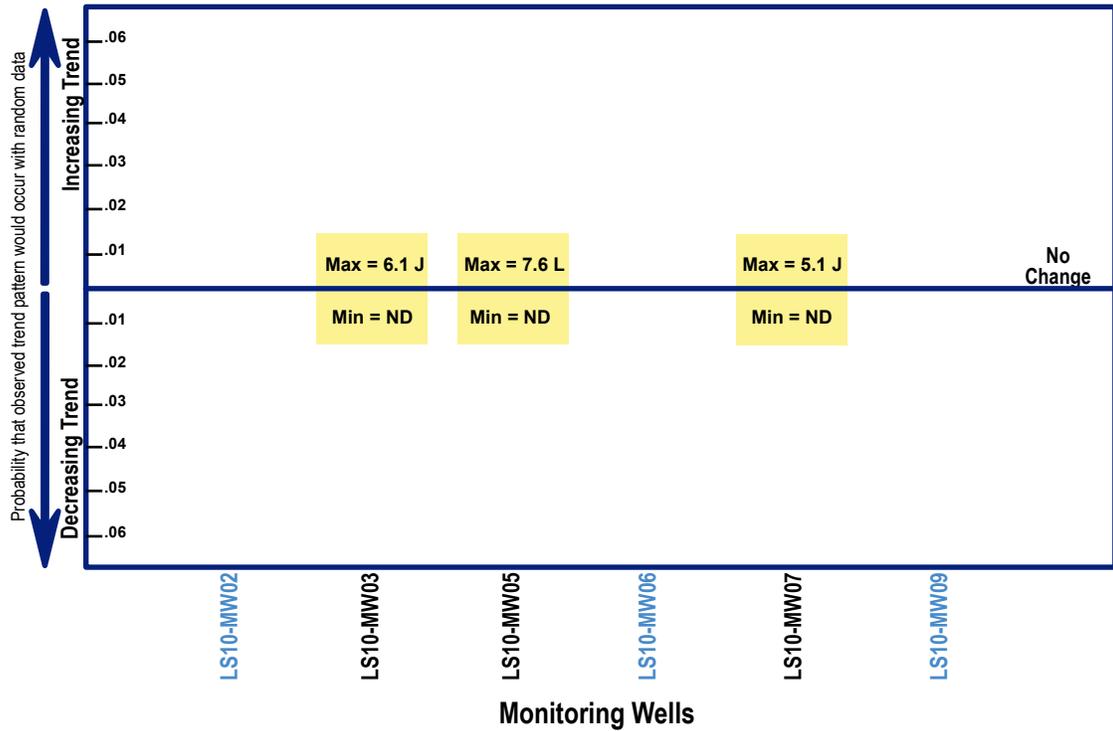
All concentrations are expressed in micrograms per Liter
 Half of the minimum detected value for a constituent in a given well used in the statistical analysis
 If the probability that an observed trend pattern would occur with random data is greater than 0.05, the increasing or decreasing trend is found to be a false positive and a no change trend is accepted.
 Monitoring wells in blue indicate no detected values during long term monitoring, therefore no case is present

Table 3-5c
 Site 10 Manganese Statistical Trends
 2008 Five Year Review
 NAB Little Creek
 Virginia Beach, Virginia

Site 10 Dissolved Thallium Trends



Site 10 Total Thallium Trends



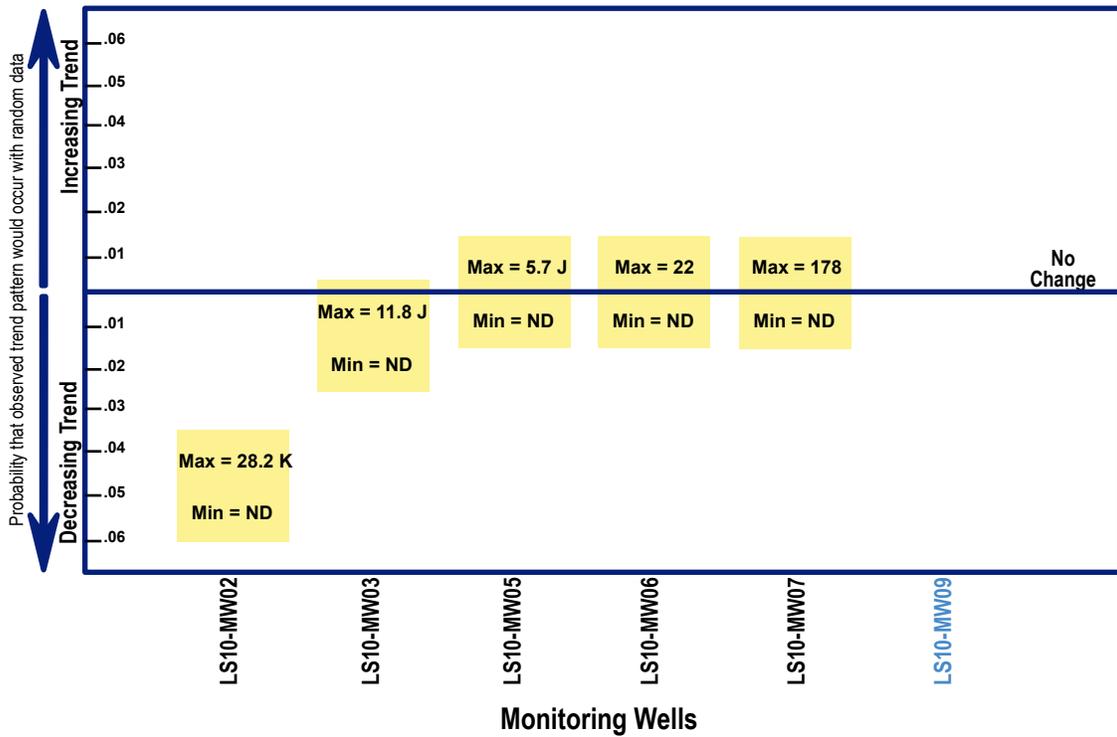
Footnotes:

- J - Reported value is estimated
- K - Reported value may be biased high
- L - Reported value may be biased low
- Min = Minimum Concentration
- Max = Maximum Concentration
- ND = Not detected

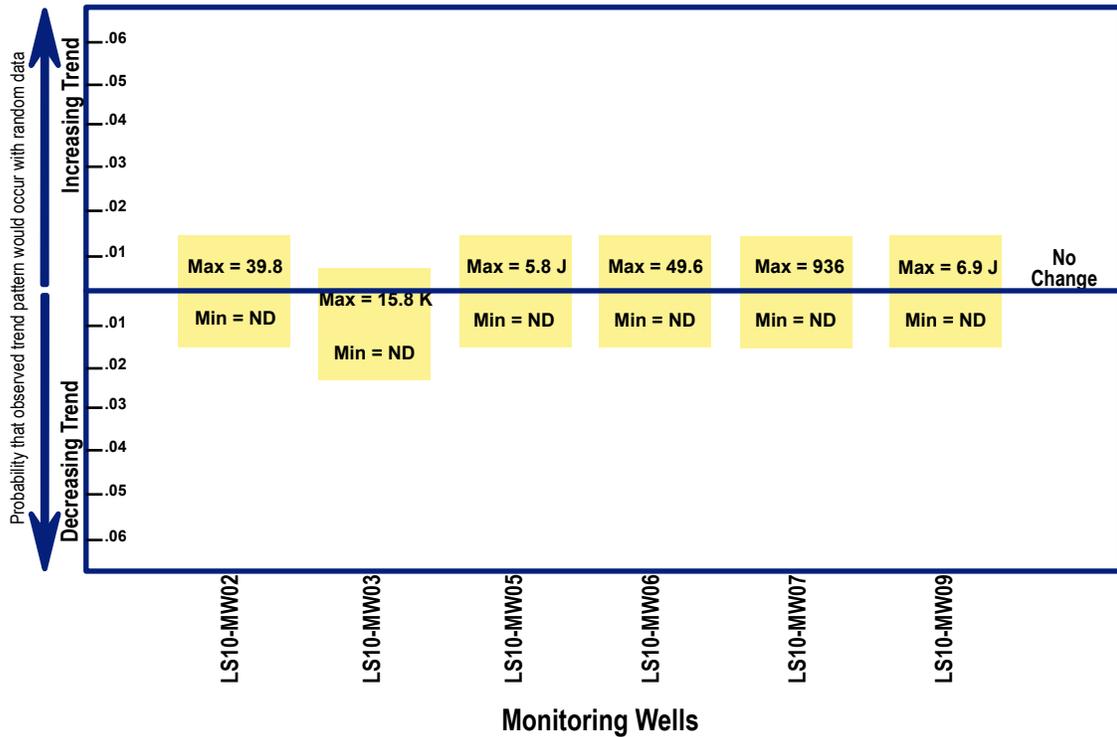
All concentrations are expressed in micrograms per Liter
 Half of the minimum detected value for a constituent in a given well used in the statistical analysis
 If the probability that an observed trend pattern would occur with random data is greater than 0.05, the increasing or decreasing trend is found to be a false positive and a no change trend is accepted.
 Monitoring wells in blue indicate no detected values during long term monitoring, therefore no case is present

Table 3-5d
 Site 10 Thallium Statistical Trends
 2008 Five Year Review
 NAB Little Creek
 Virginia Beach, Virginia

Site 10 Dissolved Zinc Trends



Site 10 Total Zinc Trends

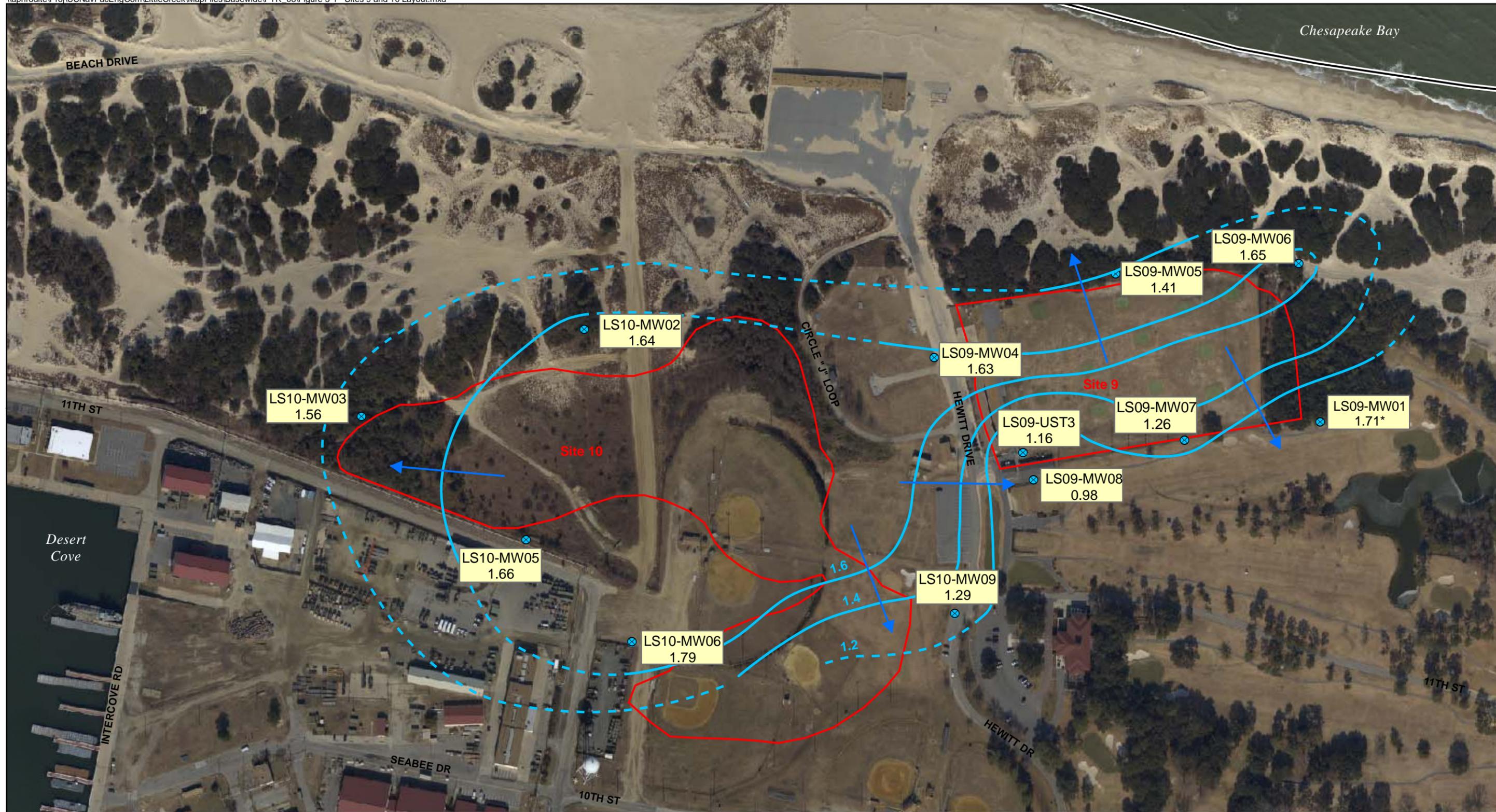


Footnotes:

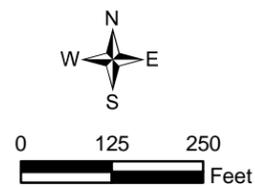
J - Reported value is estimated
 K - Reported value may be biased high
 Min = Minimum Concentration
 Max = Maximum Concentration
 ND = Not detected

All concentrations are expressed in micrograms per Liter
 Half of the minimum detected value for a constituent in a given well used in the statistical analysis
 If the probability that an observed trend pattern would occur with random data is greater than 0.05, the increasing or decreasing trend is found to be a false positive and a no change trend is accepted.
 Monitoring wells in blue indicate no detected values during long term monitoring, therefore no case is present

Table 3-5e
 Site 10 Zinc Statistical Trends
 2008 Five Year Review
 NAB Little Creek
 Virginia Beach, Virginia



- Legend**
- ⊗ Monitoring Well
 - Groundwater Elevation Contour (Contour Interval 0.2 ft)
 - - - Inferred Groundwater Elevation Contour
 - ▭ Installation Boundary
 - ▭ LUC Boundary
 - Groundwater Flow Direction



* Anomalous water level. Not used in contour.
Groundwater Gradient - (0.002 ft)

Figure 3-1
Sites 9 and 10 Layout
2008 Five Year Review
NAB Little Creek
Virginia Beach, Virginia

Station ID	LS09-MW04			
Sample Date	10/28/04	10/24/05	10/17/06	**10/23/2007
SVOC (UG/L)				
bis(2-Ethylhexyl)phthalate	NA	NA	37 J	NA
Total Metals (UG/L)				
Antimony	0.76 J	1 J	0.72 B	60 U
Dissolved Metals (UG/L)				
Antimony	0.58 J	0.79 J	0.73 B	60 U
Cadmium	0.22 J	NA	0.098 B	NA
Wet Chemistry				
Total Organic Carbon (MG/L)	NA	NA	NA	1.8 J
Specific conductance (MS/CM)	NA	NA	NA	0.21
Total organic halogens (MG/L)	NA	NA	NA	0.03 U
pH	NA	NA	NA	6.1

Station ID	LS09-MW05			
Sample Date	10/27/04	10/26/05	**10/18/2006	10/23/07
Total Metals (UG/L)				
Antimony	9.2	8	5.9	7.6 J
Zinc	84.4 J	NA	105	NA
Dissolved Metals (UG/L)				
Antimony	9.4	8.3	5.3	6.9 J
Cadmium	1.1	NA	0.026 B	NA
Chromium	NA	NA	0.83 J	NA
Zinc	95.1 J	NA	82.6	NA
Wet Chemistry				
Total Organic Carbon (MG/L)	NA	NA	NA	5
Specific conductance (MS/CM)	NA	NA	NA	0.0036
Total organic halogens (MG/L)	NA	NA	NA	0.0313
pH	NA	NA	NA	6.4

Station ID	LS09-MW06			
Sample Date	**10/27/2004	10/26/05	10/18/06	10/23/07
Total Metals (UG/L)				
Aluminum	NA	NA	1,910	NA
Antimony	0.66 B	2 U	0.38 B	60 U
Copper	NA	NA	40.6	NA
Zinc	543 J	NA	734	NA
Dissolved Metals (UG/L)				
Aluminum	NA	NA	1,720	NA
Antimony	0.49 J	0.44 J	0.38 B	60 U
Beryllium	NA	NA	0.41 J	NA
Cadmium	0.41 J	NA	1.1	NA
Copper	NA	NA	39.4	NA
Lead	NA	NA	0.61 J	NA
Zinc	513 J	NA	765	NA
Wet Chemistry				
Total Organic Carbon (MG/L)	NA	NA	NA	11.6
Specific conductance (MS/CM)	NA	NA	NA	0.212
Total organic halogens (MG/L)	NA	NA	NA	0.0435
pH	NA	NA	NA	5.2

Station ID	LS09-UST3			
Sample Date	10/28/04	10/25/05	10/17/06	10/23/07
Total Metals (UG/L)				
Aluminum	NA	NA	1,780	NA
Antimony	3.4	3.4	6.3	60 U
Arsenic	NA	NA	100	NA
Cadmium	0.52 J	NA	13	NA
Chromium	NA	NA	8.9	NA
Cobalt	NA	NA	3.1 J	NA
Iron	NA	NA	52,100	NA
Lead	NA	NA	6.8	NA
Thallium	0.059 J	NA	0.11 B	NA
Vanadium	NA	NA	67.1	NA
Zinc	93.2 J	NA	150	NA
Dissolved Metals (UG/L)				
Antimony	3.4	2.3	2.4	5.1 J
Cadmium	0.47 J	NA	7	NA
Cobalt	NA	NA	2.3	NA
Copper	NA	NA	8.3	NA
Zinc	89.8 J	NA	98.7	NA
Wet Chemistry				
Total Organic Carbon (MG/L)	NA	NA	NA	13.4
Specific conductance (MS/CM)	NA	NA	NA	0.454
Total organic halogens (MG/L)	NA	NA	NA	0.0483
pH	NA	NA	NA	5.9

Station ID	LS09-MW07			
Sample Date	10/28/04	10/24/05	**10/17/2006	10/23/07
Total Metals (UG/L)				
Antimony	5.3	3.3	8.3	60 U
Zinc	376 J	NA	232	NA
Dissolved Metals (UG/L)				
Antimony	3.2	1 J	8.7	60 U
Nickel	NA	NA	6.1	NA
Vanadium	NA	NA	2.5	NA
Zinc	6.9 B	NA	224	NA
Wet Chemistry (MG/L)				
Total Organic Carbon (MG/L)	NA	NA	NA	2.8
Specific conductance (MS/CM)	NA	NA	NA	0.367
Total organic halogens (MG/L)	NA	NA	NA	0.0206 J
pH	NA	NA	NA	6.8

Chemical Name	MCL	Background UTL
SVOC (UG/L)		
bis(2-Ethylhexyl)phthalate	6	5
Total Metals (UG/L)		
Aluminum	--	713
Antimony	6	ND
Arsenic	10	4*
Cadmium	5	2.1
Chromium	100	4.1
Cobalt	--	2.6
Copper	1300	ND
Iron	--	11200*
Lead	15	2.4U
Thallium	2	2.5U
Vanadium	--	5
Zinc	--	59
Dissolved Metals (UG/L)		
Aluminum	--	58
Antimony	6	ND
Beryllium	--	ND
Cadmium	5	ND
Chromium	--	2.1
Cobalt	--	1.9
Copper	1300	ND
Lead	15	ND
Nickel	--	6
Potassium	--	16600*
Vanadium	--	2
Zinc	--	42

Station ID	LS09-MW08			
Sample Date	10/28/04	**10/24/05	10/17/06	10/23/07
Total Metals (UG/L)				
Antimony	1 B	7.3	1.6 J	6.7 J
Arsenic	NA	NA	4	NA
Zinc	NA	NA	241	NA
Dissolved Metals (UG/L)				
Antimony	1 J	7.8	1.5 J	6.5 J
Cadmium	NA	NA	0.52 J	NA
Lead	NA	NA	0.47 J	NA
Nickel	NA	NA	6.3	NA
Zinc	NA	NA	249	NA
Wet Chemistry				
Total Organic Carbon (MG/L)	NA	NA	NA	4
Specific conductance (MS/CM)	NA	NA	NA	0.7
Total organic halogens (MG/L)	NA	NA	NA	0.0197 J
pH	NA	NA	NA	6.3

Legend
 Monitoring Well
 LUC Boundary

Notes:
 SVOC = Semi-Volatile Organic Compound
 MCL = Maximum Contaminant Level
 UTL = Upper Tolerance Limit
 UG/L - Micrograms per Liter
 MG/L = Milligrams per Liter
 MS/CM = MilliSiemens per centimeter
 NA = Not Analyzed
 ND = Not Detected

J = Value reported is estimated
 U = Not detected
 B = Not detected substantially above the level reported in laboratory or field blanks
Bold indicates MCL exceedance
 Shading indicates background UTL exceedance
 * Revised UTL (Summer 2002)
 **Indicates duplicate sample, most conservative value reported

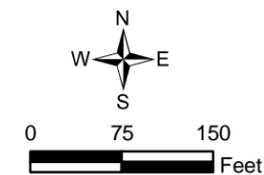
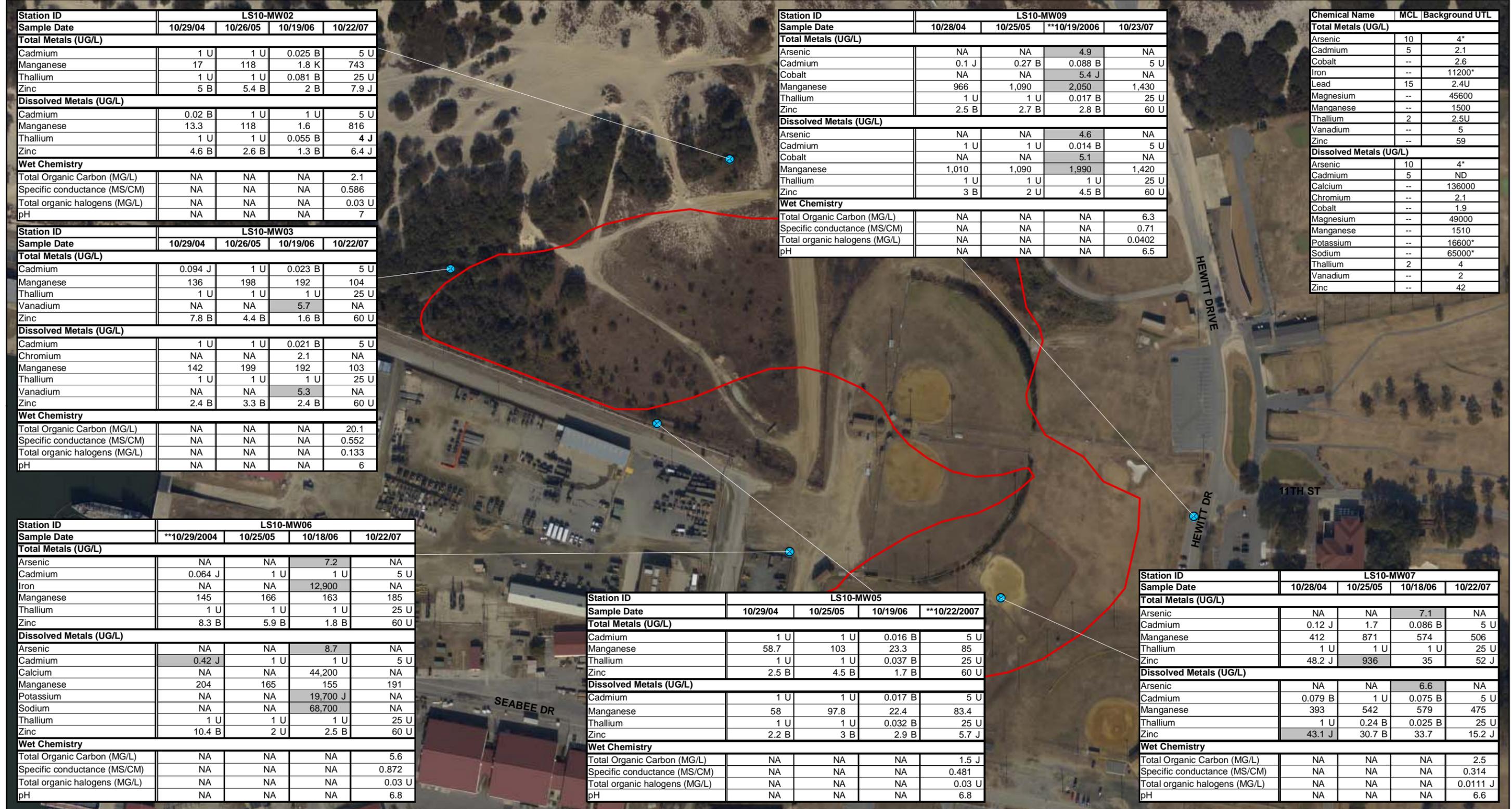


Figure 3-2
 Site 9 Post-ROD LTM Data Summary
 2008 Five-Year Review
 NAB Little Creek
 Virginia Beach, VA



Station ID	LS10-MW02			
Sample Date	10/29/04	10/26/05	10/19/06	10/22/07
Total Metals (UG/L)				
Cadmium	1 U	1 U	0.025 B	5 U
Manganese	17	118	1.8 K	743
Thallium	1 U	1 U	0.081 B	25 U
Zinc	5 B	5.4 B	2 B	7.9 J
Dissolved Metals (UG/L)				
Cadmium	0.02 B	1 U	1 U	5 U
Manganese	13.3	118	1.6	816
Thallium	1 U	1 U	0.055 B	4 J
Zinc	4.6 B	2.6 B	1.3 B	6.4 J
Wet Chemistry				
Total Organic Carbon (MG/L)	NA	NA	NA	2.1
Specific conductance (MS/CM)	NA	NA	NA	0.586
Total organic halogens (MG/L)	NA	NA	NA	0.03 U
pH	NA	NA	NA	7

Station ID	LS10-MW03			
Sample Date	10/29/04	10/26/05	10/19/06	10/22/07
Total Metals (UG/L)				
Cadmium	0.094 J	1 U	0.023 B	5 U
Manganese	136	198	192	104
Thallium	1 U	1 U	1 U	25 U
Vanadium	NA	NA	5.7	NA
Zinc	7.8 B	4.4 B	1.6 B	60 U
Dissolved Metals (UG/L)				
Cadmium	1 U	1 U	0.021 B	5 U
Chromium	NA	NA	2.1	NA
Manganese	142	199	192	103
Thallium	1 U	1 U	1 U	25 U
Vanadium	NA	NA	5.3	NA
Zinc	2.4 B	3.3 B	2.4 B	60 U
Wet Chemistry				
Total Organic Carbon (MG/L)	NA	NA	NA	20.1
Specific conductance (MS/CM)	NA	NA	NA	0.552
Total organic halogens (MG/L)	NA	NA	NA	0.133
pH	NA	NA	NA	6

Station ID	LS10-MW06			
Sample Date	**10/29/2004	10/25/05	10/18/06	10/22/07
Total Metals (UG/L)				
Arsenic	NA	NA	7.2	NA
Cadmium	0.064 J	1 U	1 U	5 U
Iron	NA	NA	12,900	NA
Manganese	145	166	163	185
Thallium	1 U	1 U	1 U	25 U
Zinc	8.3 B	5.9 B	1.8 B	60 U
Dissolved Metals (UG/L)				
Arsenic	NA	NA	8.7	NA
Cadmium	0.42 J	1 U	1 U	5 U
Calcium	NA	NA	44,200	NA
Manganese	204	165	155	191
Potassium	NA	NA	19,700 J	NA
Sodium	NA	NA	68,700	NA
Thallium	1 U	1 U	1 U	25 U
Zinc	10.4 B	2 U	2.5 B	60 U
Wet Chemistry				
Total Organic Carbon (MG/L)	NA	NA	NA	5.6
Specific conductance (MS/CM)	NA	NA	NA	0.872
Total organic halogens (MG/L)	NA	NA	NA	0.03 U
pH	NA	NA	NA	6.8

Station ID	LS10-MW05			
Sample Date	10/29/04	10/25/05	10/19/06	**10/22/2007
Total Metals (UG/L)				
Cadmium	1 U	1 U	0.016 B	5 U
Manganese	58.7	103	23.3	85
Thallium	1 U	1 U	0.037 B	25 U
Zinc	2.5 B	4.5 B	1.7 B	60 U
Dissolved Metals (UG/L)				
Cadmium	1 U	1 U	0.017 B	5 U
Manganese	58	97.8	22.4	83.4
Thallium	1 U	1 U	0.032 B	25 U
Zinc	2.2 B	3 B	2.9 B	5.7 J
Wet Chemistry				
Total Organic Carbon (MG/L)	NA	NA	NA	1.5 J
Specific conductance (MS/CM)	NA	NA	NA	0.481
Total organic halogens (MG/L)	NA	NA	NA	0.03 U
pH	NA	NA	NA	6.8

Station ID	LS10-MW09			
Sample Date	10/28/04	10/25/05	**10/19/2006	10/23/07
Total Metals (UG/L)				
Arsenic	NA	NA	4.9	NA
Cadmium	0.1 J	0.27 B	0.088 B	5 U
Cobalt	NA	NA	5.4 J	NA
Manganese	966	1,090	2,050	1,430
Thallium	1 U	1 U	0.017 B	25 U
Zinc	2.5 B	2.7 B	2.8 B	60 U
Dissolved Metals (UG/L)				
Arsenic	NA	NA	4.6	NA
Cadmium	1 U	1 U	0.014 B	5 U
Cobalt	NA	NA	5.1	NA
Manganese	1,010	1,090	1,990	1,420
Thallium	1 U	1 U	1 U	25 U
Zinc	3 B	2 U	4.5 B	60 U
Wet Chemistry				
Total Organic Carbon (MG/L)	NA	NA	NA	6.3
Specific conductance (MS/CM)	NA	NA	NA	0.71
Total organic halogens (MG/L)	NA	NA	NA	0.0402
pH	NA	NA	NA	6.5

Chemical Name	MCL	Background UTL
Total Metals (UG/L)		
Arsenic	10	4*
Cadmium	5	2.1
Cobalt	--	2.6
Iron	--	11200*
Lead	15	2.4U
Magnesium	--	45600
Manganese	--	1500
Thallium	2	2.5U
Vanadium	--	5
Zinc	--	59
Dissolved Metals (UG/L)		
Arsenic	10	4*
Cadmium	5	ND
Calcium	--	136000
Chromium	--	2.1
Cobalt	--	1.9
Magnesium	--	49000
Manganese	--	1510
Potassium	--	16600*
Sodium	--	65000*
Thallium	2	4
Vanadium	--	2
Zinc	--	42

Legend
 Monitoring Well
 LUC Boundary

Notes:
 MCL = Maximum Contaminant Level
 UTL = Upper Tolerance Limit
 UG/L - Micrograms per Liter
 MG/L = Milligrams per Liter
 MS/CM = MilliSiemens per centimeter
 NA = Not Analyzed
 ND = Not Detected
 J = Value reported is estimated

U = Not detected
 Shading indicates background UTL exceedance
 **Indicates duplicate sample, most conservative value reported
 * Revised UTL (Summer 2002)

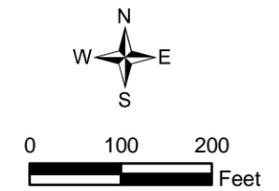
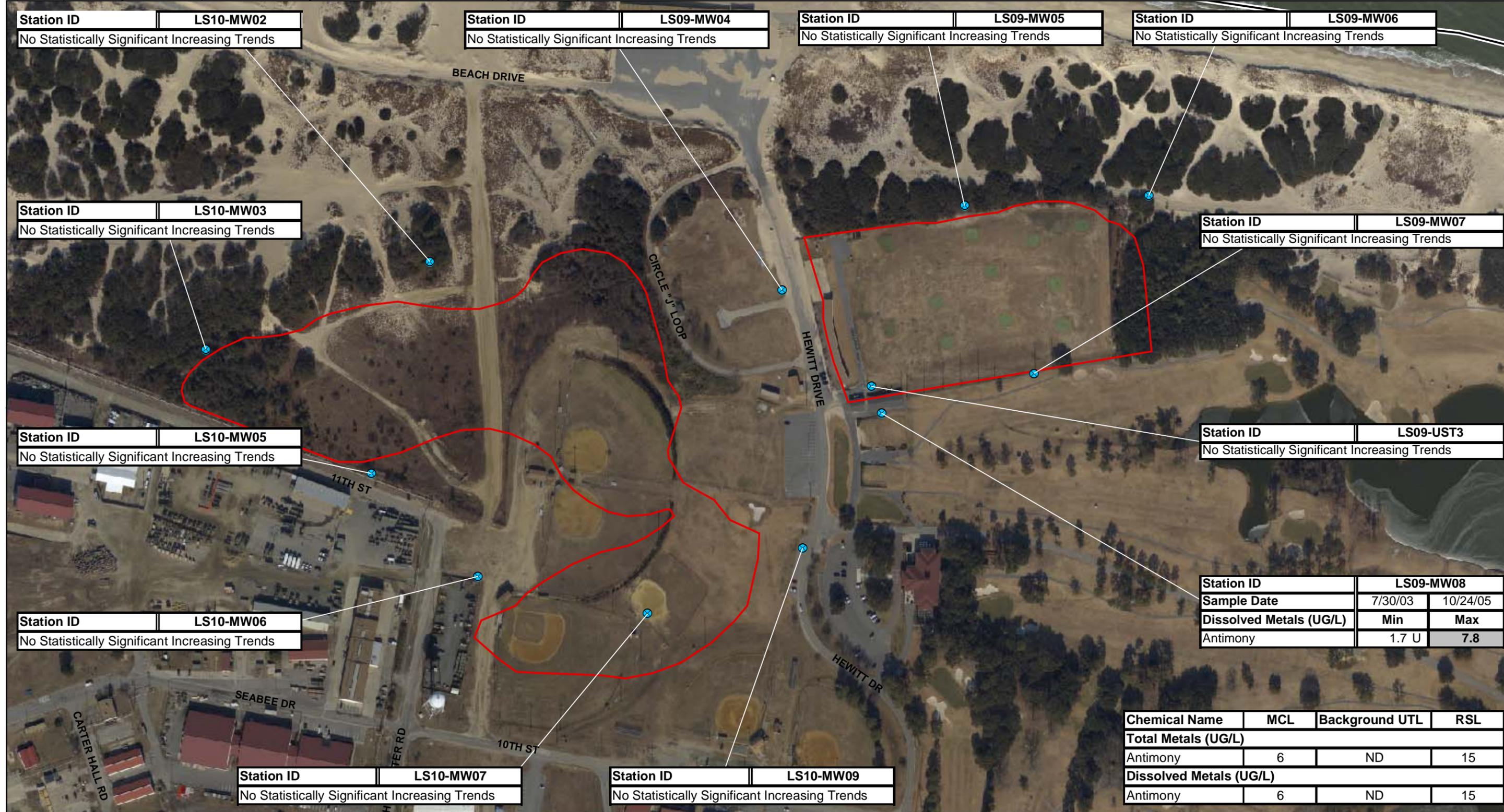


Figure 3-3
 Site 10 Post-ROD LTM Data Summary
 2008 Five-Year Review
 NAB Little Creek
 Virginia Beach, VA



Legend
 Monitoring Well
 LUC Boundary

MCL = Maximum Contaminant Level
 UTL = Upper Tolerance Limit
 UG/L - Micrograms per Liter
 ND = Not detected
 U = Not detected
 RSL = Regional Screening Level
 Min = Minimum Concentration
 Max = Maximum Concentration

Bold indicates MCL exceedance
 Shading indicates background UTL exceedance
 Half of the minimum undetected concentration was used for all non-detects.
 Min = Minimum Concentration
 Max = Maximum Concentration

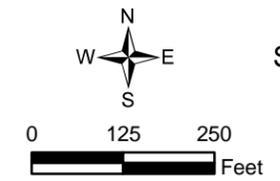


Figure 3-4
 Site 9 and 10 Groundwater Statistically Significant Increasing Trends
 2008 Five-Year Review
 NAB Little Creek
 Virginia Beach, VA

Site 11—School of Music Plating Shop

4.1 Site Chronology

Date	Event
Dec. 1984	IAS
Oct. 1986	RVS
Mar. 1989	RFA
Nov. 1991	Interim Removal Action (IRA)
Nov. 1994	RI/FS for Sites 7 and 9-13
Nov. 1994	DD for Removal of Neutralization Tank, Piping, and Surrounding Soil
May 1996	IRA Closeout Report; post-removal groundwater monitoring initiated
June 1998	Supplemental RI initiated
May 1999	NAB Little Creek on NPL
June 2000	Screening Ecological Risk Assessment (SERA)
June 2002	Cyclodextrin (CD) solution pilot test
June 2004	SRI/Human Health Risk Assessment
Sept. 2005	Vapor Intrusion Investigation
March 2006	SRI Addendum/Revised HHRA
June 2006	FS
Sept 2006	Proposed Plan
Oct. 2006	Pentachlorophenol Technical Memorandum
July 2007	ROD
July 2007	Initiated Quarterly Site Inspections
June 2008	Draft Remedial Action Work Plan (RAWP) submitted for regulatory review

4.2 Site Background

4.2.1 Site 11 Description and History

Site 11 is located in the eastern portion of the base, near the intersection of Seventh and E Streets ([Figure 4-1](#)). The School of Music (Building 3602) and a storage building (Building 3651, formerly the plating shop) are located within the site boundary. Site 11 consisted of the plating shop, an in-ground concrete tank used to neutralize plating solutions, and its associated piping. Between 1964 and 1974, plating baths, acids, and

lacquer strippers were disposed of in the plating shop sink that drained to the neutralization tank and eventually into the storm sewer system (Ebasco, 1991). The neutralization tank, piping, and surrounding soil were excavated in 1996. Following excavation, the area was backfilled with clean fill (ITC, 1996).

Degreasing solvents such as TCE and 1,1,1-trichloroethane (TCA) have historically been associated with operations at plating shops, and samples collected at the site indicated a direct release of chlorinated VOCs to subsurface soil and groundwater had occurred.

The ground surface in the vicinity of Site 11 is generally level, approximately 10 ft above msl, and includes a landscaped lawn, an asphalt parking lot, and a concrete drive behind Building 3602. The majority of precipitation is lost through infiltration or evaporation; however some stormwater runoff is collected by man-made stormwater drainage ditches and discharged to the stormwater sewer system.

4.2.2 Site 11 Geology and Hydrogeology

The surface geology at Site 11 consists of the 20 to 25 ft thick Columbia Formation, which contains the 15 to 20 ft thick unconfined Columbia Aquifer. The Columbia Formation overlies the 30 to 40 ft thick Yorktown Confining Unit. The Yorktown Confining Unit is continuous across the site and impedes the downward migration of Columbia Aquifer groundwater to the deeper Yorktown Aquifer. Depth to shallow groundwater at Site 11 varies seasonally from 5 to 7 ft bgs. Groundwater flow was influenced by a leaking sanitary sewer near the corner of Gator Boulevard and E Street and generally flowed southeast; however, following the sanitary sewer repair conducted in 2007, groundwater flow direction has been reevaluated and generally flows south ([Figure 4-2](#)). Prior to the sewer repair, the average groundwater flow velocity in the Columbia Aquifer had been calculated to be 110 ft/year (CH2M HILL, 2004a). Due to the proximity of the sites to the Chesapeake Bay, groundwater in the Yorktown Aquifer beneath the site flows north and discharges into the Chesapeake Bay.

4.3 Land and Resource Use

Site 11 was historically used for the cleaning and maintenance of instruments. Currently, Site 11 consists of the School of Music and its associated parking lot. Building 3651 is used for storage of miscellaneous items, and the grass field located north of the School of Music is used for marching band practice and drill sessions. Enlisted quarters, industrial activities, and administrative offices surround the site.

There are no potable groundwater supply wells located within the boundary of Site 11. Non-potable groundwater supply wells located on the Little Creek Golf Course, withdraw groundwater from the Yorktown Aquifer for irrigation and storage pond maintenance. There are no surface water bodies within the boundary of Site 11. Site 11 is located approximately 1,500 feet south of the golf course ponds and approximately 3,750 ft south of the Chesapeake Bay.

LUCs, though not fully implemented through documentation in an I-RACR, are currently maintained at Site 11 through quarterly site inspections. The LUCs restrict land use and

exposure to shallow groundwater until concentrations of VOCs are reduced to levels that allow for unlimited use and unrestricted exposure.

4.4 History of Contamination

Surface/subsurface soil and groundwater samples were collected during previous investigation activities for analysis of VOCs, SVOCs, metals, cyanide, acid extractable compounds, hexavalent chromium, and/or geochemical/monitored natural attenuation parameters (TOC, total oxidant demand [TOD], alkalinity, chloride, nitrate, sulfide, sulfate, and bicarbonate). Soil analytical results were screened against residential RBCs and background UTLs. Groundwater analytical results were screened against MCLs and background UTLs (metals only).

VOCs and metals were detected in surface soil during the 1993 RI (FWES, 1994b); arsenic, iron, and lead were detected above residential RBCs and background UTLs. VOCs, SVOCs, and metals were detected in subsurface soil during the 1995 SRI (CH2M HILL, 2004a); however, with the exception of arsenic, detected concentrations did not exceed residential RBCs. Arsenic concentrations detected were below the background UTLs.

Total and dissolved metals were detected in Columbia Aquifer groundwater above background UTLs; however, detected concentrations did not exceed the MCLs. One SVOC, pentachlorophenol (PCP), was detected in groundwater above the MCL. VOCs were detected above the MCLs throughout the Columbia Aquifer underlying Site 11. VOC concentrations are highest in the area of the former neutralization tank in the lower portion of the aquifer, at approximately 21 to 23 ft bgs just above the clay Yorktown Confining Unit. The Columbia Aquifer groundwater VOC contamination covers an estimated 2.5 acres underlying the School of Music ([Figure 4-2](#)). No VOCs were detected in samples collected from the Yorktown Aquifer. Residual dense non-aqueous phase liquid (DNAPL) may be present if dissolved phase concentrations are equal to 1 percent of the chemicals' maximum aqueous solubility. Subsequent to the CD pilot study, parent VOC compounds (TCE of 1,1,1-TCA have not been detected in groundwater samples at concentrations above 1 percent of their maximum aqueous solubility. Conversely, cis-1,2-dichloroethene (cis-1,2-DCE), a breakdown product of TCE, was detected at concentrations greater than 1 percent of its maximum aqueous solubility following the CD pilot study. However, cis-1,2-DCE was never used at the site in pure form, and its presence is likely due to the degradation of TCE.

4.4.1 Site Risks

An HHRA was conducted as part of the 2004 SRI to evaluate the risks to human health from exposure to soil and groundwater (CH2M HILL, 2004a). A revised HHRA was completed in 2006 to re-evaluate the potential human health risks associated with VOCs in groundwater as a result of the CD pilot study (CH2M HILL, 2006a). Additionally, in May 2005, potential risk associated with vapor intrusion of VOCs into the school of music was evaluated (CH2M HILL, 2005b). A SERA was completed in 2000 to evaluate potential exposure pathways for ecological receptors (CH2M HILL, 2000a). The summary of site risks presented in the subsections below was documented in the ROD (DON, 2007a).

Human Health Risk

No cancer risks associated with exposure to site soil were identified. Exposure to site soil by the hypothetical future child resident may present a non-cancer hazard above USEPA's target level of 1 based on RME calculations due to exposure to iron and chromium in soil at Site 11. However, CTE non-cancer hazards were below USEPA's target level of 1. RME cancer risks and/or non-cancer hazards associated with future potable use of or exposure to groundwater were identified for residents, industrial workers, and construction workers were above USEPA's target risk levels due to iron, manganese, and thallium. However, the RME EPCs of these chemicals were below their respective background UTLs and the CTE non-cancer hazards were below 1. RME and CTE cancer risks and non-cancer hazards to the future adult and child residents associated with exposure to PCP in groundwater were above USEPA's target levels. PCP, however, was only detected in one monitoring well during SRI activities and was not subsequently detected in 2006 (CH2M HILL, 2006a). Exposure to site groundwater by future residents, construction workers, and industrial workers may pose an unacceptable risk due to VOCs in groundwater based on RME and CTE calculations. COCs identified in the ROD for Site 11 are:

- 1,1,1-TCA
- 1,1,2-TCA
- 1,1-dichloroethane (1,1-DCA)
- 1,1-DCE
- 1,2-DCA
- 1,2-dichloropropane
- carbon tetrachloride
- chloroform
- methylene chloride
- TCE
- vinyl chloride
- cis-1,2-DCE
- trans-1,2-DCE

An investigation was conducted to assess whether concentrations of VOCs in groundwater could result in unacceptable vapor intrusion risks to inhabitants occupying Building 3602 (School of Music). A building inspection was conducted and groundwater samples were collected from the first two feet of the surficial aquifer. In addition a water sample was collected from the basement sump. Data results and site specific building characteristics were incorporated into the Johnson & Ettinger (J&E) model to develop site-specific screening levels. Based upon the results of the investigation, it was concluded there are limited pathways for vapor intrusion into Building 3602. The primary potential route for vapor intrusion was identified as the basement mechanical room; however, the remaining building was positively pressurized relative to the basement. Therefore, the potential for vapor intrusion was concluded to be minimal. In addition, the results of the J&E model suggested that, even in the event building conditions promote vapor intrusion, concentrations of VOCs in groundwater are unlikely to present risk to human health due to vapor intrusion. Therefore, based upon the methodology used to assess risk at the time the ROD was signed, NFA to assess the potential for vapor intrusion into Building 3602 was warranted.

Ecological Risk

A SERA completed for Site 11 concluded potential ecological risks at Site 11 are negligible based on the lack of complete and significant exposure pathways. The former neutralization tank and associated piping were located below the ground surface and were removed in 1996; therefore, surface soils were not affected by the source. There is no groundwater discharge at Site 11 and no surface water or sediment associated with the site.

4.4.2 Initial Response

Site 11 was initially identified in the IAS (RGH, 1984). A DD for removal of the neutralization tank, piping, and surrounding soil was finalized in November 1994 (FWES, 1994a) and the remedial action was completed in 1996 (ITC, 1996). A pilot study was conducted in 2002 to evaluate the *in situ* treatment of VOCs in groundwater through the injection and extraction of a CD solution. Approximately 32.5 kilograms (kg) of TCE and 1,1,1-TCA and 3 kg of 1,1,-DCE were removed as a result of the pilot study (Boving et al., 2003). Additionally, groundwater samples collected following the pilot study indicated degradation of parent VOCs (TCE and tetrachloroethylene [PCE]) had occurred (CH2M HILL, 2003c). Although the CD treatment system was able to desorb and extract contaminants, this approach was not evaluated in the Feasibility Study as a potential final remedy for the site due to both the impact of the treatment system on site use and the associated operations and maintenance required to maintain system performance.

4.4.3 Basis for Remedial Action

Based on the results of previous investigations and actions conducted to date, further remedial action is warranted to protect public health, welfare, and the environment from actual or threatened releases of VOCs in shallow groundwater at Site 11.

4.5 Remedial Actions

4.5.1 Remedy Selection

A ROD for Site 11 was signed in July 2007 (DON, 2007a). This report summarized the risks to human health, established RAOs, and defined the selected remedy. The selected remedy for Site 11 was defined as groundwater treatment through enhanced reductive dechlorination (ERD) and LUCs to meet the following RAOs:

- Prevent exposure to Site 11 groundwater until concentrations of VOCs have been reduced to levels that allow for unlimited use and unrestricted exposure.
- Reduce concentrations of VOCs in Site 11 groundwater to cleanup levels identified in [Table 4-1](#) to the maximum extent practicable within a reasonable amount of time.

The following LUC objectives for Site 11 were selected in the ROD:

- Prohibit the withdrawal of groundwater except for environmental monitoring and testing
- Prohibit the use of the site for residential, child care, elementary or secondary school, or playground facilities

- Maintain the integrity of any current or future remedial or monitoring system

LUC restrictions will be implemented in accordance with the LUC RD. The LUCs shall be maintained on all land and groundwater within the boundaries of Site 11 until the concentrations of VOCs in the groundwater have been reduced to levels that allow for unlimited use and unrestricted exposure. Groundwater performance monitoring and reporting will be completed to assess the progress of the remedy over time.

4.5.2 Remedy Implementation

In advance of remedy implementation, leaking sanitary sewer lines in the vicinity of Site 11 were repaired in October 2007. The draft RAWP (JV I, 2008b) was submitted for regulatory review in June 2008 outlining the plan for implementation of the groundwater remedy (Figure 4-2). Groundwater samples were collected in September 2008 from existing monitoring wells and discrete locations using direct push technology to refine the injection well network. Construction of the injection well network and injection of the ERD substrate began in January 2009 and is scheduled to be completed in March 2009.

A report will be issued following installation of the groundwater remediation system and execution of the LUC RD. Performance monitoring will be conducted for 1 year following installation of the system to assess the effectiveness of the design. Data technical memoranda will be generated presenting data tables and figures for each of the 1-, 3-, 6-, 9-, and 12-month sampling events. In addition, the technical memorandum for the 12-month event will include an annual evaluation of the remedy performance. Groundwater monitoring will continue past 1 year until RAOs are achieved.

4.6 Five Year Review Process

4.6.1 Site Inspections

The Navy has conducted Quarterly Environmental Restoration (ER) site inspections since September 2005 to ensure protectiveness of human health and the environment from potential exposure to VOCs in groundwater. Although the LUC RD has not been finalized, the ER quarterly inspection results were provided to the USEPA and VDEQ beginning in July 2008. Since the initiation of the inspections, only minor corrective measures, such as monitoring well lock and cap replacements, have been necessary.

In September 2008, the Navy, USEPA, and VDEQ conducted a site inspection in support of the Five-Year Review. Inspection results are provided in Appendix A. During the inspection, it was noted monitoring well LS11-MW12D was not present on the ground surface as depicted on Appendix A, Figure A-2. Additionally, an unidentified monitoring well was present along Gator Boulevard, north of LS11-MW19Y. Recommendations were made to replace the missing monitoring well and have the unidentified well surveyed for inclusion in the inspection program. It was also recommended all monitoring wells be labeled from the outside.

4.6.2 Site Interviews

Site Interviews were conducted on October 6, 2008 with Al Gregg of NAB Little Creek Base Environmental and Richard Howard of NAB Little Creek Base Planning. Interview summaries are provided in [Appendix B](#).

4.6.3 Performance Monitoring Data Summary

Remedy construction began in January 2009 and is expected to be completed in March 2009; therefore, no performance monitoring data has been collected to date. All data collected during remedy implementation will be included in the next Five-Year Review for NAB Little Creek.

4.7 Technical Assessment

Question A: Is the remedy functioning as intended by the decision document?

Remedial Action Performance: Based on the review of documents, ARARs, risk assumptions, and ER site inspection findings, the Site 11 LUCs currently in place are adequately restricting land use and exposure to groundwater as intended by the ROD. Although groundwater treatment has not been implemented at Site 11, a review of the Site 12 remedy performance (Section 5) provides no evidence to expect the Site 11 remedy will not be successful.

Implementation of LUCs: Although the LUC RD has not been fully implemented through documentation in an I-RACR, quarterly ER site inspections have ensured exposure to VOCs in groundwater is prevented.

Performance Monitoring Activities: Performance monitoring activities will begin following remedy construction scheduled for February 2009.

Opportunities for Optimization: Currently, remedy optimization is not suggested.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

Changes in Exposure Pathways: No new contaminants, sources, or routes of exposure have been identified as part of this 5-year review. Groundwater flow direction has changed from southeast to south as a result of the sewer repair conducted in 2007. Prior to finalization of the remedy design, groundwater flow direction will be evaluated in conjunction with baseline sampling. To maintain the protectiveness of the remedy, the remedy design will be adjusted as necessary.

Changes in Toxicity and Other Contaminant Characteristics: Although there have been some changes in toxicity values, regulatory levels, and risk characteristics of some Site 11 contaminants, these changes would not adversely affect the protectiveness of the selected remedy as it would not substantially change the results of the risk assessment or the classes of chemicals identified as COCs. The remediation goals for all except two of the COCs (1,1-DCA and chloroform) are the federal MCLs, which have not changed since the ROD was signed. The toxicity values for 1,1-DCA and chloroform have not been updated since the remediation goals were developed, and therefore, remediation goals for these chemicals

would not change based on toxicity changes. Additionally, any changes in toxicity would not affect the successful implementation of the LUCs.

Changes in Risk Assessment Methodologies: Although there have been some procedural changes to how human health risk assessments are conducted, including how exposure point concentrations are calculated, none of these changes adversely affect the protectiveness of the selected remedy or remediation goals for Site 11. The vapor intrusion pathway was evaluated at Site 11 in 2005 using building characteristics, shallow groundwater concentrations, and the J&E Model. The Navy is currently working with USEPA and VDEQ to modify the vapor intrusion risk assessment process. This modification will impact NAB Little Creek sites, including Site 11, where the vapor intrusion pathway has been assessed. Following resolution of risk assessment methodology, the potential for vapor intrusion at Site 11 will be re-evaluated as necessary.

Question C: Has any other information come to light that could question the protectiveness of the remedy?

No new information has come to light that would question the protectiveness of the remedy.

4.8 Site 11 Issues, Associated Recommendations, and Follow Up Actions

Issues that have been identified for Site 11 based on this five-year review are as follows:

Issue	Recommendations/ Follow-Up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness? (Y/N)	
					Current	Future
Changes to the methodology for evaluating the potential for vapor intrusion risk.	Following resolution of risk evaluation methodology, re-evaluation of the potential for vapor intrusion risk at Site 11 is recommended.	Navy	State/ USEPA	Oct. 2009	N	Y
LUC RD is not fully implemented.	Implement LUCs in accordance with the LUC RD and document in the I-RACR for the Site.	Navy	State/ USEPA	July 2010	N	Y
Site monitoring wells are not clearly labeled outside the casing.	Apply permanent identification to all well casings.	Navy	State/ USEPA	Sept. 2013	N	N

4.9 Protectiveness Summary

The remedy has not been implemented at Site 11; however, it is expected to be protective of human health and environment. In the interim, exposure pathways that could result in unacceptable risk are controlled through quarterly ER site inspections. Remedy construction

began in January 2009 and is expected to be completed in March 2009. Full implementation of the LUCs and the groundwater LTM plan will be documented in the I-RACR. Based upon a review of the Site 12 remedy performance (Section 5), there is no evidence at this time to expect the Site 11 remedy will not be successful. Further evaluation of the vapor intrusion pathway is recommended following resolution of risk evaluation methodology.

4.10 Next Review

The next Five-Year Review for Site 11 will be in 2013.

Table 4-1
Cleanup Levels for Chemicals of Concern
Site 11
Five Year Review
NAB Little Creek
Virginia Beach, Virginia

Chemical of Concern	Cleanup Level* (µg/L)
1,1,1-Trichloroethane	200
1,1,2-Trichloroethane	5
1,1-Dichloroethane	2900**
1,1-Dichloroethene	7
1,2-Dichloroethane	5
1,2-Dichloropropane	5
Carbon tetrachloride	5
Chloroform	9.6*
Methylene chloride	5
Trichloroethene	5
Vinyl chloride	2
cis-1,2-Dichloroethene	70
trans-1,2-Dichloroethene	100

*Clean-up levels are Maximum Contaminant Levels (MCLs).

** No MCL exists. Risk-based cleanup level was calculated.



Legend

 LUC Boundary

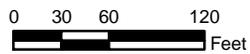


Figure 4-1
Site 11 Layout
2008 Five - Year Review
NAB Little Creek
Virginia Beach, Virginia



Legend

- ⊗ Monitoring Well
- Former Neutralization Tank
- LUC Boundary

- Groundwater Contour
- - - Groundwater Contour (Inferred)

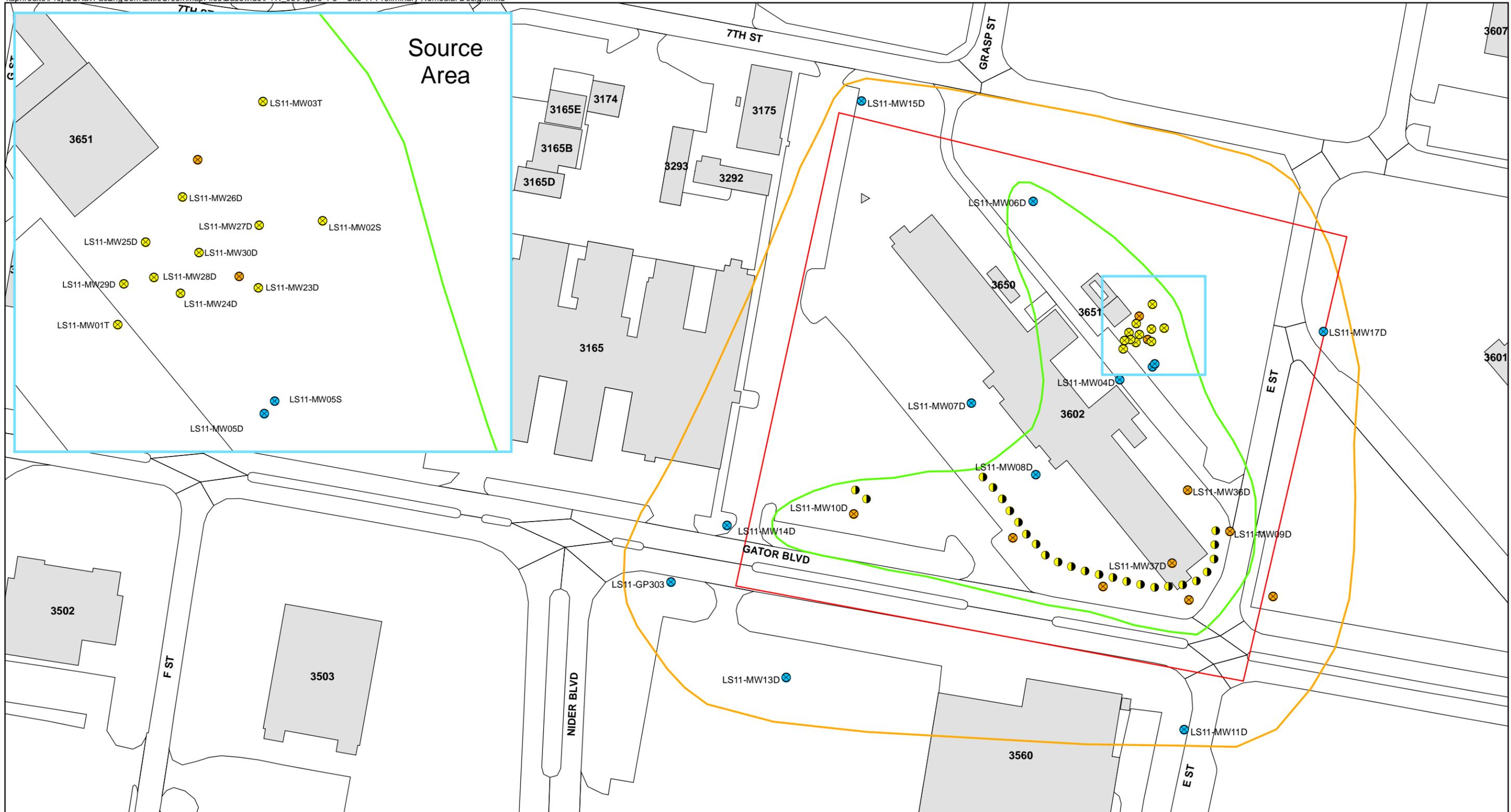
- Total VOC Concentration (µg/L)**
- 1 - 100
 - 100 - 1,000
 - 1,000 - 100,000
 - 100,000 +

→ Groundwater Flow Direction (January 2008)

Note: Groundwater VOC Plume is based on 2005 groundwater data.



Figure 4-2
Site 11 VOC Plume
2008 Five - Year Review
NAB Little Creek
Virginia Beach, Virginia



- Legend**
- VOC Plume Treatment Area
 - LUC Boundary
 - Area of Investigation
 - Buildings
 - Road
 - ⊗ Existing CD Injection Well Proposed As ERD Injection Well
 - Proposed ERD Injection Well

- Proposed Performance Monitoring Wells (Baseline, 1,3,6,9, and 12-Months)**
- ⊗ Monitoring Well
- Proposed Annual Monitoring Wells (Baseline & 12-Months)**
- ⊗ Monitoring Well

Proposed Injection and Sampling locations are based on current knowledge of the site. Locations will be finalized based on pre-construction and baseline monitoring well data.

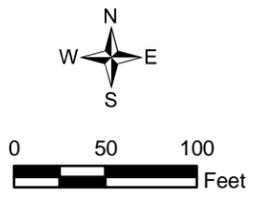


Figure 4-3
 Site 11 Preliminary Remedial Design
 2008 Five - Year Review
 NAB Little Creek
 Virginia Beach, Virginia

SECTION 5

Site 12—Former Exchange Laundry/Dry Cleaning Facility

5.1 Site Chronology

Date	Investigation
Dec. 1984	IAS
Oct. 1986	RVS
Mar. 1989	RFA
Aug. 1990	Environmental Assessment Phase I
April 1991	Environmental Assessment Phase II
June 1992	Site Closeout Report
Nov. 1994	RI/FS for Sites 7 and 9-13
May 1999	NAB Little Creek on NPL
June 2000	Screening Ecological Risk Assessment
Dec. 2000	SRI
Mar. 2003	BERA
Mar. 2004	FS
Sept. 2004	Revised FS
June 2005	Proposed Plan
Sept. 2005	ROD
Oct. 2005	Initiated Quarterly Site Inspections
Oct. 2006	Explanation of Significant Difference (ESD)
Feb. 2007	RAWP
Oct. 2008	Remedial Action Construction Completion Report
Oct. 2008	ERD Annual Groundwater Monitoring Summary

5.2 Site Background

5.2.1 Site 12 Description and History

Site 12 is located in the eastern portion of the base, near the intersection of Amphibious Drive and B Streets ([Figure 5-1](#)). The commissary (Building 3445), its associated parking lot, a self-serve car wash (Building 3528), and a drainage canal are located within the site

boundary. Site 12 consisted of the Exchange Laundry/Dry Cleaning Facility (former Building 3323), which operated from 1973 until 1987, and a catch basin located to the northeast. During operation, an estimated 1,320 gallons of waste, including chlorinated VOCs, soap, sizing, and dyes associated with dry cleaning activities were disposed in the catch basin (RGH, 1984). In 1987, Building 3323 was demolished and the catch basin and a major portion of the attached storm water line were removed in preparation for construction of the existing commissary (Building 3445).

Solvents such as PCE have historically been associated with dry cleaning operations and samples collected at the site indicated chlorinated VOCs are present in groundwater.

The ground surface in the vicinity of Site 12 is generally level, approximately 11 ft above msl, and includes asphalt parking lots, a landscaped lawn west of the commissary, and a drainage canal running north to south. The drainage canal is a relatively steep-banked linear drainage canal with a thick growth of vegetation at the top of the bank. The majority of precipitation is lost through infiltration or evaporation; however, some stormwater runoff is collected by the stormwater sewer system and is subsequently discharged into the drainage canal.

5.2.2 Site 12 Geology and Hydrogeology

The surface geology at Site 12 consists of the 19 to 24 ft thick Columbia Formation, which contains the 13 to 18 ft thick unconfined Columbia Aquifer. The Columbia Formation overlies the 30 to 40 ft thick Yorktown Confining Unit. The Yorktown Confining Unit is continuous across the site and impedes the downward migration of Columbia Aquifer groundwater to the deeper Yorktown Aquifer. Depth to shallow groundwater at Site 12 varies seasonally from 6 to 8 ft bgs. Formerly, local groundwater flow was influenced by a leaking sanitary sewer line on the west side of the site, and generally flowed west. The sewer survey conducted in 2006 as part of site preparation for the remedial action revealed the sewer line had been repaired, and the Public Works Center confirmed sanitary sewer repairs at Site 12 were completed in 2005. The average hydraulic conductivity in the Columbia Aquifer has been calculated to be 110 feet per day (ft/day) (CH2M HILL, 2002) and post-sewer repair groundwater flow velocity at Site 12 has been calculated to range from 0.61 to approximately 4.4 ft/day. Groundwater in the Yorktown Aquifer beneath the site flows north and discharges into the Chesapeake Bay.

5.3 Land and Resource Use

Site 12 was historically used for Navy Exchange dry cleaning services. Currently, Site 12 consists of the Base commissary, its associated parking lot, and a self service car wash. Enlisted quarters, industrial activities, and administrative offices surround the site. A large drainage canal is located to the west of the site; the water level in the canal is controlled by a weir at Little Creek Cove that prevents the tides in the cove from backing up into Lake Bradford. During most times of the year, except during heavy rains, the canal is stagnant with no perceptible flow. With the exception of the drainage canal, there are no additional surface water bodies within the boundary of Site 12.

There are no potable groundwater supply wells located within the boundary of Site 12. Non-potable groundwater supply wells located on the Little Creek Golf Course, withdraw

groundwater from the Yorktown Aquifer for irrigation and storage pond maintenance. Site 12 is located approximately 4,500 ft southeast of the golf course ponds and approximately 5,000 ft south of the Chesapeake Bay.

LUCs, though not fully implemented through documentation in an I-RACR, are currently maintained at Site 12 through quarterly inspections. The LUCs restrict land use and exposure to shallow groundwater until concentrations of VOCs are reduced to levels that allow for unlimited use and unrestricted exposure.

5.4 History of Contamination

Surface/subsurface soil, groundwater, sediment, and surface water samples were collected during previous investigation activities for analysis of VOCs, SVOCs, pesticides, PCBs, metals, TPH, cyanide, and/or geochemical/monitored natural attenuation parameters (TOC, TOD, alkalinity, chloride, nitrate, sulfide, and sulfate). Soil and sediment analytical results were screened against residential soil RBCs. Groundwater analytical results were screened against MCLs, Virginia Groundwater Standards, and residential tap water RBCs. Surface water analytical results were screened against residential tap-water RBCs and Virginia Water Quality Human Health Standards.

VOCs, SVOCs, pesticides, and metals were detected in surface and/or soil during the 1993 RI (FWES, 1994b) and 1995 Phase I /1999 Phase II SRI (CH2M HILL, 2000b). VOCs, SVOCs, pesticides were not detected above screening criteria. Arsenic was detected above the residential RBC; however, detected concentrations were below the background UTL.

Sediment and surface water samples were collected during the 1993 RI and 1995 Phase I/1999 Phase II SRI; however, following the Phase II sampling, the western drainage canal was dredged. Additional sediment and surface water sampling was conducted in 2001 to evaluate post-dredge conditions. During this sampling, VOCs, SVOCs, and metals were detected in sediment, and VOCs and metals were detected in surface water. Detected concentrations in both media were below screening criteria.

SVOCs, pesticides, and metals were detected in Columbia Aquifer groundwater. Detected concentrations of SVOCs and pesticides were below screening criteria. However, detected concentrations of several total and dissolved metals and VOCs exceeded screening criteria. At the time the ROD was signed (August 2005), the Columbia Aquifer groundwater VOC contamination was known to cover an estimated 1.5 acres underlying the commissary parking lot and car wash ([Figure 5-2](#)). VOCs concentrations are highest near the northwest corner of the former dry cleaning facility. The vertical extent of VOCs in groundwater is about 20 ft to the clay confining unit. Results of a membrane interface probe (MIP) investigation and discrete groundwater sampling of multi-level samplers show that there is contaminant mass near the top and bottom of the aquifer, with a smaller amount of contaminant mass in the intermediate aquifer depths. Concentrations of VOCs are highest near the bottom of the aquifer (14–19 ft below ground surface) in the source zone areas. The detection of PCE daughter products of PCE (DCE to methane) confirms active microbial areas in the shallow aquifer. No chlorinated VOCs were detected in samples collected from the Yorktown Aquifer.

5.4.1 Site Risks

An HHRA was conducted as part of the 2000 SRI to evaluate the risks to human health from exposure to soil, groundwater, surface water, and sediment (CH2M HILL, 2000b). A SERA was completed to evaluate potential exposure pathways for ecological receptors (CH2M HILL, 2000a) and a BERA was completed to re-evaluate potential ecological risks following the 1999 canal dredging action (CH2M HILL, 2003a). The summary of site risks presented in the subsections below was documented in the ROD (DON, 2005c).

Human Health Risk

No cancer risks or non-cancer hazards associated with exposure to sediment and surface water were identified. No cancer risks associated with exposure to site soil were identified. Exposure to site soil by the hypothetical future child resident may present a non-cancer hazard above USEPA's target level of 1 based on RME calculations due to exposure to chromium in soil at Site 12; however, CTE non-cancer hazards were below USEPA's target level of 1. Future potable use of groundwater by adult and child residents may present non-cancer hazards above USEPA's target level of 1 based on RME calculations. Potential unacceptable target organ effects (i.e., hazard index [HI] greater than 1) were identified for future adult and child residents due to PCE, TCE, 1,2-DCE, iron, and manganese. Iron and manganese are present in groundwater at concentrations similar to background and are not associated with dry cleaning activities. Future potable use of groundwater by a lifetime resident may present cancer risks above USEPA's target risk range (10^{-4} to 10^{-6}) due to PCE and vinyl chloride. COCs identified in the ROD for Site 12 are:

- PCE
- TCE
- cis-1,2-DCE
- vinyl chloride

Prior to construction of the new commissary in 1995, a site characterization study was completed. Soil gas samples were collected for analysis of VOCs to evaluate potential vapor intrusion pathways prior to the construction of the Commissary. Per recommendation of the study, a passive subsurface venting system was installed under the commissary floor to prevent the possibility of vapor migration into the new building. Therefore, vapor intrusion evaluation was not warranted at Site 12.

Ecological Risk

The SERA concluded the developed nature of the site (buildings and pavement) limited the available habitat, and reduced the potential for exposure by ecological receptors. The BERA focused solely on the assessment of potential risks associated with sediment and surface water in the drainage canal following dredging in 1999. Results of the BERA indicated concentrations of cadmium, copper, lead, selenium, and butylbenzylphthalate in sediment were above ecological screening values; however, due to the limited habitat contained in the canal potential ecological risks were low. Additionally, there were no food web exposures identified based on mean concentrations. The potential ecological risks are expected to be negligible; therefore, the Navy, in partnership with the USEPA and VDEQ, agreed no action was necessary to protect ecological receptors at the site.

5.4.2 Initial Response

Site 12 was initially identified in the IAS (Rogers et al., 1984). Prior to signature of the ROD, no actions had been conducted at the site.

5.4.3 Basis for Remedial Action

Based on the results of previous investigations, remedial action is warranted to protect public health, welfare, and the environment from actual or threatened releases of VOCs in shallow groundwater from Site 12.

5.5 Remedial Actions

5.5.1 Remedy Selection

A ROD for Site 12 was signed in August 2005 (DON, 2005c). This report summarized the risks to human health, established RAOs, and defined the selected remedy. The ROD concluded NFA was necessary for soil, sediment, and surface water and identified the selected remedy for Site 12 as *in situ* chemical oxidation (ISCO)/ERD, groundwater monitoring, and LUCs to meet the following RAOs:

- Prevent unacceptable risk to human health and the environment from exposure to chlorinated VOCs in groundwater
- Reduce chlorinated VOC concentrations in groundwater to the maximum contaminant levels ([Table 5-1](#)) by applying best available technologies

Based on site conditions, sodium permanganate was selected as the most appropriate oxidant for use in implementing ISCO. However, during the design phase it was determined the significant permanganate loading requirement necessary would increase the oxidation reduction potential and decrease pH of the aquifer. This would result in the mobilization of naturally occurring metals sorbed to the saturated soil. Additionally, metals impurities naturally occurring in sodium permanganate would further increase the potential for elevated metals in groundwater. Consequently, use of the calculated dose of sodium permanganate necessary for Site 12 may have resulted in metals concentrations in groundwater exceeding their respective MCL values. Therefore, the Navy, in partnership with the USEPA and VDEQ, determined the accelerated mass reduction in the source zone associated with implementing the chemical oxidation component and metals monitoring of the Selected Remedy does not outweigh the risk in increased metals concentrations in groundwater exceeding MCLs, and the use of ERD alone would achieve the RAOs outlined in the ROD (DON, 2005c). An ESD (CH2M HILL, 2006b) was signed in October 2006 to eliminate the ISCO component and use only ERD, groundwater monitoring, and LUCs as the Selected Remedy.

The following LUC objectives were selected in the ESD:

- Prohibit the withdrawal of groundwater except for environmental monitoring and testing
- Prohibit the use of the site for residential, child care, elementary or secondary school, or playground facilities
- Maintain the integrity of any current or future remedial or monitoring system

LUC restrictions will be implemented in accordance with the LUC RD. The LUCs shall be maintained on all land and groundwater within the boundaries of Site 12 until the concentrations of VOCs in the groundwater have been reduced to levels that allow for unlimited use and unrestricted exposure. Groundwater performance monitoring and reporting will be completed to assess the progress of the remedy over time.

5.5.2 Remedy Implementation

The RAWP for the implementation of the remedy was finalized in February 2007 (JV I, 2007a). The implementation of the remedy included installation of 53 injection wells and 15 monitoring wells (Figure 5-3). Following installation, baseline samples were collected from each of the newly installed monitoring wells. This data was used in conjunction with data collected from monitoring wells in May, June, and October 2005 to document the condition of the aquifer before the in situ treatment was initiated. During the 2007 baseline sampling event, PCE and TCE were detected in samples collected from the western most monitoring well pair (MW28S/D) above their respective MCLs. To verify VOCs were not migrating west or southwest following repair of the leaking sanitary sewer line, DPT grab groundwater samples were collected (Figure 5-3). The DPT analytical data confirmed the plume had been adequately delineated and the Remedial Design detailed in the RAWP (JV I, 2007a) provided appropriate treatment of site VOCs. To monitor potential VOC migration toward the creek, a shallow (MW36S) and a deep (MW36D) monitoring well were installed west of monitoring well pair MW28S/D (JV I, 2007b).

Once the wells were installed and the baseline sampling was completed, approximately 4,700 gallons of injectate solution (emulsified electron donor product [EOS®], sodium bicarbonate, vitamin B-12, and water) was applied to each of the injection wells to enhance the naturally-occurring, microbially-mediated, anaerobic degradation of COCs. (JV I, 2008a). Groundwater samples were collected from designated monitoring wells 1, 3, 6, 9, and 12-months following injection to evaluate the adequacy of the injection system and the overall effectiveness of the treatment. The final round of post-injection monitoring (12 months) was completed in May 2008. The draft ERD Groundwater Monitoring Summary was submitted for regulatory review in October 2008.

5.6 Five Year Review Process

5.6.1 Site Inspections

The Navy has conducted Quarterly ER site inspections since September 2005 to ensure protectiveness of human health and the environment from potential exposure to VOCs in groundwater. Although the LUC RD has not been finalized, the ER quarterly inspection results were provided to the USEPA and VDEQ beginning in July 2008. Since the initiation

of the inspections, only minor corrective measures, such as monitoring well lock and cap replacements, have been necessary.

In September 2008, the Navy, USEPA, and VDEQ conducted a site inspection in support of the Five-Year Review. Inspection results are provided in [Appendix A](#). During the inspection, it was noted some flanges are missing from monitoring wells in high traffic areas. Additionally, it was noted monitoring well casings are not clearly labeled to facilitate the identification of monitoring wells without opening.

5.6.2 Site Interviews

Site Interviews were conducted on October 6, 2008 with Al Gregg of NAB Little Creek Base Environmental and Richard Howard of NAB Little Creek Base Planning. Interview summaries are provided in [Appendix B](#).

5.6.3 Performance Monitoring Data Summary

Baseline sampling was conducted in May, June, and October 2005 and February 2007 to document the pre-treatment conditions of the site. To evaluate the remedy, groundwater samples were collected 1 (May 2007), 3 (August 2007), 6 (November 2007), 9 (February 2008), and 12-months (May 2008) following injection. Sampling locations are depicted on [Figure 5-3](#) and chemicals analyzed during each round are presented in [Table 5-2](#). The analytical results were evaluated in the draft ERD Groundwater Monitoring Summary to document system performance and the overall effectiveness of the injection (CH2M HILL, 2008c).

To evaluate the adequacy of the injection system, field and geochemical data were reviewed to ensure suitable anaerobic conditions were achieved, pH was maintained, and TOC levels were indicative of adequate substrate distribution. Oxidation-reduction potential (ORP) and dissolved oxygen (DO) concentrations decreased after substrate injections and DO was not detected in samples collected from performance monitoring wells by the annual sampling event. Ferrous iron and sulfide concentrations were generally greater than 1 mg/L and sulfate concentrations were generally less than 20 mg/L. These data suggest adequate reducing conditions were achieved following the application of substrate. The pH values (pH of 5 to 9) remained within the optimal range for dechlorinating microbes. Additionally, an increase in TOC concentrations in all performance monitoring wells indicates successful substrate delivery in the target treatment zones.

[Figures 5-4](#) and [5-5](#) provide COC concentrations per sampling event and [Figures 5-6](#) and [5-7](#) depict the overall distribution of COCs during the baseline and annual sampling events, respectively. The assessment of the overall effectiveness of the ERD remediation is based on changes in plume configuration, plume containment, and the concentrations of COCs remaining in groundwater at the site. Based on the COC concentrations detected in the site perimeter wells, after 1 year of treatment, the aerial extent of the plume is similar to the pre-injection aerial extent. With the exception of the northern (MW07T) and western (MW36D) boundaries, MCL exceedances were not detected in plume perimeter wells following treatment. Plume configuration will be continually evaluated during post-remedial action LTM to ensure plume migration is adequately monitored.

Overall, there has been a substantial decrease in the total concentration of the COCs, including a decrease in the parent COC PCE, detected in both the shallow and deep portions of the Columbia Aquifer. Although parent COC concentrations temporarily increased in some locations following the injection of substrate, the increase is believed to be attributed to the physical displacement of the COCs and temporary disturbance to the equilibrium of the aquifer during well installation and injection activities. Degradation of parent products has resulted in an increase in the concentration of daughter products, particularly cis-1,2-DCE; however, decreasing concentrations of daughter products was also observed. Concentrations of COCs in the downgradient portion of the groundwater plume appear to be greater in the deeper portion of the aquifer.

Although COC concentrations remain above the MCL, the presence of COC daughter products, detections of methane, and supporting field and geochemical parameters indicate the ERD approach at Site 12 was effective in achieving geochemical conditions to facilitate the reduction of PCE, TCE, cis-1,2-DCE and VC concentrations in groundwater at Site 12.

5.7 Technical Assessment

Question A: Is the remedy functioning as intended by the decision document?

Remedial Action Performance: Based on the review of documents, ARARs, risk assumptions, and ER site inspection findings, the Site 12 LUCs currently in place are adequately restricting land use and exposure to groundwater as intended by the ROD. Groundwater treatment was successfully implemented at Site 12, has been effective in achieving conditions for ERD, and has been effective in reducing the concentrations of VOCs in groundwater.

Implementation of LUCs: Although the LUC RD has not been fully implemented through documentation in an I-RACR, quarterly ER site inspections have ensured exposure to VOCs in groundwater is prevented.

Performance Monitoring Activities: Baseline sampling was completed prior to substrate injection in May, June, and October 2005 and February 2007; injections were completed in April 2007; and 1, 3, 6, 9, and 12-month post-injection sampling has been completed. A RA CCR was finalized in October 2008 and the Draft ERD Groundwater Monitoring Summary was submitted for regulatory review in October 2008. Additional injection of substrate to prolong the effectiveness of the remedy will be evaluated as part of effectiveness monitoring.

Opportunities for Optimization: Opportunities for optimization have not been recognized at this stage of remedy implementation.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

Changes in Exposure Pathways: No new contaminants or sources were identified as part of this five-year review. The hydrologic conditions changed upon the repair of the sewer system in 2005. The groundwater flow is now controlled by the drainage canal located along the western boundary of the site. Monitoring wells MW36S and MW36D were installed to monitor potential migration of VOCs to the drainage canal. During the annual sampling

event, the concentration of TCE (6.5J µg/L) slightly exceeded the MCL at monitoring well MW36D; however concentrations of chlorinated VOCs in groundwater are not reaching the canal in appreciable quantities (i.e., not in excess of groundwater PRGs in perimeter wells and not historically detected in canal surface water and sediment). VOCs concentrations in these monitoring wells will continue to be monitored for increases in concentrations that may potentially pose ecological risk to receptors in the drainage canal.

Changes in Toxicity and Other Contaminant Characteristics: Although there have been some changes in toxicity values, regulatory levels, and risk characteristics of some Site 12 contaminants, these changes would not adversely affect the protectiveness of the selected remedy as it would not substantially change the results of the risk assessment or the classes of chemicals identified as COCs. The remediation goals for all of the COCs are the federal MCLs, which have not changed since the ROD was signed. Additionally, any changes in toxicity would not affect the successful implementation of the LUCs.

Changes in Risk Assessment Methodologies: Although there have been some procedural changes to how human health risk assessments are conducted, including how exposure point concentrations are calculated, none of these changes adversely affect the protectiveness of the selected remedy or remediation goals for Site 12.

Question C: Has any other information come to light that could question the protectiveness of the remedy?

A passive vapor barrier system was installed during construction of the commissary to prevent vapor intrusion into the commissary. Prior to signature of the ROD, the vapor barrier system had not been inspected to ensure it was operating as designed. On June 12, 2007 an inspection of the vapor barrier system was conducted by the NAB Little Creek Partnering Team. The system is operating as designed and continues to be inspected as part of the quarterly ER site inspection.

5.8 Site 12 Issues, Associated Recommendations, and Follow Up Actions

Issues that have been identified for Site 12 based on this 5-year review are as follows:

Issue	Recommendations/ Follow-Up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness? (Y/N)	
					Current	Future
LUC RD is not fully implemented.	Implement LUCs in accordance with the LUC RD and document in the I-RACR for the Site.	Navy	State/ USEPA	March 2009	N	Y
Site monitoring wells are not clearly labeled outside the casing.	Apply permanent identification to all well casings.	Navy	State/ USEPA	Sept. 2013	N	N

5.9 Protectiveness Summary

The groundwater portion of the remedy for Site 12 has been implemented, is currently functioning as designed and is expected to be protective of human health and environment. In order for the remedy to be protective in the long-term, an I-RACR must be in place to document the implementation of the LUCs and the groundwater LTM plan. In the interim, exposure pathways that could result in unacceptable risk are controlled through quarterly ER site inspections. The remedy is successfully reducing concentrations of VOCs in groundwater, however, since VOC concentrations remain above their respective MCLs in some areas, additional action is warranted at Site 12. Additional injection of substrate to prolong the effectiveness of the remedy was conducted in January/February 2009. Continued monitoring of plume configuration and migration will be conducted through post-remedial action groundwater monitoring to ensure long-term effectiveness of the remedy.

5.10 Next Review

The next Five-Year Review for Site 12 will be in 2013.

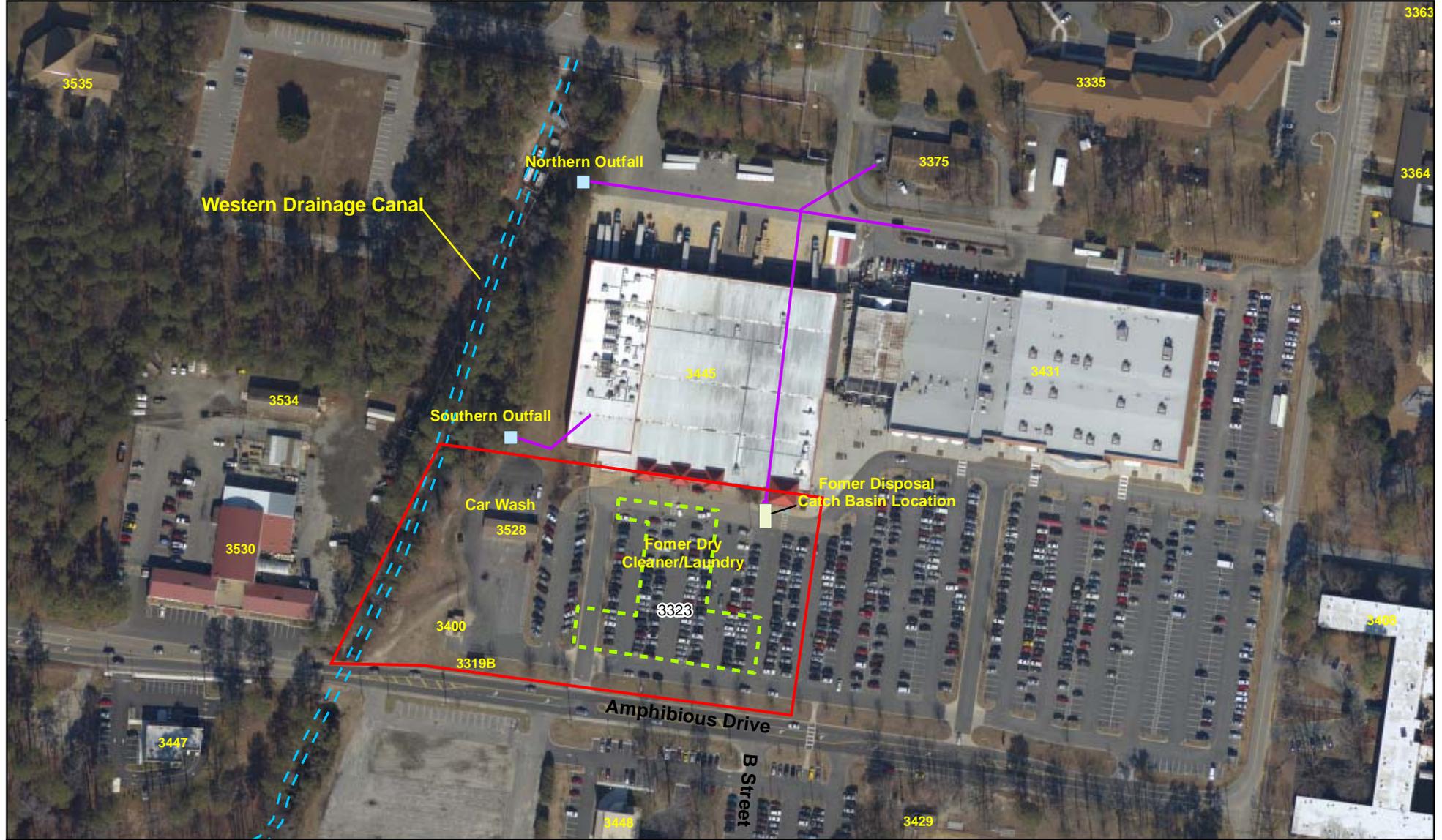
Table 5-1
Cleanup Levels for Chemicals of Concern
Site 12
Five Year Review
NAB Little Creek
Virginia Beach, Virginia

Chemical of Concern	Cleanup Level* (µg/L)
Tetrachloroethene	5
Trichloroethene	5
cis-1,2-Dichloroethene	70
Vinyl chloride	2

*Clean-up levels are Maximum Contaminant Levels (MCLs).

Table 5-2
Performance Monitoring Sampling Scheme
Site 12
Five Year Review
NAB Little Creek
Virginia Beach, Virginia

Sampling Dates	Monitoring Wells	Analytes											
		VOCs	TOC	VFAs	Methane, ethane, ethene	Dissolved iron	Dissolved manganese	Sulfate	Sulfide	Dissolved oxygen	Temperature, conductivity, turbidity, pH, ORP	Ferrous iron	Dissolved arsenic
Baseline 2005	LS12-MW01S, LS12-MW02S/D, LS12-MW24D, LS12-MW27S/D, LS12-MW06T, LS12-MW07T, LS12-MW09T, LS12-MW26T	x				x	x	x	x		x	x	x
Baseline 2007	LS12-MW01D, LS12-MW28S/D, LS12-MW29S/D, LS12-MW30S/D, LS12-MW31D, LS12-MW32S/D, LS12-MW33S/D, LS12-MW34S/D, LS12-MW35S	x	x		x	x	x	x	x	x	x	x	
1-month (May 2007)	LS12-MW02S/D, LS12-MW28S/D, LS12-MW30S/D, LS12-MW31D, LS12-MW32S/D, LS12-MW33S/D, LS12-MW34S/D, LS12-MW35S	x	x	x	x	x	x	x	x	x	x	x	
3-month (August 2007)	LS12-MW02S/D, LS12-MW28S/D, LS12-MW30S, LS12-MW31D, LS12-MW32S/D, LS12-MW33S/D, LS12-MW34S/D, LS12-MW35S, LS12-MW36S/D	x	x	x	x					x	x	x	
6-month (November 2007)	LS12-MW02S/D, LS12-MW28S/D, LS12-MW30S/D, LS12-MW31D, LS12-MW32S/D, LS12-MW33S/D, LS12-MW34S/D, LS12-MW35S, LS12-MW36S/D	x	x	x	x	x	x	x	x	x	x	x	
9-month (February 2008)	LS12-MW02S/D, LS12-MW28S/D, LS12-MW30S/D, LS12-MW31D, LS12-MW32S/D, LS12-MW33S/D, LS12-MW34S/D, LS12-MW35S, LS12-MW36S/D	x	x	x	x					x	x	x	
12-month (May 2008)	LS12-MW01S/D, LS12-MW02S/D, LS12-MW24D, LS12-MW27S/D, LS12-MW28S/D, LS12-MW29S/D, LS12-MW30S/D, LS12-MW31D, LS12-MW32S/D, LS12-MW33S/D, LS12-MW34S/D, LS12-MW35S, LS12-MW06T, LS12-MW07T, LS12-MW08T, LS12-MW09T, LS12-MW26T	x	x	x	x	x	x	x	x	x	x	x	x



Legend

-  LUC Boundary
-  Former Storm Water Line

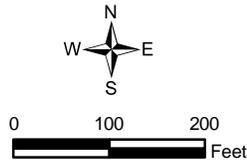


Figure 5-1
Site 12 Layout
2008 Five - Year Review
NAB Little Creek
Virginia Beach, Virginia

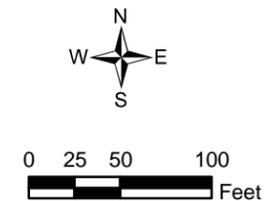
Note: Storm Sewer was removed during construction of the commissary (1987 - 1992).



- Legend**
- ⊗ Monitoring Well
 - Grounwater Contour (July 2001)
 - - - Inferred Groundwater Contour
 - Former Disposal Catch Basin Location
 - Former Dry Cleaner/Laundry
 - LUC Boundary**
 - Groundwater Flow (July 2001)

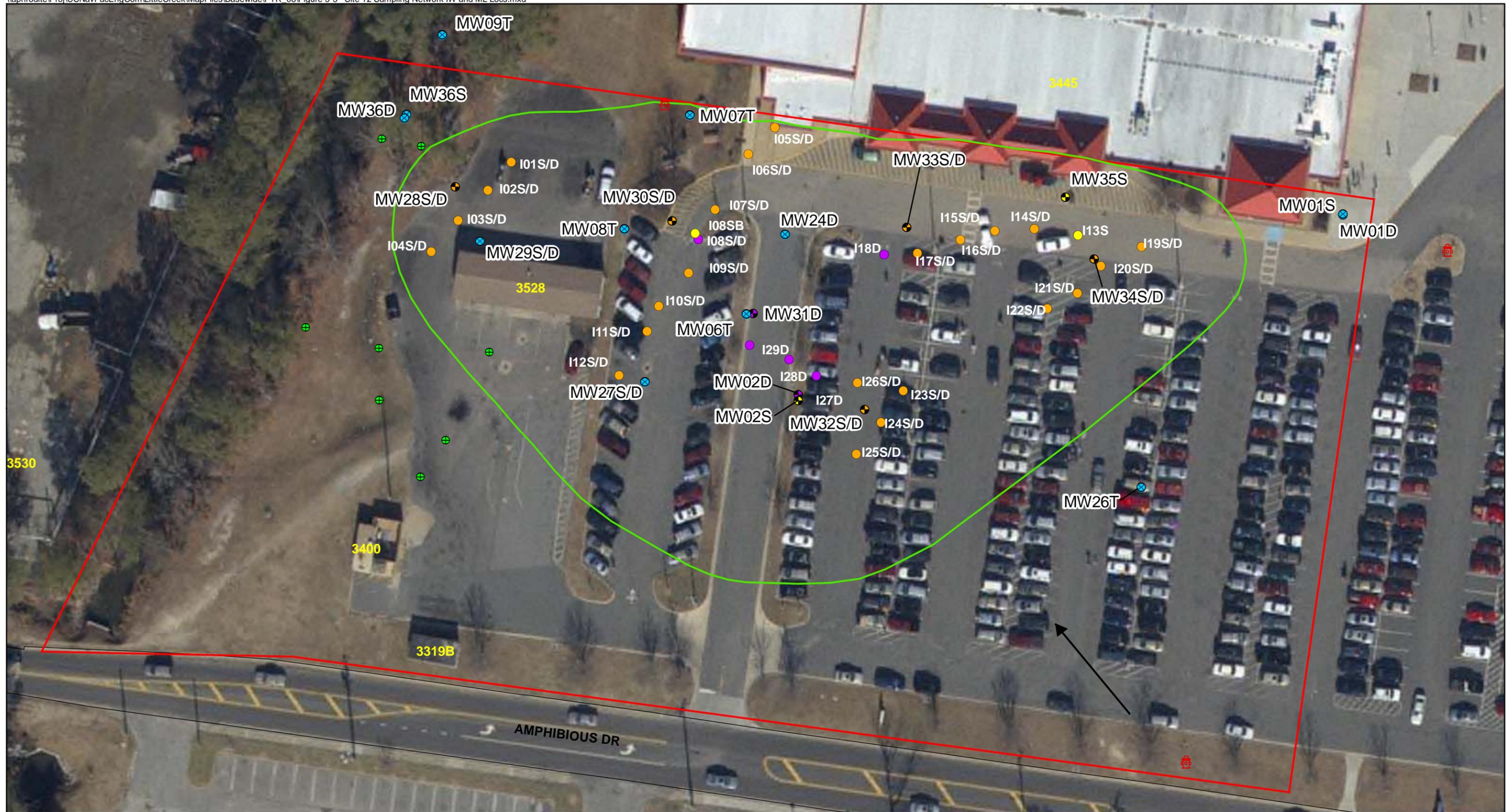
VOC Isoconcentration (as shown in August 2005 ROD)

- >1,000
- 100
- 5



Concentrations are in µg/L

Figure 5-2
 Site 12 VOC Plume
 2008 Five - Year Review
 NAB Little Creek,
 Virginia Beach, Virginia



- Legend**
- DTP Locations
 - ⛑ Fire Hydrants
 - ▭ Groundwater Plume Treatment Area
 - ▭ LUC Boundary
 - Annual Monitoring Wells**
(includes Performance Monitoring Wells)
 - Monitoring Wells

- Performance Monitoring Wells**
- Co-located
 - Deep
 - Shallow
- Injection Wells**
- Co-located
 - Deep
 - Shallow
- Groundwater Flow

MW36S and MW36D were sampled on the same frequency as performance monitoring wells.

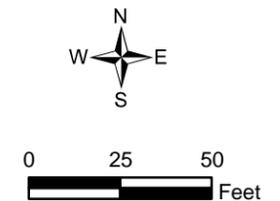
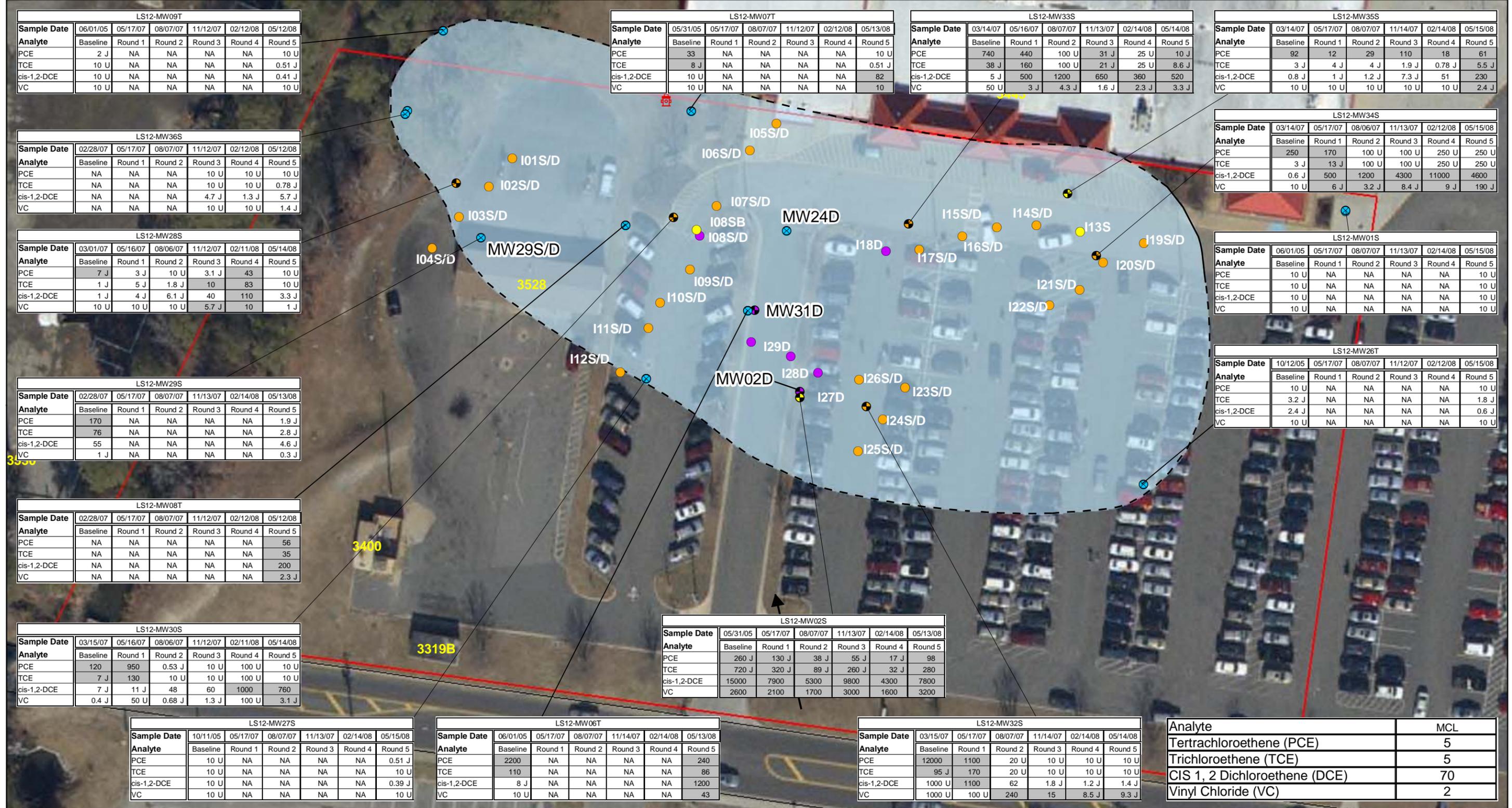


Figure 5-3
Site 12 Remedial Design
2008 Five - Year Review
NAB Little Creek
Virginia Beach, Virginia



Legend

- Shallow Isoconcentration
- - Shallow Isoconcentration (Inferred)
- Shallow Groundwater Plume (May 2008)
- LUC Boundary

Performance Monitoring Wells

- Co-located
- Deep
- Shallow

Injection Wells

- Co-located
- Deep
- Shallow

Annual Monitoring Wells (includes Performance Monitoring Wells)

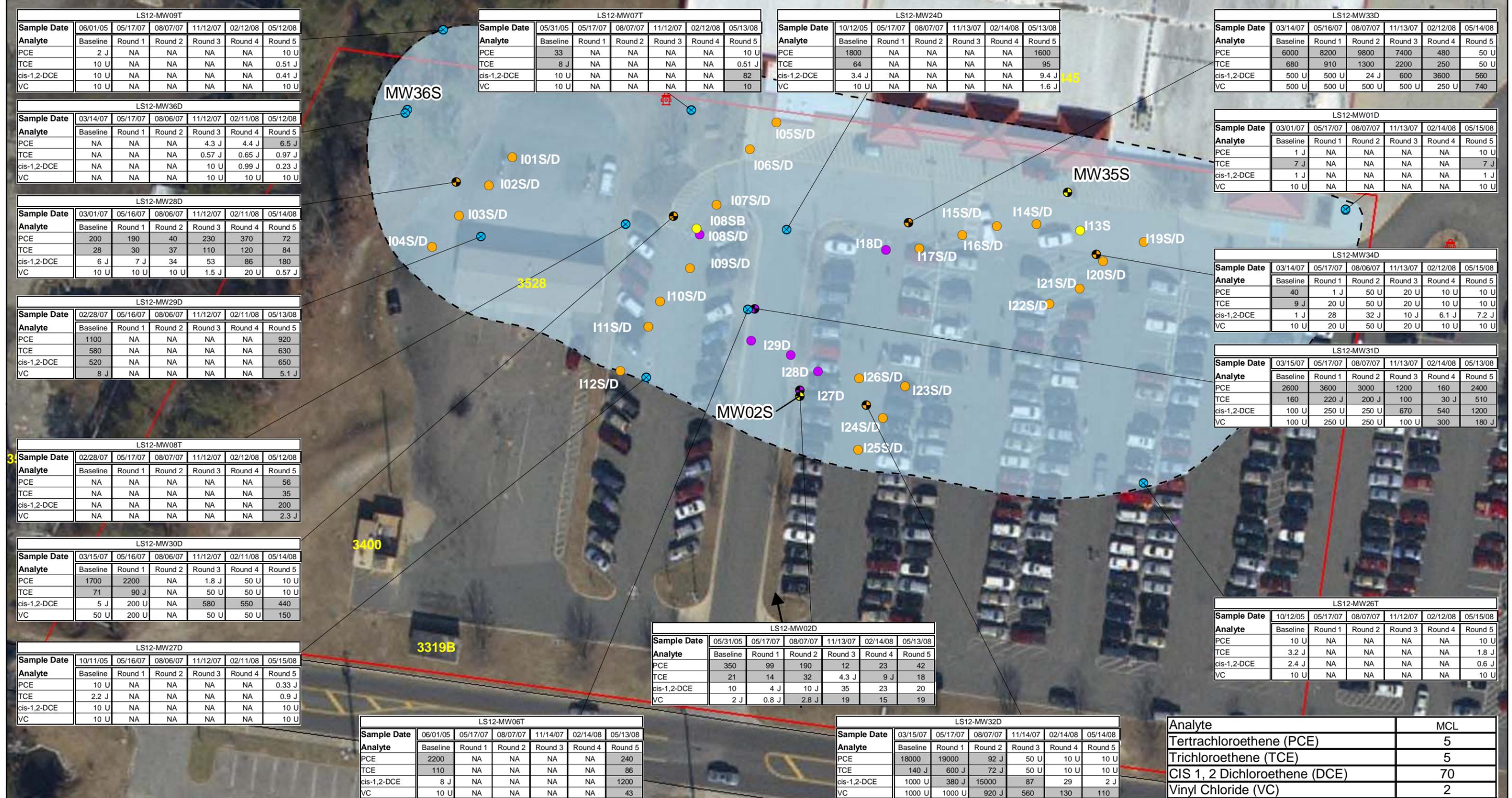
- Monitoring Wells

Notes:

- J - Analyte present, value may or may not be accurate or precise
- NA - Not Applicable, sample not collected
- U - The material was analyzed for, but not detected

Concentrations are in µg/L

Figure 5-4
Site 12 Analytical Results Shallow Wells
2008 Five - Year Review
NAB Little Creek
Virginia Beach, Virginia



Legend

- Deep Isoconcentration
- - Deep Isoconcentration (Inferred)
- Deep Groundwater Plume (May 2008)
- LUC Boundary

Performance Monitoring Wells

- Co-located
- Deep
- Shallow

Injection Wells

- Co-located
- Deep
- Shallow

→ Groundwater Flow

Annual Monitoring Wells (includes Performance Monitoring Wells)

- ⊗ Monitoring Wells

Notes:

- J - Analyte present, value may or may not be accurate or precise
- NA - Not Applicable, sample not collected
- U - The material was analyzed for, but not detected

Concentrations are in µg/L

Scale: 0, 25, 50 Feet

Figure 5-5
Site 12 Analytical Results Deep Wells
2008 Five - Year Review
NAB Little Creek
Virginia Beach, Virginia



Footnote:
 -Baseline sampling took place in May/June 2005 and February/March 2007
 -MW08T and MW36S were not included in baseline sampling

Legend

- LUC Boundary
- Annual Monitoring Wells**
(includes Performance Monitoring Wells)
- Monitoring Wells
- Baseline Isoconcentration**
- Baseline Isoconcentration (Inferred)
- Isoconcentrations (Baseline)**
- 1-10
- 10-100
- 100-1000
- >1000

Performance Monitoring Wells

- Co-located
- Deep
- Shallow

Injection Wells

- Co-located
- Deep
- Shallow

N
W —+— E
S

0 25 50
Feet

Concentrations are in µg/L

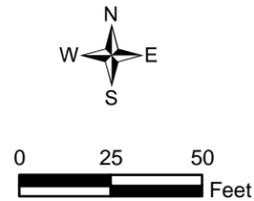
Figure 5-6
 Total COC Plume (Baseline)
 2008 Five - Year Review
 NAB Little Creek
 Virginia Beach, Virginia



Legend
 LUC Boundary
Annual Monitoring Wells
 (includes Performance Monitoring Wells)
● Monitoring Wells

— Annual Isoconcentration
 - - Annual Isoconcentration (Inferred)
Isoconcentrations (May 2008)
 1-10
 10-100
 100-1000
 >1000

Performance Monitoring Wells
● Co-located
● Deep
● Shallow
Injection Wells
● Co-located
● Deep
● Shallow



Concentrations are in µg/L

Figure 5-7
 Total COC Plume (Annual)
 2008 Five - Year Review
 NAB Little Creek
 Virginia Beach, Virginia

SECTION 6

Site 13—Former Public Works Pentachlorophenol Dip Tank and Wash Rack

6.1 Site Chronology

Date	Event
1982	Dip tank and associated drying racks dismantled
Dec. 1984	IAS
Oct. 1986	RVS
Mar. 1989	RFA
Nov. 1991	IRI
Nov. 1994	RI/FS for Sites 7 and 9-13
Mar. 1999	Engineering Evaluation/Cost Analysis (EE/CA) to evaluate alternatives for remediation of PCP-contaminated soils
May 1999	NAB Little Creek on NPL
July 1999	Removal Action CR
June 2000	SERA
August 2000	Oxygen Releasing Compound (ORC) Pilot Study initiated
Oct. 2001	BERA
May 2002	SRI/HHRA
June 2004	FS to evaluate alternatives for remediation of VOCs and PCP in groundwater
Oct. 2004	Treatability Study initiated
Aug. 2006	Treatability Study Report
Dec. 2006	Vapor Intrusion Investigation
June 2007	Proposed Plan
July 2007	ROD
July 2007	Initiated Quarterly Site Inspections
Sept. 2008	Draft RAWP submitted for regulatory review

6.2 Site Background

6.2.1 Site 13 Description and History

Site 13 is located in the eastern portion of the base, near the intersection of 7th and F Streets ([Figure 6-1](#)) within the NAB Little Creek Public Works Center (PWC). The site consisted of a wash rack, wood-treatment dip tank and its associated drying racks, and an unpaved storage area. The wash rack consisted of a concrete pad surrounded by a concrete curb with a centrally located drain. It was installed in 1945, and was used to clean vehicles and equipment with steam and biodegradable chemicals. The wash water and other runoff drained into an underground oil-water separator (OWS). An unpaved storage area located adjacent to the wash rack was used to store various materials and equipment. The wood treatment dip tank consisted of an in-ground metal tank with a capacity of 1,500 gallons. The tank was used to hold a wood-treatment mixture consisting of PCP, diesel fuel, and kerosene. The treated wood was placed on the drying racks after being dipped in the tank. The dip tank and associated drying racks were utilized from the early 1960s to 1974. In 1982 the dip tank and drying racks were dismantled and in 1999 an IRA was completed to excavate the dip tank and contaminated soil. Following confirmation sampling, the site was backfilled, re-graded, and paved (IT-OHM, 1999).

Samples collected at the site indicate direct releases of PCP may have occurred from the former dip tank to subsurface soil and groundwater. Additionally, releases of VOCs to groundwater may have occurred. The source of VOCs has not been identified but appears to have been within the PWC at a location west or southwest of the dip tank.

The ground surface in the vicinity of Site 13 is generally level, approximately 10 ft above msl, and includes areas of exposed gravel and/or grass-covered ground surface between buildings as well as a concrete and asphalt parking lot for the PWC. A grass drainage ditch located along 7th Street conveys runoff from the site to the southeast through the Base storm water system.

6.2.2 Site 11 Geology and Hydrogeology

The surface geology at Site 13 consists of the 20–27 ft thick Columbia Formation, which contains the 16–23 ft thick unconfined Columbia Aquifer. The Columbia Formation overlies the 30 to 40 ft thick Yorktown Confining Unit. The Yorktown Confining Unit is continuous across the site and impedes the downward migration of Columbia Aquifer groundwater to the deeper Yorktown Aquifer. Shallow groundwater at Site 13 varies seasonally from 4 to 7 ft bgs and generally flows toward the south ([Figure 6-2](#)). Formerly, local groundwater flow was influenced by a leaking sanitary sewer line (approximately 10 gallons per minute) that runs north-south along F Street and generally flowed southwest. The sewer survey conducted as part of the 2004 treatability study determined the sewer line had been repaired. The average hydraulic conductivity in the Columbia Aquifer has been calculated to be 110 feet per day (ft/day) (CH2M HILL, 2002) and post-sewer repair groundwater flow velocity at Site 13 has been calculated to be approximately 230 ft/year. Due to the proximity of the site to the Chesapeake Bay, groundwater in the Yorktown Aquifer beneath the site is assumed to flow north and discharge into the Chesapeake Bay.

6.3 Land and Resource Use

Site 13 was historically used by the PWC to treat wood with a mixture of PCP and diesel or kerosene. Currently, Site 13 continues to be used by the PWC for base maintenance activities and consists of several buildings (Buildings 3165, 3165B, 3165D, 3165E, and 3174), the former wash rack, and the PWC parking lot. Enlisted quarters, industrial activities, and administrative offices surround the site.

There are no potable groundwater supply wells located within the boundary of Site 13. Non-potable groundwater supply wells, located on the Little Creek Golf Course, withdraw groundwater from the Yorktown Aquifer for irrigation and storage pond maintenance. There are no surface water bodies within the boundary of Site 13. Site 13 is located approximately 1,500 ft south of the golf course ponds and approximately 3,750 ft south of the Chesapeake Bay.

LUCs, though not fully implemented through documentation in an I-RACR, are currently maintained at Site 13 through quarterly inspections. The LUCs restrict land use and exposure to shallow groundwater until concentrations of VOCs are reduced to levels that allow for unlimited use and unrestricted exposure.

6.4 History of Contamination

Surface/subsurface soil and groundwater samples were collected during previous investigation activities for analysis of VOCs, SVOCs, PCP, pesticides/PCBs, and/or metals. Soil analytical results were screened against residential and industrial RBCs and background UTLs. Groundwater samples were screened against MCLs and background UTLs (metals only).

VOCs and SVOCs were detected in surface and subsurface soil, and pesticides, PCBs, and metals were detected in subsurface soil during the 1993 RI (FWES, 1994b) and 1995/1998 SRI (CH2M HILL, 2002). Concentrations of VOCs, pesticides, PCBs, and metals detected in soil were below screening criteria. SVOCs, primarily PCP and PAHs, were detected at concentrations exceeding screening criteria. Concentrations were highest in the soils surrounding the former dip tank, which were subsequently excavated as part of the 1999 IRA. Remaining PCPs in soil were confirmed to be below the site specific soil screening level for leaching of PCPs to groundwater (16,000 micrograms per kilogram [$\mu\text{g}/\text{kg}$]) (IT-OHM, 1999).

Several total metals were detected in Columbia Aquifer groundwater above screening criteria; however, iron and manganese were the only dissolved metals detected at concentrations exceeding screening criteria. One SVOC, PCP, and several VOCs were detected in Columbia Aquifer (shallow) groundwater above the MCL. Site 13 shallow groundwater contamination covers an estimated 2.9 acres underlying the PWC parking lot (Figure 6-2). PCP concentrations are highest in the upper portion of the Columbia Aquifer (approximately 3 to 12 ft bgs) in the area of the former dip tank and VOC concentrations are highest in the central portion of the parking lot at approximately 4 to 13 ft bgs. The Yorktown Aquifer has not been impacted by Site 13 activities based on similar chemical concentrations and hydrogeologic characteristics at adjacent Site 11 located less than 100 ft

east. Detected concentrations of PCP in shallow groundwater indicate non-aqueous phase liquid (NAPL) PCP was concentrated in soil above the water table, or in the top few feet of the aquifer and was unable to migrate down through the water column. NAPL was removed in 1999 when the soil surrounding the former dip tank was excavated to a depth just below the water table. Detected concentrations of VOC compounds do not indicate the presence of DNAPL at Site 13.

6.4.1 Site Risks

An HHRA was conducted as part of the SRI to evaluate the risks to human health from exposure to soil and groundwater (CH2M HILL, 2002). Additionally, in September 2006, the potential risk associated with vapor intrusion of VOCs was evaluated (CH2M HILL, 2007a). Potential ecological risks associated with the site were evaluated in a SERA completed in 2000 (CH2M HILL, 2000a), and a BERA, through Step 3a, completed in 2001 (CH2M HILL, 2001d). The summary of site risks presented in the subsections below was documented in the ROD (DON, 2007b).

Human Health Risk

No cancer risks associated with exposure to site soil were identified. Exposure to site soil by the hypothetical future child resident may present a non-cancer hazard above USEPA's target level of 1 based on RME calculations; however there were no individual target organ effects based on the RME scenario, and the CTE non-cancer hazard was below 1. Future potable use of, or exposure to, groundwater by residents, industrial workers, and construction workers may present cancer risks and non-cancer hazards above USEPA's target risk levels based on RME calculations. No individual target organ effects were identified for the future industrial worker under the RME scenario, and the CTE cancer risks and non-cancer hazards were below USEPA's target risk levels. Potential unacceptable target organ effects (i.e., HI greater than 1) were identified for future residents and construction workers due to iron, manganese, PCP, PCE, and TCE in groundwater. Additionally, CTE cancer risks and non-cancer hazards were above USEPA's target risk levels for these potential receptors. COCs identified in the ROD for Site 13 are:

- PCE
- TCE
- Vinyl chloride (MCL exceedance)
- PCP

Iron and manganese are not included as COCs in the ROD because the detected concentrations were consistent with background levels.

An investigation was conducted to assess whether concentrations of VOCs in groundwater could result in potential unacceptable vapor intrusion risks to workers occupying Buildings 3165, 3165B, 3165D, 3165E, and 3660 (CH2M HILL, 2007a). PCP is not identified as a volatile chemical according to USEPA's vapor intrusion guidelines and has a low Henry's Law constant, thus was not investigated. A building inspection was conducted and groundwater samples were collected from the upper 2 ft of the Columbia Aquifer surrounding Building 3165. Additionally, soil samples were collected to characterize the potential of VOC vapors to pass through the soil underlying Building 3165. Analytical results and site-specific

building characteristics were incorporated into the J&E model to calculate the potential risks. Buildings 3165B, 3165E, and 3660 are unoccupied, unconditioned storage buildings with multiple holes and leaks to the outside, and Building 3165D is an open shed with only three walls, thus these buildings were not examined in detail during the inspection. Building 3165 has five wings with a main corridor through the center. Wings 1, 2, and 3 are used for offices and include a lunch room, locker room, and electrical room. Wings 4 and 5 are used as wood and metal shops. With the exception of the locker room, the individual areas of Building 3165 tested to be neutral or positively pressurized relative to the outside, and the potential for vapor intrusion was concluded to be minimal. The locker room exhibited a negatively pressurized state due to an exhaust fan located in the ceiling indicating a potential route for vapor intrusion; however the locker room is not occupied for 8 hours a day and results of the J&E model suggested, even in the event building conditions promote vapor intrusion, concentrations of VOCs in groundwater are unlikely to present risk to human health due to vapor intrusion. Therefore, based upon the methodology used to assess the risk associated with vapor intrusion at the time the ROD was signed, NFA to assess the potential for vapor intrusion at Site 13 was warranted.

Ecological Risk

The SERA concluded the developed nature of the site (buildings and pavement) limited the available habitat, reducing the potential for exposure by ecological receptors. The subsequent BERA focused solely on the assessment of potential risks associated with exposure to soil in the drainage ditch located north of the site. Results of the BERA indicated concentrations of PAHs in soil were above Biological Technical Assistance Group (BTAG) ecological screening values; however concentrations of PAHs did not exceed soil screening values and were generally consistent with urban background. The potential risks to terrestrial organisms that may utilize the drainage ditch are expected to be negligible; therefore, the Navy, in partnership with USEPA and VDEQ, agreed no action was necessary to protect ecological receptors at the site.

6.4.2 Initial Response

Site 13 was initially identified in the IAS (RGH, 1984). An EE/CA to evaluate alternatives for remediation of contaminated soils was finalized in March 1999 (CH2M HILL, 1999) and in May 1999 an IRA was conducted to excavate the dip tank and surrounding soil (IT-OHM, 1999).

In 2000 a pilot study was initiated at Site 13 to evaluate the effects of enhanced aerobic bioremediation of PCP in groundwater using an ORC in soil and groundwater. Groundwater samples collected following the pilot study indicated a reduction in the concentrations of PCP (CH2M HILL, 2003c). Additionally, from 2004 to 2005 a treatability study was conducted to evaluate the potential for treatment of PCP and VOCs in groundwater using ISCO and ERD (JV I, 2006). Groundwater samples collected following the treatability study indicated degradation of parent VOCs had occurred. Additionally, results of the study indicated ISCO was not as effective as ERD in reducing concentrations of PCP and VOCs.

6.4.3 Basis for Remedial Action

Based on the results of previous investigations and actions conducted to date, further remedial action is warranted to protect public health, welfare, and the environment from actual or threatened releases of PCP and VOCs in shallow groundwater from Site 13.

6.5 Remedial Actions

6.5.1 Remedy Selection

A ROD for Site 13 was signed in September 2007 (DON, 2007b). This report summarized the risks to human health, established RAOs, and defined the selected remedy. The ROD concluded no further action was necessary for site soil. The selected remedy for Site 13 was defined as groundwater treatment through ERD and LUCs to meet the following RAOs:

- Prevent exposure to Site 13 groundwater until concentrations of PCP and VOCs have been reduced to levels that allow for unlimited use and unrestricted exposure.
- Reduce concentrations of PCP and VOCs in Site 13 groundwater to cleanup levels identified in [Table 6-1](#) to the maximum extent practicable within a reasonable amount of time.

The following LUC objectives for Site 13 were selected in the ROD:

- Prohibit the withdrawal of groundwater except for environmental monitoring and testing
- Prohibit the use of the site for residential, child care, elementary or secondary school, or playground facilities
- Maintain the integrity of any current or future remedial or monitoring system

LUC restrictions will be implemented in accordance with the LUC RD. The LUCs shall be maintained on all land and groundwater within the boundaries of Site 13 until the concentrations of PCP and VOCs in the groundwater have been reduced to levels that allow for unlimited use and unrestricted exposure. Groundwater performance monitoring and reporting will be completed to assess the progress of the remedy over time.

6.5.2 Remedy Implementation

The draft RAWP was submitted for regulatory review in September 2008 outlining the plan for implementation of the selected remedy for Site 13 ([Figure 6-3](#)) (JV III, 2008). Baseline groundwater sampling is scheduled for October 2008 and construction of the injection well network and injection of ERD substrate are scheduled for February 2009.

A report will be issued following installation of the groundwater remediation system and execution of the LUC RD. Performance monitoring will be conducted for 1 year following installation of the system to assess the effectiveness of the design. Data technical memoranda will be generated presenting data tables and figures for each of the 1-, 3-, 6-, 9-, and 12-month sampling events. Additionally, the technical memorandum for the 12-month

event will include an annual evaluation of the remedy performance. Groundwater monitoring will continue past 1 year until RAOs are achieved.

6.6 Five-Year Review Process

6.6.1 Site Inspections

The Navy has conducted Quarterly ER site inspections since September 2005 to ensure protectiveness of human health and the environment from potential exposure to VOCs in groundwater. Although the LUC RD has not been finalized, the ER quarterly inspection results were provided to the USEPA and VDEQ beginning in July 2008. Since the initiation of the inspections, only minor corrective measures, such as monitoring well lock and cap replacements, have been necessary.

In September 2008, the Navy, USEPA, and VDEQ conducted a site inspection in support of the Five-Year Review. Inspection results are provided in [Appendix A](#). During the inspection it was noted some monitoring wells have covers labeled as sewer manholes. Recommendations were made to replace the manhole covers with proper identification. Additionally, it was recommended all monitoring wells be labeled from the outside.

6.6.2 Site Interviews

Site Interviews were conducted on October 6, 2008 with Al Gregg of NAB Little Creek Base Environmental and Richard Howard of NAB Little Creek Base Planning. Interview summaries are provided in [Appendix B](#).

6.6.3 Performance Monitoring Data Summary

Remedy construction is scheduled to begin in February 2009; therefore, no performance monitoring data has been collected to date. All data collected during remedy implementation will be included in the next Five Year Review for NAB Little Creek.

6.7 Technical Assessment

Question A: Is the remedy functioning as intended by the decision document?

Remedial Action Performance: Based on the review of documents, ARARs, risk assumptions, and ER site inspection findings, the Site 13 LUCs currently in place are adequately restricting land use and exposure to groundwater as intended by the ROD. Although groundwater treatment has not been implemented at Site 13, a review of the Site 12 remedy performance (Section 5) provides no evidence to expect the Site 13 remedy will not be successful.

Implementation of LUCs: Although the LUC RD has not been fully implemented through documentation in an I-RACR, quarterly ER site inspections have ensured exposure to PCP and VOCs in groundwater is prevented.

Performance Monitoring Activities: Performance monitoring activities will begin following remedy construction scheduled for February 2009.

Opportunities for Optimization: No further remedy optimization is suggested at this time.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

Changes in Exposure Pathways: No new contaminants, sources, or routes of exposure have been identified as part of this five-year review. There is no indication that hydrologic or hydrogeologic conditions have changed in a way to affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: Although there have been some changes in toxicity values, regulatory levels, and risk characteristics of some Site 13 contaminants, these changes would not adversely affect the protectiveness of the selected remedy as it would not substantially change the results of the risk assessment or the classes of chemicals identified as COCs. The remediation goals for all of the COCs are the federal MCLs, which have not changed since the ROD was signed. Additionally, any changes in toxicity would not affect the successful implementation of the LUCs.

Changes in Risk Assessment Methodologies: Although there have been some procedural changes to how human health risk assessments are conducted, including how exposure point concentrations are calculated, none of these changes adversely affect the protectiveness of the selected remedy or remediation goals for Site 13. The vapor intrusion pathway was evaluated at Site 13 in 2005 using building characteristics, shallow groundwater concentrations, and the J&E Model. The Navy is currently working with USEPA and VDEQ to modify the vapor intrusion risk assessment process. This modification will impact NAB Little Creek sites, including Site 13, where the vapor intrusion pathway has been assessed. Following resolution of the risk assessment methodology, the potential for vapor intrusion at Site 13 will be re-evaluated as necessary.

Question C: Has any other information come to light that could question the protectiveness of the remedy?

No new information has come to light that would question the protectiveness of the remedy.

6.8 Site 13 Issues, Associated Recommendations, and Follow Up Actions

Issues that have been identified for Site 13 based on this five-year review are as follows:

Issue	Recommendations/ Follow-Up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness? (Y/N)	
					Current	Future
Changes to the methodology for evaluating the potential for vapor intrusion risk.	Following resolution of the risk evaluation methodology, re-evaluation of the potential for vapor intrusion risk at Site 13 is recommended.	Navy	State/ USEPA	Oct. 2009	N	Y

Issue	Recommendations/ Follow-Up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness? (Y/N)	
					Current	Future
LUC RD is not fully implemented.	Implement LUCs in accordance with the LUC RD and document in the I-RACR for the Site.	Navy	State/ USEPA	Sept. 2010	N	Y
Site monitoring wells are not clearly labeled outside the casing.	Apply permanent identification to all well casings.	Navy	State/ USEPA	Sept. 2013	N	N

6.9 Protectiveness Summary

The remedy has not been implemented at Site 13, however, it is expected to be protective of human health and environment. In the interim, exposure pathways that could result in unacceptable risk are controlled through quarterly ER site inspections. Remedy construction is expected to begin in April 2009. Full implementation of the LUCs and the groundwater LTM plan will be documented in the I-RACR. Based upon a review of the Site 12 remedy performance (Section 5), there is no evidence at this time to expect the Site 13 remedy will not be successful. Further evaluation of the vapor intrusion pathway is recommended following resolution of risk evaluation methodology.

6.10 Next Review

The next Five-Year Review for Site 13 will be in 2013.

Table 6-1
Preliminary Remediation Goals
2008 Five-Year Review
NAB Little Creek
Virginia Beach, Virginia

Chemical of Concern	Cleanup Level* (µg/L)
Tetrachloroethene	5
Trichloroethene	5
Vinyl Chloride	2
Pentachlorophenol	1

*Clean-up levels are Maximum Contaminant Levels (MCLs).



Legend

- ⊗ Monitoring Well
 - LUC Boundary
 - Former Site Features (see figure 6-1)
 - Groundwater Contour (ft msl)
 - Inferred Groundwater Contour (ft msl)
 - ➔ Groundwater Flow Direction (April 2006)
- | | |
|--|---|
| <p>Estimated PCP Plume</p> <ul style="list-style-type: none"> 1-10 µg/L 10-100 µg/L 100-1000 µg/L 1000+ µg/L Inferred from 2003 data | <p>Estimated CVOC Plume</p> <ul style="list-style-type: none"> 1-10 µg/L 10-100 µg/L 100-1000 µg/L 1000+ µg/L Inferred from 2003 data |
|--|---|

Figure 6-2
 Site 13 VOC and PCP Plume
 2008 Five - Year Review
 NAB Little Creek
 Virginia Beach, Virginia



Legend

- Monitoring Well to be sampled during pre-construction sampling
- Proposed Injection Well (10-ft ROI typical; tbd by pre-construction data)
- Fomer Site Features (see figure 6-1)
- LUC Boundary
- ⋯ PCP Plume
- ⋯ Total CVOC Plume



Figure 6-3
 Site 13 Preliminary Remedial Design
 2008 Five - Year Review
 NAB Little Creek
 Virginia Beach, Virginia

References

- A. T. Kearney, Inc. 1989. *RCRA Facility Assessment, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. March.
- AGVIQ/CH2M HILL Joint Venture I (JV I). 2006. *Final Treatability Study Report, Site 13, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. August.
- JV I. 2007a. *Remedial Action Work Plan, Site 12 Former Exchange Laundry/Dry Cleaning Facility, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. February.
- JV I. 2007b. *Final Remedial Action Work Plan Addendum: Site 12 Former Exchange Laundry and Dry Cleaning Facility, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. July.
- JV I. 2008a. *Final Remedial Action Construction Closeout Report, Site 12 Former Exchange Laundry/Dry Cleaning Facility, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. October.
- JV I. 2008b. *Version 4 Site 11 – Former School of Music Plating Shop Remedial Action Work Plan and Sampling and Analysis Plan*. December.
- AGVIQ/CH2M HILL Joint Venture III (JV III). 2008. *Version 2 Site 13, Public Works Pentachlorophenol Dip Tank and Wash Rack Remedial Action Work Plan and Sampling and Analysis Plan*. December.
- Baker. 1997b. *Final Decision Document for Sites 9 and 10, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. June.
- Boving, T. B, J. E. McCray, W. J. Blanford, M. L. Brusseau. 2003. *Cyclodextrin Enhanced In situ Removal of Organic Contaminants from Groundwater at Department of Defense Sites*. University of Rhode Island, Colorado School of Mines, University of Texas at San Antonio, and University of Arizona.
- CH2M HILL. 1986. *Round 1 Verification Study, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. October.
- CH2M HILL. 1999. *Engineering Evaluation/Cost Analysis, Soil at Site 13: Public Works PCP Dip Tank and Wash Rack, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. March.
- CH2M HILL. 2000a. *Final Screening Ecological Risk Assessment, Installation Restoration Sites 5, 7, 8, 9, 10, 11, 12, 13, and 16, and Solid Waste Management Unit 3, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. June.
- CH2M HILL. 2000b. *Final Supplemental Remedial Investigation for Site 12, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. October.
- CH2M HILL. 2000c. *Final Background Investigation, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. December.

- CH2M HILL. 2001a. *Final Remedial Investigation/Human Health Risk Assessment/Focused Feasibility Study for Sites 9 and 10, Naval Amphibious Base Little Creek, Virginia Beach Virginia*. February.
- CH2M HILL. 2001b. *Final Baseline (Step 3) Ecological Risk Assessment, IR Sites 9 and 10, Naval Amphibious Base Little Creek, Virginia Beach Virginia*. March.
- CH2M HILL. 2001c. *Final Project Plans for the Long-Term Monitoring Program at Sites 9 and 10, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. August.
- CH2M HILL. 2001d. *Final Baseline (Step 3) Ecological Risk Assessment, Installation Restoration Sites 5 and 13*. October.
- CH2M HILL. 2002. *Final Supplemental Remedial Investigation (including Human Health Risk Assessment) for Site 13 Public Works PCP Dip Tank and Wash Rack. Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. May.
- CH2M HILL, 2003a. *Final Technical Memorandum Baseline Ecological Risk Assessment for Site 12, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. March.
- CH2M HILL. 2003b. *Final Background Investigation Addendum for Summer Groundwater Sampling Event, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. March.
- CH2M HILL. 2003c. *Final ORC Groundwater Remediation Report for Site 13. Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. March.
- CH2M HILL. 2003d. *Summary of Site 11 Cyclodextrin Pilot Study Post-Treatment Groundwater Sampling, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. July.
- CH2M HILL. 2004a. *Final Supplemental Remedial Investigation for Site 11 – School of Music Plating Shop, Naval Amphibious Base Little Creek*. June.
- CH2M HILL. 2004b. *Final Technical Memorandum Human Health Risk Evaluation for Site 10 Excavation, Naval Amphibious Base Little Creek*. June.
- CH2M HILL. 2004c. *Final Project Plans for the Post Record of Decision Long-Term Monitoring Program at Sites 9 and 10, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. September.
- CH2M HILL. 2005a. *Final Interim Remedial Action Completion Report, Site 9: Driving Range Landfill, Site 10: Sewage Treatment Plant Landfill, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. April.
- CH2M HILL. 2005b. *Vapor Intrusion Assessment, Site 11, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. September.
- CH2M HILL. 2006a. *Site 11 Revised HHRA SRI Addendum, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. March.
- CH2M HILL. 2006b. *Explanation of Significant Difference, Site 12: Former Exchange Laundry/Dry Cleaning Facility, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. August.
- CH2M HILL. 2007a. *Site 13 Vapor Intrusion Assessment, Former Pentachlorophenol Dip Tank and Wash Rack Area. Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. June.

- CH2M HILL. 2007b. *Technical Memorandum Work Plan Fiscal Year 2008 LTM Sites 9 and 10, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. August.
- CH2M HILL. 2007c. *Fiscal Year 2006 Long-term Monitoring Report, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. CH2M HILL, 2008a. *Site Management Plan Fiscal Years 2009 through 2013, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. September.
- CH2M HILL. 2008b. *Draft Fiscal Year 2008 Long-Term Monitoring Report Sites 9 and 10, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. September.
- CH2M HILL. 2008c. *Draft Enhanced Reductive Dechlorination Annual Groundwater Monitoring Summary 2008, Site 12, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. October.
- Department of the Navy (DON), 2003. *Final Record of Decision, Site 9: Driving Range Landfill, Site 10: Sewage Treatment Plant Landfill, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. December.
- DON. 2004. *Land Use Control Remedial Design, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*.
- DON. 2005a. *Record of Decision, SWMU 7a, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. June.
- DON. 2005b. *Record of Decision, SWMU 8, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. June.
- DON. 2005c. *Record of Decision, Site 12 Former Exchange Laundry/Dry Cleaning Facility, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. September.
- DON. 2007a. *Final Record of Decision, Site 11 School of Music*. July.
- DON. 2007b. *Final Site 13 Record of Decision, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. September.
- DON. 2008. *Record of Decision, Site 8, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. April.
- Ebasco Environmental (Ebasco). 1991. *Draft Final Interim Remedial Investigation (Draft Final Interim RI), Sites 9 and 10, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. November.
- Foster Wheeler Environmental Services (FWES). 1994a. *Final Decision Document. School of Music Plating Shop*. November.
- FWES. 1994b. *Remedial Investigation/Feasibility Study for Sites 7 and 9-13, NAB Little Creek, Virginia Beach, Virginia*. November.
- FWES. 1997. *Groundwater Monitoring Plan for Site 5 – Building 9-11 Motor Oil Disposal Area, Site 9 – Driving Range Landfill, Site 10 – Sewage Treatment Plant Landfill, Site 11 – School of Music Plating Shop, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. June.
- Gibbons, Robert D. 1994. *Statistical Methods for Groundwater Monitoring*. John Wiley & Sons, New York.

Gilbert, Richard O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. New York: Van Nostrand Reinhold Company, New York.

IT Corporation (ITC). 1996. *Interim Removal Action. Final Closeout Report. Site 11 School of Music Plating Shop*. May.

IT-OHM Corporation (IT-OHM). 1999. *Final Closeout Report, Site 13 – PCP Dip Tank, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. July.

Rodgers, Golden, and Halpern (RGH). 1984. *Initial Assessment Study of Naval Amphibious Base, Little Creek, Norfolk, Virginia*. December.

Secretary of the Navy. 1945. *Correspondence Regarding Establishment of NAB Little Creek*. July.

United States Environmental Protection Agency (USEPA). 2001. *Comprehensive Five-Year Review Guidance*.

USEPA. 2006. *Data Quality Assessment: Statistical Methods for Practitioners*. Office of Environmental Information, Washington, D.C.

Appendix A
Site Inspection Summaries

5.	Gas Generation Records	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
6.	Settlement Monument Records	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
7.	Groundwater Monitoring Records	Readily Available <input checked="" type="checkbox"/>	Up to date <input checked="" type="checkbox"/>	N/A <input type="checkbox"/>
	Remarks: Included in the Long-term Monitoring Report. Available upon request.			
8.	Leachate Extraction Records	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
9.	Discharge Compliance Records			
	Air	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
	Water (effluent)	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
10.	Daily Access/Security Logs	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
IV. O&M COST				
1.	O&M Organization			
	State in-house <input type="checkbox"/>	Contractor for State <input type="checkbox"/>		
	PRP in-house <input type="checkbox"/>	Contractor for PRP <input type="checkbox"/>		
	Federal Facility in-house <input type="checkbox"/>	Contractor for Federal Facility <input checked="" type="checkbox"/>		
	Other : In Remedial Action Completion Report for sites 9 and 10			
2.	O&M Cost Records			
	The annual cost from December 2003 through September 2008 has been approximately \$132,000 with the exception of 2004. The cost in 2004 was increased \$34,000 as a result of a landfill breach in April 2004.			
3.	Unanticipated or Unusually High O&M Costs During Review Period			
	Describe costs and reasons: <u>Site 10 landfill breach April 2004</u>			
V. ACCESS AND INSTITUTIONAL CONTROLS				
A. Fencing				
1.	Fencing damaged		N/A <input checked="" type="checkbox"/>	
	Location shown on site map <input type="checkbox"/>			
	Gates secured <input type="checkbox"/>			
	Remarks : Fencing associated with mission activities			
B. Other Access Restrictions				
1.	Signs and other security measures		N/A <input type="checkbox"/>	
	Locations shown on site map <input checked="" type="checkbox"/>			
	Remarks : Fencing associated with mission activities			
C. Institutional Controls (ICs)				
1.	Implementation and enforcement			
	Conditions imply ICs not properly implemented			
	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	N/A <input type="checkbox"/>	
	Conditions imply ICs not being fully enforced			
	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	N/A <input type="checkbox"/>	
	Type of monitoring (e.g., self-reporting, drive by) : <u>Quarterly integrity inspections, site walk visual observations</u>			
	Frequency : <u>Quarterly</u>			
	Responsible party/agency : <u>Navy</u>			
	Contact : <u>Scott Park</u>	<u>Remedial Project Manager</u>	<u>757-445-6628</u>	
	Name	Title	Phone No.	
	Reporting is up to date			
	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	N/A <input type="checkbox"/>	
	Reports are verified by the lead agency			
	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	N/A <input type="checkbox"/>	
	Specific reqs in deed or decision documents have been met			
	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	N/A <input type="checkbox"/>	
	Violations have been reported			
	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	N/A <input type="checkbox"/>	
	Other problems or suggestions: Report attached <input type="checkbox"/>			
	See comments provided in Section XI.			

2	Adequacy	ICs are adequate <input checked="" type="checkbox"/> ICs are inadequate <input type="checkbox"/>	N/A <input type="checkbox"/>
D. General			
1	Vandalism/trespassing	Location shown on site map <input type="checkbox"/> No vandalism evident <input checked="" type="checkbox"/>	
2	Land use changes on site		N/A <input checked="" type="checkbox"/>
3	Land use changes off site	Remarks : None observed	N/A <input checked="" type="checkbox"/>
VI. GENERAL SITE CONDITIONS			
A. Roads		Applicable <input checked="" type="checkbox"/>	N/A <input type="checkbox"/>
1	Roads damaged	Location shown on site map <input checked="" type="checkbox"/> Roads adequate <input checked="" type="checkbox"/>	N/A <input type="checkbox"/>
B. Other Site Conditions			
1	Remarks : <u>Site 10: An empty drum was present on site. Low spots were observed west of the ball fields due to vehicular traffic. Site 9: Bare spots were observed on the driving range.</u> <u>Sites 9 and 10: A site walk was not completed for the entire site due to facility mission activities.</u>		
VII. LANDFILL COVERS			
A. Landfill Surface			
1	Settlement	Location shown on site map <input type="checkbox"/> Settlement not evident <input checked="" type="checkbox"/>	
2	Cracks	Location shown on site map <input type="checkbox"/> Cracking not evident <input checked="" type="checkbox"/>	
3	Erosion	Location shown on site map <input type="checkbox"/> Erosion not evident <input checked="" type="checkbox"/>	
4	Holes	Location shown on site map <input checked="" type="checkbox"/> Holes not evident <input type="checkbox"/> Areal extent : <u>Shown of Figure A-1</u> Remarks : Low spots due to vehicular traffic.	Depth : <u>Approximately 2 feet</u>
5	Vegetative Cover	Grass <input checked="" type="checkbox"/> Cover properly established <input checked="" type="checkbox"/> No signs of stress <input checked="" type="checkbox"/> Trees/Shrubs (indicate size and locations on a diagram) <input type="checkbox"/> Remarks : Bare spots on Site 9 driving range and low spots on Site 10	
6	Alternative Cover (armored rock, concrete, etc.)		N/A <input checked="" type="checkbox"/>
7	Bulges	Location shown on site map <input type="checkbox"/> Bulges not evident <input checked="" type="checkbox"/>	
8	Wet Areas/Water Damage	Wet areas/water damage not evident <input type="checkbox"/> Wet areas <input type="checkbox"/> Ponding <input checked="" type="checkbox"/> Seeps <input type="checkbox"/> Soft sub grade <input type="checkbox"/>	Location shown on site map <input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> Location shown on site map <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Areal extent : _____ Areal extent : _____ Areal extent : _____ Areal extent : _____
Remarks : Ponding was observed in the low areas at Site 10 west of the ball fields.			
9	Slope Instability	No evidence of slope instability <input type="checkbox"/> Slides <input type="checkbox"/> Areal extent : _____ Remarks : Not Applicable	Location shown on site map <input type="checkbox"/>

B. Benches	Applicable <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)		
C. Letdown Channels	Applicable <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)		
D. Cover Penetrations	Applicable <input checked="" type="checkbox"/>	N/A <input type="checkbox"/>
1 Gas Vents		N/A <input checked="" type="checkbox"/>
2 Gas Monitoring Probes		N/A <input checked="" type="checkbox"/>
3 Monitoring Wells (within surface area of landfill)		
Properly secured/locked <input checked="" type="checkbox"/>		
Functioning <input checked="" type="checkbox"/>		
Routinely sampled <input checked="" type="checkbox"/>		
Good condition <input checked="" type="checkbox"/>		
Evidence of leakage at penetration <input type="checkbox"/>		
Needs maintenance <input type="checkbox"/>		
Remarks : All monitoring wells that were inspected were in acceptable condition.		
4 Leachate Extraction Wells		N/A <input checked="" type="checkbox"/>
5 Settlement Monuments		N/A <input checked="" type="checkbox"/>
E. Gas Collection & Treatment	Applicable <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
F. Cover Drainage Layer	Applicable <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
G. Detention/Sedimentation Ponds	Applicable <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
H. Retaining Walls	Applicable <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
I. Perimeter Ditches/Off-Site Discharge	Applicable <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
VIII. VERTICAL BARRIER WALLS	Applicable <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
IX. GROUNDWATER/SURFACE WATER REMEDIES		
A. Groundwater Extraction Wells/Pumps/Pipelines	Applicable <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
B. Surface Water Collection Structures, Pumps, and Pipelines	Applicable <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
C. Treatment System	Applicable <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
D. Monitoring Data		
1 Monitoring Data	Is routinely submitted on time <input checked="" type="checkbox"/>	Is of acceptable quality <input checked="" type="checkbox"/>
2 Monitoring data suggests:	Groundwater plume is effectively contained <input checked="" type="checkbox"/>	
E. Monitored Natural Attenuation	Applicable <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
X. OTHER REMEDIES		
XI. OVERALL OBSERVATIONS		
A. Implementation of the Remedy	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).	
The remedy is effective and functioning as designed. Long-term Monitoring data suggest a site release and off site migration has not occurred.		
B. Adequacy of O&M	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.	
The landfill was breached in April 2004 and was subsequently repaired. Vehicular traffic has resulted in low spots at Site 10 and denuded areas have been identified at Site 9. Repair options for the low spots and the denuded areas are being evaluated.		
An empty drum was observed at Site 10 and was promptly removed by base environmental.		

C. Early indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost of scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be comprised in the future.

Additional procedures have been implemented in an effort to prevent future breaches to the landfill.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

The Long-term Monitoring Plan is being reviewed to optimize the sampling strategy.

4.	Permits and Service Agreements			
	Air discharge permit	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
	Effluent discharge	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
	Waste disposal, POTW	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
	Other permits _____	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
5.	Gas Generation Records	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
6.	Settlement Monument Records	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
7.	Groundwater Monitoring Records	Readily Available <input checked="" type="checkbox"/>	Up to date <input checked="" type="checkbox"/>	N/A <input type="checkbox"/>
	Remarks: Included in Administrative Record File - Available upon request			
8.	Leachate Extraction Records	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
9.	Discharge Compliance Records			
	Air	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
	Water (effluent)	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
10.	Daily Access/Security Logs	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
IV. O&M COST				
1	O&M Organization			
	State in-house <input type="checkbox"/>	Contractor for State <input type="checkbox"/>		
	PRP in-house <input type="checkbox"/>	Contractor for PRP <input type="checkbox"/>		
	Federal Facility in-house <input type="checkbox"/>	Contractor for Federal Facility <input checked="" type="checkbox"/>		
	Other : O&M Cost has not been recognized since the in-situ remediation system has not been implemented to date. A O&M contractor will be responsible for O&M of the treatment system at Site 11. _____			
2	O&M Cost Records	The O&M cost for Site 11 has not be recognized because the in-situ treatment system has not been implemented.		
3	Unanticipated or Unusually High O&M Costs During Review Period	Describe costs and reasons: NA		
V. ACCESS AND INSTITUTIONAL CONTROLS				
A. Fencing				
1.	Fencing damaged			N/A <input checked="" type="checkbox"/>
B. Other Access Restrictions <input type="checkbox"/> <input type="checkbox"/>				
1.	Signs and other security measures			N/A <input checked="" type="checkbox"/>
C. Institutional Controls (ICs) <input checked="" type="checkbox"/>				
1.	Implementation and enforcement			
	Conditions imply ICs not properly implemented	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	N/A <input type="checkbox"/>
	Conditions imply ICs not being fully enforced	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	N/A <input type="checkbox"/>
	Type of monitoring (e.g., self-reporting, drive by) :	Inspection checklist, site walk _____		
	Frequency :	Quarterly _____		
	Responsible party/ager	Navy _____		
	Contact :	Scott Park -	RPM	757- 445-6628
		Name	Title	Phone No.
	Reporting is up to date	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	N/A <input type="checkbox"/>
	Reports are verified by the lead agency	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	N/A <input type="checkbox"/>
	Specific reqs in deed or decision documents have been met	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	N/A <input type="checkbox"/>
	Violations have been reported	Yes <input type="checkbox"/>	No <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
	Other problems or suggestions:	Report attached <input type="checkbox"/>		
	A LUC RD has not been developed for this Site. Quarterly inspections are completed and results are provided to regulatory agencies.			
2	Adequacy			N/A <input checked="" type="checkbox"/>
	ICs are adequate <input type="checkbox"/>			
	ICs are inadequate <input type="checkbox"/>			
	Remarks : LUC RD has not been finalized			

D. General		
1	Vandalism/trespassing Location shown on site map <input type="checkbox"/> No vandalism evident <input checked="" type="checkbox"/>	
2	Land use changes on site Remarks : None observed	N/A <input type="checkbox"/>
3	Land use changes off site Remarks : None observed	N/A <input type="checkbox"/>
VI. GENERAL SITE CONDITIONS		
A. Roads		Applicable <input checked="" type="checkbox"/> N/A <input type="checkbox"/>
1	Roads damaged Location shown on site map <input type="checkbox"/> Roads adequate <input checked="" type="checkbox"/> Remarks : Roads and parking lot are adequate	N/A <input type="checkbox"/>
B. Other Site Conditions		
1	Remarks : Leaking sanitary sewer was repaired in October-December 2007.	
VII. LANDFILL COVERS - NOT APPLICABLE		
VIII. VERTICAL BARRIER WALLS		Applicable <input type="checkbox"/> N/A <input checked="" type="checkbox"/>
IX. GROUNDWATER/SURFACE WATER REMEDIES		
A. Groundwater Extraction Wells/Pumps/Pipelines		Applicable <input type="checkbox"/> N/A <input checked="" type="checkbox"/>
B. Surface Water Collection Structures, Pumps, and Pipelines		Applicable <input type="checkbox"/> N/A <input checked="" type="checkbox"/>
C. Treatment System		Applicable <input checked="" type="checkbox"/> N/A <input type="checkbox"/>
1	Treatment Train (Check Components that apply) Metals removal <input type="checkbox"/> Oil/water separation <input type="checkbox"/> Bioremediation <input checked="" type="checkbox"/> Air stripping <input type="checkbox"/> Carbon adsorbers <input type="checkbox"/> Remarks : Enhanced reductive dechlorination	
2	Electrical Enclosures and Panels (properly rated and functional)	N/A <input checked="" type="checkbox"/>
3	Tanks, Vaults, Storage Vessels	N/A <input checked="" type="checkbox"/>
4	Discharge Structure and Appurtenances	N/A <input checked="" type="checkbox"/>
5	Treatment Building(s)	N/A <input checked="" type="checkbox"/>
6	Monitoring Wells (pump and treatment remedy) Properly secured/locked <input checked="" type="checkbox"/> Functioning <input checked="" type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input checked="" type="checkbox"/> All required wells located <input checked="" type="checkbox"/> Needs Maintenance <input type="checkbox"/> Remarks : See notes in Section XI.	N/A <input type="checkbox"/>
D. Monitoring Data - Not Applicable, a monitoring program has not been implemented		
E. Monitored Natural Attenuation		
1	Monitoring Wells (natural attenuation remedy)	N/A <input checked="" type="checkbox"/>
X. OTHER REMEDIES		
<i>If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.</i>		

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

The in-situ groundwater treatment remedy has not been implemented. The work plan is currently in regulatory review.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

LS11-MW12D is not present on the ground surface. A replacement well is recommended as a boundary well to ensure protectiveness of LUCs

An unidentified monitoring well is situated along Gator Blvd north of LS11-MW19Y. The well should be surveyed for inclusion in the inspection program.

Well covers were not opened during inspection. Team assumes well locks are in place, however recommends identifying the wells using an engraving system for long term inspection record.

C. Early indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost of scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be comprised in the future.

Remedy was not implemented at the time of the inspection.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

Will be evaluated in the next 5-yr review

4.	Permits and Service Agreements	Air discharge permit	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
		Effluent discharge	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
		Waste disposal, POTW	Readily Available <input checked="" type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input type="checkbox"/>
		Comment__Waste Manifests provided in construction close out report	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
5.	Gas Generation Records		Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
6.	Settlement Monument Records		Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
7.	Groundwater Monitoring Records		Readily Available <input checked="" type="checkbox"/>	Up to date <input checked="" type="checkbox"/>	N/A <input type="checkbox"/>
	Remarks: Included in Administrative Record File - Available upon request				
8.	Leachate Extraction Records		Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
9.	Discharge Compliance Records	Air	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
		Water (effluent)	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
10.	Daily Access/Security Logs		Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
IV. O&M COST					
1	O&M Organization				
	State in-house <input type="checkbox"/>	Contractor for State <input type="checkbox"/>			
	PRP in-house <input type="checkbox"/>	Contractor for PRP <input type="checkbox"/>			
	Federal Facility in-house <input type="checkbox"/>	Contractor for Federal Facility <input checked="" type="checkbox"/>			
	Other : <u>Remedy construction cost is approximately 1.1MM. An monitoring program has not been developed</u>				
2	O&M Cost Records				
	The O&M cost for Site 11 has not be recognized to date. Construction Completion - May 2008. O&M costs will be provided in future 5 year reviews as they are recognized.				
3	Unanticipated or Unusually High O&M Costs During Review Period				
	O& M cost has not been recognized. However, during construction of the remedy, an additional \$70,000 cost was incurred as a result of plume re-configuration when the sanitary sewer was repaired in 2005.				
V. ACCESS AND INSTITUTIONAL CONTROLS					
A. Fencing					
1.	Fencing damaged				N/A <input checked="" type="checkbox"/>
B. Other Access Restrictions <input type="checkbox"/> <input type="checkbox"/>					
1.	Signs and other security measures				N/A <input checked="" type="checkbox"/>
C. Institutional Controls (ICs) <input checked="" type="checkbox"/>					
1.	Implementation and enforcement				
	Conditions imply ICs not properly implemented				
	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	N/A <input type="checkbox"/>		
	Conditions imply ICs not being fully enforced				
	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	N/A <input type="checkbox"/>		
	Type of monitoring (e.g., self-reporting, drive by) : <u>Inspection checklist, site walk</u>				
	Frequency : <u>Quarterly</u>				
	Responsible party/ager <u>Navy</u>				
	Contact : <u>Scott Park -</u>	<u>RPM</u>	<u>757- 445-6628</u>		
	Name	Title	Phone No.		
	Reporting is up to date				
	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	N/A <input type="checkbox"/>		
	Reports are verified by the lead agency				
	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	N/A <input type="checkbox"/>		
	Specific reqs in deed or decision documents have been met				
	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	N/A <input type="checkbox"/>		
	Violations have been reported				
	Yes <input type="checkbox"/>	No <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>		
	Other problems or suggestions: Report attached <input type="checkbox"/>				
	<u>A LUC RD has not been developed for this Site. Quarterly inspections are completed and results are provided to regulatory agencies.</u>				
2	Adequacy				N/A <input checked="" type="checkbox"/>
	ICs are adequate <input type="checkbox"/>				
	ICs are inadequate <input type="checkbox"/>				
	Remarks : LUC RD has not been finalized				

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Some flanges are missing on monitoring wells in the high traffic areas

None of the monitoring well covers were opened. These wells are regularly inspected as part of ongoing quarterly inspections. Monitoring wells IDs are not permanently marked on the exterior.

C. Early indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost of scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be comprised in the future.

Remedy is in place at Site 12. Data collected to date do not indicate remedy problems.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

Will be evaluated in the next 5-yr review

I. SITE INFORMATION				
Site Name: Site 13 Former Pentachlorophenol Dip Tank and Wash Rack			Date of Inspection: September 17, 2008	
Location and Region: NAB Little Creek - Mid Atlantic			EPA ID: VA5170022482	
Agency, office, or company leading the five-year review: Navy in partnership with EPA and VDEQ			Weather/ temperature: Sunny, Mid 70s	
Remedy Includes: (Check all that apply):				
Landfill cover/containment <input type="checkbox"/>		Monitored natural attenuation <input type="checkbox"/>		
Access controls <input type="checkbox"/>		Groundwater containment <input type="checkbox"/>		
Institutional controls <input checked="" type="checkbox"/>		Vertical barrier walls <input type="checkbox"/>		
Groundwater pump and treatment <input type="checkbox"/>				
Surface water collection and treatment <input type="checkbox"/>				
Other : <u>In situ treatment (enhanced reductive dechlorination)</u>				
Attachments: Site Map is provided as Figure A-4				
1. Local regulatory authorities and response agencies (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.				
Agency <u>USEPA</u>				
Contact	<u>Jeff Boylan</u>	Remedial Project Manager	<u>9/17/2008</u>	<u>215-814-2094</u>
	Name	Title	Date	Phone #
Problems, suggestions; Report attached : <u>Not Applicable</u>				
See comments in Section XI of this Checklist				
Agency <u>VDEQ</u>				
Contact	<u>Paul Herman</u>	Remedial Project Manager	<u>9/17/2008</u>	<u>804-698-4464</u>
	Name	Title	Date	Phone #
Problems, suggestions; Report attached : <u>Not Applicable</u>				
See comments in Section XI of this Checklist				
Agency <u>NAB Little Creek</u>				
Contact	<u>Al Gregg</u>	Base Environmental	<u>9/17/2008</u>	<u>757-462-8564</u>
	Name	Title	Date	Phone #
Problems, suggestions; Report attached : <u>Not Applicable</u>				
See comments in Section XI of this Checklist				
II. INTERVIEWS - NOT APPLICABLE - SEE ATTACHMENT B.				
III. ON-SITE DOCUMENTS & RECORD VERIFIED (Check all that apply)				
1.	O&M Documents			
	O&M manual	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
	As-built drawings	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
	Maintenance logs	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
Remarks: <u>No active operating remediation system; FEAD has the Work Plan</u>				
2.	Site Specific Health and Safety Plan			
	Contingency/emergency response plan	Readily Available <input checked="" type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input type="checkbox"/>
		Readily Available <input checked="" type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input type="checkbox"/>
Remarks: <u>FEAD has the HASP</u>				
3.	O&M and OSHA Training Records			
		Readily Available <input checked="" type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input type="checkbox"/>
Remarks: <u>Per contract with Navy</u>				

4.	Permits and Service Agreements	Air discharge permit	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
		Effluent discharge	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
		Waste disposal, POTW	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
		Other permits _____	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
5.	Gas Generation Records		Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
6.	Settlement Monument Records		Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
7.	Groundwater Monitoring Records		Readily Available <input checked="" type="checkbox"/>	Up to date <input checked="" type="checkbox"/>	N/A <input type="checkbox"/>
	Remarks: Included in Administrative Record File - Available upon request				
8.	Leachate Extraction Records		Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
9.	Discharge Compliance Records	Air	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
		Water (effluent)	Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
10.	Daily Access/Security Logs		Readily Available <input type="checkbox"/>	Up to date <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
IV. O&M COST					
1	O&M Organization	State in-house <input type="checkbox"/>	Contractor for State <input type="checkbox"/>		
		PRP in-house <input type="checkbox"/>	Contractor for PRP <input type="checkbox"/>		
		Federal Facility in-house <input type="checkbox"/>	Contractor for Federal Facility <input checked="" type="checkbox"/>		
	Other : O&M Cost has not been recognized since the in-situ remediation system has not been implemented to date. A O&M contractor will be responsible for O&M of the treatment system at Site 13. _____				
2	O&M Cost Records	The O&M cost for Site 13 has not be recognized because the in-situ treatment system implemented.			
3	Unanticipated or Unusually High O&M Costs During Review Period	Describe costs and reasons: NA			
V. ACCESS AND INSTITUTIONAL CONTROLS					
A. Fencing					
1.	Fencing damaged	N/A <input checked="" type="checkbox"/>			
B. Other Access Restrictions <input type="checkbox"/> <input type="checkbox"/>					
1.	Signs and other security measures	N/A <input checked="" type="checkbox"/>			
C. Institutional Controls (ICs) <input checked="" type="checkbox"/>					
1.	Implementation and enforcement	Conditions imply ICs not properly implemented			
		Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	N/A <input type="checkbox"/>	
	Conditions imply ICs not being fully enforced				
		Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	N/A <input type="checkbox"/>	
	Type of monitoring (e.g., self-reporting, drive by) :	Inspection checklist, site walk _____			
	Frequency :	Quarterly _____			
	Responsible party/ager	Navy _____			
	Contact :	Scott Park -	RPM	757- 445-6628	
		Name	Title	Phone No.	
	Reporting is up to date	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	N/A <input type="checkbox"/>	
	Reports are verified by the lead agency	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	N/A <input type="checkbox"/>	
	Specific reqs in deed or decision documents have been met	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	N/A <input type="checkbox"/>	
	Violations have been reported	Yes <input type="checkbox"/>	No <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>	
	Other problems or suggestions:	Report attached <input type="checkbox"/>			
	A LUC RD has not been developed for this Site. Quarterly inspections are completed and results are provided to regulatory agencies.				
2	Adequacy	N/A <input checked="" type="checkbox"/>			
	ICs are adequate <input type="checkbox"/>				
	ICs are inadequate <input type="checkbox"/>				
	Remarks : LUC RD has not been finalized				

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

The in-situ groundwater treatment remedy has not been implemented. The work plan is currently in regulatory review.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Recommend permanently identifying monitoring wells using a plating or branding instrument on the cover.

Some monitoring wells have a cover mislabeling them as sewer manholes. Recommend placement of covers for proper identification.

C. Early indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be comprised in the future.

Remedy was not implemented at the time of the inspection.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

Will be evaluated in the next 5-yr review

Appendix B
Interview Summaries

INTERVIEW RECORD

Site Name: Site 9 - Driving Range Landfill Site 10 - Sewage Treatment Plant Landfill		EPA ID No: VA5170022482
Subject: NAB Little Creek Five Year Review		Time: 0800 Date: October 6, 2008
Type: Visit		Location: Base Environmental and FEAD Office

Contact Made By:

Name: Cecilia Landin	Title: Project Manager	Organization: CH2M HILL
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Individuals Contacted:

Name: Al Gregg	Title: Base Environmental	Organization: NAB Little Creek
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Telephone No: 757-462-8564 x392	Street Address: 1450 Gator Blvd.
Email Address: alfred.gregg1@navy.mil	City, State, Zip: Norfolk, Virginia 23521

Name: Richard Howard	Title: Base Planning	Organization: NAB Little Creek
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Telephone No: 757-462-7713 x314	Street Address: 1450 Gator Blvd.
Email Address: richard.d.howard2@navy.mil	City, State, Zip: Norfolk, Virginia 23521

Summary Of Conversation

Q1 - What is your overall impression of the project?

Overall impression of projects is good.

Q2 - What impacts, if any, has the remedy had on the surrounding community? Are you aware of any community concerns?

The remedies have not had any impacts on the surrounding community.

Q3. Do you feel the fact sheet distributed to the public for Site 12 was helpful? Should this be considered for future remedy implementation activities?

N/A

Q4. Does the remedy affect day to day base operations? If so, how?

The remedies do not directly affect day to day operations; however, LUC boundaries may not always be clear during potential land re-use planning.

Q5. Are LUCs and their objectives clear to appropriate base personnel? If not, what recommendations would you make to increase LUC awareness?

LUC boundaries are not always clear. Additional signs and/or monuments marking the LUC boundaries would be helpful in reducing potential impacts when re-using the land. Site 10 baseball field are privately maintained by a civilian organization that may not be aware of land restrictions.

Q6. Do you have any comments, suggestions, or recommendations regarding the site remedy?

No additional comments, suggestions, or recommendations.

INTERVIEW RECORD

Site Name: Site 11 - School of Music	EPA ID No: VA5170022482	
Subject: NAB Little Creek Five Year Review	Time: 0800	Date: October 6, 2008
Type: Visit	Location: Base Environmental and FEAD Office	

Contact Made By:

Name: Cecilia Landin	Title: Project Manager	Organization: CH2M HILL
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Individuals Contacted:

Name: Al Gregg	Title: Base Environmental	Organization: NAB Little Creek
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Telephone No: 757-462-8564 x392	Street Address: 1450 Gator Blvd.
Email Address: alfred.gregg1@navy.mil	City, State, Zip: Norfolk, Virginia 23521

Name: Richard Howard	Title: Base Planning	Organization: NAB Little Creek
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Telephone No: 757-462-7713 x314	Street Address: 1450 Gator Blvd.
Email Address: richard.d.howard2@navy.mil	City, State, Zip: Norfolk, Virginia 23521

Summary Of Conversation

Q1. What is your overall impression of the project?

Overall impression of the project is good.

Q2. What impacts, if any, has the remedy had on the surrounding community? Are you aware of any community concerns?

The remedy has not had any impacts on the surrounding community.

Q3. Do you feel the fact sheet distributed to the public for Site 12 was helpful? Should this be considered for future remedy implementation activities?

The fact sheet would not be required for implementation of the Site 11 remedy; however, building occupants should be notified.

Q4. Does the remedy affect day to day base operations? If so, how?

The remedy has not yet been implemented. Work is currently scheduled to take place during the evening hours to minimize potential impacts to building operations; however, evening hours may not be necessary to avoid direct affects on base operations. No impacts to base operations have been observed to date.

Q5. Are LUCs and their objectives clear to appropriate base personnel? If not, what recommendations would you make to increase LUC awareness?

LUC objectives are understood, however boundaries could be more clearly marked. For added value it is recommended the reference to the site as part of the IR program cease following site closure. The Base should be made aware when LUC restrictions are lifted and land is open for re-use.

Q6. Do you have any comments, suggestions, or recommendations regarding the site remedy?

It is recommended that following site closure all site monitoring wells be removed. Additionally, a better understanding of remediation timeframes would assist in base planning activities.

INTERVIEW RECORD

Site Name: Site 12 - Former Exchange Laundry/Dry Cleaning Facility	EPA ID No: VA5170022482	
Subject: NAB Little Creek Five Year Review	Time: 0800	Date: October 6, 2008
Type: Visit	Location: Base Environmental and FEAD Office	

Contact Made By:

Name: Cecilia Landin	Title: Project Manager	Organization: CH2M HILL
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Individuals Contacted:

Name: Al Gregg	Title: Base Environmental	Organization: NAB Little Creek
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Telephone No: 757-462-8564 x392	Street Address: 1450 Gator Blvd.
Email Address: alfred.gregg1@navy.mil	City, State, Zip: Norfolk, Virginia 23521

Name: Richard Howard	Title: Base Planning	Organization: NAB Little Creek
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Telephone No: 757-462-7713 x314	Street Address: 1450 Gator Blvd.
Email Address: richard.d.howard2@navy.mil	City, State, Zip: Norfolk, Virginia 23521

Summary Of Conversation

Q1. What is your overall impression of the project?

Overall impression of the project is good. Non-disruptive nature of the remedy was added value.

Q2. What impacts, if any, has the remedy had on the surrounding community? Are you aware of any community concerns?

The remedy has not had any impacts on the surrounding community. Because remedy implementation was conducted in the evening hours, the community was able to maintain use of the commissary and car wash.

Q3. Do you feel the fact sheet distributed to the public for Site 12 was helpful? Should this be considered for future remedy implementation activities?

No feedback was received from the public regarding the fact sheets distributed.

Q4. Does the remedy affect day to day base operations? If so, how?

The remedy does not affect day to day operations.

Q5. Are LUCs and their objectives clear to appropriate base personnel? If not, what recommendations would you make to increase LUC awareness?

LUC objectives are understood, however boundaries could be more clearly marked. For added value it is recommended the reference to the site as part of the IR program cease following site closure. The Base should be made aware when LUC restrictions are lifted and land is open for re-use.

Q6. Do you have any comments, suggestions, or recommendations regarding the site remedy?

It is recommended that following site closure all site monitoring wells be removed. Additionally, a better understanding of remediation timeframes would assist in base planning activities.

INTERVIEW RECORD

Site Name: Site 13 - Former PWC Pentachlorophenol Dip Tank/Wash Rack	EPA ID No: VA5170022482	
Subject: NAB Little Creek Five Year Review	Time: 0800	Date: October 6, 2008
Type: Visit	Location: Base Environmental and FEAD Office	

Contact Made By:

Name: Cecilia Landin	Title: Project Manager	Organization: CH2M HILL
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Individuals Contacted:

Name: Al Gregg	Title: Base Environmental	Organization: NAB Little Creek
Telephone No: 757-462-8564 x392	Street Address: 1450 Gator Blvd.	
Email Address: alfred.gregg1@navy.mil	City, State, Zip: Norfolk, Virginia 23521	
Name: Richard Howard	Title: Base Planning	Organization: NAB Little Creek
Telephone No: 757-462-7713 x314	Street Address: 1450 Gator Blvd.	
Email Address: richard.d.howard2@navy.mil	City, State, Zip: Norfolk, Virginia 23521	

Summary Of Conversation

Q1. What is your overall impression of the project?

Overall impression of the project is good.

Q2. What impacts, if any, has the remedy had on the surrounding community? Are you aware of any community concerns?

The remedy has not had any impacts on the surrounding community.

Q3. Do you feel the fact sheet distributed to the public for Site 12 was helpful? Should this be considered for future remedy implementation activities?

A fact sheet for PWC personnel is recommended for remedy implementation at Site 13.

Q4. Does the remedy affect day to day base operations? If so, how?

The remedy has not yet been implemented. Work is tentatively scheduled to take place during normal business hours to reduce impacts to overnight PWC vehicle parking; however, additional coordination with PWC should be conducted to establish the schedule. No impacts to base operations have been observed to date.

Q5. Are LUCs and their objectives clear to appropriate base personnel? If not, what recommendations would you make to increase LUC awareness?

LUC objectives are understood, however boundaries could be more clearly marked. For added value it is recommended the reference to the site as part of the IR program cease following site closure. The Base should be made aware when LUC restrictions are lifted and land is open for re-use.

Q6. Do you have any comments, suggestions, or recommendations regarding the site remedy?

It is recommended that following site closure all site monitoring wells be removed. Additionally, a better understanding of remediation timeframes would assist in base planning activities.