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Final

Remedial Investigation, Human Health Risk Assessment, and Ecological Risk Assessment for SWMU 7, Small Boats Sandblasting Yard

Naval Amphibious Base Little Creek
Virginia Beach, Virginia

NAVFAC
Naval Facilities Engineering Command

Prepared for

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Atlantic Division
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Executive Summary

This Remedial Investigation (RI) Report presents the data, results, and conclusions for the investigation conducted by CH2M HILL at Solid Waste Management Unit (SWMU) 7, Naval Amphibious Base (NAB) Little Creek in Virginia Beach, Virginia. SWMU 7 (Small Boats Sandblast Yard), formerly referred to as SWMU 137, is located along Piers 44-55 adjacent to Desert Cove and includes Building CB-125. The purpose of this RI is to further define the nature and extent of contamination at SWMU 7. The necessary data was collected to complete a human health risk assessment (HHRA) and ecological risk assessment (ERA) also included herein.

The Navy in partnership with the United States Environmental Protection Agency (USEPA) and the Virginia Department of Environmental Quality (VDEQ) agreed to separate the terrestrial and aquatic portion of SWMU 7 following the results of this RI, HHRA, and ERA because of the potential risks associated with the terrestrial portion of the SWMU versus Desert Cove. In this report SWMU 7a addresses groundwater and soil, and SWMU 7b addresses Desert Cove sediment, and the recommendations for the path forward for each SWMU may be different.

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Site Description and Previous Investigations

The SWMU 7 area was utilized for sandblasting and ship painting before 1996; since then sandblasting activities have been conducted in an indoor facility (Building CB-125). SWMU 7 was also used to store spent Abrasive Blast Material (ABM) pending characterization (EP Toxicity) testing results. Approximately 4,000 cubic yards (yd^3) of ABM generated from 1960 to 1982 were stored (in open piles) in the small boats sandblasting area (SWMU 7).

The ground surface at SWMU 7 consists mostly of concrete, asphalt, and hard-packed gravel. Adjacent to SWMU 7 and west of building CB-125, is a large parcel of trees and grass-covered ground. Desert Cove and the connector channel are also adjacent to SWMU 7, which receive direct runoff and discharge from the outfalls located around the cove. The cove and connector channel are inland to Little Creek Channel, which leads northward towards the Chesapeake Bay. These water bodies are tidally influenced and regularly receive influxes of surface water.

The 1984 Initial Assessment Study (IAS) conducted by Rodgers, Golden, and Halpern (R.G.H., December 1984) found that ABM and paint chips from sandblasting activities were allowed to accumulate on the site between the 1960s and 1982 and are present in onshore soils and the near-shore sediments of Desert Cove at SWMU 7. Analytical results from leachability testing for metals showed that the ABM and associated residue was non-hazardous with limited migration potential. Based on these findings, the IAS recommended that no confirmation studies or remedial actions be undertaken at SWMU 7 (R.G.H, December 1984).

A visual site inspection (VSI) was conducted (Earth Tech, 1988) in order to identify any potential sources of contamination or potentially contaminated areas without collecting samples. The VSI determined that spent blast grit and oily substances were released to Desert Cove from the Small Boats Sandblast Yard, based on visual indicators.

A 1989 Resource Conservation and Recover Act (RCRA) facility assessment (RFA) identified SWMU 7 as potentially affected by contamination resulting from historical processes and activities (A.T. Kearny, 1989).

Soil and groundwater investigations were conducted (ATEC, 1989 and 1993) prior to the construction of the indoor sandblast facility at SWMU 7. In 1989, soil was sampled at five locations for total metals, and zinc was the only detected analyte.

In January 1993, three soil samples and three groundwater samples were collected from wells installed at the SWMU (ATEC, 1993). Soil samples were analyzed for metals (Toxicity Characterization Leaching Procedure [TCLP] list) and groundwater was analyzed for total (unfiltered) metals (subset of the USEPA Target Analyte List [TAL] metals). Arsenic, selenium, and silver were the only constituents detected in soils during the 1993 investigation. Arsenic and cadmium were detected in groundwater.

CH2M HILL conducted a Site Investigation (SI) at SWMU 7 in May 2000. During the SI, ABM was only encountered on the ground surface on portions of SWMU 7; no ABM was identified in subsurface soils, and it was primarily located near the new indoor blast facility and a small area adjacent to building CB-137. A visual inspection of the surface soils estimated that ABM comprised less than 5 percent of soil matrix at SWMU 7. No release controls were in place at the site. Groundwater, soil, and sediment samples were collected as part of the SI. Surface soil samples and subsurface soil samples were collected at 14 locations at SWMU 7. Five sediment samples were collected in Desert Cove adjacent to the bulkhead. Three monitoring wells were installed at SWMU 7 and groundwater samples were collected. Samples were analyzed for USEPA target compound list (TCL) Volatile Organic Compounds (VOCs), TCL Semivolatile Organic Compounds (SVOCs), pesticides and polychlorinated biphenyls (PCBs), and TAL total (dissolved for groundwater) metals. Analytical results were screened to USEPA Region III Risk Based Concentrations (RBCs) and Maximum Contamination Levels (MCLs) in order to evaluate constituents of potential concern at the site. Potential contaminants of concern identified were metals (aluminum, arsenic, manganese, and iron) and PAHs. The investigation results were presented in the *Final Site Investigation Report for Solid Waste Management Unit (SWMU) 7 and 8, Naval Amphibious Base, Little Creek*, October 2000.

Remedial Investigation Activities

The objectives of the RI were to identify and evaluate existing information for SWMU 7; further define the nature and extent of contamination by conducting surface soil, subsurface soil, groundwater, and sediment sampling; evaluate potential transport pathways at SWMU 7; and conduct a quantitative human health risk assessment (HHRA) and ecological risk assessment (ERA) using existing and RI data. The work plan was jointly scoped by the NAB Little Creek Tier I Partnering Team (CH2M HILL, July 2002).

Concurrent with the development of this RI, and based on historical and RI data, an interim removal action was completed at SWMU 7 in September 2004 to remove an isolated area of surface soil at SWMU 7 where lead concentrations were detected above the USEPA lead guidance criteria of 400 mg/kg. Removal action alternatives were evaluated in an EE/CA (CH2M HILL, 2004). Documentation of construction completion is provided in this RI.

Hydrogeologic Characteristics

The hydrogeologic characteristics at SWMU 7 were determined by soil boring data and groundwater level measurements gathered during the SI and the RI.

The hydrostratigraphic units relevant to the RI are the Columbia Aquifer (water table aquifer), the underlying Yorktown Confining Unit and the Upper Yorktown Aquifer. At SWMU 7, Columbia Group soils generally consist of interbedded silts, silty sand, clean sand, well-sorted sand and gravel, with some clay lenses.

The Yorktown Confining Unit, consisting of clays and silty to sandy clays, is present at approximately 23 ft bgs at SWMU 7 and separates the Columbia Aquifer from the underlying Yorktown Aquifer. The Yorktown Aquifer is semiconfined beneath the Upper Yorktown Formation. Water bearing zones in the Yorktown Aquifer consist of fine to coarse grain sand, gravel, and shells.

The water table was encountered at approximately 3 to 10 ft bgs. Groundwater in the Columbia Aquifer generally flows toward Desert Cove. Due to the shallow groundwater table and the low hydraulic gradient (0.0025 to 0.0057 ft/ft), Desert Cove is likely in direct contact with the water table. Tidal influences are not likely to have a significant effect on groundwater flow directions at SWMU 7.

Nature and Extent of Contamination

Analytical results were compared to regulatory screening criteria for human health and ecological receptors. Detected constituents in the soil and groundwater were also compared to the basewide background concentrations established during the background study (CH2M HILL, December 2000).

In surface and subsurface soils (SWMU 7a), several PAHs and inorganics pose a potential risk based on human health and ecological screening values (benzo(b)fluoranthene, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene, arsenic, aluminum, chromium, copper, iron, lead, manganese, mercury, thallium, vanadium, and zinc). Highest concentrations of detected constituents were generally near

the current indoor blasting facility and near Buildings 3884 and 3869. PAHs exceeding screening criteria were not detected during the background investigation.

In shallow groundwater (SWMU 7a), methyl-tert-butyl ether (MW03) was the only organic constituent to exceed screening criteria (human health). Groundwater samples collected from MW01 and MW02 had the greatest number of total and dissolved metals concentrations exceeding screening criteria and the background UTL. The downgradient monitoring well (MW01) and the upgradient monitoring well (MW02) near the sandblast facility exhibited similar total and dissolved metals concentrations. Monitoring well MW04, northeast of Desert Cove, contained total concentrations of aluminum, iron, and manganese and dissolved concentrations of iron and manganese exceeding ecological screening criteria, but did not exceed the background UTL.

In sediment (SWMU 7b), several PAHs and inorganics pose a potential risk based on human health and ecological screening. Arsenic was the only inorganic constituent in exceedance of both the human health and ecological screening values. Iron was found in exceedance of the residential soil RBC, but the levels were not above the ecological screening value. Constituents exceeding only the ecological screening criteria include aluminum, arsenic, barium, cobalt, copper, lead, manganese, mercury, nickel, selenium, tin, vanadium, and zinc. Organic and inorganic analytes were elevated in samples collected near the bulkhead surrounding the cove. Concentrations of analytes generally decreased west towards Little Creek Channel. However, arsenic and iron concentrations were similar in both the surface and subsurface samples. PAHs were not as abundant in the subsurface sediment.

Contaminant Fate and Transport

SWMU 7a soil is a potential source of contaminants to shallow groundwater at SWMU 7a and SWMU 7b sediment and surface water of Desert Cove. The deposition of impacted soil particles transported to the Cove by overland flow and/or stormwater drainage likely contributes contaminants to the sediments. The leaching of contaminants from the soil column is a likely contributor of inorganic contaminants to shallow groundwater at SWMU 7a.

Based on the chemical and physical data gathered for SWMU 7a, releases from surface soil to the atmosphere are not likely due to surface cover and constituents that do not readily volatilize from the soil (i.e., metals and organics have little tendency to volatilize). Sediment and surface water are not likely sources of contaminants to groundwater, and groundwater discharge is not a likely source of contaminants to sediment.

Human Health Risk Assessment

A baseline HHRA was conducted to evaluate the potential human health risks associated with exposure to site-related surface soil, soil (surface and subsurface soil combined), surface sediment, sediment (surface and subsurface sediment combined), and groundwater contamination at SWMU 7. Data collected during the SI and RI indicate that no unacceptable risks or hazards exist based on current site use.

Future exposure to groundwater used as a potable water supply by an adult and child resident may result in a noncarcinogenic hazard above USEPA's target hazard level, where

ingestion of arsenic, iron, and manganese contribute the greatest hazard. However, it is extremely unlikely that the Columbia Aquifer groundwater will be used as a future source of potable water, due to its low yield and the availability of better water supplies. The carcinogenic risk associated with the resident child/adult is from the ingestion of arsenic. Arsenic was detected in groundwater at a concentration statistically similar to background concentrations, and elimination of arsenic as a chemical of potential concern (COPC) would result in the carcinogenic risk falling with USEPA's target risk range.

Ecological Risk Assessment

A baseline ERA was conducted to evaluate the potential ecological risks associated with the presence of site-related surface soil at SWMU 7a and surface sediment contamination at SWMU 7b.

The developed nature of the terrestrial portions of the site and the resulting low quality of the habitat present (gravel or hard-packed dirt with low and sparse herbaceous plants) is likely to significantly reduce potential exposures. Additionally, the September 2004 interim removal action completed for surface soil reduced the potential for continued transport of ABM residues and associated metals to Desert Cove. There were no exceedances (based upon LOAELs) for terrestrial-based food web exposures.

There were no exceedances (based upon NOAELs) for aquatic-based food web exposures. In surface sediment, a number of metals (particularly copper, lead, mercury, tin, and zinc) and PAHs were identified as COCs. A comparison of surface and subsurface sediment concentrations suggests some mixing within the top foot or two of the sediment column. In general, sediment concentrations were highest in the pier area of Desert Cove and lowest in the Connector Channel. This pattern was also reflected in the benthic invertebrate community data and is also consistent with the known site history and proximity to source areas. SEM/AVS ratios from surface sediment samples, however, suggest that metal bioavailability is relatively low, with only one of 18 ratios exceeding one. A comparison of surface sediment concentrations to equilibrium partitioning-based sediment values, which provide a measure of bioavailability, for the three PAHs with available values suggests that potential exposures and risks are high in the pier area and low elsewhere. Groundwater does not appear to be a significant transport route from the site to the Desert Cove system.

In summary, the highest site-related risks were associated with metals (primarily copper, lead, mercury, tin, and zinc) and PAHs in Desert Cove sediments, particularly in the pier areas.

Conclusions

This section presents a summary of potential risks identified in the RI and the rationale for risk management consideration for soil and groundwater at SWMU 7a.

Soil

Human health risk associated with exposure to soil at SWMU 7a are acceptable. While, the noncarcinogenic hazard associated with exposure to combined surface and subsurface soil for the future child resident scenario is above USEPA's target hazard index of 1.0 (1.4), none of the individual constituents in soil contribute HQs above 0.5, and there are no target

organs with HIs above 1 due to soil exposure. The risks for all other human health scenarios from exposure to surface soil and combined surface and subsurface soil are within USEPA's acceptable risk range.

The potential site-related ecological risks associated with SWMU 7a are acceptable. PAH exceedances of the ecological screening values were restricted to a small area near CB-125, and are not related to ABM (CERCLA) activities. The developed nature of the terrestrial portions of the site and the resulting low quality of the habitat present (gravel or hard-packed dirt with low and sparse herbaceous plants) is likely to significantly reduce potential exposures. The potential for transport of metals to Desert Cove from the northern area of the site was eliminated through the interim removal action completed in September 2004. There were no exceedances (based upon LOAELs) for terrestrial-based food web exposures.

Therefore the Navy in partnership with the EPA and VDEQ agree that no further CERCLA actions are warranted for soil at SWMU 7a.

Groundwater

Potential human health risks associated with exposure to groundwater are limited to potable use by future residents from ingestion of arsenic, iron, and manganese, and potential dermal contact of a future construction worker to manganese in groundwater. Arsenic only slightly exceeds (18.4 µg/L) the MCL (10 µg/L) in one of six samples. Based on a population to population statistical comparison, arsenic concentrations are statistically similar to the background groundwater samples.

While iron and manganese concentrations are statistically different than background, they only exceed their respective background UTLs in three of the six samples. Although, there is a slight potential risk (HI=1.7) to the future construction worker from dermal exposure to manganese in groundwater, there is no risk (HI=0.4) based on a more realistic central tendency exposure scenario.

Although arsenic, iron, and manganese in groundwater indicate a potential human health risk for potable use, these metals are not believed to be related to a CERCLA release associated with sandblasting activities at SWMU 7a based on the following:

- Concentrations of typical ABM related metals such as lead, copper, chromium, and zinc are not elevated in soil or groundwater; these metals would be expected to also be elevated if arsenic, iron, manganese were related to ABM activities as well.
- LW07-MW01, where the highest iron and manganese concentrations are present in groundwater, is located adjacent to the rip-rap shoreline of the connector channel entering Desert Cove and may be tidally influenced as evidenced by elevated conductivity and salinity measurements. Concentrations of iron and manganese may be reflective of this tidal influence.
- There is no correlation between higher concentrations of arsenic, iron, and manganese in groundwater with concentrations of iron and manganese in soil. If arsenic, iron, and manganese in groundwater were the result of leaching from surface ABM, it would be expected that these metals would also be elevated in the overlying soil.

- Desert Cove is a bulkheaded pier area created though backfill material potentially pulled from the Cove and Connector channel during dredging activities. Epic photos (1937, 1949, and 1954) indicate beach exposed land area where bulkhead piers are currently situated with at least 10 feet of fill. SWMU 7a monitoring wells are screened within this dredge fill material. Arsenic, iron, and manganese concentrations in groundwater could be reflective of the dredge fill components rather than surface ABM activities.

Therefore, the Navy in partnership with the EPA and VDEQ agree that no further CERCLA actions are warranted for groundwater at SWMU 7a.

Recommendations

SWMU 7a

Based on results from previous investigations, conclusions of the human health and ecological risk assessments, and interim removal actions completed at SWMU 7a, the Navy in partnership with the EPA and VDEQ agree that no further CERCLA actions are warranted for SWMU 7a. The proposed path forward for SWMU 7a is to complete a Proposed Remedial Action Plan (PRAP) and Record of Decision (ROD) for no further action and site closeout with unrestricted use/unrestricted exposure.

SWMU 7b

Potential risks in the Desert Cove system are high in some areas (such as near the piers). The current plans to replace the piers and dredge the cove and channel in 2006 are likely to address these potential risks. While the depth of dredging is not yet known, it is likely that at least several feet of sediment will be removed during this activity. If this activity takes place, the collection and evaluation of post-dredging surface sediment samples is recommended to confirm that concentrations of chemicals have been reduced to acceptable levels. If the activity does not take place, it is recommended that the risk evaluation for SWMU 7 be continued.

Contents

Executive Summary ..... **iii**

Acronyms and Abbreviations ..... **xvii**

1 Introduction **1-1**
1.1 Objectives and Approach 1-1
1.2 Report Organization 1-2
1.3 References 1-2

2 Background **2-1**
2.1 NAB Little Creek History and Operations 2-1
2.2 NAB Little Creek Location and Land Use 2-1
2.3 SWMU 7 History and Description 2-2
2.4 Previous Investigations 2-3
2.4.1 Initial Assessment Study (December 1984) 2-3
2.4.2 Visual Site Inspection (1988) 2-4
2.4.3 RCRA Facility Assessment (December 1989) 2-4
2.4.4 Soil and Groundwater Investigations (1989 and 1993) 2-4
2.4.5 Site Investigation (2000) 2-4
2.4.6 Baseline Ecological Risk Assessment (January 2001) 2-6
2.4.7 Engineering Evaluation Cost Analysis, Interim Removal Action and Construction Completion (2004) 2-7
2.5 References 2-8

3 Field Investigation Activities **3-1**
3.1 Surface and Subsurface Soil Sampling 3-1
3.2 Monitoring Well Installation and Groundwater Sampling 3-2
3.3 Sediment Sampling 3-2
3.4 References 3-3

4 Physical Characteristics **4-1**
4.1 Regional and Basewide Physiography, Climate, and Surface Water Hydrogeology 4-1
4.2 SWMU 7 Surface Features, Topography, and Drainage 4-2
4.3 Geology and Hydrogeology 4-2
4.3.1 General Regional Geologic and Hydrogeologic Framework 4-2
4.3.2 Regional Geologic and Hydrostratigraphic Unit Description 4-4
4.3.3 Regional Water Usage 4-6
4.3.4 Site Specific Geology and Hydrogeology 4-6
4.4 References 4-7

5 Nature and Extent of Contamination **5-1**
5.1 Data Management and Evaluation 5-1
5.1.1 Data Tracking and Validation 5-1
5.1.2 Data Qualifiers 5-1

5.1.3 Evaluation of Non-Site-Related Analytical Results ... 5-2
5.1.4 Regulatory and Risk-Based Screening Criteria ... 5-3
5.1.5 Background Data ... 5-4
5.2 SWMU 7 RI Analytical Results ... 5-5
5.2.1 Surface Soil ... 5-5
5.2.2 Subsurface Soil ... 5-6
5.2.3 Groundwater ... 5-7
5.2.4 Sediment ... 5-8
5.3 Summary of Relevant Constituents at SWMU 7 ... 5-10
5.3.1 Soil ... 5-10
5.3.2 Shallow Groundwater ... 5-10
5.3.3 Sediment ... 5-11
5.4 References ... 5-11

6 Contaminant Fate and Transport ... 6-1
6.1 Mobility and Persistence of Constituents ... 6-1
6.1.1 Constituent Groups ... 6-1
6.1.2 Physical and Chemical Properties ... 6-2
6.1.3 Representative Chemicals ... 6-3
6.1.4 Conceptual Site Model ... 6-5
6.2 COI Migration at SWMU 7 ... 6-8
6.2.1 Potential Releases from Soil to the Atmosphere ... 6-8
6.2.2 Potential Releases from Soil to Sediment and Surface Water ... 6-8
6.2.3 Potential Leaching of Constituents from Soil to Columbia Aquifer Groundwater ... 6-9
6.2.4 Potential Discharge of Impacted Groundwater ... 6-10
6.2.5 Surface Water Flow between Desert Cove and Little Creek Channel ... 6-11
6.3 Summary of Fate and Transport Conclusions ... 6-11
6.4 References ... 6-12

7 Human Health Risk Assessment ... 7-1
7.1 Introduction ... 7-1
7.2 Identification of COPCs ... 7-2
7.2.1 Data Evaluation and Selection ... 7-2
7.2.2 Data Summary ... 7-2
7.2.3 Selection of COPCs ... 7-4
7.2.4 Summary of COPCs ... 7-5
7.3 Exposure Assessment ... 7-5
7.3.1 Characterization of Exposure Setting ... 7-5
7.3.2 Identification of Exposure Pathways ... 7-6
7.3.3 Quantification of Exposure ... 7-8
7.4 Toxicity Assessment ... 7-10
7.4.1 Toxicity Information for Noncarcinogenic Effects ... 7-11
7.4.2 Information for Carcinogenic Effects ... 7-11
7.5 Risk Characterization ... 7-12
7.5.1 Methods for Evaluating Risk and Hazard ... 7-12
7.5.2 Risk Assessment Results ... 7-14
7.6 Uncertainty Assessment ... 7-19

7.6.1 Uncertainty in COPC Selection 7-20
7.6.2 Uncertainty Associated with Exposure Assessment 7-20
7.6.3 Uncertainty Associated with Toxicity Assessment 7-20
7.6.4 Uncertainty in Risk Characterization 7-21
7.6.5 Effect of Comparison of Risk Drivers to Background Concentrations ... 7-21
7.7 Summary 7-22
7.8 References 7-23

8 Ecological Risk Assessment 8-1
8.1 Introduction 8-1
8.1.1 Ecological Risk Assessment Process 8-1
8.1.2 Objectives of the ERA 8-2
8.2 Facility Environment Setting 8-3
8.2.1 Physiographic Features 8-3
8.2.2 Habitats and Biota 8-3
8.3 Screening Ecological Risk Assessment 8-6
8.3.1 Screening Problem Formulation 8-6
8.3.2 Screening Exposure Estimation 8-12
8.3.3 Screening Effects Evaluation 8-16
8.3.4 Screening Risk Calculation 8-18
8.3.5 Screening Risk Conclusions 8-19
8.4 Baseline Ecological Risk Assessment 8-19
8.4.1 Refinement of Conservative Screening Assumptions 8-19
8.4.2 Refined (Step 3A) Risk Characterization 8-21
8.4.3 Risk Evaluation 8-24
8.5 Uncertainties 8-26
8.6 Ecological Risk Assessment Conclusions 8-30
8.6.1 Recommendations 8-31
8.7 References 8-31

9 Conclusions and Recommendations 9-1
9.1 Nature and Extent of Contamination 9-1
9.1.1 Soil 9-1
9.1.2 Groundwater 9-1
9.2 Sediment 9-1
9.3 Fate and Transport of Contamination 9-2
9.4 Human Health Risk Assessment 9-2
9.5 Ecological Risk Assessment 9-2
9.6 Risk Management for SWMU 7a 9-3
9.6.1 Soil 9-3
9.6.2 Groundwater 9-3
9.7 Recommendations 9-4
9.7.1 SWMU 7a 9-4
9.7.2 SWMU 7b 9-5

Appendixes

A Summary of Analytical Results
B Borelogs and Well Construction Diagrams
C Field Parameters
D Benthic Invertebrate Report
E Data Validation Report
F Background Report Analytical Results
G Grain Size Analysis
H Human Health Risk Assessment Tables
I Construction Closeout Report

Tables (Tables are located at the end of each section.)

2-1 Characteristics of Outfalls Discharging to Desert Cove and the Connector Channel
2-2 1989 Soil Sampling Results
2-3 1993 Soil and Groundwater Sampling Results
2-4 Summary of SI Data for Groundwater at SWMU 7
2-5 Summary of SI Data for Sediment Collected at SWMU 7
2-6 Summary of SI Data for Surface Soil at SWMU 7
2-7 Summary of SI Data for Subsurface Soil at SWMU 7

3-1 Remedial Investigation Sample Summary
3-2 Vibracore Sample Summary

4-1 Lithology of Direct Push Soil Borings
4-2 Summary of Groundwater Elevations

5-1 Summary of Regulatory Criteria for Groundwater
5-2 Summary of Regulatory Criteria for Soil and Sediment
5-3 Surface Soil Exceedances of Screening Criteria
5-4 Subsurface Soil Exceedances of Screening Criteria
5-5 Monitoring Well Exceedances of Screening Criteria
5-6 Direct Push Groundwater Exceedances of Screening Criteria
5-7 Surface Sediment Exceedances of Screening Criteria
5-8 Subsurface Sediment Exceedances of Screening Criteria

6-1 SWMU 7 COIs by Media
6-2 Physical, Chemical, and Half-Life Data of Representative Chemicals
6-3 Retardation Coefficients for Representative Chemicals

7-1 Summary of Data Quantitatively Used in Risk Assessment
7-2 Summary of COPCs for the HHRA
7-3 Potentially Complete Human Health Pathways
7-4 Summary of RME Cancer Risks and Hazard Indices
7-5 Summary of RME Cancer Risks and Hazard Indices CTs

8-1 Partial List of Flora
8-2 Mammalian Species Known or Expected to Occur
8-3 Amphibians and Reptiles Known to Occur
8-4 Bird Species Known to Occur on the Base and Its Adjacent Waters
8-5 Freshwater Fish Species Known to Occur

8-6 Saltwater Fish Species Known to Occur
8-7 Water Column Parameter Measurements in Desert Cove and the Connector Channel Measured During the RI
8-8 Sediment Parameter Measurements in Desert Cove and the Connector Channel Measured During the SI and RI
8-9 Sediment Descriptions at Non-IRP Locations
8-10 Characteristics fo Outfalls Discharging to Desert Cove and the Connector Channel
8-11 Data Selected for Use in the Ecological Risk Assessment
8-12 Summary of Non-IRP Surface Water Data for Locations Near SWMU 7
8-13 Summary of Non-IRP Sediment Data for Locations Near SWMU 7
8-14 Summary Statistics – Surface Soil
8-15 Summary Statistics – Subsurface Soil
8-16 Summary Statistics – Surface Sediment
8-17 Summary Statistics – Subsurface Sediment
8-18 Summary Statistics – Groundwater (on-site)
8-19 Summary Statistics – Groundwater (upgradient)
8-20 Samples Used in the ERA
8-21 Preliminary Assessment Endpoints, Risk Hypotheses, and Measurement Endpoints
8-22 Bioaccumulative Chemicals List and K_{OW} Values for Relevant Chemicals
8-23 Soil Bioconcentration and Bioaccumulation Factors for Plants and Soil Invertebrates – Step 2
8-24 Soil Bioaccumulation Factors for Small Mammals – Step 2
8-25 Sediment Bioaccumulation Factors for Benthic Invertebrates and Fish – Step 2
8-26 Exposure Parameters for Upper Trophic Level Ecological Receptors – Step 2
8-27 Medium-Specific Screening Values
8-28 Ingestion Screening Values for Mammals
8-29 Ingestion Screening Values for Birds
8-30 Step 2 Screening Statistics – Surface Soil
8-31 Step 2 Screening Statistics – Surface Sediment
8-32 Step 2 Screening Statistics – Groundwater (on-site)
8-33 Summary of Hazard Quotients for Upper Trophic Level Receptors – Step 2
8-34 Summary of COPCs – Step 2
8-35 Soil Bioconcentration and Bioaccumulation Factors for Plants and Soil Invertebrates – Step 3
8-36 Soil Bioaccumulation Factors for Small Mammals – Step 3
8-37 Sediment Bioaccumulation Factors for Benthic Invertebrates and Fish – Step 3
8-38 Exposure Parameters for Upper Trophic Level Ecological Receptors – Step 3
8-39 Assessment Endpoints, Risk Hypotheses, and Measurement Endpoints – Step 3
8-40 Step 3 Screening Statistics – Surface Soil (Southern Area)
8-41 Step 3 Screening Statistics – Surface Soil (Eastern Area)
8-42 Step 3 Screening Statistics – Surface Soil (Northern Area)
8-43 Step 3 Screening Statistics – Surface Sediment (Connector Channel)
8-44 Step 3 Screening Statistics – Surface Sediment (Pier Area)
8-45 Step 3 Screening Statistics – Surface Sediment (Desert Cove)
8-46 Step 3 Screening Statistics – Groundwater (on-site)
8-47 Summary of Hazard Quotients for Upper Trophic Level Receptors – Step 3
8-48 Summary of PCOCs

8-49 Comparison of Inorganic PCOC Surface Soil Concentrations to Background Concentrations
8-50 Comparison of Organic PCOC Surface Soil Concentrations to Urban Background Concentrations
8-51 Comparison of Surface and Subsurface Soil Concentrations
8-52 Comparison of Surface and Subsurface Sediment Concentrations
8-53 Screening Statistics – Subsurface Sediment
8-54 Benthic Invertebrate Sampling Results
8-55 Benthic Invertebrate Sampling Results – Summary by Area
8-56 Physical Parameter Measurements – Sediment
8-57 Comparison of Surface Sediment Concentrations with Equilibrium Partitioning-Based Marine Sediment Values
8-58 Comparison of Groundwater PCOC Concentrations to Upgradient and Background Concentrations
8-59 Summary of COCs
8-60 Reporting Limit to Screening Value Comparison

Figures (Figures are located at the end of each section.)

2-1 Base Location Map for Little Creek
2-2 Site Location Map
2-3 SWMU 7 Boundary and Immediate Vicinity
2-4 Desert Cove/Connector Channel Outfall Locations
2-5 Previous Sampling Locations
2-6 Soil and Groundwater Sampling Locations (1989 and 1993) investigation
2-7 Groundwater, Soil, and Sediment Sampling Locations from the 2000 Site Investigation

3-1 Soil and Groundwater Locations
3-2 Sediment Sampling Locations

4-1 Physiographic Provinces of Southern Virginia
4-2 Virginia Tidewater Area Physiography and Hydrology Features
4-3 Generalized Geologic Section Showing Eastward-Thickening of Sedimentary Wedge of Virginia Coastal Plain
4-4 Major Structural Basement-Deformation Features of the Virginia Coastal Plain and Adjoining Areas
4-5 Stratigraphic and Hydrogeologic Framework
4-6 Locations of Hydrostratigraphic Cross-Sections
4-7 Hydrostratigraphic Cross-Section A-A'
4-8 Hydrostratigraphic Cross-Section A'-A"
4-9 Groundwater Elevation Contours (March 2003)

5-1 Surface Soil Exceedances of Screening Criteria
5-2 Subsurface Soil Exceedances of Screening Criteria
5-3 Monitoring Well Groundwater Exceedances of Screening Criteria
5-4 Surface Sediment Exceedances of Screening Criteria
5-5 Subsurface Sediment Exceedances of Screening Criteria

7-1 Conceptual Site Model for Potential Human Exposures at SWMU 7

8-1 Preliminary Diagramatic Conceptual Model

Acronyms and Abbreviations

amsl	above mean sea level
ATSDR	Agency for Toxic Substances and Disease Registry
BCF	bioconcentration factor
bgs	below ground surface
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
CNRMA	Commander Navy Region Mid-Atlantic
COI	Constituent of Interest
COPC	Chemicals of Potential Concern
CSF	carcinogenic slope factor
CT	central tendency
CTO	Contract Task Order
cy	cubic yards
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane
DO	dissolved oxygen
DoD	Department of Defense
DQO	Data Quality Objective
EE/CA	Engineering Estimate/Cost Analysis
ELCR	excess lifetime carcinogenic risk
EPC	exposure point concentration
ERA	ecological risk assessment
F	Fahrenheit
ft	feet
FS	Feasibility Study
FWES	Foster Wheeler Environmental Services
gpm	gallons per minute
GPS	Global Positioning System
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IAS	Initial Assessment Study
IDW	Investigation Derived Waste
IEUBK	Integrated Exposure Uptake Biokinetic
IR	Installation Restoration
IRI	Interim Remedial Investigation

IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
K	hydraulic conductivity
LANTDIV	Naval Facilities Engineering Command, Atlantic Division
LC	low concentration
LOAEL	lowest-observed-adverse-effect-level
MCL	Maximum Contaminant Level
MF	modification factors
MGD	million gallons per day
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mph	miles per hour
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NAB	Naval Amphibious Base
NCEA	National Center for Environmental Assessment
NFESC	Naval Facilities Engineering Service Center
NOAEL	no-observed-adverse-effect-level
NPL	National Priorities List
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	perchloroethylene or tetrachloroethylene
PCP	pentachlorophenol
PRG	preliminary remediation goal
PVC	polyvinylchloride
PWC	Public Works Center
QA/QC	quality assurance/quality control
RAB	Restoration Advisory Board
RAGS	Risk Assessment Guidance for Superfund
RBC	Risk-Based Concentration
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RfD	reference dose
RGH	Rogers, Golden, and Halpern
RI	Remedial Investigation
RME	reasonable maximum exposure
RRRS	Relative Risk Ranking System
RVS	Round 1 Verification Step
SARA	Superfund Amendments and Reauthorization Act
SERA	Screening Ecological Risk Assessment
SI	Site Investigation
SOP	Standard Operating Procedure
SQL	sample quantitation limit

SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TAL	target analyte list
TCL	target compound list
TOC	total organic carbon
UCL	upper confidence limit
UF	uncertainty factor
USEPA	United States Environmental Protection Agency
UTL	upper tolerance limit
VAWQS-HH	Virginia Water Quality Human Health Standard
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound
yd^3	cubic yards
µg/kg	micrograms per kilogram or parts per billion in solid
µg/L	micrograms per liter or parts per billion in liquid

SECTION 1

Introduction

This Remedial Investigation (RI) Report presents the data, results, and provides conclusions for CH2M HILL's investigation conducted at Solid Waste Management Unit 7 (SWMU), the Small Boats Sandblast Yard, at Naval Amphibious Base (NAB) Little Creek, Virginia Beach, Virginia. The described activities are part of the overall Installation Restoration Program (IRP) being implemented at NAB Little Creek.

Abrasive blast material (ABM) was visually noted in previous site inspections of SWMU 7 near the Small Boats Sandblast Yard (ATEC, 1989). These inspections determined that spent ABM and oily substances might have been released to Desert Cove and may serve as a potential source of contamination to the environment. There have been six previous investigations at SWMU 7 conducted between 1984 and 2004. A Remedial Investigation Work Plan for SWMU 7 was developed in order fill data gaps and complete quantitative ecological and human health risk assessments (CH2M HILL, July 2002). A limited number of metals, SVOCs, and VOCs were detected in the soil and groundwater at the SWMU during the previous investigations. Most recently, an engineering evaluation and cost analysis (EE/CA) was completed and an interim removal action (IRA) was conducted in September 2004 (AGVIQ, June 2004).

As a result of all previous investigations conducted at SWMU 7, the Navy in partnership with the United States Environmental Protection Agency (USEPA) and the Virginia Department of Environmental Quality (VDEQ) agreed to separate the terrestrial and aquatic portion of SWMU 7; SWMU 7a addresses groundwater and soil, and SWMU 7b addresses Desert Cove sediment.

CH2M HILL prepared this RI report under the Naval Facilities Engineering Command, Mid Atlantic Division (NAVFAC Mid Atlantic), Comprehensive Long-Term Environmental Action Navy (CLEAN) II Contract N62470-95-D-6007, Contract Task Order (CTO) 0159, for submittal to NAVFAC Mid Atlantic, the NAB Little Creek Base Civil Engineering Department—Environmental Division, the USEPA, Commander Navy Region Mid-Atlantic (CNRMA), and the VDEQ.

1.1 Objectives and Approach

The purpose of this RI is to further define the nature and extent of contamination at SWMU 7 through the necessary data collection to complete a Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA), the following objectives were identified:

- Identify and evaluate existing information at SWMU 7;
- Conduct surface soil, subsurface soil, groundwater, and sediment sampling and analysis to further characterize the nature and extent of contamination at, and along the contaminant transport pathways from, SWMU 7 in order to better establish the potential magnitude of risks to human and ecological receptors;

- Conduct a quantitative HHRA and ERA using existing data and data collected during the RI

The RI data collection activities included the sampling and analysis of groundwater, surface soil, subsurface soil, surface sediment, and subsurface sediment. No surface water samples were collected at SWMU 7, so the impacts to site surface water and potential impacts to connected water bodies cannot be determined with the available data.

1.2 Report Organization

The RI is organized into the following:

- Section 1—Introduction
- Section 2—Background
- Section 3—RI Field Investigation Activities
- Section 4—Physical Characteristics
- Section 5—Nature and Extent of Contamination
- Section 6—Contaminant Fate and Transport
- Section 7—HHRA
- Section 8—ERA
- Section 9—Conclusions and Recommendations

Figures and tables referenced throughout the text are provided at the end of each section. Figures and tables are numbered sequentially within each section according to the following format:

#—## : Section Number (1-8).

#—**##** : Sequential Figure/Table (starts with 1 within each section).

For example, Figure 4-10 refers to the tenth figure within Section 4.

References are provided at the end of each section following the text. Appendixes are provided after Section 9.

1.3 References

ATEC Environmental Consultants. Letter reports dated August 22, 1989 (Environmental subsurface exploration at LANTDIV blast and paint facility) and January 26, 1993 (Soil and groundwater sampling, ELCAS Blast/Paint Facility).

CH2M HILL. *Final Site Investigation, SWMU 7 and SWMU 8, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. August 2001.

CH2M HILL. *Final SWMUs 3, 7, and 8 Remedial Investigation Work Plan, Naval Amphibious Base Little Creek, Virginia Beach, Virginia.* July 2002.

SECTION 2

Background

2.1 NAB Little Creek History and Operations

When NAB Little Creek was officially commissioned on July 30, 1945, the base's mission was the training of landing craft personnel for operational assignments. In order to accomplish this mission, the Navy began purchasing land in the area from private estates and the Pennsylvania Railroad just prior to World War II. The first activity to be commissioned was the Amphibious Training Base used for training the amphibious landing craft crews. The other activities commissioned in the area were the Naval Frontier Base, a forwarding center for the Amphibious Force and equipment destined for the European Theater; Camp Bradford, a training base for the Navy Seabees; and Camp Shelton, an armed guard training center for merchant ship gun crews.

Operations at the NAB Little Creek facility have included vehicle and boat maintenance, boat sandblasting and painting, 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 (CH2M HILL, June 2003). The generation and disposal of wastes—pesticides, paints, solvents, inorganics, heavy metals, polychlorinated biphenyls (PCBs), mixed municipal wastes, nickel-plating baths, chromic acid, silver cyanide, copper cyanide, lacquer, lacquer stripper, perchloroethylene (PCE) sludge, soap, dyes, and degreasers—have occurred at NAB Little Creek (USEPA, May 2002).

Over 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 are geared predominantly to meet the amphibious warfare training requirements of the Armed Forces of the United States (CH2M HILL, June 2003).

The population of the base increases in summer, when a significant number of midshipmen and Navy and Marine Corps reservists train in amphibious/expeditionary warfare. Approximately 3,650 military personnel and their families live on the base. In addition, approximately 3,000 civilians are employed at NAB Little Creek (USEPA, May 2002).

2.2 NAB Little Creek Location and Land Use

NAB Little Creek is located in the northwestern corner of Virginia Beach, Virginia, along the Chesapeake Bay's southern shore. The base's western border abuts the City of Norfolk, Virginia. The area surrounding this 2,147-acre base is low-lying and relatively flat. Chesapeake Bay borders the base on the north; residential communities and several marinas on the west; Shore Drive on Lake Whitehurst, Lake Smith Little Creek Reservoir, Norfolk International Airport Industrial Park, and residential development on the south; and east by Lake Bradford on the east (Figures 2-1 and 2-2).

NAB Little Creek is primarily an industrial facility located around three saltwater bodies: Little Creek Cove, Desert Cove, and Little Creek Channel, which connects the two coves with the Chesapeake Bay (Figure 2-2). The bay, harbor, and wetland areas, including two large lakes, at least seven ponds, and a freshwater marsh, provide habitat for a variety of wildlife. NAB Little Creek is in the Atlantic Migratory Flyway (CH2M HILL, June 2003).

In addition to industrial land-use, NAB Little Creek and the surrounding areas are also used for recreational, commercial, and residential purposes. Specifically, the base's southeastern and northeastern corners have been developed for residential use and the Lake Smith Little Creek Reservoir, located upgradient of the base, serves as a secondary drinking water supply for parts of the City of Norfolk (CH2M HILL, June 2003). Although the base is mostly urbanized, small pockets of wooded habitat are within its boundaries, primarily in its eastern and south-central portions. The upland habitats are composed of pine and hardwood forests and open fields (Department of Defense [DoD]: Partners in Flight, 1998). A broken line of vegetated primary and secondary dunes extend along the entire 2.25 miles of Chesapeake Bay shoreline. Portions of the NAB Little Creek landmass is comprised of dredge fill material.

2.3 SWMU 7 History and Description

SWMU 7 (Small Boats Sandblast Yard), formerly referred to as SWMU 137 (A.T. Kearney, 1989), is along Piers 44-55 at Desert Cove and includes Building CB-125 (Figure 2-3). The SWMU 7a area was utilized for sandblasting and ship painting prior to 1996, since then sandblasting activities are conducted in an indoor facility (Building CB-125). SWMU 7a was used as a storage area for spent ABM while awaiting EP toxicity characterization prior to disposal. Approximately 4,000 cubic yards (yd^3) of ABM generated from 1960 to 1982 were stored (in open piles) in the yard. This ABM has since been sampled, characterized, removed, and properly disposed of offsite. Based on historical photographs, the ABM piles were located in the construction footprint for the new blasting facility (Building CB-125).

No release controls were identified at SWMU 7a. Based on visual inspections conducted in 1988 (Earth Technology Corp., 1988), spent ABM has historically been released to soils and Desert Cove (SWMU 7b) at this site. According to the Navy's responses to the draft RCRA Facility Assessment (RFA [A.T. Kearney, 1989]), oil-stained soils in the area have been removed. The RFA also stated that ABM is present near Buildings CB-125, CB-317, and CB-318 and a small amount of ABM was also found west of Building 3869. The SWMU 7's southwestern area is the location of the new indoor sandblast facility, Building CB-125 (Figure 2-3).

During the 2000 SI, ABM was only encountered on the ground surface on portions of SWMU 7; no ABM was identified in subsurface soils. A visual inspection of the surface soils estimated that ABM comprised less then 5 percent of the soil matrix at SWMU 7. The ABM identified in soils was primarily located near the new indoor sandblast facility as well as a small area near Building CB-317.

Asphalt, concrete or buildings cover a large portion of the ground surface at SWMU 7a. Most of the remaining area consists of hard-packed gravel. Heavy equipment (cranes and trailers) are stored on portions of the site.

Most precipitation runs off toward Desert Cove and the Small Boat Piers, with the balance evaporating, transpiring, or infiltrating into the ground. Infiltration is limited to those areas of the SWMU that are unpaved and where the residence time for precipitation on the ground surface is sufficient for infiltration to occur.

There are no wooded ecological habitats or wetlands within SWMU 7a. Open areas of maintained grass are present, but are limited in extent. Almost the entire shoreline of the cove at SWMU 7a is bulkheaded and is used to moor small ships. A very small portion of the shoreline, near the boat ramp just north of Building CB-125, is not bulkheaded and consists of a narrow fringe with a riprap bank and shrubbery atop the bank. This fringe is adjacent to a concrete/asphalt covered work area.

Much of the landmass surrounding Desert Cove (SWMU 7b) was partially formed with dredge-fill material from pier construction when the base was developed in the 1940s. Desert Cove is a tidal marine environment. All drainage to Desert Cove is from on-base areas, consisting mainly of buildings and paved parking areas.

No visible ABM was observed in surface (0–4 in.) sediment samples collected from Desert Cove during the 2000 SI. SWMU 7b sediment samples were composed of greenish-black fine sand and silt and all had an oily appearance. Other potential sources of contaminants to Desert Cove other than ABM residue from SWMU 7b are about a dozen stormwater outfall locations in the northern, eastern, and southern sides (Figure 2-4 and Table 2-1). Desert Cove was last dredged in 1953. However, frequent dredging in Little Creek Inlet is required to maintain navigable depths. The U.S. Army Corps of Engineers maintains the main navigation channel (from the jetties at the inlet to Little Creek Channel to the Thimble Shoal Channel, located approximately 4.25 miles north of the inlet). NAB Little Creek maintains the rest of the inlet. Based on available information, Desert Cove was dredged to 10 ft below mlw in 1953. Plans to replace Piers 44-51 on the eastern end of Desert Cove in 2006 may include dredging activities.

2.4 Previous Investigations

Six previous investigations have been conducted at SWMU 7 and are described in the following subsections. A baseline ERA and an HHRA were conducted as well, utilizing data collected during the 2000 SI. Previous sampling locations and the potentiometric surface are shown on Figure 2-5.

2.4.1 Initial Assessment Study (December 1984)

The purpose of the IAS (RGH, 1984) was to compile and evaluate existing information on identified sites to determine if additional investigations were warranted. ABM and paint chips from sandblasting activities were allowed to accumulate on the site between the 1960s and 1982, and are present in onshore soils and the near-shore sediments of Desert Cove at SWMU 7. The Navy and the State Water Control Board (SWCB) tested and evaluated the ABM and paint chips, using leachability testing (for a limited set of metals). Based on the results, the material was classified as nonhazardous. The IAS recommended that no confirmation studies or remedial actions be undertaken at SWMU 7 since the waste materials (i.e., ABM) were now being collected and disposed of offsite. Also, leachability studies indicated that the materials were non-hazardous and had limited migration

potential. The State Water Control Board (SWCB) took the position that the ABM and residues currently on the onshore soils and near-shore sediment would not require removal.

2.4.2 Visual Site Inspection (1988)

The purpose of the Visual Site Inspection (VSI; Earth Technologies Corp., 1988) was to identify any potential sources of contamination or potentially contaminated areas without collecting samples. The VSI determined that spent blast grit and oily substances were released to Desert Cove from the Small Boats Sandblast Yard, based on visual indicators.

2.4.3 RCRA Facility Assessment (December 1989)

The purpose of the 1989 RFA (A.T. Kearny, 1989) was to identify and assess areas of potential environmental concern at NAB Little Creek. This investigation included a records review and site inspection. No environmental samples were collected as part of this assessment. Based on its results, SWMU 7 was identified as potentially affected by contamination resulting from historical processes and activities.

2.4.4 Soil and Groundwater Investigations (1989 and 1993)

SWMU 7's southwestern area is the site of the current indoor sandblast facility, located inside Building CB-125. Prior to the building's construction, NAVFACENGCOMLANT contracted with ATEC Environmental to conduct soil and groundwater investigations at the proposed building site. In 1989, soil was sampled at five locations (ATEC, 1989; Figure 2-6). At borings B-1, B-2, and B-3, samples were collected from 0–2.5 ft and 2.5–5.0 ft bgs (labeled A and B, respectively). At B-4 and B-5, samples were collected from 0 to 2.5 ft bgs only. A duplicate was obtained from B-2B and was labeled B-2C. The samples were analyzed for total metals and EP toxicity metals. Although the full results are available for the total metals (Table 2-2), the EP toxicity results could not be located. However, ATEC noted in its summary report that the only metal detected in the EP toxicity tests was zinc at 3.4 mg/L for sample B-1A.

In January 1993, three soil samples and three groundwater samples were collected from monitoring wells (MW-1, MW-2, and MW-3) installed at the SWMU (ATEC, 1993). Soil samples were analyzed for metals (Toxicity Characterization Leaching Procedure [TCLP] list) and groundwater was analyzed for total (unfiltered) metals (subset of the Target Analyte List [TAL] metals). The results are provided in Table 2-3.

In March 1999, the NAB Little Creek Tier I Partnering Team conducted a site visit at SWMU 7 and agreed that SWMU 7 should be elevated in priority and an SI conducted.

2.4.5 Site Investigation (2000)

In 1999, prior to the start of the SI, a site reconnaissance was conducted by CH2M HILL to determine the presence of ABM. Blast material was visually identified in the area of Building CB-125 with only trace amounts along Small Boat Piers 44–51.

The SI field activities at SWMU 7 began May 22, 2000 (CH2M HILL, August 2001). Three monitoring wells were installed (MW01, MW02, MW03), and groundwater, soil, and sediment samples were collected as part of the SI. Surface soil samples (0–6 inches bgs) and subsurface soil samples (1–3 ft bgs) were collected at 14 locations at SWMU 7. Sediment

samples (0–4 inches bgs) were collected in Desert Cove adjacent to the bulkhead at five locations. Groundwater, sediment, and soil sampling locations are shown on Figure 2-7. Detected analytes are summarized in Tables 2-4 (groundwater), 2-5 (sediment), 2-6 (surface soil), and 2-7 (subsurface soil). The raw analytical data are provided in Appendix A.

The following is summary of the August 2001 SI results:

- ABM was observed only in the surface soils, making up 5 percent or less of the soil samples. No ABM was observed in the subsurface soils at SWMU 7. Most ABM was observed near Building CB-125, which currently serves as an indoor sandblasting facility, and in a small area near Building CB-317. No metals exceeding background concentrations were detected in subsurface soils.
- Metals in surface soils were elevated along the site's western portion, near Piers 52–55. The elevated concentrations (exceeding human health screening criteria) of some metals in surface soil may be related to former sandblasting operations or characteristic of the industrial nature of the area at SWMU 7. Elevated metal concentrations (iron) appeared to be limited to the areas immediately south and west of Piers 52–55, which are used for heavy equipment and container storage. Lead, which is generally indicative of ABM contamination, did not exceed human health screening criteria, although concentrations in several surface soil samples did exceed background.
- Except for iron and arsenic, the frequency of exceedance of human health screening criteria in surface soils was low (5 exceedances of 28 detections), indicating that there is not widespread contamination. For iron and arsenic, the frequency of exceedance of background was greater (11 of 23 for arsenic and 21 of 28 for iron). However, average concentrations of these metals in surface and subsurface soils were consistent with background levels, suggesting localized contamination.
- Localized exceedances of metals in soil (including aluminum, arsenic, chromium, iron, and manganese) indicate there may be localized contamination from past sandblasting activities. Iron was the most prevalent, with a maximum concentration more than 10 times the adjusted USEPA Region III residential risk-based concentration (RBC). All metal concentrations in surface and subsurface soil are well below the adjusted industrial RBC, except for three arsenic results. Based on statistical comparisons, arsenic and manganese are not statistically different from background.
- PAH concentrations exceeding human health screening criteria were limited to the surface (six PAHs) and subsurface (one PAH) soil samples at LW07-MW01, northwest of Building CB-125. This may indicate a localized impact related to past or current site activities.
- Arsenic and iron were found at concentrations that exceeded human health screening criteria in the sediment sample collected just north of Pier 44. Benzo(a)pyrene exceeded human health screening criteria in all sediment samples. These exceedances could be related to sandblasting activities at SWMU 7. However, it is likely that there are other sources related to the use of the piers and Desert Cove, especially for benzo(a)pyrene, since PAHs are typically related to pyrogenic or petrochemical sources.

- Groundwater samples near Building CB-125 contained levels of manganese and sodium that exceeded human health screening criteria in unfiltered samples. Filtered samples contained these same metals at comparable concentrations. The upgradient well just east of SWMU 7 also contained levels of iron, manganese, and sodium that exceeded human health screening criteria, indicating that SWMU 7 groundwater may be influenced more by regional factors than a direct release at the site. Additionally, concentrations of sodium likely reflect the nearby saltwater of Desert Cove and are not considered a contaminant of concern. There was also one volatile organic compound (VOC)—chloroform—detected in the groundwater sample from this area. The extremely low chloroform concentration detected was considered an artifact of the analytical process and likely due to laboratory contamination.

2.4.5.1 Human Health Risk Screening

Based on the human health screening evaluation conducted as part of the SI, chemicals representative of potential site-related risks at SWMU 7 were identified and are discussed below by media. Most of these chemicals were present only in localized areas near Building CB-125.

- Potentially site-related chemicals identified by the screening evaluation in surface soils (in one sample near Building CB-125) included aluminum, iron, chromium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene.
- One potentially site-related chemical (benzo[a]pyrene in sample LW07-SB01) was identified during the screening evaluation of subsurface soils.
- Arsenic, iron, and benzo(a)pyrene were identified as potentially site-related chemicals in sediment during the screening evaluation.

Manganese (maximum concentrations LW07-MW01 and LW07-MW02) and chloroform (maximum concentration LW07-MW01) were identified as potentially site-related chemicals in groundwater during the screening evaluation.

2.4.6 Baseline Ecological Risk Assessment (January 2001)

A draft baseline ERA was completed for SWMU 7 in January 2001 (CH2M HILL, 2001). The ERA was based upon analytical data collected as part of the SI. This ERA concluded that five metals (chromium, iron, lead, silver, and zinc) exceeded both surface soil screening values and background concentrations. In addition, PAHs exceeded both surface soil screening values and background concentrations, although these exceedances were driven by a single sample location (LW07-SS01). Thus, risks to lower trophic level receptors that might utilize terrestrial habitats at SWMU 7 are possible, although habitat quality—and thus exposure potential—is very limited. Almost the entire SWMU is paved, covered by buildings, or composed of hard-packed dirt or gravel parking lots. Vegetated areas are very limited, which would minimize potential exposures to plants. The nature of the substrate would not be conducive to inhabitation by most types of soil invertebrates. Potential risks to upper trophic level terrestrial receptors were minimal since HQs based on LOAELs (food web exposures) did not exceed one.

Currently, general contamination transport via groundwater to Desert Cove's surface water and sediments is not likely to be significant at SWMU 7, except possibly for manganese. However, manganese was not identified as a COPC in any other medium and it was unclear if its presence was site-related. In sediment, 5 metals and 14 PAHs exceeded their screening values based upon detected concentrations. The HQs exceeded five for lead, eight of the individual PAHs, and total PAHs. Lead, silver, zinc, and PAHs were also identified as COPCs in surface soils. Thus, risks to lower trophic level receptors utilizing the portion of Desert Cove adjacent to SWMU 7 are possible although habitat quality is currently limited by the developed nature of the cove. Potential risks to upper trophic level aquatic receptors were low, as no chemical exceeded a LOAEL-based screening value for piscivorous birds.

Based on the draft baseline ERA findings, former sandblasting operations (and possibly current heavy equipment storage at SWMU 7) have resulted in localized areas of surface soil (and possibly groundwater) contamination (e.g., near Building CB-125), as evidenced by soil screening values and background exceedances for several metals (particularly lead, silver, and zinc) and PAHs. Given the site's industrial nature and the limited, low-quality habitats present, the ecological significance of these exceedances is low in terms of potential exposure.

Several metals (particularly copper, lead, silver, and zinc) and PAHs exceeded screening values in sediment samples from Desert Cove. Concentrations of copper, silver, and zinc were fairly uniform among the five sediment sampling locations. The highest lead concentrations occurred at sample location LW07-SD03 and those of PAHs occurred at sample location LW07-SD04 (Figures 2-5 and 2-7); concentrations at the remaining four locations were fairly uniform. No single sample had the highest concentration of all sediment COPCs and there was no evident correlation to areas with elevated surface soil concentrations (e.g., PAHs in surface soils were highest near Building CB-125 but were highest in sediments on the Cove's eastern side). Many PAHs detected in sediments may reflect point-source discharges from outfalls or the operation of diesel engines within Desert Cove (Figure 2-4). Almost the entire Desert Cove shoreline is developed, consisting of boat piers and bulkheads, and lacks vegetated wetlands to provide habitat for most ecological receptors.

Based upon existing terrestrial site conditions, current site-related contaminant transport to Desert Cove is very low. Although ABM was not detected in the sediment samples from Desert Cove, historical releases from the site to Desert Cove are known to have occurred. Because of the possibility of multiple sources of contamination to Desert Cove (especially for chemicals like lead and PAHs), the draft Step 3 baseline ERA report concluded that further evaluation of this water body was warranted.

2.4.7 Engineering Evaluation Cost Analysis, Interim Removal Action and Construction Completion (2004)

An EE/CA was completed in 2004 to evaluate alternatives for surface soil removal at SWMU 7 (Appendix H). A non-time critical removal action was completed in September 2004 whereby approximately 40 cubic yards of surface soil was removed and backfilled with clean fill material. The removal action was completed under the AGVIQ/CH2M HILL Joint Venture I Program. Documentation of construction activities is provided in Appendix I.

2.5 References

A.T. Kearny. *RCRA Facility Assessment*. December 1989.

ATEC Environmental Consultants. Letter reports dated August 22, 1989 (Environmental subsurface exploration at LANTDIV blast and paint facility) and January 26, 1993 (Soil and groundwater sampling, ELCAS Blast/Paint Facility).

CH2M HILL. *Draft screening and baseline (Steps 1-3) ecological risk assessment for SWMUs 7 and 8, NAB Little Creek, Virginia Beach, VA.* January 2001.

CH2M HILL. *Final Site Management Plan Fiscal Years 2004 through 2009, NAB Little Creek, Virginia Beach, VA.* June 2003.CH2M HILL. *Final site investigation, SWMU 7 and SWMU 8, NAB Little Creek, Virginia Beach, VA.* August 2001.

CH2M HILL. *Final Engineering Evaluation and Cost Analysis for SWMU 7 and SWMU 8, Naval Amphibious Base Little Creek, Virginia Beach, Virginia*. June 2004

Department of Defense: Partners in Flight. Department of Defense: Partners in Flight website; Naval Amphibious Base Little Creek (http://www.monumental.com/ceberly/dodpif/checklist.html). 1998.

Earth Technologies Corporation. *Visual site inspection report*. Prepared for the USEPA. 1988.

Rogers, Golden, and Halpern (RGH). *Initial assessment study, Naval Amphibious Base, Little Creek, Norfolk, Virginia.* December 1984.

USEPA, NPL Site Narrative Listing. http://epa.gov/reg3hwmd/super/VA/naval-amphibious/pad.htm Updated May 2002.

Table 2-1
Characteristics of Outfalls Discharging to Desert Cove and the Connector Channel
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Area	Outfall	Drainage (sq. ft.)	Drainage (Percent)	Drainage Characteristics
Northwest	NR-009	117,500	4.2	Road-Potential Fuel
	NR-008	25,000	0.9	Road-Potential Fuel
	NR-004	11,973	0.4	Road-Potential Fuel
Subtotal		**154,473**	**5.5**	
Northeast	NR-007b	1,042,734	37.2	Road-Parking
	NR-011	148,613	5.3	Road-Potential Fuel
	NR-010	64,941	2.3	Road-Potential Fuel
Subtotal		**1,256,288**	**44.8**	
East-Central	NR-012	151,445	5.4	Road-Potential ABM
Subtotal		**151,445**	**5.4**	
Southeast	NR-034	473,426	16.9	Road-Parking
	00X	225,412	8.0	Road-Parking
	NR-033	197,797	7.1	Road-Parking
	NR-035	79,521	2.8	Road-Parking
	NR-032	67,705	2.4	Road-Parking
	NR-031	24,023	0.9	Road-Parking
Subtotal		**1,067,884**	**38.1**	
Connector	NR-007a	145,767	5.2	Road-Potential ABM
	NR-005	13,854	0.5	Road-Grass
	NR-006	13,854	0.5	Road-Grass
Subtotal		**173,475**	**6.2**	
TOTAL		**2,803,565**	**100.0**	

Table 2-2
1989 Soil Sampling Results
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Chemical	Boring Location (all results in mg/kg)								
	B-1		B-2			B-3		B-4	B-5
	B-1A	B-1B	B-2A	B-2B	B-2C	B-3A	B-3B	B-4	B-5
Arsenic	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0
Barium	11	13	8.7	3.5	6.1	18	10	7.3	16
Cadmium	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chromium	12	12	8.4	2.7	5.4	15	7.5	4.1	13
Lead	98	45	94	8.3	9.4	75	4.2	13	96
Mercury	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Selenium	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Silver	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Copper	41	23	24	2.9	3.0	27	3.6	8.2	61
Nickel	4.8	4.1	2.9	1.8	2.6	9.2	5.4	1.6	7.5
Zinc	110	280	44	3.3	2.9	55	14	19	80

Notes:
U - Analyte not detected
Data from ATEC (1989)
A - indicates surface soil sample
B - indicates subsurface soil sample
C - indicates duplicate sample

Table 2-3
1993 Soil and Groundwater Sampling Results
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Chemical	Soil (TCLP - mg/L)			Groundwater (mg/L)		
	MWS-1	MWS-2	MWS-3	MW-1	MW-2	MW-3
Arsenic	0.002 U	0.057	0.002 U	0.287	0.111	0.198
Barium	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
Cadmium	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.016
Chromium	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U
Lead	0.099 U	0.099 U	0.099 U	0.099 U	0.099 U	0.099 U
Mercury	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Selenium	0.020	0.476	0.449	0.002 U	0.002 U	0.002 U
Silver	0.045	0.016 U	0.016 U	0.016 U	0.016 U	0.016 U

Notes:
U - Analyte not detected

Table 2-4
Summary of 2000 SI Detections for Groundwater at SWMU 7
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean	Standard Deviation of Mean
Inorganics (UG/L)						
Aluminum	200 - 200	2 / 3	3,380	LW07-MW02-00B	1,955	1,464
Barium	200 - 200	3 / 3	117	LW07-MW01-00B	101	17.7
Calcium	5,000 - 5,000	3 / 3	132,000	LW07-MW01-00B	93,433	35,026
Chromium	10.0 - 10.0	2 / 3	22.1	LW07-MW01-00B	13.4	8.96
Cobalt	50.0 - 50.0	1 / 3	44.4	LW07-MW02-00B	19.7	21.5
Iron	100 - 100	3 / 3	42,500	LW07-MW01-00B	26,633	14,588
Lead	3.00 - 3.00	2 / 3	3.40	LW07-MW01-00B	2.48	1.26
Magnesium	5,000 - 5,000	3 / 3	106,000	LW07-MW01-00B	58,600	44,431
Manganese	15.0 - 15.0	3 / 3	4,900	LW07-MW02-00B	3,581	2,250
Potassium	5,000 - 5,000	3 / 3	18,400	LW07-MW01-00B	9,153	8,131
Silver	10.0 - 10.0	1 / 3	8.30	LW07-MW03-00B	4.67	3.15
Sodium	5,000 - 25,000	3 / 3	729,000	LW07-MW01-00B	371,000	318,746
Vanadium	50.0 - 50.0	3 / 3	11.4	LW07-MW02-00B	8.87	2.90
Dissolved Metals (UG/L)						
Barium	200 - 200	2 / 3	120	LW07-MW01-00B	78.8	43.7
Calcium	5,000 - 5,000	3 / 3	142,000	LW07-MW01-00B	94,833	42,449
Cobalt	50.0 - 50.0	1 / 3	34.5	LW07-MW02-00B	15.5	16.8
Iron	100 - 100	3 / 3	44,800	LW07-MW01-00B	24,597	18,403
Magnesium	5,000 - 5,000	3 / 3	121,000	LW07-MW01-00B	63,567	52,811
Manganese	15.0 - 15.0	3 / 3	5,690	LW07-MW01-00B	3,876	2,551
Potassium	5,000 - 5,000	3 / 3	19,800	LW07-MW01-00B	9,527	9,060
Sodium	5,000 - 25,000	3 / 3	847,000	LW07-MW01-00B	412,000	385,226
Pesticide/Polychlorinated Biphenyls (UG/L)						
No Detections						
Semivolatile Organic Compounds (UG/L)						
No Detections						
Volatile Organic Compounds (UG/L)						
Chloroform	10.0 - 10.0	1 / 3	14.0	LW07-MW01-00B	8.00	5.20

Table 2-5
Summary of 2000 SI Detections for Sediment Samples at SWMU 7
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean	Standard Deviation of Mean
Inorganics (MG/KG)						
Aluminum	40.9 - 144	5 / 5	17,100	LW07-SD05-00	8,786	5,758
Antimony	12.3 - 43.2	2 / 5	2.10	LW07-SD05-00	0.83	0.76
Arsenic	2.00 - 7.20	5 / 5	11.9	LW07-SD05-00	6.36	3.66
Barium	40.9 - 144	4 / 5	49.1	LW07-SD05-00	24.6	16.8
Calcium	1,023 - 3,601	5 / 5	35,400	LW07-SD04-00	14,324	14,286
Chromium	2.00 - 7.20	5 / 5	53.9	LW07-SD05-00	26.3	17.4
Copper	5.10 - 18.0	5 / 5	142	LW07-SD05-00	79.4	41.6
Iron	20.5 - 72.0	5 / 5	31,000	LW07-SD05-00	16,726	9,869
Lead	0.60 - 2.20	5 / 5	1,810	LW07-SD03-00	409	784
Magnesium	1,023 - 3,601	5 / 5	8,520	LW07-SD05-00	4,518	2,667
Manganese	3.10 - 10.8	5 / 5	226	LW07-SD05-00	125	70.5
Mercury	0.10 - 0.30	1 / 5	0.36	LW07-SD02-00	0.18	0.13
Nickel	8.20 - 28.8	1 / 5	2.60	LW07-SD01-00	6.36	3.13
Potassium	1,023 - 3,601	5 / 5	4,310	LW07-SD05-00	2,132	1,397
Silver	2.00 - 7.20	4 / 5	7.80	LW07-SD05-00	4.08	2.57
Sodium	1,023 - 3,601	5 / 5	20,500	LW07-SD05-00	9,028	6,793
Thallium	2.00 - 7.20	1 / 5	0.55	LW07-SD01-00	0.51	0.18
Vanadium	10.2 - 36.0	5 / 5	47.7	LW07-SD05-00	26.1	15.2
Zinc	4.10 - 14.4	4 / 5	534	LW07-SD05-00	296	217
Pesticide/Polychlorinated Biphenyls (UG/KG)						
Endosulfan sulfate	4.50 - 4.50	1 / 1	5.80	LW07-SD01-00	5.80	--
Semivolatile Organic Compounds (UG/KG)						
Acenaphthene	290 - 3,500	4 / 5	3,000	LW07-SD05-00	1,166	1,210
Acenaphthylene	449 - 6,900	1 / 5	60.0	LW07-SD01-00	1,168	1,408
Anthracene	29.0 - 449	5 / 5	2,300	LW07-SD04-00	892	822
Benzo(a)anthracene	29.0 - 449	5 / 5	4,400	LW07-SD04-00	2,260	1,330
Benzo(a)pyrene	29.0 - 449	5 / 5	2,700	LW07-SD04-00	1,366	756
Benzo(b)fluoranthene	57.0 - 690	4 / 5	4,500	LW07-SD04-00	1,752	1,626
Benzo(g,h,i)perylene	57.0 - 690	5 / 5	1,800	LW07-SD04-00	864	558
Benzo(k)fluoranthene	29.0 - 449	5 / 5	2,000	LW07-SD04-00	1,112	577
Carbazole	449 - 449	1 / 1	130	LW07-SD01-00	130	--
Chrysene	29.0 - 449	5 / 5	7,100	LW07-SD04-00	3,280	2,189
Di-n-butylphthalate	449 - 449	1 / 1	83.0	LW07-SD01-00	83.0	--
Dibenz(a,h)anthracene	57.0 - 690	4 / 5	210	LW07-SD04-00	148	49.4
Fluoranthene	57.0 - 690	5 / 5	25,970	LW07-SD04-00	8,944	10,113
Fluorene	57.0 - 690	5 / 5	2,100	LW07-SD04-00	591	854
Indeno(1,2,3-cd)pyrene	29.0 - 449	5 / 5	1,500	LW07-SD04-00	690	459
Naphthalene	290 - 3,500	1 / 5	430	LW07-SD02-00	670	655
Phenanthrene	29.0 - 449	5 / 5	18,360	LW07-SD04-00	4,590	7,733
Pyrene	29.0 - 449	5 / 5	22,300	LW07-SD04-00	8,180	8,282
bis(2-Ethylhexyl)phthalate	449 - 449	1 / 1	66.0	LW07-SD01-00	66.0	--
Other Parameters						
Total organic carbon (TOC) (MG/KG)	66.0 - 191	5 / 5	21,200	LW07-SD05-00	10,332	6,461
pH (pH units)	-- - --	5 / 5	8.25	LW07-SD01-00	7.98	0.23

Table 2-6
Summary of 2000 SI Detections for Surface Soil at SWMU 7
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean	Standard Deviation of Mean
Inorganics (MG/KG)						
Aluminum	30.8 - 47.7	14 / 14	12,100	LW07-SS09-00	4,784	3,087
Antimony	9.20 - 14.3	4 / 14	0.73	LW07-SS09-00	0.36	0.19
Arsenic	1.50 - 2.40	11 / 14	27.7	LW07-SS01-00	3.72	7.06
Barium	30.8 - 47.7	14 / 14	263	LW07-SS09-00	52.3	68.7
Beryllium	0.80 - 1.20	10 / 14	0.77	LW07-SS09-00	0.25	0.23
Cadmium	0.80 - 1.90	3 / 14	0.32	LW07-SS11-00	0.089	0.073
Calcium	769 - 1,192	13 / 14	36,700	LW07-SS07-00	4,790	9,614
Chromium	1.50 - 2.40	14 / 14	33.3	LW07-SS01-00	14.7	8.61
Cobalt	7.70 - 11.9	3 / 14	13.2	LW07-SS09-00	3.14	3.89
Copper	3.80 - 6.00	10 / 14	181	LW07-SS14-00	40.4	53.8
Iron	15.4 - 23.8	14 / 14	26,600	LW07-SS09-00	9,715	7,081
Lead	0.50 - 0.70	14 / 14	122	LW07-SS03-00	58.1	36.6
Magnesium	769 - 1,192	14 / 14	8,300	LW07-SS09-00	1,979	2,457
Manganese	2.30 - 3.60	14 / 14	617	LW07-SS09-00	152	169
Mercury	0.10 - 0.10	8 / 14	0.74	LW07-SS14-00	0.10	0.19
Nickel	6.20 - 9.50	6 / 14	25.0	LW07-SS09-00	6.43	6.63
Potassium	769 - 1,192	14 / 14	8,650	LW07-SS09-00	1,939	2,554
Silver	1.50 - 2.40	11 / 14	6.70	LW07-SS09-00	2.45	1.98
Sodium	769 - 1,192	2 / 14	359	LW07-SS12-00	91.8	96.5
Vanadium	7.70 - 11.9	14 / 14	43.2	LW07-SS09-00	14.7	10.9
Zinc	3.10 - 4.80	14 / 14	602	LW07-SS04-00	175	174
Pesticide/Polychlorinated Biphenyls (UG/KG)						
4,4'-DDE	3.55 - 4.30	1 / 3	23.0	LW07-SS01-00	8.89	12.2
4,4'-DDT	3.55 - 4.30	1 / 3	10.0	LW07-SS01-00	4.55	4.72
alpha-Chlordane	1.83 - 2.20	1 / 3	24.0	LW07-SS01-00	8.63	13.3
Semivolatile Organic Compounds (UG/KG)						
Acenaphthylene	35.0 - 10,963	1 / 13	2,700	LW07-SS01-00	254	737
Anthracene	1.80 - 10,963	6 / 13	4,700	LW07-SS01-00	392	1,296
Benzo(a)anthracene	1.80 - 10,963	12 / 14	12,000	LW07-SS01-00	922	3,189
Benzo(a)pyrene	1.80 - 10,963	13 / 14	14,000	LW07-SS01-00	1,045	3,729
Benzo(b)fluoranthene	3.50 - 10,963	12 / 14	30,000	LW07-SS01-00	2,212	7,998
Benzo(g,h,i)perylene	3.50 - 10,963	11 / 14	16,000	LW07-SS01-00	1,195	4,261
Benzo(k)fluoranthene	1.80 - 10,963	12 / 14	27,000	LW07-SS01-00	1,970	7,204
Chrysene	1.80 - 10,963	13 / 14	24,000	LW07-SS01-00	1,775	6,397
Di-n-butylphthalate	358 - 10,963	1 / 3	65.0	LW07-SS02-00	1,911	3,093
Dibenz(a,h)anthracene	3.50 - 10,963	1 / 13	6,600	LW07-SS01-00	538	1,823
Fluoranthene	3.50 - 10,963	12 / 14	9,600	LW07-SS01-00	779	2,540
Fluorene	3.50 - 10,963	1 / 13	3.60	LW07-SS08-00	452	1,513
Indeno(1,2,3-cd)pyrene	1.80 - 10,963	13 / 14	17,000	LW07-SS01-00	1,255	4,532
Phenanthrene	1.80 - 10,963	11 / 14	46.0	LW07-SS14-00	435	1,454
Pyrene	1.80 - 10,963	12 / 14	24,000	LW07-SS01-00	1,819	6,385
bis(2-Ethylhexyl)phthalate	358 - 10,963	2 / 3	74.0	LW07-SS03-00	1,868	3,129
Volatile Organic Compounds (UG/KG)						
No Detections						

Table 2-7
Summary of 2000 SI Detections for Subsurface Soil at SWMU 7
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean	Standard Deviation of Mean
Inorganics (MG/KG)						
Aluminum	29.3 - 41.7	14 / 14	3,170	LW07-SB13-01	1,971	895
Arsenic	1.50 - 2.10	12 / 14	2.20	LW07-SB14-01	0.98	0.53
Barium	29.3 - 41.7	10 / 14	17.7	LW07-SB05-01	10.3	6.29
Beryllium	0.70 - 1.00	3 / 14	0.41	LW07-SB12-01	0.09	0.10
Cadmium	0.70 - 1.00	1 / 14	0.17	LW07-SB09-01	0.06	0.03
Calcium	732 - 1,044	10 / 14	1,470	LW07-SB07-01	502	409
Chromium	1.50 - 2.10	13 / 14	15.9	LW07-SB01-01	5.16	3.93
Copper	3.70 - 5.20	8 / 14	58.5	LW07-SB12-01	11.5	17.1
Iron	14.6 - 20.9	14 / 14	8,250	LW07-SB01-01	3,250	2,195
Lead	0.40 - 0.60	14 / 14	145	LW07-SB01-01	24.9	39.0
Magnesium	732 - 1,044	14 / 14	1,320	LW07-SB07-01	354	328
Manganese	2.20 - 3.10	14 / 14	79.0	LW07-SB07-01	26.1	24.8
Mercury	0.10 - 0.10	5 / 14	0.090	LW07-SB04-01	0.03	0.03
Nickel	5.90 - 8.30	3 / 14	10.6	LW07-SB12-01	1.79	2.59
Potassium	732 - 1,044	14 / 14	1,450	LW07-SB07-01	365	336
Silver	1.50 - 2.10	3 / 14	2.20	LW07-SB01-01	0.70	0.51
Vanadium	7.30 - 10.4	14 / 14	12.7	LW07-SB07-01	5.83	3.10
Zinc	2.90 - 4.20	13 / 14	431	LW07-SB12-01	60.6	111
Pesticide/Polychlorinated Biphenyls (UG/KG)						
No Detections						
Semivolatile Organic Compounds (UG/KG)						
Anthracene	1.70 - 708	4 / 14	13.0	LW07-SB05-01	52.2	107
Benzo(a)anthracene	1.70 - 708	11 / 14	97.0	LW07-SB01-01	43.7	64.2
Benzo(a)pyrene	1.70 - 708	10 / 14	260	LW07-SB01-01	54.2	85.3
Benzo(b)fluoranthene	3.40 - 708	11 / 14	370	LW07-SB01-01	57.1	104
Benzo(g,h,i)perylene	3.40 - 708	8 / 14	210	LW07-SB01-01	55.1	78.2
Benzo(k)fluoranthene	1.70 - 708	9 / 14	270	LW07-SB01-01	42.6	80.6
Chrysene	1.70 - 708	10 / 14	190	LW07-SB01-01	49.9	73.4
Di-n-butylphthalate	350 - 708	1 / 3	42.0	LW07-SB02-01	191	156
Dibenz(a,h)anthracene	3.40 - 708	1 / 13	1.80	LW07-SB13-01	55.7	111
Fluoranthene	3.40 - 708	11 / 14	120	LW07-SB01-01	48.3	64.2
Fluorene	3.40 - 708	1 / 13	2.30	LW07-SB05-01	55.7	111
Indeno(1,2,3-cd)pyrene	1.70 - 708	9 / 14	210	LW07-SB01-01	48.5	77.4
Naphthalene	17.0 - 708	1 / 13	5.50	LW07-SB13-01	61.1	108
Phenanthrene	1.70 - 708	10 / 14	14.0	LW07-SB05-01	54.4	106
Pyrene	1.70 - 708	12 / 14	170	LW07-SB01-01	46.8	68.8
bis(2-Ethylhexyl)phthalate	350 - 708	3 / 3	1,600	LW07-SB02-01	873	740
Volatile Organic Compounds (UG/KG)						
No Detections						

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LEGEND

Activity Boundary

N

Figure 2-1
Base Location Map
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

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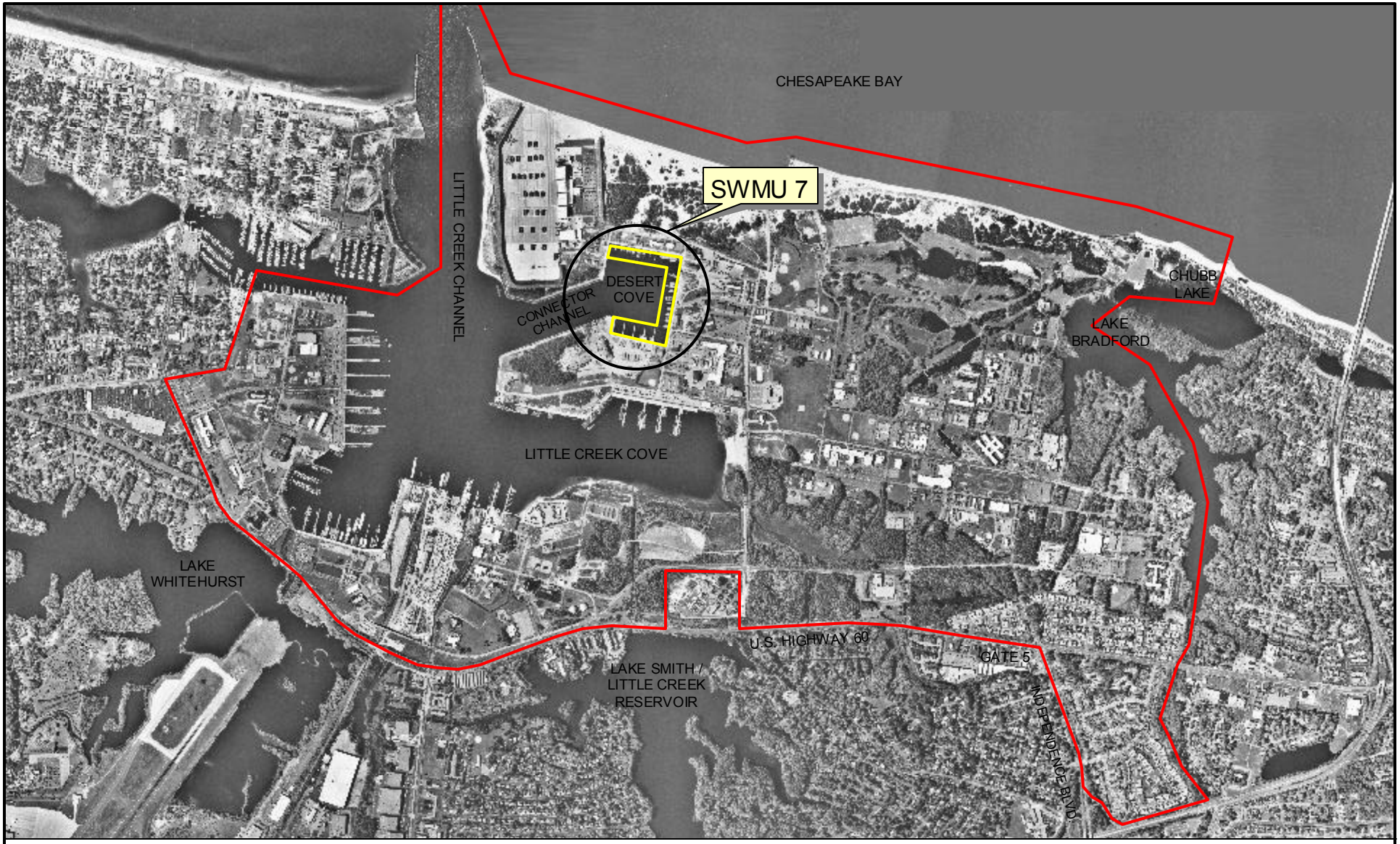

LEGEND

Activity Boundary

Piers 44-55

N

2000 0 2000 Feet

Figure 2-2
Site Location Map
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

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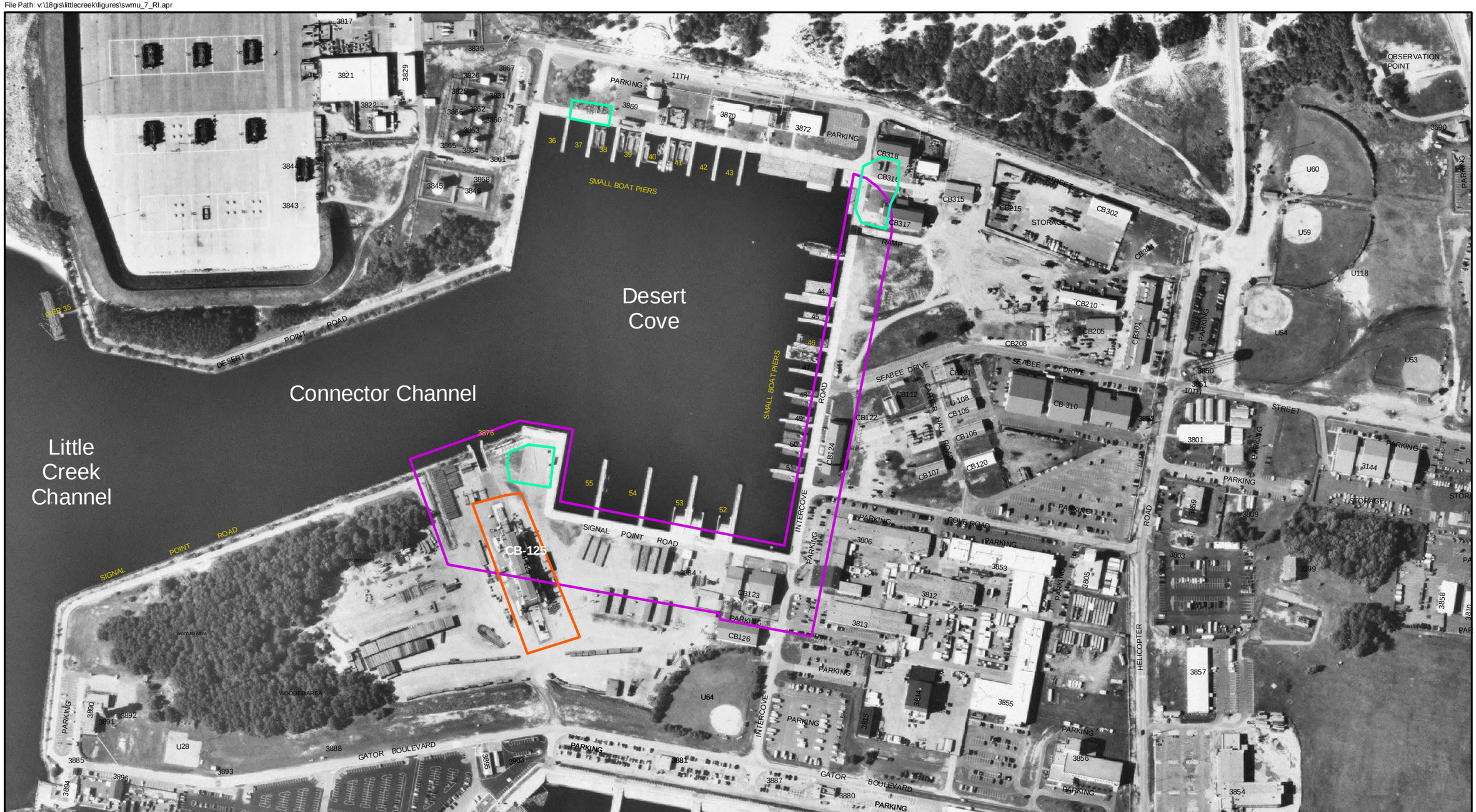

LEGEND

- SWMU Boundary
- Location of indoor blasting facility
- Location where ABM was observed during RFA (A. T. Kearney, 1989)

N

0 400 800 Feet

Figure 2-3
SWMU 7 Boundary and Immediate Vicinity
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

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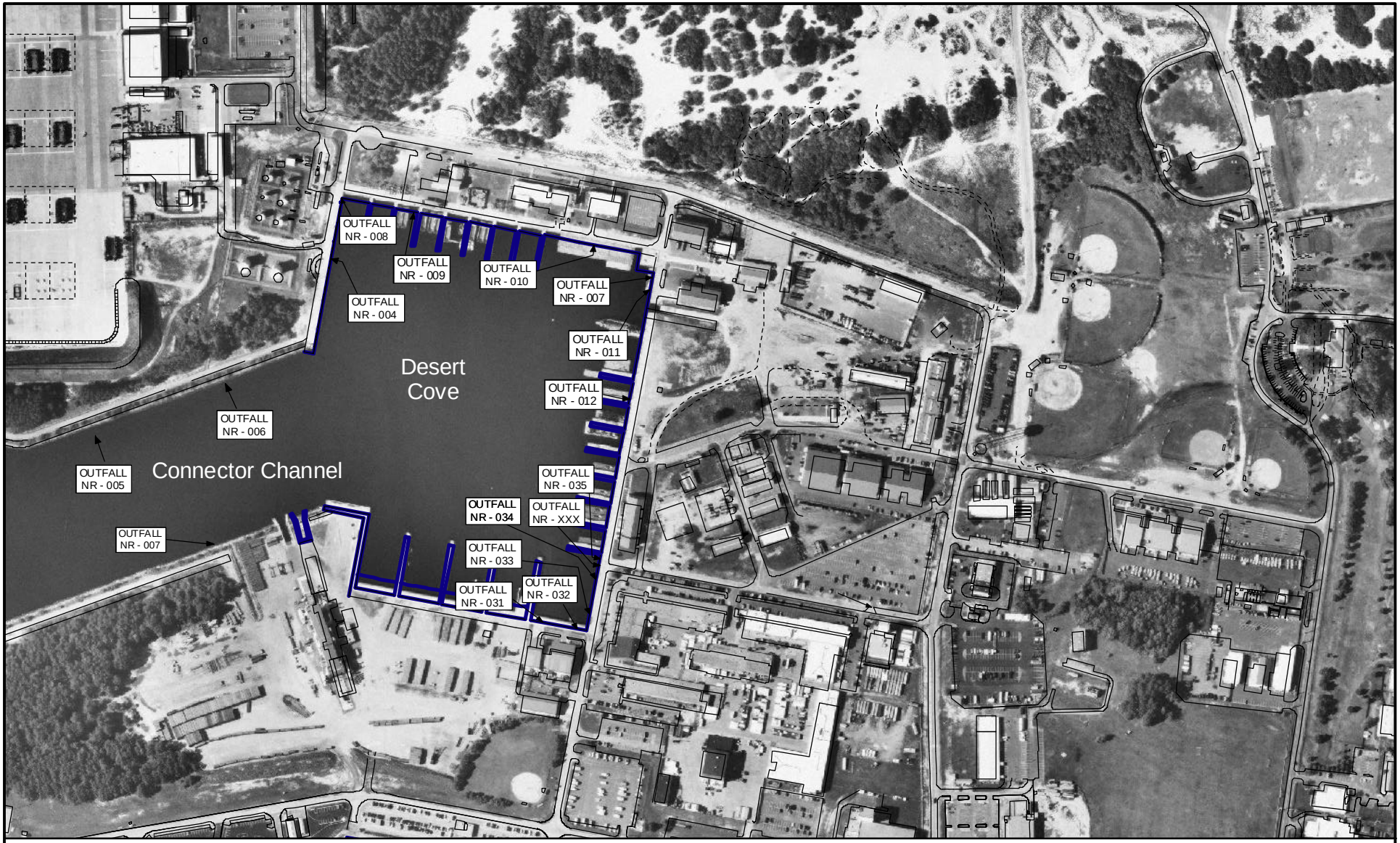

OUTFALL XXX — Regulated Outfall

OUTFALL NR - XXX — Non-Regulated Outfall

OUTFALL ND - XXX — Non-Discharge Outfall

N

0 300 600 900 Feet

Figure 2-4
Desert Cove / Connector Channel Outfall Locations
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

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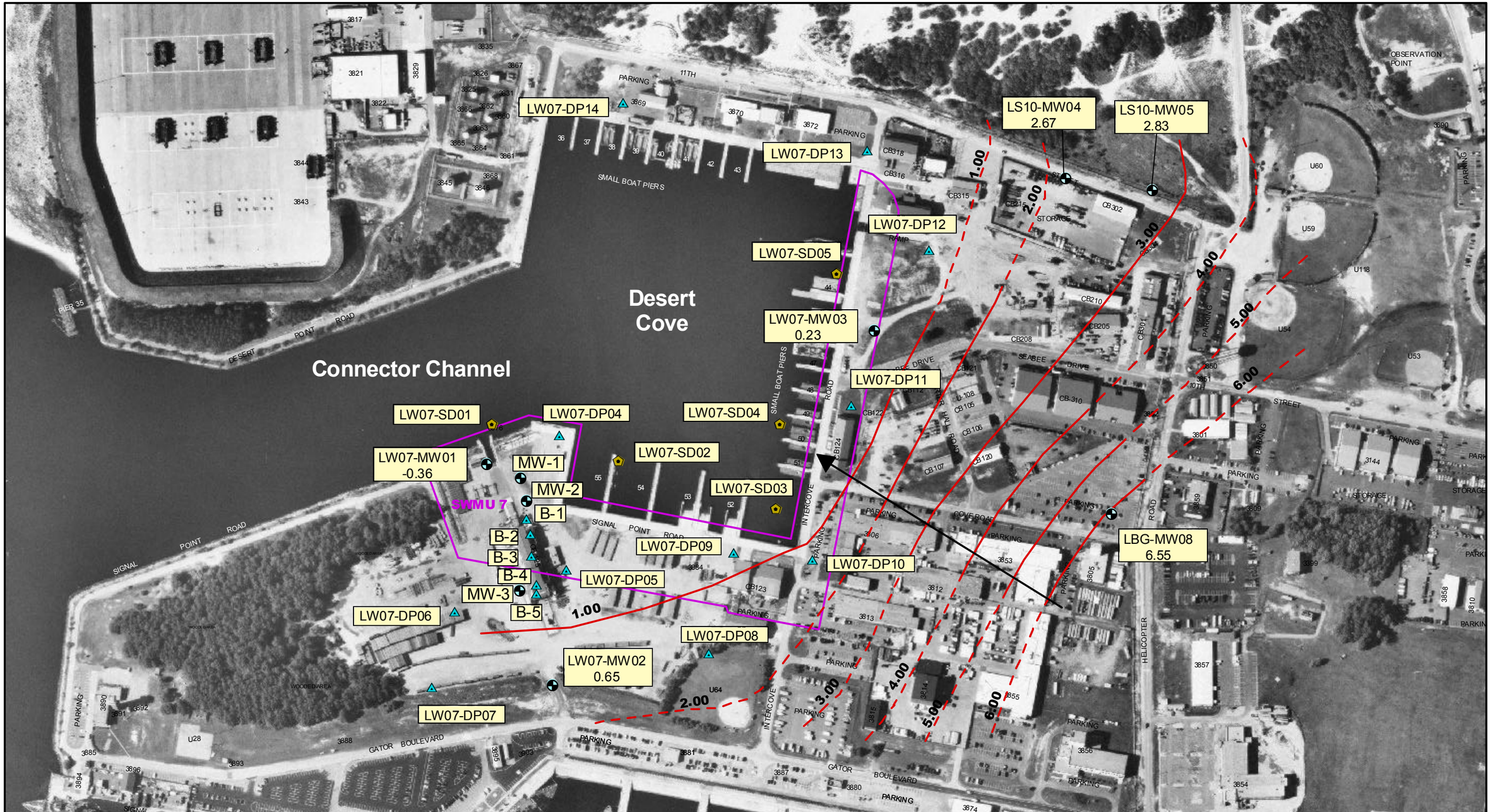

LEGEND

- Direct Push Sample Location
- Monitoring Well
- Sediment Sample Location
- Buildings
- SWMU Boundary
- Inferred Contours
- 1.0 Potentiometric Surface - (ft amsl)
- Groundwater Flow Direction

LW07-MW01 -0.36 — Monitoring Well ID, Groundwater Elevation (ft amsl)

Note:
Potentiometric surface based on May 2000 data.

N

450 0 450 Feet

Figure 2-5
Previous Sampling Locations and Potentiometric Surface Map
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

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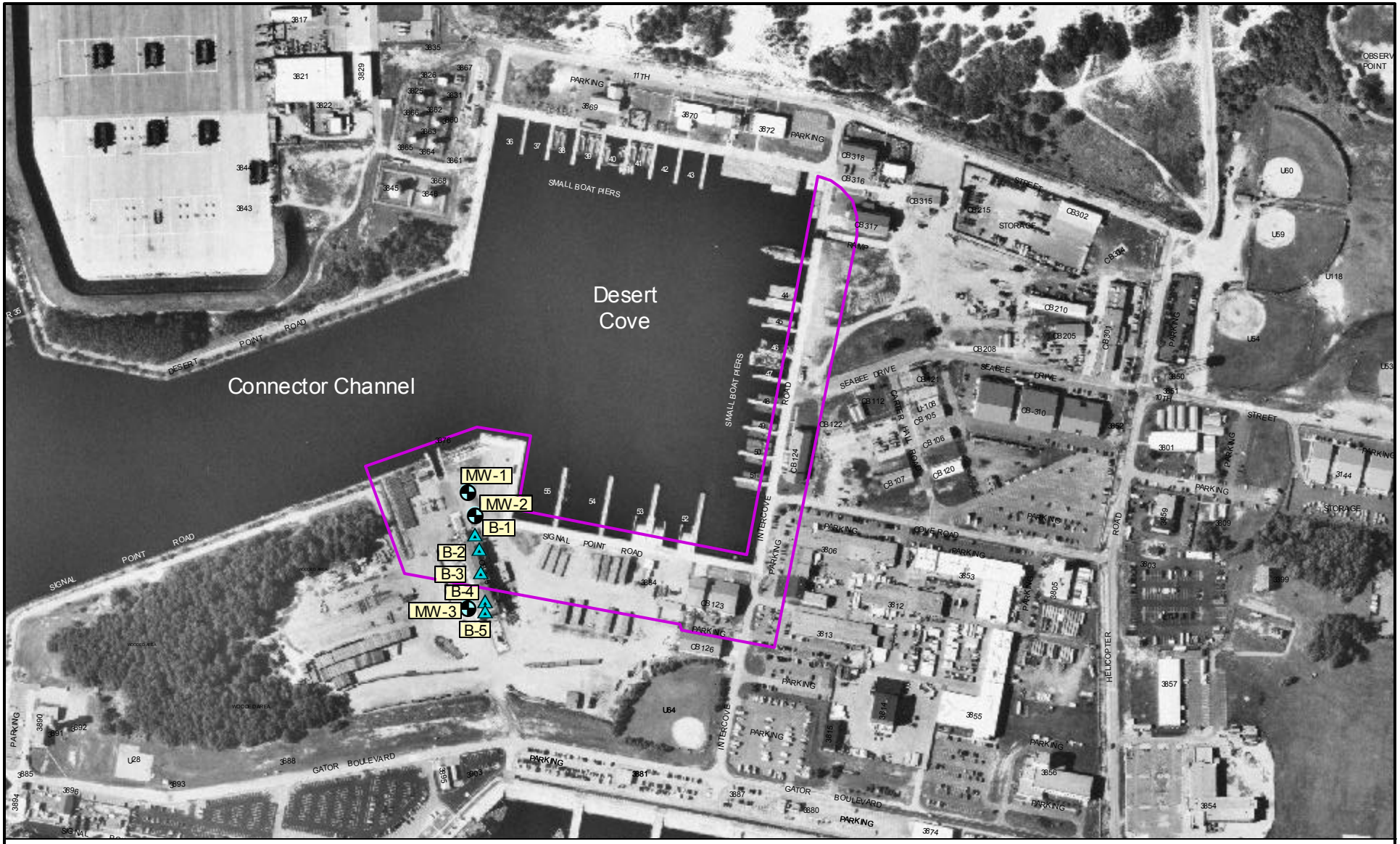

LEGEND

- Direct Push Sample Locations
- Monitoring Well
- SWMU Boundary

N

450 0 450 Feet

Figure 2-6
Soil and Groundwater Sampling Locations (1989 and1993) Investigation
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

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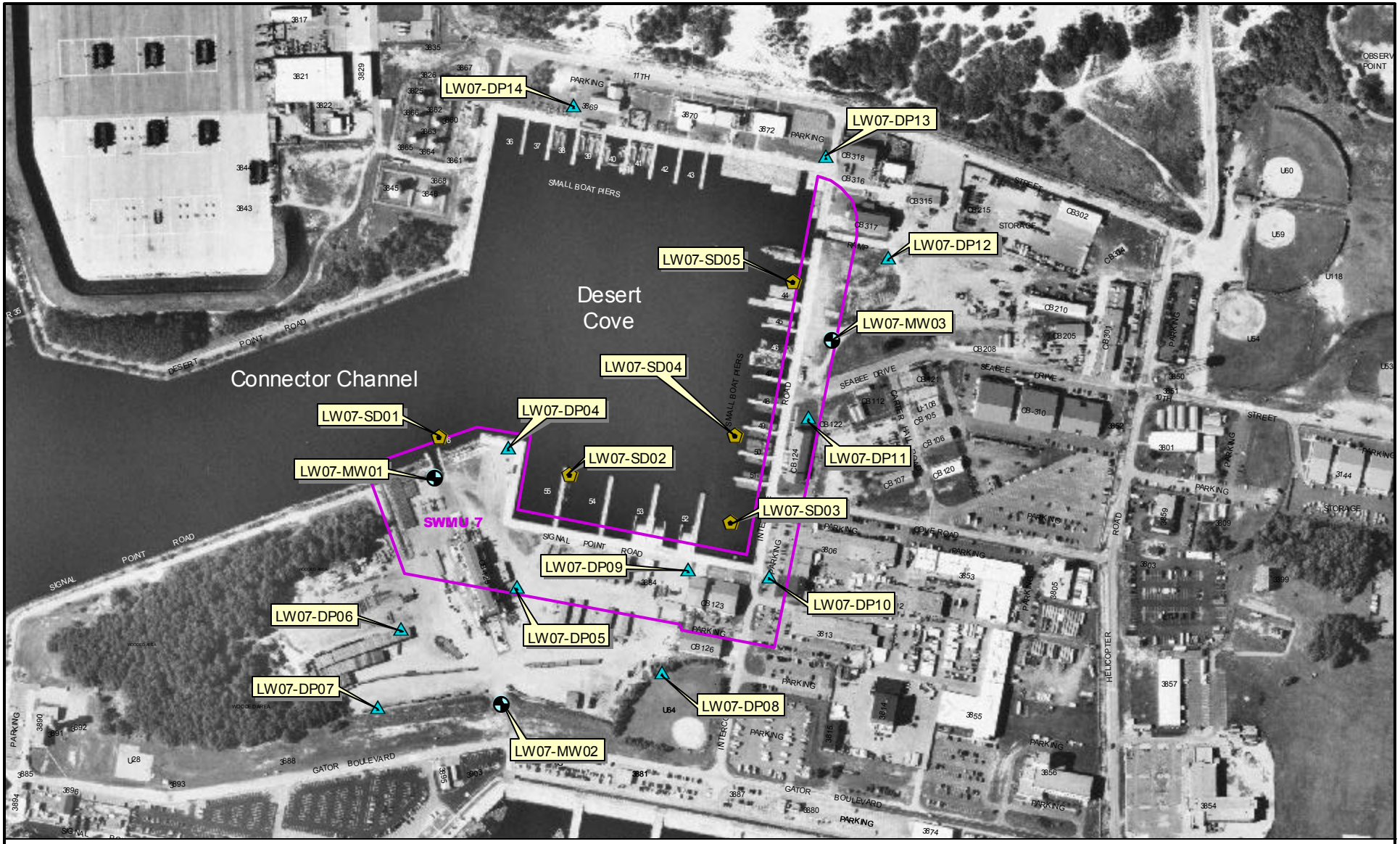


LEGEND

- Direct Push Sample Locations
- Monitoring Well
- Sediment Sample Locations
- SWMU Boundary

Note: Surface Soil Samples SS01, SS02, SS03, and Subsurface Soil Samples SB01, SB02, SB03 were collected from corresponding monitoring well locations MW01, MW02, and MW03 respectively.

N

450 0 450 Feet

Figure 2-7
Groundwater, Soil, and Sediment Sampling Locations From the 2000 Site Investigation
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

CH2MHILL

SECTION 3

Field Investigation Activities

Section 3 presents the scope and method of the field investigation activities conducted as part of the RI at SWMU 7a and SWMU 7b in August 2002, carried out in accordance with the Final RI Work Plan (CH2M HILL, July 2002). The RI Field activities included installation of three new groundwater monitoring wells (MW04, MW05, and MW06), collection of 11 co-located surface and subsurface soil samples, nine groundwater samples, and surface and subsurface sediment samples from 19 node locations in Desert Cove. The field investigation activities were conducted to meet the objectives of the RI described in Section 1.1. Analyte selection was based on the COPCs identified from previous human health and ecological risk screening. The frequency and placement of samples was designed to fill gaps identified during previous investigations and/or to confirm previous sampling results. The monitoring well locations; specifically, were selected based on spatial data gaps.

The RI soil and groundwater sample locations are presented on Figure 3-1 (SWMU 7a), and the sediment sample locations are presented on Figure 3-2 (SWMU 7b). The analytes, methods, and the number of samples per media are provided in Table 3-1.

Detailed field procedures for the activities conducted as part of this RI are outlined in the *Final SWMUs 3, 7, and 8 Remedial Investigation Work Plan,* CH2M HILL, July 2002. All field activities were conducted in accordance with Final Work Plan and the Standard Operating Procedures (SOPs) outlined in the Field Sampling Plan section of the *Final Master Project Plans, NAB Little Creek, Virginia Beach, Virginia,* CH2M HILL, August 2000. Appropriate quality assurance/quality control (QA/QC) samples were collected in accordance with Navy CLEAN and CH2M HILL protocol, including equipment blanks, field blanks, trip blanks, duplicates, and matrix spike/matrix spike duplicates (MS/MSDs).

3.1 Surface and Subsurface Soil Sampling

Surface and subsurface soil samples were collected from 11 locations at SWMU 7a (Figure 3-1). Soil samples were obtained at each from 0–6 inches bgs, 6-12 inches bgs, and 12-24 inches bgs, resulting in 33 soil samples. Soil samples were collected in a disposable acetate-sleeve-lined direct push technology (DPT) sampler and then placed in sample containers provided by the analytical laboratory for shipment.

Surface and subsurface soil samples were analyzed at an offsite laboratory for USEPA Target Compound List (TCL) SVOCs, Target Analyte List (TAL) metals, cyanide, total organic carbon (TOC), pH, and grain size. All the subsurface soil samples were analyzed at an offsite laboratory for Target Compound List (TCL) SVOCs, TAL metals, cyanide, total organic carbon (TOC), and pH. The soil sample locations are shown on Figure 3-1.

3.2 Monitoring Well Installation and Groundwater Sampling

Three shallow groundwater monitoring wells (MW04, MW05, and MW06 were installed at SWMU 7a as part of the RI field activities;(Figure 3-1). In addition, the three existing shallow groundwater monitoring wells (MW01 through MW03) were sampled.

During monitoring well installation, CH2M HILL field staff observed and recorded soil descriptions of soil cores collected from the boreholes, including grain size, color, moisture content, relative density, consistency, soil structure, and mineralogy. Additionally, any evidence of contamination such as staining or contaminant odors were recorded and summarized in Appendix B. Soil cores were collected using DPT with disposal acetate sleeves in 4-ft intervals. Groundwater monitoring wells were installed in the shallow surficial aquifer to depths ranging from 16.5 to 20 ft bgs. The groundwater monitoring wells were constructed with a screened interval of 10 ft positioned to bracket the water table surface. Appendix B contains detailed soil-boring logs and well-construction diagrams for the existing and newly installed monitoring wells.

Groundwater samples were collected from the three existing and three new shallow monitoring wells (Figure 3-1). Samples were collected with a Grundfos® submersible pump using the low-flow sampling protocol described in the Master Project Plans (CH2M HILL, August 2000). Water quality parameters (pH, conductivity, turbidity, dissolved oxygen [DO], temperature, salinity, oxidation/reduction potential [ORP], and depth to water) were measured in the field using a water quality meter and sampling was conducted upon stabilization of the water quality parameters. The results from the water quality monitoring conducted during sample collection are provided in Appendix C. Groundwater samples were collected in laboratory-prepared, pre-preserved sample bottles (if required), and packed on ice for overnight delivery to the offsite laboratory. All groundwater samples were submitted for analysis of low-concentration TCL VOCs, TCL SVOCs, TAL total metals, TAL dissolved metals, and cyanide.

In addition, grab groundwater samples were collected utilizing DPT from three locations at SWMU 7a (Figure 3-1). Groundwater was collected at each from two discrete depths:8-12 ft bgs (water table) and 17-21 ft bgs (just above confining unit). These samples were obtained to further investigate petroleum-related constituents detected in the previous SI samples. These samples were analyzed at an offsite laboratory for TCL SVOCs and low-concentration VOCs.

Depth to water measurements were collected from each monitoring well on September 5, 2002. The vertical and horizontal coordinates of the newly installed monitoring wells were surveyed by a licensed surveyor. The survey results were used to compute water level elevations and construct potentiometric surface maps for the area. The results of the water level surveys (Table 4-2) are discussed in greater detail and the potentiometric surface map (Figure 4-9) is shown in Section 4 of this report.

3.3 Sediment Sampling

Sediment samples were obtained using a multiphased collection approach (the outcome of each round dictates the collection of the next round). This design rationale and approach are discussed in the Final SWMUs 3, 7, and 8 RI workplan (CH2M HILL, July 2002). Sediment

samples were collected to evaluate SI-identified COPCs, and evaluate the nature and presence of ABM at SWMU 7b. Discrete and composite sediment samples were collected during the SWMU 7 RI. Surface sediment, subsurface sediment, and biota samples were obtained at 19 node locations. Seventeen composite surface sediment samples were collected by combining samples from 3 locations surrounding 17 of the 19 nodes (composite samples were not collected from Tertiary nodes L2 and L6). Sediments from each set of three composite locations were homogenized into single sediment samples for submission to the analytical laboratory. Samples from all locations were collected utilizing a Vibracore™ vessel. Figure 3-2 illustrates the sediment sampling locations. Surface samples were collected to approximately 4 in. below the sediment surface at each of the 13 primary nodes, 4 secondary nodes, 2 tertiary nodes, and composite locations using a Ponar dredge. Composite sample locations surrounding each primary and secondary node were collected and homogenized into a single sample for chemical analysis. In addition, samples were collected for identification of benthic invertebrates. The invertebrate identification samples were collected by sieving the sediment to capture particles greater than 500 micron, which were preserved with a formalin solution and stored until delivery to the invertebrate identification laboratory. The benthic invertebrate identification report is presented as Appendix D.

Subsurface sediment samples were collected at the 19 node locations utilizing a Vibracore™ sampling device. Subsurface samples were collected to identify the maximum depth of ABM, using disposable 4-in.-diameter aluminum liners to a minimum of 3 ft below the sediment surface. However, the average depth of the core collection was approximately 62 in. below the sediment surface. The deepest core was to 88 in. below the sediment surface at L6-SD201 (Figure 3-2). The shallowest core was collected from 34 in. below the sediment surface at M3-SD201 (Figure 3-2).

CH2M HILL personnel handled and processed all cores after retrieval from the coring apparatus. The core was visually inspected for the presence or absence of ABM; each core description was logged in the field book (Table 3-2). Subsurface samples were collected at 6-in. intervals beginning 1 inch below the visible ABM boundary. Where ABM was not visually observed, the subsurface sediment sample was collected at 6-in. below sediment surface. The sediment in direct contact with the liner was excluded from analytical sample submission.

The sediment samples were analyzed for the following analytes: TCL PAHs, ammonia, TAL metals, total tin, pH, TOC, and grain size. In addition, the 19 surface sediment samples collected at node locations were submitted for AVS/SEM and cation exchange capacity (CEC) analyses. Redox potential measurements were collected in the field from each node location. Water Quality parameters (temperature, pH, conductivity, DO, turbidity, salinity, and ORP) associated with sediment samples are provided in Appendix D. Grain size data is provided as Appendix G

3.4 References

CH2M HILL. *Master Project Plans, NAB Little Creek, Virginia Beach, Virginia*. August 2000.

CH2M HILL. *Final SWMUs 3, 7, and 8 Remedial Investigation Workplan, NAB Little Creek, Virginia Beach, VA*. July 2002.

Table 3-1
Remedial Investigation Sample Summary SWMU 7
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

SWMU 7 Samples	TAL Total Metals/Cyanide (ILM04)	TAL Dissolved Metals (ILM04)	VOCs (OLM04 or OLC02)	SVOCs (OLM04)	TOC (Lloyd Kahn)	pH	Grain size	TCL PAHs (OLM04)	Total Tin (ILM04)	Ammonia	CEC	AVS/SEM
Surface Soil Samples	10	--	--	--	10	10	--	10	--	--	--	--
Subsurface Soil Samples (6-12" bgs)	11	--	--	--	11	11	4	11	--	--	--	--
Subsurface Soil Samples (12-24" bgs)	11	--	--	--	11	11	4	11	--	--	--	--
Groundwater Samples	6	6	6	6	--	--	--	--	--	--	--	--
Direct Push Groundwater Samples	--	--	6	6	--	--	--	--	--	--	--	--
Surface Sediment Samples	36	--	--	--	35	36	19	36	36	36	--	19
Subsurface Sediment Samples	19	--	--	--	19	19	15	19	19	19	19	--

Note:
TCL: Target Compound List
TAL: Target Analyte List
VOCs: Volatile Organic Compounds
SVOCs: Semivolatile Organic Compounds
PAHs: Polycyclic Aromatic Hydrocarbons
TOC: Total Organic Carbon
CEC: Cation Exchange Capacity
AVS/SEM : Acid Volatile Sulfides/Simultaneously Extractable Metals

Table 3-2
Vibracore Sample Summary
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	Sample ID	Date Sampled	Depth Interval	Sample Description
LW07-B5-SD201	LW07-B5-SD201-00-02C	9/27/2002	0"-4"	clay; green black; ABM present; shell fragments present.
LW07-B5-SD201	LW07-B5-SD201-02-02C	9/30/2002	6"-12"	Redox = -252 at 1" 0"-6" Trace ABM from 0-3" 5gy 4/1; silty clay; very soft. 6"-19" Silty clay; 10y 3/1; SP; mild oxidation; organic material. 19"-40" silty sand with silt lenses at 34" lighter color at 33" 10yr 4/2. Oxidation lenses about 1mm thick every .5 ". 40"-43" silty clay with some fine sand; 10yr 6/3. 43"-54" Stiff clay; 10yr 6/3; Some traces of oxidation lenses.
LW07-B5-SD202	LW07-B5-SD202-00-02C	9/27/2002	0"-4"	B5-1 - clay; black; small amount ABM visible; Twigs; shell fragments. B5-2 - silty clay; small amount ABM visible; clay fragments. clay; greenish black; no ABM present; no shell fragments.
LW07-B7-SD201	LW07-B7-SD201-00-02C	9/27/2002	0"-4"	clay; live clam; black; sulfur odor; no ABM present.
LW07-B7-SD201	LW07-B7-SD201-02-02C	9/29/2002	12"-18"	Redox = -532.1 at 1" 0"-13" 5gy 3/1; silt clay; some shells. 13"-18" 5gy 4/1 fine sand clean. 18"-28" 5gy 4/1 silty clay. 28"-38" 5gy 4/1; interbedded find sand and silty clay. 38"-43" 5gy; clean sand; fines. 43"-53" 10yr 5/4; silty fine sand 53" 5gy 5/1; consolidated clay matrix oyster shell hash; dense.
LW07-B7-SD202	LW07-B7-SD202-00-02C	9/27/2002	0"-4"	B7-1 - clay and fine silts; no ABM; sulfur odor; no shell fragments. B7-2 - Clay; live clam; black; has sulfur odor; (high organics) B7-3 - Black; small amount of ABM present; clay; shell pieces; whole clam shells.
LW07-D5-SD201	LW07-D5-SD201-00-02C	9/27/2002	0"-4"	black; small amout of ABM present; no shell fragments; clay.
LW07-D5-SD201	LW07-D5-SD201-02-02C	9/30/2002	7"-13"	Redox = -259.1 at 1" 0"-6" No presence of ABM; very soft clay; 6"-14" Very soft clay; 5gy 4/1 14"-23.5" silty sand changing to silt clay at 16"below sediment surface; oxidation present 10yr 4/1. 23.5"-64" Silty clay; shell fragments at interface.
LW07-D5-SD202	LW07-D5-SD202-00-02C	9/27/2002	0"-4"	D5-1 - Blast grit present in small amounts; silty clay; small shell fragments; no debris. D5-2 - Black silty clay; small amount of ABM present; No shell fragments present. D5-3 - Blast Grit; small amounts; silty clay; small shell fragments; no debris.
LW07-F3-SD201	LW07-F3-SD201-00-02C	9/27/2002	0"-4"	ABM present in small amounts; some debris; no shell fragments observed; black; sulfur odor.
LW07-F3-SD201	LW07-F3-SD201-02-02C	9/29/2002	12"-18"	Redox = -181.4 at 1" 0"-14" clayey silt; 5gy 5/1. 14"-16" 5gy 4/1; clay. 16"-21" 5gy 4/1; fine sand. 21"-48" 5gy 4/1; silty clay. 48"-58" 5gy 4/1; fine sandy clay. 58"-63" 5gy clean sand; fine to medium grained; sub-rounded some shell fragments. 63"-69" 5gy 6/1; with red oxidation bands; dense clay; no shells; no organics.
LW07-F3-SD202	LW07-F3-SD202-00-02C	9/27/2002	0"-4"	F3-1 - Very shelly; whole shells and shell fragments; blackish green; ABM present; sandy; nearshore. F3-2 - Grey Brown; strond sulfur odor; small shell fragments; no visible signs of ABM. F3-3 - ABM in small amounts; some debris; no shell fragments; black; sulfur odor.
LW07-F5-SD201	LW07-F5-SD201-00-02C	9/27/2002	0"-4"	sandy silt; greenish black live conch snails; shell fragments present; ABM present but not abundant.
LW07-F5-SD201	LW07-F5-SD201-02-02C	9/29/2002	9"-16"	Redox = -299.1 at 1" 0"-5" 5gy 4/1; soft silty clay with grey shell 5"-7.5" 5gy 4/1 fine sandy silt; organics; trace ABM present. 7.5"-39" 5gy 4/1 silty fine sand; some clay lenses. 39"-49" 10yr 5/4; medium-fine subrounded sand; oxidation bands 49"-51" 5gy 4/1. Stiff clay. 51" -60" 10yr 5/4; medium sand; with clay lenses 60"-65" 5gy 4/1 -moderately stiff clay.

Table 3-2
Vibracore Sample Summary
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	Sample ID	Date Sampled	Depth Interval	Sample Description
LW07-F5-SD202	LW07-F5-SD202-00-02C	9/27/2002	0"-4"	F5-1- Clayey sand; greenish black; shell fragments present. F5-2 - Silty Clay; Black; no ABM; wood present; no shell fragments. F5-3 - Sandy numerous shell fragments; blast grit presnt but not abundant; twigs.
LW07-H1-SD201	LW07-H1-SD201-00-02C	9/27/2002	0"-4"	black silty clay; small shell fragments; no ABM visible.
LW07-H1-SD201	LW07-H1-SD201-02-02C	9/29/2002	12"-16"	Redox = -292.2 at 0.01" 0"-23" 5gy 3/1; silty clay. 23"-32" 5gy 4/1 clay; plastic; dense. 32"-63" 5gy 4/1 fine to med grained sand dense; sub angular; rounded.
LW07-H1-SD202	LW07-H1-SD202-00-02C	9/27/2002	0"-4"	H1-1 - Silty Clay; ABM present; large shell fragments; black. H1-2 - Silty Clay; Strong Sulfur Odor H1-3 - Black Silty Clay; small shell fragments; No ABM.
LW07-H3-SD201	LW07-H3-SD201-00-02C	9/27/2002	0"-4"	black clay; small shell fragments; no ABM visible; sulfur odor.
LW07-H3-SD201	LW07-H3-SD201-02-02C	9/30/2002	7"-13"	Redox = -324.9 at 1" 0"-15" Clay Pudding like; Very Soft; 10y 4/1; No ABM; shell fragments present. 15"-23" Sandy silt; 10y 4/1. 23"-26" Stiff Clay layer; Oxidation zone. 27"- 40" Silty sand; 10y 5/1. 40"-49" Silty clay; stiff; friable; laminations of oxidation layers.
LW07-H3-SD202	LW07-H3-SD202-00-02C	9/27/2002	0"-4"	H3-1 - ABM Present; Greenish Black; small shell fragments; clay. H3-2 - Black Clay; Small shell fragments; no ABM visble; sulfur odor. H3-3 - Silty Clay; sulfur odor; ABM present; black green.
LW07-H5-SD201	LW07-H5-SD201-00-02C	9/26/2002	0"-4"	Shell fragments present; sandy; ABM present
LW07-H5-SD201	LW07-H5-SD201-02-02C	9/26/2002	7"-13"	Redox = 0 at 1inch 0"-6" Black sandy silt with ABM present; material mussel shell pieces near surface. 6"-36" Clay; green; no ABM present. 36"-48" sand; well sorted; grey broun in color; no ABM present.
LW07-H5-SD202	LW07-H5-SD202-00-02C	9/26/2002	0"-4"	H5-1- Clayey; No ABM; greenish. H5-2- ABM Present/debris; sticks; pebbles; stone from dock; oyeter shells; sheen on sediment H5-3- Triangular proce of paint approximately 1"-1" fragments of shells; pieces of road; small presence of ABM; Clayey; puding greenish.
LW07-J4-SD201	LW07-J4-SD201-00-02C	9/28/2002	0"-4"	5gy 4/1; silty clay with shells; no ABM; oyster shell; no organics.
LW07-J4-SD201	LW07-J4-SD201-02-02C	9/30/2002	7"-13"	Redox = -305.9 at 1" 0"-11" Silty Caly 10y 4/1; grey; soft. 12"-29" Sandy Silt; SM; 104 4/1; peat lenses. 30"-36" Clay; Medium stiff; 10y 2.5/1. 36"-64" Silty clay; stiff; 10y 4/1; peat lenses.
LW07-J4-SD202	LW07-J4-SD202-00-02C	9/28/2002	0"-4"	J4-1 5gy 4/1; fine sandy clay; shells present; no ABM; no organics J4-2 - 5gy 4/1; silty clay; no ABM; no organics; some shells. J4-3 - 5gy 4/1; silty clay; shells; no ABM; oyster shell; no organics
LW07-K1-SD201	LW07-K1-SD201-00-02C	9/27/2002	0"-4"	black; some ABM present; large clam shells; silty clay.
LW07-K1-SD201	LW07-K1-SD201-02-02C	9/28/2002		Redox = -294.00 at 0" 0"-10" 5gy 3/1 silty clay; shells. 11"-15" 5gy 4/1 silty clay. 15"-35" alternating sands and silty clay 5gy 4/1.
LW07-K1-SD202	LW07-K1-SD202-00-02C	9/27/2002	0"-4"	K1-1 - Black; some ABM present; lare clam shells; silty clay. K1-2 Black; Strong sulfur odor; organic sheen; clay; no ABM present; small shell fragments. K 1-3 - No ABM; Greenish Black clay; small shell fragments
LW07-K3-SD201	LW07-K3-SD201-00-02C	9/28/2002	0"-4"	dark olive greenish gray; silty; trace shells; no ABM; no organics.
LW07-K3-SD201	LW07-K3-SD201-02-02C	9/29/2002	8"-15"	Redox = -62 at 0.5" 0"-3" 5gy 4/1 fine sandy clay. 3"-20" 5gy 4/1 silty clay; trace shells; trace ABM at 5". 20"-54" 5gy 4/1; fine-med sand clean; organics; silty clay shell fragments.
LW07-K3-SD202	LW07-K3-SD202-00-02C	9/28/2002	0"-4"	K3-1 - Dark Olive greenish grey; silty sand; trace shells; no ABM; no organics. K3-2 - Dark Olive Greenish Grey; fine sandy clay; ABM present; organics; twigs; leaves; shells; 5gy 4/1. K3-3 - 5gy 4/1 Clayey fine sand; slight sheen; some shells; no ABM.

Table 3-2
Vibracore Sample Summary
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

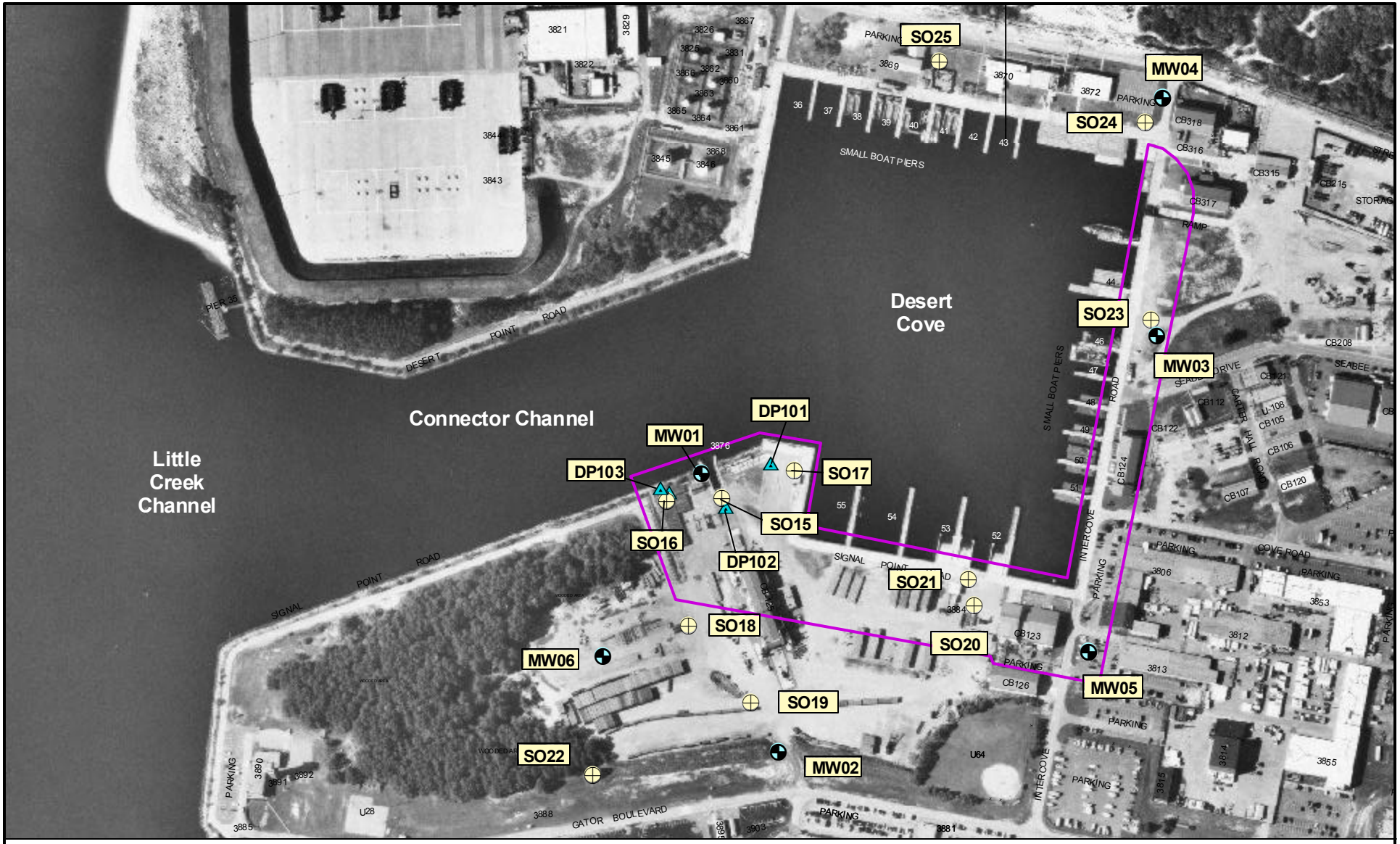
Station ID	Sample ID	Date Sampled	Depth Interval	Sample Description
LW07-K4-SD201	LW07-K4-SD201-00-02C	9/28/2002	0"-4"	5gy 4/1; fine sandy clay; some shells and organics; trace ABM.
LW07-K4-SD201	LW07-K4-SD201-02-02C	9/30/2002	7"-13"	Redox = -325.1 at 1" 0"-6" sandy silt; 5y 3/1; ABM present. 6"-12" clay 10y 4/1; soft; no ABM present. 12"-24" Silty Clay 10y 3/1. 25"-35" sandy grey; loose SM; 10y 4/1. 35"-48" silty clay with some sand lenses; 10y 4/1.
LW07-K4-SD202	LW07-K4-SD202-00-02C	9/28/2002	0"-4"	K4-1 - 5gy 4/1; silty clay; some shells; no organics; no ABM. K4-2 - 5gy 4/1; fine sandy clay; some shells; organics; trace ABM. K4-3 - 5gy 4/1 silty clay; shells; organics; no ABM.
LW07-K5-SD201	LW07-K5-SD201-00-02C	9/28/2002	0"-4"	5gy 4/1 silty clay; no ABM; trace shells.
LW07-K5-SD201	LW07-K5-SD201-02-02C	9/30/2002	7"-20"	ms/msd collected at this location. Extra volume was needed. Redox = 385.5 at 1" 0"-6" 10y 3/1; silty clay; very soft; ABM present to 3 " below sediment surface. 7"-20" color change 10y 4/1 at 10"below sediment surface; clay' soft; no ABM. 20"-31" silty clay 10y 4/1; no ABM; organic present. 31"-34" peat layer brownish 10yr 2/2 34"-47" clay 10y 3/1; very soft with silty clay 1 inch layer at 42" below sediment surface 47"-74" silty clay with shell fragments at interface; stiff.
LW07-K5-SD202	LW07-K5-SD202-00-02C	9/28/2002	0"-4"	K5-1 5gy 4/1; silty clay; shells; trace organics; no ABM. K5-2 - 5gy 4/1; silt clay; no ABM; plactiand wood debris. K5-3 - 5gy 4/1 silty clay; plastic debris; no ABM; trace shells.
LW07-K6-SD201	LW07-K6-SD201-00-02C	9/28/2002	0"-4"	5gy 3/1; silty fine sand; some ABM; some gravel; trace organics; shells; sheen; cresote odor.
LW07-K6-SD201	LW07-K6-SD201-02-02C	9/28/2002		Redox = -6.4 at 0.5" 0"-5" 5gy 4/1; fine-med sand; trace ABM. 5"-16" silty clay; shells; trace organics; no ABM 16"-51" 5gy 4/1; clay. 51"-54" silty fine sand.
LW07-K6-SD202	LW07-K6-SD202-00-02C	9/28/2002	0"-4"	K6-1 - 5gy 3/1; silty fine sand; sheen; cresate odor; trance organics; shells; trace ABM. K6-2 - 5gy 3/1; silty fine-medium sand; some shells; organics; debris; heavy ABM; trace gravel. K6-3 - 5gy 3/1 clayey fine sand with some ABM; some shell fragments; no sheen/odor; trace organics.
LW07-L2-SD201	LW07-L2-SD201-00-02C	10/1/2002	0"-4"	ABM present; black silty clay; shell fragments.
LW07-L2-SD201	LW07-L2-SD201-02-02C	10/1/2002	7"-13"	Redox = -170.3 at 1" 0"-15" clay pudding like; 10y 2.5/1; 0-3 " mor silty clay; no ABM; small shell fragments. 15"-23" Sandy silt; 10y 4/1. 23"-48" Silty clay with some find sands; 10y 5/1; some oxidation lenses beginning at 34" 48"-66" sandy silt; 10yr 5/1.
LW07-L5-SD201	LW07-L7-SD201-00-02C	9/28/2002	0"-4"	5gy 3/1 silty clay; no ABM; trace shells; no organics; some sheen.
LW07-L5-SD201	LW07-L5-SD201-02-02C	9/29/2002	13"-20"	Rdeox = -412.8 at 1" 0"-6" 5gy 3/1 stiff silt clay. 6"-21" 5gy 4/1 fid sandy clay. 21"-35" 5gy 4/1 silft fine sand; subangular; loose. 35"-39" 5gy 3/1 moderately sofr silty clay; some organics. 39"-42" peat zone. 42"-56" 5gy 4/1; interbedded silty clay and fine sand 56"-65" 5 gy 6/1 dense silty clay; 10yr 5/4 trace organics.
LW07-L5-SD202	LW07-L5-SD202-00-02C	9/28/2002	0"-4"	L5-1 - 5gy 3/1, silty clay; no ABM; some shells; some sheen; no organics L5-2 - 5gy 3/1; silty clay; trace shells; no organics; no ABM. L5-3 - 5gy 3/1 fine sandy clay; abundant shell fragments; ABM present; some organics; noticable ABM.
LW07-L6-SD201	LW07-L6-SD201-00-02C	10/1/2002	0"-4"	black silty mud; no ABM present; shell fragments; organics sulfur odor.
LW07-L6-SD201	LW07-L6-SD201-02-02C	10/1/2002	6"-12"	Redox = -196.3 at 1" 0"-10" Silty Clay 10y 2.5/1; no ABM; shell fragments 10"-25" 10y 4/1; clay; very soft. 25"-56" Silty sand turning more silty clay at 50". Tree bark present at 57". 56"-80" 10y 6/1; sand; peat mixed sub angular. 80"-88" Stiff clay; 10y 6/1; Oxidation lenses intetwined.

Table 3-2
Vibracore Sample Summary
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	Sample ID	Date Sampled	Depth Interval	Sample Description
LW07-M1-SD201	LW07-M1-SD201-00-02C	9/27/2002	0"-4"	sandy silt; ABM present brownish black; shell fragments.
LW07-M1-SD201	LW07-M1-SD201-02-02C	9/29/2002	17"-25"	Redox = -250.1 at 1" 0"-5" 5gy 4/1 fine sandy silt; trace shells; trace ABM. 5"-12" 5gy 2/1 some ABM. 12"-33" 5gy 2/1 silty clay. 33"- 45" 5gy 5/1 fine medium clean sand. 45"-58" 5gy 5/1; silt clay.
LW07-M1-SD202	LW07-M1-SD202-00-02C	9/27/2002	0"-4"	M1-1 - Black Silty Clay; Shell fragments; ABM present. M1-2 - Sandy Silt; ABM present; brownish black; shell fragments. M1-3 - Black silty clay; Pieces of boat bottom; no ABM present.
LW07-M3-SD201	LW07-M3-SD201-00-02C	9/28/2002	0"-4"	olive grey green; traces of organics; ABM present; moderate sheen; silty clay with shells; organics; and pebbles.
LW07-M3-SD201	LW07-M3-SD201-02-02C	9/28/2002	11"-18"	Redox = -6.4 at 0.5" 0"-5" 5gy 4/1; silty clay with shell; ABM debris; grout? 5"-8" 5 gy 3/1 fine sandy clay with shells. 8"-24" 5gy 4/1 silty clay. 24"-32" 5gy 5/1 fine sand with clay lenses.
LW07-M3-SD202	LW07-M3-SD202-00-02C	9/28/2002	0"-4"	M3-1 - green silty clay; shell fragments; no visible ABM. M3-2 - Greenish Grey; trace organics; no visible ABM silty clay. M3-3 - olive greenish gray; trace organics; sheen; silty clay; trace ABM.

Note:
Sample ID: LW07-B5-SD201-00-02C
LW07 - SWMU 7
B5 - Transect B
SD201 - Sediment Sample Location 201
00 - Surface Interval (0-4 inches below sediment surface; 02 indicates additional depth interval collected and depth is given in " Depth Interval " column)
02C - Sample collected 3rd quarter 2002

File Path: v:\18gis\littlecreek\figures\ri_workplan.apr



LEGEND

- Monitoring Well
- Surface and Subsurface Soil Sample
- Direct Push Groundwater Sample
- SWMU Boundary

N

500 0 500 Feet

Figure 3-1
Soil and Groundwater Sampling Locations
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

CH2MHILL

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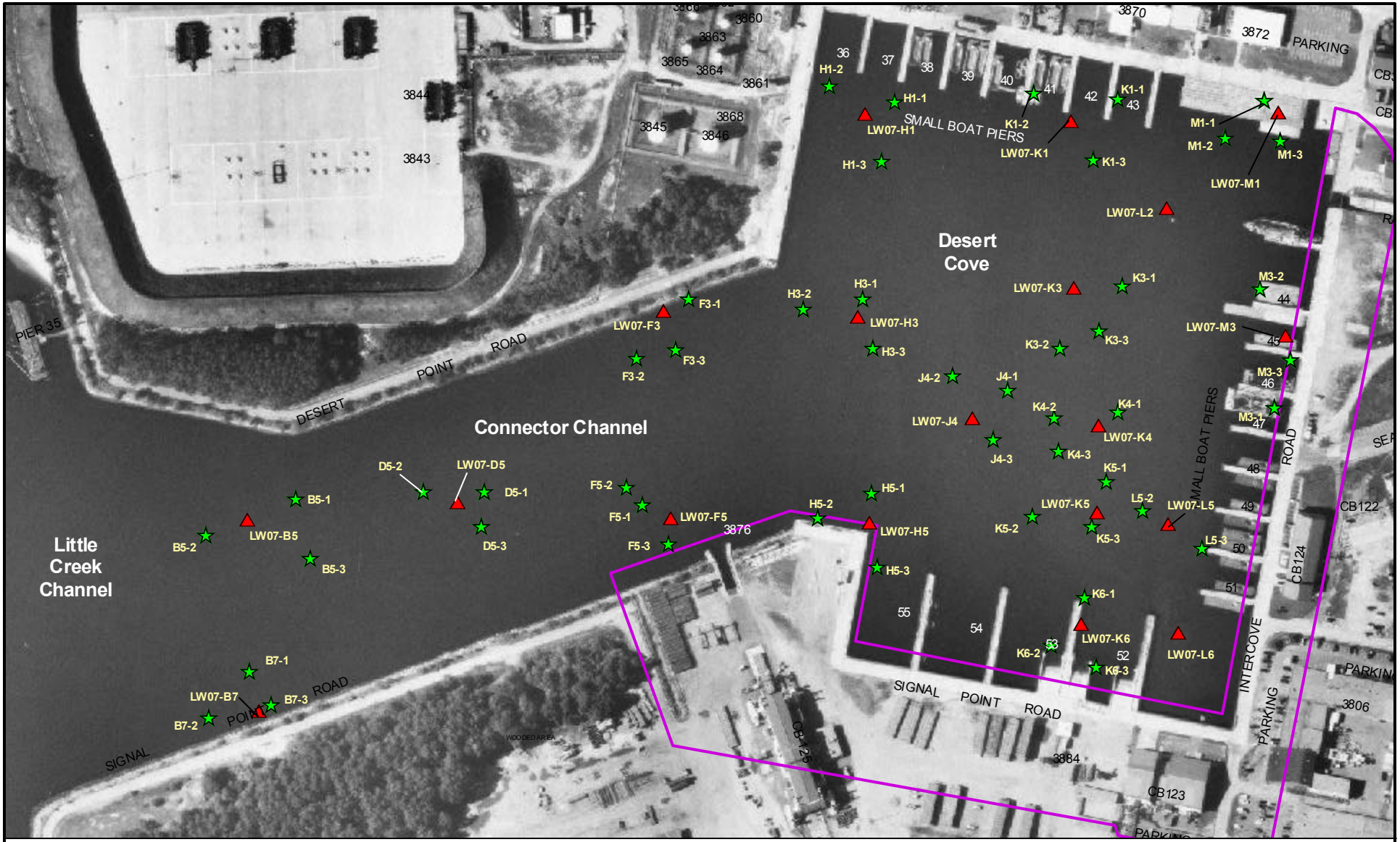

LEGEND

- Node (Discrete) Location for Sediment Sample
- Composite Location for Sediment Sample
- SWMU Boundary

Notes:
Corresponding composite sample identification is SD202 for composite samples at each location. (i.e. for B5-1, B5-2, B5-3 the corresponding sample ID is LW07-B5-SD202-00)
The structure located at sample locations LW07-M1 and M1-1 was not in place during the 2002 RI sampling event.

N

250 0 250 Feet

Figure 3-2
Sediment Sampling Locations
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

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SECTION 4

Physical Characteristics

Section 4 summarizes the physical characteristics of the region, NAB Little Creek, and SWMU 7 in particular. Section 4.1 discusses the regional and basewide physiography and climate. Section 4.2 presents a discussion of the topography, drainage, and surface features at SWMU 7. The regional, basewide, and site-specific geology and hydrogeology are described in Section 4.3.

4.1 Regional and Basewide Physiography, Climate, and Surface Water Hydrogeology

NAB Little Creek is located in the Tidewater region of Virginia, adjacent to the Chesapeake Bay. The facility lies within the outer part of the Atlantic Coastal Plain Physiographic Province in Virginia Beach, Virginia (Figure 4-1). The area's physiography is typical of the Atlantic Coastal Plain with stepped terraces consisting of wide, gently eastward-sloping plains separated by linear, steeper, northward- and eastward-facing scarps. This part of the Atlantic Coastal Plain is characterized by low elevations and relatively flat relief, with few elevations greater than 25 ft above mean sea level (msl) (Figure 4-2).

The physiography at NAB Little Creek consists of low relief ranging in elevation from msl along the Chesapeake Bay shoreline to 40 ft above msl at some of the larger dunes along Chesapeake Bay (Ebasco, November 1991; Foster Wheeler Environmental Services [FWES], November 1994). Immediately south of NAB Little Creek, the Diamond Springs Scarp generally runs east to west. The Hickory Scarp, which generally runs north to south, terminates and intersects the Diamond Springs Scarp south of NAB Little Creek (Oaks and Coch, 1973).

NAB Little Creek is within the Lynnhaven River Basin, which drains into the Chesapeake Bay (Siudyla, et al., 1981;Hamilton and Larson, 1988;). Approximately 3 miles of Chesapeake Bay shoreline serves as the Base's northern boundary. Chubb Lake and Lake Bradford bound the base on the east. In addition to these two onsite freshwater bodies, two offsite freshwater bodies, Little Creek Reservoir /Lake Smith and Lake Whitehurst, are south of NAB Little Creek. Four saltwater bodies are present within the boundaries of NAB Little Creek—Little Creek Cove, Desert Cove, Little Creek, and Little Creek Channel, which connects the other three bodies to the Chesapeake Bay. The previously mentioned freshwater lakes are connected to the Little Creek Channel system by a series of canals and weirs. The major surface water bodies near NAB Little Creek are illustrated in Figure 2-2.

The Tidewater area climate is moderated by its proximity to the Atlantic Ocean and the Chesapeake Bay. The average annual temperature is 60° Fahrenheit (F) with average temperatures ranging from 42° in the winter to 77° F in the summer. The relative humidity averages 57 to 78 percent. Average total annual precipitation is 45 in., with approximately 56 percent of the rainfall between April and September. The prevailing wind direction is to

the southwest with an average speed of approximately 11 miles per hour (mph) (FWES, November 1994).

Precipitation is the main source of recharge to area aquifers. Between 50 and 70 percent of the precipitation is removed from the area via runoff along the relatively flat topography and through evapotranspiration. Approximately 30 to 50 percent of the annual precipitation (14 to 23 in.) recharges the water table aquifer by percolating through the soil zone (Siudyla, et al., 1981). This recharge volume is approximately equivalent to 0.6 to 1.1 million gallons per day (MGD) per square mile. Approximately 90 percent of recharged groundwater returns to surface water lakes, canals, and coves as baseflow.

4.2 SWMU 7 Surface Features, Topography, and Drainage

The ground surface at SWMU 7 is mostly concrete, asphalt, and hard-packed gravel covered. Adjacent to SWMU 7 and west of building CB-125 is a large parcel of trees and grass-covered ground. Desert Cove and the connector channel are also adjacent to SWMU 7, which receive direct runoff and discharge from the outfalls located around the cove (Figure 2-4). The cove and connector channel are inland to Little Creek Channel, which leads northward towards the Chesapeake Bay. These water bodies are tidally influenced and regularly receive influxes of surface water. The surface features and water bodies adjacent to SWMU 7 are depicted in Figures 3-1 and 3-2.

Ground elevations were surveyed by a licensed surveyor at each monitoring well location during the RI field activities. The ground surface elevation at SWMU 7's southwestern edge is from 9 ft msl at MW06 to 7.38 ft above msl at MW01. The eastern boundary is flat, with the elevation at MW04 9 ft above msl and that at MW05 of 9.1 ft above msl. The SWMU's topography generally slopes toward Desert Cove (Figure 4-2).

Precipitation would be expected to run off directly to Desert Cove with very little infiltration to groundwater. Precipitation that does not run off to the cove or infiltrate to the groundwater would evaporate or transpire.

4.3 Geology and Hydrogeology

4.3.1 General Regional Geologic and Hydrogeologic Framework

Southeastern Virginia lies within the Atlantic Coastal Plain physiographic province and is underlain by an eastward thickening wedge of marine and nonmarine sediments from early Cretaceous to Holocene (Figure 4-3). Along the coastline, several thousand ft of interlayered, unconsolidated sediment, consisting of gravel; sand; silt; and clay deposits; overlay pre-Cretaceous crystalline basement rock. Minor amounts of detrital carbonate shells and secondary minerals (such as glauconite, siderite, and chlorite) often distinguish these sedimentary units. These sediments range from 2,000 ft thick in the western Tidewater Area to more than 4,000 ft thick in its southeastern part (Siudyla, et al., 1981).

Historical Coastal Plain sedimentation and deposition were controlled by fluctuations in sea level on a subsiding continental margin (Hamilton and Larson, 1988; Meng and Harsh, 1988). The Virginia Coastal Plain sediment wedge is mostly undeformed but generally dips

gently to the southeast (Figure 4-3). The average structural dip of the oldest and deepest deposits is approximately 40 ft/mile and is less than 3 ft/mile for the youngest and shallowest deposits (Meng and Harsh, 1988).

Differential subsidence produced a series of gently dipping regional structural highs and lows, known as arches and embayments (or basins). The Virginia Tidewater Region is located along the axis of a regional structural feature known as the Norfolk Arch (Meng and Harsh, 1988) (Figure 4-4), an east-west structural ridge of crystalline basement rock that separates the Salisbury Embayment to the north from Albemarle Embayment to the south. Thicker sediment accumulations occurred in the basins relative to over the arches. The arches were partially responsible for characteristic depositional sequences within the different basins, as described below.

The eastward-dipping sediments consist of unconsolidated marine, alluvial, and lagoonal deposits. Sediments of the Salisbury Embayment, north of the Norfolk Arch, are characteristically glauconite-rich, while those of the Albemarle Embayment, south of the Norfolk Arch, are characteristically carbonate rich. Sediments at Virginia Beach may be more than 3,500 ft thick.

A generalized stratigraphic column for the Virginia Coastal Plain is presented in Figure 4-5. Both geologic (i.e., time-stratigraphic) units and corresponding hydrostratigraphic units are presented.

Based on the generalized regional column (Meng and Harsh, 1988), the geologic units beneath the study area include, from youngest to oldest:

- Holocene (Recent) deposits
- Undifferentiated Pleistocene deposits
- The Miocene to Pliocene Chesapeake Group of formations (including the Yorktown Formation)
- The Paleocene to Eocene Pamunkey Group of formations
- Late Cretaceous undifferentiated sediments
- Early to Late Cretaceous Potomac Formation

Corresponding to the regional geologic formations and groups listed above are 17 hydrostratigraphic units—nine aquifers separated by eight aquitards or confining units (Meng and Harsh, 1988). Of these regional hydrostratigraphic units, only the youngest three are studied in any detail in the activities at the NAB Little Creek because only these are likely to be potentially affected by base operations, which are conducted at the ground surface and in the shallow subsurface. The hydrostratigraphic units are shown in Figure 4-5.

Regional groundwater flow boundaries are the Fall Line to the west (which separates the relatively impervious, metamorphic rocks of the Piedmont from the relatively permeable sediment of the Coastal Plain), the freshwater-saltwater interface to the north and east, and the granitic basement rock. Discharge ultimately occurs at springs, streams, lakes, the Chesapeake Bay, and the Atlantic Ocean.

4.3.2 Regional Geologic and Hydrostratigraphic Unit Description

The regional geologic and hydrostratigraphic units beneath the Tidewater region are described in the following paragraphs. A greater emphasis is placed on the uppermost (i.e., youngest) three hydrostratigraphic units (Columbia Aquifer, Yorktown Confining Unit, and Yorktown-Eastover Aquifer) and their corresponding geologic units. These units make up the uppermost 350 to 400 ft beneath the NAB Little Creek facility and are those most likely to be affected by site operations.

4.3.2.1 Columbia Formation

In this RI, the term "Columbia Formation" represents any Holocene or Pleistocene deposits and includes any fill material present in these deposits. The Columbia Aquifer is the Virginia Hydrostratigraphic Unit, representing the Holocene and Pleistocene age deposits composing the Columbia Formation (Meng and Harsh, 1988). The Pleistocene deposits are considered to be undifferentiated in the Coastal Plain region. Regionally, Holocene age deposits include alluvial, marsh, swamp, and beach sediments. The water table at SWMU 7 is located within the Columbia Aquifer.

Beds and lenses of shell containing light-colored clay, sand, gravel, and silt characterize the Columbia formation. Sand and shell beds and lenses, the major water-bearing strata, are heterogeneous and discontinuous in the region due to the complex marine estuarine environments where they were deposited. The saturated thickness of the Columbia Aquifer ranges from about 15 ft near its western extent to about 80 ft in southeastern Virginia (Harsh and Laczniak, 1990).

The Columbia Aquifer, overlying the Yorktown Confining Unit, is generally unconfined. Regionally, however, clayey sediments within the unit may produce confined or leaky-confined conditions (Siudyla et. al., 1981).

The transmissivity of the Columbia Aquifer is variable in the Tidewater region, ranging over several orders of magnitude, due to its heterogeneous and anisotropic nature. The transmissivity of the Columbia Aquifer is generally less than 400 square ft per day (ft^2/day) and can be as little as 1 to tens of ft^2/day (Siudyla et. al., 1981).

The water quality of the Columbia Aquifer is quite variable and suitable for limited uses, such as lawn watering. Columbia Aquifer groundwater typically contains low amounts of dissolved solids (ranging from 200 to 300 mg/L). Chlorides are generally low but can be high adjacent to tidal waters. The groundwater ranges from hard (121-180 mg/L) to moderately hard (61-120 mg/L). The most common water quality problems for the Columbia Aquifer are low pH and high iron content (Siudyla, et. al., 1981).

4.3.2.2 Yorktown Confining Unit

The Bacons Castle Formation underlies the Columbia Formation and acts as a confining unit for the Yorktown and Eastover formations. The Bacons Castle Formation will be referred to as the Yorktown Confining Unit in this report (Meng and Harsh, 1988).

The Yorktown Confining Unit was deposited on a shallow, marine shelf in broad lagoonal and bay areas (Meng and Harsh, 1988). This unit consists of very fine sandy to silty clay beds containing shells and fine-grained sand. The beds of this unit are reported by Hamilton and

Larson (1988) to be massive and well-bedded; however, Meng and Harsh (1988) report that the beds may not be a single clay layer but may consist of a series of coalescing clay layers.

The Yorktown Confining Unit ranges from almost nonexistent in the western portion of southeastern Virginia to approximately 56 ft thick in the Virginia Beach area. It is highly dissected along its western limit (Hamilton and Larson, 1988). Major rivers and tributaries often incise the confining unit, particularly north of the James River (Harsh and Laczniak, 1990).

4.3.2.3 Yorktown and Eastover Formations

The Yorktown and Eastover Formations, comprising the Yorktown-Eastover Aquifer or also known as the Yorktown Aquifer, lie beneath the Bacons Castle Formation, which separates the Yorktown Aquifer from the Columbia Aquifer.

The Yorktown Formation represents a fining upward marine depositional sequence. It consists of basal coarse sand and gravel; fining upward through a fine to medium, shelly sand facies; and capped by fine silty clay. The major water-bearing zones of the Yorktown Aquifer are found in the upper 50 to 150 ft of the Yorktown Formation and are beds of fine to coarse sand, gravel, and shells generally 5 to 20 ft thick. The Yorktown consists of three major sand units, referred to as the upper, middle, and lower units that, although generally continuous throughout the Tidewater area, vary considerably in thickness; permeability; and coarseness from one area to another. Silt and clay separate these sandy units (Siudyla, et. al., 1981). Near the base, the Yorktown Formation combines with the Eastover Formation, and possibly, the sandy basal portion of the overlying Bacons Castle Formation to make up the Yorktown-Eastover Aquifer. The thickness of the St. Mary's Confining Unit, which lies beneath the Yorktown Aquifer, ranges from approximately 40 to 60 ft near the base.

The Yorktown Aquifer is thickest in the northeastern Virginia Coastal Plain and is approximately 280 ft thick in the area of the base (Meng and Harsh, 1988). The Yorktown Aquifer is unconfined in the westernmost portion of the Virginia Coastal Plain but is a confined aquifer in the eastern portion. The formation is heterogeneous and anisotropic (Siudyla, et. al., 1981).

Water enters the Yorktown Aquifer primarily through downward leakage from the Columbia Aquifer. The transmissivity of the Yorktown Aquifer ranges from approximately 210 to 8,800 ft^2/day in the Tidewater area and averages about 2,000 ft^2/day. Specific capacities range from 0.5 to 14.4 gpm/ft and average 5 gpm/ft. (Siudyla, et. al., 1981).

The Yorktown Aquifer is generally suitable for potable and most other uses and is an important groundwater resource in southeastern Virginia for domestic, commercial, and light industrial use (Siudyla, et. al., 1981; Hamilton and Larson, 1988). The water quality of this aquifer varies within the Tidewater area. Hardness ranges from less than 1 to 1,430 mg/L. Iron ranges from less than 0.1 to 48 mg/L. Chloride ranges from 6 to 2,000 mg/L and TDS ranges from 77 to 4,110 mg/L. Although corrosion and iron problems are not as severe in the Yorktown Aquifer, a number of public water supplies and domestic wells contain high iron concentrations and therefore, require treatment. Brackish water in the Yorktown Aquifer can be a problem in some areas (Siudyla, et. al., 1981).

4.3.3 Regional Water Usage

The Columbia Aquifer may be utilized for watering lawns or filling swimming pools in Southeastern Virginia. Near NAB Little Creek; however, no wells reportedly utilize the Columbia Aquifer for domestic potable supply.

Throughout the eastern Coastal Plain, the Yorktown Aquifer is used extensively for domestic and public water supply, as well as for industrial purposes. In the area surrounding the base, it is reported that the Yorktown Aquifer is not used as a potable source of supply.

Although the aquifers of the deeper Pamunkey Group can produce water of notable quality and quantity and are used in other areas of the Virginia Coastal Plain, large-scale municipal wells in the Tidewater area typically bypass these aquifers for the even more productive Cretaceous aquifers. The City of Norfolk supplies potable water to NAB Little Creek and the surrounding residential area with surface water from Lake Whitehurst and Lake Smith, located south of the site. Groundwater from four deep wells, screened in the Upper/Middle or Middle Potomac Aquifers, is used as a secondary source in drought or emergency conditions. The nearest groundwater supply wells are located on the Little Creek Golf Course, approximately 1/2 mile (2300 ft) east of SWMU 7. These four supply wells withdraw groundwater from the Yorktown Aquifer for irrigation purposes at the golf course; the wells are not used for drinking-water supply.

4.3.4 Site Specific Geology and Hydrogeology

The site conditions at SWMU 7 are described using geologic and hydrogeologic information gathered during the RI and previous investigations, the installation of six monitoring wells to approximately 15 to 20 ft bgs, and the collection of soil and sediment samples. A geologic cross-section was created from the lithological information gathered from the monitoring well borings. Boring locations are illustrated in Figure 4-6. The cross-sections are shown in Figure 4-7 and 4-8. SWMU 7 is primarily asphalt, concrete, and hardpacked gravel covered.

The SWMU is adjacent to Desert Cove and the connector channel running to Little Creek Channel. The soil at SWMU 7 is classified as dredge-fill for screening purposes.

A description of the lithology of the surface and subsurface soil and sediment samples at SWMU 7 as observed during the RI is presented in Table 4-1. Fill extended to at least 5.5-ft bgs. The upper 0-6 in. of soil consists of various materials ranging from fine sands and silts to gravel. The soils comprising the Columbia Formation consist of interbedded silts, silty sand, clean sand, well-sorted sand and gravel, with some clay lenses. The lithology is primarily sand with some fines becoming saturated at approximately 8-12 ft bgs. The Yorktown Confining Unit, clays and silty clays, is present at approximately 20 ft bgs.

Grain-size analyses were performed at each sediment sampling location. The Cove is mostly overlain with fine silty clay material. Locations near the bulkhead wall along the connector cove as well as a few along Desert Cove's southern perimeter are composed of more sandy material. The grain size analysis report is located in Appendix E.

Six monitoring wells screened in the Columbia Aquifer are located within the site (Figure 4-8). The Columbia Aquifer is typically unconfined at SWMU 7; however, clay layers

may produce localized semi-confined conditions within the aquifer. Groundwater elevations observed in all six monitoring wells are representative of unconfined conditions.

Groundwater elevations in the unconfined Columbia Aquifer measured at SWMU 7 monitoring wells have ranged between 0.36 ft below to 1.97 ft above msl over four rounds of surveys between 2000 and 2003 (Table 4-2). A relatively low hydraulic gradient exists across the site (0.003 to 0.006 ft/ft; March 2003 survey). The water table surface elevations observed May 2000 and March 2003 are represented in Figure 4-9. Groundwater in the Columbia Aquifer flows toward Desert Cove at SWMU 7, ultimately discharging into Desert Cove.

Due to the shallow nature of the groundwater table and the low water table gradient, Desert Cove is likely to be hydraulically contacted with the SWMU 7 water table. The groundwater flow rate and elevations in wells closest to the cove, however, may be slightly affected by tidal fluctuations.

4.4 References

Ebasco Environmental Consultants. *Draft Final Interim Remedial Investigation (Draft Final Interim RI).* November 1991.

Foster Wheeler Environmental Services (FWES) under Baker Environmental Inc. *Remedial Investigation/Feasibility Study (RI/FS) for Sites 7 and 9-13.* November 1994.

Hamilton, P. A. and Larson J. P. "*Hydrogeology and Analysis of the Groundwater Flow system in the Coastal Plain of Southeastern Virginia*," US Geological Survey Water Resources Investigation Report 87 4240. 1988.

Harsh, J. F. and Lacziniak, R. J. *Conceptualization and Analysis of Ground-Water Flow System in the Coastal Plain of Virginia and Adjacent Parts of Maryland and North Carolina*. USGS Professional Paper 1404-F. 1990.

Meng, A. A. III and Harsh, J. F. *Hydrogeologic Framework of the Virginia Coastal Plain*. RASA. USGS Professional Paper 1404-C. 1988.

Oaks, R. Q. and Coch, N. K. *Post-Miocene stratigraphy and morphology, southeastern Virginia*: Virginia Division of Mineral Resources Bulletin 82, 135p. 1973.

Siudyla, E. A. et. al. "*Groundwater Resources of the Four Cities Area*" Virginia State Water Control Board. 1981.

Table 4-1
Lithology of Direct Push Soil Borings
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, VA

Boring	Soil Description	Presence of grit at surface*
LW07-DP04	0-7": clean sand (SP), 10YR4/2 dark grayish brown, moist, loose; 7-15": same as above, 2.5Y5/3 light olive brown; 15-27": clean gravel (GP), 2.5Y5/3 light olive brown, moist, medium loose to loose; 27-36": clean sand (SP), 2.5Y6/3 light yellowish brown, moist, medium loose to loose	<5%
LW07-DP05	0-36": clean sand (SP); 2.5Y5/4, light olive brown; stiff, moist, some gravel at top of sample	<5%
LW07-DP06	0-7": gravel with fines (GM), 5Y4/3 olive, medium loose, moist; 7-12": clean sand (SW), 10YR4/6, dark yellowish brown, dry to moist, medium loose; 12-36": clean sand (SP), 5Y7/2, light gray, moist to dry, some clay lenses near bottom, one organic clay lense 0.5 inches, 5YR2.5/2, dark reddish brown, soft	<5%
LW07-DP07	0-14": clean gravel (GM), 10YR5/2 grayish brown, dry to moist, loose; 14-17": sand with fines (SC), 10YR3/1 very dark gray, dry to moist, medium stiff to stiff; 17-23": gravel with some fines (GM), 10YR3/2 very dark gray, dry to moist, medium loose; 23-36": sand with some fines, (SM), 5Y7/2, light gray, moist to dry, medium loose	<5%
LW07-DP08	0-3": organic silt and clay (OL), 10YR4/3 brown, dry to moist, medium loose; 3-36": clean sand (SP), 5Y7/2, light gray	<5%
LW07-DP09	0-5": silt and clay (ML), 10YR4/1 dark gray, moist, loose, some asphalt pieces; 5-9": gravel, some fines (GM), 10YR4/4 dark yellowish brown, dry to moist, loose; 9-22": clayey silt (ML), 10YR5/4 yellowish brown, dry to moist, medium loose; 22-36": clean sand (SP), 5Y6/2 light olive gray, dry, medium loose	<5%
LW07-DP10	0-4": clayey silt (ML); 10YR3/3 dark brown, loose, moist; 4-9": gravel with fines (GM), pebbles up to 1 in., 5Y6/4 pale olive, dry, loose; 9-14": same as above, pebbles and cobbles >1"; 14-36": silt and clay (ML), 2.5Y5/4 light olive brown, moist, medium loose	None
LW07-DP11	0-4": silty clay (ML), very dark grayish brown 10YR3/2; soft; 4-6": gravel, some fines (GM), yellowish brown 10YR5/4, soft; 6-13": gravel, some silt, (GM), 10YR5/4 yellowish brown, soft; 13-16": silty sand (SM), very pale brown, 10YR7/4, very soft; 16-24": clayey sand, plastic, (SC), olive gray 5Y4/2, medium stiff; 24-36": clean sand (SW); light olive 5Y6/2; loose	None
LW07-DP12	0-5": silt, some clay (ML), brown 10YR4/3, medium stiff; 5-15": gravel with some silt (GM), 10YR5/6 yellowish brown, loose, pebbles >.5 inches; 15-30":silty clay (CH), 2.5Y5/1 gray, very stiff, lean; 30-36": clean sand (SP), 5Y6/3 light olive	<5% at surface
LW07-DP13	0-8": silt and clay (ML), 10YR3/3 dark brown, moist, loose; 8-10" concrete; 10-18": sand with some fines, plastic (SC), 5Y5/3 olive, medium stiff; 18-26": same as above yellowish brown 10YR5/6; 26-29": silt and clay (CH), 5Y5/2 olive gray, soft; 29-36": clean sand (SP), 5Y7/2 light gray, dry	No

Table 4-1
Lithology of Direct Push Soil Borings
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, VA

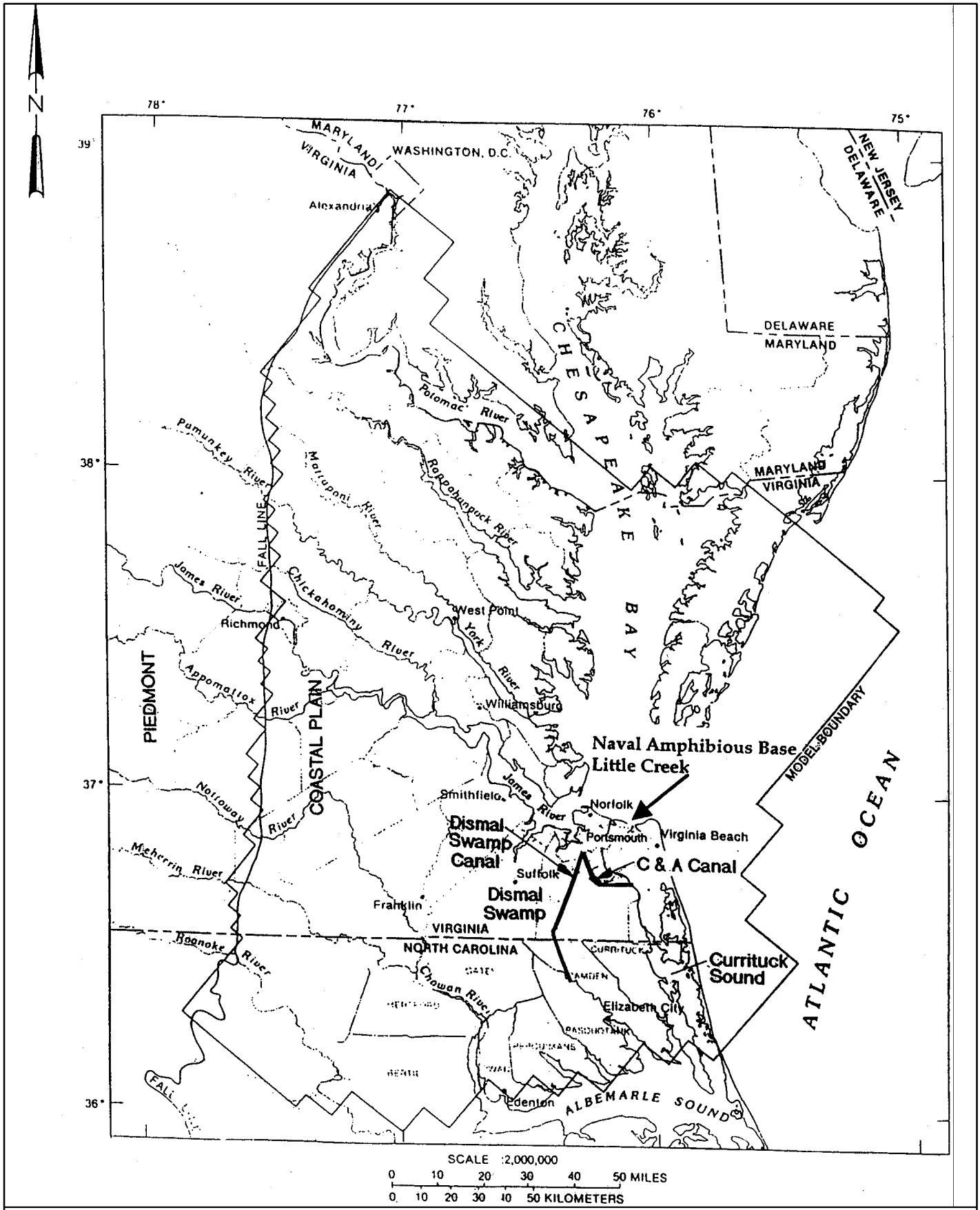
Boring	Soil Description	Presence of grit at surface*
LW07-DP14	0-4": clean sand (SP), 5Y7/3 pale yellow, moist, loose; 4-12": same as above, 2.5Y5/3 olive; 12-16": same as above, 5Y4/1 dark gray; 16-26": silty sand, dense, very stiff, 5Y4/1 dark gray, moist; 26-30": clay (CH) 2.5Y5/2; grayish brown, dry, stiff, dense	None

* Percentage estimated visually

Table 4-2
Summary of Groundwater Elevations
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

		5/31/2000		8/29/2002		9/5/2002		3/17/2003	
Sample ID	**Casing Elevation (ft amsl)**	**Depth to Water (ft)**	**Groundwater Elevation (ft-amsl)**	**Depth to Water (ft)**	**Groundwater Elevation (ft-amsl)**	**Depth to Water (ft)**	**Groundwater Elevation (ft-amsl)**	**Depth to Water (ft)**	**Groundwater Elevation (ft-amsl)**
LS10-MW03	12.51	9.84	2.67	--	--	--	--	--	--
LS10-MW04	14.43	--	--	--	--	--	--	10.3	4.13
LS10-MW05	13.14	10.31	2.83	--	--	--	--	9.18	3.96
LS10-MW06	11.68	--	--	--	--	--	--	6.65	5.03
LBG-MW08	10.45	3.9	6.55	--	--	--	--	3.29	7.16
LW07-MW01	7.17	7.53	-0.36	--	--	7.5	-0.33	7.63	-0.46
LW07-MW02	8.75	8.1	0.65	8.51	0.24	8.58	0.17	7.32	1.43
LW07-MW03	8.52	8.29	0.23	7.82	0.7	8.46	0.06	9.24	-0.72
LW07-MW04	8.72	--	--	7.23	1.49	6.97	1.75	6.75	1.97
LW07-MW05	8.8	--	--	7.4	1.4	7.35	1.45	7.29	1.51
LW07-MW06	8.72	--	--	--	--	--	--	--	--

amsl - above mean sea level
dash - no data available
The August 2002 water level survey was conducted in the early PM approximately 2 hours after Low Tide
The September 2002 water level survey was conducted in the early PM approximately 1 hour after high tide.
The March 2003 water level survey was conducted in the AM approximately 2 hours after low tide.

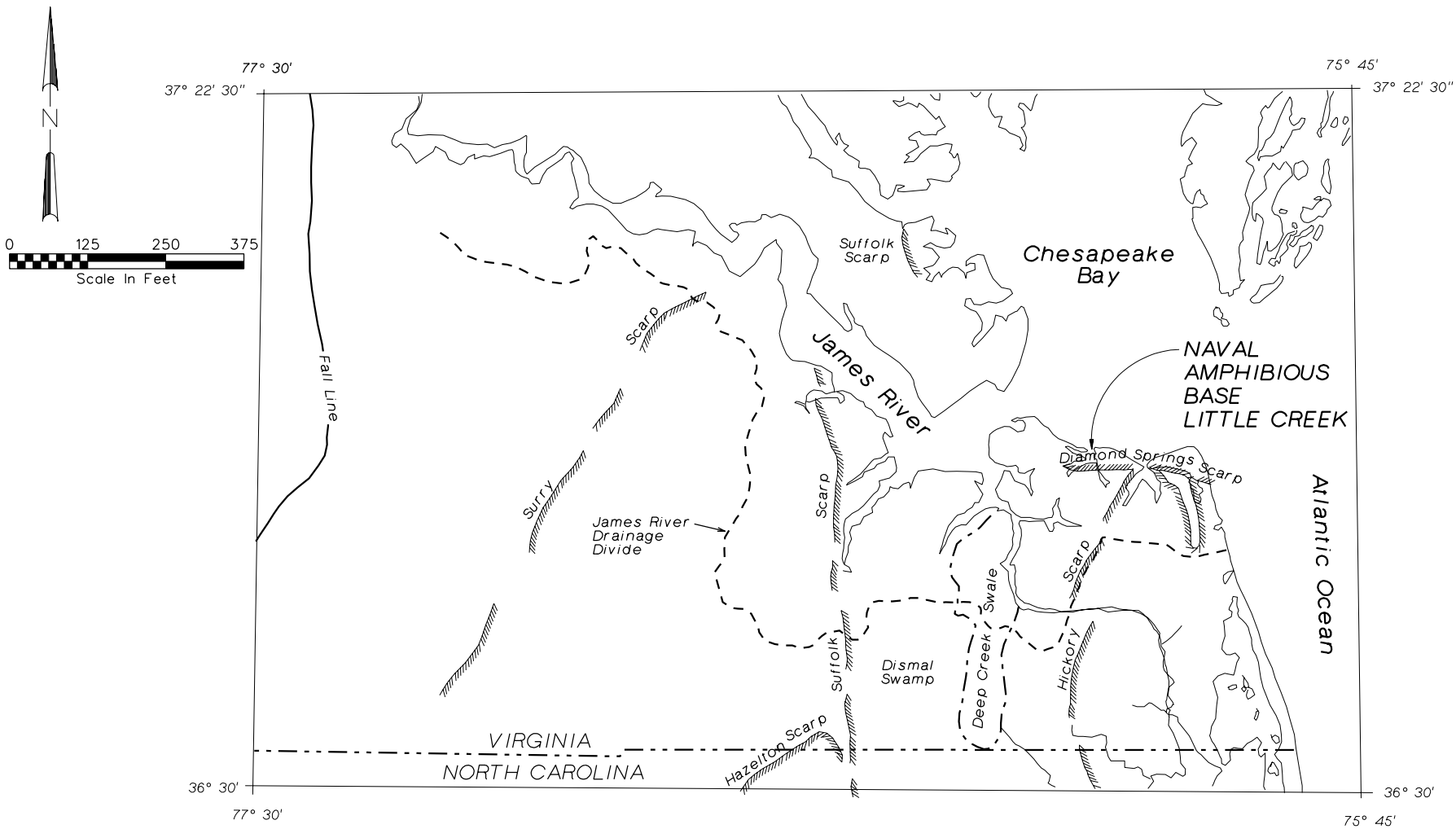


SOURCES:
BASE FROM U.S. GEOLOGICAL SURVEY
STATE BASE MAPS 1:1,000,000 AND
USGS SURVEY PROFESSIONAL
PAPER 1404-F

FIGURE 4-1
PHYSIOGRAPHIC PROVINCES OF SOUTHERN VIRGINIA
SWMU 7 REMEDIAL INVESTIGATION REPORT
NAB LITTLE CREEK
VIRGINIA BEACH, VIRGINIA

CH2MHILL

16-APR-2003 7234f023.dlv



SOURCE:
FIGURE 6 OF POST-MIOCENE STRATIGRAPHIC AND MORPHOLOGY, SOUTHERN VIRGINIA, BULLETIN 82, DATED 1973.

FIGURE 4-2
VIRGINIA TIDEWATER AREA PHYSIOGRAPHY AND HYDROLOGY FEATURES
SWMU 7 REMEDIAL INVESTIGATION REPORT
NAB LITTLE CREEK
VIRGINIA BEACH, VIRGINIA

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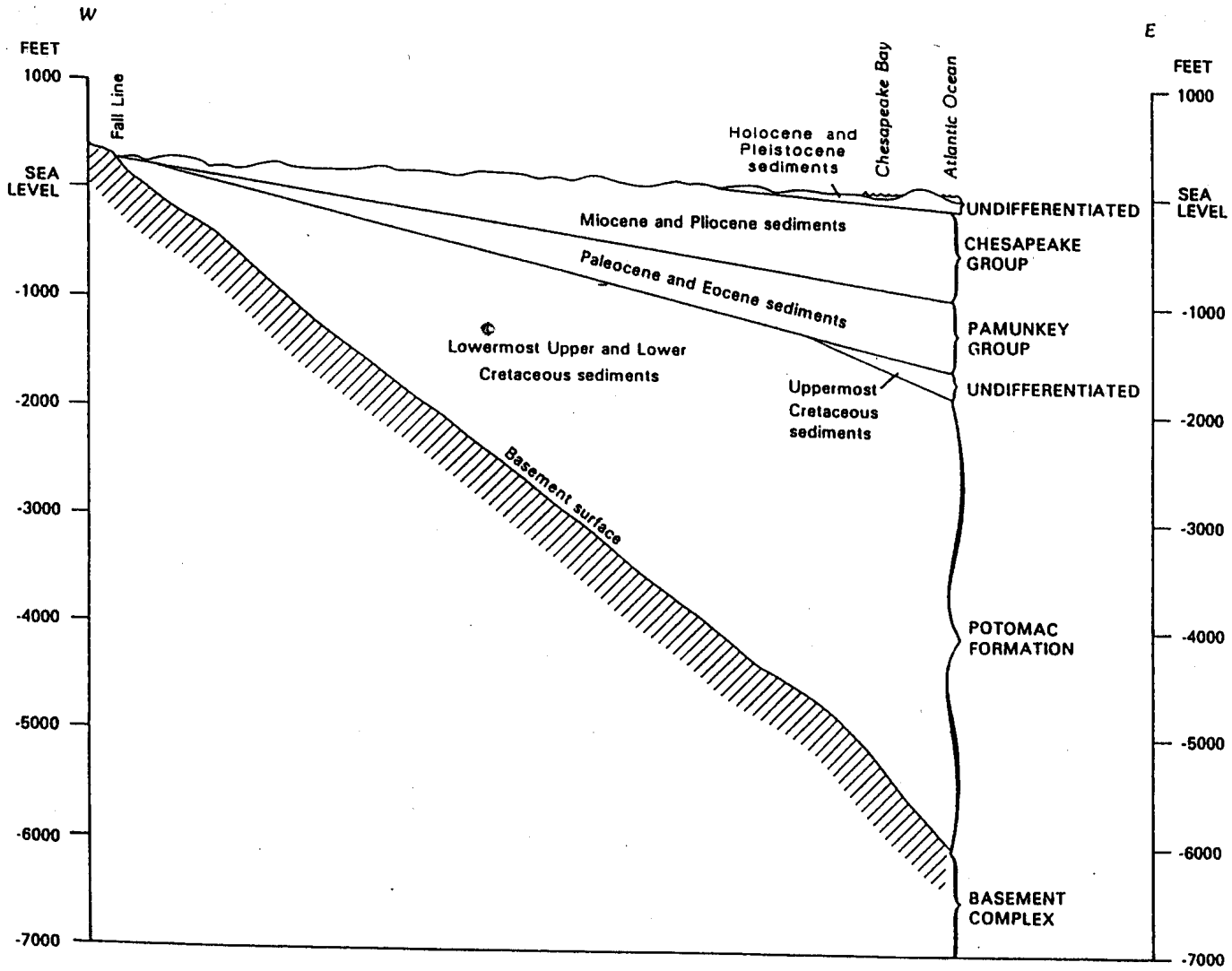

FIGURE 4-3
GENERALIZED GEOLOGIC SECTION SHOWING
EASTWARD-THICKENING SEDIMENTARY WEDGE
OF VIRGINIA COASTAL PLAIN
SWMU 7 REMEDIAL INVESTIGATION REPORT
NAB LITTLE CREEK
VIRGINIA BEACH, VIRGINIA

SOURCE:
FIGURE 5 OF REGIONAL AQUIFER-SYSTEM ANALYSIS
USGS SURVEY PROFESSIONAL PAPER 1404-C

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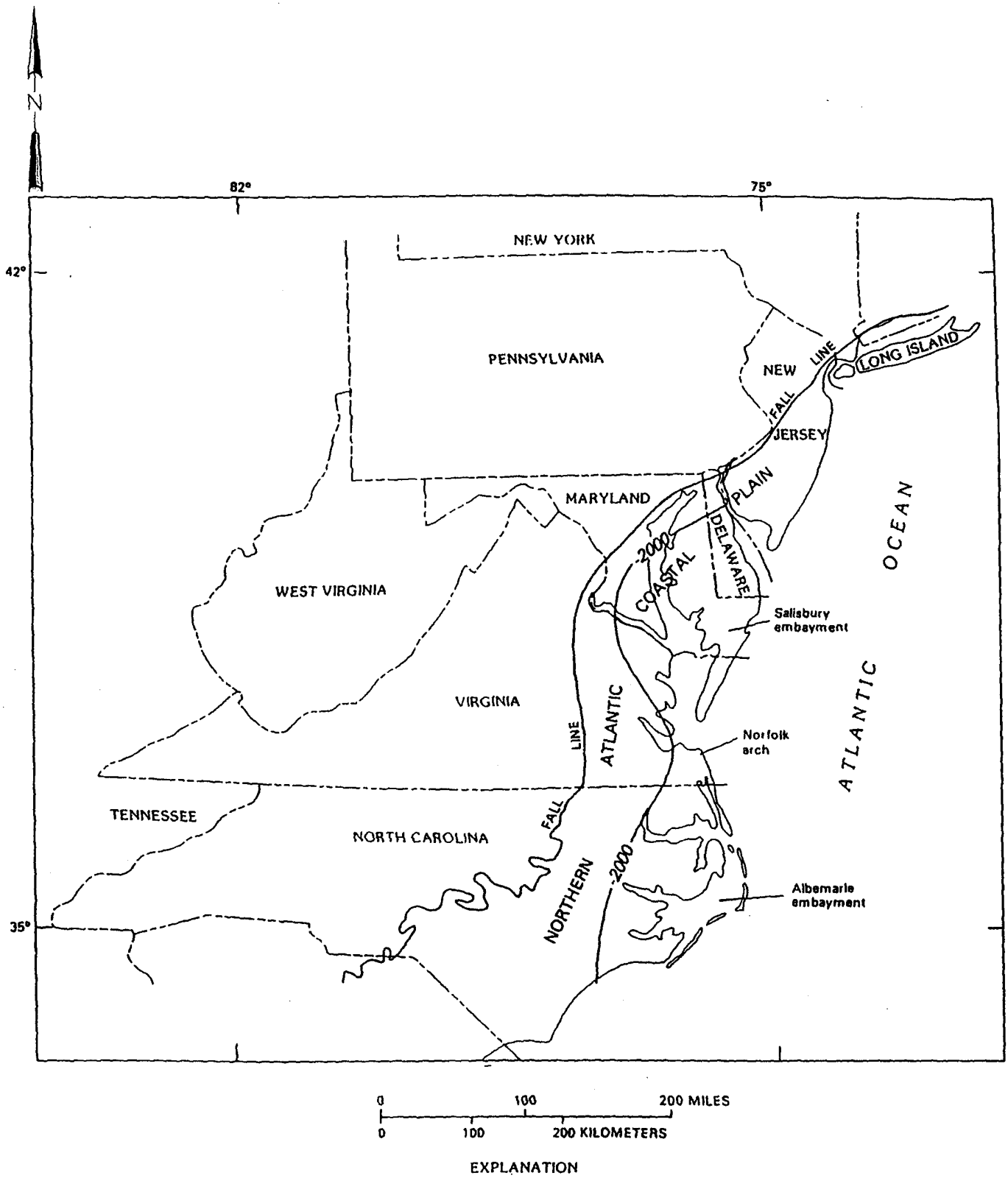

FIGURE 4-4
MAJOR STRUCTURAL BASEMENT-DEFORMATION FEATURES
OF THE VIRGINIA COASTAL PLAIN AND ADJOINING AREAS
SWMU 7 REMEDIAL INVESTIGATION REPORT
NAB LITTLE CREEK
VIRGINIA BEACH, VIRGINIA

SOURCE:
FIGURE 6 OF REGIONAL AQUIFER-SYSTEM ANALYSIS
USGS SURVEY PROFESSIONAL PAPER 1404-C

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10-APR-2003 7234f026.dlv

PERIOD	EPOCH	AGE	STRATIGRAPHIC FORMATION		VIRGINIA RASA HYDROGEOLOGIC UNIT
QUATERNARY	HOLOCENE	POST-GLACIAL	HOLOCENE DEPOSITS		COLUMBIA AQUIFER
	PLEISTOCENE	WISCONSIN TO NEBRASKAN	PLEISTOCENE UNDIFFERENTIATED DEPOSITS		
TERTIARY	PLIOCENE	PIACENZIAN	BACONS CASTLE FORMATION (OAKS AND COCH, 1973)		YORKTOWN CONFINING UNIT
		ZANCLEAN	CHESAPEAKE GROUP	YORKTOWN FORMATION	YORKTOWN - EASTOVER AQUIFER
	MIOCENE	MESSINIAN		EASTOVER FORMATION	
		TORTONIAN			ST. MARYS CONFINING UNIT
		SERRAVALLIAN		ST. MARYS FORMATION	ST. MARYS-CHOPTANK AQUIFER
				CHOPTANK FORMATION	
		LANGHIAN		CALVERT FORMATION	CALVERT CONFINING UNIT
		BURDIGALIAN			
		AQUITANIAN		OLD CHURCH FORMATION	CHICKAHOMINY-PINEY POINT AQUIFER
	OLIGOCENE	CHICKASAWHAYAN[1]	NOT PRESENT IN STUDY AREA		
		VICKSBURGIAN[1]			
	EOCENE	JACKSONIAN[1]	PAMUNKEY GROUP	CHICKAHOMINY FORMATION	CHICKAHOMINY-PINEY POINT AQUIFER
		CLAIBORNIAN[1]		PINEY POINT FORMATION	
		SABINIAN[1]		NANJEMOY FORMATION	NANJEMOY-MARLBORO CLAY CONFINING UNIT
	PALEOCENE			MARLBORO CLAY	
		MIDWAYAN[1]		AQUIA FORMATION	AQUIA AQUIFER
				BRIGHTSEAT FORMATION	BRIGHTSEAT FORMATION
					BRIGHTSEAT AQUIFER
CRETACEOUS	LATE CRETACEOUS	MAASTRICHTIAN	UNDIFFERENTIATED SEDIMENTS		UPPER POTOMAC CONFINING UNIT
		CAMPANIAN			
		SANTONIAN			
		CONIACIAN			
		TURONIAN			
		CENOMANIAN	POTOMAC FORMATION		UPPER POTOMAC AQUIFER
	EARLY CRETACEOUS	ALBIAN			MIDDLE POTOMAC CONFINING UNIT
					MIDDLE POTOMAC AQUIFER
		APTIAN			LOWER POTOMAC CONFINING UNIT
		BARREMIAN			
		HAUTERIVIAN			
		VALANGINIAN			LOWER POTOMAC AQUIFER
		BERRIASIAN			

[1] COMMONLY USED AGES IN ATLANTIC COASTAL PLAIN PROVINCE

Table copied from: The Effects of the Chesapeake Bay Impact Crater on the Geological Framework and Correlation of the Hydrogeologic Unit of the Lower York-James Peninsula, by David S. Powars and T. Scott Bruce, U.S. Geological Survey Professional Paper 1612.

FIGURE 4-5
STRATIGRAPHIC AND HYDROGEOLOGIC FRAMEWORK
SWMU 7 REMEDIAL INVESTIGATION REPORT
NAB LITTLE CREEK
VIRGINIA BEACH, VIRGINIA

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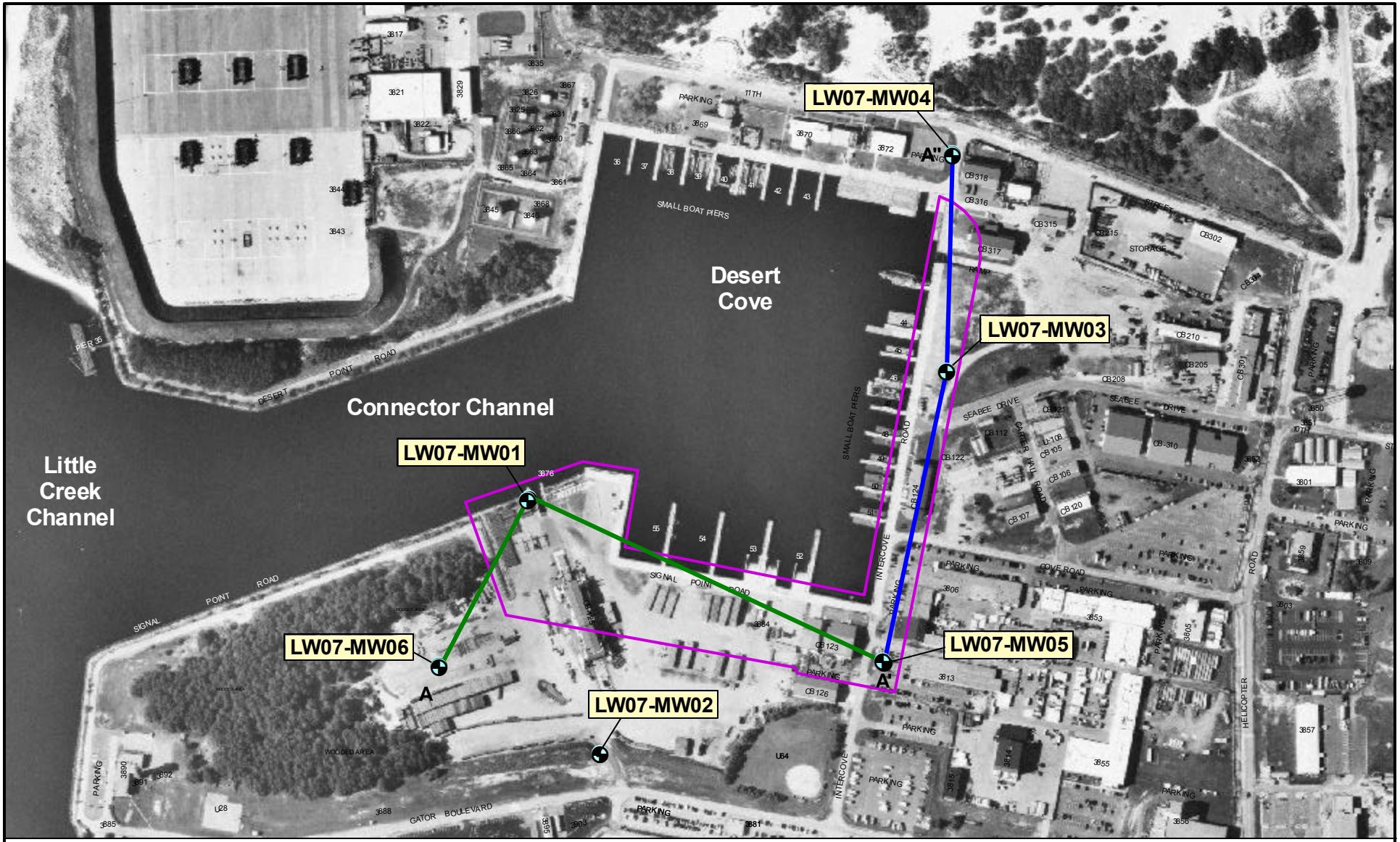

LEGEND

- Monitoring Well Locations
- SWMUs
- A - A'
- A' - A"

N

0 300 600 Feet

Figure 4-6
Locations of Geologic Cross Sections
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

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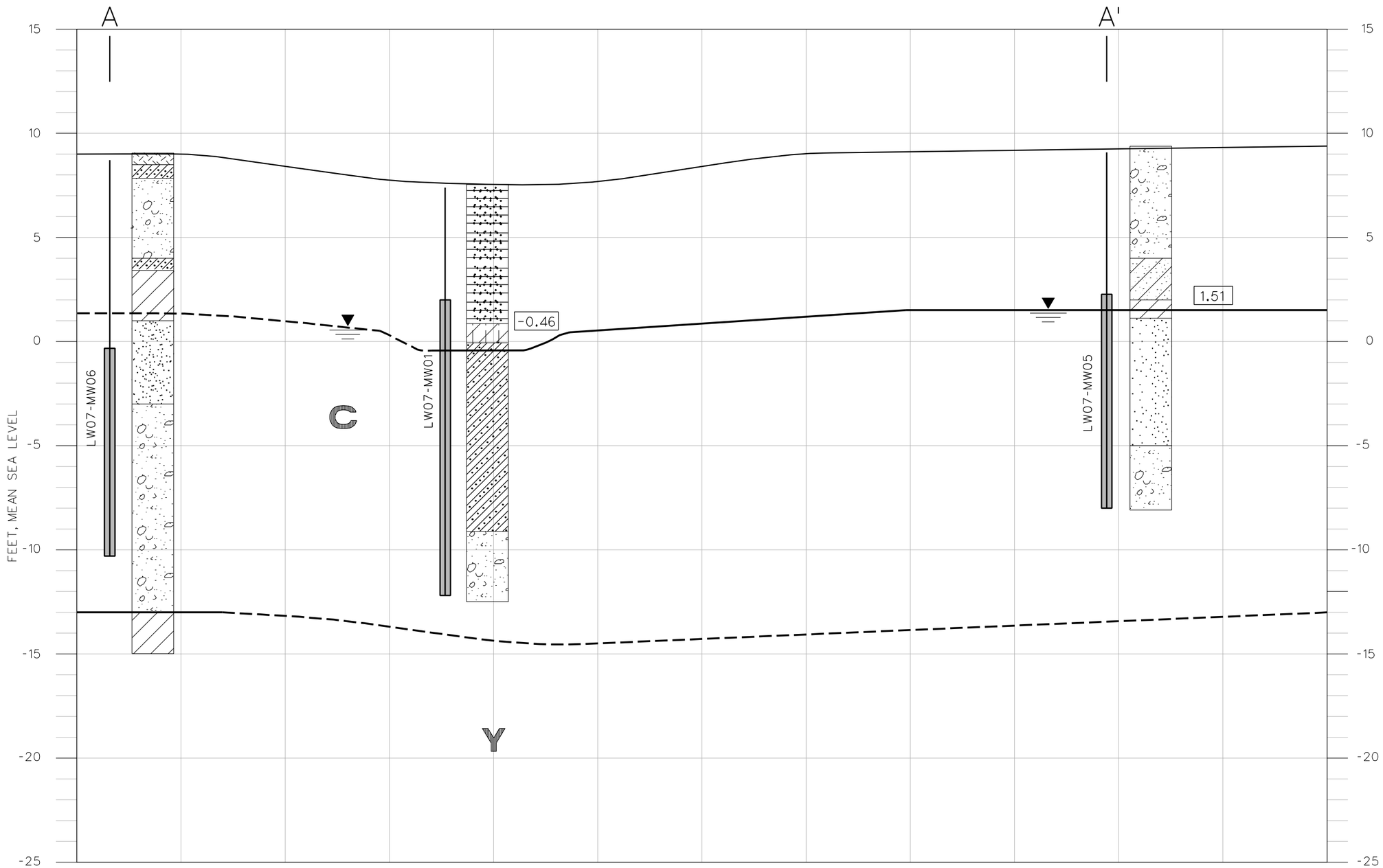


LEGEND

WELL CONSTRUCTION DIAGRAM INCLUDING SCREENED INTERVAL

WATER TABLE SURFACE: (MARCH 2003)

INFERRED WATER TABLE SURFACE

1.51 WATER LEVEL MEASURED IN FT ABOVE MSL MARCH 2003

STRATIGRAPHY

GROUND SURFACE

CONTACT BETWEEN HYDROSTRATIGRAPHIC UNITS

INFERRED CONTACT BETWEEN HYDROSTRATIGRAPHIC UNITS

C COLUMBIA AQUIFER: UNDIFFERENTIATED SILTY SANDS/ CLAYEY SANDS/SANDS/ RAVEL/INTERBEDDED CLAYS

Y YORKTOWN CONFINING UNIT: SILTS/ CLAYS/SILTY CLAYS WITH SOME FINE SAND/SHELLS AND WOOD

LITHOLOGY/USCS DESCRIPTION

SM: SILTY SANDS. SAND/SILT MIXTURES

SP: POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES

SC: CLAYEY SANDS. SAND/CLAY MIXTURES

CL: INORGANIC CLAYS, LOW TO MEDIUM PLASTICITY. LEAN

SW: WELL GRADED SANDS. SAND/CLAY MIXTURES

ML: INORGANIC SILTS/VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS/CLAYEY SILTS

CH: INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS

DREDGE FILL

VERTICAL SCALE: 5, 0

HORIZONTAL SCALE: 0, 100, 200

SCALE IN FEET

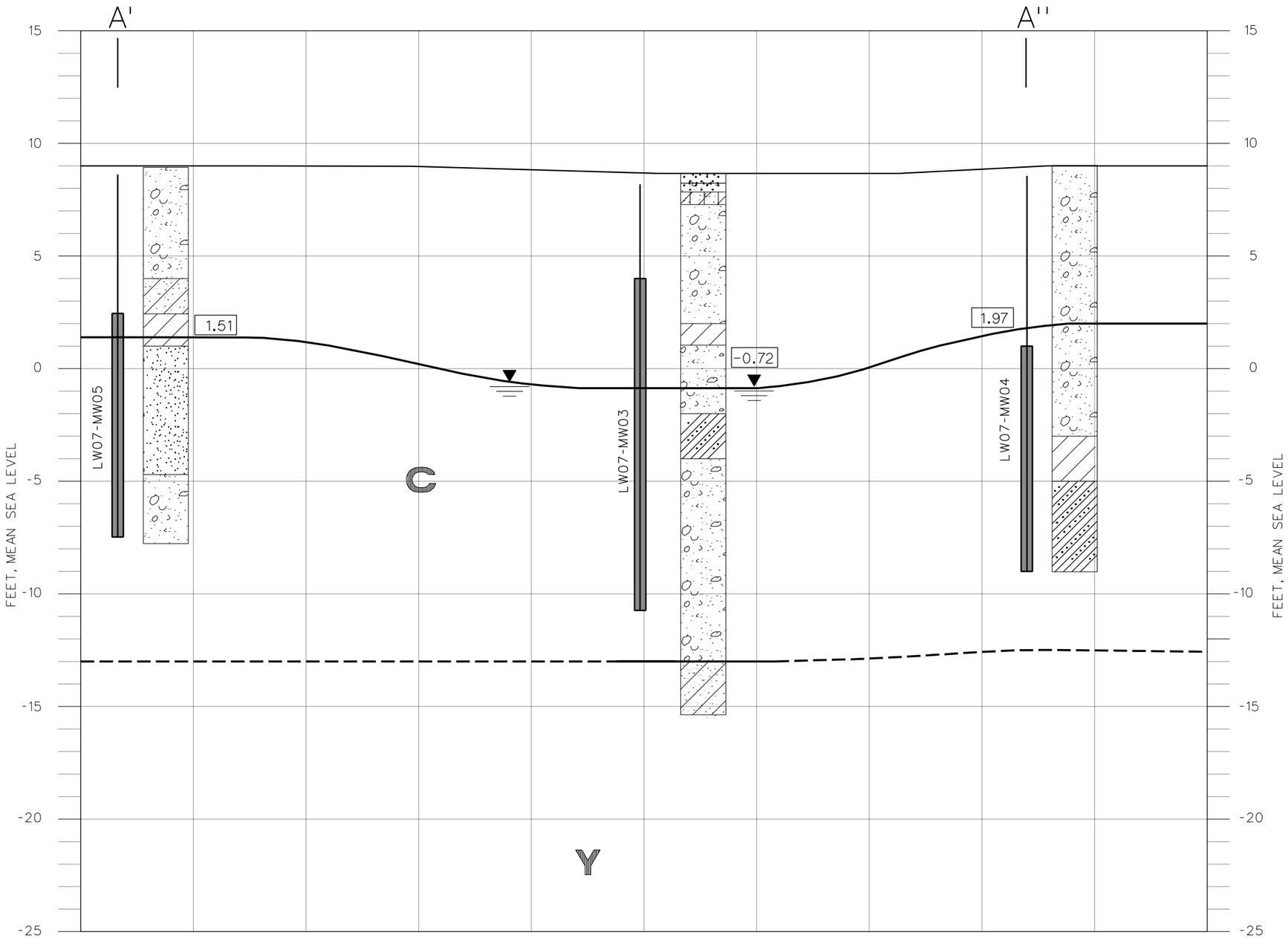
VERTICAL EXAGGERATION = 40X

NOTE:
THIS CROSS SECTION IS INTERPRETIVE AND WAS PREPARED BY INTERPOLATION BETWEEN BORING LOCATIONS. ACTUAL CONDITIONS BETWEEN BORINGS MAY DIFFER FROM THOSE SHOWN HERE.

FIGURE 4-7
GEOLOGIC CROSS-SECTION A-A'
SWMU 7 REMEDIAL INVESTIGATION REPORT
NAB LITTLE CREEK
VIRGINIA BEACH, VIRGINIA

CH2MHILL

14-DEC-2004 7234f022.dlv



LEGEND

WELL CONSTRUCTION DIAGRAM INCLUDING SCREENED INTERVAL

WATER TABLE SURFACE: (MARCH 2003)

1.97 WATER LEVEL MEASURED IN FT ABOVE MSL MARCH 2003

STRATIGRAPHY

GROUND SURFACE

CONTACT BETWEEN HYDROSTRATIGRAPHIC UNITS

INFERRED CONTACT BETWEEN HYDROSTRATIGRAPHIC UNITS

C COLUMBIA AQUIFER: UNDIFFERENTIATED SILTY SANDS/ CLAYEY SANDS/SANDS/GRAVEL/INTERBEDDED CLAYS

Y YORKTOWN CONFINING UNIT: SILTS/CLAYS/SILTY CLAYS WITH SOME FINE SAND/SHELLS AND WOOD

LITHOLOGY/USCS DESCRIPTION

SM: SILTY SANDS. SAND/SILT MIXTURES

SP: POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES

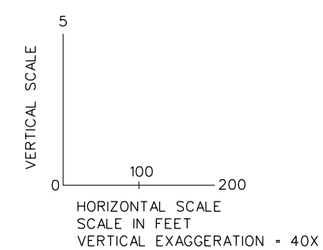
SC: CLAYEY SANDS. SAND/CLAY MIXTURES

CL: INORGANIC CLAYS, LOW TO MEDIUM PLASTICITY. LEAN

SW: WELL GRADED SANDS. SAND/CLAY MIXTURES

ML: INORGANIC SILTS/VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS/CLAYEY SILTS

CH: INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS



NOTE:
THIS CROSS SECTION IS INTERPRETIVE AND WAS PREPARED BY INTERPOLATION BETWEEN BORING LOCATIONS. ACTUAL CONDITIONS BETWEEN BORINGS MAY DIFFER FROM THOSE SHOWN HERE.

FIGURE 4-8
HYDROSTRATIGRAPHIC CROSS-SECTION A'-A''
SWMU 7 REMEDIAL INVESTIGATION REPORT
NAB LITTLE CREEK
VIRGINIA BEACH, VIRGINIA

CH2MHILL
05-AUG-2003 7234f021.dlv

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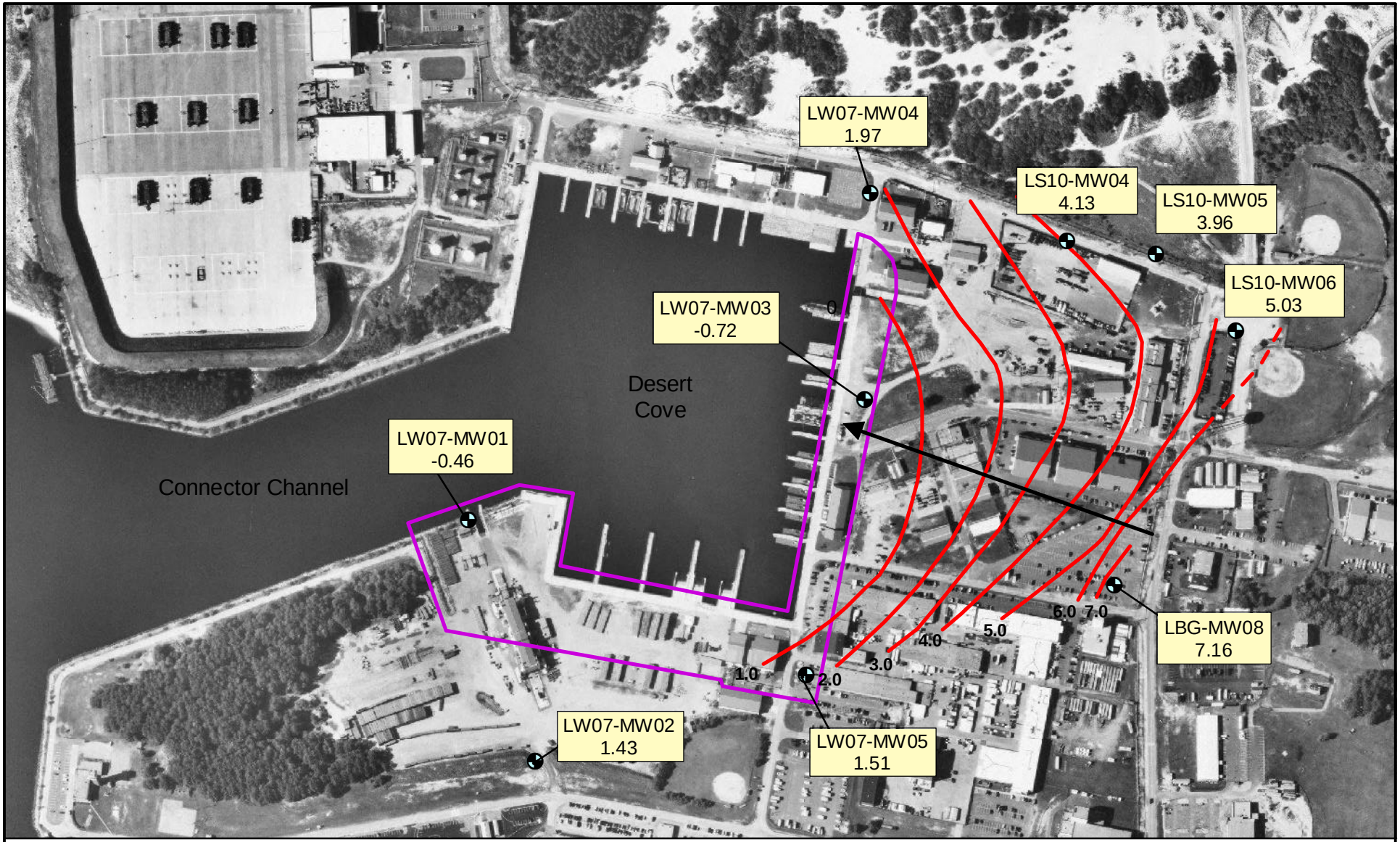

LEGEND

- Monitoring Wells
- 1.0 Potentiometric Surface - (ft amsl)
- Inferred Potentiometric Surface - (ft amsl)
- Building
- Groundwater Flow Direction
- LW07-MW01 -0.46 — Monitoring Well ID, Groundwater Elevation (ft amsl)

N

0 300 600 Feet

Figure 4-9
Potentiometric Surface Map (March,2003)
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

CH2MHILL

SECTION 5

Nature and Extent of Contamination

Section 5 discusses the nature and extent of contamination identified in soil (surface and subsurface), sediment, and groundwater at SWMU 7 during the RI. The discussion is divided into two parts. Section 5.1 summarizes the management and evaluation of laboratory analytical data for all media (surface soil, subsurface soil, groundwater, and sediment). Section 5.2 presents the analytical results of the sampling activities.

5.1 Data Management and Evaluation

This section provides information on the management and evaluation of analytical data collected during the RI. This includes data tracking and validation to ensure data quality. It also includes a discussion of non-site-related analytical results, regulatory and risk-based standards, data presentation, and evaluation.

5.1.1 Data Tracking and Validation

The data management and tracking from the time of field collection to receipt of validated electronic analytical results is of primary importance and reflects the overall quality of the analytical results. Field samples and their corresponding analytical tests were recorded on chain-of-custody forms, which were submitted with the samples to the laboratory. Chain-of-custody entries were checked against the Sampling and Analysis Plan to determine if all designated samples were collected and submitted for the appropriate analyses. On the laboratory's receipt of the samples, a comparison to the field information was made to verify that each was analyzed for the correct parameters. In addition, a check was made to ensure that the proper number and types of QA/QC samples were collected for each medium. QA/QC samples included field blanks, equipment blanks, trip blanks, duplicates, MS/MSD samples, and laboratory blanks.

Hardcopies and electronic versions of the analytical data reports for the RI were submitted to a third party for validation. CH2M HILL then formatted the files to automatically download data into the CH2M HILL master Oracle database. Validation procedures established by the USEPA Region III Modification to the National Functional Guidelines for Organic (USEPA, 1994) and Inorganic Analyses (USEPA, 1994) were adhered to during the validation process. These steps (third-party validation and electronic data handling) serve to reduce inherent uncertainties associated with data authenticity and usability.

5.1.2 Data Qualifiers

Section 5 tables summarize the validated results. Appendix E contains the data validation reports. The data validation qualifiers, or "flags," used for the SWMU 7 data and a brief interpretation are presented herein:

- Data qualified with a "B" flag by the data validator indicate that the analytes have also been detected in a field, equipment, or trip blank, or in a laboratory QA/QC sample. The

concentration of a "B" qualified result is less than 10 times the concentration of the constituent for an associated QA/QC result. If the sample concentration is less than 10 times the associated blank concentration, the conclusion is that the parameter was not detected. Further discussion of potential sources of blank contamination is provided in Section 5.1.3.

- Data qualified with a "J" flag indicate that the values were estimated.
- Data qualified with a "U" indicate that the analyte was not detected and the associated number indicates the approximate sample concentration necessary to be detected.
- Data qualified with a "D" indicate that the result came from a diluted sample.
- Data qualified with a "JD" indicate that the values were estimated and the results came from a diluted run.
- Data qualified with a "UJ" indicate that the analyte was not detected and the quantitation limit may be inaccurate or imprecise.

5.1.3 Evaluation of Non-Site-Related Analytical Results

Some of the organic and inorganic constituents detected in various media from SWMU 7 may be attributed to non-site-related conditions or sources such as laboratory contaminants, anthropogenic non-site-release sources, and naturally occurring (background) concentrations of constituents.

In some instances, chemical compounds detected in samples may have been introduced during field sampling, transportation to the analytical laboratory, or during laboratory procedures. Thus, a variety of blank samples were analyzed and used in the QA process to determine if the contamination is site-related or is due to sample handling. Blank samples typically collected include a field blank to account for ambient conditions during sampling; an equipment or rinsate blank, to determine if the equipment used to collect the samples (e.g. augers, pumps, and sample containers) was adequately clean; and a trip blank, to ascertain if VOCs were introduced during packing or shipping. Additionally, the laboratory analyzes a method blank in each batch of 20 samples to verify instrument cleanliness and function. Common organic compounds typically found to be laboratory artifacts introduced during the analytical process are acetone, 2-butanone, methylene chloride, and common phthalate contaminants.

When blank samples are found to contain common laboratory contaminants, each of the aqueous field samples associated with that blank and that contain up to 10 times the concentrations in the blanks are qualified during data validation with a "B" for that compound. A "B" qualifier means that the compound may not be attributed to the site at that sample location. When a sampling or laboratory blank contains contaminants other than the common laboratory contaminants, each of the aqueous field samples associated with that blank and that contain up to five times the concentration are qualified during data validation with a "B" for that compound.

To determine if a "B" qualifier should be assigned to a soil sample, a unit conversion is performed whereby soil sample concentrations relative to aqueous samples or laboratory blank concentrations are determined by dividing the soil concentration by the percentage of

moisture, then dividing the result by five. A "B" qualifier designation as described above for aqueous samples can then be applied directly to the converted soil concentrations.

5.1.4 Regulatory and Risk-Based Screening Criteria

Analytical results for the samples collected from various media during the RI were screened against common regulatory, ecological, and human-health-based standards or criteria. This screening was conducted to evaluate the potential nature and extent of parameters detected above the aforementioned criteria and not to eliminate compounds from further consideration in this document. The comparison criteria utilized are identified below (USEPA, April 2003):

- *Surface and subsurface soil* results were screened against USEPA Region III Risk Based Concentration (RBCs) for residential soil and the ecological screening criteria.
- *Groundwater* results were screened against Federal Maximum Contaminant Levels (MCL) and Region III USEPA RBCs for tap water (USEPA, April 2003).
- *Sediment* results were screened against Region III USEPA RBCs for residential soil and the site specific ecological screening criteria for sediment.

The enforceable regulatory standards are Federal MCLs (used for groundwater comparison). The USEPA Region III RBCs were used in order to evaluate the potential human health risk associated with detected concentrations.

Table 5-1 presents the chemical-specific regulatory criteria used to evaluate groundwater results. Table 5-2 summarizes the chemical-specific regulatory criteria used to evaluate for sediment and soil results. Brief explanations of the general classes of criteria are provided below.

- **MCLs for Groundwater**—MCLs are enforceable standards promulgated under the Safe Drinking Water Act for public water supplies consumed by a minimum of 25 persons. The MCLs are designed for the protection of human health, based on laboratory or epidemiological studies. They are designed to prevent adverse human health effects associated with a 70-year lifetime exposure for an average adult (70 kg) consuming 2 L of water per day. Parameters exceeding MCLs must be treated/removed from the public water supply prior to its potable use.
- **Region III RBCs for residential soil and tap water (USEPA April 2003)**—These criteria, used to evaluate human health risk, correspond to a systemic hazard quotient of 1.0 or a lifetime cancer risk of 10E-6 (one additional cancer case per 1,000,000 people). The risk-based concentrations are developed using protective default exposure scenarios recommended by USEPA (2002) and the best available reference doses and carcinogenic potency slopes. Exceeding these criteria may result in adverse effects in a receptor, and might require remedial action by the USEPA or state regulatory agency. Because there are no enforceable regulatory standards for soil in the Commonwealth of Virginia, these criteria are commonly used as a basis for evaluating the nature and extent for soil. They also provide a solely health-based level of comparison for potable water at the point of use.

The RBCs listed in the USEPA Region III table are adjusted for comparison in the HHRA (Section 7) to correspond to a systemic hazard quotient of 0.1 to account for an exposure to multiple constituents on the same target organ.

- **Ecological Screening Criteria**—These criteria are based upon USEPA Region III BTAG screening values (USEPA, 1995), alternative screening values approved for use at NAB Little Creek and additional screening values available from scientific literature. Ecological screening values represent conservative thresholds for adverse ecological effects. When more than one screening value is available for a specific medium and chemical, the lowest of these values will be selected. Exceeding these criteria may result in adverse effects in a receptor and require remedial action by the USEPA or state regulatory agency.

The inorganic constituents calcium, magnesium, potassium, and sodium are not typical in waste streams characteristic of the activities conducted at SWMU 7; and, therefore, do not warrant detailed attention or discussion. Additionally, there are no human health or ecological screening criteria for these metals because they are considered essential nutrients.

5.1.5 Background Data

Remedial investigation data were first evaluated against regulatory screening criteria followed by comparison to basewide background data. Data gathered at SWMU 7 during the RI field investigation were compared to the background data set to determine if site data reflected a site-related release. All SWMU 7 soil-sampling locations fall into the urban soil type. Therefore, parameters that exceeded the established screening criteria in SWMU 7 soils were compared to the urban soil background 95percent upper tolerance limits (UTLs). Site groundwater data were also compared to the background 95percent UTLs for parameters that exceeded the established screening criteria.

Background soil and groundwater constituent concentrations were addressed for NAB Little Creek as part of the basewide *Final Background Investigation* (CH2M HILL, December 2000) and *Final Background Investigation Addendum for Summer Groundwater Sampling Event* (CH2M HILL, March 2003). The investigation's objective was to establish background concentrations of metals, pesticides, and PAHs in surface and subsurface soil and groundwater for use in comparison to IRP site data to better identify release-related constituents 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.

Basewide groundwater quality samples were collected at 10 wells as part of the background investigation. To establish background groundwater concentrations for the various parameters, both a winter sampling event (conducted during January 2000) and summer sampling event (conducted during June 2001 with additional sampling in October 2001) were conducted to account for potential changes in groundwater parameter concentrations due to seasonal fluctuations in groundwater. The seasonal results did not reflect a statistically significant different data set; therefore, only one data set is referenced for groundwater comparison. However, it should be noted that background UTLs for total arsenic and iron were re-assessed as part of the 2001 addendum; more conservative UTLs were presented for arsenic (4 µg/L) and iron (17,100 µg/L). Background soil quality was

established by collecting samples from non-impacted areas that represent the underlying geologic conditions at NAB Little Creek and those indicative of anthropogenic background conditions. Basewide background data for surface and subsurface soil and groundwater are provided in Appendix F.

After regulatory screening, basewide background data were compared to those gathered at SWMU 7 during the RI field investigation to determine if site data reflected a site-related release. All site soil-sampling locations fall into the dredge-fill soil type. Therefore, contaminants that exceeded the established screening criteria in site soil were compared to the dredge-fill background 95-percent (UTLs). Site groundwater data were also compared to the background 95-percent UTLs for parameters that exceeded the established screening criteria.

5.2 SWMU 7 RI Analytical Results

This section presents the analytical results obtained from laboratory analyses of the various media and discusses the nature and extent of elevated parameters identified at SWMU 7.

5.2.1 Surface Soil

Eleven surface soil samples (SS15 through SS25) were collected 0–6 in. bgs during the RI event at SWMU 7 (Figure 5-1). The surface soil samples were analyzed for TCL PAHs, total TAL metals and cyanide, total organic carbon (TOC), pH, and grain size. Table 5-3 lists all detected constituents in surface soil and compares the results to screening criteria. Figure 5-1 illustrates the surface soil sample locations and the results exceeding screening criteria.

5.2.1.1 Polycyclic Aromatic Hydrocarbons

Of the 15 PAHs detected in surface soil, 1 exceeded the soil residential RBC screening criteria at one location. Benzo(a)pyrene (110 J µg/kg) exceeded the residential soil RBC and the ecological screening criteria at SS21. Six additional PAHs (benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene) exceeded the ecological screening criteria at this location. Fluoranthene and pyrene were also detected above the ecological screening criteria at SS25, located north of Desert Cove and east of Building 3869. No other surface soil locations had detections of PAHs above the screening criteria. PAHs detected in surface soil samples from the RI field investigation in exceedance of the screening criteria were not detected during the background investigation.

5.2.1.2 Inorganics

Twenty-three metals were detected at least once in the surface soil samples collected at SWMU 7. Of these, only three exceeded the residential soil RBC, and 10 exceeded the ecological screening criteria.

Iron and lead were the only analytes detected in exceedance of both the ecological screening criteria and residential soil RBCs. Iron concentrations exceeded the ecological screening criteria in all 11 surface soil samples collected at SWMU 7, and iron exceeded the residential RBC in 1 location (SS17). Analytical results from SS15, SS16, and SS17 (all located near the current indoor sandblast facility) revealed iron concentrations above the background UTL with the highest concentration located at SS17 (25,500 J mg/kg). Additionally, SS20

(23,900 mg/kg) exceeds the background UTL iron concentration. The lead concentration (1,240 mg/kg) at SS24, located near building CB-317, exceeded the residential soil RBC, the ecological screening value, and background UTL. During the previous SIs at SWMU 7, ABM was visually present at these locations (CH2M HILL, June 2000).

Arsenic concentrations exceeded the residential soil RBC in 10 of the 11 surface soil samples collected. The highest arsenic concentrations were detected at SS16 (4.1 mg/kg) and SS18 (4.2 mg/kg), collected near the current indoor sandblast facility, however, none of these concentrations exceeded the background UTL of 5.1 mg/kg.

Inorganic constituents exceeding only the ecological screening criteria included aluminum, chromium, copper, manganese, mercury, thallium, vanadium, and zinc. Aluminum, chromium, and vanadium concentrations exceeded their respective ecological screening value in all 11 surface soil samples collected. Aluminum also exceeded the background UTL (8,500 mg/kg) at stations SS15, SS16, and SS17. These stations are located near the indoor sandblasting facility. Chromium and vanadium also exceed the background UTL at sampling locations near the indoor sandblasting area. Chromium exceeded the background UTL at one sampling location north of Desert Cove (SS24). The highest copper (518 mg/kg), mercury (0.99 mg/kg), and zinc (590 mg/kg) concentrations were found in sample SS24in the northeastern portion of the SWMU, where ABM was observed during a previous investigation. These metals exceeded background UTLs in samples SS24 and SS25. Additionally, zinc exceeded the background UTL in samples SS17 and SS20. Screening value and background UTL exceedances of manganese and thallium were observed in one sample, SS17, located south of Desert Cove.

5.2.2 Subsurface Soil

Eleven subsurface soil samples (SB15 through SB25) were collected at co-locations with the surface soil samples. The subsurface soil samples were collected 6–12 and 12–24 in. bgs. The samples were analyzed for TCL PAHs, total TAL metals and cyanide, TOC, pH, and grain size. Table 5-4 lists all detected constituents in subsurface soil and compares the results to screening criteria. Because subsurface soil is not being evaluated in the ERA as a pathway that may impact ecological receptors, analytical results from subsurface soil samples were not compared to ecological screening criteria. Figure 5-2 presents the subsurface soil sample results exceeding screening criteria.

5.2.2.1 Polycyclic Aromatic Hydrocarbons

Fifteen PAHs were detected at least one subsurface soil sample collected at SWMU 7, of which benzo(a)pyrene (160 J µg/kg) exceeded the residential soil RBC in sample SB25-01 collected at 6–12 in. bgs. Benzo(a)pyrene was not detected during the background investigation, therefore, a UTL was not established.

5.2.2.2 Inorganics

Twenty-one metals were detected in one or more of the subsurface soil samples collected at SWMU 7. However, only arsenic was detected at concentrations exceeding the residential soil RBC in 10 of the 11 subsurface soil samples collected (arsenic was not detected in either of the two samples SB24-01 or SB24-02). The highest arsenic concentrations were detected in SB15-01, SB15-02, SB16-01, SB18-01, and SB18-02, collected near the current indoor sandblast

facility. Sample SB18-02 was the only sample to have an arsenic concentration exceed the background UTL of 5.6 mg/kg.

5.2.3 Groundwater

Six groundwater samples from shallow monitoring wells (MW01 through MW06) and six DPT groundwater samples (DP101 through DP103) were collected during the SWMU 7 RI field investigation. At each DPT sample location, groundwater samples were collected from two discrete depths (10–14 ft bgs and 17–21 ft bgs). The monitoring well groundwater samples were analyzed for USEPA TCL VOCs, TCL SVOCs, total and dissolved TAL metals, and cyanide. The DPT groundwater samples were analyzed for low-concentration TCL VOCs and for TCL SVOCs.

Table 5-5 summarizes all constituents detected in the monitoring well groundwater samples, and Table 5-6 lists all the constituents found in the DPT groundwater samples. Both tables compare the results to human health screening criteria. Monitoring well groundwater sample data exceeding screening criteria are depicted on Figure 5-3.

Volatile Organic Compounds. Methyl-tert-butyl ether (MTBE) was detected in three monitoring well groundwater samples and tetrachloroethene (PCE) was detected in one monitoring well groundwater sample during the SWMU 7 RI. Only MTBE (25 µg/L) exceeded the tap water RBC (2.6 µg/L) in the sample collected from monitoring well LS07-MW03. During the background investigation, samples were not analyzed for MTBE; therefore, no UTL was established.

Acetone (all samples) and cis-1,3-dichloropropene (LW07-DP101 at 17-21 ft bgs) were detected in the direct-push groundwater samples. The detected concentrations did not exceed the screening criteria.

Semivolatile Organic Compounds. Four SVOCs (acenaphthene, caprolactam, di-n-butylphthalate, and dimethyl phthalate) were detected at low estimated concentrations in monitoring well groundwater samples at SWMU 7. The detected concentrations did not exceed screening criteria. There were no SVOCs detected in the DPT groundwater samples collected at SWMU 7.

Inorganics. Sixteen total and 15 dissolved metals were detected in the monitoring well groundwater at SWMU 7. Total and dissolved arsenic, iron, and manganese exceeded human health groundwater screening criteria.

Total arsenic concentrations exceeded the tap water RBC of 0.045 µg/L in five of the six monitoring wells (LS07-MW01, MW02, MW-03, MW05, and MW06). Groundwater samples from LW07-MW01 and LS07-MW05, exceeded the arsenic concentrations also exceeded the MCL of 10 µg/L. Dissolved arsenic concentrations exceeded the tap water RBC and/or the MCL in three of the five monitoring wells. LW07-MW05 was the only location where both total and dissolved arsenic concentrations exceeded the tap water RBC and the MCL.

Total iron concentrations exceeded the tap water RBC (11,000 µg/L) and the background UTL (17,100 µg/L) at four of the six monitoring well locations. Dissolved iron concentrations exceeded the tap water RBC (11,000 µg/L) and the background UTL (17,100 µg/L) at LW07-MW01, LW07-MW03, and LW07-MW05.

Total and dissolved manganese concentrations exceeded the tap water RBC of 730 µg/L in the samples collected from LW07-MW01, LW07-MW02, LW07-MW03, and LW07-MW06. With the exception of LW07-MW03, the total and dissolved manganese concentrations also exceeded the background UTL of 1,510 µg/L.

5.2.4 Sediment

5.2.4.1 Surface Sediment

Thirty-six surface sediment samples were collected in Desert Cove during the RI field investigation at SWMU 7. Discrete surface sediment samples were obtained from 19 node locations. Additionally, surface sediment samples were collected from three locations surrounding each discrete node and homogenized as a composite sample. Composite samples were not collected from tertiary node locations L2 and L6. Table 5-7 lists the constituents detected in surface sediment at SWMU 7. The samples were collected from a depth of 0-4 in. below sediment surface and analyzed for PAHs, ammonia, TAL metals, total tin, pH, TOC, and grain size. The 19 surface sediment samples collected at node locations were also submitted for AVS/SEM and cation-exchange capacity (CEC) analyses. Discrete node sample concentrations and corresponding composite sample concentrations were similar in exceedances and detected constituents at most locations in Desert Cove. The results are shown on Figure 5-4 and discussed below.

5.2.4.2 Polycyclic Aromatic Hydrocarbons

All PAH compounds (16 Total) were detected at least once in exceedance of the screening criteria in sediment samples collected during SWMU 7 RI field activities. Nine were detected in each surface sediment sample; Anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene. However, only benzo(a)pyrene exceeded the RBC at each node location. PAHs were not detected in exceedance of the ecological screening criteria at B5, B7, and D5 located in the western portion of the connector channel. Concentrations increase significantly eastward into the Cove.

PAHs were elevated near the bulkhead areas surrounding the cove with elevated concentrations of Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(a)pyrene at locations K4, L5, M3, K5, H1, K1, and L2. Concentrations of PAHs were lower west of Desert Cove in the channel, however benzo(a)pyrene exceed the RBC in the western portion of the cove.

5.2.4.3 Inorganics

Fifteen inorganic constituents were detected in each surface sediment location during the SWMU 7 RI. Of these, only arsenic and iron exceeded the RBC for residential soil. Nine compounds exceeded ecological screening criteria: arsenic, copper, iron, lead, mercury, nickel, selenium, tin, and zinc.

Arsenic exceeded the RBC for residential soil at all sampling locations in Desert Cove. Arsenic concentrations at eight of these locations also exceeded the ecological screening value. The highest concentrations were located in the inlet's eastern and northeastern portions at

locations L5, K4, M4, K5, H1, M1, L2 H3, J4, and K3. The lowest concentrations were located in the channel's southwestern area at locations B5, B7, H5, and F3.

Iron exceeded the RBC for residential soil at 10 locations sampled during the RI field investigation. All sample results in Desert Cove's eastern portion have iron concentrations above the RBC. Iron exceedances of the RBC for residential soil were less abundant in the inlet's western portion; however exceedances of the RBC for residential soil were found towards the center of the channel at locations J4 and D5. Iron exceeded the ecological screening value of 220,000 mg/kg at only one node location, K5, located in the cove's southern portion.

Copper, lead, mercury, nickel, selenium, tin, and zinc exceeded the ecological screening criteria but not the RBCs for residential soil. Copper exceeded ecological screening criteria at all locations, except K6, with the highest concentration at location H1 (134 mg/kg) in the northwestern portion of Desert Cove. Lead exceeded screening criteria at 13 of the 19 locations with the highest concentration at location K3 (255 mg/kg), also in the cove's northern portion. Fourteen node locations had exceedances of mercury with the highest concentrations in the samples collected from within the cove. Nickel was only found to exceed ecological screening criteria at two locations, K5 (23.4 mg/kg) and M3 (25.4 mg/kg). Both stations, K5 and M3, are located in Desert Cove's eastern portion. Nickel exceeded the ecological screening value (1 mg/kg) at eight node locations with concentrations ranging from 1.3 mg/kg (F5) to 2.5 mg/kg (H3 and K1). Tin exceeded screening criteria at 10 locations with the highest concentrations in the cove's eastern portion at locations M3 (14.5 mg/kg), K4 (9.4 mg/kg), and K5 (8.8 mg/kg). Zinc exceeded ecological screening criteria at all sample locations except K6 where there were no inorganic exceedances. Location M3, the easternmost sample location, had the highest concentration of zinc at 1,360 mg/kg.

5.2.4.4 Subsurface Sediment

Subsurface sediment samples were collected at 19 node locations at Desert Cove utilizing a vibracore sampling device. Analytes include TCL SVOCs, ammonia, TAL metals, total tin, pH, and TOC. Table 5-8 lists the constituents detected in the subsurface sediment samples and compares them to human health screening criteria. Subsurface sediment is not being evaluated as a potential pathway for impacts to ecological receptors; therefore, analyte concentrations are not compared to ecological screening criteria. Vibracore samples were collected using disposable 4-in. diameter aluminum liners to at least 3 ft below the sediment surface. The average depth of the core collection was approximately 62 in. below the sediment surface with the greatest depth, 88 in. below the sediment surface at L6-SD201. The shallowest core was collected from 34 in. below the sediment surface at M3-SD201. The results are shown on Figure 5-5 and discussed below.

5.2.4.5 Semivolatile Organic Compounds

Sixteen SVOCs were detected in subsurface sediment samples collected during RI field activities at SWMU 7. Five exceeded the RBC for residential soil at locations H1, M1, L2, M3, B5, K6, and L6. Benzo(a)pyrene was the only SVOC exceedance in Tertiary node samples L2 and L6. The highest concentrations and most exceedances of the RBC for residential soil were generally located toward the bulkhead surrounding the cove, where concrete pieces from the pavement were observed during drilling activities.

5.2.4.6 Inorganics

Fourteen inorganic constituents were detected in subsurface sediment samples collected from Desert Cove during Remedial Investigation activities. Only arsenic and iron exceeded the RBC for residential soil while 12 metals.

Arsenic concentrations exceeded the RBC for residential soil at all sampling locations, except for F5, just northwest of the current sand blasting facility. The highest concentrations were near the bulkhead surrounding Desert Cove. Arsenic levels decreased westward towards the channel.

Iron exceeded the RBC for residential soil at five node sampling locations in Desert Cove. Sampling locations H1, M1, M3, H3, and K6 had iron concentrations above the screening criteria with the highest concentrations at H3 (40,600 mg/kg) and M3 (48,500 mg/kg).

5.3 Summary of Relevant Constituents at SWMU 7

5.3.1 Soil

In surface soils, several PAHs and metals may pose a potential risk based on comparisons to human health and ecological screening criteria. The highest concentrations of detected constituents were generally near the current indoor sandblasting facility and near Buildings 3884 and 3869. PAHs exceeding screening criteria were primarily found in one sample, SS21. Fluoranthene exceeded the screening criteria but was not analyzed during the background investigation; therefore, a UTL was not established. The remaining PAHs detected in exceedance of the screening criteria were not detected during the background investigation. The soil samples with metals concentrations exceeding screening criteria and the background UTL were collected from locations along the bulkhead to the north and south of Desert Cove. Only chromium and vanadium exceeded screening criteria and the background UTL in samples collected to the west and south beyond the indoor sandblasting facility.

Only arsenic and benzo(a)pyrene exceeded screening criteria in subsurface soil samples. Arsenic exceeded screening criteria in a number of subsurface soil samples, but only exceeded the background UTL in one sample, near the indoor sandblasting facility. Benzo(a)pyrene exceeded screening criteria in one sample located north of Desert Cove.

Surface soil sample LW07-SS24 located north of the SWMU 7 boundary, indicated lead concentrations above the RBC for residential and industrial soil. Because lead is indicative of a release caused by sandblasting activities (although there were no human health risks associated with surface soil at the SWMU) an interim removal action (IRA) was completed in September 2004 to eliminate future potential risk in the isolated area of LW07-SS24. Additionally, the highest inorganic concentrations of PCOCs identified in the ERA, specifically chromium, copper, lead mercury, and zinc due to potential transport in the terrestrial area of SWMU 7a to Desert Cove and the Connector Channel via wind and surface runoff, were located at LW07-SS24 and were removed during the IRA.

5.3.2 Shallow Groundwater

In shallow groundwater, methyl-tert-butyl ether (MW03) was the only organic constituent to exceed screening criteria (human health). The downgradient monitoring well (MW01) and the upgradient monitoring well (MW02) near the sandblast facility had similar

concentrations of total and dissolved metals. Samples collected from monitoring wells MW01 and MW02 had the greatest number of total and dissolved metals concentrations exceeding screening criteria and the background UTL.

5.3.3 Sediment

In sediment, all PAHs, and several inorganics pose a potential risk based on human health and ecological screening. Arsenic was the only inorganic constituent in exceedance of both the human health and ecological screening values. Iron was found in exceedance of the residential soil RBC, but the levels were not elevated above the ecological screening value. Constituents exceeding only the ecological screening criteria include copper, lead, mercury, nickel, selenium, tin, and zinc. Generally, organic and inorganic analytes were elevated in samples collected near the bulkhead surrounding the cove. Concentrations of analytes generally decreased west towards Little Creek Channel. PAHs were not as abundant in the subsurface sediment; however, arsenic and iron concentrations were similar in both the surface and subsurface samples.

5.4 References

CH2M HILL. *Final Background Investigation for NAB Little Creek, Virginia Beach, Virginia.* December 2000.

CH2M HILL. Final Background Investigation Addendum for Summer Groundwater Sampling Event, NAB Little Creek, Virginia Beach, Virginia. March 2003.

USEPA. *USEPA Region III Modification to National Functional Guidelines for Data Review*. 1994.

USEPA. *Drinking Water Standards and Health Advisories.* Summer 2000.

USEPA. *USEPA Region III Risk-Based Concentration (RBC) Table.* Superfund Technical Support Section, Philadelphia, PA. April 2003.

USEPA Region III. *Revised Region III BTAG screening levels. Memorandum from R.S. Davis to Users.* August 1995.

Table 5-1
Summary of Regulatory Criteria for Groundwater
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

		Criteria	
Parameter	**CAS Number**	**MCL-Groundwater[1] (UG/L)**	**RBC-Tap[2] (UG/L)**
Acenaphthene	83-32-9	--	370
Acetone	67-64-1	--	5,500
Aluminum	7429-90-5	--	37,000
Arsenic	7440-38-2	10	0.045
Barium	7440-39-3	2,000	2,600
Calcium	7440-70-2	--	--
Caprolactam	105-60-2	--	18,000
Chromium	7440-47-3	100	110
cis-1,3-Dichloropropene	10061-01-5	--	0.44
Cobalt	7440-48-4	--	730
Copper	7440-50-8	1,300	1,500
Dimethyl phthalate	131-11-3	--	370,000
Di-n-butylphthalate	84-74-2	--	3,700
Iron	7439-89-6	--	11,000
Lead	7439-92-1	15	15
Magnesium	7439-95-4	--	--
Manganese	7439-96-5	--	730
Methyl-tert-butyl ether (MTBE)	1634-04-4	--	2.6
Nickel	7440-02-0	--	730
Potassium	7440-09-7	--	--
Selenium	7782-49-2	50	180
Sodium	7440-23-5	--	--
Tetrachloroethene	127-18-4	5	0.1
Vanadium	7440-62-2	--	37
Zinc	7440-66-6	--	11,000

Notes:

-- No Criteria Available

[1] Federal Maximum Contaminant Levels for Drinking Water, Summer 2000.

[2] USEPA Region III Risk-Based Concentrations for Tap Water.

Table 5-2
Summary of Regulatory Criteria for Soil and Sediment
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Parameter	CAS Number	RBC-Soil Residential[1] (MG/KG)
Aluminum	7429-90-5	78,000
Antimony	7440-36-0	31
Arsenic	7440-38-2	0.43
Barium	7440-39-3	5,500
Beryllium	7440-41-7	160
Cadmium	7440-43-9	78
Calcium	7440-70-2	--
Chromium	7440-47-3	230
Cobalt	7440-48-4	1,600
Copper	7440-50-8	3,100
Cyanide	57-12-5	1,600
Iron	7439-89-6	23,000
Lead	7439-92-1	400
Magnesium	7439-95-4	--
Manganese	7439-96-5	1,600
Mercury	7439-97-6	23
Nickel	7440-02-0	1600
Potassium	7440-09-7	--
Selenium	7782-49-2	390
Silver	7440-22-4	390
Sodium	7440-23-5	--
Thallium	7440-28-0	5.5
Tin	7440-31-5	47,000
Vanadium	7440-62-2	78
Zinc	7440-66-6	23,000

Parameter	CAS Number	RBC-Soil Residential[1] (UG/KG)
Acenaphthene	83-32-9	4,700,000
Acenaphthylene	208-96-8	--
Anthracene	120-12-7	23,000,000
Benzo(a)anthracene	56-55-3	870
Benzo(a)pyrene	50-32-8	87
Benzo(b)fluoranthene	205-99-2	870
Benzo(g,h,i)perylene	191-24-2	2,300,000
Benzo(k)fluoranthene	207-08-9	8,700
Chrysene	218-01-9	87000
Dibenz(a,h)anthracene	53-70-3	87
Fluoranthene	206-44-0	3,100,000
Fluorene	86-73-7	3,100,000
Indeno(1,2,3-cd)pyrene	193-39-5	870
Naphthalene	91-20-3	1,600,000
Phenanthrene	85-01-8	2,300,000
Pyrene	129-00-0	2,300,000

Notes:
-- No Criteria Available
[1] USEPA Region III Risk-Based Concentrations for Residential Soil.

Table 5-3
Surface Soil Exceedances of Screening Criteria
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Station ID	RBC-Soil Residential	Ecological Screening Value	Backgound 95% UTL for Dredge Fill Surface Soil	LW07-SO15	LW07-SO16	LW07-SO17	LW07-SO18	LW07-SO19	LW07-SO20	LW07-SO21	LW07-SO22	LW07-SO23	LW07-SO24	LW07-SO25
Sample ID				LW07-SS15-00	LW07-SS16-00	LW07-SS17-00	LW07-SS18-00	LW07-SS19-00	LW07-SS20-00	LW07-SS21-00	LW07-SS22-00	LW07-SS23-00	LW07-SS24-00	LW07-SS25-00
Sample Date				08/26/02	08/26/02	09/05/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02
Chemical Name														
Polycyclic Aromatic Hydrocarbons (UG/KG)														
Acenaphthene	4,700,000	2,500	ND	350 U	340 U	380 U	340 U	340 U	390 U	14 J	340 U	340 U	340 U	350 U
Acenaphthylene	--	100	ND	350 U	340 U	380 U	340 U	340 U	390 U	13 J	340 U	340 U	340 U	350 U
Anthracene	23,000,000	100	ND	350 U	340 U	380 U	340 U	340 U	390 U	21 J	340 U	340 U	340 U	14 J
Benzo(a)anthracene	870	100	ND	350 U	340 U	12 J	340 U	340 U	18 J	140 J	340 U	340 U	14 J	77 J
Benzo(a)pyrene	87	100	ND	350 U	340 U	10 J	340 U	340 U	15 J	**110 J**	11 J	340 U	11 J	60 J
Benzo(b)fluoranthene	870	100	ND	350 U	340 U	27 J	340 U	340 U	31 J	**140 J**	340 U	340 U	24 J	57 J
Benzo(g,h,i)perylene	2,300,000	100	--	350 U	340 U	380 U	340 U	340 U	390 U	73 J	340 U	340 U	340 U	350 U
Benzo(k)fluoranthene	8,700	100	ND	350 U	340 U	26 J	340 U	340 U	20 J	**140 J**	340 U	340 U	27 J	78 J
Chrysene	87,000	100	ND	350 U	340 U	42 J	340 U	340 UJ	28 J	**250 J**	15 J	340 U	39 J	98 J
Dibenz(a,h)anthracene	87	100	ND	350 U	340 U	380 U	340 U	340 U	390 U	30 J	340 U	340 U	340 U	15 J
Fluoranthene	3,100,000	100	--	350 U	340 U	42 J	8 J	340 U	32 J	**240 J**	17 J	340 U	42 J	**110 J**
Fluorene	3,100,000	1,700	ND	350 U	340 U	380 U	340 U	340 U	390 U	14 J	340 U	340 U	340 U	350 U
Indeno(1,2,3-cd)pyrene	870	100	ND	350 U	340 U	13 J	340 U	340 U	16 J	85 J	340 U	340 U	14 J	52 J
Phenanthrene	2,300,000	100	ND	350 U	340 U	380 U	340 U	340 U	19 J	**190 J**	340 U	340 U	26 J	51 J
Pyrene	2,300,000	100	ND	350 U	340 U	31 J	340 U	340 U	31 J	**380 J**	19 J	340 U	53 J	**160 J**
Total Metals (MG/KG)														
Aluminum	78,000	50	8500	**8,750**	**8,600**	**11,400 J**	**3,960**	**2,870 J**	**8,390**	**4,040 J**	**1,340**	**1,450 J**	**2,340 J**	**1,470 J**
Antimony	31	5	ND	0.34 U	0.32 U	0.36 U	0.38 J	0.32 U	0.34 U	0.34 U	0.32 U	0.33 U	0.93 J	2.7 J
Arsenic	0.43	60	5.6	3.3	4.1	1.7 J	4.2	0.87 J	3.7	1.3 J	2.6	0.49 J	1.1 J	0.51 U
Barium	5,500	500	69	66	68.2	222	26.2 J	20.9 J	89.4	66.9	5.7 J	8.2 J	18.4 J	23.8 J
Beryllium	160	10	0.6	0.15 J	0.23 J	0.5 J	0.21 J	0.15 J	0.29 J	0.16 J	0.06 J	0.15 J	0.42 J	0.18 J
Cadmium	78	4	ND	0.04 U	0.03 U	0.3 J	0.03 U	0.08 J	0.04 U	0.22 J	0.04 U	0.07 U	0.33 J	0.3 J
Calcium	--	--	1817	2,020 J	2,180 J	4,370	1,150 J	5,460	2,470 J	1,150	80 J	550 J	1,250	572 J
Chromium	230	0.4	20	**14.9**	**16.7**	**28**	**8.4**	**18.7**	**27.6**	**8.8**	**4.6**	**6.4**	**79.3**	**19**
Cobalt	1,600	100	5.1	4.8 J	5.8 J	9.2 J	2.2 J	1.4 J	8.3 J	1.5 J	0.31 J	1.7 J	3.5 J	1.2 J
Copper	3,100	50	ND	16.2 J	22.1 J	22.6	10.9 J	8.6	34.7 J	9.8	10.6 J	4.7 J	**518**	**156**
Cyanide	1,600	27.5	ND	0.08 U	0.07 U	0.08 U	0.17 J	0.07 U	0.08 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U
Iron	23,000	200	15,000	**18,300**	**18,000**	**25,500 J**	**8,590**	**5,680 J**	**23,900**	**6,470 J**	**2,790**	**3,420 J**	**9,290 J**	**5,080 J**
Lead	400	50	110	2.2 J	18.6 J	47	35.3 J	28.8	31.2 J	32.1	**69.9 J**	8	**1,240**	**230**
Magnesium	--	--	1,347	6,290	5,910	7,340	1,710	1,080	6,260	1,110	176 J	301 J	358 J	236 J
Manganese	1,600	500	267	348	443	**515 J**	104	76.8 J	460	93.8 J	6	30.2 J	54.5 J	23.8 J
Mercury	23	0.1	ND	0.04 U	0.04 U	0.05 U	0.04 U	0.04 U	0.04 U	0.04 U	0.03 U	0.03 U	**0.99**	**0.4**
Nickel	1,600	30	9.5	4.8 J	7.2 J	20.1	3.8 J	3.1 J	13.5	3.8 J	1.5 J	2.5 J	10.5	3.3 J
Potassium	--	--	1435	3,580	3,900	7,800	1,280	1,080	3,070	1,040	120 J	324 J	281 J	254 J
Selenium	390	1.8	ND	0.61 U	0.57 U	0.75 J	0.56 U	0.32 UJ	0.62 U	0.34 UJ	0.59 U	0.33 UJ	0.57 J	0.45 J
Sodium	--	--	623	32.2 U	355 B	455 J	29.1 U	133 J	335 B	501 J	30.8 U	87.5 J	465 J	276 J
Thallium	5.5	1	ND	0.55 UJ	0.51 UJ	**1.3 J**	0.5 UJ	0.8 U	0.56 UJ	0.84 U	0.53 UJ	0.82 U	0.82 U	0.86 U
Vanadium	78	2	34.3	**26.7**	**35.4**	**39.3**	**14.9**	**12.7**	**32.1**	**10.4**	**30**	**4.6 J**	**5.6 J**	**4.1 J**
Zinc	23,000	50	123	**59.5**	**68.3**	**229**	**52.6**	42.1	**198**	**78.2**	10	30.9	**590**	**320**
Wet Chemistry (MG/KG)														
Total organic carbon (TOC)	--	--	30,000	1,639	29,210	2,354	3,590	2,199	3,243	1,050	1,719	1,365	6,619	2,705
pH	--	--	7.7	8.11	7.49	8.52	7.84	8.28	8.07	8.06	4.65	9.45	8.1	8.01

Notes:
Surface soil samples were collected from 0-6" bgs.
Exceeds RBC Soil Residential Screening Criteria
Exceeds RBC Soil Residential and Background UTL
Exceeds Ecological Screening Value
Exceeds Ecological Screening Value and Background UTL
RBC - Risk-Based Concentration

UTL - Upper Tolerance Limit
ND - Not detected in background
-- No criteria established
J - Analyte present. Reported value may not be accurate or precise.
U - Not detected
B- Possible blank contamination

Table 5-4
Subsurface Soil Exceedances of Screening Criteria
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Station ID	**RBC-Soil Residential**	**Backgound 95% UTL for Dredge Fill Subsurface Soil**	LW07-SO15		LW07-SO16		LW07-SO17		LW07-SO18		LW07-SO19		LW07-SO20		LW07-SO21	
Sample ID			LW07-SB15-01	LW07-SB15-02	LW07-SB16-01	LW07-SB16-02	LW07-SB17-01	LW07-SB17-02	LW07-SB18-01	LW07-SB18-02	LW07-SB19-01	LW07-SB19-02	LW07-SB20-01	LW07-SB20-02	LW07-SB21-01	LW07-SB21-02
Sample Date			08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02
Sample Depth (bgs)			6-12"	12-24"	6-12"	12-24"	6-12"	12-24"	6-12"	12-24"	6-12"	12-24"	6-12"	12-24"	6-12"	12-24"
Chemical Name																
Polycyclic Aromatic Hydrocarbons (UG/KG)																
Acenaphthene	4,700,000	ND	380 U	400 U	360 U	49 J	350 U	350 U	340 U	340 U	350 U	460 U	340 U	340 U	350 U	340 U
Anthracene	23,000,000	ND	380 U	400 U	360 U	11 J	350 U	350 U	340 U	340 U	350 U	460 U	10 J	340 U	350 U	340 U
Benzo(a)anthracene	870	ND	380 U	400 U	360 U	13 J	350 U	350 U	340 U	340 U	350 U	18 J	53 J	340 U	18 J	52 J
Benzo(a)pyrene	87	ND	380 U	400 U	360 U	12 J	20 J	12 J	10 J	11 J	350 U	13 J	59 J	340 U	12 J	34 J
Benzo(b)fluoranthene	870	ND	380 U	400 U	360 U	360 U	34 J	29 J	15 J	18 J	350 U	460 U	77 J	340 U	15 J	43 J
Benzo(g,h,i)perylene	2,300,000	--	380 U	400 U	360 U	360 U	350 U	350 U	340 U	340 U	350 U	460 U	340 U	340 U	350 U	340 U
Benzo(k)fluoranthene	8,700	ND	380 U	400 U	360 U	360 U	29 J	32 J	340 U	340 U	350 U	24 J	46 J	340 U	350 U	53 J
Chrysene	87,000	ND	380 U	400 U	360 U	13 J	20 J	12 J	14 J	13 J	350 UJ	26 J	60 J	340 U	350 UJ	69 J
Dibenz(a,h)anthracene	87	ND	380 U	400 U	360 U	360 U	350 U	350 U	340 U	340 U	350 U	460 U	340 U	340 U	350 U	340 U
Fluoranthene	3,100,000	--	380 U	400 U	360 U	42 J	11 J	17 J	16 J	16 J	350 U	30 J	97 J	340 U	26 J	73 J
Fluorene	3,100,000	ND	380 U	400 U	360 U	360 U	350 U	350 U	340 U	340 U	350 U	460 U	340 U	340 U	350 U	340 U
Indeno(1,2,3-cd)pyrene	870	--	380 U	400 U	360 U	360 U	23 J	10 J	340 U	340 U	350 U	16 J	44 J	340 U	10 J	31 J
Naphthalene	1,600,000	ND	380 U	400 U	360 U	16 B	350 U	350 U	340 U	340 U	350 U	460 U	340 U	340 U	350 U	340 U
Phenanthrene	2,300,000	ND	380 U	400 U	360 U	13 J	350 U	350 U	340 U	340 U	350 U	460 U	43 J	340 U	20 J	50 J
Pyrene	2,300,000	ND	380 U	400 U	360 U	41 J	14 J	17 J	18 J	33 J	350 U	58 J	110 J	340 U	45 J	99 J
Total Metals (MG/KG)																
Aluminum	78,000	8500	7,870	8,580	9,140	2,530	987	1,040	2,380	5,490	1,070 J	4,310 J	1,840	926	2,140 J	980 J
Antimony	31	ND	0.36 U	0.35 U	0.53 J	0.34 J	0.32 U	0.34 U	0.42 J	0.39 U	0.34 U	0.47 U	0.31 U	0.31 U	0.34 U	0.34 U
Arsenic	0.43	5.6	4.9	5	3.6	4.2	3.3	2.6	4.1	6.3	0.49 U	1.9 J	2.3	2.3	0.5 J	0.49 U
Barium	5,500	69	33.7 J	28.2 J	96	15.5 J	8.6 J	7.8 J	12.5 J	18.8 J	5.1 J	19.7 J	13.7 J	4.7 J	16.9 J	5 J
Beryllium	160	0.6	0.25 J	0.18 J	0.12 J	0.16 J	0.06 J	0.11 J	0.12 J	0.3 J	0.07 J	0.25 J	0.16 J	0.08 J	0.17 J	0.07 J
Cadmium	78	ND	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 J	0.04 U	0.04 U	0.07 U	0.16 J	0.03 U	0.03 U	0.21 J	0.07 U
Calcium	--	1817	2,200 J	637 J	2,310 J	809 J	300 J	292 J	371 J	529 J	406 J	613 J	651 J	251 J	2,020	483 J
Chromium	230	20	12.2	10.8	89.2	7	19.5	4.7	10.5	12.5	4.4	9.8	4.7	2.6	6.5	2.4
Cobalt	1,600	5.1	2.2 J	1.7 J	6.4 J	1.2 J	0.94 J	0.38 J	0.9 J	2.4 J	0.56 J	0.69 J	0.54 J	0.45 J	0.9 J	0.4 J
Copper	3,100	ND	5.3 J	3.3 J	8.6 J	16.2 J	15.9 J	7.5 J	24.4 J	12.9 J	9.5	1.3 J	5.2 J	0.85 B	14.6	0.66 J
Iron	23,000	15,000	8,720	7,580	16,900	5,580	22,300	2,870	7,290	7,330	2,140 J	6,810 J	3,660	1,630	4,080 J	1,510 J
Lead	400	16.4	10.9 J	5.7 J	2.3 J	26.7 J	25.7 J	8.5 J	75.6 J	17.7 J	31.9	6.2	19.2 J	6.9 J	33.8	2.6
Magnesium	--	1347	1,150	676 J	7,700	603 J	246 J	228 J	501 J	1,060 J	215 J	708 J	667 J	219 J	525 J	169 J
Manganese	1,600	267	73.4	22.8	391	72.4	251	23.4	39.8	36.1	9.6 J	24.1 J	63.2	13.6	64.2 J	11.7 J
Mercury	23	ND	0.04 U	0.04 U	0.03 U	0.04 U	0.07 J	0.09 J	0.04 U	0.06 U	0.03 U	0.06 U	0.03 U	0.04 U	0.04 U	0.05 U
Nickel	1,600	9.5	5.3 J	6 J	14.9	3.3 J	3.9 J	1.5 J	2.6 J	5 J	1.1 J	2.4 J	1.7 J	0.9 J	3 J	0.76 J
Potassium	--	1435	639 J	460 J	5,070	354 J	149 J	140 J	374 J	767 J	239 J	713 J	423 J	145 J	453 J	197 J
Selenium	390	ND	0.65 U	0.64 U	0.58 U	0.58 U	0.58 U	0.61 U	0.6 U	0.7 U	0.34 UJ	1 J	0.55 U	0.56 U	0.34 UJ	0.34 UJ
Sodium	--	623	143 B	182 B	168 B	30.6 U	30.7 U	32.2 U	31.4 U	159 B	95.7 J	153 J	249 B	46.5 B	200 J	88.4 J
Vanadium	78	34.3	15.1	13.5	22	11	7.1 J	4.2 J	9.7 J	14.7	5.1 J	13.9	5.4 J	2.8 J	6.5 J	2.7 J
Zinc	23,000	39	17.9	9.4	51.9	46.8	79.4	65.6	65.5	51.1	36.9	11.4	21.9	5	59.7	5
Wet Chemistry (MG/KG)																
Total organic carbon (TOC)	--	--	2,872	1,467	283	6,185	997	922	3,118	2,030	1,652	7,746	464	2,544	559	629
pH	--	--	8.88	7.86	8.6	7.69	7.83	7.77	7.73	7.46	7.43	5.93	7.27	7.61	8.16	8.29

Notes:

Exceeds RBC-Soil Residential

Exceeds RBC-Soil Residential and Background UTL

RBC - Risk-Based Concentration

UTL - Upper Tolerance Limit

ND - Compounds considered not detected during Background Investigation and UTLs were not established

-- No criteria established

B - Possible blank contamination

J - Analyte present, reported value may not be accurate or precise

U - Not detected

Table 5-4
Subsurface Soil Exceedances of Screening Criteria
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Station ID	**RBC-Soil Residential**	**Backgound 95% UTL for Dredge Fill Subsurface Soil**	LW07-SO22		LW07-SO23		LW07-SO24		LW07-SO25	
Sample ID			LW07-SB22-01	LW07-SB22-02	LW07-SB23-01	LW07-SB23-02	LW07-SB24-01	LW07-SB24-02	LW07-SB25-01	LW07-SB25-02
Sample Date			08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02
Sample Depth (bgs)			6-12"	12-24"	6-12"	12-24"	6-12"	12-24"	6-12"	12-24"
Chemical Name										
Polycyclic Aromatic Hydrocarbons (UG/KG)										
Acenaphthene	4,700,000	ND	330 U	340 U	350 U	350 U	340 U	340 U	21 J	340 U
Anthracene	23,000,000	ND	330 U	340 U	9 J	350 U	340 U	340 U	44 J	340 U
Benzo(a)anthracene	870	ND	330 U	340 U	46 J	350 U	340 U	340 U	240 J	340 U
Benzo(a)pyrene	87	ND	330 U	340 U	23 J	11 J	340 U	340 U	160 J	340 U
Benzo(b)fluoranthene	870	ND	330 U	340 U	39 J	18 J	340 U	340 U	160 J	340 U
Benzo(g,h,i)perylene	2,300,000	--	330 U	340 U	350 U	350 U	340 U	340 U	92 J	340 U
Benzo(k)fluoranthene	8,700	ND	330 U	340 U	40 J	16 J	340 U	340 U	190 J	340 U
Chrysene	87,000	ND	330 U	340 U	67 J	18 J	340 U	340 U	350 J	340 U
Dibenz(a,h)anthracene	87	ND	330 U	340 U	350 U	350 U	340 U	340 U	41 J	340 U
Fluoranthene	3,100,000	--	330 U	340 U	59 J	350 U	340 U	340 U	330 J	340 U
Fluorene	3,100,000	ND	330 U	340 U	350 U	350 U	340 U	340 U	14 J	340 U
Indeno(1,2,3-cd)pyrene	870	--	330 U	340 U	18 J	30 J	340 U	340 U	140 J	340 U
Naphthalene	1,600,000	ND	330 U	340 U	350 U	350 U	18 J	340 U	350 U	340 U
Phenanthrene	2,300,000	ND	330 U	340 U	35 J	350 U	340 U	340 U	170 J	340 U
Pyrene	2,300,000	ND	330 U	340 U	100 J	350 U	340 U	340 U	560 J	340 U
Total Metals (MG/KG)										
Aluminum	78,000	8500	667	516	3,300 J	1,260 J	1,510 J	491 J	4,640 J	704 J
Antimony	31	ND	0.44 J	0.3 U	1.3 J	0.35 U	0.37 J	0.32 U	0.35 U	0.66 J
Arsenic	0.43	5.6	2.6	2.6	2.5	0.51 U	0.47 U	0.47 U	1.1 J	0.51 U
Barium	5,500	69	2.9 J	3.3 J	26.8 J	8 J	11.5 J	3.6 J	23.2 J	4 J
Beryllium	160	0.6	0.05 J	0.04 J	0.91 J	0.13 J	0.09 J	0.03 U	0.19 J	0.04 U
Cadmium	78	ND	0.03 U	0.03 U	0.49 J	0.08 U	0.09 J	0.07 U	0.08 U	0.08 U
Calcium	--	1817	32.3 B	42 B	2,190	271 B	1,260	130 B	369 B	145 B
Chromium	230	20	2.5	2.4	29.9	6.7	14.6	3.7	7.5	2.1
Cobalt	1,600	5.1	0.14 J	0.07 U	6.3 J	0.8 J	1.4 J	0.11 J	0.88 J	0.14 J
Copper	3,100	ND	5.4 J	2.1 J	148	32.2	65.8	3.1 J	107	8.4
Iron	23,000	15,000	1,470	908	13,300 J	3,700 J	2,800 J	741 J	5,050 J	1,010 J
Lead	400	16.4	45.8 J	10.9 J	144	18.8	59.8	12.2	15.3	1.8
Magnesium	--	1347	76 J	64.4 J	618 J	156 J	256 J	62.6 B	386 J	116 J
Manganese	1,600	267	3.1	5.1	111 J	30.2 J	31.1 J	8.1 J	27.7 J	5.9 J
Mercury	23	ND	0.04 U	0.05 U	0.27	0.04 U	0.37	0.03 U	0.04 U	0.04 U
Nickel	1,600	9.5	0.81 J	0.59 J	24.4	3.9 J	1.8 J	0.26 J	2.6 J	0.37 J
Potassium	--	1435	68.6 J	67.4 J	548 J	153 J	232 J	67.5 J	354 J	175 J
Selenium	390	ND	0.55 U	0.55 U	0.33 UJ	0.35 UJ	0.32 UJ	0.32 UJ	0.35 UJ	0.35 UJ
Sodium	--	623	29.1 U	29 U	573 J	119 J	132 J	53.9 J	111 J	91.6 J
Vanadium	78	34.3	6.8 J	1.9 J	9.7 J	3.4 J	4.3 J	1.7 J	9 J	2.3 J
Zinc	23,000	39	3.8 B	4.1	723	94.4	132	18.2	71.6	17.4
Wet Chemistry (MG/KG)										
Total organic carbon (TOC)	--	--	294	113	3,885	554	968	353	3,345	379
pH	--	--	5.36	6.01	8.37	8.52	8.87	7.68	7.36	6.45

Notes:

Exceeds RBC-Soil Residential

Exceeds RBC-Soil Residential and Background UTL

RBC - Risk-Based Concentration

UTL - Upper Tolerance Limit

ND - Compounds considered not detected during Background Investigation and UTLs

-- No criteria established

B - Possible blank contamination

J - Analyte present, reported value may not be accurate or precise

U - Not detected

Table 5-5
Monitoring Well Groundwater Exceedances of Screening Criteria
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Station ID	RBC-Tap Water	MCL-Groundwater	Background -95% UTL for Groundwater	LW07-MW01	LW07-MW02	LW07-MW03	LW07-MW04	LW07-MW05	LW07-MW06
Sample ID				LW07-MW01-02C	LW07-MW02-02C	LW07-MW03-02C	LW07-MW04-02C	LW07-MW05-02C	LW07-MW06-02C
Sample Date				09/04/02	09/04/02	09/04/02	09/03/02	09/04/02	09/03/02
Chemical Name									
Volatile Organic Compounds (UG/L)									
Methyl-tert-butyl ether (MTBE)	2.6	--	--	0.96	0.5 U	25	0.5 U	1.4	0.5 U
Tetrachloroethene	0.1	5	ND	0.5 U	0.5 U	0.14 J	0.5 U	0.5 U	0.5 U
Semivolatile Organic Compounds (UG/L)									
Acenaphthene	370	--	ND	0.3 J	10 U	10 U	10 U	10 U	10 U
Caprolactam	18,000	--	--	10 U	10 U	10 U	10 U	10 U	2 J
Di-n-butylphthalate	3,700	--	--	10 U	10 U	10 U	0.5 J	0.6 J	0.3 J
Dimethyl phthalate	370,000	--	ND	10 U	10 U	10 U	10 U	4 J	4 J
Total Metals (UG/L)									
Aluminum	37,000	--	713	1,740 J	2,960 J	1,780 J	431 J	2,910 J	2,300 J
Arsenic	0.045	10	4	10.4	4.8 J	7.5 J	2.5 U	18.4	5.2 J
Barium	2,600	2,000	130	82.7 J	62.8 J	91.1 J	6.3 J	53.4 J	62.5 J
Calcium	--	--	129,000	159,000	78,600	60,700	4,820 J	13,700	96,500
Chromium	110	100	4.1	7.6 J	13.8	8.3 J	2.6 B	16.7	7.3 J
Cobalt	730	--	2.6	28.3 J	33.8 J	3.3 J	0.4 U	2 B	2.7 B
Copper	1,500	1,300	ND	30.2	50	7.8 B	10.9 B	12.8 B	12 B
Iron	11,000	--	17,100	52,400	17,600	35,200	1,340	56,500	5,910
Lead	15	15	2.4	3 B	4.4	2.1 J	1.3 U	2.3 J	1.3 U
Magnesium	--	--	45,600	160,000	43,800	17,900	3,840 J	7,050	59,300
Manganese	730	--	1,500	5,710	3,730	1,170	43.2	202	1,680
Nickel	730	--	14	8 J	14.7 J	3.8 B	0.6 U	9.6 J	5.1 B
Potassium	--	--	36,800	62,100 J	16,000 J	4,350 J	4,060 J	5,340 J	33,600 J
Sodium	--	--	337,000	1,120,000 J	458,000 J	123,000 J	23,900 J	37,700 J	729,000 J
Vanadium	37	--	5	3.6 J	7.3 J	4.4 J	3.7 J	10 J	7.2 J
Zinc	11,000	--	59	70.3	67.5	19.3 B	16.2 B	41	29.2
Dissolved Metals (UG/L)									
Aluminum	37,000	--	58	235	151 B	43.5 B	164 B	37.5 B	7.6 U
Arsenic	0.045	10	4	6.4 J	2.5 U	7 J	2.5 U	12.3	2.5 U
Barium	2,600	2,000	136	85.6 J	55.9 J	86.5 J	5.4 B	43.1 J	58.4 J
Calcium	--	--	136,000	165,000	79,000	58,900	5,050	12,500	95,100
Cobalt	730	--	1.9	28.2 J	32.7 J	2.9 B	0.4 U	1.7 B	3.2 J
Copper	1,500	1,300	ND	1 B	14.6 J	0.8 U	1.1 B	1.1 B	6.7 B
Iron	11,000	--	17,100	52,800	4,420	33,500	1,040	49,000	3,000
Magnesium	--	--	49,000	167,000	42,900	17,400	3,950 J	6,330	58,600
Manganese	730	--	1,510	5,910	3,630	1,190	43.2	169	1,690
Nickel	730	--	6	4.5 J	10.3 J	1.5 B	0.6 U	1.7 B	3 B
Potassium	--	--	35,500	63,800 J	15,500 J	4,080 J	4,140 J	4,500 J	31,800 J
Selenium	180	50	9	1.9 B	3.5 B	3.3 B	1.7 U	2.5 B	5
Sodium	--	--	360,000	1,210,000 J	438,000 J	119,000 J	24,000 J	34,600 J	736,000 J
Vanadium	37	--	2	0.34 J	0.3 U	0.3 U	3.1 J	0.3 U	0.3 U
Zinc	11,000	--	42	37	34.8	16.1 B	11.3 B	18.6 B	22.9

Notes:

Exceeds RBC - Tap Water and/or MCL

Exceeds RBC - Tap Water or MCL and Background UTL

ND - Not detected in background

-- No criteria established

J - Analyte present. Reported result may not be accurate or precise.

U - Not detected

B - Possible blank contamination.

Table 5-6
Direct Push Groundwater Exceedances of Screening Criteria
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Station ID	**RBC-Tap**	**MCL-Groundwater**	**Background 95% UTL for Groundwater**	LW07-DP101		LW07-DP102		LW07-DP103	
Sample ID				LW07-DP101-10	LW07-DP101-17	LW07-DP102-10	LW07-DP102-17	LW07-DP103-10	LW07-DP103-17
Sample Date				08/25/02	08/25/02	08/25/02	08/25/02	08/25/02	08/25/02
Sample Depth (bgs)				10-14"	17-21"	10-14"	17-21"	10-14"	17-21"
Chemical Name									
Volatile Organic Compounds (UG/L)									
Acetone	5,500	--	ND	4.8 J	4.2 J	5.8	3.9 J	3.2 J	2.5 J
cis-1,3-Dichloropropene	0.44	--	ND	0.5 U	0.12 J	0.5 U	0.5 U	0.5 U	0.5 U
Semivolatile Organic Compounds (UG/L)									
No Detections									

Notes:

Exceeds RBC - Tap Water or MCL

-- No criteria established

U - Not detected

J - Analyte present. Reported result may not be accurate or precise.

ND - Not detected in background

Table 5-7
Surface Sediment Exceedances of Screening Criteria
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Node Location	RBC-Soil Residential	Ecological Screening Value	B5		B7		D5		F3		F5		H1	
Station ID			LW07-B5-SD201	LW07-B5-SD202	LW07-B7-SD201	LW07-B7-SD202	LW07-D5-SD201	LW07-D5-SD202	LW07-F3-SD201	LW07-F3-SD202	LW07-F5-SD201	LW07-F5-SD202	LW07-H1-SD201	LW07-H1-SD202
Sample ID			LW07-B5-SD201-00-02C	LW07-B5-SD202-00-02C	LW07-B7-SD201-00-02C	LW07-B7-SD202-00-02C	LW07-D5-SD201-00-02C	LW07-D5-SD202-00-02C	LW07-F3-SD201-00-02C	LW07-F3-SD202-00-02C	LW07-F5-SD201-00-02C	LW07-F5-SD202-00-02C	LW07-H1-SD201-00-02C	LW07-H1-SD202-00-02C
Sample Date			09/27/02	09/27/02	09/27/02	09/27/02	09/27/02	09/27/02	09/27/02	09/27/02	09/27/02	09/27/02	09/27/02	09/27/02
Chemical Name														
Semivolatile Organic Compounds (UG/KG)														
Acenaphthene	4,700,000	16	590 U	610 U	410 U	700 U	750 U	770 U	510 U	620 U	520 U	500 U	**27 J**	800 U
Acenaphthylene	--	44	22 J	24 J	410 U	27 J	24 J	42 J	35 J	**50 J**	41 J	26 J	**310 J**	**180 J**
Anthracene	23,000,000	85.3	55 J	42 J	11 J	47 J	47 J	70 J	**86 J**	**100 J**	**140 J**	68 J	**350 J**	**320 J**
Benzo(a)anthracene	870	261	92 J	73 J	26 J	100 J	84 J	120 J	140 J	190 J	**300 J**	150 J	**1,800**	**1,000**
Benzo(a)pyrene	87	430	120 J	120 J	25 J	150 J	130 J	230 J	220 J	310 J	310 J	160 J	**1,800**	**1,300**
Benzo(b)fluoranthene	870	3,200	190 J	190 J	42 J	270 J	190 J	350 J	360 J	470 J	440 J	260 J	**4,100 J**	2,800 J
Benzo(g,h,i)perylene	2,300,000	670	590 U	610 U	410 U	88 J	750 U	120 J	110 J	130 J	120 J	69 J	**900**	660 J
Benzo(k)fluoranthene	8,700	1,800	160 J	180 J	37 J	180 J	180 J	340 J	280 J	350 J	330 J	190 J	**3,900 J**	**2,700 J**
Chrysene	87,000	384	220 J	160 J	48 J	180 J	160 J	230 J	280 J	**400 J**	**640**	300 J	**3,400**	**3,000**
Dibenz(a,h)anthracene	87	63.4	34 J	24 J	410 U	41 J	750 U	770 U	54 J	54 J	59 J	48 J	**480 J**	**290 J**
Fluoranthene	3,100,000	600	130 J	100 J	59 J	140 J	100 J	190 J	170 J	240 J	420 J	450 J	**970**	**770 J**
Fluorene	3,100,000	19	590 U	610 U	410 U	700 U	750 U	770 U	510 U	620 U	**22 J**	500 U	**54 J**	**40 J**
Indeno(1,2,3-cd)pyrene	870	600	85 J	82 J	18 J	120 J	94 J	160 J	140 J	180 J	170 J	97 J	**1,100**	**750 J**
Naphthalene	1,600,000	160	590 U	610 U	410 U	700 U	750 U	770 U	510 U	620 U	520 U	500 U	21 J	800 U
Phenanthrene	2,300,000	240	54 J	26 J	410 U	36 J	32 J	52 J	42 J	65 J	100 J	50 J	**320 J**	**250 J**
Pyrene	2,300,000	665	190 J	190 J	49 J	250 J	170 J	390 J	250 J	360 J	440 J	400 J	**4,400**	**2,800**
Total Metals (MG/KG)														
Aluminum	78,000	18,000	8,450	9,140	1,230	11,400	12,300	12,000	4,510	7,560	4,930	6,510	10,600	12,300
Antimony	31	150	0.78 J	0.44 U	0.27 U	0.99 J	0.5 U	0.51 U	0.53 J	0.6 J	0.59 J	0.74 J	0.85 B	1.2 B
Arsenic	0.43	8.2	7.4	7.3	1.1 J	**9.2**	**9.5**	**9.1**	4.4	7.4	4.8	5.9	**10.6**	**11.3**
Barium	5,500	48	21.2 J	23.5 J	4.2 J	30.4 J	32.1 J	30.3 J	16.5 J	21.1 J	13.6 J	17.5 J	32.2 J	36.7 J
Beryllium	160	1,500	0.45 J	0.45 J	0.07 J	0.63 J	0.62 J	0.57 J	0.3 J	0.4 J	0.28 J	0.34 J	0.79 J	0.72 J
Cadmium	78	1.2	0.1 U	0.11 U	0.06 U	0.12 J	0.12 U	0.16 J	0.11 J	0.1 U	0.08 U	0.09 J	0.88 J	0.59 J
Calcium	--	--	4,040 J	3,900 J	2,050 J	11,600 J	4,330 J	3,870 J	22,100 J	7,300 J	2,380 J	2,250 J	3,710	5,660
Chromium	230	81	21.5	22.6	3.9	28.1	30.3	29.5	12.4	22.8	15	18.2	36	39
Cobalt	1,600	10	3.9 J	4.2 J	0.62 J	5.1 J	5.2 J	5 J	2.3 J	3.4 J	2.2 J	2.8 J	5.6 J	6.3 J
Copper	3,100	34	**48.9**	**53.5**	9.2	**68.7**	**72.5**	**70.3**	**42.7**	**55.9**	**37.6**	**47.7**	**110**	**134**
Cyanide	1,600	--	0.13 U	0.14 U	0.08 U	0.16 U	0.17 U	0.17 U	0.12 U	0.13 U	0.11 U	0.11 U	0.17 U	0.2 J
Iron	23,000	220,000	17,400	18,500	2,360	22,100	24,700	23,200	9,180	15,500	10,400	13,300	22,000	25,200
Lead	400	47	27.9	28.4	5.7	37.8	38.1	38.5	30.1	38.1	36.2	32.9	**69.1**	**70.1**
Magnesium	--	--	4,010	4,350	757 J	5,350	5,660	5,480	2,620	3,650	2,300	2,880	5,700	6,520
Manganese	1,600	260	132	151	26.1	184	208	196	91.1	123	76.3	93.8	183	204
Mercury	23	0.15	0.13 J	0.15	0.04 U	**0.16**	**0.25**	**0.23**	0.12 J	**0.19**	0.12	0.14	**0.46**	**0.46**
Nickel	1,600	20.90	10.8 J	10.8 J	1.6 J	14.2 J	14.3 J	13.8 J	5.5 J	8.9 J	6.3 J	8 J	15.4 J	17.6 J
Potassium	--	--	1,740 J	1,870 J	328 J	2,360 J	2,610 J	2,510 J	1,140 J	1,650 J	1,010 J	1,350 J	2,680	3,100
Selenium	390	1	**1.7 J**	1.1 U	0.68 U	**1.4 J**	1.3 U	**1.5 J**	0.92 U	1.1 U	0.87 U	**1.3 J**	1.4 U	1.3 U
Silver	390	1	0.28 U	0.29 U	0.18 U	0.32 U	0.33 U	0.34 U	0.24 U	0.28 U	0.23 U	0.23 U	0.39 J	0.36 U
Sodium	--	--	6,840	7,470	2,490	8,620	10,000	10,800	5,270	7,430	4,290	5,400	11,500	12,600
Tin	47,000	3.40	1.4 U	2.1 J	1 J	1.6 J	3 J	2.5 J	1.6 J	1.7 J	1.8 J	2.3 J	**6.2 J**	**6.7 J**
Vanadium	78	57	24.6	25.5	4.2 J	32.7	32.7	32.6	13.3 J	21.6	13.9 J	18.3	32.7	36.7
Zinc	23,000	150	149	**174**	34.8	**223**	**223**	**222**	146	**212**	142	**162**	**397**	**445**
Wet Chemistry (MG/KG)														
Ammonia	--	100,000	3.9	4.56	2.48 U	9.18	12.7	10.1	4.54	10.5	3.17 U	3.02 U	20.2	23.8
Total organic carbon (TOC)	--	--	16,830	24,160	3,125	18,670	29,330	30,490	12,900	22,230	24,170	8,024	21,790	21,790
pH	--	--	7.94	7.85	8.18	7.86	7.78	7.69	8.05	8.06	8.14	7.96	7.93	7.95
Acid Volatile Sulfide/Simultaneously Extractable Metals (UMOLE/G)														
Cadmium	--	--	0.0014 J	NA	3.60E-04 J	NA	0.0023 J	NA	0.0015 J	NA	0.0012 J	NA	0.003 J	NA
Copper	--	--	0.35 J	NA	0.093 J	NA	0.51 J	NA	0.34 J	NA	0.26 J	NA	0.53 J	NA
Lead	--	--	0.073 J	NA	0.033 J	NA	0.092 J	NA	0.084 J	NA	0.06 J	NA	0.13 J	NA
Mercury	--	--	3.40E-05 B	NA	1.50E-05 B	NA	8.50E-05 J	NA	6.00E-05 J	NA	1.20E-04 J	NA	2.10E-05 B	NA
Nickel	--	--	0.036 J	NA	0.01 B	NA	0.056 J	NA	0.029 J	NA	0.027 J	NA	0.068 J	NA
Zinc	--	--	1.4 J	NA	0.59 J	NA	2 J	NA	1.9 J	NA	1.2 J	NA	3 J	NA
Cation Exchange Capacity (MEQ/100G)														
Cation Exchange Capacity	--	--	10.2	NA	5.9	NA	9.6	NA	15	NA	11.5	NA	10.6	NA

Notes:
Exceeds RBC Soil Residential Screening Criteria.
Exceeds Ecological Screening Value
ND - Not detected in background
-- No criteria established
J - Analyte present. Reported result may not be accurate or precise.
U - Not detected
B - Possible blank contamination.
D - Dilution run

Table 5-7
Surface Sediment Exceedances of Screening Criteria
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Node Location	RBC-Soil Residential	Ecological Screening Value	H3		H5		J4		K1		K3		K4	
Station ID			LW07-H3-SD201	LW07-H3-SD202	LW07-H5-SD201	LW07-H5-SD202	LW07-J4-SD201	LW07-J4-SD202	LW07-K1-SD201	LW07-K1-SD202	LW07-K3-SD201	LW07-K3-SD202	LW07-K4-SD201	LW07-K4-SD202
Sample ID			LW07-H3-SD201-00-02C	LW07-H3-SD202-00-02C	LW07-H5-SD201-00-02C	LW07-H5-SD202-00-02C	LW07-J4-SD201-00-02C	LW07-J4-SD202-00-02C	LW07-K1-SD201-00-02C	LW07-K1-SD202-00-02C	LW07-K3-SD201-00-02C	LW07-K3-SD202-00-02C	LW07-K4-SD201-00-02C	LW07-K4-SD202-00-02C
Sample Date			09/27/02	09/27/02	09/26/02	09/26/02	09/28/02	09/28/02	09/27/02	09/27/02	09/28/02	09/28/02	09/28/02	09/28/02
Chemical Name														
Semivolatile Organic Compounds (UG/KG)														
Acenaphthene	4,700,000	16	790 U	790 U	420 U	660 U	720 U	700 U	970 U	**2,000**	540 U	650 U	**26 J**	600 U
Acenaphthylene	--	44	**89 J**	**55 J**	16 J	660 U	43 J	**56 J**	**120 J**	**160 J**	**77 J**	**96 J**	**210 J**	**140 J**
Anthracene	23,000,000	85.3	**150 J**	**100 J**	**320 J**	**87 J**	**120 J**	73 J	**430 J**	**1,000**	**94 J**	**280 J**	**440 J**	**320 J**
Benzo(a)anthracene	870	261	**330 J**	210 J	120 J	170 J	180 J	210 J	**1,000**	**2,000**	**300 J**	**360 J**	**2,700**	**550 J**
Benzo(a)pyrene	87	430	**520 J**	320 J	100 J	140 J	270 J	280 J	**1,000**	**1,300**	**470 J**	**630 J**	**1,800**	**830**
Benzo(b)fluoranthene	870	3,200	860	500 J	160 J	170 J	730 J	750 J	1,600	1,900	1,100 J	1,600 J	**3,600 J**	2,000 J
Benzo(g,h,i)perylene	2,300,000	670	220 J	160 J	420 U	660 U	170 J	180 J	400 J	440 J	300 J	350 J	**950**	530 J
Benzo(k)fluoranthene	8,700	1,800	600 J	380 J	140 J	170 J	710 J	730 J	1,200	1,700	1,100 J	1,500 J	**3,100 J**	1,700 J
Chrysene	87,000	384	**700 J**	**400 J**	260 J	340 J	320 J	**470 J**	**2,200**	**2,800**	**580**	**980**	**4,400 J**	**1,300 J**
Dibenz(a,h)anthracene	87	63.4	**95 J**	62 J	23 J	24 J	**70 J**	**70 J**	**170 J**	**210 J**	**110 J**	**150 J**	**340 J**	**210 J**
Fluoranthene	3,100,000	600	330 J	230 J	190 J	270 J	200 J	450 J	**990**	**8,900 D**	210 J	410 J	**4,200**	**610**
Fluorene	3,100,000	19	790 U	790 U	**59 J**	660 U	720 U	700 U	970 U	**690 J**	16 J	650 U	**39 J**	**27 J**
Indeno(1,2,3-cd)pyrene	870	600	320 J	210 J	66 J	72 J	170 J	210 J	510 J	**660 J**	310 J	390 J	**1,100 J**	**620 J**
Naphthalene	1,600,000	160	790 U	790 U	13 J	660 U	720 U	700 U	970 U	940 U	540 U	650 U	23 J	600 U
Phenanthrene	2,300,000	240	110 J	85 J	130 J	80 J	87 J	56 J	**360 J**	**3,600**	67 J	130 J	**270 J**	230 J
Pyrene	2,300,000	665	**710 J**	390 J	340 J	350 J	**1,200**	**730**	**3,900**	**6,800**	600	**940**	**7,100 D**	**1,300**
Total Metals (MG/KG)														
Aluminum	78,000	18,000	12,000	11,300	1,910	12,200	12,700	11,200	14,800	13,100	5,980	8,190	7,860	6,990
Antimony	31	150	0.61 J	0.53 U	0.33 J	0.46 U	1.1 B	0.79 B	0.98 J	0.97 J	0.74 B	0.52 B	0.57 B	19 J
Arsenic	0.43	8.2	**10.4**	**9**	1.5 J	7.6	**10.6**	**8.7**	**11.4**	**9.6**	6.2	7.3	8.2	7.4
Barium	5,500	48	30.6 J	29.3 J	9.2 J	27.2 J	33.1 J	30.4 J	38.6 J	33.8 J	20.1 J	24.9 J	23.7 J	28.1 J
Beryllium	160	1,500	0.64 J	0.57 J	0.14 J	0.6 J	0.68 J	0.66 J	0.73 J	0.64 J	0.49 J	0.52 J	0.49 J	0.5 J
Cadmium	78	1.2	0.45 J	0.33 J	0.07 U	0.11 U	0.6 J	0.22 J	0.31 J	0.28 J	0.35 J	0.33 J	0.34 J	0.33 J
Calcium	--	--	4,180 J	4,080 J	2,820 J	6,520 J	3,560	2,720	4,040 J	4,390 J	2,270	4,510	3,640	2,910
Chromium	230	81	32.7	30.2	15.9	28.4	34.9	31.3	39.2	37.4	30.4	25.2	28.8	33.1
Cobalt	1,600	10	5 J	4.6 J	0.99 J	5.3 J	6.1 J	5.8 J	6 J	5.2 J	4 J	4.2 J	4.4 J	3.9 J
Copper	3,100	34	**90**	**83.5**	**35.2**	21.6	**65.7**	**55**	**118**	**102**	**65**	**63.2**	**70.1**	**58.6**
Cyanide	1,600	--	0.17 B	0.17 U	0.09 U	0.15 U	0.16 U	0.16 U	0.22 U	0.2 U	0.12 U	0.15 U	0.22 J	0.16 J
Iron	23,000	220,000	25,200	23,200	6,080	21,600	23,200	20,900	29,300	25,100	13,400	17,100	17,100	15,400
Lead	400	47	**56.9**	**50.8**	**56.4**	**63.1**	**50.7**	**46.9**	**65.2**	**67.6**	**255**	40.1	**152**	**49.5**
Magnesium	--	--	5,610	5,340	1,030 J	5,230	5,710	5,380	7,090	6,260	3,130	4,160	4,000	3,550
Manganese	1,600	260	185	172	42.8	167	188	180	209	175	112	143	137	125
Mercury	23	0.15	**0.27**	**0.76**	0.05 J	0.14	**0.66**	**0.24**	**0.3**	**0.31**	0.15	**0.25**	**0.19 J**	**0.19**
Nickel	1,600	20.90	14.2 J	13.6 J	2.7 J	14 J	16.4 J	16.4 J	16.9 J	15.2 J	15.5	12.9 J	13.8 J	11.1 J
Potassium	--	--	2,670 J	2,550 J	386 J	2,330 J	2,890	2,550	3,390 J	2,960 J	1,410 J	1,940	1,840 J	1,580 J
Selenium	390	1	**2 J**	**2.5 J**	0.73 U	**1.5 J**	1.3 U	1.3 U	**2.5 J**	**1.6 J**	0.91 U	1.1 U	1.2 U	1.1 U
Silver	390	1	0.38 U	0.36 U	0.2 U	0.3 U	0.35 U	0.33 U	0.45 U	0.43 U	0.24 U	0.29 U	0.31 U	0.29 U
Sodium	--	--	11,500	11,000	1,930	7,630	10,500	9,580	15,400	14,900	5,500	7,940	7,640	6,320
Tin	47,000	3.40	2.5 J	2.1 J	1.6 J	1.5 U	**4.8 J**	**6.6 J**	2.8 J	2.6 J	**5.8 J**	**5.2 J**	**9.4 J**	**5 J**
Vanadium	78	57	31.5	29.9	5.6 J	29.6	37.4	31.2	38.3	33.9	18.4	24.2	24.2	21.4
Zinc	23,000	150	**328**	**310**	**157**	97	**308**	**299**	**415**	**383**	**402**	**283**	**303**	**299**
Wet Chemistry (MG/KG)														
Ammonia	--	100,000	8.98	7.41	2.54 U	3.99 U	21	17.5	41.2	40.7	8.17	11.9	11.5	11.8
Total organic carbon (TOC)	--	--	22,280	23,260	3,463	15,590	14,950	15,900	28,880	23,400	10,780	10,800	13,870	13,940
pH	--	--	8.08	8.13	8.35	8.03	8	7.86	8.36	8.35	7.89	7.8	7.8	7.79
Acid Volatile Sulfide/Simultaneously Extractable Metals (UMOLE/G)														
Cadmium	--	--	0.0031 J	NA	5.50E-04 J	NA	0.0023 J	NA	0.0041 J	NA	0.002 J	NA	0.0023 J	NA
Copper	--	--	0.68 J	NA	0.24 J	NA	0.34 J	NA	0.93 J	NA	0.51 J	NA	0.39 J	NA
Lead	--	--	0.14 J	NA	0.25 J	NA	0.09 J	NA	0.19 J	NA	0.14 J	NA	0.24 J	NA
Mercury	--	--	1.00E-04 J	NA	1.00E-04 J	NA	6.00E-05 J	NA	1.30E-04 J	NA	3.80E-05 B	NA	6.00E-05 J	NA
Nickel	--	--	0.061 J	NA	0.027 J	NA	0.051 J	NA	0.075 J	NA	0.072 J	NA	0.048 J	NA
Zinc	--	--	3 J	NA	4.1 J	NA	2 J	NA	4.1 J	NA	2.8 J	NA	2.7 J	NA
Cation Exchange Capacity (MEQ/100G)														
Cation Exchange Capacity	--	--	15	NA	5.4	NA	14	NA	9.7	NA	18.6	NA	17.6	NA

Notes:

Exceeds RBC Soil Residential Screening Criteria.

Exceeds Ecological Screening Value

ND - Not detected in background

-- No criteria established

J - Analyte present. Reported result may not be accurate or precise.

U - Not detected

B - Possible blank contamination.

D - Dilution run

Table 5-7
Surface Sediment Exceedances of Screening Criteria
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Node Location	RBC-Soil Residential	Ecological Screening Value	K5		K6		L5		M1		M3		L2	L6
Station ID			LW07-K5-SD201	LW07-K5-SD202	LW07-K6-SD201	LW07-K6-SD202	LW07-L5-SD201	LW07-L5-SD202	LW07-M1-SD201	LW07-M1-SD202	LW07-M3-SD201	LW07-M3-SD202	LW07-L2-SD201	LW07-L6-SD201
Sample ID			LW07-K5-SD201-00-02C	LW07-K5-SD202-00-02C	LW07-K6-SD201-00-02C	LW07-K6-SD202-00-02C	LW07-L5-SD201-00-02C	LW07-L5-SD202-00-02C	LW07-M1-SD201-00-02C	LW07-M1-SD202-00-02C	LW07-M3-SD201-00-02C	LW07-M3-SD202-00-02C	LW07-L2-SD201-00-02C	LW07-L6-SD201-00-02C
Sample Date			09/28/02	09/28/02	09/28/02	09/28/02	09/28/02	09/28/02	09/27/02	09/27/02	09/28/02	09/28/02	10/01/02	10/01/02
Chemical Name														
Semivolatile Organic Compounds (UG/KG)														
Acenaphthene	4,700,000	16	**1,400**	**23 J**	**20 J**	13 J	**29 J**	**78 J**	**38 J**	**19 J**	**170 J**	**82 J**	**24 J**	890 U
Acenaphthylene	--	44	**340 J**	**130 J**	23 J	21 J	**260 J**	**520 J**	**170 J**	**91 J**	**790 J**	**430 J**	**190 J**	**190 J**
Anthracene	23,000,000	85.3	**1,000**	**1,500**	**92 J**	85 J	**630 J**	**2,200**	**410 J**	**160 J**	**2,000**	**840**	**360 J**	**500 J**
Benzo(a)anthracene	870	261	**1,400**	**680 J**	190 J	260 J	**1,200**	**7,500 D**	**660 J**	**270 J**	**4,900**	**3,100**	**1,500**	**960**
Benzo(a)pyrene	87	430	**1,600**	**830**	190 J	200 J	**1,700**	**5,100**	**850**	420 J	**6,100**	**3,000**	**1,300**	**1,300**
Benzo(b)fluoranthene	870	3,200	2,800 J	2,000 J	440 J	300 J	**3,800 J**	**12,000 J**	1,300	660	**7,800 D**	**7,600 J**	3,000	2,700 J
Benzo(g,h,i)perylene	2,300,000	670	**1,100**	530 J	110 J	91 J	**870**	**2,100**	330 J	180 J	**2,500**	**1,400**	**710 J**	**790 J**
Benzo(k)fluoranthene	8,700	1,800	**2,300 J**	1,700 J	420 J	280 J	**3,700 J**	**11,000 J**	1,000	540 J	**6,700 D**	**6,400 J**	**2,600**	**2,400 J**
Chrysene	87,000	384	**3,000 J**	**1,600 J**	370 J	**440**	**3,300**	**21,000 J**	**1,000**	**470 J**	**14,000 J**	**5,900**	**3,200 J**	**2,100 J**
Dibenz(a,h)anthracene	87	63.4	**330 J**	**160 J**	34 J	32 J	**370 J**	**1,200 J**	**140 J**	**79 J**	**1,200 J**	**630 J**	**280 J**	**220 J**
Fluoranthene	3,100,000	600	**1,700**	500 J	280 J	330 J	**1,200**	**4,300**	**830**	**700**	**4,700**	**3,400**	**950**	**1,600**
Fluorene	3,100,000	19	**620 J**	**260 J**	**21 J**	**20 J**	**85 J**	**220 J**	750 U	650 U	**280 J**	**150 J**	**44 J**	**42 J**
Indeno(1,2,3-cd)pyrene	870	600	**990 J**	570 J	110 J	110 J	**990**	**2,600**	450 J	250 J	**3,000**	**1,600**	**820 J**	**840 J**
Naphthalene	1,600,000	160	**1,500**	32 J	410 U	32 J	790 U	29 J	750 U	650 U	34 J	26 J	790 U	890 U
Phenanthrene	2,300,000	240	**3,200**	**800**	140 J	76 J	**460 J**	**1,100**	220 J	87 J	**960**	**650 J**	**320 J**	**390 J**
Pyrene	2,300,000	665	**5,100**	**1,300**	470	380 J	**2,300**	**12,000 D**	**1,400**	**1,200**	**13,000 D**	**11,000 D**	**3,600**	**2,500**
Total Metals (MG/KG)														
Aluminum	78,000	18,000	12,600	11,300	1,870	1,920	11,300	11,200	10,600	9,040	9,520	11,000	13,700	11,400
Antimony	31	150	0.94 B	0.76 B	0.39 B	0.29 U	0.79 B	1.1 B	1.7 J	0.9 J	1 B	1.5 B	1.3 B	0.62 U
Arsenic	0.43	8.2	**10.7**	**10.2**	2 J	2.1 J	**11.3**	**12.1**	**8.7**	7.6	**10.6**	**12.4**	**12.6**	**9.8**
Barium	5,500	48	35.4 J	32.7 J	15.9 J	10.9 J	32.6 J	45.4 J	33.4 J	27.9 J	37.6 J	39.4 J	40.5 J	34 J
Beryllium	160	1,500	0.67 J	0.63 J	0.13 J	0.17 J	0.62 J	0.66 J	0.6 J	0.55 J	0.76 J	0.67 J	0.77 J	0.66 J
Cadmium	78	1.2	0.38 J	0.38 J	0.07 U	0.07 U	0.46 J	0.56 J	0.42 J	0.34 J	0.47 J	0.58 J	0.65 J	0.47 J
Calcium	--	--	2,900	3,180	1,140 J	7,540	2,560	7,060	4,020 J	5,870 J	9,510	6,390	5,280	2,800
Chromium	230	81	36	34.2	7.6	8.2	37.2	40.8	63.1	36.5	35.2	41.9	43.7	33.7
Cobalt	1,600	10	6.1 J	5.8 J	1.8 J	1.6 J	5.7 J	5.8 J	5 J	4.4 J	6.4 J	6.3 J	6.8 J	5.5 J
Copper	3,100	34	**90**	**103**	24.5	19.4	**90.1**	**104**	**109**	**88**	**121**	**124**	**117**	**87**
Cyanide	1,600	--	0.27 J	0.17 U	0.09 U	0.09 U	0.17 J	0.16 U	0.17 U	0.14 U	0.18 U	0.18 U	0.17 U	0.2 U
Iron	23,000	220,000	25,100	23,200	7,710	5,220	23,500	23,800	23,600	22,500	23,200	24,700	27,600	22,400
Lead	400	47	**51.1**	**59.3**	14	12.7	**69.8**	**143**	**177**	**143**	**107**	**110**	**83.9**	**60**
Magnesium	--	--	6,390	5,880	1,040 J	1,130 J	5,940	5,850	4,900	4,290	5,480	5,950	6,640	6,350
Manganese	1,600	260	204	190	38.5	33.7	185	178	151	130	177	180	220	167
Mercury	23	0.15	**0.29**	**0.33**	0.07 J	0.08 J	0.41	4.1	**0.33**	**0.56**	**0.45**	**0.36**	**0.43**	**0.29**
Nickel	1,600	20.90	16.6 J	**23.4**	4.1 J	4 J	15.1 J	16.2 J	15.9 J	14.2 J	**25.4**	18.3 J	19.1	14.9 J
Potassium	--	--	2,950	2,750	425 J	465 J	2,780	2,660	2,260 J	1,990 J	2,300	2,660	3,130	3,000
Selenium	390	1	1.5 U	1.3 U	0.73 U	0.71 U	1.3 U	1.3 U	1.3 U	**1.4 J**	1.3 U	1.4 U	1.3 U	1.6 U
Silver	390	1	0.4 U	0.36 U	0.2 U	0.19 U	0.35 U	0.38 J	0.35 U	0.32 J	0.36 U	0.39 U	0.35 U	0.42 U
Sodium	--	--	12,300	11,700	2,390	2,550	11,900	9,900	10,500	8,400	11,200	11,300	11,700	15,200
Tin	47,000	3.40	**6.6 J**	**8.8 J**	3.2 J	3.3 J	**5.6 J**	**6 J**	**6.6 J**	**5.1 J**	**14.5 J**	**9.1 J**	**7.1 J**	**5.4 J**
Vanadium	78	57	36.4	33.4	6.8 J	7.6 J	33.9	34.7	30.3	26.6	31.7	37.1	40.2	34.2
Zinc	23,000	150	**336**	**305**	75.9	73.1	**362**	**419**	**628**	**449**	**1,360**	**767**	**491**	**354**
Wet Chemistry (MG/KG)														
Ammonia	--	100,000	35.7	23.1	3.5	2.6 U	20.4	21.1	11.5	3.92 U	24.4	21.9	15.8	28
Total organic carbon (TOC)	--	--	22,360	18,450	2,245	2,937	20,410	19,870	20,080	17,030	20,080	19,110	22,230	23,790
pH	--	--	7.92	7.82	8.2	8.04	7.89	8.01	8.32	7.86	7.81	7.92	7.8	7.65
Acid Volatile Sulfide/Simultaneously Extractable Metals (UMOLE/G)														
Cadmium	--	--	0.0028 J	NA	5.20E-04 J	NA	0.0032 J	NA	0.0042 J	NA	0.0036 J	NA	0.0039 J	0.0037 J
Copper	--	--	0.56 J	NA	0.15 J	NA	0.78 J	NA	0.8 J	NA	0.89 J	NA	0.67 J	0.61 J
Lead	--	--	0.16 J	NA	0.052 J	NA	0.15 J	NA	0.59 J	NA	0.33 J	NA	0.15 J	0.15 J
Mercury	--	--	4.10E-05 B	NA	4.70E-05 B	NA	6.50E-05 J	NA	2.00E-04 J	NA	1.00E-04 J	NA	6.00E-04 J	6.00E-04 J
Nickel	--	--	0.063 J	NA	0.019 J	NA	0.06 J	NA	0.11 J	NA	0.12 J	NA	0.083 J	0.07 J
Zinc	--	--	3 J	NA	0.77 J	NA	3.5 J	NA	7.3 J	NA	10.7 J	NA	3.2 J	2.9 J
Cation Exchange Capacity (MEQ/100G)														
Cation Exchange Capacity	--	--	13.4	NA	4.7	NA	8	NA	7.8	NA	14.2	NA	8.9	8.3

Notes:

Exceeds RBC Soil Residential Screening Criteria.

Exceeds Ecological Screening Value

ND - Not detected in background

-- No criteria established

J - Analyte present. Reported result may not be accurate or precise.

U - Not detected

B - Possible blank contamination.

D - Dilution run

Table 5-8
Subsurface Sediment Exceedances of Screening Criteria
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Station ID	**RBC-Soil Residential**	LW07-K1-SD201	LW07-K3-SD201	LW07-K4-SD201	LW07-K5-SD201	LW07-K6-SD201	LW07-L2-SD201	LW07-L5-SD201	LW07-L6-SD201	LW07-M1-SD201	LW07-M3-SD201
Sample ID		LW07-K1-SD201-02-02C	LW07-K3-SD201-02-02C	LW07-K4-SD201-02-02C	LW07-K5-SD201-02-02C	LW07-K6-SD201-02-02C	LW07-L2-SD201-02-02C	LW07-L5-SD201-02-02C	LW07-L6-SD201-02-02C	LW07-M1-SD201-02-02C	LW07-M3-SD201-02-02C
Sample Date		09/28/02	09/29/02	09/30/02	09/30/02	09/28/02	10/01/02	09/29/02	10/01/02	09/29/02	09/28/02
Chemical Name											
Semivolatile Organic Compounds (UG/KG)											
Acenaphthene	4,700,000	520 U	400 U	540 U	430 U	11,000 JD	500 U	730 U	610 U	930	47 J
Acenaphthylene	--	15 J	400 U	540 U	430 U	510 J	26 J	730 U	53 J	170 J	130 J
Anthracene	23,000,000	14 J	400 U	26 J	16 J	750 U	50 J	730 U	65 J	1,700	530 J
Benzo(a)anthracene	870	32 J	13 J	32 J	41 J	8,400 JD	51 J	730 U	150 J	1,100	820 J
Benzo(a)pyrene	87	41 J	11 J	44 J	33 J	3,000	140 J	730 U	310 J	660	770 J
Benzo(b)fluoranthene	870	48 J	400 U	52 J	37 J	4,500	220 J	730 U	400 J	1,100	1,400
Benzo(g,h,i)perylene	2,300,000	520 U	400 U	520 U	430 U	950	61 J	730 U	150 J	270 J	350 J
Benzo(k)fluoranthene	8,700	48 J	400 U	47 J	40 J	3,400	170 J	730 U	430 J	890	1,000 J
Chrysene	87,000	45 J	11 J	31 J	48 J	6,000	73 J	730 U	290 J	1,600	1,300
Dibenz(a,h)anthracene	87	520 U	400 U	520 U	31 J	320 J	500 U	730 U	42 J	52 J	84 J
Fluoranthene	3,100,000	62 J	17 J	30 J	26 J	56,000 D	49 J	21 J	120 J	7,600 D	3,200
Fluorene	3,100,000	520 U	400 U	520 U	430 U	16,000 D	500 U	730 U	610 U	440 J	80 J
Indeno(1,2,3-cd)pyrene	870	29 J	400 U	23 J	40 J	1,200	87 J	730 U	200 J	340 J	370 J
Naphthalene	1,600,000	520 U	400 U	520 U	430 U	97 J	500 U	31 J	610 U	24 J	1,000 U
Phenanthrene	2,300,000	32 J	400 U	520 U	430 U	62,000 D	20 J	730 U	45 J	4,500	330 J
Pyrene	2,300,000	140 J	33 J	89 J	48 J	44,000 D	550	31 J	790	5,400 D	7,600
Total Metals (MG/KG)											
Aluminum	78,000	6,460	11,900	12,700 J	9,720 J	13,600	10,200 J	10,600	9,960 J	12,100	20,700
Antimony	31	0.35 UJ	0.33 J	0.36 UJ	0.44 J	1.3 J	0.79 J	0.53 UJ	0.41 UJ	2 J	1.5 J
Arsenic	0.43	5.3	6.3	6.3	7.1	9.9	7.6	9.2	7.5	9.8	15.4
Barium	5,500	16.9 J	24.4 J	24.8 J	21.1 J	39.1 J	24.1 J	21.5 J	29.9 J	44.7 J	55.3 J
Beryllium	160	0.29 J	0.57 J	0.55 J	0.4 J	0.81 J	0.62 J	0.52 J	0.48 J	1.5 J	1.2 J
Cadmium	78	0.08 U	0.07 U	0.09 U	0.07 U	0.66 J	0.38 J	0.13 U	0.56 J	1.1 J	0.82 J
Calcium	--	707 J	1,460	1,540 J	763 J	16,200	1,520 J	1,570 J	2,160 J	2,130	4,550
Chromium	230	13.9	24.6	24.6	18.6	45.2	30.6	22.5	27.3	49.9	53.2
Cobalt	1,600	2.3 J	4.8 J	4.8 J	4.1 J	6.5 J	4.5 J	4.6 J	4.2 J	8.6 J	10.1 J
Copper	3,100	8.2	8.2 J	11.1	9.4	135	54.7	7.7 J	71.5	220	145
Cyanide	1,600	0.14 J	0.12 U	0.12 U	0.09 U	0.2 J	0.11 U	0.17 U	0.14 U	0.38 J	0.36 J
Iron	23,000	10,100	21,200	18,800	13,300	29,700	17,600	22,500	20,400	32,200	48,500
Lead	400	6.8	8.9	12.6	8.7	135	52.7	8.9	85.3	139	156
Magnesium	--	2,230	5	4,920	2,430	7,910	4,040	4,440	4,750	6,210	8,370
Manganese	1,600	62.3	147	150	68.5	213	141	137	141	212	275
Mercury	23	0.06 J	0.08 J	0.06 U	0.06 U	1.1	0.28	0.1 J	0.24	1.5	0.96
Nickel	1,600	5.8 J	12.4 J	12.1	7.6 J	22.6	14.3	11.7 J	11.7 J	41.5	43.9
Potassium	--	1,180 J	2,220 J	2,560 J	1,470 J	2,860 J	2,090 J	1,890 J	2,280 J	2,570 J	4,620 J
Selenium	390	1.3 J	0.76 J	1.6	0.79 U	1.5 J	0.92 J	1.3 U	1.4 J	1.3 J	1.7 U
Sodium	--	3,780	6,070	6,930	4,180	9,060	6,830	6,230	9,710	8,530	15,900
Tin	47,000	1.4 J	0.96 U	2 J	1 U	7 J	5.6 J	1.8 U	1.7 J	23.5	16.7 J
Vanadium	78	18.6	26.2	28.9	22.5	40.5	25.7	32.3	27.5	39.2	60.3
Zinc	23,000	21.6	38.3	45.1	29.3	633	382	33.9	398	1,390	828
Wet Chemistry (MG/KG)											
Ammonia	--	26.5	8.83	8.19	15.8	38.8	5.96	17.3	8.06	11.9	6.23 U
Total organic carbon (TOC)	--	9,591	9,016	6,321	12,710	21,690	12,820	17,070	14,280	27,940	34,450
pH	--	8.65	8.36	8.26	8.15	8.44	8.12	7.8	8.14	8.64	8.16

Notes:

Exceeds RBC for residential soil

-- No criteria established

U - Not detected

J - Analyte present. Reported result may not be accurate or precise.

B - Possible blank contamination.

ND - Not detected in background

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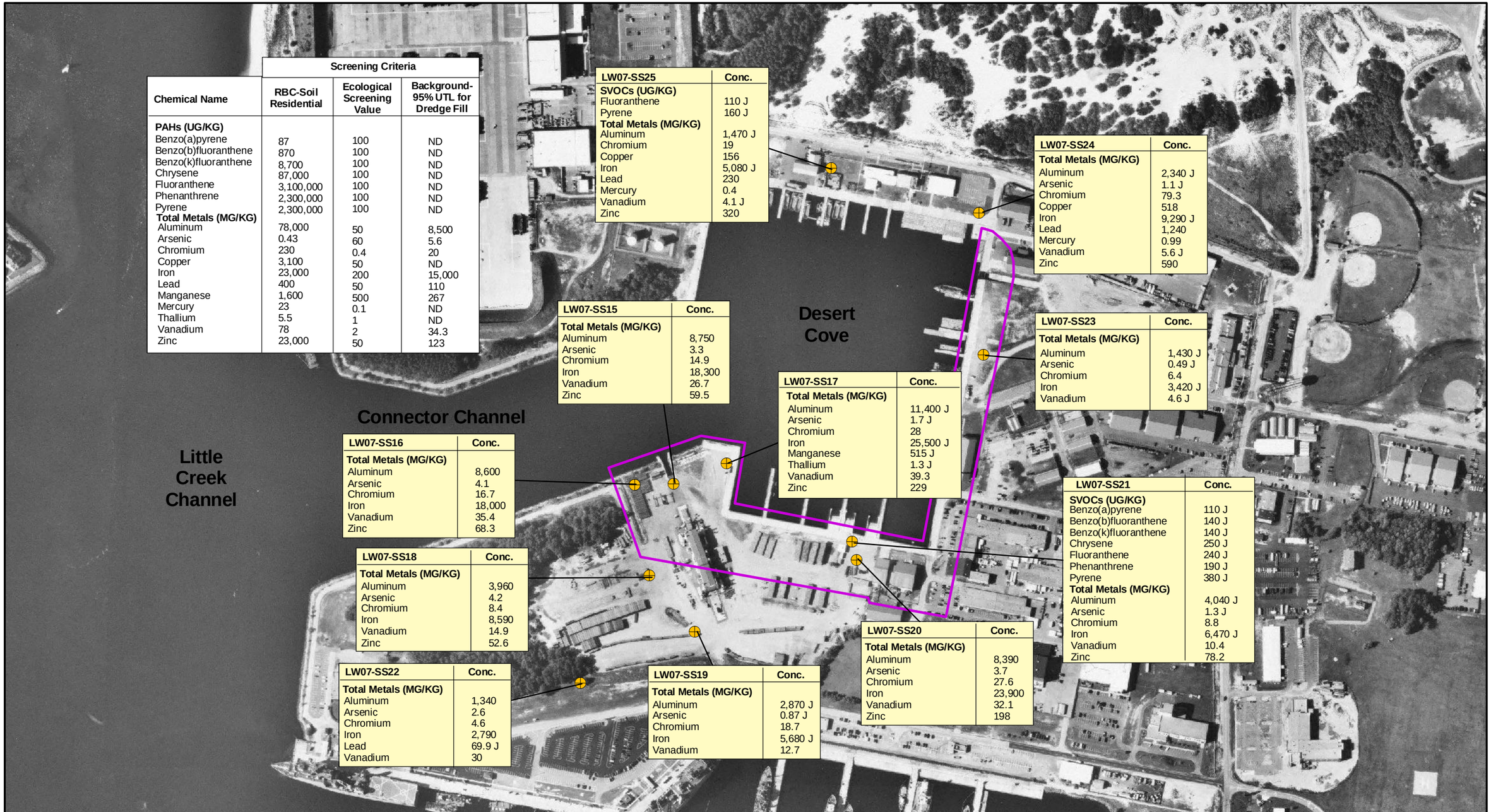

Chemical Name	Screening Criteria: RBC-Soil Residential	Ecological Screening Value	Background-95% UTL for Dredge Fill
PAHs (UG/KG)			
Benzo(a)pyrene	87	100	ND
Benzo(b)fluoranthene	870	100	ND
Benzo(k)fluoranthene	8,700	100	ND
Chrysene	87,000	100	ND
Fluoranthene	3,100,000	100	ND
Phenanthrene	2,300,000	100	ND
Pyrene	2,300,000	100	ND
Total Metals (MG/KG)			
Aluminum	78,000	50	8,500
Arsenic	0.43	60	5.6
Chromium	230	0.4	20
Copper	3,100	50	ND
Iron	23,000	200	15,000
Lead	400	50	110
Manganese	1,600	500	267
Mercury	23	0.1	ND
Thallium	5.5	1	ND
Vanadium	78	2	34.3
Zinc	23,000	50	123

LW07-SS25	Conc.
SVOCs (UG/KG)	
Fluoranthene	110 J
Pyrene	160 J
Total Metals (MG/KG)	
Aluminum	1,470 J
Chromium	19
Copper	156
Iron	5,080 J
Lead	230
Mercury	0.4
Vanadium	4.1 J
Zinc	320

LW07-SS24	Conc.
Total Metals (MG/KG)	
Aluminum	2,340 J
Arsenic	1.1 J
Chromium	79.3
Copper	518
Iron	9,290 J
Lead	1,240
Mercury	0.99
Vanadium	5.6 J
Zinc	590

LW07-SS23	Conc.
Total Metals (MG/KG)	
Aluminum	1,430 J
Arsenic	0.49 J
Chromium	6.4
Iron	3,420 J
Vanadium	4.6 J

LW07-SS15	Conc.
Total Metals (MG/KG)	
Aluminum	8,750
Arsenic	3.3
Chromium	14.9
Iron	18,300
Vanadium	26.7
Zinc	59.5

LW07-SS17	Conc.
Total Metals (MG/KG)	
Aluminum	11,400 J
Arsenic	1.7 J
Chromium	28
Iron	25,500 J
Manganese	515 J
Thallium	1.3 J
Vanadium	39.3
Zinc	229

LW07-SS16	Conc.
Total Metals (MG/KG)	
Aluminum	8,600
Arsenic	4.1
Chromium	16.7
Iron	18,000
Vanadium	35.4
Zinc	68.3

LW07-SS21	Conc.
SVOCs (UG/KG)	
Benzo(a)pyrene	110 J
Benzo(b)fluoranthene	140 J
Benzo(k)fluoranthene	140 J
Chrysene	250 J
Fluoranthene	240 J
Phenanthrene	190 J
Pyrene	380 J
Total Metals (MG/KG)	
Aluminum	4,040 J
Arsenic	1.3 J
Chromium	8.8
Iron	6,470 J
Vanadium	10.4
Zinc	78.2

LW07-SS18	Conc.
Total Metals (MG/KG)	
Aluminum	3,960
Arsenic	4.2
Chromium	8.4
Iron	8,590
Vanadium	14.9
Zinc	52.6

LW07-SS20	Conc.
Total Metals (MG/KG)	
Aluminum	8,390
Arsenic	3.7
Chromium	27.6
Iron	23,900
Vanadium	32.1
Zinc	198

LW07-SS22	Conc.
Total Metals (MG/KG)	
Aluminum	1,340
Arsenic	2.6
Chromium	4.6
Iron	2,790
Lead	69.9 J
Vanadium	30

LW07-SS19	Conc.
Total Metals (MG/KG)	
Aluminum	2,870 J
Arsenic	0.87 J
Chromium	18.7
Iron	5,680 J
Vanadium	12.7

LEGEND

- Surface Soil Sample Locations
- SWMU Boundary

Notes:
RBC - Risk-Based Concentration
J - Reported value is estimated
ND - Not Detected
UTL - Upper Tolerance Limit
Surface Soil samples were collected from 0-6" bgs.

N

0 400 800 Feet

Figure 5-1
Surface Soil Exceedances of Screening Criteria
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

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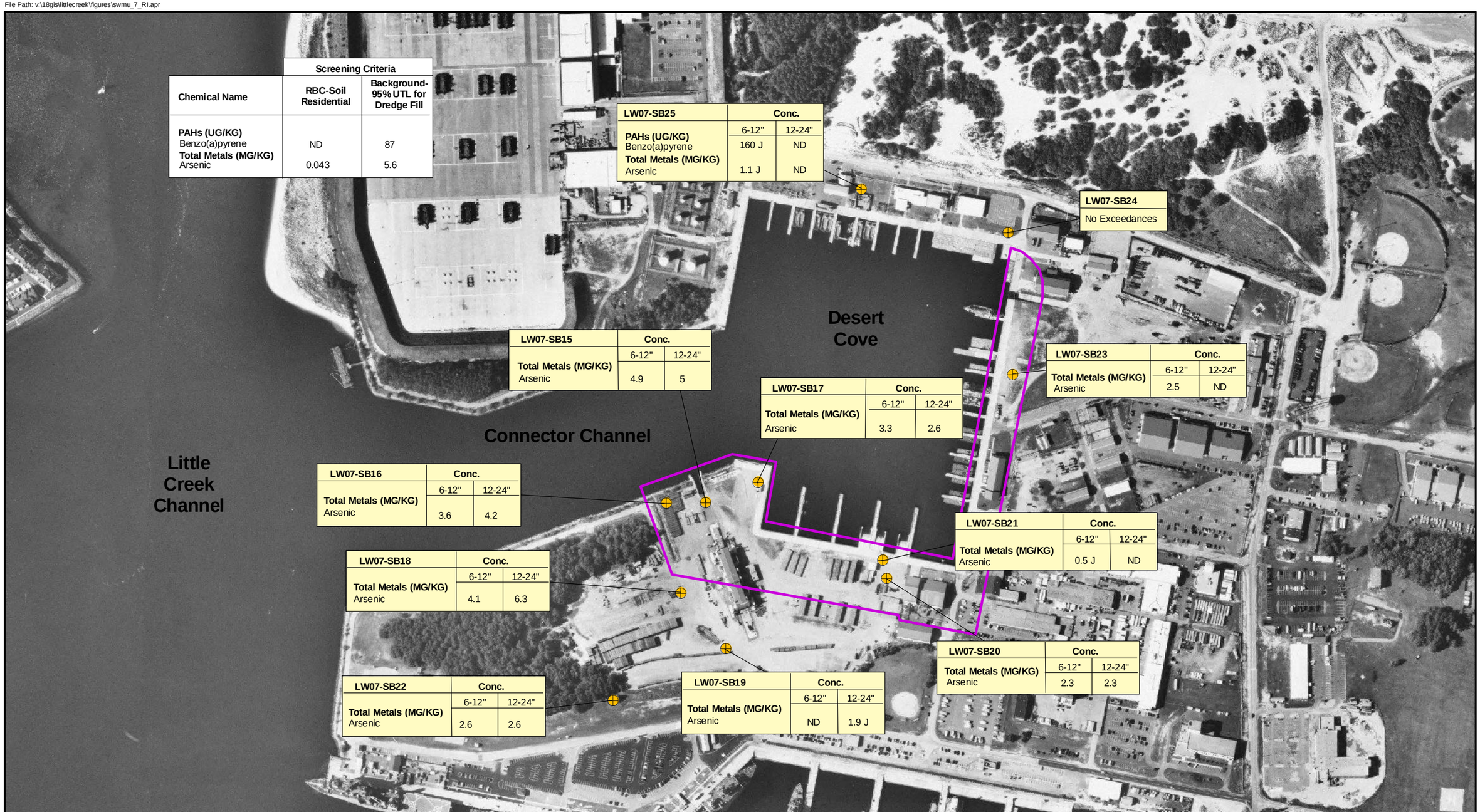

Chemical Name	Screening Criteria: RBC-Soil Residential	Screening Criteria: Background-95% UTL for Dredge Fill
PAHs (UG/KG)		
Benzo(a)pyrene	ND	87
Total Metals (MG/KG)		
Arsenic	0.043	5.6

LW07-SB25	Conc. 6-12"	Conc. 12-24"
PAHs (UG/KG)		
Benzo(a)pyrene	160 J	ND
Total Metals (MG/KG)		
Arsenic	1.1 J	ND

LW07-SB15	Conc. 6-12"	Conc. 12-24"
Total Metals (MG/KG)		
Arsenic	4.9	5

LW07-SB17	Conc. 6-12"	Conc. 12-24"
Total Metals (MG/KG)		
Arsenic	3.3	2.6

LW07-SB23	Conc. 6-12"	Conc. 12-24"
Total Metals (MG/KG)		
Arsenic	2.5	ND

LW07-SB16	Conc. 6-12"	Conc. 12-24"
Total Metals (MG/KG)		
Arsenic	3.6	4.2

LW07-SB21	Conc. 6-12"	Conc. 12-24"
Total Metals (MG/KG)		
Arsenic	0.5 J	ND

LW07-SB18	Conc. 6-12"	Conc. 12-24"
Total Metals (MG/KG)		
Arsenic	4.1	6.3

LW07-SB20	Conc. 6-12"	Conc. 12-24"
Total Metals (MG/KG)		
Arsenic	2.3	2.3

LW07-SB22	Conc. 6-12"	Conc. 12-24"
Total Metals (MG/KG)		
Arsenic	2.6	2.6

LW07-SB19	Conc. 6-12"	Conc. 12-24"
Total Metals (MG/KG)		
Arsenic	ND	1.9 J

LEGEND

- Subsurface Soil Sample Locations
- SWMU Boundary

Notes:
RBC - Risk-Based Concentration
J - Reported value is estimated
ND - Not Detected
UTL - Upper Tolerance Limit
Subsurface Soil sample depths are in inches bgs

N

0 400 800 Feet

Figure 5-2
Subsurface Soil Exceedances of Screening Criteria
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

CH2MHILL

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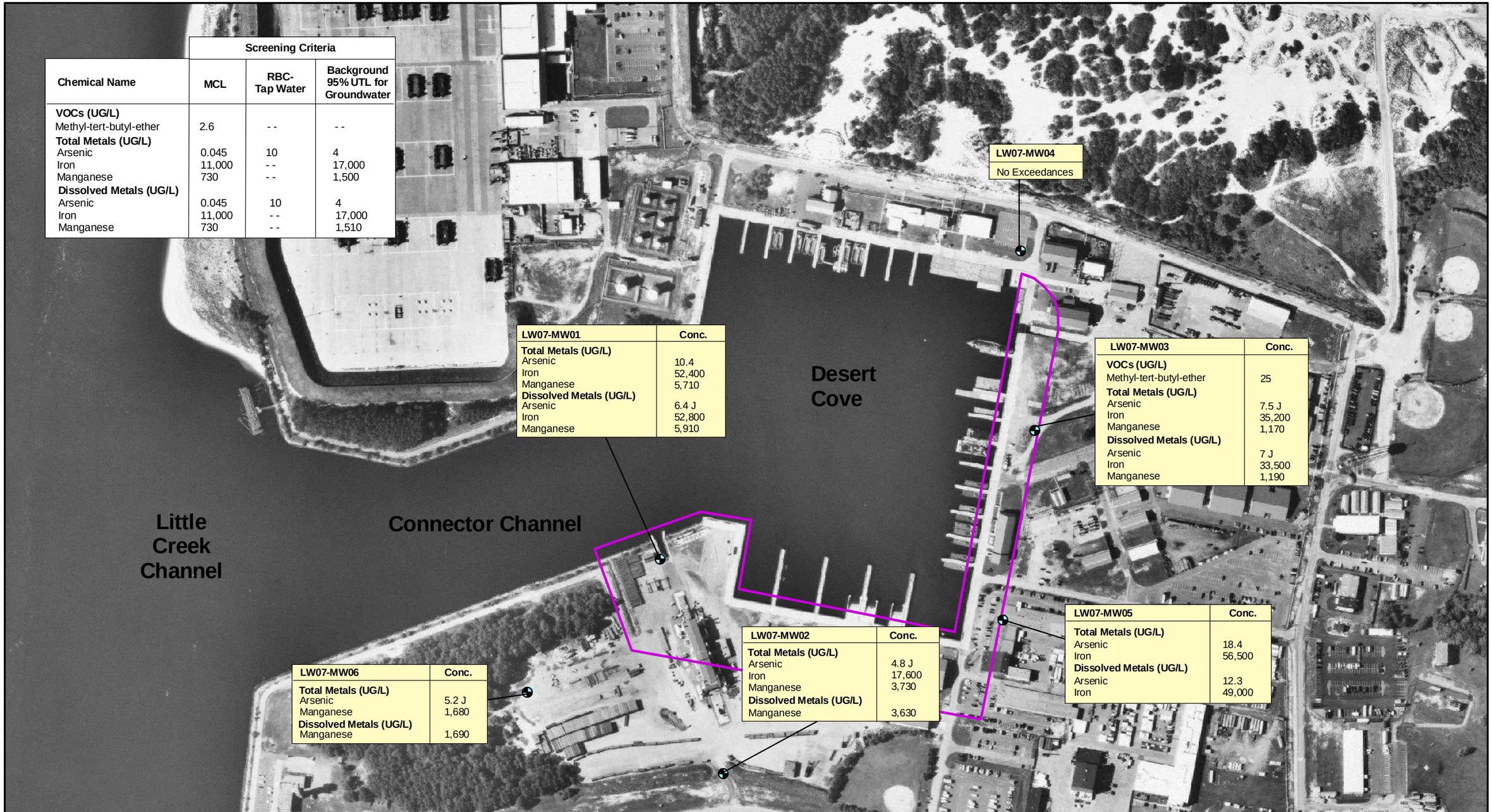

Chemical Name	Screening Criteria: MCL	RBC-Tap Water	Background 95% UTL for Groundwater
VOCs (UG/L)			
Methyl-tert-butyl-ether	2.6	- -	- -
Total Metals (UG/L)			
Arsenic	0.045	10	4
Iron	11,000	- -	17,000
Manganese	730	- -	1,500
Dissolved Metals (UG/L)			
Arsenic	0.045	10	4
Iron	11,000	- -	17,000
Manganese	730	- -	1,510

LEGEND

- Monitoring Well
- SWMU Boundary

Notes:
MCL - Maximum Contaminant Level
RBC - Risk-Based Concentration
J - Reported value is estimated
UTL - Upper Tolerance Limit
- - No criteria established

N

0 400 800 Feet

Figure 5-3
Monitoring Well Groundwater Exceedances of Screening Criteria
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

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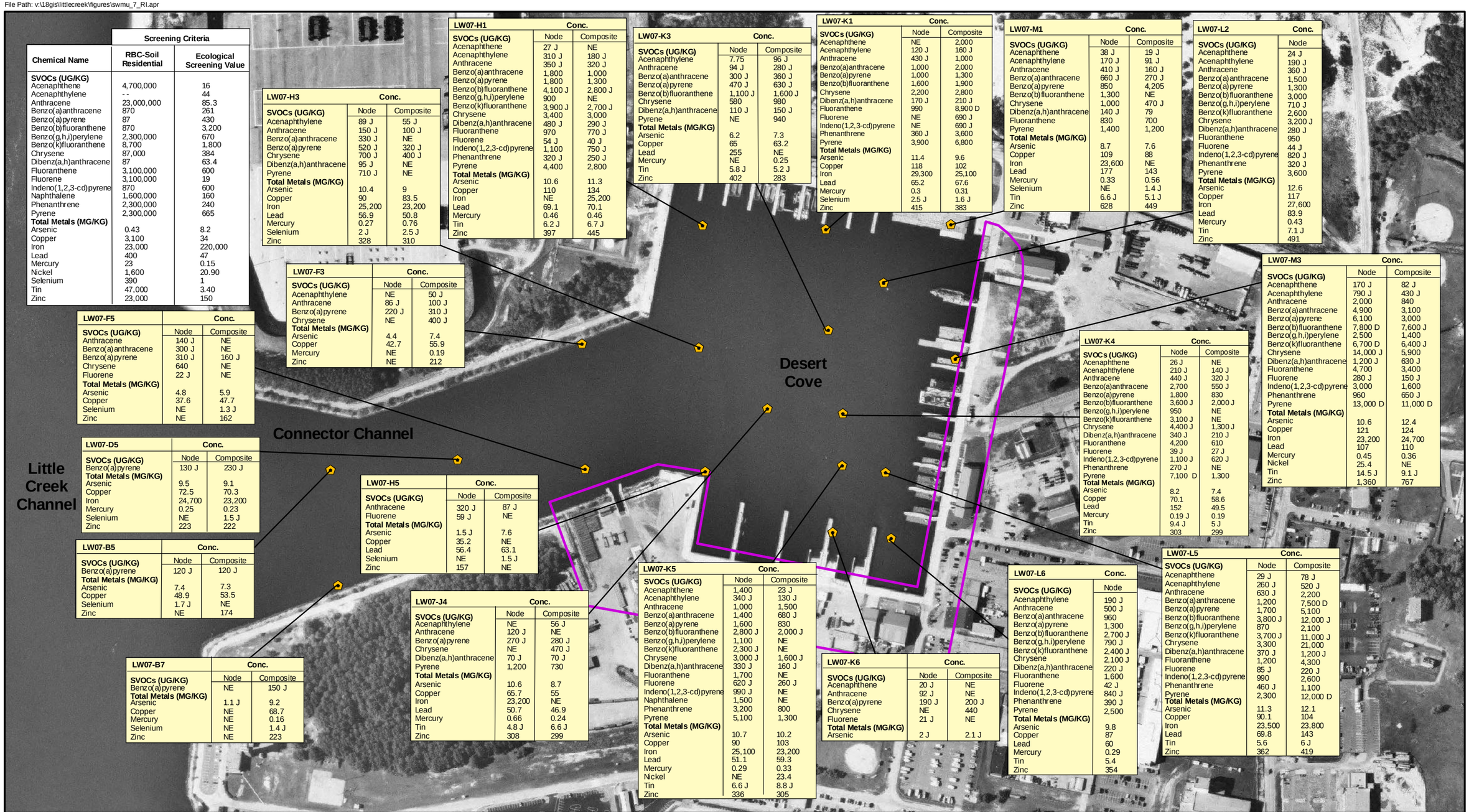

Chemical Name	Screening Criteria: RBC-Soil Residential	Screening Criteria: Ecological Screening Value
SVOCs (UG/KG)		
Acenaphthene	4,700,000	16
Acenaphthylene	--	44
Anthracene	23,000,000	85.3
Benzo(a)anthracene	870	261
Benzo(a)pyrene	87	430
Benzo(b)fluoranthene	870	3,200
Benzo(g,h,i)perylene	2,300,000	670
Benzo(k)fluoranthene	8,700	1,800
Chrysene	87,000	384
Dibenz(a,h)anthracene	87	63.4
Fluoranthene	3,100,000	600
Fluorene	3,100,000	19
Indeno(1,2,3-cd)pyrene	870	600
Naphthalene	1,600,000	160
Phenanthrene	2,300,000	240
Pyrene	2,300,000	665
Total Metals (MG/KG)		
Arsenic	0.43	8.2
Copper	3,100	34
Iron	23,000	220,000
Lead	400	47
Mercury	23	0.15
Nickel	1,600	20.90
Selenium	390	1
Tin	47,000	3.40
Zinc	23,000	150

LW07-H3	Conc. Node	Conc. Composite
SVOCs (UG/KG)		
Acenaphthylene	89 J	55 J
Anthracene	150 J	100 J
Benzo(a)anthracene	330 J	NE
Benzo(a)pyrene	520 J	320 J
Chrysene	700 J	400 J
Dibenz(a,h)anthracene	95 J	NE
Pyrene	710 J	NE
Total Metals (MG/KG)		
Arsenic	10.4	9
Copper	90	83.5
Iron	25,200	23,200
Lead	56.9	50.8
Mercury	0.27	0.76
Selenium	2 J	2.5 J
Zinc	328	310

LW07-H1	Conc. Node	Conc. Composite
SVOCs (UG/KG)		
Acenaphthene	27 J	NE
Acenaphthylene	310 J	180 J
Anthracene	350 J	320 J
Benzo(a)anthracene	1,800	1,000
Benzo(a)pyrene	1,800	1,300
Benzo(b)fluoranthene	4,100 J	2,800 J
Benzo(g,h,i)perylene	900	NE
Benzo(k)fluoranthene	3,900 J	2,700 J
Chrysene	3,400	3,000
Dibenz(a,h)anthracene	480 J	290 J
Fluoranthene	970	770 J
Fluorene	54 J	40 J
Indeno(1,2,3-cd)pyrene	1,100	750 J
Phenanthrene	320 J	250 J
Pyrene	4,400	2,800
Total Metals (MG/KG)		
Arsenic	10.6	11.3
Copper	110	134
Iron	NE	25,200
Lead	69.1	70.1
Mercury	0.46	0.46
Tin	6.2 J	6.7 J
Zinc	397	445

LW07-K3	Conc. Node	Conc. Composite
SVOCs (UG/KG)		
Acenaphthylene	7.75	96 J
Anthracene	94 J	280 J
Benzo(a)anthracene	300 J	360 J
Benzo(a)pyrene	470 J	630 J
Benzo(b)fluoranthene	1,100 J	1,600 J
Chrysene	580	980
Dibenz(a,h)anthracene	110 J	150 J
Pyrene	NE	940
Total Metals (MG/KG)		
Arsenic	6.2	7.3
Copper	65	63.2
Lead	255	NE
Mercury	NE	0.25
Tin	5.8 J	5.2 J
Zinc	402	283

LW07-K1	Conc. Node	Conc. Composite
SVOCs (UG/KG)		
Acenaphthene	NE	2,000
Acenaphthylene	120 J	160 J
Anthracene	430 J	1,000
Benzo(a)anthracene	1,000	2,000
Benzo(a)pyrene	1,000	1,300
Benzo(b)fluoranthene	1,600	1,900
Chrysene	2,200	2,800
Dibenz(a,h)anthracene	170 J	210 J
Fluoranthene	990	8,900 D
Fluorene	NE	690 J
Indeno(1,2,3-cd)pyrene	NE	690 J
Phenanthrene	360 J	3,600
Pyrene	3,900	6,800
Total Metals (MG/KG)		
Arsenic	11.4	9.6
Copper	118	102
Iron	29,300	25,100
Lead	65.2	67.6
Mercury	0.3	0.31
Selenium	2.5 J	1.6 J
Zinc	415	383

LW07-M1	Conc. Node	Conc. Composite
SVOCs (UG/KG)		
Acenaphthene	38 J	19 J
Acenaphthylene	170 J	91 J
Anthracene	410 J	160 J
Benzo(a)anthracene	660 J	270 J
Benzo(a)pyrene	850	4,205
Benzo(b)fluoranthene	1,300	NE
Chrysene	1,000	470 J
Dibenz(a,h)anthracene	140 J	79
Fluoranthene	830	700
Pyrene	1,400	1,200
Total Metals (MG/KG)		
Arsenic	8.7	7.6
Copper	109	88
Iron	23,600	NE
Lead	177	143
Mercury	0.33	0.56
Selenium	NE	1.4 J
Tin	6.6 J	5.1 J
Zinc	628	449

LW07-L2	Conc. Node
SVOCs (UG/KG)	
Acenaphthene	24 J
Acenaphthylene	190 J
Anthracene	360 J
Benzo(a)anthracene	1,500
Benzo(a)pyrene	1,300
Benzo(b)fluoranthene	3,000
Benzo(g,h,i)perylene	710 J
Benzo(k)fluoranthene	2,600
Chrysene	3,200 J
Dibenz(a,h)anthracene	280 J
Fluoranthene	950
Fluorene	44 J
Indeno(1,2,3-cd)pyrene	820 J
Phenanthrene	320 J
Pyrene	3,600
Total Metals (MG/KG)	
Arsenic	12.6
Copper	117
Iron	27,600
Lead	83.9
Mercury	0.43
Tin	7.1 J
Zinc	491

LW07-F3	Conc. Node	Conc. Composite
SVOCs (UG/KG)		
Acenaphthylene	NE	50 J
Anthracene	86 J	100 J
Benzo(a)pyrene	220 J	310 J
Chrysene	NE	400 J
Total Metals (MG/KG)		
Arsenic	4.4	7.4
Copper	42.7	55.9
Mercury	NE	0.19
Zinc	NE	212

LW07-F5	Conc. Node	Conc. Composite
SVOCs (UG/KG)		
Anthracene	140 J	NE
Benzo(a)anthracene	300 J	NE
Benzo(a)pyrene	310 J	160 J
Chrysene	640	NE
Fluorene	22 J	NE
Total Metals (MG/KG)		
Arsenic	4.8	5.9
Copper	37.6	47.7
Selenium	NE	1.3 J
Zinc	NE	162

LW07-D5	Conc. Node	Conc. Composite
SVOCs (UG/KG)		
Benzo(a)pyrene	130 J	230 J
Total Metals (MG/KG)		
Arsenic	9.5	9.1
Copper	72.5	70.3
Iron	24,700	23,200
Mercury	0.25	0.23
Selenium	NE	1.5 J
Zinc	223	222

LW07-H5	Conc. Node	Conc. Composite
SVOCs (UG/KG)		
Anthracene	320 J	87 J
Fluorene	59 J	NE
Total Metals (MG/KG)		
Arsenic	1.5 J	7.6
Copper	35.2	NE
Lead	56.4	63.1
Selenium	NE	1.5 J
Zinc	157	NE

LW07-B5	Conc. Node	Conc. Composite
SVOCs (UG/KG)		
Benzo(a)pyrene	120 J	120 J
Total Metals (MG/KG)		
Arsenic	7.4	7.3
Copper	48.9	53.5
Selenium	1.7 J	NE
Zinc	NE	174

LW07-J4	Conc. Node	Conc. Composite
SVOCs (UG/KG)		
Acenaphthylene	NE	56 J
Anthracene	120 J	NE
Benzo(a)pyrene	270 J	280 J
Chrysene	NE	470 J
Dibenz(a,h)anthracene	70 J	70 J
Pyrene	1,200	730
Total Metals (MG/KG)		
Arsenic	10.6	8.7
Copper	65.7	55
Iron	23,200	NE
Lead	50.7	46.9
Mercury	0.66	0.24
Tin	4.8 J	6.6 J
Zinc	308	299

LW07-B7	Conc. Node	Conc. Composite
SVOCs (UG/KG)		
Benzo(a)pyrene	NE	150 J
Total Metals (MG/KG)		
Arsenic	1.1 J	9.2
Copper	NE	68.7
Mercury	NE	0.16
Selenium	NE	1.4 J
Zinc	NE	223

LW07-K5	Conc. Node	Conc. Composite
SVOCs (UG/KG)		
Acenaphthene	1,400	23 J
Acenaphthylene	340 J	130 J
Anthracene	1,000	1,500
Benzo(a)anthracene	1,400	680 J
Benzo(a)pyrene	1,600	830
Benzo(b)fluoranthene	2,800 J	2,000 J
Benzo(g,h,i)perylene	1,100	NE
Benzo(k)fluoranthene	2,300 J	NE
Chrysene	3,000 J	1,600 J
Dibenz(a,h)anthracene	330 J	160 J
Fluoranthene	1,700	NE
Fluorene	620 J	260 J
Indeno(1,2,3-cd)pyrene	990 J	NE
Naphthalene	1,500	NE
Phenanthrene	3,200	800
Pyrene	5,100	1,300
Total Metals (MG/KG)		
Arsenic	10.7	10.2
Copper	90	103
Iron	25,100	23,200
Lead	51.1	59.3
Mercury	0.29	0.33
Nickel	NE	23.4
Tin	6.6 J	8.8 J
Zinc	336	305

LW07-K6	Conc. Node	Conc. Composite
SVOCs (UG/KG)		
Acenaphthene	20 J	NE
Anthracene	92 J	NE
Benzo(a)pyrene	190 J	200 J
Chrysene	NE	440
Fluorene	21 J	NE
Total Metals (MG/KG)		
Arsenic	2 J	2.1 J

LW07-K4	Conc. Node	Conc. Composite
SVOCs (UG/KG)		
Acenaphthene	26 J	NE
Acenaphthylene	210 J	140 J
Anthracene	440 J	320 J
Benzo(a)anthracene	2,700	550 J
Benzo(a)pyrene	1,800	830
Benzo(b)fluoranthene	3,600 J	2,000 J
Benzo(g,h,i)perylene	950	NE
Benzo(k)fluoranthene	3,100 J	NE
Chrysene	4,400 J	1,300 J
Dibenz(a,h)anthracene	340 J	210 J
Fluoranthene	4,200	610
Fluorene	39 J	27 J
Indeno(1,2,3-cd)pyrene	1,100 J	620 J
Phenanthrene	270 J	NE
Pyrene	7,100 D	1,300
Total Metals (MG/KG)		
Arsenic	8.2	7.4
Copper	70.1	58.6
Lead	152	49.5
Mercury	0.19 J	0.19
Tin	9.4 J	5 J
Zinc	303	299

LW07-M3	Conc. Node	Conc. Composite
SVOCs (UG/KG)		
Acenaphthene	170 J	82 J
Acenaphthylene	790 J	430 J
Anthracene	2,000	840
Benzo(a)anthracene	4,900	3,100
Benzo(a)pyrene	6,100	3,000
Benzo(b)fluoranthene	7,800 D	7,600 J
Benzo(g,h,i)perylene	2,500	1,400
Benzo(k)fluoranthene	6,700 D	6,400 J
Chrysene	14,000 J	5,900
Dibenz(a,h)anthracene	1,200 J	630 J
Fluoranthene	4,700	3,400
Fluorene	280 J	150 J
Indeno(1,2,3-cd)pyrene	3,000	1,600
Phenanthrene	960	650 J
Pyrene	13,000 D	11,000 D
Total Metals (MG/KG)		
Arsenic	10.6	12.4
Copper	121	124
Iron	23,200	24,700
Lead	107	110
Mercury	0.45	0.36
Nickel	25.4	NE
Tin	14.5 J	9.1 J
Zinc	1,360	767

LW07-L6	Conc. Node
SVOCs (UG/KG)	
Acenaphthylene	190 J
Anthracene	500 J
Benzo(a)anthracene	960
Benzo(a)pyrene	1,300
Benzo(b)fluoranthene	2,700 J
Benzo(g,h,i)perylene	790 J
Benzo(k)fluoranthene	2,400 J
Chrysene	2,100 J
Dibenz(a,h)anthracene	220 J
Fluoranthene	1,600
Fluorene	42 J
Indeno(1,2,3-cd)pyrene	840 J
Phenanthrene	390 J
Pyrene	2,500
Total Metals (MG/KG)	
Arsenic	9.8
Copper	87
Lead	60
Mercury	0.29
Tin	5.4
Zinc	354

LW07-L5	Conc. Node	Conc. Composite
SVOCs (UG/KG)		
Acenaphthene	29 J	78 J
Acenaphthylene	260 J	520 J
Anthracene	630 J	2,200
Benzo(a)anthracene	1,200	7,500 D
Benzo(a)pyrene	1,700	5,100
Benzo(b)fluoranthene	3,800 J	12,000 J
Benzo(g,h,i)perylene	870	2,100
Benzo(k)fluoranthene	3,700 J	11,000 J
Chrysene	3,300	21,000
Dibenz(a,h)anthracene	370 J	1,200 J
Fluoranthene	1,200	4,300
Fluorene	85 J	220 J
Indeno(1,2,3-cd)pyrene	990	2,600
Phenanthrene	460 J	1,100
Pyrene	2,300	12,000 D
Total Metals (MG/KG)		
Arsenic	11.3	12.1
Copper	90.1	104
Iron	23,500	23,800
Lead	69.8	143
Tin	5.6	6 J
Zinc	362	419

LEGEND

- Surface Sediment Sample Location
- SWMU Boundary

Notes:
RBC - Risk-Based Criteria
J - Reported value is estimated
D - Result from a diluted sample
NE - Result was detected but did not exceed the screening criteria

N

0 400 800 Feet

Figure 5-4
Surface Sediment Exceedances of Screening Criteria
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

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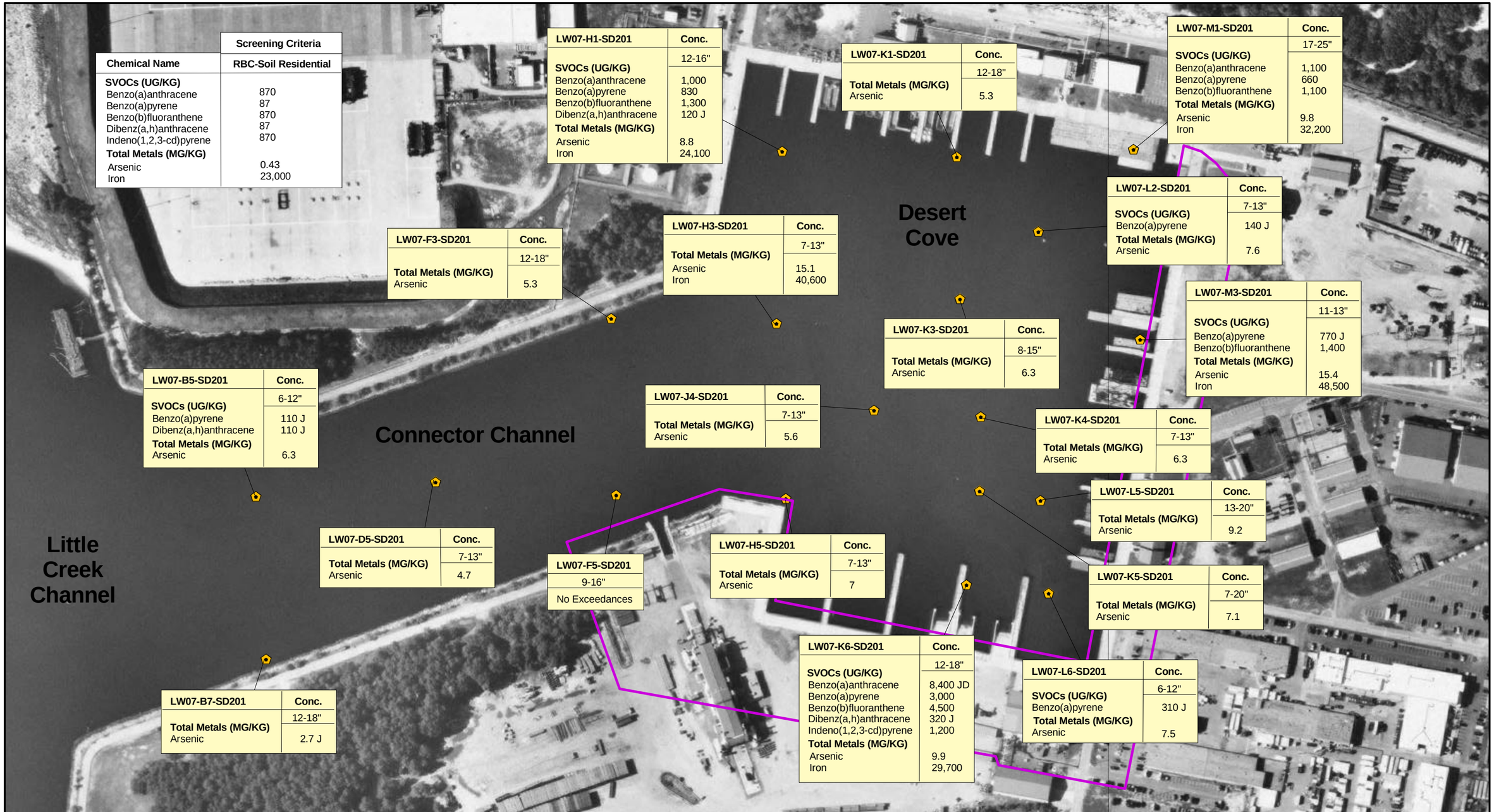

Chemical Name	Screening Criteria RBC-Soil Residential
SVOCs (UG/KG)	
Benzo(a)anthracene	870
Benzo(a)pyrene	87
Benzo(b)fluoranthene	870
Dibenz(a,h)anthracene	87
Indeno(1,2,3-cd)pyrene	870
Total Metals (MG/KG)	
Arsenic	0.43
Iron	23,000

LW07-H1-SD201	Conc.
	12-16"
SVOCs (UG/KG)	
Benzo(a)anthracene	1,000
Benzo(a)pyrene	830
Benzo(b)fluoranthene	1,300
Dibenz(a,h)anthracene	120 J
Total Metals (MG/KG)	
Arsenic	8.8
Iron	24,100

LW07-K1-SD201	Conc.
	12-18"
Total Metals (MG/KG)	
Arsenic	5.3

LW07-M1-SD201	Conc.
	17-25"
SVOCs (UG/KG)	
Benzo(a)anthracene	1,100
Benzo(a)pyrene	660
Benzo(b)fluoranthene	1,100
Total Metals (MG/KG)	
Arsenic	9.8
Iron	32,200

LW07-L2-SD201	Conc.
	7-13"
SVOCs (UG/KG)	
Benzo(a)pyrene	140 J
Total Metals (MG/KG)	
Arsenic	7.6

LW07-F3-SD201	Conc.
	12-18"
Total Metals (MG/KG)	
Arsenic	5.3

LW07-H3-SD201	Conc.
	7-13"
Total Metals (MG/KG)	
Arsenic	15.1
Iron	40,600

LW07-M3-SD201	Conc.
	11-13"
SVOCs (UG/KG)	
Benzo(a)pyrene	770 J
Benzo(b)fluoranthene	1,400
Total Metals (MG/KG)	
Arsenic	15.4
Iron	48,500

LW07-K3-SD201	Conc.
	8-15"
Total Metals (MG/KG)	
Arsenic	6.3

LW07-B5-SD201	Conc.
	6-12"
SVOCs (UG/KG)	
Benzo(a)pyrene	110 J
Dibenz(a,h)anthracene	110 J
Total Metals (MG/KG)	
Arsenic	6.3

LW07-J4-SD201	Conc.
	7-13"
Total Metals (MG/KG)	
Arsenic	5.6

LW07-K4-SD201	Conc.
	7-13"
Total Metals (MG/KG)	
Arsenic	6.3

LW07-L5-SD201	Conc.
	13-20"
Total Metals (MG/KG)	
Arsenic	9.2

LW07-D5-SD201	Conc.
	7-13"
Total Metals (MG/KG)	
Arsenic	4.7

LW07-F5-SD201
9-16"
No Exceedances

LW07-H5-SD201	Conc.
	7-13"
Total Metals (MG/KG)	
Arsenic	7

LW07-K5-SD201	Conc.
	7-20"
Total Metals (MG/KG)	
Arsenic	7.1

LW07-K6-SD201	Conc.
	12-18"
SVOCs (UG/KG)	
Benzo(a)anthracene	8,400 JD
Benzo(a)pyrene	3,000
Benzo(b)fluoranthene	4,500
Dibenz(a,h)anthracene	320 J
Indeno(1,2,3-cd)pyrene	1,200
Total Metals (MG/KG)	
Arsenic	9.9
Iron	29,700

LW07-L6-SD201	Conc.
	6-12"
SVOCs (UG/KG)	
Benzo(a)pyrene	310 J
Total Metals (MG/KG)	
Arsenic	7.5

LW07-B7-SD201	Conc.
	12-18"
Total Metals (MG/KG)	
Arsenic	2.7 J

LEGEND

- Sediment Sample Location
- SWMU Boundary

Notes:
RBC - Risk-Based Criteria
J - Reported value is estimated
D - Result from a diluted sample
Subsurface Sediment sample depths are in inches bgs.

N

300 0 300 Feet

Figure 5-5
Subsurface Sediment Exceedances of Screening Criteria
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

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SECTION 6

Contaminant Fate and Transport

Section 6 discusses the fate and transport of constituents of interest (COIs) (those analytes that exceed screening criteria discussed in Section 5) at SWMU 7 and their expected interactions with the soil, groundwater, surface water, and sediment. The fate and transport of COIs are described to support future risk evaluations and to aid in evaluating potential remedial alternatives. The constituents detected in environmental media at SWMU 7 considered as COIs in this section are presented in Table 6-1.

6.1 Mobility and Persistence of Constituents

The mobility and persistence of the chemicals in the environment are two key characteristics in determining probable behavior. Mobility is the potential for a chemical to migrate to and from a site, and persistence is a measure of how long it will remain in the environment. Environmental factors that affect the mobility and persistence of the COIs include: pH, concentration of other chemicals in the media, soil moisture, oxidation-reduction potential (measured as Eh), water chemistry, organic-matter content, and microbiology.

The behavior of chemical constituents in the environment is also determined by the physical and hydraulic properties of the water-bearing units through which the COIs are transported and the properties of the constituents themselves. These properties control the advection and dispersion of the COIs.

The following sections identify the constituent group(s) of interest at the site, their physical and chemical properties, and the physical and hydraulic properties of the water-bearing units at the site. Section 6.2 then applies these properties in a discussion of the observed constituent migration and attenuation at SWMU 7.

6.1.1 Constituent Groups

A number of organic and inorganic constituents were detected in environmental media exceeding screening criteria at SWMU 7 (Table 6-1). The potential for a constituent to contribute to human health and/or ecological risk is evaluated in Sections 7 and 8, respectively.

Certain chemicals were selected to represent the range of chemical COIs associated with the site. The representative chemicals were selected on the basis of concentrations exceeding screening criteria, frequency of occurrence, occurrence in several media, variable migration potential, and likely contribution to overall risk to human health and the environment. The chemicals discussed in this section are Benzo(a)pyrene, Arsenic, and Iron, and their specific fate-and-transport properties are described in the following section. These properties provide a range of the properties characteristic of each chemical group.

6.1.2 Physical and Chemical Properties

Various basic physical and chemical properties affect the transport of constituents in the environment at the site. The following are considered to be the most important properties:

- Sorption
- Volatilization
- Degradation
- Transformation
- Bioaccumulation

Table 6-2 contains data for the representative chemicals on the physical and chemical properties relevant to fate and transport. Appendix D contains data on pH, specific conductance, turbidity, temperature, salinity, dissolved oxygen, and oxidation/reduction potential in groundwater samples obtained from the SWMU 7 monitoring and Desert Cove. Properties affecting the transport of constituents in the environment are discussed below.

6.1.2.1 Sorption

Sorption is the tendency for constituents to adsorb to and desorb from materials in the medium through which the constituents are transported. The subsurface materials likely to sorb chemicals typically are clays and organic material, both of which exist abundantly at the site. Inorganic chemicals also adsorb onto iron, manganese, and aluminum-oxyhydroxide or -oxide coatings on soil and sediment grains. Adsorption of metals can be irreversible because of the process of fixation. Adsorption of constituents in groundwater to soils can retard the movement of groundwater constituents. The retardation of constituent migration in groundwater is discussed in Section 6.1.4.

6.1.2.2 Volatilization

Volatilization is the tendency for some chemicals, particularly VOCs, to change from a liquid or adsorbed state to a gas. A conventional measure of volatility is Henry's Law Constant (K_h). Values of K_h for the representative chemicals are provided in Table 6-2.

Compounds with K_h values higher than 10^{-3} atmosphere-m^3 per mole (atm-m^3/mol) (e.g., vinyl chloride) are expected to volatilize readily from water to air, whereas those with K_h values lower than 10^{-5} atm-m^3/mol (e.g., benzo(a)pyrene) are relatively non-volatile. Most inorganic chemicals are not volatile under normal temperature and pressure.

6.1.2.3 Degradation

Degradation is the transformation of one chemical to another by such processes as hydrolysis, photolysis, and biodegradation. Hydrolysis is the reaction of a chemical with water and photolysis is the result of exposing the chemical to light.

Degradation is commonly expressed as a half-life that composites the degradation by whatever processes may be operating. Estimates of half-lives for the representative chemicals are provided in Table 6-2. For example, under favorable and identical conditions, in surface water, benzo(a)pyrene would be expected to degrade more rapidly than would aldrin.

6.1.2.4 Transformation

Transformation occurs when metals are increased or reduced in valence state by oxidation or reduction, respectively. Transformation may have a significant effect on the mobility of a metal, either increasing or decreasing it. Transformation can be caused by Eh and pH changes and by microbial or non-microbial (abiotic) processes. This process commonly affects arsenic, iron, chromium, and a number of other metals found at the site.

6.1.2.5 Bioaccumulation

Bioaccumulation is the extent to which a chemical will partition from water into the lipophilic parts (e.g., fat) of an organism. Bioaccumulation commonly is estimated by the octanol-water partition coefficient (K_{ow}). Chemicals with high values of K_{ow} tend to avoid the aqueous phase and remain in soil longer or bioaccumulate in the lipid tissue of exposed organisms. Accumulation of a chemical in the tissue of the organism can be quantified by a bioconcentration factor (BCF), which is the ratio of the concentration of the chemical in the tissue to the concentration in the water. BCFs are both contaminant- and species-specific.

Estimates of the K_{ow} values for the representative chemicals are provided in Table 6-2. Many inorganic chemicals, SVOCs, PCBs, and dioxins tend to have higher K_{ow} values and bioaccumulate more extensively than VOCs. Although not COIs for SWMU 7, the variability in BCFs can be seen in the following example using 4,4′ DDT and vinyl chloride. The BCF for 4,4′ DDT ranges from 21,580 to 690,000; that for vinyl chloride ranges from 10 to 40.

6.1.3 Representative Chemicals

The following chemical-specific profiles briefly describe how the representative COI chemical (subset of chemicals whole properties are similar to other chemicals detected at the site) and physical properties affect their mobility and persistence in the environment. Most information provided in these profiles was obtained from factsheets available from:

- Spectrum Laboratories chemical fact sheets available at the website http://www.speclab.com/compound/chemabc.htm
- Agency for Toxic Substances and Disease Registry (ATSDR), an agency of the U.S. Department of Health and Human Services, at http://www.atsdr.cdc.gov/toxfaq.html

6.1.3.1 Benzo(a) pyrene

Benzo(a)pyrene was detected above screening levels in soil and sediments at SWMU 7; it is not a COI for groundwater at SWMU 7 because is was detected below groundwater screening criteria.

Benzo(a)pyrene release to the environment is commonly widespread, since it is a ubiquitous product of incomplete combustion. It is largely associated with particulate matter, soil, and sediment. Although environmental concentrations are highest near sources, its presence in places distant from primary sources indicates that it is reasonably stable in the atmosphere and capable of long-distance transport. When released to air it may be subject to direct photolysis, although adsorption to particulates apparently can retard this process.

If released to soil it will be expected to adsorb very strongly to the soil and not to appreciably leach to the groundwater, although its presence in some samples of groundwater illustrates

that it can be transported. It will not be expected to hydrolyze or significantly evaporate from soil and other organic surface. It may be subject to appreciable biodegradation in soil. Biodegradation of PAHs is well documented and likely the ultimate fate of benzo(a)pyrene. Limited nutrient and oxygen availability and the presence of such potential microbe inhibitors as arsenic could limit the effectiveness of biodegradation.

Human exposure would be from inhalation of impacted air and consumption of impacted food and water. Especially high exposure occurs through cigarette smoking and the ingestion of certain foods (e.g., smoked and charcoal-broiled meats and fish).

Benzo(a)pyrene may bioconcentrate in organisms unable to metabolize the chemical.

6.1.3.2 Arsenic

Arsenic was detected above screening criteria and background concentrations in all media at SWMU 7 and as such is considered herein as a COI. Background concentrations for arsenic were exceeded in surface soils, subsurface soils, and groundwater at SWMU 7.

The predominant soluble form of arsenic in oxidizing environments is usually arsenate (As^{5+}). Under slightly reducing acidic conditions, the more toxic and mobile arsenite (As^{3+}) form dominates. Arsenite and methylated arsine predominate in moderately reducing soil found in areas such as tidal marshes and consistently flooded soil. In natural environments, arsenic also may exist in the As^{3-} and As^{0} states, but only under highly reducing conditions.

The transport and partitioning of arsenic (and all other metals) in water depends on the oxidation state of the arsenic and interactions with other materials present. Organic matter, divalent metals, and dissolved sulfide enhance the reduction of the arsenic valence state to a more mobile form.

Soluble forms move with water, but arsenic may be adsorbed from water onto sediment or soil, especially clay particles, iron oxyhydroxides and oxides, aluminum hydroxides, manganese compounds, and organic matter. Adsorption to oxyhydroxides is the most important natural adsorption process.

Arsine gases (arsenic trihydride and mono-, di-, and trimethylarsines) generally are formed only under strongly reducing, acidic conditions, in the presence of a methyl donor (e.g., methylcobolamin), and in the presence of easily biodegraded organic matter (e.g., sewage sludge). Biorefractive organic matter like that typically found in soils does not favor methylation of inorganic arsenic. Additionally, given the environmental conditions in gw at SWMU-7 (ORP converted to Eh indicates oxidizing condition; near-neutral pH), lack of a biologically favorable substrate, biotransformation of arsenic to arsine gases is not expected to be a significant phenomenon. Any arsine gas produced would like be at very low concentrations that would dissipate nearly instantaneously in the environment.

Bioaccumulation of arsenic occurs in aquatic organisms, particularly algae and lower invertebrates. Although some fish and invertebrates may contain high levels of arsenic compounds, the predominant arsenic form, arsenobetaine, is relatively inert. Biomagnification in aquatic food chains does not appear to be significant.

6.1.3.3 Iron

SWMU 7 iron concentrations in sediment, surface soil, and groundwater exceeded screening criteria. Iron concentrations in surface soil exceeded background concentrations, also.

Iron is a common element in minerals of many rocks and sediment. When these minerals encounter water, the iron often is released, but generally is reprecipitated nearby upon exposure to oxygenated water. The behavior of iron in aquatic environments is strongly dependent on the system's pH and reduction/oxidation (redox) potential. The solubility of iron is favored in the presence of acidifying or oxidizing conditions. Under typical soil conditions of pH and redox potential, it is present in the form of an insoluble hydroxide or oxide with little potential to leach. Under oxidizing conditions, the ferric form of iron (Fe^{3+}) is predominant, where it forms insoluble iron oxides. Conversely, the more mobile ferrous iron (Fe^{2+}) predominates under reducing conditions. Microorganisms are often an integral part of redox reactions involving iron.

6.1.4 Conceptual Site Model

Impacted soil and groundwater are sources for contaminant migration and transport at SWMU 7. The principal mechanisms for transport of constituents from the SWMU 7 areas are from surface water runoff and erosion resulting in potential leaching and dissolution of constituents from soil, groundwater flow, and infiltrating precipitation and flow through the vadose zone resulting in the leaching of constituents from soil to the groundwater system. Because the SWMU ground surface is mostly paved and volatile compounds are not prevalent in site media, wind erosion and volatilization to the atmosphere are not pathways of concern at the sites.

6.1.4.1 General Conceptual Model of Groundwater Flow

The following physical mechanisms control the fate and transport of COIs dissolved in groundwater during migration:

- Advection, the transport of dissolved COIs by the bulk motion of flowing groundwater, is the primary transport mechanism for dissolved constituent migration along the hydraulic gradient. Advection controls the rate and direction of contaminant migration.
- Dispersion, the spreading of dissolved COIs from the path they would be expected to follow during advection, results from the spatial variation in aquifer permeability, fluid mixing, and molecular diffusion. Dispersion primarily controls the concentration of the contaminant at any point in the flow system.

Dispersion occurs in moving groundwater because of local variations in flow velocities caused by the variability of the hydraulic conductivity of the porous media. Typically, the degree of dispersion is greater in the direction of water flow than perpendicular to it. The concentrations of the chemicals at the center of the contaminant plume will decrease as dispersion dilutes the contaminant mass. Some contaminants will migrate more rapidly at the center of mass of the concentration and some will migrate more slowly. The center of mass would move at the rate estimated by dividing the groundwater flow velocity by the retardation coefficient of the migrating chemical, as described earlier in this section.

The shallow groundwater system at SWMU 7 is located in the Columbia Aquifer (described in Section 4.3 of this report). At SWMU 7, this aquifer consists of natural aquifer and fill material. The groundwater gradients and hydraulic conductivities of the aquifer at SWMU 7 are discussed in Section 4.3.2. A brief summary is presented below.

Shallow groundwater in the area flows from the north, south, and east toward Desert Cove. The water table at SWMU 7 generally mirrors the ground surface, which slopes from the bounding roads along the northern, southern, and eastern boundaries toward Desert Cove. Shallow groundwater at SWMU 7 may discharge to the cove depending on groundwater levels and tides.

Underlying the Columbia Aquifer is the Yorktown Confining Unit, a clay unit with interbedded fine sand and silt. The Yorktown Confining Unit that separates the overlying Columbia Aquifer from the sand and silty sand of the underlying Upper Yorktown Formation Aquifer, as described in Section 4.3.2.2.

6.1.4.1 Precipitation

Precipitation that falls on the base near SWMU 7 will evaporate or be used by plants in evapotranspiration, become surface runoff, or infiltrate to the shallow groundwater system. The areas surrounding SWMU 7 are largely flat, with impermeable surfaces surrounding the site that promote runoff instead of infiltration. Infiltration will likely occur in surrounding small areas onsite where the ground surface is vegetated. The topography of SWMU 7 defines its recharge characteristics. Most of SWMU 7 is concrete, asphalt, or hard-packed gravel covered. Vegetated areas south and west would allow for the most infiltration and recharge to groundwater. Precipitation that falls on the site will flow over the predominately impermeable surfaces and into Desert Cove or the connector channel.

6.1.4.2 Groundwater Flow Rates

The migration rates of COIs have a wide range of values because of differing degrees of adsorption by different chemicals. As a first estimate, constituents will move at the rate of groundwater flow or by advection. The average linear velocity is estimated using Darcy's Law and dividing it by the effective porosity (Felter, 1988):

$$V_x = K \times \nabla h / n_e$$

where V_x = Groundwater-flow velocity (ft/day)
K = Hydraulic conductivity (ft/day)
∇h = Hydraulic gradient (dimensionless)
n_e = Effective porosity (dimensionless)

Average rates of advective horizontal groundwater flow (V_x) for SWMU 7 groundwater were estimated based on pumping tests and slug tests conducted by FWES (February 1996) in the Columbia Aquifer at NAB Little Creek IR Site 12. Site 12 is approximately 2 miles east of SWMU 7. No pump tests or slug tests have been performed at SWMU 7; however the subsurface geology at Site 12 is similar to that found at SWMU 7. Therefore, the Site 12 data are used in this section to estimate the groundwater flow and subsurface constituent transport characteristics at SWMU 7.

Based on the similarity of geologic materials across NAB Little Creek, it is assumed that the average hydraulic conductivity for Site 12 is representative of SWMU 7. Therefore, average rate of advective flow in the Columbia Aquifer at the site is:

- *K = 109 ft/day*
- ∇h = 0.0045 (dimensionless; average value; ∇h ranges from 0.002 to 0.007 at SWMU 7)
- n_e = 0.35 (dimensionless, value for sand (Fetter, 1988))
- V_x= 1.4 ft/day (average value; V_x ranges from 0.6 to 2.2 ft/day at SWMU 7

It should be stressed that the flow rate is an approximation of the likely groundwater-flow velocity in the groundwater system at the site. The uncertainty in the hydraulic conductivity and the variability make dependable and representative values difficult to estimate.

6.1.4.3 Retardation of Constituent Flow

Typically, constituents will not move as rapidly as the groundwater does because of adsorption of the contaminant by the geologic medium. For each contaminant detected at the site it is theoretically possible to calculate a retardation coefficient, which is an estimate of the degree that the contaminant is slowed by adsorption in relation to the groundwater-flow velocity. The effect of retardation is estimated by dividing the groundwater-flow velocity by the retardation factor R. This retarded constituent flow rate provides a migration value either equal to the flow rate (in the case of no retardation) or less than the flow rate (in the presence of retardation). The retardation coefficient is calculated according to the following equation:

$$R = 1 + p_b \times K_d/n_e$$

where R = Retardation coefficient (dimensionless)

p_b = Bulk density (gm/cm^3)

K_d = Distribution coefficient (ml/gm)

The retardation coefficient for a particular constituent is calculated using the above formula, site data, and the K_d. For inorganics, K_d estimates obtained from the literature are provided in Table 6-2 for representative chemicals. These K_ds were used to calculate the R for inorganics listed in Table 6-3. In order to estimate the retardation coefficient of a particular organic chemical it is necessary to obtain the K_{oc} (literature values provided in Table 6-2), and then convert this value to a K_d:

$$K_d = K_{oc} * f_{oc}$$

where f_{oc} = Average TOC concentration/1,000,000

Site-specific measurements of TOC in soil are not available but the average TOC concentration for Site 12 saturated zone soil was calculated to be 1,200 mg/kg. For this report, this 1,200 mg/kg is also being applied to SWMU 7 to estimate f_{oc}. Retardation coefficients for each major chemical group were estimated and are provided in Table 6-3. A bulk density of 1.85 grams per cm^3 and an effective porosity of 0.35 were assumed. A range of values was calculated to show the effects of the variability in the K_d. Both the ranges in

lower and upper values of K_d for metals were used because many metals, such as arsenic and chromium, vary widely in their mobility depending upon their valence state.

There is a wide range of estimated retardation rates (Table 6-3). Using the average hydraulic conductivity of the Columbia Aquifer (109 ft/day) calculated from pumping and slug tests conducted at Site 12, an estimated effective porosity of 0.35, and an average hydraulic gradient of 0.0045 (ranging from 0.002 to 0.007) observed for across the site, an average groundwater velocity of 1.4 ft/day (ranging from 0.6 to 2.2 ft/day) was calculated for the Columbia Aquifer. When the groundwater velocity of 1.4 ft/day is divided by the range of retardation coefficients (10 to 52,860 for iron) migration rates range from 0.14 to 2.6×10^{-5} ft/day.

The K_ds of the COIs associated with the site vary widely between the organic and inorganic analytes. The K_ds of the inorganic analytes also vary widely depending upon the valence state of some of the analytes and the pH and other conditions encountered in the subsurface. The data in Table 6-2 are from various reports and documents in the literature, not from the site. Therefore, the estimates of R in Table 6-3 have an even greater level of uncertainty than do the estimates of the rates of groundwater flow. As a result, estimates of the rates of contaminant migration are very approximate.

6.2 COI Migration at SWMU 7

The source area for potential transport and migration of site-related constituents at SWMU 7 consists of soil/gravel potentially impacted by historical ABM use and storage. The primary release mechanisms at SWMU 7 are discussed in this section.

6.2.1 Potential Releases from Soil to the Atmosphere

The movement from impacted soil to the atmosphere by constituent volatilization is not a likely release mechanism at SWMU 7. The metals and SVOC COIs present in SWMU 7 surface soils have a very low ability to volatilize to air (Table 6-2), so volatilization of these chemicals from SWMU 7 surface soil is unlikely. Moreover, a significant portion of SWMU 7 is asphalt and concrete covered and the COIs found in surface soil bind tightly to the soil media and are unlikely to volatilize.

Wind erosion of constituents is considered a possible mechanism for releases of SWMU 7 COIs to the atmosphere, from areas where the ground surface is covered by gravel and/or soil. However, SWMU 7 is almost entirely covered with either concrete, asphalt, or hard packed gravel, which would prohibit the entrainment of contaminant particulates. Therefore, wind erosion is a viable, but not likely, mechanism for releasing SWMU 7 surface soil COIs to the environment.

6.2.2 Potential Releases from Soil to Sediment and Surface Water

The releases of surface soil COIs to surface water and sediment can occur by either wind or surface water runoff erosion. As detailed above, wind erosion of surface soil, while possible, is not likely. However, transport of impacted SWMU 7 surface soil and gravel by overland surface water flow to surface water and sediment in Desert Cove and the connector channel

is a viable method of release, although the impact of this pathway is likely limited by asphalt and concrete ground cover.

Semivolatile Organic Compounds. Fifteen SVOCs are present in surface soil at SWMU 7. The SVOCs identified as COIs in surface soil were also identified as COIs in sediments. SVOCs are prominent in sediments at locations adjacent to the bulkheads in the Cove. The presence of SVOCs at these locations is likely due in large part to runoff transporting impacted soil particles, which quickly settle out of the water column to the Cove floor. As mentioned previously, SVOCs are a common byproduct of incomplete combustion and petrogenic sources such as lubricating oils, greases fuels, etc., so frequent motorized watercraft traffic has likely contributed some SVOCs to the sediments in the Cove.

Inorganics. Aluminum, arsenic, copper, and iron are inorganic COIs at SWMU 7 common to surface soil and sediment. Surface soil locations where the metals concentrations are elevated exist throughout SWMU 7, and likely sources of metals to surface water and sediment via surface water runoff. Surface soil can release COIs to sediment by suspension of impacted particles within surface water runoff, and dissolution of COIs from soil to surface water runoff.

6.2.2.1 Potential Offsite Sources

Surface water runoff that originates offsite is a possible source of COIs to SWMU 7 surface water and sediment as surface water flows into the Desert Cove and the connector channel. Roadways run along SWMU 7's northern, southern, and eastern borders. These roads may drain offsite contaminants to SWMU 7. A number of stormwater outfalls discharge to Desert Cove and likely the connector channel. The connector channel flowing into Desert Cove is tidally influenced and receives influxes of surface water from Little Creek Channel, Chesapeake Bay, and other local water bodies. Many of the local water bodies connected to the tidal channel and tidally influenced receive surface water runoff from areas where surface soil and sediment may be impacted due to current and/or historic activities not related to SWMU 7.

6.2.3 Potential Leaching of Constituents from Soil to Columbia Aquifer Groundwater

There are two primary release mechanisms of COIs to groundwater: leaching of constituents by infiltration from soils as water migrates to the water table and infiltration of surface water through sediments.

Infiltration of precipitation through the surface soil vadose zone is the primary release mechanism of COIs to groundwater. Rainfall or snowmelt precipitation at NAB Little Creek will either evaporate or evapotranspirate back into the atmosphere, infiltrate to groundwater, or be transported off the facility as surface water runoff, which may come into contact with impacted soils, and these constituents may dissolve into surface water. This surface water can then infiltrate into the surface and subsurface soil, and the dissolved COIs may be transported with the water as it migrates. Surface water infiltration is much more likely where there is standing water or water with a higher residence time, such as in landscape depressions and drainage ditches. A number of depressions exist across the site that may catch precipitation and other surface waters, but most exist in areas that are

concrete- or hard-packed-gravel covered. Infiltration would not be expected to occur in the concrete-covered areas; however, some infiltration may occur in those with gravel cover.

Surface water can infiltrate through impacted surface and subsurface soils, and this infiltration can leach waste constituents through the soil profile. The dissolved constituents then migrate to the water table. Therefore, constituents in surface and subsurface soil can be the sources for a release to groundwater.

Volatile Organic Compounds. Methyl-tert-butyl ether (MTBE) was detected at a concentration exceeding the USEPA Region III tap water RBC in one well at SWMU 7. The CSM does not support that MTBE would be related to blasting activities at this site and therefore is not believed to be site related.

Semivolatile Organic Compounds. There were no groundwater SVOC detections that exceeded screening criteria. Based on the lack of exceedances in groundwater and the fact that most SVOCs are not particularly mobile, it is unlikely that SVOCs in soil are impacting groundwater at SWMU 7.

Inorganics. Seven dissolved and total metals (aluminum, arsenic, cobalt, copper, iron, manganese, and nickel) are COIs in shallow groundwater. Surface soil inorganic COIs are distributed throughout SWMU 7 and include those found in groundwater with the exception of cobalt and nickel. However, only arsenic is a common COI to subsurface soil and groundwater. The source of the shallow groundwater exceedances may be leaching from soil since a number of these inorganics are soil COIs. Iron and manganese are common in groundwater from this region; therefore, SWMU 7 concentrations of these constituents may not indicate groundwater contamination. Aluminum, arsenic, and copper in groundwater may be a result of leaching from the soil to shallow groundwater.

The primary means of sediment COIs being released to groundwater is by dissolution of sediment constituents into surface water as it migrates into the groundwater system. Tidal water in Desert Cove will potentially flow into the nearby shallow aquifer when the tidal elevation exceeds the groundwater elevation, due to greater hydraulic head.

Sediment impacts to groundwater do not appear to be a significant mechanism based on sediment and groundwater analytical data, which show that the only subsurface sediment COIs that are also groundwater COIs are arsenic and iron. This indicates that either other surface sediment COIs are not dissolving into surface water as it migrates to groundwater or that the sediment particulates are not being transported by surface water into the groundwater. Overall, it appears that there is minimal, if any, impact from sediment to groundwater or that if there is an influence, it is likely insignificant because arsenic and iron are ubiquitous in geological materials of the southeastern Virginia coastal plain.

6.2.4 Potential Discharge of Impacted Groundwater

6.2.4.1 Upgradient Groundwater

As described earlier, shallow groundwater in the Columbia Aquifer at SWMU 7 primarily flows from the north, south, and east toward Desert Cove (Figure 4-9). Well MW02 at the southernmost site boundary is considered to be an upgradient well for the site's southern portion. In the case of total and dissolved iron and manganese, which exceed screening

criteria, the downgradient well, MW01 has greater concentrations of these constituents than the upgradient well, MW02.

6.2.4.2 Onsite Groundwater

Shallow groundwater at SWMU 7 may discharge to the surface water in Desert Cove. The groundwater flow is toward the cove, which indicates that the cove would be a likely discharge point. The topography and impermeable surface materials dominant at SWMU 7 will limit the amount of local infiltration to groundwater, so most groundwater recharge at SWMU 7 will originate upgradient and offsite.

6.2.4.3 Groundwater Discharge

Groundwater from the Columbia Aquifer impacted with SWMU 7 COIs can discharge into Desert Cove, which may then flow into other water bodies connected to the cove. The sediment sampling results across the site suggest that the potential impact from groundwater discharge is minimal since only arsenic, copper, and iron are COIs common to groundwater and sediment. The conclusion is that groundwater discharge is not significantly impacting contaminant concentrations in sediments in Desert Cove.

6.2.4.4 Vertical Groundwater Flow

There are no groundwater monitoring wells screened in the deeper Upper Yorktown Aquifer at SWMU 7; therefore, no site-specific vertical groundwater flow and subsequent contamination can be identified. However, results from nearby NAB Little Creek IR Site 11 suggest that little to no migration of contaminants will take place from the surficial aquifer to the underlying Yorktown Aquifer due to the thickness and lithology (silty clay) of the Yorktown Confining Unit, which typically exceeds 20 ft as observed in borings at various locations at NAB Little Creek (CH2M HILL, October 2002). Also, an upward hydraulic gradient was identified between the Yorktown Aquifer and surficial aquifer (0.016 ft/ft). The proximity of SWMU 7 groundwater to the surface water bodies also encourages lateral flow directly into those bodies.

6.2.5 Surface Water Flow between Desert Cove and Little Creek Channel

COIs can migrate to surface water bodies and sediment by overland flow (Section 6.2.4) and groundwater discharge (Section 6.2.6). Once in the surface water (and related sediment), constituents may migrate between SWMU 7 surface water and other connected surface water bodies due to the tidal flux, which can transport both surface water and sediment entrained in the surface water. No surface water samples were collected at SWMU 7, so the impacts to site surface water and potential impacts to connected water bodies cannot be determined with the available data.

6.3 Summary of Fate and Transport Conclusions

The following bullets summarize the potential migration pathways that appear to be present at SWMU 7 and also indicate whether the data show the existence of a likely source or no source for constituent migration.

Releases to the Atmosphere

Releases from surface soil to the atmosphere are not likely due to surface cover and constituents that do not readily volatilize (i.e., metals and organics with little tendency to volatilize).

Surface Soil Releases to Sediment

Metals and SVOCs present in SWMU 7 surface soils appear to be a source to sediment. Surface water flow into Desert Cove from offsite and onsite stormwater drainage and overland flow is a possible transport mechanism for contaminants.

Soil Releases to Groundwater

Surface water infiltration containing suspended or dissolved inorganic contaminants is a potential source of contaminants to SWMU 7 groundwater.

Sediment and Surface Water Releases to Groundwater

Sediment and surface water are not likely sources of contaminants to groundwater.

Groundwater Releases to Sediment

Shallow groundwater is not a likely source of contaminants found in sediment.

6.4 References

CH2M HILL. *Draft Final Supplemental Remedial Investigation for Site 11 – School of Music Plating Shop*. NAB Little Creek, Virginia Beach, VA. October 2002.

Dragun, James. *The Soil Chemistry of Hazardous Materials. Second Edition.* Amherst Scientific Publishers, Amherst, Massachusetts. 862 pages. 1998.

Montgomery, J.H., and L.M. Welkom. *Groundwater Chemicals Desk Reference.* Lewis Publishers. Chelsea, Michigan. 640 pages. 1990.

Fetter, C.W. *Applied Hydrogeology*. Third Edition. Prentice Hall, Upper Saddle River, New Jersey. 691 pages. 1994.

Foster Wheeler Environmental Services (FWES). *Draft Supplemental Remedial Investigation for Sites 12 and 13*. September 1996.

Table 6-1
SWMU 7 COIs by Media
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

	Media				
Compounds and Analytes	**Groundwater**	**Surface Soil**	**Subsurface Soil**	**Surface Sediment**	**Subsurface Sediment**
Semivolatile Organic Compounds					
Acenaphthene				X	
Acenaphthylene				X	
Anthracene				X	
Benzo(a)anthracene				X	X
Benzo(a)pyrene		X	X	X	X
Benzo(b)fluoranthene		X		X	X
Benzo(g,h,I)perylene				X	
Benzo(k)fluoranthene		X		X	
Chrysene		X		X	
Dibenz(a,h)anthracene				X	X
Fluoranthene		X		X	
Fluorene				X	
Indeno(1,2,3-cd)pyrene				X	X
Naphthalene				X	
Phenanthrene		X		X	
Pyrene		X		X	
Volatile Organinc Compounds					
Methyl-tert-butyl ether (MTBE)	X				
Inorganics					
Aluminum		X			
Arsenic	X	X	X	X	X
Chromium		X			
Cobalt	X				
Copper	X	X		X	
Iron	X	X		X	X
Lead		X		X	
Manganese	X	X			
Mercury		X		X	
Nickel	X				
Selenium				X	
Thallium		X			
Tin				X	
Vanadium		X			
Zinc		X		X	

Table 6-2
Physical, Chemical, and Half-Life Data of Representative Chemicals
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Chemical	Molecular Weight (g/mole)	Specific Gravity (unitless)	Water Solubility (mg/L)	Vapor Pressure (mm Hg)	K_h (atm-m^3/mole)	K_d or Log K_{oc}[1] (ml/g)	Log K_{ow} (ml/g)	Half-Life Range (days)					
								Soil		Groundwater		Surface Water	
								Low	High	Low	High	Low	High
Semi Volatile Organic Compounds													
Benzo(a)pyrene	252.32 (1)	1.35 (1)	0.003 (1)	5.5 x 10^{-9} (1)	<2.4 x 10^{-6} (1)	5.6 (1)	5.99 (1)	57 (2)	529 (2)	114 (2)	1,058 (2)	0.15 (2)	0.46 (2)
Metals													
Arsenic	U	U	U	U	U	20 - 70 (3)	U	NP	NP	NP	NP	NP	NP
Iron	U	U	U	U	U	1.4-10,000 (3)	U	NP	NP	NP	NP	NP	NP

[1] K_d for inorganics and log K_{oc} for organics K_d = Distribution Coefficient K_{oc} = Organic carbon partition coefficient K_{ow} = Octanol-water partition coefficient K_h= Henry's Law Constant

U = No value is provided because of the uncertainty in the form of these chemicals in the environment.

NP = Not Applicable - inorganics do not degrade

Data sources:

(1) Montgomery and Welkom. 1990. Groundwater Chemicals Desk Reference. Volume 1.

(2) Howard, Ph. H. et al. 1991. *Handbook of Environmental Degradation Rates.*

(3) Dragun, James. 1998. *The Soil Chemistry of Hazardous Materials2nd Edition*. Kd estimates, not Koc

Table 6-3
Retardation Coefficients for Representative Chemicals
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Chemical Group	Low Log K_{oc}	High Log K_{oc}	Low K_d	High K_d	Low R	High R
Semivolatile organic compounds (benzo(a)pyrene)	5.6	5.6	478	478	2,528	2,528
Metals (Low range - arsenic)	NA	NA	20	70	109	373
Metals (High range - iron)	NA	NA	1.4	10,000	10	52,860

K_{oc} = Organic carbon partition coefficient
K_d = Distribution coefficient
R = Retardation coefficient = $1 + K_d \times p_b / n_e$
p_b = Soil bulk density = 1.85 grams per cubic centimeter
n_e = Effective porosity = 0.35
NA = Not applicable; K_d provided
For organics, $K_d = K_{oc}$ x fraction of organic carbon (approximately 0.0012 for soils at Site 12)

SECTION 7

Human Health Risk Assessment

7.1 Introduction

Section 7 presents the HHRA results for SWMU 7, NAB Little Creek. The risk assessment was prepared using conservative assumptions as described herein. Exposure pathways were evaluated for current and potential future site use based on current site conditions. The risk assessment incorporates the general methodology described in USEPA's *Risk Assessment Guidance for Superfund (RAGS), Volume 1, Human Health Evaluation Manual, Part D* (USEPA, December 2001), and USEPA Region III Technical Guidance Manuals for Risk Assessment (USEPA, 1993). Many of the interim deliverables required for *RAGS Part D* (USEPA, December 2001) were submitted to USEPA as they were completed. The RAGS Part D tables are included in Appendix H as Tables 1 through 10.

The results of this baseline human-health risk assessment will be used to:

- Document if there is a potential for risks to human health that may warrant further action
- Assist in identifying the areas and media that may need to be remediated; and
- Provide a basis for selecting action levels and remediation goals, as necessary.

The HHRA for SWMU 7 comprises the following components:

- **Identification of Chemicals of Potential Concern (COPCs)**—identifies and characterizes the distribution of COPCs found on the site.
- **Exposure Assessment**—identifies potential pathways by which exposure could occur; characterizes the potentially exposed populations; and estimates the magnitude, frequency, and duration of exposures.
- **Toxicity Assessment**—identifies the types of adverse health effects associated with exposure to COPCs and lists available toxicity factors for the COPCs.
- **Risk Characterization**—integrates the results of the exposure assessment and toxicity assessment to estimate the potential risks to human health.
- **Uncertainty Assessment**—identifies sources of uncertainty associated with the data, methodology, and the values used in the risk assessment estimation.

These components are described briefly in the following sections. Spreadsheets prepared in accordance with USEPA RAGS Part D were used to screen for COPCs, and to calculate estimated exposures and health risks associated with the COPCs. These spreadsheets are presented in Appendix H, Tables 1 through 10.3.CT.

7.2 Identification of COPCs

The identification of COPCs includes data collection, data evaluation, and data screening steps. The data collection and evaluation steps involve gathering and reviewing the available site data and identifying a set of data that is of acceptable quality for the risk assessment. This data set is then further screened against concentrations that are protective of human health to reduce the data set to those chemicals and media of potential concern.

7.2.1 Data Evaluation and Selection

Previous field investigations and sampling and monitoring programs have generated information on the constituents in the SWMU 7 media. The investigation activities that have occurred at SWMU 7 are discussed in Sections 2 and 3 of this report.

All of the data collected during previous investigations were evaluated to determine their reliability for use in the quantitative risk assessment. Data were available for surface soil, subsurface soil, groundwater, and sediment. Surface water samples have not been collected for SWMU 7. Surface water samples collected from Desert Cove (the surface water closest to SWMU 7) would not necessary be representative of site conditions because the cove is tidal. It would not be possible to say that any detected constituents were related to SWMU 7, since they could be transported to and from the cove via tidal fluctuations. Therefore, surface water was not evaluated in the SWMU 7 HHRA.

A QA/QC review of the data and past discussions with USEPA and the Navy identified the following criteria for data usability:

- Estimated values flagged with a J qualifier were treated as unqualified detected concentrations and were included in the calculation of summary statistics without modification.
- Data qualified with an R (rejected) were not used in the risk assessment.
- Data qualified with a B (blank contamination) were used in the risk assessment as if they were non-detects, with the blank-related concentrations of each constituent used as the sample detection limit. One-half of the blank-related concentrations were used to calculate exposure point concentrations in the risk assessment.
- One-half of the sample detection limit was used in the risk assessment for cases where no detectable contaminant quantities were found in that sample, but the contaminant was detected in other samples from the same medium.
- For duplicate samples, the maximum concentration between the two samples was used as the sample concentration.

7.2.2 Data Summary

CH2M HILL completed an SI for SWMU 7 in May 2000 (CH2M HILL, August 2001). Surface soil, subsurface soil, sediment, and groundwater samples were collected and analyzed for USEPA TCL VOCs, TCL SVOCs, TCL pesticides and PCBs, and TAL total and dissolved metals and cyanide. The results are presented in the *Final Site Investigation, SWMU 7 and SWMU 8* (CH2M HILL, August 2001).

During the RI that began in August 2002, groundwater, surface soil, subsurface soil, and discrete and composite sediment samples were collected following the approved RI Work Plan (CH2M HILL, June 2002) and analyzed to further characterize the nature and extent of contamination at SWMU 7, and to collect the data necessary to complete human health and ERAs.

Table 7-1 lists the samples collected from each medium that were evaluated in the HHRA.

7.2.2.1 Surface Soil

Surface soil data collected during the SI and RI were evaluated in the risk assessment. During the SI, surface soil samples were collected from four locations. Figure 3-1 identifies the surface soil sample locations. Surface soil samples were collected from ten locations during the RI (Figure 3-1). The surface soil data evaluated in the risk assessment are included in Appendix A.

7.2.2.2 Surface and Subsurface Soil

Combined surface and subsurface soil data collected during the SI and RI were evaluated in the risk assessment. During the SI, combined surface and subsurface soil samples were collected from 14 locations. Figure 2-4 identifies the soil sample locations. Combined surface and subsurface soil samples were collected from 11 locations during the RI. The soil data evaluated in the risk assessment are included in Appendix A.

7.2.2.3 Groundwater

Shallow aquifer groundwater data collected during the SI and the RI were evaluated in the risk assessment. During the SI, samples were collected from three monitoring wells. Groundwater samples were collected from the three existing and the three new monitoring wells at SWMU 7 during the RI. Both filtered and unfiltered samples were analyzed for inorganic constituents. Following USEPA guidance (USEPA, August 1992), because there were notable differences in the filtered and unfiltered samples for aluminum, data from the filtered samples were used to evaluate the potable use scenarios (residential and industrial scenarios). Data from the unfiltered samples were used to evaluate the direct contact scenario (construction worker scenario). Figure 3-1 identifies the locations of the monitoring wells sampled at SWMU 7. The groundwater data evaluated in the risk assessment are included in Appendix A.

7.2.2.4 Sediment

Discrete and composite sediment samples collected during the SI and RI were evaluated in the risk assessment. During the SI, surface sediment samples were collected from five locations in desert cove adjacent to SWMU 7's northern boundary. Surface sediment and subsurface sediment samples were collected at 19 node locations during the RI. These 19 locations are listed on Table 7-1 under node samples for surface sediment and Vibracore™ samples for the subsurface sediment samples. Additionally, surface sediment samples were collected from three locations surrounding each node. However, samples were not collected from Tertiary nodes L2 and L6. The three sediment samples collected around each node were homogenized into single composite sediment samples (17 total) for submission to the analytical lab. The various types of sediment samples collected at SWMU 7 were combined into one data set for evaluation in the risk assessment. Surface sediment samples were

analyzed as one data set, and all sediment samples (surface and subsurface sediment samples) were analyzed as another data set. Figure 3-2 identifies the locations of the sediment samples collected at SWMU 7. The data evaluated in the risk assessment are included in Appendix A.

7.2.3 Selection of COPCs

All of the detected constituents were screened following the procedures described below. The selection of COPCs was based on the criteria presented in USEPA Region III guidelines (USEPA, January 1993) and USEPA's *RAGS Part D* (USEPA, December 2001). The maximum detected concentration of each constituent in each media was compared to the criteria discussed below to select the COPCs for the media. If the maximum concentration exceeded the criteria, the constituent was selected as a COPC. Constituents that were not detected in any of the samples were not retained as COPCs. The COPC screening is presented in Appendix H, Tables 2.1 through 2.8.

Constituents detected in each media grouping were selected or eliminated as COPCs based on the following comparisons:

- Soil data were compared to the USEPA Region III RBCs for residential soil (USEPA, April 2004). RBCs that are based on noncarcinogenic effects were divided by 10 to account for exposure to multiple constituents. RBCs based on carcinogenic effects were used as presented in the RBC table. Lead concentrations in soil were compared to the USEPA residential child soil screening value of 400 ppm as determined by the Integrated Exposure Uptake Biokinetic (IEUBK) Model.

- Air concentrations were estimated from the soil data using the methodology presented in USEPA's *Soil Screening Guidance*, (USEPA, April 1996). These calculated air concentrations were compared to the USEPA Region III RBCs for ambient air (USEPA, April 2004). RBCs that are based on noncarcinogenic effects were divided by 10 to account for exposure to multiple constituents. RBCs based on carcinogenic effects were used as presented in the RBC table.

- Groundwater data were compared to the USEPA Region III RBCs for tap water (USEPA, April 2004). RBCs that are based on noncarcinogenic effects were divided by 10 to account for exposure to multiple constituents. RBCs based on carcinogenic effects were used as presented in the RBC table. Lead concentrations in groundwater were compared to the lead Safe Drinking Water Act (SDWA) action level of 15 ppb.

- Sediment data were compared to10 times the USEPA Region III residential soil RBCs (USEPA, April 2004). This was done following USEPA Region III guidance since exposure to sediment is expected to be significantly less than exposure to soil, and there are no screening levels for sediment. Therefore, RBCs based on noncarcinogenic effects were used as presented in the RBC table, and RBCs based on carcinogenic effects were multiplied by 10. Lead concentrations in sediment were compared to the USEPA residential child soil screening value of 400 ppm as determined by the IEUBK Model.

- Constituents that are essential human nutrients (magnesium, calcium, potassium and sodium) were not considered further in the quantitative risk assessment.

7.2.4 Summary of COPCs

Table 7-2 identifies the chemicals that were selected as COPCs for each of the media. The COPCs for all of the media are predominately inorganic constituents. For surface and subsurface sediment, PAHs, along with arsenic and iron, are retained as COPCs. Benzo(a)pyrene and inorganic constituents are selected as COPCs for the surface soil. Additionally, COPCs selected for surface and subsurface soil combined are PAHs and inorganic constituents. There were no COPCs retained for the surface soil or combined surface and subsurface soil for the soil to air exposure pathways. Along with inorganic constituents, chloroform, methyl-tert-butyl ether, and tetrachloroethene are retained as COPCs for groundwater, with the addition of chromium and vanadium for the construction worker scenario (the inorganic constituents for the construction worker are for total metals, and the inorganic constituents for the residential receptor are dissolved metals). Chloroform is a common laboratory contaminant; however, it is not qualified as laboratory contamination (B qualifier) in the one sample in which it is detected. Although lead is included on Table 7-2 as a COPC for surface sediment, combined surface and subsurface sediment, and combined surface and subsurface soil, quantitative risk calculations were performed only for the combined surface and subsurface soils Risks to the residential child receptor and the adult worker were calculated using USEPA's Integrated Exposure Uptake Biokinetic Model (IEUBK) and the Adult Lead Model (ALM), respectively, using the average concentration of lead for combined soils (USEPA, July 1994). There is currently no method to evaluate risks associated with exposure to lead by recreational users in sediment. However, it should be noted that the average lead concentrations in surface sediment and combined surface and subsurface sediment is below the screening value.

7.3 Exposure Assessment

Exposure assessment evaluates potential human exposure to the COPCs present at or migrating from the site. Exposure can occur when contaminants migrate from a source to an exposure point, or when a receptor comes into direct contact with contaminated media.

The three components of exposure assessment include:

1. Characterization of exposure setting
2. Identification of exposure pathways
3. Quantification of exposure

7.3.1 Characterization of Exposure Setting

Characterizing an exposure setting consists of two parts—identifying the physical characteristics of the site as they relate to exposure and characterizing human populations on or near the site (the potentially exposed populations).

Basic site characteristics such as physical setting, climate, geology, and hydrogeology were summarized in the Section 4.

Potentially exposed populations are identified based on their locations relative to the site, their activity patterns, and the presence of potentially sensitive subpopulations. Table 7-3 summarizes the potentially exposed populations evaluated in this risk assessment.

The population of the base increases in summer, when a significant number of midshipmen and Navy and Marine Corps reservists train in amphibious/expeditionary warfare. Approximately 3,650 military personnel and their families live on the base. In addition, approximately 3,000 civilians are employed at NAB Little Creek (USEPA, May 2002).

7.3.2 Identification of Exposure Pathways

To determine the potential health risks associated with site-related contamination, potential exposure pathways need to be identified. The exposure pathway describes a mechanism by which a receptor may be exposed to a COPC at or originating from the site. An exposure pathway must be complete for exposure to occur. A complete exposure pathway has four elements:

- A source or a release from a source
- An environmental transport medium
- An exposure point (receptor location)
- A route of intake (inhalation, direct contact, or incidental ingestion)

The potential exposure pathways were identified in the conceptual exposure model (Figure 7-1), are summarized in Table 7-3, and shown in greater detail in Appendix H, Table 1.

7.3.2.1 Contaminant Sources

The source of contamination at SWMU 7 is the former sandblasting operations. SWMU 7 (Small Boats Sandblast Yard), formerly referred to as SWMU 137, is located along Piers 44 through 55 at Desert Cove and includes an area surrounding the northern portion of Building CB-125. SWMU 7 was used to sandblast and paint ships prior to 1996, when sandblasting activities were moved to an indoor facility (Building CB-125). SWMU 7 was also used to store spent ABM while awaiting characterization (EP toxicity) testing results. Approximately 4,000 cubic yards of ABM generated from 1960 to 1982 were stored (in open piles) in the yard. This ABM has since been sampled (EP toxicity), removed, and disposed of offsite. Based on available photography, the ABM piles were located in the area where the new blasting facility (Building CB-125) was constructed.

7.3.2.2 Release and Transport Mechanisms

Contaminant fate and transport, including contaminant mobility and persistence, and the potential contaminant migration pathways and release mechanisms at the site, are discussed in detail in Section 6, and summarized here.

The primary contaminant release and transport mechanisms at SWMU 7 appear to be leaching from the sandblast residue (ABM) and soil to the shallow groundwater, and transport from the shallow groundwater to the cove. ABM contains primarily inorganic contaminants mentioned above as COPCs. Additionally, transport of soil through overland flow to the cove may be a transport mechanism. As mentioned earlier, surface water was not evaluated in the HHRA because the cove is tidal, and any contamination detected in the cove may or may not be associated with SWMU 7. The sediment in the cove is evaluated in the risk assessment.

7.3.2.3 Exposure Points and Exposure Routes

Exposure points are locations where humans could come in contact with contamination. Onsite exposure points include surface soil, combined surface and subsurface soil, surface and subsurface sediment at Desert Cove, and upper aquifer groundwater. Offsite exposure points were not evaluated in the risk assessment.

Potential exposure routes are evaluated for potential current and future site use. Existing and potential exposure pathways are illustrated in the conceptual exposure model (Figure 7-1). Exposure scenarios and potentially complete pathways of exposure evaluated in this risk assessment are presented in Table 7-3 and Appendix H, Table 1.

Groundwater is not currently used as a potable water supply at SWMU 7. The shallow groundwater (Columbia Aquifer) is not used as a water supply at the Base and is not a likely future potable water source for NAB Little Creek. Additionally, it is not likely that shallow groundwater downgradient of SWMU 7 would be used as a potable water supply. Shallow groundwater from beneath SWMU 7 flows directly into the cove. However, for the risk assessment it was assumed that wells could be placed within or downgradient of SWMU 7. Therefore, potential future exposure to Columbia Aquifer groundwater at SWMU 7 used as a potable water supply by industrial workers and residents was evaluated in the risk assessment as a hypothetical worst case scenario. It is assumed that adult residents would be exposed to groundwater through ingestion, and dermal contact and inhalation while showering, and child residents could be exposed through ingestion, and dermal contact while bathing. Future industrial workers could be exposed to the groundwater through ingestion in the unlikely event the upper aquifer groundwater is used as a potable water supply for the base. Additionally, since the water table at SWMU 7 is within 10 feet of the ground surface, a construction worker could be exposed to shallow groundwater beneath the site during construction or excavation activities. The construction worker would be exposed to the upper aquifer groundwater through dermal contact and inhalation of volatiles.

The deep confined aquifer (Yorktown Aquifer) groundwater is not currently used at the Base, except for four irrigation wells at the Little Creek golf course which are used infrequently to fill storage ponds on the golf course. The Yorktown Aquifer flows to the north under NAB Little Creek and discharges directly from the Base to the Chesapeake Bay.

Because access to SWMU 7 is unrestricted, exposure to site surface soil by adolescent and adult trespassers was evaluated. As a conservative evaluation, it was also assumed a maintenance worker may mow the grass at SWMU 7 or perform other landscaping activities and be exposed to the surface soil. These receptors may be exposed to the surface soil through incidental ingestion and dermal contact.

Exposure to surface and subsurface soil could occur for a construction worker performing any type of excavation activities at SWMU 7. The construction worker would be exposed to both surface and subsurface soil during excavation activities. Additionally, although extremely unlikely, it was assumed a future resident or industrial worker could be exposed to the soil (both surface and disturbed subsurface soil) at SWMU 7 in the unlikely event the site is used for residential or industrial development. Exposure to combined surface and subsurface soil by these receptors could occur through incidental ingestion and dermal contact.

Exposure to surface sediment and combined surface and subsurface sediment from Desert Cove were evaluated. It is assumed that the populations that would potentially be exposed to surface and subsurface sediment are adult and adolescent trespassers/visitors who could possibly swim in the cove and other workers who use the cove for scuba diving practice and training. Additionally, maintenance workers may be exposed to the subsurface sediment while performing any types of maintenance activities at the cove. The cove is along the shore of Little Creek Cove, in shallow locations, so it was assumed that the trespassers/ visitors and workers would be exposed while swimming. Exposure to surface and subsurface sediment may occur through incidental ingestion and dermal contact.

7.3.3 Quantification of Exposure

Quantification of exposure involves estimating the exposure point concentration (EPC) and chemical intake.

7.3.3.1 Exposure Concentrations

The EPC is the concentration at the point of contact. EPCs may be measured directly or calculated using fate and transport models. For this assessment, fate and transport modeling was used to estimate constituent concentrations in vapors from groundwater while showering, and in vapors volatilized from groundwater from an open excavation. Volatilization while showering was estimated using the Foster and Chrostowski shower model (Foster and Chrostowski, 1987). Concentrations of VOCs in air resulting from volatilization from shallow aquifer groundwater in an open excavation were calculated using a two-film volatilization model. The model calculations are shown in Tables 7.9.RME Supplement C, 7.11.RME Supplement A, and 7.13.RME Supplement C in Appendix H.

The reasonable maximum exposure (RME) EPCs were calculated as the 95 percent upper confidence limit (95-percent UCL), the 97.5-percent UCL, or the 99-percent UCL of the arithmetic mean concentration. The maximum detected concentration was used in place of the appropriate UCL as the EPC when the calculated UCL was greater than the maximum detected value or less than five samples were available for the data grouping.

ProUCL, Version 2.1 (USEPA, April 2002), was used to calculate the UCLs and determine the distribution the data fit using various statistical analysis as described below. The ProUCL model uses the Shapiro-Wilk W-test to determine if the data fit a lognormal or normal distribution for data sets with less than 50 samples. For data sets with greater than 50 samples, Lilliefors test is used to determine the distribution of the data. The distribution that the data fit is then used to choose the method that ProUCL uses to calculate the UCL. The recommendations outlined in the ProUCL model documentation were used to select the appropriate UCL. For data that were determined to fit a normal distribution, the student's t-statistic was used to calculate the 95% UCL. For data determined to fit a lognormal distribution, either Land's H-statistic was used to calculate the 95% UCL, or the Chebyshev Theorem using the MVUE of the parameters was used to calculate the 95% UCL or 99% UCL, depending on the standard deviation of the data set. For data that fit neither a lognormal or normal distribution, the Chebyshev Theorem using the sample arithmetic mean and standard deviation was used to calculate the 95% UCL, 97.5% UCL, or 99% UCL, depending on the standard deviation of the data set. For data sets that fit both a lognormal

and normal distribution, the distribution with the higher W-value was used to calculate the UCL.

The average concentration was used as the central tendency (CT) EPC. For data that fit a lognormal distribution (based on the discussion above), the minimum variance unbiased estimate of the mean was used as the CT EPC as calculated by ProUCL. For data that fit a normal distribution, the average of the non-transformed data was used as the CT EPC. For data sets that neither a lognormal nor normal distribution, the average based on a normal distribution was used as the UCL.

The data qualifiers were handled as discussed in Section 7.2.1, to calculate the RME and CT EPCs. The RME EPCs are included in Appendix H, Tables 3.1.RME through 3.6.RME and the CT EPCs are included in Appendix H, Tables 3.1.CT through 3.5.CT.

The filtered inorganic data were used to evaluate the residential and industrial worker scenarios following USEPA guidance (USEPA, August 1992). Unfiltered inorganic data were used to evaluate the construction worker scenario.

7.3.3.2 Estimation of Chemical Intakes

The quantification of exposure is based on an estimate of the average daily intake, the average amount of the chemical contaminant entering the receptor's body per day. Chemical intakes are generally expressed as follows:

$$ADI = \frac{C \times CR \times EF \times ED}{BW \times AT}$$

Where:

ADI = average daily intake (mg/kg-day)
C = chemical concentration (mg/L, mg/kg)
CR = contact rate (L/day, mg/day)
EF = exposure frequency (days/year)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time (days)

The intake equation requires specific exposure parameters for each exposure pathway. Appendix H, Tables 4.1 (RME and CT) through 4.8 (RME and CT) present the exposure factors used for the site. Both RME and CT intakes were included in this evaluation. CT intakes were calculated for exposure scenarios with RME cumulative cancer risks greater than $1x10^{-4}$ or cumulative noncancer hazards greater than 1

A dermal absorption factor is required for the dermal exposure to soil pathway. Dermal absorption factors were obtained from USEPA's RAGS, Part E (USEPA, July 2004), Exhibit 3-4. For the inorganic constituents not included in this reference, 1 percent was used as the default value (USEPA, December 1995).

The methods presented in USEPA's RAGS, Part E (USEPA, July 2004), for estimating dermal exposure to water were used to evaluate dermal exposure to groundwater during bathing and showering, and in an open excavation. The non-steady state model or pseudo steady-

state model was used to estimate the dermally absorbed dose per event for organic constituents (USEPA, July 2004). If the exposure time (or event time, t_{event}) was shorter than the time to reach steady state (t*), the non-steady state model was used. If t_{event} was greater than t*, the pseudo-steady state model was used. For inorganics, the absorbed dose was calculated using a steady-state approach. These models are shown in Table 4.5 (RME and CT), in Appendix H.

For residential exposure to soil and groundwater, lifetime age-adjusted intakes were calculated to evaluate carcinogenic risk. Age-adjusted exposure factors were calculated using the equations presented in the USEPA Region III RBC table (USEPA, April 2004).

7.4 Toxicity Assessment

Toxicity assessment defines the relationship between the magnitude of exposure and possible severity of adverse effects, and weighs the quality of available toxicological evidence. Toxicity assessment generally consists of two steps: hazard identification and dose-response assessment. Hazard identification is the process of determining the potential adverse effects from exposure to the chemical along with the type of health effect involved. Dose-response assessment is the process of quantitatively evaluating the toxicity information and characterizing the relationship between the dose of the contaminant administered or received and the incidence of adverse health effects in the exposed population. Toxicity criteria (e.g., reference doses and slope factors) are derived from the dose-response relationship.

USEPA has performed the toxicity assessment step for many chemicals and has published the results in the Integrated Risk Information System (IRIS) and other databases. The IRIS database is the USEPA's preferred source of toxicity information and only includes reference doses (RfDs) and cancer slope factors (CSFs) that have been verified by USEPA work-groups. In accordance with USEPA guidance (USEPA, December 2003), the second tier of toxicity factors is the Provisional Peer Reviewed Toxicity Value (PPRTV) database maintained by the USEPA's National Center for Environmental Assessment (NCEA) and the Superfund Health Risk Technical Support Center (STSC). This database is publicly available online for a trial basis, so toxicity values were obtained for several COPCs, as noted in Tables 5.1, 5.2, 6.1, and 6.2 in Appendix H from the PPRTV database. If toxicity data are not available from either of these sources, the USEPA considers toxicity values obtained from other USEPA and peer-reviewed non-USEPA sources, such as provisional NCEA toxicity values and the USEPA's Health Effects Assessment Summary Tables (HEAST) (USEPA, July 1997). The use of provisional toxicity values, including those from the PPRTV database, in an HHRA increases the uncertainty of the quantitative risk estimate. If no toxicity values were available, appropriate surrogate constituent toxicity values were used for the COPC screening (identified in Appendix H, Tables 2.1 through 2.8).

Health effects are divided into two broad groups: noncarcinogenic and carcinogenic. This division is based on the different mechanisms of action currently associated with each category. Chemicals causing noncarcinogenic health effects are evaluated independently from those having carcinogenic effects. Some chemicals may produce both noncarcinogenic and carcinogenic effects, and are therefore evaluated in both groups. This section discusses noncarcinogenic and carcinogenic effects separately (USEPA, July 2004).

Per USEPA guidance, oral toxicity values (noncarcinogenic RfDs and carcinogenic cancer slope factors [CSFs]) were adjusted from administered doses to absorbed doses for evaluating dermal toxicity. The RfDs and CSFs were adjusted using oral absorption factors from USEPA dermal assessment guidance (USEPA, July 2004). The adjusted dermal RfDs and CSFs are summarized in Appendix H, Tables 5.1 and 6.1, respectively.

7.4.1 Toxicity Information for Noncarcinogenic Effects

Noncarcinogenic health effects include a variety of toxic effects on body systems, such as renal toxicity (toxicity to the kidneys) to central nervous system disorders. Noncarcinogenic health effects can be grouped into two basic categories: acute toxicity and chronic toxicity. Acute toxicity can occur after a single exposure (usually at high doses), and the effect is most often seen immediately. Chronic toxicity generally occurs after repeated exposure (usually at low doses) and is seen months or years after the initial exposure. The toxicity of a chemical is assessed through a review of toxic effects noted in short-term (acute) animal studies, long-term (chronic) animal studies, and epidemiological investigations of exposed human populations, typically in the workplace.

USEPA (USEPA, December 1989) defines the chronic RfD as a dose that is likely to be without appreciable risk of deleterious effects during a lifetime of exposure. Chronic RfDs are specifically developed to be protective for long-term exposure to a chemical (for example, 7 years to a lifetime), and consider uncertainty in the toxicological database and sensitive receptors. Chronic RfDs may be overly protective if used to evaluate the potential for adverse health effects resulting from short-term exposure. USEPA's PPRTV, NCEA, and HEAST develop subchronic RfDs for short-term exposure (2 weeks to 7 years). Subchronic RfDs were used for the construction worker scenario because the exposure duration is assumed to be 1 year.

USEPA-derived oral and inhalation RfDs, and associated uncertainty factor (UF) and modifying factor (MF) values, for the COPCs at SWMU 7 are listed in Tables 5.1 and 5.2 in Appendix H.

7.4.2 Information for Carcinogenic Effects

Potential carcinogenic effects from human exposure to chemicals are estimated quantitatively using oral and inhalation CSFs. CSFs may be derived from the results of chronic animal bioassays, human epidemiological studies, or both. Animal bioassays are usually conducted at dose levels that are much higher than levels likely to be produced by human exposure to environmental media. This design detects possible adverse effects in the relatively small test populations used in the studies. These high dose levels must be extrapolated to lower doses. A number of mathematical models and procedures have been developed to extrapolate from the high doses used in the studies to the low doses typically associated with environmental exposures.

The USEPA-preferred linearized multistage model is usually used to estimate the largest linear slope (within the upper 95-percent UCL) at low extrapolated doses consistent with the data. The 95%UCL slope of the dose-response curve is subjected to various adjustments, including an inter-species scaling factor, to derive a CSF. It is assumed that if a cancer response occurs at the dose level in the study, there is some probability that a response will

occur at all lower exposure levels (i.e., a dose-response relationship with no threshold is assumed). Dose-response data derived from human epidemiological studies are fitted to dose-time-response curves on an ad hoc basis. In both types of analyses, conservative (e.g., health protective) assumptions are applied and the models are believed to provide rough estimates of the upper limits on potential lifetime risk.

In addition to deriving a quantitative estimate of carcinogenic potency, USEPA also assigns weight-of-evidence classifications to potential carcinogens. Chemicals are classified as Group A, Group B1, Group B2, Group C, Group D, or Group E carcinogens. The classifications are described as follows:

- Group A chemicals (known human carcinogens) are agents for which there is sufficient evidence to support the causal association between exposure to the agents in humans and cancer.
- Group B1 chemicals (probable human carcinogens) are agents for which there is limited evidence of possible carcinogenicity in humans.
- Group B2 chemicals (probable human carcinogens) are agents for which there is sufficient evidence of carcinogenicity in animals but inadequate or a lack of evidence in humans.
- Group C chemicals (possible human carcinogens) are agents for which there is limited evidence of carcinogenicity in animals and inadequate or a lack of human data.
- Group D chemicals (not classifiable as to human carcinogenicity) are agents with inadequate human and animal evidence of carcinogenicity or for which no data are available.
- Group E chemicals (evidence of noncarcinogenicity in humans) are agents for which there is no evidence of carcinogenicity from human or animal studies, or both.

USEPA-derived oral and inhalation CSFs for the COPCs at SWMU 7 are listed in Appendix H, Tables 6.1 and 6.2

7.5 Risk Characterization

Risk characterization combines the results of the previous elements of the risk assessment to evaluate the potential health risks associated with exposure to the COPCs. The risk characterization is then used as an integral component in remedial decision making and selection of potential remedies or actions, as necessary.

7.5.1 Methods for Evaluating Risk and Hazard

Potential human health risks are discussed independently for carcinogenic and noncarcinogenic contaminants because of the different toxicological endpoints, relevant exposure duration, and methods used to characterize risk. Some chemicals may produce both noncarcinogenic and carcinogenic effects, and were evaluated in both groups. The methodology used to estimate noncarcinogenic hazards and carcinogenic risks are described below. Following the description of the methodology, the noncarcinogenic hazards and carcinogenic risks for SWMU 7 are discussed.

7.5.1.1 Noncarcinogenic Hazard Estimation

Noncarcinogenic health risks are estimated by comparing the calculated exposures to RfDs. The calculated intake divided by the RfD is equal to the hazard quotient (HQ):

Hazard Quotient (HQ) = Intake / RfD

The intake and RfD are expressed in the same units (mg/kg-day) and represent the same exposure period (i.e., chronic or subchronic). The intake and RfD also represent the same exposure route (i.e., oral intakes are divided by oral RfDs). A HQ that exceeds 1.0 (i.e., intake exceeds the RfD), indicates that there is a potential for adverse health effects associated with exposure to that chemical (USEPA, September 1986).

To assess the potential for noncarcinogenic health effects posed by exposure to multiple chemicals, a "hazard index" approach is used (USEPA, September 1986). This approach assumes that noncarcinogenic hazards associated with exposure to more than one chemical are additive. Synergistic or antagonistic interactions between chemicals are not considered. The hazard index (HI) may exceed 1.0 even if all of the individual HQs are less than one. HIs may be added across exposure routes to estimate the total noncarcinogenic health effects to a receptor posed by exposure through multiple routes. A HI greater than one indicates that there is some potential for adverse noncarcinogenic health effects associated with exposure to the contaminants of concern, possibly warranting remedial action. However, if the HI is greater than one, it is possible to separate the HI by target organ, to determine if the HI for a specific target organ is greater than one. If the HI for each target organ is not above one, it can be assumed that there is no noncarcinogenic hazard above USEPA's targets to the receptor.

7.5.1.2 Carcinogenic Risk Estimation

The potential for carcinogenic effects due to exposure to site-related contamination is evaluated by estimating the excess lifetime carcinogenic risk (ELCR). ELCR is the incremental increase in the probability of developing cancer during one's lifetime in addition to the background probability of developing cancer. For example, a $2x10^{-6}$ ELCR means that for every one million people exposed to the carcinogen throughout their lifetimes, the incidence of cancer may increase by two cases. The background probability of developing cancer, from all known causes, is about one in two for men and one in three for women (American Cancer Society, 2002) or 500,000 per million for men and 333,000 per million for women.

The carcinogenic risk is calculated by multiplying the intake by the CSF.

Risk = Intake × CSF

The combined risk from exposure to multiple chemicals was evaluated by adding the risks from individual chemicals. Risks were also added across the exposure routes if an individual would be exposed through multiple routes.

The USEPA (USEPA, 1991) considers action to be warranted at a site when the total carcinogenic risk to a receptor exceeds 10^{-4}. Action is generally not required for risks falling within 10^{-4} to 10^{-6}; however, this is judged on a case-by-case basis. Risks less than 10^{-6} usually are not of concern to regulatory agencies.

7.5.2 Risk Assessment Results

The results of the risk characterization are presented below. Total risks are summarized by receptor following the media specific discussions. The risk calculation tables are presented in Appendix H, Table 7s and summarized in Appendix H, Table 9s for each receptor. A summary of the results for all receptors is shown in Table 7-4 for the RMEs and Table 7-5 for the CTs. CT risks were calculated only when the RME hazards exceeded one or the cancer risks exceeded 10^{-4}.

7.5.2.1 Surface Sediment Exposure

RME risks estimates for exposure to surface sediment were calculated for adult other worker and adult and adolescent trespasser/visitor under current site use. Exposure to surface soil via incidental ingestion and dermal contact was evaluated.

- **Current Other Worker**
  The risk assessment assumed that a current maintenance worker could be exposed to SWMU 7 surface sediment in Desert Cove during scuba diving practice and training. Table 9.1.RME, Appendix H, summarizes the hazards and risks to the current/future maintenance worker.

  The noncarcinogenic hazard associated with exposure to surface sediment (0.004) is below USEPA's target hazard index of 1.0. The carcinogenic risk associated with exposure to the surface soil ($7.7x10^{-7}$) is below USEPA's target risk range of $1x10^{-6}$ to $1x10^{-4}$.

- **Current Adult Trespasser/Visitor**
  The risk assessment assumed that a current adult trespasser/visitor could be exposed to SWMU 7 surface sediment. Table 9.2.RME, Appendix H, summarizes the hazards and risks to the current/future adult trespasser/visitor.

  The noncarcinogenic hazard associated with exposure to surface sediment (0.008) is below USEPA's target hazard index of 1.0. The carcinogenic risk associated with exposure to the surface soil ($1.6x10^{-6}$) is within USEPA's target risk range of $1x10^{-6}$ to $1x10^{-4}$.

- **Current Adolescent Trespasser/Visitor**
  The risk assessment assumed that a current adolescent trespasser/visitor could be exposed to SWMU 7 surface sediment. Table 9.3.RME, Appendix H, summarizes the hazards and risks to the current adolescent trespasser/visitor.

  The RME noncarcinogenic hazard associated with exposure to surface sediment (0.01) is below USEPA's target hazard index of 1.0. The RME carcinogenic risk associated with exposure to the surface soil ($8.6x10^{-7}$) is below USEPA's target risk range of $1x10^{-6}$ to $1x10^{-4}$.

7.5.2.2 Surface Soil Exposure

RME risk estimates for exposure to surface soil were calculated for adult maintenance worker and adult and adolescent trespasser/visitor under current site use. Exposure to surface soil via incidental ingestion and dermal contact was evaluated. Inhalation of fugitive dust was not quantified because no COPCs were retained for the soil to air exposure pathway.

- **Current Maintenance Worker**
  The risk assessment assumed that a current maintenance worker could be exposed to SWMU 7 surface soil during lawnmowing and landscaping activities. Table 9.4.RME, Appendix H, summarizes the hazards and risks to the current maintenance worker.

  The noncarcinogenic hazard associated with exposure to surface soil (0.02) is below USEPA's target hazard index of 1.0. The carcinogenic risk associated with exposure to the surface soil ($3.3x10^{-7}$) is below USEPA's target risk range of $1x10^{-6}$ to $1x10^{-4}$.

- **Current Adult Trespasser/Visitor**
  The risk assessment assumed that a current adult trespasser/visitor could be exposed to SWMU 7 surface soil. Table 9.2.RME, Appendix H, summarizes the hazards and risks to the current adult trespasser/visitor.

  The noncarcinogenic hazard associated with exposure to surface soil (0.07) is below USEPA's target hazard index of 1.0. The carcinogenic risk associated with exposure to the surface soil ($8.2x10^{-7}$) is below USEPA's target risk range of $1x10^{-6}$ to $1x10^{-4}$.

- **Current Adolescent Trespasser/Visitor**
  The risk assessment assumed that a current adolescent trespasser/visitor could be exposed to SWMU 7 surface soil. Table 9.3.RME, Appendix H, summarizes the hazards and risks to the current child trespasser/visitor.

  The RME noncarcinogenic hazard associated with exposure to surface soil (0.08) is below USEPA's target hazard index of 1.0. The RME carcinogenic risk associated with exposure to the surface soil ($3.9x10^{-7}$) is below USEPA's target risk range of $1x10^{-6}$ to $1x10^{-4}$.

7.5.2.3 Sediment Exposure

RME risks estimates for exposure to combined surface and subsurface sediment were calculated for adult maintenance worker, adult other worker, and adult and adolescent trespasser/visitor under future site use. Exposure to surface and subsurface sediment via incidental ingestion and dermal contact was evaluated.

- **Future Adult Trespasser/Visitor**
  The risk assessment assumed that a future adult trespasser/visitor could be exposed to SWMU 7 combined surface and subsurface sediment at Desert Cove. Table 9.5.RME, Appendix H, summarizes the hazards and risks to the future adult trespasser/visitor.

  The noncarcinogenic hazard associated with exposure to combined surface and subsurface sediment (0.008) is below USEPA's target hazard index of 1.0. The carcinogenic risk associated with exposure to the combined surface and subsurface sediment ($1.6x10^{-6}$) is within USEPA's target risk range of $1x10^{-6}$ to $1x10^{-4}$.

- **Future Adolescent Trespasser/Visitor**
  The risk assessment assumed that a future adolescent trespasser/visitor could be exposed to SWMU 7 combined surface and subsurface sediment at Desert Cove. Table 9.6.RME, Appendix H, summarizes the hazards and risks to the future adolescent trespasser/visitor.

The RME noncarcinogenic hazard associated with exposure to combined surface and subsurface sediment (0.01) is below USEPA's target hazard index of 1.0. The RME carcinogenic risk associated with exposure to the combined surface and subsurface sediment (8.0×10^{-7}) is below USEPA's target risk range of 1×10^{-6} to 1×10^{-4}.

- **Future Maintenance Worker**
  The risk assessment assumed that a future maintenance worker could be exposed to SWMU 7 combined surface and subsurface sediment at Desert Cove during maintenance of the Cove. Table 9.7.RME, Appendix H, summarizes the hazards and risks to the future maintenance worker.

  The noncarcinogenic hazard associated with exposure to combined surface and subsurface sediment (0.001) is below USEPA's target hazard index of 1.0. The carcinogenic risk associated with exposure to the combined surface and subsurface sediment (3.0×10^{-7}) is below USEPA's target risk range of 1×10^{-6} to 1×10^{-4}.

- **Future Other Worker**
  The risk assessment assumed that a future other worker could be exposed to SWMU 7 combined surface and subsurface sediment at Desert Cove during scuba-diving practice and training in Desert Cove. Table 9.8.RME, Appendix H, summarizes the hazards and risks to the future other worker.

  The noncarcinogenic hazard associated with exposure to combined surface and subsurface sediment (0.003) is below USEPA's target hazard index of 1.0. The carcinogenic risk associated with exposure to the combined surface and subsurface sediment (7.2×10^{-7}) is below USEPA's target risk range of 1×10^{-6} to 1×10^{-4}.

7.5.2.4 Groundwater Exposure

Groundwater beneath the site is not currently used as a potable water supply and not anticipated to be used as a potable water supply in the future. However, the shallow aquifer groundwater data from the site was evaluated as a worst-case risk estimate for potable groundwater use at the site for a future-residential-exposure scenario.

Risk estimates for exposure to shallow aquifer groundwater were calculated for the hypothetical future child and adult residents and industrial workers. Exposure to the shallow aquifer groundwater by a construction worker during excavation was also evaluated as a potential future exposure scenario. It was assumed that a residential user would ingest the water, have dermal contact while bathing (child only), and inhale volatile constituents while showering (adult only). An industrial worker would ingest the water used as a potable water supply for the industrial facility. Future construction workers were evaluated based on exposure via inhalation and the dermal contact.

- **Future Adult Resident (noncarcinogenic hazard**)
  The risk assessment assumed that a future adult resident could be exposed to SWMU 7 upper aquifer groundwater. Table 9.9.RME, Appendix H, summarizes the hazards to the future adult resident. Carcinogenic risks were not calculated for an adult resident, they were calculated for a lifetime resident, following USEPA guidance.

  The RME noncarcinogenic hazard associated with use of the upper aquifer groundwater as a potable water supply (15) exceeds USEPA's target hazard index of 1.0. This hazard

is associated with ingestion of arsenic (HQ = 1.1), iron (HQ = 4.8) and manganese (HQ = 8.1), and the dermal contact with manganese (HQ = 1.1), which all contribute HQs above 1.0. The CT noncarcinogenic hazard associated with potable use of the upper aquifer (3.1) is above USEPA's target hazard index due to the ingestion of arsenic, iron, and manganese, which all contribute HQs below 1.0.

- **Future Child Resident (noncarcinogenic hazard)**
  The risk assessment assumed that a future child resident could be exposed to SWMU 7 upper aquifer groundwater. Table 9.10.RME, Appendix H, summarizes the hazards and risks to the future child resident. Carcinogenic risks were not calculated for a child resident, they were calculated for a lifetime resident, following USEPA guidance.

  The RME noncarcinogenic hazard associated with exposure to the upper aquifer groundwater as a potable water supply (35) exceeds USEPA's target hazard index of 1.0. The hazard due to groundwater use is associated with ingestion of arsenic (HQ = 2.6), iron (HQ = 11) and manganese (HQ = 19), and dermal contact with manganese (HQ = 1.8), which all contribute HQs above 1.0. The CT noncarcinogenic hazard associated with potable use of the upper aquifer (10) is above USEPA's target hazard index due to the ingestion of iron and manganese, which both contribute HQs above 1.0.

- **Future Lifetime Resident (carcinogenic risk)**
  The risk assessment assumed that a lifetime resident could be exposed to SWMU 7 upper aquifer groundwater. Table 9.11.RME, Appendix H, summarizes the carcinogenic risks to the future lifetime resident.

  The RME carcinogenic risk associated with exposure to the upper aquifer groundwater as a potable water supply ($3.6x10^{-4}$) is above USEPA's target risk range of 10^{-6} to 10^{-4} due to the ingestion of arsenic (risk = $2.8x10^{-4}$). The CT carcinogenic risks associated with potable use of the upper aquifer ($3.8x10^{-5}$) is within USEPA's target risk range of $1x10^{-6}$ to $1x10^{-4}$.

- **Future Industrial Worker**
  The risk assessment assumed that a future industrial worker could use upper aquifer groundwater from beneath the site for drinking water. Table 9.12.RME, Appendix H, summarizes the hazards and risks to the future industrial worker.

  The RME noncarcinogenic hazard associated with drinking the upper aquifer groundwater (5.0) exceeds USEPA's target hazard index. Iron (HQ = 1.7) and manganese (HQ = 2.9) have HQs above USEPA's target level of 1.0. The CT noncarcinogenic hazard associated with groundwater ingestion (2.0) is above the USEPA's target level. Ingestion of manganese contributes an HQ greater than one (1.2). The RME carcinogenic risk associated with exposure to groundwater ($7.4x10^{-5}$) is within USEPA's target risk range of $1x10^{-6}$ to $1x10^{-4}$.

- **Future Construction Worker**
  The risk assessment assumed that a future construction worker could be exposed to the upper aquifer groundwater during excavation and construction activities. Table 9.13.RME, Appendix H, summarizes the hazards and risks to the future construction worker.

The RME noncarcinogenic hazard associated with exposure to groundwater (1.8) is above USEPA's target hazard index of 1.0 due to dermal contact with manganese (HQ = 1.7). The CT noncarcinogenic hazard associated with the dermal contact to groundwater (0.40) is below USEPA's target level. The RME carcinogenic risk associated with exposure to groundwater (4.1×10^{-7}) is below USEPA's target risk range of 1×10^{-6} to 1×10^{-4}.

7.5.2.5 Soil Exposure

RME risks estimates for exposure to combined surface and subsurface soil were calculated for adult, child, and lifetime resident, and adult industrial and construction worker under future site use. Exposure to combined soil via incidental ingestion and dermal contact was evaluated. Inhalation of fugitive dust was not quantified because no COPCs were retained for the soil to air exposure pathway.

- **Future Adult Resident (noncarcinogenic hazard**)
  The risk assessment assumed that a future adult resident could be exposed to SWMU 7 combined surface and subsurface soil. Table 9.9.RME, Appendix H, summarizes the hazards to the future adult resident. Carcinogenic risks were not calculated for an adult resident, they were calculated for a lifetime resident, following USEPA guidance.

  The RME noncarcinogenic hazard associated with exposure to combined surface and subsurface soil (0.3) is below USEPA's target hazard index of 1.0.

- **Future Child Resident (noncarcinogenic hazard)**
  The risk assessment assumed that a future child resident could be exposed to SWMU 7 combined surface and subsurface soil. Table 9.10.RME, Appendix H, summarizes the hazards and risks to the future child resident. Carcinogenic risks were not calculated for a child resident, they were calculated for a lifetime resident, following USEPA guidance.

  The RME noncarcinogenic hazard associated with exposure to combined surface and subsurface soil (1.4) exceeds USEPA's target hazard index of 1.0. None of the individual constituents in soil contribute HQs above 0.5, and there are no target organs with HIs above 1.0 due to soil exposure.

  Lead was retained as a COPC for the combined surface and subsurface soil, and therefore, the IEUBK model was used to evaluate exposure to lead in soil by a future child resident. The results of the IEUBK model for SWMU 7 combined surface and subsurface soil are summarized in Table 8. The IEUBK evaluation resulted in a geometric mean blood lead concentration of 2.1 µg/dL (micrograms of lead per deciliter blood) for children 0 to 84 months old. Approximately 0.04% of this population had a blood lead level above USEPA's recommended level of 10 µg/dL. USEPA considers lead not to be a health concern if less than 5 percent of the population has a blood-lead level greater than 10 µg/dL. Therefore, residential exposure to lead in combined surface and subsurface soil at SWMU 7 would not be a potential health concern for residential children.

- **Future Lifetime Resident (carcinogenic risk)**
  The risk assessment assumed that a lifetime resident could be exposed to SWMU 7 combined surface and subsurface soil. Table 9.11.RME, Appendix H, summarizes the carcinogenic risks to the future lifetime resident.

The RME carcinogenic risk associated with exposure to combined surface and subsurface soil ($6.5x10^{-5}$) is within USEPA's target risk range of 10^{-6} to 10^{-4}.

- **Future Industrial Worker**
  The risk assessment assumed that a future industrial worker could be exposed to combined surface and subsurface soil. Table 9.12.RME, Appendix H, summarizes the hazards and risks to the future industrial worker.

  The RME noncarcinogenic hazard associated with exposure to soil (0.3) is below USEPA's target hazard index of 1.0. The RME carcinogenic risk associated with exposure to the soil ($2.6x10^{-5}$) is within USEPA's target risk range of $1x10^{-6}$ to $1x10^{-4}$.

  The Adult Lead model (USEPA, January 2003) was used to evaluate exposure to lead in soil by a future adult industrial worker, since lead was selected as a COPC for combined surface and subsurface soils. The model assumes that pregnant women and their fetuses would be most susceptible to adverse effects resulting from exposures to lead and therefore predicts blood lead concentrations in women of child bearing age, as well as fetal blood concentrations.

  The results of the Adult Lead model for SWMU 7 combined surface and subsurface soil are summarized in Table 9. Blood lead concentrations were calculated for homogenous and heterogenous populations. For homogenous populations, the adult lead model predicted a geometric mean blood lead concentration of 1.6 µg/dL (micrograms of lead per deciliter blood) for women of child bearing age and a 95th percentile blood lead concentrations of 4.8 µg/dL among fetuses of these women. Similarly, for heterogenous populations, the adult lead model predicted a geometric mean blood lead concentration of 1.8 µg/dL for women of child bearing age and a 95th percentile blood lead concentrations of 6.3 µg/dL among fetuses of these women. The model also predicts that approximately 0.4% and 1.4% of the fetal population will have blood lead levels above USEPA's recommended concentrations of 10 µg/dL, among the homogenous and heterogenous populations, respectively. USEPA considers lead not to be a health concern if less than 5 percent of the population has a blood-lead level greater than 10 µg/dL. Therefore, non-residential exposure of adults to lead in combined surface and subsurface soil at SWMU 7 would not be a potential health concern.

- **Future Construction Worker**
  The risk assessment assumed that a future construction worker could be exposed to combined surface and subsurface soil during excavation and construction activities. Table 9.13.RME, Appendix H, summarizes the hazards and risks to the future construction worker.

  The RME noncarcinogenic hazard associated with exposure to soil (0.3) is below USEPA's target hazard index of 1.0. The RME carcinogenic risk associated with exposure to the soil ($1.1x10^{-6}$) is below USEPA's target risk range of $1x10^{-6}$ to $1x10^{-4}$.

7.6 Uncertainty Assessment

The risk measures used in Superfund risk assessments are not fully probabilistic estimates of risk but are conditional estimates given that a set of assumptions about exposure and

toxicity are realized. Thus, it is important to specify the assumptions and uncertainties inherent in the risk assessment to place the risk estimates in proper perspective (USEPA, December 1989).

7.6.1 Uncertainty in COPC Selection

The sampling conducted at SWMU 7 focused on areas of known or suspected contamination. The uncertainty associated with sampling and the possibility of missing a contaminated location is expected to be minimal based on the methods used to select the sampling locations. The general assumptions used in the COPC selection process were conservative to ensure that true COPCs were not eliminated from the quantitative risk assessment and that the highest possible risk was estimated.

The metals retained as COPCs are a source of uncertainty in the risk assessment. The metals may not be related to site activities, but may have been retained as COPCs based on the conservative screening process. A comparison of the risk drivers to background concentrations is included in Section 7.6.5.

7.6.2 Uncertainty Associated with Exposure Assessment

Most of the exposure pathways evaluated for the site were assumed, and the exposure factors used for the quantitation of exposure were conservative and reflect worst-case or upper-bound assumptions on the exposure. The reliability of the values chosen for the exposure factors also contributes substantially to the uncertainty of the resulting risk estimates. Because most of the exposure factors are worst-case or upper-bound assumptions, the resulting risks are worst-case and likely to overestimate the actual risk.

It was assumed that the site might be used for residential purposes in the future. Based on the nature of NAB Little Creek and the area of SWMU 7, this is not a likely scenario. It is particularly not likely that the shallow groundwater would ever be used as a potable or industrial water supply due to the low yield of the shallow aquifer and the availability of better water supplies.

Site-related contamination would be expected to decrease with time. The risk assessment assumed concentrations would remain constant throughout the exposure period. This will likely result in an overestimation of risk.

It was assumed that the receptor would be exposed to the most contaminated location at the site for the full exposure duration. This is not likely since the receptors' area of activity is larger than this location. Therefore, this will result in an over-estimation of risk.

7.6.3 Uncertainty Associated with Toxicity Assessment

Uncertainty associated with the noncarcinogenic toxicity factors is included in Appendix H, Tables 5.1 and 5.2. Several uncertainty factors (UFs) were applied to extrapolate dose points from animal studies to humans. These UFs range between 10 and 10,000. Additional modification factors are also used based on the professional judgment of the USEPA. Therefore, there is a high degree of uncertainty in the noncarcinogenic toxicity criteria, based on the available scientific data for each compound. The noncarcinogenic toxicity factors are most likely an overestimate of actual toxicity.

CSFs developed by USEPA represent upper bound estimates. Carcinogenic risks generated in this assessment should be regarded as an upper bound estimate on the potential carcinogenic risks rather than an accurate representation of carcinogenic risk. The true carcinogenic risk is likely to be less than the predicted value (USEPA, December 1989).

The uncertainty associated with CSFs is also associated with the low dose extrapolation where carcinogenicity at low doses is assumed to be straight-line responses. This is a conservative assumption, which introduces a high uncertainty into slope factors that are extrapolated from this area of the dose-response curve.

Use of provisional toxicity factors increases the degree of uncertainty associated with the risk assessment. Provisional chronic toxicity values used in this assessment include oral RfDs for aluminum, copper, iron, thallium, and vanadium; inhalation RfDs for chloroform and tetrachloroethene; oral CSFs for several PAHs, methyl-tert-butyl ether and tetrachloroethene; and the inhalation CSF for tetrachloroethene. Therefore, the quantitative estimates of risk for these constituents are associated with greater uncertainty. Since IRIS does not include subchronic toxicity values, the subchronic RfDs used in this assessment are also provisional toxicity values and hence associated with greater uncertainty.

There is a large degree of uncertainty associated with the oral to dermal adjustment factors (based on chemical-specific gastrointestinal absorption factors) used to transform the oral RfDs based on administered doses to dermal RfDs based on absorbed doses. It is not know if the adjustment factor results in an underestimate or overestimate of the actual toxicity associated with dermal exposure.

7.6.4 Uncertainty in Risk Characterization

The uncertainties identified in each component of risk assessment ultimately contribute to uncertainty in risk characterization. The addition of risks and HIs across pathways and chemicals contributes to uncertainty based on the interaction of chemicals, such as additivity, synergism, potentiation, and susceptibility of exposed receptors. The simple assumption of additivity used for this site may or may not be accurate and may over- or under-estimate risk.

7.6.5 Effect of Comparison of Risk Drivers to Background Concentrations

The background data and statistical evaluation of the background data included in the *Final Background Investigation for NAB Little Creek* (CH2M HILL, December 2000) and *the Final Background Investigation Addendum for Summer Groundwater Sampling Event, NAB Little Creek Virginia Beach, Virginia* (CH2M HILL, March 2003) were used to determine if the SWMU 7 groundwater risk drivers may be present at concentrations similar to background concentrations at NAB Little Creek. The methodology discussed in the background investigation report was followed for this evaluation. The maximum detected site concentrations were compared to the 95% upper tolerance limits (UTLs) (filtered data were used), and a population to population comparison was conducted. For the population to population comparison, if the site data and background data fit the same distribution (i.e. both normal or lognormal) the student t-test was used. If the data do not fit the same distribution the nonparametric Mann-Whitney U test was used. If both the comparison to the 95% UTL and the population to population comparison indicate that the site

concentration is statistically similar to the background concentration, it was assumed that the site concentration is statistically similar to the background concentration. If one of these tests indicated that the site concentration is statistically greater than the background concentration, it was assumed that the site and background data are not statistically similar. Tables 11.1 and 11.1a present the background statistical evaluations.

The three constituents that are risk drivers for shallow aquifer groundwater potable use scenarios are arsenic, iron, and manganese. Based on a population to population statistical comparison, arsenic was detected in the SWMU 7 shallow aquifer filtered groundwater samples at concentrations statistically similar to the NAB Little Creek background upper aquifer filtered groundwater samples. Iron and manganese were detected in the SWMU 7 filtered groundwater samples at concentrations statistically above the background levels. Elimination of arsenic as a COPC from groundwater would result in the carcinogenic risk for the lifetime residential receptor who uses shallow aquifer groundwater as a potable water supply being reduce to a risk level within USEPA's target risk range of 10^{-6} to 10^{-4}. It would not affect the result of the noncarcinogenic hazard evaluation.

The one constituent that is the risk driver for shallow aquifer groundwater through direct contact (construction worker scenario) is manganese. Manganese was detected in the SWMU 7 shallow aquifer unfiltered groundwater samples at concentrations statistically above the NAB Little Creek background upper aquifer unfiltered groundwater samples.

7.7 Summary

This baseline risk assessment was conducted to evaluate the potential human-health risks associated with the presence of site-related soil, groundwater, and sediment contamination at NAB Little Creek SWMU 7. This risk assessment quantifies potential human-health risks at SWMU 7 under current conditions and under potential current and future use scenarios, if no additional remediation is implemented.

The hazards and risks are calculated in Appendix H, Tables 7.1.RME through 7.13.RME and 7.1.CT through 7.5.CT. Tables 9.1.RME through 9.13.RME in Appendix H summarize the RME total potential risks to each receptor. Tables 9.1.CT through 9.5.CT in Appendix H summarize the CT total potential risks to each receptor that had risks that exceeded an HI of 1.0 or a carcinogenic risk of $1x10^{-4}$. Tables 10.1.RME through 10.5.RME, and 10.1.CT through 10.3.CT in Appendix H summarize only the chemicals that contribute a HI greater than 0.1 to a total HI greater than 1.0 or carcinogenic risk greater than 10^{-6} to a total carcinogenic risk greater than 10^{-4}.

There are no risks or hazards that exceed USEPA target levels for the other worker, maintenance worker or the adult and adolescent trespasser/visitor under current and future site use. The following receptors had total RME noncarcinogenic hazards or carcinogenic risks that exceeded USEPA's target levels:

- Future adult resident exposed to groundwater
- Future child resident exposed to groundwater
- Future child/adult exposed to groundwater
- Future industrial worker exposed to groundwater
- Future construction worker exposed to groundwater

Future potable use of Columbia Aquifer groundwater would result in noncarcinogenic hazards slightly above USEPA's target hazard index of 1.0 to child and adult residents, and industrial workers, and carcinogenic risks above USEPA's target level of 10^{-6} to 10^{-4} for child/adult residents. It is extremely unlikely that the Columbia Aquifer groundwater will be used as a future source of potable water, due to the low yield and availability of better water supplies. The noncarcinogenic hazards are associated with arsenic, iron and manganese. The carcinogenic risk for the resident child/adult is from the ingestion of arsenic. Arsenic was detected in the SWMU 7 filtered groundwater samples at concentrations statistically similar to concentrations detected in the Little Creek background filtered groundwater samples. Elimination of arsenic as a COPC would result in the carcinogenic risk falling within USEPA's target risk level.

Future exposure to Columbia Aquifer groundwater in an open excavation by an adult construction worker may result in a noncarcinogenic hazard above USEPA's target hazard index of 1.0 due to dermal contact with manganese. The CT noncarcinogenic hazard is below USEPA's target HI.

7.8 References

American Cancer Society. *Cancer Facts and Figures – 2002*. American Cancer Society, Atlanta, Georgia. 2002.

CH2M HILL. *Final Site Investigation SWMU 7 and 8 for Naval Amphibious Base Little Creek Virginia Beach, Virginia*. August 2001.

CH2M HILL. *Final Background Investigation for NAB Little Creek, Virginia Beach, Virginia.* December 2000.

CH2M HILL. Final Background Investigation Addendum for Summer Groundwater Sampling Event, NAB Little Creek, Virginia Beach, Virginia. March 2003.

HEAST. *Health Effects Assessment Summary Tables, Annual Update*. USEPA, Environmental Criterion Assessment Office, Office of Research and Development, Cincinnati, OH. 1997.

Foster, S. A. and P. C. Chrostowski. *Inhalation Exposures to Volatile Organic Contaminants in the Shower*. ICF-Clement Associates, Inc. Washington, D.C. 1987.

USEPA. *Guidelines for Health Risk Assessment of Chemical Mixtures*. Federal Register Vol. 51 34014-34041. September 24, 1986.

USEPA. *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part A, Interim Final*. Office of Solid Waste and Emergency Response. USEPA/540/1-89/002. December 1989.

USEPA. *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part B, Interim Final*. Office of Solid Waste and Emergency Response. 1991.

USEPA. *Draft Guidance on the Selection of Analytical Metal Results from Monitoring Well Samples for Use in the Quantitative Assessment of Risk*. USEPA Region III. August 10, 1992.

USEPA. *Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening*. Region III, Hazardous Waste Management Division, Office of Superfund Programs. EPA/903/R-93-001. January 1993.

USEPA. *Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities*. OSWER Directive #9355.4-12. July 14, 1994.

USEPA. *Assessing Dermal Exposure from Soil*. Region III Technical Guidance Manual, Risk Assessment. Hazardous Waste Management Division, Office of Superfund Programs. EPA/903-K-003. December 1995.

USEPA. *Soil Screening Guidance: User's Guide*. Office of Solid Waste and Emergency Response, Washington, D.C. EPA/540/R-96/018. April 1996.

USEPA. *Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessment) Final.* Office Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. Publication 9285.7-47. December 2001.

USEPA. ProUCL, Version 2.1. Prepared by Lockheed Martin Environmental Services. April 2002.

USEPA, NPL Site Narrative Listing. http://epa.gov/reg3hwmd/super/VA/naval-amphibious/pad.htm Updated May 2002.

USEPA. *Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil.* EPA-540-R-03-001, OSWER Directive 9285.7-54. January 2003.

USEPA. *Human Health Toxicity Values in Superfund Risk Assessments*. OSWER Directive 9285.7-53. December 5, 2003.

USEPA. *USEPA Region III Risk-Based Concentration Table*. April 14, 2004.

USEPA. *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment (Final*). Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. EPA/540/R/99/005. July 2004.

USEPA. Integrated Risk Information System Database. 2004.

Table 7-1
Summary of Data Quantitatively Used in Risk Assessment
SWMU 7
Little Creek

Medium	Date of Sampling	Sample Location	Sample	Parameters
Surface Soil				
SWMU 7				
	5/23/2000	LW07-DP05	LW07-SS05-00	PAHs, Metals
	5/22/2000	LW07-DP06	LW07-SS06-00	PAHs, Metals
	5/22/2000	LW07-DP07	LW07-SS07-00	PAHs, Metals
	5/22/2000	LW07-MW02	LW07-SS02-00	VOCs, SVOCs, Metals, Pest/PCBs
	5/22/2000	LW07-MW02	LW07-SS02-00P	VOCs, SVOCs, Metals, Pest/PCBs
	8/26/2002	LW07-SO18	LW07-SS18-00	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO19	LW07-SS19-00	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO20	LW07-SS20-00	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO21	LW07-SS21-00	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO22	LW07-SS22-00	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO25	LW07-SS25-00	PAHs, Metals, Cyanide
Surface Sediment				
	6/2/2000	LW07-SD01	LW07-SD01-00	SVOCs, Metals, Pest/PCBs
	6/1/2000	LW07-SD02	LW07-SD02-00	PAHs, Metals, Pest/PCBs
	6/1/2000	LW07-SD03	LW07-SD03-00	PAHs, Metals, Pest/PCBs
	6/1/2000	LW07-SD04	LW07-SD04-00	PAHs, Metals, Pest/PCBs
	6/1/2000	LW07-SD05	LW07-SD05-00	PAHs, Metals, Pest/PCBs
	6/1/2000	LW07-SD05	LW07-SD05-00P	PAHs, Metals, Pest/PCBs
Node (surface sediment)	9/30/2002	LW07-B5-SD201	LW07-B5-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/30/2002	LW07-B5-SD201	LW07-B5-SD201P-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/29/2002	LW07-B7-SD201	LW07-B7-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-D5-SD201	LW07-D5-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-F3-SD201	LW07-F3-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-F5-SD201	LW07-F5-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-H1-SD201	LW07-H1-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-H1-SD201	LW07-H1-SD201P-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-H3-SD201	LW07-H3-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-H3-SD201	LW07-H3-SD201P-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/26/2002	LW07-H5-SD201	LW07-H5-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-J4-SD201	LW07-J4-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-K1-SD201	LW07-K1-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-K3-SD201	LW07-K3-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-K4-SD201	LW07-K4-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-K5-SD201	LW07-K5-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-K6-SD201	LW07-K6-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	10/1/2002	LW07-L2-SD201	LW07-L2-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-L5-SD201	LW07-L5-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	10/1/2002	LW07-L6-SD201	LW07-L6-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-M1-SD201	LW07-M1-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-M3-SD201	LW07-M3-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin

Table 7-1
Summary of Data Quantitatively Used in Risk Assessment
SWMU 7
Little Creek

Medium	Date of Sampling	Sample Location	Sample	Parameters
Composite (surface sediment)	9/30/2002	LW07-B5-SD202	LW07-B5-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/29/2002	LW07-B7-SD202	LW07-B7-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-D5-SD202	LW07-D5-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-F3-SD202	LW07-F3-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-F5-SD202	LW07-F5-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-H1-SD202	LW07-H1-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-H3-SD202	LW07-H3-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/26/2002	LW07-H5-SD202	LW07-H5-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-J4-SD202	LW07-J4-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-K1-SD202	LW07-K1-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-K3-SD202	LW07-K3-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-K4-SD202	LW07-K4-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-K5-SD202	LW07-K5-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-K6-SD202	LW07-K6-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-L5-SD202	LW07-L5-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-M1-SD202	LW07-M1-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-M3-SD202	LW07-M3-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
Sediment*				
	6/2/2000	LW07-SD01	LW07-SD01-00	SVOCs, Metals, Pest/PCBs
	6/1/2000	LW07-SD02	LW07-SD02-00	PAHs, Metals, Pest/PCBs
	6/1/2000	LW07-SD03	LW07-SD03-00	PAHs, Metals, Pest/PCBs
	6/1/2000	LW07-SD04	LW07-SD04-00	PAHs, Metals, Pest/PCBs
	6/1/2000	LW07-SD05	LW07-SD05-00	PAHs, Metals, Pest/PCBs
	6/1/2000	LW07-SD05	LW07-SD05-00P	PAHs, Metals, Pest/PCBs
Vibracore (subsurface sediment)	9/30/2002	LW07-B5-SD201	LW07-B5-SD201-02-02C	PAHs, Metals, Cyanide, Total Tin
	9/30/2002	LW07-B5-SD201	LW07-B5-SD201P-02-02C	PAHs, Metals, Cyanide, Total Tin
	9/29/2002	LW07-B7-SD201	LW07-B7-SD201-02-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-D5-SD201	LW07-D5-SD201-02-02C	PAHs, Metals, Cyanide, Total Tin
	9/29/2002	LW07-F3-SD201	LW07-F3-SD201-02-02C	PAHs, Metals, Cyanide, Total Tin
	9/29/2002	LW07-F5-SD201	LW07-F5-SD201-02-02C	PAHs, Metals, Cyanide, Total Tin
	9/29/2002	LW07-H1-SD201	LW07-H1-SD201-02-02C	PAHs, Metals, Cyanide, Total Tin
	9/30/2002	LW07-H3-SD201	LW07-H3-SD201-02-02C	PAHs, Metals, Cyanide, Total Tin
	9/26/2002	LW07-H5-SD201	LW07-H5-SD201-02-02C	PAHs, Metals, Cyanide, Total Tin
	9/30/2002	LW07-J4-SD201	LW07-J4-SD201-02-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-K1-SD201	LW07-K1-SD201-02-02C	PAHs, Metals, Cyanide, Total Tin
	9/29/2002	LW07-K3-SD201	LW07-K3-SD201-02-02C	PAHs, Metals, Cyanide, Total Tin
	9/29/2002	LW07-K3-SD201	LW07-K3-SD201P-02-02C	PAHs, Metals, Cyanide, Total Tin
	9/30/2002	LW07-K4-SD201	LW07-K4-SD201-02-02C	PAHs, Metals, Cyanide, Total Tin
	9/30/2002	LW07-K4-SD201	LW07-K4-SD201P-02-02C	PAHs, Metals, Cyanide, Total Tin
	9/30/2002	LW07-K5-SD201	LW07-K5-SD201-02-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-K6-SD201	LW07-K6-SD201-02-02C	PAHs, Metals, Cyanide, Total Tin
	10/1/2002	LW07-L2-SD201	LW07-L2-SD201-02-02C	PAHs, Metals, Cyanide, Total Tin
	9/29/2002	LW07-L5-SD201	LW07-L5-SD201-02-02C	PAHs, Metals, Cyanide, Total Tin
	10/1/2002	LW07-L6-SD201	LW07-L6-SD201-02-02C	PAHs, Metals, Cyanide, Total Tin
	9/29/2002	LW07-M1-SD201	LW07-M1-SD201-02-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-M3-SD201	LW07-M3-SD201-02-02C	PAHs, Metals, Cyanide, Total Tin

Table 7-1
Summary of Data Quantitatively Used in Risk Assessment
SWMU 7
Little Creek

Medium	Date of Sampling	Sample Location	Sample	Parameters
Node (surface sediment)	9/30/2002	LW07-B5-SD201	LW07-B5-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/30/2002	LW07-B5-SD201	LW07-B5-SD201P-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/29/2002	LW07-B7-SD201	LW07-B7-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-D5-SD201	LW07-D5-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-F3-SD201	LW07-F3-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-F5-SD201	LW07-F5-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-H1-SD201	LW07-H1-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-H1-SD201	LW07-H1-SD201P-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-H3-SD201	LW07-H3-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-H3-SD201	LW07-H3-SD201P-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/26/2002	LW07-H5-SD201	LW07-H5-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-J4-SD201	LW07-J4-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-K1-SD201	LW07-K1-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-K3-SD201	LW07-K3-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-K4-SD201	LW07-K4-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-K5-SD201	LW07-K5-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-K6-SD201	LW07-K6-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	10/1/2002	LW07-L2-SD201	LW07-L2-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-L5-SD201	LW07-L5-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	10/1/2002	LW07-L6-SD201	LW07-L6-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-M1-SD201	LW07-M1-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-M3-SD201	LW07-M3-SD201-00-02C	PAHs, Metals, Cyanide, Total Tin
Composite (surface sediment)	9/30/2002	LW07-B5-SD202	LW07-B5-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/29/2002	LW07-B7-SD202	LW07-B7-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-D5-SD202	LW07-D5-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-F3-SD202	LW07-F3-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-F5-SD202	LW07-F5-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-H1-SD202	LW07-H1-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-H3-SD202	LW07-H3-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/26/2002	LW07-H5-SD202	LW07-H5-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-J4-SD202	LW07-J4-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-K1-SD202	LW07-K1-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-K3-SD202	LW07-K3-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-K4-SD202	LW07-K4-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-K5-SD202	LW07-K5-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-K6-SD202	LW07-K6-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-L5-SD202	LW07-L5-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/27/2002	LW07-M1-SD202	LW07-M1-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin
	9/28/2002	LW07-M3-SD202	LW07-M3-SD202-00-02C	PAHs, Metals, Cyanide, Total Tin

Table 7-1
Summary of Data Quantitatively Used in Risk Assessment
SWMU 7
Little Creek

Medium	Date of Sampling	Sample Location	Sample	Parameters
Groundwater				
SWMU 7				
	5/31/2000	LW07-MW01	LW07-MW01-00B	VOCs, SVOCs, Metals, Diss. Metals, Pest/PCBs
	5/31/2000	LW07-MW02	LW07-MW02-00B	VOCs, SVOCs, Metals, Diss. Metals, Pest/PCBs
	5/31/2000	LW07-MW03	LW07-MW03-00B	VOCs, SVOCs, Metals, Diss. Metals, Pest/PCBs
	9/4/2002	LW07-MW01	LW07-MW01-02C	VOCs, SVOCs, Metals, Cyanide, Diss. Metals
	9/4/2002	LW07-MW02	LW07-MW02-02C	VOCs, SVOCs, Metals, Cyanide, Diss. Metals
	9/4/2002	LW07-MW03	LW07-MW03-02C	VOCs, SVOCs, Metals, Cyanide, Diss. Metals
	9/3/2002	LW07-MW04	LW07-MW04-02C	VOCs, SVOCs, Metals, Cyanide, Diss. Metals
	9/3/2002	LW07-MW04	LW07-MW04P-02C	VOCs, SVOCs, Metals, Cyanide, Diss. Metals
	9/4/2002	LW07-MW05	LW07-MW05-02C	VOCs, SVOCs, Metals, Cyanide, Diss. Metals
	9/3/2002	LW07-MW06	LW07-MW06-02C	VOCs, SVOCs, Metals, Cyanide, Diss. Metals
Soil*				
SWMU 7				
	5/23/2000	LW07-DP04	LW07-SS04-00	PAHs, Metals
	5/23/2000	LW07-DP04	LW07-SB04-01	PAHs, Metals
	5/23/2000	LW07-DP05	LW07-SS05-00	PAHs, Metals
	5/23/2000	LW07-DP05	LW07-SB05-01	PAHs, Metals
	5/22/2000	LW07-DP06	LW07-SS06-00	PAHs, Metals
	5/22/2000	LW07-DP06	LW07-SB06-01	PAHs, Metals
	5/22/2000	LW07-DP07	LW07-SS07-00	PAHs, Metals
	5/22/2000	LW07-DP07	LW07-SB07-01	PAHs, Metals
	5/22/2000	LW07-DP08	LW07-SS08-00	PAHs, Metals
	5/22/2000	LW07-DP08	LW07-SS08-00P	PAHs, Metals
	5/22/2000	LW07-DP08	LW07-SB08-01	PAHs, Metals
	5/22/2000	LW07-DP09	LW07-SS09-00	PAHs, Metals
	5/22/2000	LW07-DP09	LW07-SB09-01	PAHs, Metals
	5/22/2000	LW07-DP10	LW07-SS10-00	PAHs, Metals
	5/22/2000	LW07-DP10	LW07-SB10-01	PAHs, Metals
	5/22/2000	LW07-DP11	LW07-SS11-00	PAHs, Metals
	5/22/2000	LW07-DP11	LW07-SB11-01	PAHs, Metals
	5/22/2000	LW07-DP12	LW07-SS12-00	PAHs, Metals
	5/22/2000	LW07-DP12	LW07-SB12-01	PAHs, Metals
	5/22/2000	LW07-DP13	LW07-SS13-00	PAHs, Metals
	5/22/2000	LW07-DP13	LW07-SB13-01	PAHs, Metals
	5/22/2000	LW07-DP14	LW07-SS14-00	PAHs, Metals
	5/22/2000	LW07-DP14	LW07-SS14-00P	PAHs, Metals
	5/22/2000	LW07-DP14	LW07-SB14-01	PAHs, Metals
	5/22/2000	LW07-MW01	LW07-SS01-00	VOCs, SVOCs, Metals, Pest/PCBs
	5/22/2000	LW07-MW01	LW07-SB01-01	VOCs, SVOCs, Metals, Pest/PCBs
	5/22/2000	LW07-MW02	LW07-SS02-00	VOCs, SVOCs, Metals, Pest/PCBs
	5/22/2000	LW07-MW02	LW07-SS02-00P	VOCs, SVOCs, Metals, Pest/PCBs
	5/22/2000	LW07-MW02	LW07-SB02-01	VOCs, SVOCs, Metals, Pest/PCBs
	5/22/2000	LW07-MW03	LW07-SS03-00	VOCs, SVOCs, Metals, Pest/PCBs
	5/22/2000	LW07-MW03	LW07-SB03-01	VOCs, SVOCs, Metals, Pest/PCBs

Table 7-1
Summary of Data Quantitatively Used in Risk Assessment
SWMU 7
Little Creek

Medium	Date of Sampling	Sample Location	Sample	Parameters
(Soil* continued)	8/26/2002	LW07-SO15	LW07-SB15-02	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO15	LW07-SB15-01	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO15	LW07-SS15-00	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO16	LW07-SB16P-02	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO16	LW07-SB16-01	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO16	LW07-SB16-02	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO16	LW07-SS16-00	PAHs, Metals, Cyanide
	9/5/2002	LW07-SO17	LW07-SS17-00	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO17	LW07-SB17-02	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO17	LW07-SB17-01	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO18	LW07-SB18-02	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO18	LW07-SB18P-02	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO18	LW07-SB18-01	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO18	LW07-SS18-00	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO19	LW07-SB19-02	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO19	LW07-SB19-01	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO19	LW07-SS19-00	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO20	LW07-SB20P-02	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO20	LW07-SB20-02	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO20	LW07-SB20-01	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO20	LW07-SS20-00	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO21	LW07-SB21P-02	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO21	LW07-SB21-02	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO21	LW07-SB21-01	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO21	LW07-SS21-00	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO22	LW07-SB22-02	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO22	LW07-SB22-01	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO22	LW07-SS22-00	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO23	LW07-SB23-01	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO23	LW07-SB23-02	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO23	LW07-SS23-00	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO24	LW07-SB24-02	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO24	LW07-SB24-01	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO24	LW07-SS24-00	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO25	LW07-SB25-02	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO25	LW07-SB25-01	PAHs, Metals, Cyanide
	8/26/2002	LW07-SO25	LW07-SS25-00	PAHs, Metals, Cyanide

Soil*- surface and subsurface soil combined.
Sediment*- surface and subsurface sediment combined.

Table 7-2
Summary of COPCs for the HHRA
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Surface Soil	Surface Sediment	Sediment*	Groundwater	Soil*
SWMU 7	***Desert Cove***	***Desert Cove***	***Upper Aquifer-Tap Water***	***SWMU 7***
Benzo(a)pyrene	Benzo(a)pyrene	Benzo(a)pyrene	Chloroform	Benzo(a)anthracene
Aluminum	Benzo(b)fluoranthene	Benzo(b)fluoranthene	Methyl-tert-butyl ether (MTBE)	Benzo(a)pyrene
Arsenic	Dibenz(a,h)anthracene	Dibenz(a,h)anthracene	Tetrachloroethene	Benzo(b)fluoranthene
Chromium	Arsenic	Arsenic	Arsenic	Benzo(k)fluoranthene
Iron	Iron	Iron	Iron	Dibenz(a,h)anthracene
Manganese	Lead	Lead	Manganese	Indeno(1,2,3-cd)pyrene
Vanadium				Aluminum
			Upper Aquifer-Excavation Pit	Arsenic
			Chloroform	Chromium
			Methyl-tert-butyl ether (MTBE)	Copper
			Tetrachloroethene	Iron
			Arsenic	Lead
			Chromium	Manganese
			Iron	Thallium
			Manganese	Vanadium
			Vanadium	
			Inhalation	
			Chloroform	
			Methyl-tert-butyl ether (MTBE)	
			Tetrachloroethene	

Sediment*- Surface and subsurface sediment combined.
Soil* - Surface and subsurface soil combined.

Table 7-3
Potentially Complete Human Health Exposure Pathways
Conceptual Site Model
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Land Use	Contaminated Media	Potentially Exposed Populations	Exposure Route (Human Health)	Pathway Selected for Evaluation	Rationale
Current					
Industrial	Surface Sediment	Other Worker	Ingestion and dermal contact	Yes	Other workers could contact surface sediment in cove during scuba diving practice and training.
Industrial	Surface Sediment	Trepassers/Visitors - Adult and Adolescents	Ingestion and dermal contact	Yes	Although access to site is limited a trespasser could contact site surface sediment in cove during swimming.
Industrial	Surface Soil	Maintenance Worker	Ingestion and dermal contact	Yes	Site maintenance workers could contact surface soil while mowing grass or performing other activities at site.
Industrial	Surface Soil	Trepassers/Visitors - Adult and Adolescents	Ingestion and dermal contact	Yes	Although access to site is limited a trespasser could contact site surface soil.
Future					
Industrial or Residential	Sediment*	Trepassers/Visitors - Adult and Adolescents	Ingestion and dermal contact	Yes	Although access to site is limited a trespasser could contact site sediment in cove during swimming.
Industrial	Sediment*	Maintenance Worker	Ingestion and dermal contact	Yes	Site maintenance workers could contact sediment while mowing grass or performing other activities at site and may inhale vapors and dust while working.
Industrial	Sediment*	Other Worker	Ingestion and dermal contact	Yes	Other workers could contact sediment in cove during scuba diving practice and training.
Residential	Groundwater	Residents - Adults and Children	Ingestion, dermal contact, and inhalation	Yes	Although unlikely, groundwater could be used as a potable water supply in the future
	Surface and Subsurface Soil		Ingestion and dermal contact	Yes	Although unlikely, if site used for future residential development, residents could contact soil.
	Groundwater	Construction Worker	Dermal contact and inhalation	Yes	Construction workers may contact groundwater and inhale vapors during excavation activities.
	Surface and Subsurface Soil		Ingestion and dermal contact	Yes	Exposure to soil during construction activities
Industrial	Groundwater	Industrial Worker	Ingestion	Yes	If future site use is industrial, future Industrial workers may ingest groundwater and inhale vapors.
	Surface and Subsurface Soil		Ingestion and dermal contact	Yes	If future site use is industrial, future industrial workers could contact surface and subsurface soil.

Table 7-4
Summary of RME Cancer Risks and Hazard Indices
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $>10^{-4}$	Chemicals with Cancer Risks $>10^{-5}$ and $<10^{-4}$	Chemicals with Cancer Risks $>10^{-6}$ and $<10^{-5}$	Hazard Index	Chemicals with HI>1
Current Other Worker	Surface Sediment	Ingestion	2.8E-07				0.0027	
		Dermal Contact	4.9E-07				0.00092	
		Inhalation	NA				NA	
		Total	7.7E-07				0.0036	
	All Media	Total	7.7E-07				0.0036	
Current Trespasser/Visitor Adult	Surface Sediment	Ingestion	5.9E-07				0.0058	
		Dermal Contact	1.0E-06				0.0021	
		Inhalation	NA				NA	
		Total	1.6E-06				0.0079	
	Surface Soil	Ingestion	5.3E-07				0.025	
		Dermal Contact	2.9E-07				0.042	
		Inhalation	NA				NA	
		Total	8.2E-07				0.067	
	All Media	Total	2.4E-06				0.075	
Current Trespasser/Visitor Adolescent	Surface Sediment	Ingestion	3.0E-07				0.0079	
		Dermal Contact	5.6E-07				0.0028	
		Inhalation	NA				NA	
		Total	8.6E-07				0.011	
	Surface Soil	Ingestion	2.7E-07				0.035	
		Dermal Contact	1.2E-07				0.046	
		Inhalation	NA				NA	
		Total	3.9E-07				0.081	
	All Media	Total	1.2E-06				0.092	
Current Maintenance Worker Adult	Surface Soil	Ingestion	2.5E-07				0.012	
		Dermal Contact	7.8E-08				0.011	
		Inhalation	NA				NA	
		Total	3.3E-07				0.023	
	All Media	Total	3.3E-07				0.023	
Future Trespasser/Visitor Adult	Sediment*	Ingestion	5.3E-07				0.0056	
		Dermal Contact	1.1E-06				0.0019	
		Inhalation	NA				NA	
		Total	1.6E-06				0.0075	
	All Media	Total	1.6E-06				0.0075	
Future Trespasser/Visitor Adolescent	Sediment*	Ingestion	2.7E-07				0.0077	
		Dermal Contact	5.3E-07				0.0026	
		Inhalation	NA				NA	
		Total	8.0E-07				0.010	
	All Media	Total	8.0E-07				0.010	
Future Maintenance Worker Adult	Sediment*	Ingestion	1.1E-07				0.0011	
		Dermal Contact	1.9E-07				0.00034	
		Inhalation	NA				NA	
		Total	3.0E-07				0.0014	
	All Media	Total	3.0E-07				0.0014	
Future Other Worker Adult	Sediment*	Ingestion	2.6E-07				0.0026	
		Dermal Contact	4.6E-07				0.00081	
		Inhalation	NA				NA	
		Total	7.2E-07				0.0034	
	All Media	Total	7.2E-07				0.0034	
Future Resident Adult	Groundwater	Ingestion	NA				14	Arsenic, Iron, Manganese
		Dermal Contact	NA				1.1	Manganese
		Inhalation	NA				0.000	
		Total	NA				15	
	Soil*	Ingestion	NA				0.00	
		Dermal Contact	NA				0.00	
		Inhalation	NA				NA	
		Total	NA				0.00	
	All Media	Total	NA				15	
Future Resident Child	Groundwater	Ingestion	NA				33	Arsenic, Iron, Manganese
		Dermal Contact	NA				1.9	Manganese
		Inhalation	NA				NA	
		Total	NA				35	
	Soil*	Ingestion	NA				1.1	
		Dermal Contact	NA				0.25	
		Inhalation	NA				NA	
		Total	NA				1.4	
	All Media	Total	NA				36	

Table 7-4
Summary of RME Cancer Risks and Hazard Indices
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

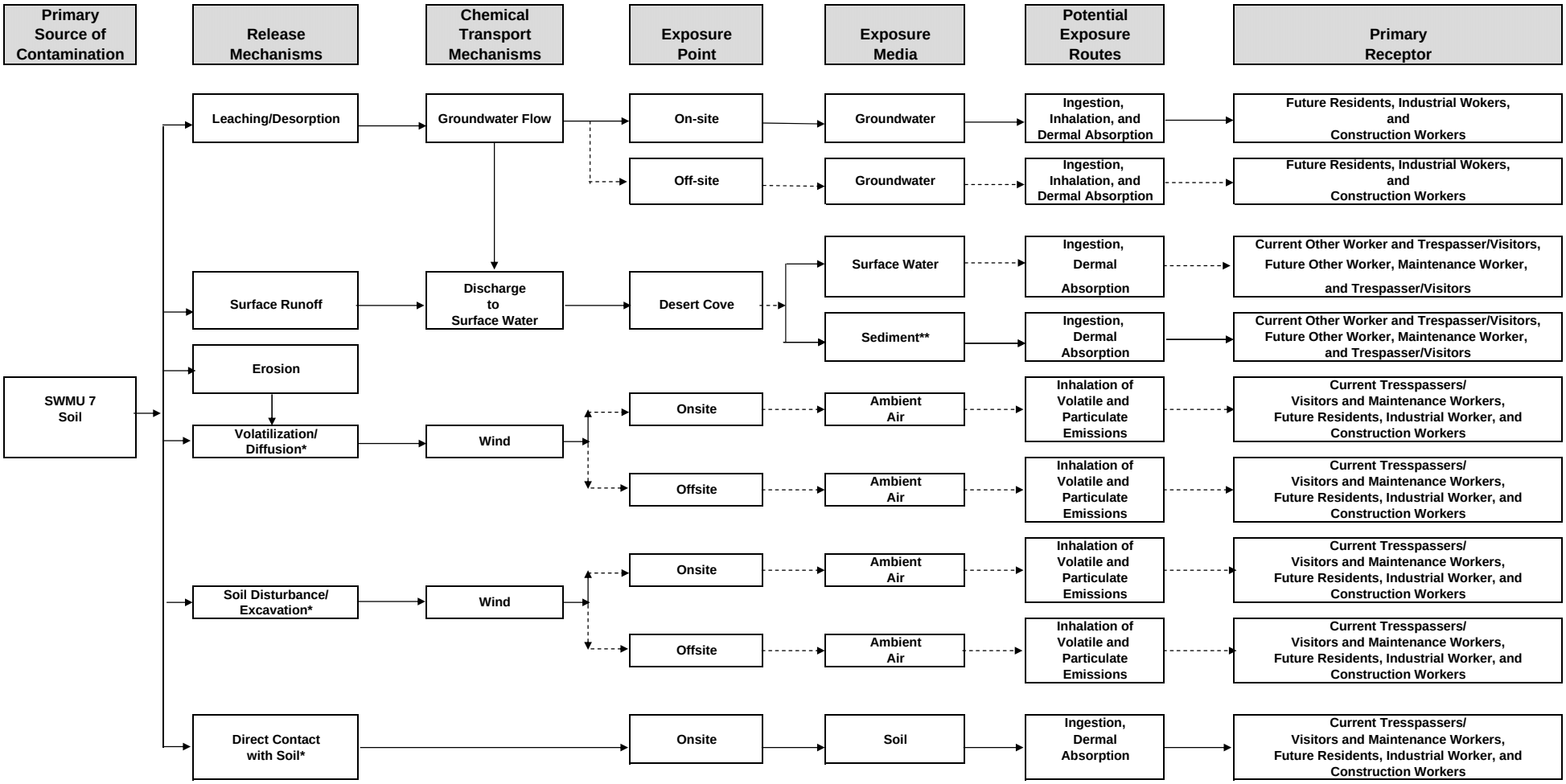
Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $>10^{-4}$	Chemicals with Cancer Risks $>10^{-5}$ and $<10^{-4}$	Chemicals with Cancer Risks $>10^{-6}$ and $<10^{-5}$	Hazard Index	Chemicals with HI>1
Future Resident Child/Adult	Groundwater	Ingestion	3.2E-04	Arsenic	Tetrachloroethene	Methyl-tert-butyl ether (MTBE)	NA	
		Dermal Contact	2.5E-05		Tetrachloroethene	Arsenic	NA	
		Inhalation	0.0E+00		Chloroform		NA	
		Total	3.4E-04				NA	
	Soil*	Ingestion	0.0E+00		Benzo(a)pyrene, Arsenic	Benzo(a)anthracene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene, Indeno(1,2,3-cd)pyrene	NA	
		Dermal Contact	0.0E+00		Benzo(a)pyrene	Benzo(a)anthracene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene, Indeno(1,2,3-cd)pyrene, Arsenic	NA	
		Inhalation	NA				NA	
		Total	0.0E+00				NA	
	All Media	Total	3.4E-04				NA	
Future Industrial Worker	Groundwater	Ingestion	7.4E-05		Arsenic	Tetrachloroethene	5.0	Iron, Manganese
		Dermal Contact	NA				NA	
		Inhalation	NA				NA	
		Total	7.4E-05				5.0	
	Soil*	Ingestion	9.4E-06			Benzo(a)pyrene, Arsenic	0.086	
		Dermal Contact	1.6E-05			Benzo(apyrene, Benzo(b)fluoanthene, Indeno(1,2,3-cd)pyrene, Arsenic	0.17	
		Inhalation	NA				NA	
		Total	2.6E-05				0.26	
	All Media	Total	1.0E-04				5.3	
Future Construction Worker	Groundwater	Ingestion	NA				NA	
		Dermal Contact	3.7E-07				1.8	Manganese
		Inhalation	0.0E+00				0.00000	
		Total	3.7E-07				1.8	
	Soil*	Ingestion	0.0E+00				0.00	
		Dermal Contact	0.0E+00				0.000	
		Inhalation	NA				NA	
		Total	0.0E+00				0.00	
	All Media	Total	3.7E-07				1.8	

NA - Not applicable, pathway incomplete.
Sediment*- Surface and subsurface sediment combined.
Soil*- Surface and subsurface soil combined.

Table 7-5
Summary of RME Cancer Risks and Hazard Indices CTs
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10^{-4}	Chemicals with Cancer Risks >10^{-5} and <10^{-4}	Chemicals with Cancer Risks >10^{-6} and <10^{-5}	Hazard Index	Chemicals with HI>1
Future Resident Adult	Groundwater	Ingestion	NA				2.9	
		Dermal Contact	NA				0.14	
		Inhalation	NA				NA	
		Total	NA				3.1	
	All Media	Total	NA				3.1	
Future Resident Child	Groundwater	Ingestion	NA				9.8	Iron, Manganese
		Dermal Contact	NA				0.25	
		Inhalation	NA				NA	
		Total	NA				10.0	
	All Media	Total	NA				10.0	
Future Resident Child/Adult	Groundwater	Ingestion	3.6E-05		Arsenic	Tetrachloroethene	NA	
		Dermal Contact	2.2E-06				NA	
		Inhalation	NA				NA	
		Total	3.8E-05				NA	
	All Media	Total	3.8E-05				NA	
Future Industrial Worker	Groundwater	Ingestion	5.4E-06			Arsenic	2.0	
		Dermal Contact	NA				NA	
		Inhalation	NA				NA	
		Total	5.4E-06				2.0	
	All Media	Total	5.4E-06				2.0	
Future Construction Worker Adult	Groundwater	Ingestion	NA				NA	
		Dermal Contact	NA				0.40	
		Inhalation	NA				NA	
		Total	NA				0.40	
	All Media	Total	NA				0.40	

NA - Not applicable.



* Surface soil for current maintanence worker and trespasser/visitor; surface and subsurface soil for future industrial worker, trespasser/visitor, resident, and construction worker.
**Surface sediment for current other worker and trespasser/visitor; surface and subsurface sediment for future other worker, maintenance worker, and trespasser/visitor.

→ Complete Pathway
- - → Incomplete Pathway

Figure 7-1
Conceptual Site Model for Potential Human Exposures at SWMU 7
NAB Little Creek, Virginia Beach, Virginia

SECTION 8

Ecological Risk Assessment

This section contains a screening ecological risk assessment (SERA), constituting Steps 1 and 2 of the ecological risk assessment (ERA) process, and the first step (Step 3) of a baseline ecological risk assessment (BERA) for SWMU 7. A regional map showing the location of NAB Little Creek is provided as Figure 2-1. Figure 2-2 shows the location of SWMU 7.

8.1 Introduction

This section defines the objectives of the ERA and describes the ERA process.

A draft ERA (through Step 3) was previously completed for SWMU 7 in January 2001 (CH2M HILL, 2001) and was based upon analytical data collected as part of the Site Investigation (SI). Subsequent to the completion of this previous ERA, additional sediment, surface soil, subsurface soil, and groundwater samples were collected at SWMU 7. This additional sampling included a number of sediment, soil, and groundwater locations not evaluated in the previous ERA. Thus, this ERA reiterates Steps 1 through 3 of the ERA process, incorporating these new data. However, the basic conceptual model for the site developed as part of the 2001 draft ERA has not changed and has been retained.

8.1.1 Ecological Risk Assessment Process

This ERA was conducted in accordance with the *Navy Policy for Conducting Ecological Risk Assessments* (CNO, 1999), the Navy guidance for implementing this ERA policy (NAVFAC, 2001), and the Navy/Tier II ERA approach developed for USEPA Region III. The Navy ERA policy and guidance, which describe a process consisting of eight steps organized into three tiers, are conceptually similar to the 8-step ERA process outlined in USEPA ERA guidance for the Superfund program (USEPA, 1997a). The major differences between the Navy ERA policy/guidance and the USEPA ERA guidance are: (1) the Navy policy/guidance provides clearly defined criteria for exiting the ERA process at specific points, (2) the Navy policy/guidance divides Step 3 (the first step of the BERA) into two distinct sub-steps (Steps 3A and 3B), with a potential exit point after Step 3A, and (3) the Navy policy/guidance incorporates risk management considerations throughout all tiers of the ERA process.

Steps 1 and 2 of the ERA process comprise the SERA, which is conducted using intentionally conservative assumptions. If complete exposure pathways exist at a site and the results of the SERA indicate that risks are possible, the site normally continues on to Step 3, the first step in the BERA, for the pathways, chemicals (termed Chemicals of Potential Concern [COPCs] at the end of Step 2), receptors, and areas identified in the SERA. As indicated above, Step 3 is divided into two distinct sub-steps in Navy ERA guidance.

Step 3 of the USEPA ERA guidance consists of the following activities (USEPA, 1997a):

1. Refinement of the COPCs from the SERA. In this ERA, the refined COPCs are termed Preliminary Chemicals of Concern (PCOCs) following Step 3A and Chemicals of Concern (COCs) following the risk evaluation.
2. Further characterizing the potential ecological effects of contaminants.
3. Refining information on contaminant fate and transport, complete exposure pathways, and receptors potentially at risk.
4. Selecting assessment endpoints.
5. Refining the conceptual model and risk hypotheses from the SERA.

Step 3A of the Navy policy/guidance (refinement of conservative exposure assumptions) corresponds to the first activity listed above for the USEPA ERA guidance. In Step 3A, a refined evaluation of exposure estimates is conducted using more realistic assumptions and additional methodologies relative to those used in the SERA, which is intended to be a very conservative assessment. Examples of more realistic exposure assumptions include using central tendency estimates (rather than maximums) for media concentrations, exposure parameters, and bioaccumulation factors. Examples of additional methodologies include consideration of upgradient and background concentrations, detection frequency, and bioavailability (CNO, 1999; NAVFAC, 2001).

If risk estimates (and their associated uncertainty) are acceptable following Step 3A, the site will meet the conditions of the exit criterion specified in the Navy guidance. If the Step 3A evaluation does not support an acceptable risk determination within acceptable uncertainty, the site continues to Step 3B. This possible exit point is not present in the USEPA ERA guidance.

Step 3B of the Navy policy/guidance (problem formulation) corresponds conceptually to the last four activities listed above for the USEPA ERA guidance. In Step 3B, the preliminary conceptual model from the SERA is refined based upon the results of the Step 3A evaluation to develop a revised list of key receptors, critical exposure pathways, COCs (risk drivers), assessment endpoints, measurement endpoints, and risk hypotheses. Based upon the revised conceptual model, the lines of evidence to be used in characterizing risk are determined. Agreement on the revised conceptual model, COCs, exposure pathways, endpoints, and risk hypotheses constitutes the Scientific Management Decision Point (SMDP) at the end of Step 3 in both Navy and USEPA ERA guidance.

8.1.2 Objectives of the ERA

The objectives of the SERA are to:

- Determine if potential risks to ecological receptors warrant either: (1) additional assessment beyond the conservative screening steps of the ERA process (unacceptable ecological risks are possible); or (2) the removal of the site from further ecological consideration (no unacceptable ecological risks likely).
- Focus subsequent steps of the ERA process on the specific chemicals, pathways, and receptors of potential concern if unacceptable ecological risks are possible.

- Identify any data gaps or areas of unacceptable uncertainty that may require the collection of additional data to support ERA evaluations beyond the screening level.

If the site is not screened out in the SERA, the evaluation continues to Step 3. The general objectives of the Step 3 ERA are to:

- Refine the risk estimates from the SERA to determine if risks to ecological receptors from site-related chemicals are likely to occur based upon realistic exposure scenarios.
- Focus subsequent data collection activities if potential risks are indicated, uncertainties are unacceptably high, and/or data gaps are identified.
- Refine the COPC list.

At the conclusion of Step 3, there are three possible decision points:

- **No further action is warranted.** This decision is appropriate if the evaluation indicates that sufficient data are available on which to base a conclusion of no unacceptable risk within acceptable uncertainty.
- **Further data are required.** This decision is appropriate if the evaluation indicates that the potential for unacceptable risk exists and additional data to refine these estimates (e.g., additional analytical data, measures of bioavailability) are needed. In this case, the site continues to Step 4 of the ERA process.
- **Take remedial action.** This decision may be appropriate for circumstances in which the potential for unacceptable risks was identified but these potential risks could best be addressed through remedial action (e.g., presumptive remedy) rather than additional study.

8.2 Facility Environment Setting

This section describes the environmental setting (habitats and biota) of NAB Little Creek. The description of the environmental setting was extracted mostly from the latest Integrated Natural Resources Management Plan for the base (Geo-Marine, 1997). The description of the environmental setting at SWMU 7 is provided in Section 8.3.1 as part of the screening problem formulation. A description of the facility history is contained in Section 2.1 and facility features are shown on Figure 2-2.

8.2.1 Physiographic Features

The major physiographic features (climate, topography, geology/soils, hydrology, and hydrogeology) of NAB Little Creek and SWMU 7 are described in Section 4.

8.2.2 Habitats and Biota

NAB Little Creek is located on the southern shore of Chesapeake Bay. Little Creek Harbor, which is connected to the bay by Little Creek Channel, is a tidal estuary with a semi-diurnal tidal range of about 2.6 feet. The spring tidal range is 3.1 feet and the mean tide is 1.3 feet above mean low water (mlw). Storm-induced tidal levels have been recorded ranging from 2.0 feet below mlw to 8.5 feet above mlw. Tidal currents in the entrance channel average

0.9 knots. In the absence of freshwater flow, tidal mixing flushes the harbor. The flushing rate is estimated to be long, on the order of weeks. The Northwest Branch of Little Creek flows into the harbor from the west through Fisherman's Cove (Figure 2-2). Little Creek Cove and Desert Cove branch off from the eastern part of the harbor. The city of Norfolk reservoir (Little Creek Reservoir/Lake Smith) has overflow channels that discharge into the harbor from the south. The bypass line from the Hampton Roads Sanitation District wastewater treatment plant discharges into the southeastern corner of Little Creek Cove. During severe storm events, raw sewage could be discharged to the cove via this line. Salinity in the coves, harbor, and channel ranges from 18.4 to 26.5 parts per thousand based upon data collected during July 1996 analytical sampling.

Although the base is mostly urbanized, small pockets of forested habitats are scattered primarily in the eastern and south-central portions of the base. A broken line of vegetated primary and secondary dunes extends along the entire 2.25-mile length of the Chesapeake Bay shoreline. The shoreline inside of Little Creek Harbor is almost entirely developed (bulkheaded) with the exception of the southern and eastern portions of Little Creek Cove. There are about 7 miles of shoreline within the harbor and coves. A large percentage of the landmass that makes up NAB Little Creek is composed of fill material. Much of the landmass surrounding Little Creek Cove, Desert Cove, and Little Creek Channel was formed with dredge material from pier construction when the base was developed in the 1940s.

Wetlands occupy approximately 166 acres of the base. The shorelines of several freshwater lakes and ponds found in the northeastern portion of the base are bounded by freshwater forested, scrub/shrub, and emergent wetlands. A drainage canal flows south-southwest from the largest of these lakes (Lake Bradford) to near the southern base boundary, where it turns west and connects to the southeastern corner of Little Creek Cove (Figure 2-2). This drainage canal contains freshwater over most of its approximately 2-mile length but becomes tidal and marine for several thousand feet prior to its connection with Little Creek Cove. Vegetated tidal marine wetlands on the base are generally confined to this portion of this canal and the southern shoreline of Little Creek Cove.

8.2.2.1 Flora

The majority of NAB Little Creek is developed, with little native vegetative cover present in most areas of the base. The areas that are vegetated contain a fairly diverse variety of habitats, however, and consequently a diversity of flora. Table 8-1 contains a partial list of flora found in the various habitats on the base, and includes the most common species as well as some of the more uncommon or unusual species.

The dune system along the Chesapeake Bay shoreline possesses examples of maritime forest flora, including mature live oak, turkey oak, and blue jack oak. There are also some interdunal swale wetlands located within this dune system that are vegetated with both emergent and scrub-shrub wetland vegetation. The species found in these interdunal swale wetland plant communities typically differ substantially from those found in emergent and scrub-shrub wetland communities elsewhere on the base.

The forest tracts found on the base can be subdivided into hardwood, pine, and mixed pine-hardwood classifications. The overstory in the hardwood tracts is dominated by a variety of

oaks, hickories, and sweet gum. The understory in these tracts is moderately diverse, with wax myrtle, hardwood seedlings, Virginia creeper, honeysuckle, and greenbrier occurring most commonly. In the mixed pine-hardwood tracts, the overstory is dominated by sweet gum, red maple, tulip poplar, and loblolly pine. Common species in the midstory include flowering dogwood, American holly, sassafras, mulberry, live oak, and wax myrtle. The species composition of the understory is similar to the hardwood tracts, but is somewhat more diverse. The pine tracts are dominated by loblolly pine, with a scattering of hardwoods in the midstory. The understory in the pine stands is dominated by greenbrier and honeysuckle.

The lake and pond margins are bounded by typical freshwater wetland plant communities, and examples of forested, scrub-shrub, and emergent wetland plant communities can also be found here. The forested communities are dominated by bald cypress, black gum, and sweet gum, with understories of highbush blueberry, wax myrtle, and a variety of ferns. Scrub-shrub communities are dominated by swamp rose, groundsel-tree, marsh mallow, and button bush. Emergent communities are dominated by lizard's tail, yellow pond lily, water primrose, and cattail.

The tidal marshes on NAB Little Creek have land-ward fringes dominated by common reed (phragmites), groundsel-tree, and marsh elder. The marshes themselves are dominated by saltmarsh cordgrass, with limited areas of needlerush, saltmeadow cordgrass, and saltgrass.

The most diverse floral communities occurring on the base can be found on Scout Island. This island, which contains a large interdunal swale wetland, is a portion of a relict dune that is now located within a man-made freshwater lake. With the exception of tidal marsh species, examples of most plant species that occur on NAB Little Creek can be found on this island.

8.2.2.2 Fauna

The fauna of NAB Little Creek is generally typical of that expected to occur in a highly urbanized region. Most of these species are highly adaptable and can exist under a broad range of habitat conditions.

The most common larger mammals on NAB Little Creek include gray and red foxes, raccoon, Virginia opossum, eastern cottontail, gray squirrel, and muskrat. Beaver have re-colonized nearby Norfolk water supply lakes, although they have not yet taken up residence in base lakes. Table 8-2 lists the mammalian species that are known to occur at NAB Little Creek, or might reasonably be expected to occur there.

At least seven species of turtles, three species of frogs, and two species of snakes commonly occur around the freshwater lakes. Two species of salamanders, two species of tree frogs, the southern toad, and the eastern box turtle occur commonly in forested areas adjacent to temporary or isolated freshwater wetlands. Upland areas are known to be used by two species of snakes and at least four species of lizards. Table 8-3 lists the amphibian and reptilian species known to occur on NAB Little Creek.

One of the most diverse faunal communities present at NAB Little Creek is the bird community. Forested habitats on the base may serve as stopover locations for neotropical migratory birds. Lakes and ponds on the base also serve as resting stops for migrating

waterfowl. A number of migratory shorebird species can be found along the shoreline at different times of the year. In addition to migratory species, the base hosts a number of year-round resident species. Table 8-4 lists bird species that have been observed on NAB Little Creek and its adjacent waters.

In an effort to help with a nationwide species recovery effort, the base participates in an osprey monitoring program and actively places nesting platforms out for new pairs. In 1993, three osprey nesting platforms were erected and several baseball field lights were modified with platforms to provide additional nesting opportunities. In 1995, three more platforms were installed. Also in 1995, an osprey nest monitoring program was implemented. There were 11 osprey nests and/or nesting platforms recorded on NAB Little Creek in 1996, two near Lake Bradford, three in the vicinity of Sites 9 and 10, five along the eastern shoreline of Little Creek Harbor, and one near Sites 7 and 8.

Fish communities at NAB Little Creek can be divided into two groups, freshwater fishes and estuarine fishes. The freshwater fishes are residents of the base's lakes, ponds, and nontidal ditches. Table 8-5 lists the freshwater fish species known to be present in the base's waters. The estuarine fish species may be found in the tidal creeks, the harbor and coves, and the adjacent waters of Chesapeake Bay. The estuarine fish species are primarily migratory, however, some species are year-round residents. Table 8-6 lists the estuarine fish species that are known or expected to occur in the waters on and near the base.

8.2.2.3 Rare, Threatened, and Endangered Species

A survey was conducted in 1989 by the Virginia Department of Conservation and Recreation for rare, threatened, and endangered species at NAB Little Creek (VDCR-DNH, 1990). No state or federally listed threatened or endangered species were found at NAB Little Creek. Three state listed rare plants were identified, however. The Virginia Beach pinweed (*Lechea maritima var. virginica*) was found on the fore dunes and secondary dunes in the open herbaceous and scrub zones between the maritime forest and the beach. Since that survey, the VDCR has downlisted this species from the rare plant list to the plant watch list. The bluejack oak (*Quercus incana*) was found in the maritime forests of the secondary dunes. Finally, Spanish moss (*Tillandsia usneoides*) was found on the eastern half of Scout Island. These species are all relatively common globally within their geographic ranges, but are rare in Virginia.

8.3 Screening Ecological Risk Assessment

As discussed in Section 8.1, Steps 1 and 2 of the ERA process constitute the SERA, which is conducted using intentionally conservative assumptions. The principal components of the SERA are problem formulation, exposure estimation, effects evaluation, and risk calculation.

8.3.1 Screening Problem Formulation

Problem formulation establishes the goals, scope, and focus of the ERA. As part of problem formulation, the environmental setting of SWMU 7 is characterized in terms of the habitats and biota known or likely to be present. The types and concentrations of chemicals that are present in ecologically relevant media are also described. A preliminary conceptual model is developed for SWMU 7 that describes potential sources, potential transport pathways,

potential exposure pathways and routes, and potential receptors. Assessment endpoints, measurement endpoints, and risk hypotheses are then selected to evaluate those receptors for which complete and potentially critical exposure pathways are likely to exist. The fate, transport, and toxicological properties of the chemicals present at SWMU 7, particularly the potential to bioaccumulate, are also considered during this process.

8.3.1.1 Environmental Setting

SWMU 7 is located along Piers 44 through 55 at Desert Cove and includes Building CB-125 (Figure 2-3). SWMU 7 was formerly used to sandblast and paint ships prior to 1996, when sandblasting activities were moved to an indoor facility (Building CB-125). SWMU 7 was also used to store spent ABM while awaiting characterization (EP toxicity) testing results. Approximately 4,000 cubic yards of ABM generated from 1960 to 1982 were stored (in open piles) in the yard. This ABM has since been sampled (EP toxicity), removed, and disposed of off-site. Based upon available photography, the ABM piles were located in the area used for constructing the new indoor blasting facility (Building CB-125).

No release controls have been identified at this SWMU. Based upon visual site inspections conducted in 1988 (Earth Technology Corp., 1988), historic releases of spent ABM and oily substances to soils and to Desert Cove have occurred at this site. According to the Navy's responses to the draft RFA (A.T. Kearney, 1989), oil-stained soils in the area have been removed. During the SI, ABM was found near Buildings CB-125, CB-317, CB-318, and 3869. The southwestern area of SWMU 7 is the site of the new indoor sandblast facility, Building CB-125 (Figure 2-3).

During the SI, ABM was only encountered on the ground surface in portions of SWMU 7; no ABM was identified in subsurface soils. From visual observations, it was estimated that ABM comprised less than five percent of surface soils at SWMU 7. The majority of observed ABM was noted in the vicinity of Building CB-125, which currently serves as an indoor sandblasting facility, and a small area near Building CB-317.

An EE/CA was completed in 2004 to evaluate alternatives for surface soil removal at SWMU 7. A non-time critical removal action was completed in September 2004 whereby approximately 40 cubic yards of surface soil was removed and backfilled with clean fill material. The removal action was completed under the AGVIQ/CH2M HILL Joint Venture I Program. Documentation of construction activities is provided in Appendix I.

A large portion of the ground surface at SWMU 7 is covered by asphalt or buildings. Most of the remaining area consists of hard-packed dirt or gravel. Heavy equipment (e.g., cranes and trailers) is currently stored in portions of the site. Most precipitation runs off towards Desert Cove at the Small Boat Piers, with the balance evaporating, transpiring, or infiltrating into the ground. Infiltration is limited to those areas of the site that are unpaved and where the ground surface is reasonably level. Groundwater flow in the area is west-northwest towards Desert Cove (Figure 4-9).

There are no forested habitats on SWMU 7. Open areas of maintained grass occur, but are very limited in extent. There are no wetlands on SWMU 7. Desert Cove borders SWMU 7 to the north and west. Almost the entire shoreline of the cove at SWMU 7 is bulkheaded and is used to moor small ships. A very small portion of the shoreline, near the boat ramp just

north of Building CB-125, is not bulkheaded and consists of a narrow, shrubby fringe adjacent to developed areas.

The salinity of Desert Cove and the Connector Channel is generally about 25 parts per thousand (Table 8-7) but may be lower at locations near storm water outfalls during rain events. The total organic carbon concentrations in surface sediment generally exceeds one percent (range of 0.22 to 3.05 percent) and the percent fines generally exceeds 50 percent (range of 11.1 to 92.0 percent) (Tables 8-8 and 8-9).

No visible ABM was observed in surface (0 to 4 inches) sediment samples collected from Desert Cove during the SI. During the sampling conducted as part of this RI, ABM was present in 63 percent of surface sediment samples, generally at low to trace amounts. ABM was also observed in about half of the RI sediment cores (core depths were approximately 5 feet), generally at depths of less than 6 inches and not at depths below 12 inches. Considering the presence of ABM in surface sediments found during the RI contradicts the lack of ABM present in surface sediments during the SI suggests that the ABM is probably present from current operations and not historical CERCLA releases.

Desert Cove has not been dredged since 1953, when it was dredged to a depth of 10 feet below mlw. There are currently plans to replace the piers in Desert Cove and to dredge the entire cove and channel in 2006.

Other potential sources of contaminants to Desert Cove, other than ABM residue from SWMU 7, are leaks/spills from fuel barges moored at the piers in the cove and about a dozen storm water outfalls that enter the cove along the northern, eastern, and southern sides (Figure 2-4; Table 8-10). The effect of outfall inputs into the Desert Cove system on the chemical concentrations in sediment is not known. The northeastern and southeastern corners of Desert Cove represent the areas of largest storm water runoff loading.

8.3.1.2 Summary of Available Analytical Data

The southwestern area of SWMU 7 is the site of the new indoor sandblast facility, located inside Building CB-125. Prior to construction of the building, LANTDIV contracted with ATEC Environmental to conduct soil and groundwater investigations at the proposed building site. In 1989, soil was sampled at five locations (Figure 2-6; Section 2.4.4). At borings B-1, B-2, and B-3, samples were collected from 0 to 2.5 feet and 2.5 to 5.0 feet bgs (labeled A and B, respectively). At borings B-4 and B-5, samples were collected from 0 to 2.5 feet bgs only. A duplicate was obtained from B-2B and was labeled B-2C. The samples were analyzed for total metals and EP toxicity metals. Although the full results are available for the total metals, the EP toxicity results have been lost. However, ATEC noted in their summary report that the only metal detected in the EP toxicity tests was zinc at 3.4 mg/L for sample B-1A. In January 1993, three soil samples and three groundwater samples were collected from wells installed at the site (Figure 2-6; Section 2.4.4). Soil samples were analyzed for metals (Toxicity Characterization Leaching Procedure [TCLP] list) and groundwater was analyzed for total (unfiltered) metals (subset of the Target Analyte List [TAL] metals). The 1989 and 1993 data are not considered in this ERA because they have not been validated (Table 8-11).

Some surface water and sediment data have been collected in Desert Cove as part of non-IRP studies (date range of 1974 to 1996). These data are shown in Tables 8-12 and 8-13. These

data are only considered qualitatively in this ERA because data quality and validation status are not known.

The SI field activities conducted at SWMU 7 commenced on 22 May 2000. Groundwater, soil, and sediment samples were collected as part of the SI (see Section 2.4.5). Surface soil samples (0 to 6 inches bgs) and subsurface soil samples (1 to 3 feet bgs) were collected at 14 locations at SWMU 7. Sediment samples (0 to 4 inches bgs) were collected in Desert Cove adjacent to the bulkhead at five locations. Three monitoring wells were installed at SWMU 7 and groundwater samples were collected. All of the SI data were used in this ERA.

Section 2.4 outlines the previous investigations at the site and Section 3 describes the data collection activities associated with RI sampling. Table 8-11 summarizes (in terms of source and number of samples) the data that were used in this ERA by medium and chemical group. These data are summarized in Tables 8-14 (surface soil), 8-15 (subsurface soil), 8-16 (surface sediment), 8-17 (subsurface sediment), 8-18 (site groundwater wells), and 8-19 (upgradient groundwater wells). Sampling locations are shown on Figures 2-7, 3-1, and 3-2. Table 8-20 lists the IDs of all samples used in the ERA. The raw analytical data are provided in Appendix A.

The number and spatial distribution of the analytical samples were sufficient to adequately estimate potential ecological risks. There were 41 surface sediment samples collected from Desert Cove and the Connector Channel (5 during the SI, 19 discrete samples during the RI, and 17 composite samples during the RI[1]) and 19 subsurface sediment samples. The 25 surface and 36 subsurface (two depths) soil samples that were collected from SWMU 7 during the SI and RI were used in the ERA. Six groundwater monitoring wells have been installed at the site, including one (MW-02) located upgradient of SWMU 7. The number and location of all RI samples were scoped jointly by the Navy, other Little Creek Tier I partnering team members, and the USEPA Region III BTAG.

8.3.1.3 Preliminary Conceptual Model

Information on the habitat features at the site and on the fate and transport of the chemicals detected at the site was used to build the preliminary conceptual model (Figure 8-1). Key components of the preliminary conceptual model include the identification of potential source areas, transport pathways, exposure media, exposure routes, and receptors.

Potential Source Areas

The facility-related potential source areas at SWMU 7 include the areas in which historic sandblasting-related activities have occurred.

Transport Pathways and Exposure Media

A transport pathway describes the mechanisms whereby chemicals may be transported from a source of contamination to ecologically relevant media. These transport pathways are shown on Figure 8-1. Site-related chemicals in surface and subsurface soils may leach to groundwater and then discharge to downgradient water bodies (Desert Cove). Site-related

[1] Because the composite RI surface sediment samples (three locations per composite sample) were collected around 17 of the 19 discrete RI surface sediment samples (representing sample grid nodes), and thus represent the same general area, a weighted average concentration was determined for each composite/discrete sample pair ([[composite concentration X 3] + [discrete concentration]] / 4) and this weighted concentration was used in the ERA. Thus, the total surface sediment sample size is 24 (17 weighted samples, two RI samples with discrete samples only, and five SI samples).

chemicals in soils may have been transported via direct and/or indirect (via the storm sewer system) surface runoff to Desert Cove. ABM residue may also have been transported via wind to Desert Cove. Site-related chemicals in surface soil, surface sediment, and surface water may be taken up and accumulated in the tissue of biota, and thus be transported to upper trophic level receptors via food webs.

Exposure media for ecological receptors are typically limited to surface water, surface sediment, and surface soil. Groundwater is generally considered only as a transport medium since there are no ecological exposures to groundwater until it discharges to a water body or surfaces as a seep. Since some ecological receptors may be exposed, at least periodically, to subsurface soils (e.g., down to 2 feet below the ground surface), available subsurface soil data from the 6- to 24-inch depth interval were also qualitatively considered as an exposure medium.

Exposure Pathways and Routes

An exposure pathway links a source of contamination with one or more receptors through exposure via one or more media and exposure routes. Exposure, and thus potential risk, can only occur if complete exposure pathways exist. Figure 8-1 shows the potentially complete exposure pathways to ecological receptors at SWMU 7.

Potentially complete exposure pathways to terrestrial receptors utilizing the upland habitats present on SWMU 7 exist (exposure to surface soils in undeveloped areas) but are limited due to the low quality of the habitats that are present. Potentially complete exposure pathways to aquatic (e.g., benthic invertebrates and fish) and semi-aquatic (e.g., osprey) receptors utilizing Desert Cove and the Connector Channel also exist (exposure to surface water and sediment). Groundwater flow from the site is toward Desert Cove.

An exposure route describes the specific mechanism(s) by which a receptor is exposed to a chemical present in an environmental medium. Terrestrial plants may be exposed to chemicals present in surface soils through their root surfaces during water and nutrient uptake. Unrooted, floating aquatic plants, and rooted submerged vascular aquatic plants and algae, may be exposed to chemicals directly from the water or (for rooted plants) from sediments.

Animals may be exposed to chemicals through: (1) direct inhalation of gaseous chemicals or of chemicals adhered to airborne particulate matter; (2) incidental ingestion of contaminated abiotic media (soil or sediment) during feeding or preening activities; (3) the direct ingestion of contaminated water; (4) the ingestion of contaminated plant and/or animal tissues for chemicals that have entered food webs; and/or (5) dermal contact with contaminated abiotic media. Based upon the general fate properties (relatively high adsorption to solids) of the chemicals present on SWMU 7 (primarily metals and PAHs) and the protection offered by hair or feathers, potential dermal exposures for upper trophic level receptors are not considered significant relative to ingestion exposures and are not evaluated in this ERA. Upper trophic level receptors considered in this ERA would not likely be exposed, via inhalation, to significant airborne sources of chemicals because the primary chemicals present on the site (metals) typically adsorb to soil, suggesting that the potential for volatilization and thus exposure via inhalation is very limited. Incidental ingestion of soil or sediment during feeding, preening, or grooming activities is, however, considered in the risk

estimates. Direct contact is considered for lower trophic level receptors (e.g., soil and benthic invertebrates).

Direct ingestion of drinking water is only considered when the salinity is below 15 parts per thousand, the approximate toxic threshold for wildlife receptors (Humphreys, 1988). Based upon available data (Table 8-7), the salinity in Desert Cove and the Connector Channel exceeds this threshold. Thus, direct ingestion of drinking water is not considered in this ERA.

Receptors

Because of the complexity of natural systems, it is generally not possible to directly assess the potential impacts to all ecological receptors present at a site. Therefore, specific receptor species or species groups (e.g., deer mouse) are often selected as surrogates to evaluate potential risks to larger portions of the ecological community (guilds; e.g., omnivorous mammals) used to represent the assessment endpoints (e.g., survival and reproduction of omnivorous mammals). Selection criteria typically include those species that:

- Are known to occur, or are likely to occur, at the site.
- Have a particular ecological, economic, or aesthetic value.
- Are representative of taxonomic groups, life history traits, and/or trophic levels in the habitats present at the site for which complete exposure pathways are likely to exist.
- Can, because of toxicological sensitivity or potential exposure magnitude, be expected to represent potentially sensitive populations at the site.

The following upper trophic level receptor species have been chosen for exposure modeling based upon the criteria listed above:

- Deer mouse (*Peromyscus maniculatus*) - terrestrial mammalian omnivore.
- Red fox (*Vulpes vulpes*) - terrestrial mammalian carnivore.
- Killdeer (*Charadrius vociferous*) - terrestrial avian insectivore.
- American kestrel (*Falco sparverius*) - terrestrial avian carnivore.
- Osprey (*Pandion haliaetus*) - aquatic avian piscivore.

Upper trophic level receptor species quantitatively evaluated in the ERA were limited to birds and mammals, the taxonomic groups with the most available information regarding exposure and toxicological effects. Amphibians are typically selected as a receptor group only when freshwater aquatic or wetland habitats are present on, or in the contaminant transport pathways (as defined in the conceptual model) of a site. Since freshwater habitats do not occur on, or adjacent to, SWMU 7, amphibians were not evaluated in the ERA. Because of the limited amount of ingestion-related toxicological data available for reptiles, exposures via the food web for this taxon were evaluated using bird and mammal receptors as surrogates.

Lower trophic level receptor species were evaluated in the ERA based upon those taxonomic groupings for which screening values have been developed (see Section 8.3.3.1); these groupings and screening values are used in most ERAs. As such, specific species of aquatic biota were not chosen as receptors because of the limited information available for specific species and because these receptors (fish and macroinvertebrates) were evaluated

on a community level via a comparison to sediment screening values. Similarly, terrestrial plants and soil invertebrates (earthworms are the standard surrogate) were evaluated using soil screening values developed for these groups.

Endpoints and Risk Hypotheses

The conclusion of the screening problem formulation includes the selection of ecological endpoints and risk hypotheses, which are based upon the preliminary conceptual model. Two types of endpoints, assessment endpoints and measurement endpoints, are defined as part of the ERA process (USEPA, 1997a). An assessment endpoint is an explicit expression of the environmental component or value that is to be protected. A measurement endpoint is a measurable ecological characteristic that is related to the component or value chosen as the assessment endpoint. The considerations for selecting assessment and measurement endpoints are summarized in USEPA (1997a) and discussed in detail in Suter (1989, 1990, 1993). Risk hypotheses are testable hypotheses about the relationship among the assessment endpoints and their predicted responses when exposed to contaminants.

Endpoints define ecological attributes that are to be protected (assessment endpoints) and measurable characteristics of those attributes (measurement endpoints) that can be used to gauge the degree of impact that has or may occur. Assessment endpoints most often relate to attributes of biological populations or communities, and are intended to focus the risk assessment on particular components of the ecosystem that could be adversely affected by chemicals attributable to the site (USEPA, 1997a). Assessment endpoints contain an entity (e.g., osprey population) and an attribute of that entity (e.g., survival rate). Individual assessment endpoints usually encompass a group of species or populations (the receptor) with some common characteristic, such as specific exposure route or contaminant sensitivity, with the receptor then used to represent the assessment endpoint in the risk evaluation.

Assessment and measurement endpoints may involve ecological components from any level of biological organization, from individual organisms to the ecosystem itself. Effects on individual organisms are important for some receptors, such as rare and endangered species; population- and community-level effects are typically more relevant to ecosystems. Population- and community-level effects are usually difficult to evaluate directly without long-term and extensive study. However, measurement endpoint evaluations at the individual level, such as an evaluation of the effects of chemical exposure on reproduction, can be used to predict effects on an assessment endpoint at the population or community level. Assessment endpoints at the population/community level were the focus of this ERA.

Table 8-21 shows the preliminary assessment endpoints, risk hypotheses, and measurement endpoints used in the screening portion (Steps 1 and 2) of the ERA. Table 8-21 also shows the receptors associated with each endpoint.

8.3.2 Screening Exposure Estimation

Maximum concentrations were used in the screening portion of the ERA to conservatively estimate potential chemical exposures for the ecological receptors selected to represent the assessment endpoints at SWMU 7. Food web exposures for upper trophic level receptor species were determined by estimating the chemical-specific concentrations in each dietary component using uptake and food web models. Incidental ingestion of soil or sediment was also included when calculating the total level of exposure. Maximum sediment or surface

soil concentrations were used in all screening food web calculations to provide a conservative assessment.

For conservatism, the maximum reporting limit for chemicals analyzed for but not detected was also compared to medium-specific screening values and (where applicable) used for food web exposure modeling. This was done to determine if reporting limits were less than or equal to chemical concentrations at which potential adverse effects to ecological receptors may occur.

8.3.2.1 Selection Criteria for Analytical Data

Available analytical data (described in Section 8.3.1.2 and summarized in Table 8-11) were selected for use in the ERA based upon the following:

- Data must have been validated by a qualified data validator using acceptable data validation methods. Rejected (R) values were not used in the ERA. Unqualified data and data qualified as J, L, or K were treated as detected. Data qualified as U or B were treated as non-detected.
- For samples with duplicate analyses, the higher of the two concentrations was used when both values were detects or when both values were non-detects. In cases where one result was a detection and the other a non-detect, the detected value was used in the assessment.
- For groundwater, data from Geoprobe® sampling and from temporary groundwater wells were not considered.
- For surface soil, samples collected from depths of 0 to 6 inches were quantitatively used since this depth range represents the most realistic potential exposures for most of the ecological receptors evaluated in terrestrial habitats. Because some ecological receptors may be exposed, at least periodically, to deeper soils (e.g., down to 2 feet below the ground surface), available subsurface soil data from the 6- to 24-inch depth interval were also qualitatively considered.
- For sediment, samples from depths of 0 to 6 inches were used preferentially since this depth range represents the most realistic exposures for sediment-dwelling species. Available subsurface sediment data were qualitatively considered from a transport perspective.

8.3.2.2 Exposure Estimation

Upper trophic level receptor exposures (via the food web) to chemicals present in surface soil or sediment were determined by estimating the concentration of each bioaccumulating chemical in each relevant dietary component. Incidental ingestion of soil or sediment was included when calculating the total exposure. Exposure via drinking water was not included because SWMU 7 lacks a freshwater drinking source. Since receptors (and their prey) are not exposed directly to groundwater, food web exposures were not calculated based upon groundwater concentrations. Groundwater is, however, evaluated as a potential transport medium for site-related chemicals to surface water and sediment.

Chemicals with the potential to bioaccumulate were evaluated for exposures via food webs. This list of bioaccumulating chemicals is provided in Table 8-22 (for constituents relevant to SWMU 7) and is based upon the list provided in Table 4-2 of USEPA (2000).

Dietary items for which tissue concentrations were modeled included terrestrial plants, soil invertebrates, small mammals, benthic invertebrates, and fish. For the screening portion of the ERA, the uptake of chemicals from the abiotic media into these food items was based upon conservative (e.g., maximum or 90th percentile) bioconcentration factors (BCFs) or bioaccumulation factors (BAFs) from the literature. Default factors of 1.0 were used only when data were unavailable for a chemical in the literature.

Screening Exposure Point Concentrations

Maximum media concentrations were used as exposure point concentrations for exposure estimation and food web modeling in the screening portion of the ERA. Exposure point concentrations (concentrations in plant, soil invertebrate, small mammal, fish, and benthic invertebrate prey items) for terrestrial and aquatic upper trophic level receptors were estimated using bioaccumulation models and maximum measured surface soil or sediment concentrations. The methodology and models used to derive these estimates are described below.

Terrestrial Plants. Tissue concentrations in the aboveground vegetative portion of terrestrial plants were estimated by multiplying the maximum surface soil concentration for each chemical by chemical-specific soil-to-plant BCFs obtained from the literature. The BCF values used were based upon root uptake from soil and upon the ratio between dry-weight soil and dry-weight plant tissue. Literature values based upon the ratio between dry-weight soil and wet-weight plant tissue were converted to a dry-weight basis by dividing the wet-weight BCF by the estimated solids content for terrestrial plants (15 percent [0.15]; Sample et al., 1997).

For inorganic chemicals without literature-based BCFs, a soil-to-plant BCF of 1.0 was assumed. For organic chemicals without literature-based BCFs, soil-to-plant BCFs were estimated using the algorithm provided in Travis and Arms (1988):

$$\log B_v = 1.588 - (0.578)(\log K_{ow})$$

where: B_v = Soil-to-plant BCF (unitless; dry-weight basis)
K_{ow} = Octanol-water partitioning coefficient (unitless)

The log K_{ow} values used in the calculations were obtained mostly from USEPA (1995b, 1996a) and are listed in Table 8-22. The soil-to-plant BCFs used in the screening portion of the ERA are shown in Table 8-23.

Soil Invertebrates. Tissue concentrations in soil invertebrates (earthworms) were estimated by multiplying the maximum surface soil concentration for each chemical by chemical-specific BCFs or BAFs obtained from the literature. BCFs are calculated by dividing the concentration of a chemical in the tissues of an organism by the concentration of that same chemical in the surrounding environmental medium (in this case, soil) without accounting for uptake via the diet. BAFs consider both direct exposure to soil and exposure via the diet. Since earthworms consume soil, BAFs are more appropriate values and were used in the

food web models when available. BAFs based upon depurated analyses (soil was purged from the gut of the earthworm prior to analysis) were given preference over undepurated analyses when selecting BAF values since direct ingestion of soil is accounted for separately in the food web model.

The BCF/BAF values used were based upon the ratio between dry-weight soil and dry-weight earthworm tissue. Literature values based upon the ratio between dry-weight soil and wet-weight earthworm tissue were converted to a dry-weight basis by dividing the wet-weight BCF/BAF by the estimated solids content for earthworms (16 percent [0.16]; USEPA, 1993). For chemicals without available measured BAFs or BCFs, an earthworm BAF of 1.0 was assumed. The soil-to-earthworm BCFs/BAFs used in the screening portion of the ERA are shown in Table 8-23.

Small Mammals. Whole-body tissue concentrations in small mammals (shrews, voles, and/or mice) were estimated using one of two methodologies. For chemicals with literature-based soil-to-small mammal BAFs, the small mammal tissue concentration was calculated by multiplying the maximum surface soil concentration for each chemical by a chemical-specific soil-to-small mammal BAF obtained from the literature. The BAF values used were based upon the ratio between dry-weight soil and whole-body dry-weight tissue. Literature values based upon the ratio between dry-weight soil and wet-weight tissue were converted to a dry-weight basis by dividing the wet-weight BAF by the estimated solids content for small mammals (32 percent [0.32]; USEPA, 1993). The BAF values reported in Sample et al. (1998b) for insectivores (or for general small mammals if insectivore values were unavailable), for herbivores, and for omnivores were applied to shrews, voles, and mice, respectively. The soil-to-small mammal BAFs used in the screening portion of the ERA are shown in Table 8-24.

For chemicals without soil-to-small mammal BAF values, an alternate approach was used to estimate whole-body tissue concentrations. Because most chemical exposure for these small mammals is via the diet, it was assumed that the concentration of each chemical in the small mammal's tissues was equal to the chemical concentration in its diet, that is, a diet to whole-body BAF (wet-weight basis) of one was assumed. The use of a diet to whole-body BAF of one is likely to result in a conservative estimate of chemical concentrations for chemicals that are not known to biomagnify in terrestrial food chains (such as PAHs) based upon reported literature values for chemicals that are known to biomagnify in food webs. For example, a maximum BAF (wet-weight) value of 1.0 was reported by Simmons and McKee (1992) for PCBs based on laboratory studies with white-footed mice. Menzie et al. (1992) reported BAF values (wet-weight) for DDT of 0.3 for voles and 0.2 for short-tailed shrews. Reported BAF (wet-weight) values for dioxin were only slightly above one (1.4) for the deer mouse (USEPA, 1990). Resulting tissue concentrations (wet-weight) were converted to dry-weight using an estimated solids content of 32 percent (see above).

Benthic Invertebrates. Tissue concentrations in benthic invertebrates were estimated by multiplying the maximum sediment concentration for each chemical by chemical-specific sediment-to-invertebrate BAFs obtained from the literature. The BAF values used were based upon the ratio between dry-weight sediment and dry-weight invertebrate tissue. BAFs based upon depurated analyses (sediment was purged from the gut of the organism prior to analysis) were given preference over undepurated analyses when selecting BAF values since direct ingestion of sediment is accounted for separately in the food web model.

Literature values based upon the ratio between dry-weight sediment and wet-weight invertebrate tissue were converted to a dry-weight basis by dividing the wet-weight BAF by the estimated solids content for benthic invertebrates (21 percent [0.21]; USEPA,1993). For chemicals without literature-based sediment-to-invertebrate BAFs, a BAF of 1.0 was assumed. The sediment-to-invertebrate BAFs used in the screening portion of the ERA are shown in Table 8-25.

Fish. Tissue concentrations in whole-body fish were estimated by multiplying the maximum sediment concentration for each chemical by chemical-specific sediment-to-fish BAFs obtained from the literature. The BAF values used were based upon the ratio between dry-weight sediment and dry-weight fish tissue. Literature values based upon the ratio between dry-weight sediment and wet-weight fish tissue were converted to a dry-weight basis by dividing the wet-weight BAF by the estimated solids content for fish (25 percent [0.25]; USEPA, 1993). For chemicals without literature-based sediment-to-fish BAFs, a BAF of 1.0 was assumed. The sediment-to-fish BAFs used in the screening portion of the ERA are shown in Table 8-25.

Dietary Intakes

Dietary intakes for each receptor species were calculated using the following formula (modified from USEPA [1993]):

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

where:

	DI_x	=	Dietary intake for chemical x (mg chemical/kg body weight/day)
	FIR	=	Food ingestion rate (kg/day, dry-weight)
	FC_{xi}	=	Concentration of chemical x in food item i (mg/kg, dry-weight)
	PDF_i	=	Proportion of diet composed of food item i (dry-weight basis)
	SC_x	=	Concentration of chemical x in soil/sediment (mg/kg, dry-weight)
	PDS	=	Proportion of diet composed of soil/sediment (dry-weight basis)
	WIR	=	Water ingestion rate (L/day)
	WC_x	=	Concentration of chemical x in water (mg/L)
	BW	=	Body weight (kg, wet-weight)

Receptor-specific values used as inputs to this equation for the screening portion of the ERA are provided in Table 8-26. Consistent with the conservative approach used for a SERA, the minimum adult body weight and maximum food ingestion rate from the scientific literature were used for each receptor (water ingestion was set to zero since the site lacks a reliable freshwater drinking source). It was assumed that chemicals were 100 percent bioavailable to the receptor and it was also assumed that each receptor spent 100 percent of its time on the site (i.e., an area use factor [AUF] of 1.0 was assumed).

8.3.3 Screening Effects Evaluation

The purpose of the screening effects evaluation is to establish chemical exposure levels (screening values) that represent conservative thresholds for adverse ecological effects. One set of screening values is typically developed for each selected assessment endpoint.

8.3.3.1 Medium-Specific Screening Values

Medium-specific screening values were established for each ecologically relevant media. Based upon the preliminary conceptual model (Figure 8-1), direct exposure to surface soil, surface water, and sediment are potentially complete pathways at SWMU 7, as is indirect exposure to groundwater.

The screening values used in the ERA were based upon Region III BTAG screening values (USEPA, 1995a) and additional screening values available from the literature. When more than one screening value was available for a specific medium (e.g., fauna and flora) and chemical, the lower of these values was selected.

For surface water (applied to groundwater), the screening values for chemicals known to bioaccumulate in aquatic food webs were based upon the final chronic value (rather than the final residue value) as per USEPA (1996b, 2002) and Suter and Tsao (1996). The use of final chronic values is intended to protect aquatic receptors from direct exposure to chemicals in water, rather than from exposure via food webs. Potential risks to upper trophic level receptors from food web exposures (tissue residues) were evaluated separately using the ingestion-based screening values outlined in the following subsection.

Screening values were adjusted based upon modifying factors as follows:

- Soil screening values based upon Dutch soil standards for certain organic chemicals were adjusted based upon a total organic carbon (TOC) value of two percent. This two percent value represents the default minimum adjustment value and was used because the site-specific TOC data indicated TOC concentrations in on-site surface soil were less than two percent.

The screening values used in the ERA are summarized, by medium, in Table 8-27.

8.3.3.2 Ingestion Screening Values

Ingestion screening values for dietary exposures were derived for each mammalian and avian receptor species and chemical evaluated in the ERA. Toxicological information from the literature for wildlife species most closely related to the receptor species was used, when available, but was supplemented by laboratory studies of non-wildlife species (e.g., chickens and laboratory mice) when necessary. The ingestion screening values are expressed as milligrams of the chemical per kilogram body weight of the receptor per day (mg/kg-BW/day).

Growth and reproduction were emphasized as assessment endpoints because they are the most relevant, ecologically, to maintaining viable populations and because they are generally the most studied chronic toxicological endpoints for ecological receptors. If several chronic toxicity studies were available from the literature, the most appropriate study was selected for each receptor species based upon study design, study methodology, study duration, study endpoint, and test species. No Observed Adverse Effect Levels (NOAELs) based on growth and reproduction were utilized, when available, as the primary screening values. When chronic NOAEL values were unavailable, estimates were extrapolated from chronic Lowest Observed Adverse Effect Levels (LOAELs) using an uncertainty factor of 10. Ingestion screening values for mammals and birds are summarized in Tables 8-28 and 8-29, respectively.

8.3.4 Screening Risk Calculation

The screening risk calculation is the final step in a SERA. In this step, the maximum exposure concentrations (abiotic media) or exposure doses (upper trophic level receptor species) are compared with the corresponding screening values to derive screening risk estimates. The outcome of this step is a list of COPCs for each medium-pathway-receptor combination evaluated or a conclusion of acceptable risk.

8.3.4.1 Selection of Chemicals of Potential Concern (COPCs)

COPCs are selected using the hazard quotient (HQ) method. HQs are calculated by dividing the chemical concentration in the medium being evaluated by the corresponding medium-specific screening value or by dividing the exposure dose by the corresponding ingestion screening value. Chemicals with HQs greater than or equal to one are considered COPCs in the SERA. Detected chemicals for which toxicological data were not available were also identified as COPCs in the SERA. Undetected chemicals for which toxicological data were not available were not identified as COPCs. Undetected chemicals whose maximum reporting limits exceeded screening values are addressed in the uncertainty section (Section 8.5).

HQs exceeding one indicate the potential for risk since the chemical concentration or dose (exposure) exceeds the screening value (effect). However, screening values and exposure estimates are derived using intentionally conservative assumptions such that HQs greater than or equal to one do not necessarily indicate that risks are present or impacts are occurring. Rather, it identifies chemical-pathway-receptor combinations requiring further evaluation. HQs that are less than one indicate that risks are very unlikely, enabling a conclusion of no unacceptable risk to be reached with high confidence.

Surface Soil

Maximum surface soil concentrations are compared to screening values in Table 8-30. Based upon this comparison, 11 metals (aluminum, chromium, copper, iron, lead, manganese, mercury, silver, thallium, vanadium, and zinc) and 13 PAHs had HQs equaling or exceeding one based upon detected concentrations and were identified as COPCs. Total PAHs[2] also exceeded screening values (Table 8-30).

Surface Sediment

Maximum surface sediment concentrations are compared to screening values in Table 8-31. Based upon this comparison, ten metals (arsenic, barium, copper, lead, mercury, nickel, selenium, silver, tin, and zinc) and 16 PAHs had HQs equaling or exceeding one based upon detected concentrations and were identified as COPCs. Total PAHs also exceeded screening values (Table 8-31). Beryllium, cyanide, and thallium were identified as COPCs because they were detected and a screening value was not available.

Groundwater

Maximum groundwater concentrations in site wells are compared to screening values in Table 8-32. Based upon this comparison, seven metals (aluminum, cobalt, copper, iron, manganese, nickel, and silver) had HQs equaling or exceeding one based upon detected

[2] Total PAHs were calculated, on a sample-by-sample basis, as the sum total of the concentrations of all PAH compounds analyzed for at the site. If an individual PAH compound was not detected in a sample, one-half of the reporting limit was used in calculating the total for that sample.

total (unfiltered) concentrations and were identified as COPCs (aluminum, cobalt, iron, and manganese also exceeded screening values based upon dissolved [filtered] concentrations). Caprolactam and methyl-tert-butyl ether (MTBE) were identified as COPCs because they were detected and a screening value was not available.

Food Web Exposures

HQs based upon maximum exposure doses for each upper trophic level receptor are listed in Table 8-33. Based upon a comparison to NOAELs, eight metals (arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc) had HQs equaling or exceeding one for one or more receptors and were identified as COPCs.

Two SVOCs (hexachlorobenzene and pentachlorophenol) also exceeded screening values but the exceedances for both SVOCs were based upon maximum reporting limits. These two chemicals are addressed in the uncertainty section (Section 8.5). Ingestion screening values were not available for two other SVOCs (4-bromophenyl-phenylether and 4-chlorophenyl-phenylether). These two SVOCs were not identified as COPCs because neither was detected on the site.

8.3.5 Screening Risk Conclusions

COPCs were identified in each of the media evaluated. These COPCs are summarized in Table 8-34.

8.4 Baseline Ecological Risk Assessment

The SERA resulted in a set of COPCs for each medium. This set of COPCs includes chemicals with HQs equaling or exceeding one (based upon maximum exposures) and detected chemicals for which toxicological data (screening values) were not available.

8.4.1 Refinement of Conservative Screening Assumptions

According to Superfund guidance (USEPA, 1997a), Step 3 initiates the problem formulation phase of the BERA. Under Navy policy/guidance (CNO, 1999; NAVFAC, 2001), the BERA begins with a preliminary step (Step 3A) in which the conservative assumptions employed in the SERA are refined and risk estimates are recalculated using the same conceptual model for the site. In addition, the re-evaluation may include consideration of other factors such as upgradient and background data, detection frequency, and chemical-specific bioavailability (CNO, 1999; NAVFAC, 2001).

The assumptions, parameter values, and methods that were modified for the Step 3A re-evaluation included:

- Risk estimates based upon maximum chemical concentrations were supplemented by risk estimates based upon average (arithmetic mean) chemical concentrations. In addition, BAFs and BCFs were based upon, or modeled from, central tendency estimates (e.g., median or mean) from the literature as opposed to the maximum or “high-end” (e.g., 90th percentile) estimates used in the SERA for many chemicals. Revised BAF/BCF values used in Step 3A are provided in Tables 8-35, 8-36, and 8-37.

In the BERA, using central tendency estimates (rather than high end or maximums) for exposure parameters such as BAFs provides a more representative estimate of potential exposures and risks to receptor populations (the focus of the assessment endpoints) of upper trophic level receptors. Because these upper trophic level species are highly mobile, they would be expected to effectively average their exposure over time as they forage within the area defining their home range (which will extend to off-site areas). Average prey concentrations at Step 3A are most appropriately estimated using central tendency estimates of media concentrations and accumulation factors. For example, the wildlife dietary exposure models contained in the Wildlife Exposure Factors Handbook (USEPA, 1993) specify the calculation of an average daily dose. Increasing the representativeness of the exposure estimates relative to population-level effects is consistent with the intent of the Step 3A evaluation. In cases where adequate spatial sampling coverage exists, mean concentrations are also appropriate for evaluating potential risks to populations of lower trophic level receptors because the members of the population are expected to be found throughout a site (where suitable habitat is present), rather than concentrated in one particular area. Habitat composition in terrestrial areas of the site is relatively uniform as is the habitat composition in the Desert Cove system, suggesting that receptor usage would be relatively uniform among areas. While effects on individual organisms might be important for some receptors, such as rare and endangered species, population- and community-level effects are typically more relevant to ecosystems. A discussion of the uncertainties associated with the number of available samples and their spatial distribution is contained in Section 8.5.

- Central tendency estimates (e.g., mean, median, midpoint) for body weight and ingestion rate (Table 8-38) were used to develop exposure estimates for upper trophic level receptors, rather than the minimum body weights and maximum ingestion rates used in the SERA. Central tendency estimates for these exposure parameters are more relevant for a BERA because they better represent the characteristics of a greater proportion of the individuals in the population. Populations (rather than individual organisms) were emphasized during the development of the assessment endpoints for the ERA.

- The SERA conservatively identified a chemical as a food web COPC if the estimated dose for at least one upper trophic level receptor exceeded the NOAEL. The actual dose that is protective of an individual receptor, however, will fall between the NOAEL and the LOAEL. Both the NOAEL and LOAEL were used for comparison in the BERA.

- Site-specific upgradient concentrations and base-wide background concentrations were also considered in the re-evaluation. Upgradient groundwater concentrations were derived from monitoring wells that were hydrologically upgradient of the site (MW-02). Background concentrations for both soil and groundwater were obtained from the 2000 Little Creek Background Study (CH2M HILL, 2000).

- USEPA guidance (USEPA, 1996b) indicates that the dissolved metal fraction should be preferentially used to the total metal fraction in surface water (and by extension in groundwater) screening. For conservatism, total metal concentrations were included in the SERA for the groundwater screen. Since high levels of suspended solids and sediment-adsorbed metals could result in overstating bioavailable concentrations (and

thus potential exposures and risks), filtered metal concentrations (representing the dissolved fraction) in groundwater were also evaluated through a comparison to screening values based upon the dissolved metal fraction.

Only complete, critical pathways identified in the SERA were re-evaluated in Step 3A of the ERA. Similarly, only COPCs and receptors identified in the SERA as requiring further evaluation were addressed in Step 3A. Although many aspects of the estimation of exposure were modified in Step 3A (see above), the screening values (effects) used in Step 3A were the same as the values used in the SERA. Although the same basic conceptual model from the SERA was also used in Step 3A, the endpoints and risk hypotheses from the SERA were modified slightly to better reflect the Step 3A analysis (Table 8-39).

8.4.2 Refined (Step 3A) Risk Characterization

Based upon the results of the SERA, the assessment endpoints, measurement endpoints, and risk hypotheses were modified for the Step 3A evaluation (Table 8-39). Modifications included eliminating from further consideration those assessment endpoints for which no unacceptable risk was found during the SERA and modifying the measurement endpoints to reflect the assumptions and methods used in the Step 3A evaluation. The results of the refined risk characterization are discussed, by medium, in the following subsections.

8.4.2.1 Data Groupings

Because the SERA was conducted using maximum media concentrations, data were not partitioned into spatial groupings in the SERA. However, the following spatial groupings were utilized for surface soil in Step 3A:

- Southern area - samples collected from the area of SWMU 7 south of Desert Cove and the Connector Channel (Table 8-20).
- Eastern area - samples collected from the area of SWMU 7 east of Desert Cove and the Connector Channel (Table 8-20).
- Northern area - samples collected from the area of SWMU 7 north of Desert Cove and the Connector Channel (Table 8-20).

Sediment:

- Connector Channel - samples collected for the Connector Channel (Table 8-20).
- Pier Area - samples collected along and within the existing piers in Desert Cove (Table 8-20).
- Desert Cove - samples collected in Desert Cove not within or immediately adjacent to the piers (Table 8-20).

These spatial groupings were used in Step 3A to better evaluate potential risks in different areas of the site where potential exposures could vary due to differences in the magnitude of chemical concentrations. In addition, these groupings assist in the evaluation of the spatial distribution of potential risks across the site.

8.4.2.2 Surface Soil

The Step 3A surface soil evaluation was conducted using the data groupings discussed in Section 8.4.2.1 and is contained in the following subsections.

Southern Area

Mean chemical concentrations in surface soils from the southern area of the site are compared with screening values in Table 8-40 (highlighted cells indicate mean HQs that exceed one). Based upon this comparison, five metals (aluminum, chromium, iron, vanadium, and zinc), 13 individual PAH compounds, and total PAHs had mean HQs that equaled or exceeded one and were identified as PCOCs. Although the mean HQs for lead and silver did not exceed one, these two metals are also carried into the risk evaluation based upon a combination of the frequency of exceedance and the magnitude of the maximum HQ.

Eastern Area

Mean chemical concentrations in surface soils from the eastern area of the site are compared with screening values in Table 8-41 (highlighted cells indicate mean HQs that exceed one). Based upon this comparison, six metals (aluminum, chromium, iron, lead, vanadium, and zinc) had mean HQs that equaled or exceeded one and were identified as PCOCs. Although the mean HQ for copper did not exceed one, this metal is also carried into the risk evaluation based upon a combination of the frequency of exceedance and the magnitude of the maximum HQ.

Northern Area

Mean chemical concentrations in surface soils from the northern area of the site are compared with screening values in Table 8-42 (highlighted cells indicate mean HQs that exceed one). Based upon this comparison, eight metals (aluminum, chromium, copper, iron, lead, mercury, vanadium, and zinc) and five PAHs had mean HQs that equaled or exceeded one and were identified as PCOCs.

8.4.2.3 Surface Sediment

The Step 3A surface sediment evaluation was conducted using the data groupings discussed in Section 8.4.2.1 and is contained in the following subsections.

Connector Channel

Mean chemical concentrations in sediments from the Connector Channel are compared with screening values in Table 8-43 (highlighted cells indicate mean HQs that exceed one). Based upon this comparison, three metals (copper, selenium, and zinc), eight individual PAHs, and total PAHs had mean HQs that equaled or exceeded one and were identified as PCOCs. Although the mean HQs for mercury did not exceed one, this metal is also carried into the risk evaluation based upon a combination of the frequency of exceedance and the magnitude of the maximum HQ. Beryllium and thallium, which were detected but lacked screening values, were also identified as PCOCs.

Pier Area

Mean chemical concentrations in sediments from the pier area of Desert Cove are compared with screening values in Table 8-44 (highlighted cells indicate mean HQs that exceed one). Based upon this comparison, six metals (copper, lead, mercury, silver, tin, and zinc), 14

individual PAHs, and total PAHs had mean HQs that equaled or exceeded one and were identified as PCOCs. Although the mean HQs for arsenic and selenium did not exceed one, these two metals are also carried into the risk evaluation based upon a combination of the frequency of exceedance and the magnitude of the maximum HQ. Beryllium and cyanide, which were detected but lacked screening values, were also identified as PCOCs.

Desert Cove

Mean chemical concentrations in sediments from Desert Cove (areas outside of the boat slips) are compared with screening values in Table 8-45 (highlighted cells indicate mean HQs that exceed one). Based upon this comparison, six metals (arsenic, copper, lead, mercury, tin, and zinc), 14 individual PAHs, and total PAHs had mean HQs that equaled or exceeded one and were identified as PCOCs. Although the mean HQs for selenium did not exceed one, this metal is also carried into the risk evaluation based upon a combination of the frequency of exceedance and the magnitude of the maximum HQ. Beryllium and cyanide, which were detected but lacked screening values, were also identified as PCOCs.

8.4.2.4 Groundwater

Mean chemical concentrations in groundwater samples collected from on-site wells are compared with screening values in Table 8-46 (highlighted cells indicate mean HQs that exceed one). The purpose of this comparison was to qualitatively evaluate potential chemical transport via groundwater to Desert Cove, located downgradient of SWMU 7 in the approximate groundwater flow direction. This comparison was done both assuming no dilution and using a dilution factor of 10. In the absence of site-specific dilution factors, Buchman (1999) recommends using a conservative dilution factor of 10 to account for the dilution expected during migration and upon discharge of groundwater to surface water bodies. Based upon this comparison, iron and manganese had mean HQs that equaled or exceeded one in both filtered and unfiltered samples when a dilution factor of 10 was applied (Table 8-46). Thus, iron and manganese were identified as PCOCs in site groundwater. Aluminum, the only other chemical with a mean HQ exceeding one (based upon unfiltered samples) when dilution was considered, was not identified as a PCOC based upon the lack of exceedances in filtered samples. Chemicals in groundwater are most likely to travel dissolved in water rather than adhered to particles since they must travel through soil pores or fractured rock. Similarly, when groundwater discharges to a water body, the bulk of the discharged chemicals are likely to be dissolved in water since the discharge must pass through the pores in the underlying sediments. Thus, the dissolved concentrations are likely to be more representative of what would be transported via the groundwater than the total concentrations.

Caprolactam and MTBE, which were detected but lacked screening values, were also identified as PCOCs.

8.4.2.5 Food Web Exposures

HQs based upon average exposure doses for each upper trophic level receptor are listed in Table 8-47. Based upon a comparison to NOAELs, no chemical had a HQ that equaled or exceeded one for a semi-aquatic receptor. Based upon a comparison to NOAELs, the HQ for lead exceeded one (1.17) for the killdeer and the HQ for zinc exceeded one for the killdeer

(3.55) and the American kestrel (1.12) in terrestrial habitats. HQs based upon the LOAEL were less than one for all terrestrial receptors.

8.4.3 Risk Evaluation

The potential for adverse effects associated with the PCOCs identified in Section 8.4.2 and Table 8-48 are evaluated in this section. The goal of this evaluation is to finalize a list of COCs.

8.4.3.1 Terrestrial Habitats

The risk evaluation for terrestrial habitats is conducted for each of the three areas in the following subsections.

Southern Area

Seven metals (aluminum, chromium, iron, lead, silver, vanadium, and zinc), 13 individual PAH compounds, and total PAHs were identified as PCOCs in surface soils from the southern area of the site (Table 8-48). On-site surface soil concentrations for these metals and PAHs are compared to base-wide background surface soil concentrations developed as part of the Little Creek Background Study (CH2M HILL, 2000). As part of this background study, Upper Tolerance Limit (UTL) values were developed for a number of metals and organic chemicals in urban and native surface soils. On-site concentrations in southern area surface soils are compared to these UTLs in Table 8-49. Since the PAHs lacked UTL values, a direct comparison of maximum and mean concentrations from on-site and background data sets was conducted for these compounds (Table 8-50).

All of the metals except lead exceeded background concentrations in both native and urban soils (Table 8-49), although the exceedance for aluminum was low (ratio of 1.01 in native soils). PAHs also exceeded background. Aluminum is not expected to be toxic when the soil pH is greater than 5.5 and iron is not expected to be toxic in well aerated soils between pH 5 and 8 (USEPA, 2003). The mean soil pH on the site is 7.9. The mean HQ for silver did not exceed one based upon the screening value comparison.

On an area-wide basis, the risk associated with metals (chromium, vanadium, and zinc) and PAHs is expected to be low. Total PAHs only exceeded screening values in one location (SS-01) near CB-125. The developed nature of the southern area and the resulting low quality of the habitat present (gravel or hard-packed dirt with low and sparse herbaceous plants) is likely to significantly reduce potential exposures. There is the possibility of minor continued transport to Desert Cove and the Connector Channel from this area via wind and surface runoff.

Eastern Area

Seven metals (aluminum, chromium, copper, iron, lead, vanadium, and zinc) were identified as PCOCs in surface soils from the eastern area of the site (Table 8-48). Since copper lacked a UTL value, a direct comparison of maximum and mean concentrations from on-site and background data sets was conducted for this metal. Copper, lead, and zinc exceeded background concentrations in both native and urban soils (Table 8-49), although the exceedance for lead was low (ratio of 1.11).

On an area-wide basis, the risk associated with metals (copper and zinc) is expected to be low. The developed nature of this area and the resulting low quality of the habitat present (gravel or hard-packed dirt with low and sparse herbaceous plants) is likely to significantly reduce potential exposures. There is the possibility of minor continued transport to Desert Cove and the Connector Channel from this area via wind and surface runoff.

Northern Area

Eight metals (aluminum, chromium, copper, iron, lead, mercury, vanadium, and zinc) and five individual PAH compounds were identified as PCOCs in surface soils from the northern area of the site (Table 8-48). Since mercury lacked a UTL value, a direct comparison of maximum and mean concentrations from on-site and background data sets was conducted for this metal.

Chromium, copper, lead, mercury, and zinc exceeded background concentrations in both native and urban soils (Table 8-49) but PAHs did not (Table 8-50). On an area-wide basis, the risk associated with these five metals is expected to be low. The developed nature of this area and the resulting low quality of the habitat present (gravel or hard-packed dirt with low and sparse herbaceous plants) is likely to significantly reduce potential exposures. Additionally, the September 2004 interim removal action completed for surface soil in the northern area of SWMU 7 reduced the potential for continued transport of ABM residues and associated metals to Desert Cove.

Site-Wide Summary for Terrestrial Habitats

In summary, potential site-related risks in terrestrial areas of the site are low and, for PAHs, were restricted to a small area near CB-125. The developed nature of the terrestrial portions of the site and the resulting low quality of the habitat present (gravel or hard-packed dirt with low and sparse herbaceous plants) is likely to significantly reduce potential exposures. The possibility of continued transport to Desert Cove and the Connector Channel via wind and surface runoff from unremediated areas is low. There were no exceedances (based upon LOAELs) for terrestrial-based food web exposures.

Table 8-51 shows a comparison of chemical concentrations in surface and subsurface soil samples (highlighted values differed by more than 50 percent). Concentrations were higher in surface soils than in subsurface soils which is consistent with the known history of releases at the site. This comparison suggests that a quantitative risk evaluation of potential subsurface soil exposures for ecological receptors is not warranted.

8.4.3.2 Aquatic Habitats

In surface sediment, a number of metals (particularly copper, lead, mercury, silver, tin, and zinc based upon the magnitude and frequency of screening value exceedances) and PAHs were identified as PCOCs (Table 8-48). Three detected chemicals (beryllium, cyanide, and thallium) did not have a screening value and could not be evaluated quantitatively. Beryllium, cyanide, and thallium are not likely to be site-related. There were no exceedances (based upon NOAELs) for aquatic-based food web exposures.

Concentrations of metals based upon means were generally higher in surface sediment samples although maximum concentrations for some metals (such as tin) were higher in subsurface samples (Table 8-52; highlighted values differed by more than 50 percent). On

balance, PAH concentrations were similar between surface and subsurface samples. This, along with the observed distribution of ABM, suggests some mixing within the top foot or two of the sediment column. As such, many of the key PCOCs in surface sediment (i.e., copper, lead, mercury, tin, zinc, and PAHs) also exceeded screening values for subsurface sediment samples (Table 8-53).

The benthic invertebrate community found within the Desert Cove system is generally typical of what is expected for this area and type of habitat (Table 8-54). The dominant organisms are generally characterized as tolerant of pollutants and low dissolved oxygen, and opportunistic; are indicative of organic enrichment and depositional environments; and are surface dwellers, inhabiting the sediment/water interface (deeper-dwelling organisms were generally low to absent, probably due to anoxic conditions at depths more than a few cm below the sediment surface).

In general, PCOC (i.e., copper, lead, mercury, tin, zinc, and PAHs) sediment concentrations were highest in the pier area and lowest in the Connector Channel. This pattern is also reflected in the benthic invertebrate community data (Table 8-55). It is also consistent with the known site history and proximity to source areas. SEM/AVS ratios from surface sediment samples, however, suggest that metal bioavailability is relatively low, with only one of 18 SEM/AVS ratios exceeding one (Table 8-56). A comparison of surface sediment concentrations to equilibrium partitioning-based sediment values, which provide a measure of bioavailability, for the three PAHs (acenaphthene, fluoranthene, and phenanthrene) with available values (Table 8-57) suggests that potential exposures and risks are high in the pier area and low elsewhere.

Manganese and iron were identified as PCOCs in groundwater (Table 8-48). The purpose of the groundwater evaluation was to qualitatively evaluate potential risks for chemicals that may be transported via groundwater to Desert Cove, which is located downgradient of SWMU 7 in the approximate groundwater flow direction. Iron and manganese are evaluated relative to upgradient and background groundwater concentrations in Table 8-58. Based upon this comparison, manganese concentrations in on-site groundwater samples are similar to, or less than, concentrations in upgradient samples. Total iron concentrations in on-site groundwater samples are similar to, or less than, concentrations in background samples. Neither of these metals is likely to be site-related based upon site history. Thus, groundwater does not appear to be a significant transport route from the site to the Desert Cove system.

8.4.3.3 Summary of COCs

COCs are summarized in Table 8-59 by medium and area. The highest site-related risks are associated with metals and PAHs in Desert Cove sediments, particularly in the pier areas.

8.5 Uncertainties

Uncertainties are present in all risk assessments because of the limitations of the available data and the need to make certain assumptions and extrapolations based upon incomplete information. The uncertainty in this ERA is mainly attributable to the following factors:

- **Reporting Limits**. Reporting limits for some undetected analytes exceeded applicable screening values in some media. Table 8-60 summarizes these chemicals, by medium, and reports both the ratio of the maximum reporting limit to the screening value as well as the ratio of the mean value (calculated using one-half of the reporting limit for each sample) to the screening value. Because these chemicals were not detected, they are not known to be present on the site but the potential for unacceptable risks cannot be totally discounted because the reporting limits are higher than the screening values. The magnitude of the ratios can be used to qualitatively evaluate the magnitude of the associated uncertainty (e.g., there is more uncertainty in terms of the potential for risk for a ratio of 100 relative to a ratio of 10). There were relatively few chemicals with very high mean ratios (Table 8-60), suggesting that the associated uncertainties are relatively low. Because standard analytical methods were used and the sample reporting limits were not elevated relative to the method reporting limits (with the exception of one SVOC sample), these uncertainties are considered to be acceptable.

- **Duplicate Analyses**. When evaluating samples with field duplicates, the value used in the ERA was always the detect when one result was a detect and the duplicate was a non-detect, regardless of whether or not the non-detected value was higher. In these cases, the use of the detect has less uncertainty since it represents an actual measured value (versus an upper limit bound) and the two samples will have identical or similar reporting limits.

- **Selection of COPCs**. Chemicals without available screening values for a medium were not retained as COPCs in the SERA portion of the assessment unless they were detected. This was particularly an issue for the surface soil and sediment screens (most chemicals had water screening values). This could result in an underestimation of risks if these chemicals are actually present on the site at ecologically significant concentrations.

- **Use of Freshwater-Based Screening Values.** When marine-based water screening values were not available, freshwater-based screening values were used if available. This only occurred three times but does introduce some uncertainty into the assessment as it assumes that toxicity is similar in freshwater and marine organisms for these chemicals.

- **Evaluation of Soils**. The quantitative evaluation of chemical concentrations in soils was restricted to surface soils from the 0 to 6-inch depth range, where the highest exposures for most ecological receptors would be expected to occur. Because some ecological receptors may be exposed to deeper soils (e.g., down to 2 feet below the ground surface) at least periodically, subsurface soil data (from 6 to 24 inches) were also qualitatively evaluated. With few exceptions, surface soil concentrations were higher than, or similar to, subsurface soil concentrations.

- **Evaluation of Groundwater.** Although ecological receptors are not directly exposed to groundwater, groundwater concentrations were compared to surface water screening values. A dilution factor of 10 (Buchman, 1999) was used in the evaluation because site-specific factors were not available. This introduces some uncertainty into the analysis as a dilution factor of 10 is likely to be conservative.

- **Surface Soil Screening Values.** For surface soil screening values from MHSPE (1994), the soil standard decreases with decreasing TOC levels in a linear fashion, that is, the

soil standard decreases by a factor of two if the TOC decreases by a factor of two. Mean surface soil TOC is approximately 0.5 percent (Table 8-14), about one-fourth of the default minimum. Because the maximum HQs for all chemicals based upon these standards, except PAHs, are less than or equal to 0.25, the use of a default minimum TOC of 2 percent has minimal impact on the ERA. It should be noted that the actual default TOC for PAHs is 10 percent but 2 percent was used for conservatism.

- **Sediment Screening Values**. Most of the sediment screening values used in the ERA do not consider site-specific bioavailability to ecological receptors and are typically based upon correlational studies (termed the Screening Level Concentration approach). These factors tend to make the resulting screening values very conservative and likely overestimate potential risk.

- **Ingestion Screening Values**. Data on the toxicity of many chemicals to the receptor species were sparse or lacking, requiring the extrapolation of data from other wildlife species or from laboratory studies with non-wildlife species. This is a typical limitation and extrapolation for ecological risk assessments because so few wildlife species have been tested directly for most chemicals. The uncertainties associated with toxicity extrapolation were minimized through the selection of the most appropriate test species for which suitable toxicity data were available. The factors considered in selecting a test species to represent a receptor species included taxonomic relatedness, trophic level, foraging method, and similarity of diet.

  A second uncertainty related to the derivation of ingestion screening values applies to metals. Most of the toxicological studies on which the ingestion screening values for metals were based used forms of the metal (such as salts) that have high water solubility and high bioavailability to receptors. Since the analytical samples on which site-specific exposure estimates were based measured total metal, regardless of form, and these highly bioavailable forms are expected to compose only a fraction of the total metal concentration, this is likely to result in an overestimation of potential risks for these chemicals.

  A third source of uncertainty associated with the derivation of ingestion screening values concerns the use of uncertainty factors. For example, NOAELs were extrapolated to LOAELs using an uncertainty factor of ten. This approach is likely to be conservative since Dourson and Stara (1983) determined that 96 percent of the chemicals included in a data review had LOAEL/NOAEL ratios of five or less. The use of an uncertainty factor of 10, although potentially conservative, also serves to counter some of the uncertainty associated with interspecies extrapolations, for which a specific uncertainty factor was not used.

- **Chemical Mixtures**. Information on the ecotoxicological effects of chemical interactions is generally lacking, which required (as is standard for ecological risk assessments) that the chemicals be evaluated on a compound-by-compound basis during the comparison to screening value. This could result in an underestimation of risk (if there are additive or synergistic effects among chemicals) or an overestimation of risks (if there are antagonistic effects among chemicals).

- **Receptor Species Selection**. Reptiles were selected as receptors in the ERA, but were not evaluated quantitatively even when exposure pathways were complete. Reptiles were evaluated using other fauna (birds and mammals) as surrogates due to the general lack of taxon-specific toxicological data. This represents an uncertainty in the assessment

  It was also assumed that reptiles were not exposed to significantly higher concentrations of chemicals and were not more sensitive to chemicals than the other receptor species evaluated. This assumption was a source of uncertainty in the ERA. In addition, there is some uncertainty associated with the use of specific receptor species to represent larger groups of organisms (e.g., guilds).

- **Food Web Exposure Modeling.** Chemical concentrations in terrestrial and aquatic food items (plants, earthworms, small mammals, benthic invertebrates, and fish) were modeled from measured media concentrations and were not directly measured. The use of generic, literature-derived exposure models and bioaccumulation factors introduces some uncertainty into the resulting estimates. The values selected and methodology employed were intended to provide a conservative (SERA) or realistic (Step 3A) estimate of potential food web exposure concentrations.

  Another source of uncertainty is the use of default assumptions for exposure parameters such as BCFs and BAFs). Although BCFs or BAFs for many bioaccumulative chemicals were readily available from the literature and were used in the ERA, the use of a default factor of 1.0 to estimate the concentration of some chemicals in receptor prey items is a source of uncertainty.

  Area use factors were assumed to equal one. This is a conservative assumption since a significant percentage of each upper trophic level receptor species time could be spent foraging off-site in unimpacted areas or areas where chemical concentrations are expected to be significantly lower.

- **Total Versus Dissolved Metals.** USEPA guidance (USEPA, 1996b) indicates that the dissolved metal fraction should be preferentially used to the total metal fraction in surface water screening. Both total and dissolved concentrations were used in the ERA for the groundwater screens. High levels of suspended solids and sediment-adsorbed metals would result in overstating bioavailable water concentrations and thus potential exposures and risks.

  In addition, chemicals in groundwater are most likely to travel dissolved in water rather than adhered to particles since they must travel through soil pores or fractured rock. Similarly, when groundwater discharges to a water body, the bulk of the discharged chemicals are likely to be dissolved in water since the discharge must pass through the pores in the underlying sediments. Thus, the dissolved concentrations are likely to be more representative of what would be transported via the groundwater than the total concentrations. Once discharged (at which point exposures can occur), the dissolved metal fraction in water (filtered samples) is more representative of the bioavailable fraction to aquatic receptors than the total metal fraction (unfiltered samples) (USEPA, 1996b). This is reflected in how the most recent Ambient Water Quality Criteria have been developed for many metals, that is, they are based on the dissolved fraction. Only total concentrations were used in the SERA to reflect the conservative nature of the

initial steps in the ERA process. However, the main purpose of the Step 3A analysis was to revisit these initial assumptions, thus the use of dissolved metal concentrations.

- **Mean Versus Maximum Media Concentrations.** As is typical in an ERA, a finite number of samples of environmental media are used to develop the exposure estimates. The maximum measured concentration provides a conservative estimate for immobile biota or those with a limited home range. The most realistic exposure estimates for mobile species with relatively large home ranges and for species populations (even those that are immobile or have limited home ranges) are those based upon the mean chemical concentrations in each medium to which these receptors are exposed. This is reflected in the wildlife dietary exposure models contained in the Wildlife Exposure Factors Handbook (USEPA, 1993), which specify the use of average media concentrations. Given the mobility of the upper trophic level receptor species used in the ERA, the use of maximum chemical concentrations (rather than mean concentrations) in the SERA to estimate the exposure via food webs is very conservative. This conservatism was reduced to more realistic levels in the values selected for use in the Step 3A evaluation. It should also be noted that the spatial groupings used in the Step 3A evaluation reduced the spatial area evaluated, making the mean more relevant to population-level exposures in each area.
- **Comparison to Upgradient/Background Concentrations.** Upgradient (groundwater) and background (surface soil and groundwater) concentrations were used to judge the site-relatedness of individual chemicals in particular media. If site chemical concentrations were consistent with these levels, it was assumed that the concentrations were not site-related. There exists the possibility that concentrations below background were indeed site-related, rendering the assumption false. However the impact of this possibility is minimal since chemicals at concentrations consistent with background conditions should exhibit no different ecological effects than commonly occurring in areas not affected by releases, regardless of their source.
- **Spatial Distribution of Samples**. The number and spatial distribution of the analytical samples were sufficient to adequately estimate potential ecological risks. There were 41 surface sediment samples collected from Desert Cove and the Connector Channel (5 during the SI, 19 discrete samples during the RI, and 17 composite samples during the RI) and 19 subsurface sediment samples. The 25 surface and 36 subsurface (two depths) soil samples that were collected from SWMU 7 during the SI and RI were used in the ERA. Six groundwater monitoring wells have been installed at the site, including one (MW-02) located upgradient of SWMU 7. The number and location of all RI samples were scoped jointly by the Navy, other Little Creek Tier I partnering team members, and the Region III BTAG.

8.6 Ecological Risk Assessment Conclusions

In conclusion, potential site-related risks in terrestrial areas of the site were low and, for PAHs, were restricted to a small area near CB-125. The developed nature of the terrestrial portions of the site and the resulting low quality of the habitat present (gravel or hard-packed dirt with low and sparse herbaceous plants) is likely to significantly reduce potential exposures. The possibility of continued transport to Desert Cove and the Connector Channel

via wind and surface runoff from unremediated areas is low. There were no exceedances (based upon LOAELs) for terrestrial-based food web exposures.

There were no exceedances (based upon NOAELs) for aquatic-based food web exposures. In surface sediment, a number of metals (particularly copper, lead, mercury, tin, and zinc) and PAHs were identified as COCs. A comparison of surface and subsurface sediment concentrations suggests some mixing within the top foot or two of the sediment column. In general, sediment concentrations were highest in the pier area of Desert Cove and lowest in the Connector Channel. This pattern was also reflected in the benthic invertebrate community data and is also consistent with the known site history and proximity to source areas. SEM/AVS ratios from surface sediment samples, however, suggest that metal bioavailability is relatively low, with only one of 18 ratios exceeding one. A comparison of surface sediment concentrations to equilibrium partitioning-based sediment values, which provide a measure of bioavailability, for the three PAHs with available values suggests that potential exposures and risks are high in the pier area and low elsewhere. Groundwater does not appear to be a significant transport route from the site to the Desert Cove system.

In summary, the highest site-related risks were associated with metals (primarily copper, lead, mercury, tin, and zinc) and PAHs in Desert Cove sediments, particularly in the pier areas.

8.6.1 Recommendations

The low quality of the terrestrial habitats present on-site suggests that significant direct exposures for terrestrial receptors are unlikely. Potential risks in the Desert Cove system are high in some areas (such as near the piers). However, the current plans to replace the piers and dredge the cove and channel in 2006 are likely to address these potential risks. While the depth of dredging is not yet known, it is likely that at least several feet of sediment will be removed during this activity. If this activity takes place, the collection and evaluation of post-dredging surface sediment samples is recommended to confirm that concentrations of chemicals have been reduced to acceptable levels. If the activity does not take place, it is recommended that the risk evaluation for SWMU 7 be continued.

8.7 References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999a. *Toxicological profile for cadmium*. July.

Agency for Toxic Substances and Disease Registry (ATSDR). 1999b. *Toxicological profile for hexachlorocyclopentadiene*. July.

Agency for Toxic Substances and Disease Registry (ATSDR). 1998. *Toxicological profile for 1,4-dichlorobenzene*. December.

Agency for Toxic Substances and Disease Registry (ATSDR). 1997a. *Toxicological profile for nickel*. September.

Agency for Toxic Substances and Disease Registry (ATSDR). 1997b. *Toxicological profile for hexachloroethane*. September.

Agency for Toxic Substances and Disease Registry (ATSDR). 1996a. *Toxicological profile for 1,1,2,2-tetrachloroethane*. August.

Agency for Toxic Substances and Disease Registry (ATSDR). 1996b. *Toxicological profile for hexachlorobenzene*. August.

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. *Toxicological profile for polycyclic aromatic hydrocarbons (PAHs)*. August.

Agency for Toxic Substances and Disease Registry (ATSDR). 1994a. *Toxicological profile for zinc*. May.

Agency for Toxic Substances and Disease Registry (ATSDR). 1994b. *Toxicological profile for 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD*. May.

Agency for Toxic Substances and Disease Registry (ATSDR). 1994c. *Toxicological profile for hexachlorobutadiene*. May.

Agency for Toxic Substances and Disease Registry (ATSDR). 1994d. *Toxicological profile for pentachlorophenol*. May.

Agency for Toxic Substances and Disease Registry (ATSDR). 1993a. *Toxicological profile for arsenic*. April.

Agency for Toxic Substances and Disease Registry (ATSDR). 1993b. *Toxicological profile for aldrin/dieldrin*. April.

Agency for Toxic Substances and Disease Registry (ATSDR). 1993c. *Toxicological profile for endosulfan*. April.

Agency for Toxic Substances and Disease Registry (ATSDR). 1993d. *Toxicological profile for heptachlor/heptachlor epoxide*. April.

Agency for Toxic Substances and Disease Registry (ATSDR). 1990a. *Toxicological profile for copper*. December.

Agency for Toxic Substances and Disease Registry (ATSDR). 1990b. *Toxicological profile for silver*. TO-90/24.

A.T. Kearny. 1989. *RCRA Facility Assessment*. December.

Bechtel Jacobs. 1998a. *Empirical models for the uptake of inorganic chemicals from soil by plants.* Prepared for U.S. Department of Energy. BJC/OR-133. September 1998.

Bechtel Jacobs. 1998b. *Biota sediment accumulation factors for invertebrates: review and recommendations for Oak Ridge Reservation.* Prepared for U.S. Department of Energy. BJC/OR-112. August 1998.

Beyer, W.N. 1996. Accumulation of chlorinated benzenes in earthworms. *Bulletin of Environmental Contamination and Toxicology.* 57:729-736.

Beyer, W.N., E.E. Connor, and S. Gerould. 1994. Estimates of soil ingestion by wildlife. *Journal of Wildlife Management.* 58:375-382.

Beyer, W.N. and C. Stafford. 1993. Survey and evaluation of contaminants in earthworms and in soil derived from dredged material at confined disposal facilities in the Great Lakes Region. *Environmental Monitoring and Assessment.* 24:151-165.

Beyer, W.N. and C.D. Gish. 1980. Persistence in earthworms and potential hazards to birds of soil applied DDT, dieldrin, and heptachlor. *Journal of Applied Ecology.* 17:295-307.

Blus, L.J. 1996. DDT, DDD, and DDE in birds. Pages 49-71 IN Beyer, W.N., G.H. Heinz, and A.W. Redmon-Norwood (eds). *Environmental contaminants in wildlife: interpreting tissue concentrations.* Lewis Publishers, Boca Raton, FL. 494 pp.

Buchman, M.F. 1999. *NOAA screening quick reference tables.* NOAA HAZMAT Report 99-1, Seattle, WA. 12 pp.

CH2M HILL. 2001. *Draft screening and baseline (Steps 1- 3) ecological risk assessment for SWMUs 7 and 8, NAB Little Creek, Virginia Beach, VA.* January.

CH2M HILL. 2000. *Background investigation for Naval Amphibious Base Little Creek, Virginia Beach, Virginia.* Final. December.

Chandler, G.T. and G.I. Scott. 1991. Effects of sediment-bound endosulfan on survival, reproduction, and larval settlement of meiobenthic polychaetes and copepods. *Environmental Toxicology and Chemistry.* 10:375-382.

Chief of Naval Operations (CNO). 1999. *Navy policy for conducting ecological risk assessments.* Memorandum from Chief of Naval Operations to Commander, Naval Facilities Engineering Command. Ser N453E/9U595355. April 5, 1999.

Cope, W.G., J.G. Wiener, and R.G. Rada. 1990. Mercury accumulation in yellow perch in Wisconsin seepage lakes: relation to lake characteristics. *Environmental Toxicology and Chemistry.* 9:931-940.

Coulston, F. and A.C. Kolbye, Jr. (eds). 1994. Interpretive review of the potential adverse effects of chlorinated organic chemicals on human health and the environment. *Regulatory Toxicology and Pharmacology.* 20:S1-S1056.

Cubbage, J., D. Batts, and S. Breidenbach. 1997. *Creation and analysis of freshwater sediment quality values in Washington State.* Washington State Department of Ecology Publication No. 97-323a.

Dourson, M.L. and J.F. Stara. 1983. Regulatory history and experimental support of uncertainty (safety) factors. *Regulatory Toxicology and Pharmacology.* 3:224-238.

Dunning, J.B., Jr. (editor). 1993. *CRC handbook of avian body masses.* CRC Press, Boca Raton, FL. 371 pp.

Earth Technologies Corporation. 1988. *Visual site inspection report*. Prepared for the USEPA.

Edwards, C.A. and P.J. Bohlen. 1992. The effects of toxic chemicals on earthworms. *Reviews of Environmental Contamination and Toxicology.* 125:23-99.

Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997a. *Toxicological benchmarks for screening contaminants of potential concern for effects on terrestrial plants: 1997 revision.*

Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-85/R3.

Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997b. *Toxicological benchmarks for screening contaminants of potential concern for effects on soil and litter invertebrates and heterotrophic process: 1997 revision.* Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-126/R2.

Eisler, R. 1996. *Silver hazards to fish, wildlife, and invertebrates: a synoptic review.* National Biological Service, Biological Report 32, Contaminant Hazard Reviews Report 32. 44 pp.

Eisler, R. 1989. *Pentachlorophenol hazards to fish, wildlife, and invertebrates: a synoptic review.* U.S. Fish and Wildlife Service Biological Report 85(1.17), Contaminant Hazard Reviews Report No. 17. 72 pp.

Geo-Marine, Inc. 1997. *Integrated natural resources management plan, Naval Amphibious Base Little Creek, Virginia Beach, Virginia. Plan years 1997-2006.* Prepared for Atlantic Division, Naval Facilities Engineering Command. March.

Hill, E.F., R.G. Heath, J.W. Spann, and J.D. Williams. 1975. *Lethal dietary toxicities of environmental pollutants to birds.* U.S. Fish and Wildlife Service Special Scientific Report - Wildlife No. 191, Washington D.C.

Hirsch, M.P. 1998. Bioaccumulation of silver from laboratory-spiked sediments in the oligochaete (*Lumbriculus variegatus*). *Environmental Toxicology and Chemistry.* 17:605-609.

Humphreys, D.J. 1988. *Veterinary toxicology.* ISBN 0702012491.

International Programme on Chemical Safety (IPCS). 1992. *Environmental health criteria 131 - diethylhexyl phthalate.* World Health Organization, Geneva.

Jones, D.S., G.W. Suter II, and R.N. Hull. 1997. *Toxicological benchmarks for screening contaminants of potential concern for effects on sediment-associated biota: 1997 revision.* Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-95/R4.

Krantzberg, G. and D. Boyd. 1992. The biological significance of contaminants in sediment from Hamilton Harbour, Lake Ontario. *Environmental Toxicology and Chemistry.* 11:1527-1540.

Martin, A.C., H.S. Zim, and A.L. Nelson. 1951. *American wildlife and plants: a guide to wildlife food habits.* Dover Publications, Inc. New York, NY. 500 pp.

Maruya, K.A., R.W. Risebrough, and A.J. Horne. 1997. The bioaccumulation of polynuclear aromatic hydrocarbons by benthic invertebrates in an intertidal marsh. *Environmental Toxicology and Chemistry.* 16:1087-1097.

Menzie, C.A., D.E. Burmaster, J.S. Freshman, and C.A. Callahan. 1992. Assessment of methods for estimating ecological risk in the terrestrial component: a case study at the Baird & McGuire Superfund Site in Holbrook, Massachusetts. *Environmental Toxicology and Chemistry.* 11:245-260.

Ministry of Housing, Spatial Planning and Environment (MHSPE). 1994. *Intervention values.* Directorate-General for Environmental Protection, Department of Soil Protection, The Hague, Netherlands. 9 May. DBO/07494013.

NAVFAC (Naval Facilities Engineering Command). 2001. *Navy guidance for conducting ecological risk assessments.* http://web.ead.anl.gov/ecorisk/. February.

Oliver, B.G. and A.J. Niimi. 1988. Trophodynamic analysis of polychlorinated biphenyl congeners and other chlorinated hydrocarbons in the Lake Ontario ecosystem. *Environmental Science and Technology.* 22:388-397.

Ontario Ministry of Environment and Energy (MOE). 1993. *Guidelines for the protection and management of aquatic sediment quality in Ontario.* ISBN 0-7729-9248-7. 27 pp.

Palmer, R.S. (ed). 1988. *Handbook of North American birds. Volume 5.* Yale University Press, New Haven, CT.

Parkerton, T.F., J.P. Connolly, R.V. Thomann, and C.G. Uchrin. 1993. Do aquatic effects or human health end points govern the development of sediment-quality criteria for nonionic organic chemicals. *Environmental Toxicology and Chemistry.* 12:507-523.

Pascoe, G.A., R.J. Blanchet, and G. Linder. 1996. Food chain analysis of exposures and risks to wildlife at a metals-contaminated wetland. *Archives of Environmental Contamination and Toxicology.* 30:306-318.

Rigdon, R.H. and J. Neal. 1963. Fluorescence of chickens and eggs following the feeding of benzpyrene crystals. *Texas Reports on Biology and Medicine.* 21(4):558-566.

Robbins, C.S. and E.A.T. Blom. 1996. *Atlas of the breeding birds of Maryland and the District of Columbia.* University of Pittsburgh Press, Pittsburgh, PA.

Sample, B.E., J.J. Beauchamp, R.A. Efroymson, G.W. Suter II, and T.L. Ashwood. 1998a. *Development and validation of bioaccumulation models for earthworms.* Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-220.

Sample, B.E., J.J. Beauchamp, R.A. Efroymson, and G.W. Suter II. 1998b. *Development and validation of bioaccumulation models for small mammals.* Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-219.

Sample, B.E., M.S. Aplin, R.A. Efroymson, G.W. Suter II, and C.J.E. Welsh. 1997. *Methods and tools for estimation of the exposure of terrestrial wildlife to contaminants.* Environmental Sciences Division, Oak Ridge National Laboratory. ORNL/TM-13391.

Sample, B.E., D.M. Opresko, and G.W. Suter II. 1996. *Toxicological benchmarks for wildlife: 1996 revision.* Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-86/R3.

Sample, B.E. and G.W. Suter II. 1994. *Estimating exposure of terrestrial wildlife to contaminants.* Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-125.

Silva, M. and J.A. Downing. 1995. *CRC handbook of mammalian body masses.* CRC Press, Boca Raton, FL. 359 pp.

Simmons, G.J. and M.J. McKee. 1992. Alkoxyresorufin metabolism in white-footed mice at relevant environmental concentrations of Aroclor 1254. *Fundamental and Applied Toxicology.* 19:446-452.

Standley, L.J. 1997. Effect of sedimentary organic matter composition on the partitioning and bioavailability of dieldrin to the oligochaete *Lumbriculus variegatus. Environmental Science and Technology.* 31:2577-2583.

Suter, G.W. II. 1993. *Ecological risk assessment*. Lewis Publishers, Chelsea, MI. 538 pp.

Suter, G.W. II. 1990. Endpoints for regional ecological risk assessment. *Environmental Management.* 14:9-23.

Suter, G.W. II. 1989. Ecological endpoints. Chapter 2 IN Warren-Hicks, W., B.R. Parkhurst, and S.S. Baker, Jr. (eds*). Ecological assessment of hazardous waste sites: a field and laboratory reference.* EPA/600/3-89/013.

Suter, G.W. II and C.L. Tsao. 1996. *Toxicological benchmarks for screening potential contaminants of concern for effects on aquatic biota: 1996 revision.* Environmental Restoration Division, ORNL Environmental Restoration Program, ES/ER/TM-96/R2. 54 pp.

TERRETOX. 2002. On-line terrestrial toxicity database. U.S. Environmental Protection Agency.

Travis, C.C. and A.D. Arms. 1988. Bioconcentration of organics in beef, milk, and vegetation. *Environmental Science and Technology.* 22:271-274.

U.S. Environmental Protection Agency (USEPA). 2003. *Guidance for developing ecological soil screening levels (Eco-SSLs).* OSWER Directive 92857-55. August.

U.S. Environmental Protection Agency (USEPA). 2002. *National recommended water quality criteria - 2002.* EPA/822/R-02/047. November.

U.S. Environmental Protection Agency (USEPA). 2000. *Bioaccumulation testing and interpretation for the purpose of sediment quality assessment - status and needs.* EPA/823/R-00/001.

U.S. Environmental Protection Agency (USEPA). 1999a. *Supplemental guidance to RAGS: Region 4 ecological risk assessment bulletins.* August.

U.S. Environmental Protection Agency (USEPA). 1999b. *National recommended water quality criteria - correction.* EPA/822/Z-99/001.

U.S. Environmental Protection Agency (USEPA). 1999c. *Screening level ecological risk assessment protocol for hazardous waste combustion facilities.* Peer Review Draft. EPA/530/D-99/001.

U.S. Environmental Protection Agency (USEPA). 1997a. *Ecological risk assessment guidance for Superfund: process for designing and conducting ecological risk assessments.* Interim Final. EPA/540/R-97/006.

U.S. Environmental Protection Agency (USEPA). 1997b. *Mercury study report to Congress. Volume VI: an ecological assessment of anthropogenic mercury emissions in the United States.* EPA/452/R-97/008.

U.S. Environmental Protection Agency (USEPA). 1996a. *Superfund chemical data matrix.* EPA/540/R-96/028.

U.S. Environmental Protection Agency (USEPA). 1996b. *Ecotox thresholds.* Eco Update, Volume 3, Number 2. EPA/540/F-95/038. 12 pp.

U.S. Environmental Protection Agency (USEPA) Region III. 1995a. *Revised Region III BTAG screening levels.* Memorandum from R.S. Davis to Users. 9 August.

U.S. Environmental Protection Agency (USEPA). 1995b. *Internal report on summary of measured, calculated and recommended log k_{ow} values.* Environmental Research Laboratory, Athens, GA. 10 April.

U.S. Environmental Protection Agency (USEPA). 1995c. *Great Lakes Water Quality Initiative criteria documents for the protection of wildlife: DDT, mercury, 2,3,7,8-TCDD, PCBs*. EPA/820/B-95/008.

U.S. Environmental Protection Agency (USEPA). 1994. *Water quality criteria summary.* Office of Science and Technology, Health and Ecological Criteria Division, Washington, DC.

U.S. Environmental Protection Agency (USEPA). 1993. *Wildlife exposure factors handbook. Volume I of II.* EPA/600/R-93/187a.

U.S. Environmental Protection Agency (USEPA). 1990. *Assessment of risks from exposure of humans, terrestrial and avian wildlife, and aquatic life to dioxins and furans from disposal and use of sludge from bleached kraft and sulfite pulp and paper mills*. EPA/560/5-90/013.

Van Gestel, C.A.M. and W. Ma. 1988. Toxicity and bioaccumulation of chlorophenols in earthworms, in relation to bioavailability in soil. *Ecotoxicology and Environmental Safety.* 15:289-297.

Virginia Department of Conservation and Recreation, Division of Natural Heritage (VDNR-DNH). 1990. *An inventory of rare, threatened, and endangered species of the Little Creek Naval Amphibious Base, Virginia Beach, Virginia.* Nat. Her. Tech. Rep. No. 90-3. 34pp.

Wiemeyer, S.N. 1996. Other organochlorine pesticides in birds. Pages 99-115 IN Beyer, W.N., G.H. Heinz, and A.W. Redmon-Norwood (eds). *Environmental contaminants in wildlife: interpreting tissue concentrations.* Lewis Publishers, Boca Raton, FL. 494 pp.

Table 8-1
Partial List of Flora
NAB Little Creek, Virginia Beach, VA

Scientific Name	Common Name	Dune Forests	Interdunal Swales	Urban Forests	Developed Land	Lake/Pond Edges	Tidal Marshes	Scout Island
Trees								
Acer palmatum	Japanese maple				x			
Acer platanoides	Norway maple				x			
Acer rubrum	Red maple		x	x	x	x		x
Acer saccharinum	Silver maple				x			
Acer saccharum	Sugar maple			x	x			
Albizia julibrissin	Mimosa				x			
Betula nigra	River birch				x	x		
Betula populifolia	Gray birch				x			
Cedrus deodara	Deodar cedar				x			
Carpinus caroliniana	Ironwood			x				
Carya cordiformis	Bitternut hickory			x	x			
Carya glabra	Pignut hickory			x	x			
Carya illinoensis	Pecan				x			
Carya ovata	Shagbark hickory			x	x			
Carya tomentosa	Mockernut hickory			x	x			
Celtis laevigata	Hackberry			x		x		x
Chamaecyparis pisifera	Sarawa false cypress				x			
Chamaecyparis thyoides	Atlantic white cedar			x				
Cornus florida	Flowering dogwood			x	x			
Cornus kousa	Japanese dogwood				x			
Crataegus nitida	Glossy hawthorn			x	x			
Diospyros virginiana	Persimmon	x		x	x		x	
Fagus grandifolia	American beech			x		x		
Fraxinus americana	White ash			x				
Gleditsia triacanthos	Honey locust			x	x			
Ilex cassine	Dahoon holly			x	x			
Ilex opaca	American holly			x	x	x		x
Juglans nigra	Black walnut				x			
Juniperus virginiana	Eastern red cedar			x	x			x
Liquidambar styraciflua	Sweetgum		x	x	x	x		x
Liriodendron tulipifera	Tulip poplar			x	x	x		x
Magnolia grandiflora	Southern magnolia			x	x			

Table 8-1
Partial List of Flora
NAB Little Creek, Virginia Beach, VA

Scientific Name	Common Name	Dune Forests	Interdunal Swales	Urban Forests	Developed Land	Lake/Pond Edges	Tidal Marshes	Scout Island
Magnolia virginiana	Sweet bay			x		x		x
Malus spp.	Flowering crab apple				x			
Morus alba	White mulberry			x	x			
Morus rubra	Red mulberry			x	x			
Nyssa sylvatica	Black gum		x	x		x		x
Oxydendron arboreum	Sourwood			x				x
Paulownia tomentosa	Empress tree				x			
Persea borbonia	Red bay			x		x		x
Picea abies	Norway spruce				x			
Picea pungens glauca	Colorado blue spruce				x			
Picea rubens	Red spruce				x			
Pinus echinata	Shortleaf pine			x	x			
Pinus elliotii	Slash pine			x	x			
Pinus strobus	White pine			x	x			
Pinus taeda	Loblolly pine	x		x	x	x		x
Pinus thunbergii	Japanese black pine				x			
Pinus virginiana	Virginia pine			x	x			
Platanus occidentalis	American sycamore			x	x			
Populus deltoides	Eastern cottonwood				x			
Populus nigra	Lombardy poplar				x			
Prunus cerasifera	Purple-leaf plum				x			
Prunus serotina	Black cherry	x		x	x			x
Prunus serrulata	Japanese flowering cherry				x			
Pyrus calleryana	Bradford pear				x			
Quercus alba	White oak			x	x	x		
Quercus coccinea	Scarlet oak			x	x			
Quercus falcata	Southern red oak			x	x			x
Quercus incana	Bluejack oak	x						
Quercus laevis	Turkey oak	x						
Quercus laurifolia	Laurel oak			x	x	x		
Quercus lyrata	Overcup oak					x		
Quercus marilandica	Blackjack oak				x			
Quercus michauxii	Swamp chestnut oak					x		

Table 8-1
Partial List of Flora
NAB Little Creek, Virginia Beach, VA

Scientific Name	Common Name	Dune Forests	Interdunal Swales	Urban Forests	Developed Land	Lake/Pond Edges	Tidal Marshes	Scout Island
Quercus nigra	Water oak			x	x	x		x
Quercus palustris	Pin oak			x	x			
Quercus phellos	Willow oak			x	x	x		x
Quercus rubra	Northern red oak			x	x			
Quercus stellata	Post oak			x	x			
Quercus velutina	Black oak			x	x			
Quercus virginiana	Live oak	x		x	x			x
Robinia pseudoacacia	Black locust			x	x			
Salix alba	White willow			x	x			
Salix babylonica	Weeping willow				x	x		
Salix matsudana tortuosa	Corkscrew willow				x			
Salix nigra	Black willow		x	x	x	x		x
Sassafras albidum	Sassafras			x				x
Taxodium distichum	Bald cypress					x		x
Thuja occidentalis	Arborvitae			x	x			
Tilia cordata	Little-leaf linden				x			
Ulmus americana	American elm			x	x	x		
Ulmus pumila	Siberian elm				x			
Ulmus thomasii	Rock elm				x			
Shrubs								
Alnus rugosa	Speckled alder					x		x
Alnus serrulata	Smooth alder					x		x
Amelanchier laevis	Serviceberry			x		x		
Aralia spinosa	Devil's walking stick			x	x			x
Asimina triloba	Pawpaw			x				x
Baccharis halimifolia	Groundsel-tree		x				x	
Callicarpa americana	American beauty-berry			x				x
Cephalanthus occidentalis	Buttonbush		x			x		x
Cercis canadensis	Eastern redbud			x	x			
Clethra alnifolia	Sweet pepperbush			x		x		x
Euonymus americanus	American strawberry bush					x		
Ilex cornuta	Chinese holly				x			
Ilex cornuta burfordi	Burford holly				x			

Table 8-1
Partial List of Flora
NAB Little Creek, Virginia Beach, VA

Scientific Name	Common Name	Dune Forests	Interdunal Swales	Urban Forests	Developed Land	Lake/Pond Edges	Tidal Marshes	Scout Island
Ilex fosteri	Foster's holly				x			
Iva frutescens	Marsh elder		x	x	x		x	
Kalmia latifolia	Mountain laurel			x				
Hibiscus moscheutos	Swamp rosemallow		x			x		x
Ligustrum spp.	Privet spp.	x		x	x			x
Myrica cerifera	Wax myrtle		x	x	x	x	x	x
Osmanthus americanus	Wild olive		x					
Osmanthus fortunei	Osmanthus				x			
Photinia serrulata	Chinese photinia				x			
Prunus virginiana	Choke cherry			x	x			
Rhus copallina	Winged sumac			x	x			
Rhus glabra	Smooth sumac			x	x			
Rhus typhina	Staghorn sumac			x	x			
Rosa multiflora	Multiflora rose			x	x			
Rosa palustris	Swamp rose					x		x
Salix discolor	Pussy willow				x			
Salix nigra	Black willow		x			x		x
Sambucus canadensis	Elderberry			x		x		x
Sassafras albidum	Sassafras			x				x
Vaccinium angustifolium	Lowbush blueberry	x		x				x
Vaccinium corymbosum	Highbush blueberry		x	x		x		x
Herbaceous Plants								
Allium canadense	Meadow onion				x			
Ammophila breviligulata	American beachgrass	x						
Asplenium platyneuron	Ebony spleenwort			x				x
Aster novi-belgii	New York aster			x		x		
Aster vimineus	Small white aster			x		x		
Cakile edentula	American searocket	x						
Carex spp.	Sedges		x			x	x	x
Commelina communis	Asiatic dayflower			x	x			
Cuscuta gronovii	Common dodder			x		x		x
Cyperus spp.	Flatsedges	x	x			x		x
Distichlis spicata	Seashore saltgrass						x	

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NAB Little Creek, Virginia Beach, VA

Scientific Name	Common Name	Dune Forests	Interdunal Swales	Urban Forests	Developed Land	Lake/Pond Edges	Tidal Marshes	Scout Island
Eleocharis parvula	Dwarf spikerush		x					
Eleocharis quadrangulata	Square-stemmed spikerush		x					
Eleocharis rostellata	Beaked spikerush		x					
Erianthus spp.	Plumegrasses		x		x			
Eupatorium perfoliatum	Common boneset			x		x		x
Festuca arundinacea	Kentucky fescue				x			
Hemerocallis fulva	Day lilly				x			
Impatiens capensis	Spotted jewelweed					x		x
Juncus effusus	Soft rush					x		x
Juncus roemerianus	Black needlerush						x	
Juncus scirpoides	Needle-pod rush		x					
Lechea maritima virginica	Virginia Beach pinweed	x						
Lobelia cardinalis	Cardinal flower					x		x
Ludwigia spp.	Seedboxes		x			x		x
Lycopodium spp.	Ground pines		x	x				x
Mitchella repens	Partridgeberry			x				x
Nuphar luteum	Spatterdock					x		
Onoclea sensibilis	Sensitive fern			x				x
Osmunda cinnamomea	Cinnamon fern			x				x
Osmunda regalis	Royal fern			x		x		x
Phragmites australis	Common reed		x		x	x	x	
Poa pratensis	Kentucky bluegrass				x			
Podophylum peltatum	May-apple			x				x
Pontederia cordata	Pickerelweed					x		x
Polygonum spp.	Smartweeds		x	x		x		x
Pteridium aquilinum	Bracken fern	x		x				x
Rhexia mariana	Maryland meadow-beauty		x			x		
Rhynchospora spp.	Beakrushes		x			x		
Rubus argutus	Serrate-leaf blackberry			x	x			
Rubus hispidus	Bristly blackberry			x		x		
Rumex crispus	Curly dock				x			
Sagittaria latifolia	Broad-leaved arrow-head					x		x
Saururus cernuus	Lizard's tail					x		x

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NAB Little Creek, Virginia Beach, VA

Scientific Name	Common Name	Dune Forests	Interdunal Swales	Urban Forests	Developed Land	Lake/Pond Edges	Tidal Marshes	Scout Island
Scirpus cyperinus	Wool grass		x			x		
Scirpus pungens	Common three-square		x			x		
Scirpus robustus	Saltmarsh bulrush						x	
Solidago spp.	Goldenrods	x		x	x	x		x
Spartina alterniflora	Saltmarsh cordgrass						x	
Spartina patens	Saltmeadow grass						x	
Taraxacum officinale	Common dandelion				x			
Tillandsia usneoides	Spanish moss							x
Trifolium pratense	Red clover				x			
Trifolium repens	White clover				x			
Typha latifolia	Broad-leaved cattail					x		x
Woodwardia areolata	Netted chain fern			x		x		x
Woodwardia virginica	Virginia chain fern							x
Vines								
Campsis radicans	Trumpet creeper	x		x	x			x
Gelsemium sempervirens	Yellow jessamine	x		x				
Lonicera japonica	Japanese honeysuckle	x		x	x			x
Lonicera sempervirens	Trumpet honeysuckle	x						
Parthenocissus quinquefol	Virginia creeper	x		x	x			x
Smilax bona-nox	Saw greenbrier			x				
Smilax glauca	Cat greenbrier	x		x				x
Smilax rotundifolia	Greenbrier	x		x	x	x		x
Toxicodendron radicans	Poison ivy	x		x	x	x		x
Vitis labrusca	Fox grape	x		x				x
Vitis rotundifolia	Muscadine grape	x		x	x			x

From Geo-Marine (1997)

Table 8-2 Mammalian Species Known or Expected to Occur *NAB Little Creek, Virginia Beach, VA*	
Scientific Name	Common Name
Order Marsupialia	Marsupials
Didelphis virginianus	Virginia opossum
Order Insectivora	Insectivores
Blarina carolinensis	Southern short-tailed shrew
Cryptotis parva	Least shrew*
Scalopus aquaticus	Eastern mole
Order Chiroptera	Bats
Eptesicus fuscus	Big brown bat*
Lasiurus borealis	Northern red bat*
Myotis lucifugus	Little brown bat*
Pipistrellus subflavus	Eastern pipistrelle*
Order Rodentia	Rodents
Castor canadensis	Beaver*
Glaucomys volans	Southern flying squirrel*
Microtus pennsylvanicus	Meadow vole*
Microtus pinetorum	Pine vole*
Mus musculus	House mouse
Myocastor coypus	Nutria*
Ondatra zibethica	Muskrat
Oryzomis palustris	Marsh rice rat*
Peromyscus leucopus spp.	White-footed mouse
Rattus norvegicus	Norway rat
Sciurus carolinensis	Gray squirrel
Synaptomys cooperi	Southern bog lemming*
Order Lagomorpha	Lagomorphs
Sylvilagus floridana	Eastern cottontail
Order Carnivora	Carnivores
Procyon lotor	Raccoon
Urocyon cinereoargenteus	Gray fox
Vulpes vulpes	Red fox
* Mammals whose presence at NAB Little Creek is unconfirmed but may reasonably be expected to occur there From Geo-Marine (1997)	

Table 8-3 Amphibians and Reptiles Known to Occur *NAB Little Creek, Virginia Beach, VA*	
Scientific Name	Common Name
Amphibians	
Salamanders	
Plethodon chlorobryonis	Coastal plain slimy salamander
Plethodon cinereus	Red-backed salamander
Frogs and Toads	
Bufo terrestris	Southern toad
Hyla chrysocelis	Gray treefrog
Pseudacris crucifer	Spring peeper
Rana catesbeiana	Bullfrog
Rana clamitans	Green frog
Rana utricularia	Leopard frog
Reptiles	
Turtles	
Chelydra serpentina	Common snapping turtle
Chrysemys picta	Painted turtle
Kinosternon subrubrum	Eastern mud turtle
Pseudemys rubriventris	Red-bellied turtle
Sternothorus odoratus	Musk turtle (stinkpot turtle)
Terrapene carolina	Eastern box turtle
Trachemys scripta scripta	Yellow-bellied slider
Trachemys scripta elegans	Red-bellied slider
Lizards	
Cnemidophorus sexlineatus	Six-lined racerunner
Eumeces fasciatus	Five-lined skink
Sceloporus undulatus	Northern fence lizard
Scincella lateralis	Ground skink
Snakes	
Carphophis amoenus	Worm snake
Diadophis punctatus	Ringneck snake
Nerodia sipedon	Northern water snake
Thamnophis carolina	Eastern garter snake
From Geo-Marine (1997)	

Table 8-4
Bird Species Known to Occur on the Base and Its Adjacent Waters
NAB Little Creek, Virginia Beach, VA

Scientific Name	Common Name	Status
Gavia immer	Common loon	W
Podilymbus podiceps	Pied-billed grebe	W
Podiceps auritus	Horned grebe	W
Morus bassanus	Northern gannet	W
Pelecanus occidentalis	Brown pelican	
Phalacrocorax auritus	Double-crested cormorant	
Ardea herodias	Great blue heron	
Butorides virescens	Green heron	
Ardea alba	Great egret	
Egretta thula	Snowy egret	
Nycticorax nycticorax	Black-crowned night-heron	
Nyctanassa violacea	Yellow-crowned night-heron	
Coragyps atratus	Black vulture	
Cathartes aura	Turkey vulture	
Branta bernicla	Brant	W
Branta canadensis	Canada goose	B
Aix sponsa	Wood duck	
Anas rubripes	American black duck	W
Anas platyrhynchos	Mallard	B
Aythya valisineria	Canvasback	W
Aythya americana	Redhead	W
Aythya marila	Greater scaup	W
Aythya affinis	Lesser scaup	W
Somateria mollissima	Common eider	V
Bucephlal albeola	Bufflehead	W
Lophodytes cucullatus	Hooded merganser	W
Mergus merganser	Common merganser	W
Pandion haliaetus	Osprey	B
Circus cyaneus	Northern harrier	W
Accipiter striatus	Sharp-shinned hawk	
Accipiter cooperii	Cooper's hawk	
Buteo jamaicensis	Red-tailed hawk	
Falco sparverius	American kestrel	
Colinus virginianus	Northern bobwhite (B)	B
Rallus longirostris	Clapper rail	
Fulica americana	American coot	W
Pluvialis squatarola	Black-bellied plover	
Charadrius semipalmatus	Semipalmated plover	
Charadrius vociferus	Killdeer	
Catoptrophorus semipalmatus	Willet	
Actitus macularia	Spotted sandpiper	
Arenaria interpres	Ruddy turnstone	
Calidris maritima	Purple sandpiper	
Calidris pusilla	Semipalmated sandpiper	
Calidris alba	Sanderling	
Larus marinus	Great black-backed gull	
Larus fuscus	Lesser black-backed gull	
Larus argentatus	Herring gull	

Table 8-4 Bird Species Known to Occur on the Base and Its Adjacent Waters *NAB Little Creek, Virginia Beach, VA*		
Scientific Name	Common Name	Status
Larus delawarensis	Ring-billed gull	
Larus atricilla	Laughing gull	
Larus philadelphia	Bonaparte's gull	
Sterna hirundo	Common tern	
Sterna antillarum	Least tern	
Sterna maxima	Royal tern	
Sterna caspia	Caspian tern	
Rynchops niger	Black skimmer	
Uria aalga	Common murre	V
Zenaida macroura	Mourning dove	B
Columba livia	Rock dove	B
Bubo virginianus	Great horned owl	
Strix varia	Barred owl	
Chaetura pelagica	Chimney swift	
Archilochus colubris	Ruby-throated hummingbird	
Ceryle alcyon	Belted kingfisher	
Colaptes auratus	Northern Flicker	
Dryocopus pileatus	Pileated woodpecker	
Melanerpes carolinus	Red-bellied woodpecker	
Picoides pubescens	Downy woodpecker	
Picoides villosus	Hairy woodpecker	
Sphyrapicus varius	Yellow-bellied sapsucker	
Contopus virens	Eastern wood-pewee	
Tyrannus tyrannus	Eastern kingbird	
Myiarchus crinitus	Great crested flycatcher	
Vireo griseus	White-eyed vireo	
Vireo olivaceus	Red-eyed vireo	B
Cyanocitta cristata	Blue jay	
Corvus brachyrhynchos	American crow	B
Corvus ossifragus	Fish crow	
Progne subis	Purple martin	B
Hirundo rustica	Barn swallow	B
Tachycineta bicolor	Tree swallow	B
Poecile carolinensis	Carolina chickadee	
Baeolophus bicolor	Tufted titmouse	
Thryothorus ludovicianus	Carolina wren	B
Cistothorus palustris	Marsh wren	
Regulus calendula	Ruby-crowned kinglet	
Polioptila caerulea	Blue-gray gnatcatcher	
Catharus ustulatus	Swainson's thrush	
Catharus guttatus	Hermit thrush	
Turdus migratorius	American robin	B
Dumetella carolinensis	Gray catbird	
Mimus polyglottos	Northern mockingbird	B
Toxostoma rufum	Brown thrasher	B
Sturnus vulgaris	European starling	B
Bombycilla cedrorum	Cedar waxwing	
Protonotaria citrea	Prothonotary warbler	

Table 8-4
Bird Species Known to Occur on the Base and Its Adjacent Waters
NAB Little Creek, Virginia Beach, VA

Scientific Name	Common Name	Status
Dendroica petechia	Yellow warbler	
Dendroica caerulescens	Black-throated blue warbler	
Dendroica coronata	Yellow-rumped warbler	
Dendroica striata	Blackpoll warbler	
Dendroica pinus	Pine warbler	
Dendroica discolor	Prairie warbler	
Seiurus aurocapillus	Ovenbird	
Geothlypis trichas	Common yellowthroat	
Pipilo erythrophthalmus	Eastern towhee	
Melospiza melodia	Song sparrow	B
Zonotrichia albicollis	White-throated sparrow	
Junco hyemalis	Dark-eyed junco	W
Cardinalis cardinalis	Northern cardinal	B
Guiraca caerulea	Blue grosbeak	
Passerina cyanea	Indigo bunting	
Agelaius phoeniceus	Red-winged blackbird	B
Sturnella magna	Eastern meadowlark	
Quiscalus major	Boat-tailed grackle	
Quiscalus quiscula	Common grackle	
Molothrus ater	Brown-headed cowbird	
Icterus galbula	Baltimore oriole	
Carpodacus mexicanus	House finch	
Carduelis tristis	American goldfinch	
Passer domesticus	House sparrow	B

V - Vagrant, not normally expected
B - Direct evidence of breeding seen
W - Winter observation
From Geo-Marine (1997)

Table 8-5 Freshwater Fish Species Known to Occur *NAB Little Creek, Virginia Beach, VA*	
Scientific Name	Common Name
Amia calva	Bowfin
Cyprinus carpio	European carp
Dorosoma cepedianum	Gizzard shad
Esox niger	Chain pickerel
Gambusia affinis	Mosquitofish
Ictalurus catus	White catfish
Ictalurus natalis	Yellow bullhead
Ictalurus nebulosus	Brown bullhead
Lepomis gibbosus	Pumpkinseed
Lepomis gulosus	Warmouth
Lepomis macrochirus	Bluegill
Lucania parva	Rainwater killifish
Menidia beryllina	Tidewater silverside
Micropterus salmoides	Largemouth bass
Morone americana	White perch
Notemigonus crysoleucas	Golden shiner
Notropis cornutus	Common shiner
Perca flavescens	Yellow perch
Pomoxis nigromaculatus	Black crappie
Stizostedion vitreum	Walleye
From Geo-Marine (1997)	

Table 8-6 Saltwater Fish Species Known or Expected to Occur *NAB Little Creek, Virginia Beach, VA*		
Scientific Name	Common Name	Status
Class Agnatha	Jawless Fishes	
Petromyzon marinus	Sea lamprey	
Class Chondrichthyes	Cartilaginous Fishes	
Ginglymostoma cirratum	Nurse shark	
Carcharhinus leucas	Bull shark	
Carcharhinus plumbeus	Sandbar shark	
Carcharhinus obscurus	Dusky shark	
Mustelus canis	Smooth dogfish	
Sphyrna zygaena	Smooth hammerhead	
Squalus acanthias	Spiny dogfish	
Squatina dumerili	Atlantic angel shark	
Raja eglanteria	Clearnose skate	
Raja erinacea	Little skate	
Dasyatis americana	Southern stingray	
Dasyatis centroura	Roughtail stingray	
Dasyatis sabina	Atlantic stingray	
Dasyatis sayi	Bluntnose stingray	
Gymnura micrura	Smooth butterfly ray	
Aetobatus narinari	Spotted eagle ray	
Myliobatis freminvillei	Bullnose ray	
Rhinoptera bonasus	Cownose ray	
Class Osteichthyes	Bony Fishes	
Acipenser oxyrhynchus	Atlantic sturgeon	
Elops saurus	Ladyfish	
Megalops atlanticus	Tarpon	
Anguilla rostrata	American eel	
Conger oceanicus	Conger eel	
Alosa aestivalis	Blueback herring	
Alosa mediocris	Hickory shad	
Alosa pseudoharengus	Alewife	
Alosa sapidissima	American shad	
Brevoortia tyrannus	Atlantic menhaden	
Clupea harengus	Atlantic herring	
Dorosoma cepedianum	Gizzard shad	
Opisthonema oglinum	Atlantic thread herring	
Anchoa hepsetus	Striped anchovy	
Anchoa mitchilli	Bay anchovy	R
Synodus foetens	Inshore lizardfish	R
Opsanus tau	Oyster toadfish	R
Gobiesox strumosus	Skilletfish	R
Gadus morhua	Atlantic cod	
Pollachius virens	Pollock	
Urophycis chuss	Red hake	
Urophycis regia	Spotted hake	
Merluccius bilinearis	Silver hake	
Ophidion marginata	Striped cusk-eel	
Ablennes hians	Flat needlefish	
Strongylura marina	Atlantic needlefish	

Table 8-6 Saltwater Fish Species Known or Expected to Occur *NAB Little Creek, Virginia Beach, VA*		
Scientific Name	Common Name	Status
Cyprinodon variegatus	Sheepshead minnow	R
Fundulus heteroclitus	Mummichog	R
Fundulus luciae	Spotfin killifish	R
Fundulus majalis	Striped killifish	R
Menidia beryllina	Tidewater silverside	
Menidia menidia	Atlantic silverside	
Hippocampus erectus	Lined seahorse	R
Syngnathus floridae	Dusky pipefish	R
Syngnathus fuscus	Northern pipefish	R
Syngnathus louisianae	Chain pipefish	R
Morone americana	White perch	
Morone saxatilis	Striped bass	
Centropristis striata	Black sea bass	
Mycteroperca microlepis	Gag	
Priacanthus arenatus	Bigeye	
Pristigenys alta	Short bigeye	
Pomatomus saltatrix	Bluefish	
Rachycentron canadum	Cobia	
Echeneis naucrates	Sharksucker	
Alectis ciliaris	African pompano	
Caranx crysos	Blue runner	
Caranx hippos	Crevalle jack	
Chloroscombrus chrysurus	Atlantic bumper	
Oligoplites saurus	Leatherjacket	
Selene vomer	Lookdown	
Seriola dumerili	Greater amberjack	
Seriola zonata	Banded rudderfish	
Trachinotus carolinus	Florida pompano	
Selene setapinnis	Atlantic moonfish	
Lutjanus jocu	Dog snapper	
Lutjanus cyanoptera	Tripletail	
Lutjanus campechanus	Spotfin mojarra	
Orthopristis chrysoptera	Pigfish	
Stenotomus chrysops	Scup	
Archosargus probatocephalus	Sheepshead	
Bairdiella chrysoura	Silver perch	
Cynoscion nebulosus	Spotted seatrout	
Cynoscion regalis	Weakfish	
Leiostomus xanthurus	Spot	
Larimus fasciatus	Banded drum	
Menticirrhus americanus	Southern kingfish	
Menticirrhus littoralis	Gulf kingfish	
Menticirrhus saxatilis	Northern kingfish	
Micropogonias undulatus	Atlantic croaker	
Pogonias cromis	Black drum	
Sciaenops ocellatus	Red drum	
Chaetodipterus faber	Atlantic spadefish	
Chaetodon ocellatus	Spotfin butterflyfish	

Table 8-6
Saltwater Fish Species Known or Expected to Occur
NAB Little Creek, Virginia Beach, VA

Scientific Name	Common Name	Status
Tautoga onitis	Tautog	
Mugil cephalus	Striped mullet	
Mugil curema	White mullet	
Sphyraena borealis	Northern sennet	
Astroscopus guttatus	Northern stargazer	R
Hypsoblennius hentzi	Feather blenny	R
Chasmodes bosquianus	Striped blenny	R
Evorthodus lyricus	Lyre goby	R
Gobiosoma bosci	Naked goby	R
Gobiosoma ginsburgi	Seaboard goby	R
Microgobius thalassinus	Green goby	R
Trichiurus lepturus	Atlantic cutlassfish	
Scomber scombrus	Atlantic mackerel	
Scomberomorus cavalla	King mackerel	
Scomberomorus maculatus	Spanish mackerel	
Peprilus alepidotus	Harvestfish	
Peprilus triacanthus	Butterfish	
Prionotus carolinus	Northern searobin	
Prionotus evolans	Striped searobin	
Etropus crossotus	Fringed flounder	
Etropus microstomus	Smallmouth flounder	
Paralyichthys dentatus	Summer flounder	
Scopthalmus aquosus	Windowpane flounder	
Pseudopleuronectes americanus	Winter flounder	
Trinectes maculatus	Hogchoker	R
Symphurus plagiusa	Blackcheek tonguefish	
Aluterus schoepfi	Orange filefish	
Balistes capriscus	Gray triggerfish	
Monacanthus hispidus	Planehead filefish	
Lagocephalus laevigatus	Smooth puffer	
Sphoeroides maculatus	Northern puffer	
Chilomycterus schoepfi	Striped burrfish	

R = Year-round resident
From Geo-Marine (1997)

Table 8-7
Water Column Parameter Measurements in Desert Cove and the Connector Channel Measured During the RI
NAB Little Creek, Virginia Beach, VA

Station	Date	Dissolved Oxygen (mg/L)	EH/ORP (MV)	pH	Salinity (ppt)	Specific Conductivity (ms/cm)	Temperature (C)	Turbidity (NTU)
LW07-B5-SD201	09/27/02	11.2	5.0	7.71	23.5	37.8	23.6	0
LW07-B7-SD201	09/27/02	10.8	62	5.48	25.7	40.0	24.2	0
LW07-D5-SD201	09/27/02	11.1	88	6.74	24.3	37.7	23.6	0
LW07-F3-SD201	09/27/02	10.1	39	5.50	25.3	39.4	24.0	0
LW07-F5-SD201	09/27/02	10.3	86	5.27	26.6	41.3	24.2	0
LW07-H1-SD201	09/27/02	8.35	116	5.45	26.3	40.9	23.4	0
LW07-H3-SD201	09/27/02	12.1	88	7.37	24.4	38.7	23.9	0.5
LW07-H5-SD201	09/26/02	8.02	289	5.14	25.7	40.0	23.9	0
LW07-J4-SD201	09/28/02	13.1	102	7.31	24.4	38.2	23.7	23.7
LW07-K1-SD201	09/27/02	7.66	73	5.68	27.2	42.0	24.2	0
LW07-K3-SD201	09/28/02	9.01	-211	6.46	26.0	40.5	23.1	0
LW07-K4-SD201	09/28/02	12.5	83	7.46	24.4	38.1	23.7	0
LW07-K5-SD201	09/28/02	12.1	89	7.33	24.5	38.3	23.5	0.5
LW07-K6-SD201	09/28/02	7.48	157	5.63	25.4	39.5	24.2	0
LW07-L2-SD201	10/01/02	9.74	101	5.96	14.0	20.6	22.9	0
LW07-L5-SD201	09/28/02	11.0	103	5.41	26.6	41.2	24.2	0
LW07-L6-SD201	10/01/02	9.18	2.0	5.54	16.9	27.4	22.4	0
LW07-M1-SD201	09/27/02	7.56	114	5.43	26.5	41.9	23.5	0
LW07-M3-SD201	09/28/02	7.60	70	5.69	25.3	39.3	24.3	0

Table 8-8
Sediment Parameter Measurements in Desert Cove and the Connector Channel Measured During the SI and RI
NAB Little Creek, Virginia Beach, VA

Sample	Total organic carbon (mg/kg)	pH	Cation Exchange Capacity (meq/100g)	Grain Size (percent)						Percent ABM
				Coarse gravel	Fine gravel	Coarse sand	Medium sand	Fine sand	Silt/ Clay	
Surface Sediment										
LW07-B5-SD201-00-02C	16,830	7.94	10.2	0.00	0.00	0.08	4.47	33.29	62.17	Present
LW07-B5-SD201P-00-02C	NS	7.85	NS	NS	NS	NS	NS	NS	NS	--
LW07-B5-SD202-00-02C	24,160	7.85	NS	0.00	0.00	0.08	4.06	30.22	65.64	Present (2 of 3)
LW07-B7-SD201-00-02C	3,125	8.18	5.90	NS	NS	NS	NS	NS	NS	0.00
LW07-B7-SD202-00-02C	18,670	7.86	NS	0.00	6.28	1.40	4.24	29.19	58.89	Present (1 of 3)
LW07-D5-SD201-00-02C	29,330	7.78	9.60	0.00	0.00	0.11	1.66	9.07	89.16	Present
LW07-D5-SD202-00-02C	30,490	7.69	NS	0.00	0.70	0.14	3.05	13.58	82.54	Present (3 of 3)
LW07-F3-SD201-00-02C	12,900	8.05	15.0	0.00	5.21	3.78	16.05	44.38	30.58	Present
LW07-F3-SD202-00-02C	22,230	8.06	NS	0.00	2.04	2.49	3.28	33.87	58.32	Present (2 of 3)
LW07-F5-SD201-00-02C	24,170	8.14	11.5	0.00	0.92	0.89	22.77	45.89	29.53	Present
LW07-F5-SD202-00-02C	8,024	7.96	NS	0.00	0.06	0.61	8.96	54.35	36.03	Present (1 of 3)
LW07-H1-SD201-00-02C	20,310	7.90	10.6	0.00	0.03	0.27	6.92	26.87	65.91	0.00
LW07-H1-SD201P-00-02C	21,790	7.93	NS	NS	NS	NS	NS	NS	NS	--
LW07-H1-SD202-00-02C	21,790	7.95	NS	0.00	0.00	0.26	2.43	16.71	80.59	Present (1 of 3)
LW07-H3-SD201-00-02C	22,280	7.98	15.0	0.00	0.54	0.10	0.79	23.29	75.28	0.00
LW07-H3-SD201P-00-02C	NS	8.08	NS	NS	NS	NS	NS	NS	NS	--
LW07-H3-SD202-00-02C	23,260	8.13	NS	NS	NS	NS	NS	NS	NS	Present (2 of 3)
LW07-H5-SD201-00-02C	3,463	8.35	5.40	0.00	2.17	2.52	30.06	54.18	11.07	Present
LW07-H5-SD202-00-02C	15,590	8.03	NS	NS	NS	NS	NS	NS	NS	Present (2 of 3)
LW07-J4-SD201-00-02C	14,950	8.00	14.0	0.00	0.00	0.07	2.50	23.15	74.28	0.00
LW07-J4-SD202-00-02C	15,900	7.86	NS	0.00	0.28	0.19	2.38	21.36	75.80	0.00
LW07-K1-SD201-00-02C	28,880	8.36	9.70	0.00	0.01	0.16	1.16	6.71	91.96	Present
LW07-K1-SD202-00-02C	23,400	8.35	NS	NS	NS	NS	NS	NS	NS	Present (1 of 3)
LW07-K3-SD201-00-02C	10,780	7.89	18.6	0.00	0.63	0.44	15.17	43.19	40.56	0.00
LW07-K3-SD202-00-02C	10,800	7.80	NS	0.00	0.46	0.85	22.85	32.91	42.93	Present (1 of 3)
LW07-K4-SD201-00-02C	13,870	7.80	17.6	0.00	1.30	0.91	9.27	41.77	46.75	Present (trace)
LW07-K4-SD202-00-02C	13,940	7.79	NS	0.00	0.77	0.35	8.99	38.23	51.67	Present (1 of 3)
LW07-K5-SD201-00-02C	22,360	7.92	13.4	0.00	0.00	0.02	1.29	11.81	86.88	0.00
LW07-K5-SD202-00-02C	18,450	7.82	NS	0.00	0.13	0.13	2.85	20.65	76.25	0.00
LW07-K6-SD201-00-02C	2,245	8.20	4.70	0.00	0.86	2.48	19.13	44.93	32.60	Present

NS - Not Sampled

Table 8-8
Sediment Parameter Measurements in Desert Cove and the Connector Channel Measured During the SI and RI
NAB Little Creek, Virginia Beach, VA

Sample	Total organic carbon (mg/kg)	pH	Cation Exchange Capacity (meq/100g)	Grain Size (percent)						Percent ABM
				Coarse gravel	Fine gravel	Coarse sand	Medium sand	Fine sand	Silt/ Clay	
LW07-K6-SD202-00-02C	2,937	8.04	NS	9.80	7.80	2.69	24.61	40.17	14.92	Present (3 of 3) Abundant at K6-2
LW07-L2-SD201-00-02C	22,230	7.80	8.90	0.00	0.00	0.43	1.18	18.25	80.14	Present
LW07-L5-SD201-00-02C	20,410	7.89	8.00	0.00	0.00	0.03	0.49	17.44	82.04	0.00
LW07-L5-SD202-00-02C	19,870	8.01	NS	0.00	2.51	2.92	5.38	24.67	64.51	Present (1 of 3)
LW07-L6-SD201-00-02C	23,790	7.65	8.30	0.00	0.00	0.06	1.10	11.99	86.85	0.00
LW07-M1-SD201-00-02C	20,080	8.32	7.80	0.00	1.51	0.80	5.16	29.16	63.37	Present
LW07-M1-SD202-00-02C	17,030	7.86	NS	NS	NS	NS	NS	NS	NS	Present (2 of 3)
LW07-M3-SD201-00-02C	20,080	7.81	14.2	0.00	2.48	1.94	11.78	35.51	48.29	Present
LW07-M3-SD202-00-02C	19,110	7.92	NS	0.00	0.18	0.97	4.75	24.67	69.43	Present (1 of 3)
LW07-SD01-00	4,400	8.25	NS	NS	NS	NS	NS	NS	NS	0.00
LW07-SD02-00	7,880	8.09	NS	NS	NS	NS	NS	NS	NS	0.00
LW07-SD03-00	7,580	7.88	NS	NS	NS	NS	NS	NS	NS	0.00
LW07-SD04-00	10,600	8.04	NS	NS	NS	NS	NS	NS	NS	0.00
LW07-SD05-00	21,200	7.60	NS	NS	NS	NS	NS	NS	NS	0.00
LW07-SD05-00P	18,900	7.64	NS	NS	NS	NS	NS	NS	NS	--
Subsurface Sediment										
LW07-B5-SD201-02-02C	14,690	8.15	NS	0.00	0.00	0.01	1.42	38.61	59.95	Trace (0-3")
LW07-B5-SD201P-02-02C	NS	8.24	NS	NS	NS	NS	NS	NS	NS	--
LW07-B7-SD201-02-02C	5,591	8.15	NS	0.00	0.40	0.98	31.73	42.28	24.60	0.00
LW07-D5-SD201-02-02C	7,718	8.18	NS	0.00	0.00	0.30	11.17	25.42	63.10	0.00
LW07-F3-SD201-02-02C	12,870	8.52	NS	0.00	0.00	0.00	8.07	38.24	53.69	0.00
LW07-F5-SD201-02-02C	1,337	7.99	NS	0.00	0.00	0.05	3.70	78.33	17.92	Trace (5-7.5")
LW07-H1-SD201-02-02C	24,430	8.58	NS	NS	NS	NS	NS	NS	NS	0.00
LW07-H3-SD201-02-02C	21,800	8.15	NS	0.00	0.00	0.07	1.71	4.76	93.46	0.00
LW07-H5-SD201-02-02C	8,387	8.17	NS	0.00	0.08	0.51	10.88	16.98	71.54	Present (0-6")
LW07-J4-SD201-02-02C	15,150	8.05	NS	0.00	0.02	0.02	4.92	57.72	37.32	0.00
LW07-K1-SD201-02-02C	9,591	8.65	NS	NS	NS	NS	NS	NS	NS	0.00
LW07-K3-SD201-02-02C	9,016	8.36	NS	0.00	0.00	0.10	2.31	14.54	83.05	Trace (5")
LW07-K3-SD201P-02-02C	NS	8.12	NS	NS	NS	NS	NS	NS	NS	--
LW07-K4-SD201-02-02C	6,321	8.15	NS	0.00	0.39	0.06	16.92	50.56	32.07	Present (0-6")

NS - Not Sampled

Table 8-8
Sediment Parameter Measurements in Desert Cove and the Connector Channel Measured During the SI and RI
NAB Little Creek, Virginia Beach, VA

Sample	Total organic carbon (mg/kg)	pH	Cation Exchange Capacity (meq/100g)	Grain Size (percent)						Percent ABM
				Coarse gravel	Fine gravel	Coarse sand	Medium sand	Fine sand	Silt/ Clay	
LW07-K4-SD201P-02-02C	NS	8.26	NS	NS	NS	NS	NS	NS	NS	--
LW07-K5-SD201-02-02C	12,710	8.15	NS	0.00	0.00	0.02	1.14	30.03	68.82	Present (0-3")
LW07-K6-SD201-02-02C	21,690	8.44	NS	0.00	0.51	1.37	11.45	28.54	58.13	Trace (0-5")
LW07-L2-SD201-02-02C	12,820	8.12	NS	0.00	0.00	0.08	5.76	21.70	72.46	0.00
LW07-L5-SD201-02-02C	17,070	7.80	NS	0.00	0.70	0.17	1.27	30.83	67.02	0.00
LW07-L6-SD201-02-02C	14,280	8.14	NS	0.00	0.00	0.19	3.57	15.83	80.40	0.00
LW07-M1-SD201-02-02C	27,940	8.64	NS	0.00	0.26	0.74	3.63	27.82	67.55	Trace (0-12")
LW07-M3-SD201-02-02C	34,450	8.16	NS	NS	NS	NS	NS	NS	NS	Present (0-5")

NS - Not Sampled

Table 8-9
Sediment Descriptions at Non-IRP Locations
NAB Little Creek, Virginia Beach, VA

Sample	Location	Depth (cm)	% Sand	% Clay	% Silt	Description
LC-09	Desert Cove	0 - 10	53.9	12.7	33.4	fine, black muck, clay/sand
LC-09	Desert Cove	30 - 90	--	--	--	gray, medium sand, some clay
LC-09	Desert Cove	100 - 110	44.0	13.3	42.7	gray, clay, medium sand
LC-09	Desert Cove	200 - 210	55.2	12.9	32.0	gray, clay, medium sand, mottles
LC-09	Desert Cove	300 - 310	27.8	27.7	44.5	fine, gray, sand/clay, mottled, shells
LC-09	Desert Cove	400 - 410	11.3	33.0	55.8	mostly gray clay, mottles
LC-09	Desert Cove	500 - 510	5.77	32.5	61.7	mostly gray clay, mottles
LC-08	Desert Cove Connector Channel	0 - 10	5.23	23.8	71.0	fine, gray, clay with minor silt
LC-08	Desert Cove Connector Channel	100 - 110	14.7	23.0	62.2	fine, gray, silt/clay
LC-08	Desert Cove Connector Channel	200 - 210	4.99	29.6	65.4	fine, gray, silt/clay
LC-08	Desert Cove Connector Channel	300 - 310	10.7	30.6	58.8	fine, gray, silt/clay
LC-08	Desert Cove Connector Channel	400 - 410	5.73	26.6	67.7	fine, gray, silt/clay; shells
LC-08	Desert Cove Connector Channel	500 - 510	8.82	34.4	56.8	fine, gray, silt/clay; shells

Table 8-10
Characteristics of Outfalls Discharging to Desert Cove and the Connector Channel
NAB Little Creek, Virginia Beach, VA

Area	Outfall	Drainage (sq ft)	Drainage (percent)	Drainage Characteristics
Northwest	NR-009	117,500	4.2	Road - Potential Fuel
	NR-008	25,000	0.9	Road - Potential Fuel
	NR-004	11,973	0.4	Road - Potential Fuel
SubTotal		154,473	5.5	
Northeast	NR-007b	1,042,734	37.2	Road - Parking
	NR-011	148,613	5.3	Road - Potential Fuel
	NR-010	64,941	2.3	Road - Potential Fuel
SubTotal		1,256,289	44.8	
East-Central	NR-012	151,445	5.4	Road - Potential ABM
SubTotal		151,445	5.4	
Southeast	NR-034	473,426	16.9	Road - Parking
	00X	224,512	8.0	Road - Parking
	NR-033	197,797	7.1	Road - Parking
	NR-035	79,521	2.8	Road - Parking
	NR-032	67,705	2.4	Road - Parking
	NR-031	24,023	0.9	Road - Parking
SubTotal		1,066,984	38.1	
Connector	NR-007a	145,767	5.2	Road - Potential ABM
	NR-005	13,854	0.5	Road - Grass
	NR-006	13,854	0.5	Road - Grass
SubTotal		173,475	6.2	
TOTAL		2,802,666	100.0	

Table 8-11
Data Selected for Use in the Ecological Risk Assessment
NAB Little Creek, Virginia Beach, VA

Groundwater							Surface Sediment							Subsurface Sediment		
		Metals														
VOCs	SVOCs	Total	Dissolved	Cyanide	Pesticides	PCBs	VOCs	SVOCs	PAHs	Metals	Cyanide	Pesticides	PCBs	VOCs	SVOCs	PAHs
		3 (1993)														
3 (SI)	3 (SI)	3 (SI)	3 (SI)		3 (SI)	3 (SI)		1 (SI)	5 (SI)	5 (SI)		1 (SI)	1 (SI)			
6 (RI)	6 (RI)	6 (RI)	6 (RI)	6 (RI)					36 (RI)	36 (RI)	36 (RI)					19 (RI)

SHADED CELLS - DATA USED IN THE ECOLOGICAL RISK ASSESSMENT
SI - Site Investigation - May/June 2000
RI - Remedial Investigation - August/September 2002

Table 8-11
Data Selected for Use in the Ecological Risk Assessment
NAB Little Creek, Virginia Beach, VA

Subsurface Sediment				Surface Soil							Subsurface Soil						
Metals	Cyanide	Pesticides	PCBs	VOCs	SVOCs	PAHs	Metals	Cyanide	Pesticides	PCBs	VOCs	SVOCs	PAHs	Metals	Cyanide	Pesticides	PCBs
							5 (1989)							3 (1989)			
							3 (1993)										
				3 (SI)	3 (SI)	14 (SI)	14 (SI)		3 (SI)	3 (SI)	3 (SI)	3 (SI)	14 (RI)	14 (SI)		3 (SI)	3 (SI)
19 (RI)	19 (RI)					11 (RI)	11 (RI)	11 (RI)					22 (RI)	22 (RI)	22 (RI)		

SHADED CELLS - DATA USED IN THE ECOLOGICAL RISK ASSESSMENT
SI - Site Investigation - May/June 2000
RI - Remedial Investigation - August/September 2002

Table 8-12
Summary of Non-IRP Surface Water Data for Locations Near SWMU 7
NAB Little Creek, Virginia Beach, VA

Station:	LC1-04-W-1	ST-3	ST-3 Replicate	ST-3	ST-3 Replicate
Location:	Desert Cove	Desert Cove	Desert Cove	Desert Cove	Desert Cove
Date:	5/29/1984	8/12/1992	8/12/1992	7/30/1996	7/30/1996
Organotin (UG/L)					
Butyltin	0.005 UJ	NA	NA	NA	NA
Dibutyltin	0.005 U	0.021	0.003 U	NA	NA
Tributyltin	0.005 U	0.003 U	0.003 U	NA	NA
Total Inorganics (UG/L)					
Arsenic	NA	0.30	0.70	1.00 U	NA
Beryllium	NA	1.00 U	1.00 U	0.20 U	NA
Cadmium	NA	1.00	1.00	15.0	NA
Chromium	NA	4.00	4.00	500	NA
Copper	NA	0.81	0.89	24.0	NA
Cyanide	NA	5.00 U	5.00 U	20.0 U	20.0 U
Lead	NA	0.80	1.50	200	NA
Mercury	NA	0.25 U	0.25 U	0.30	NA
Nickel	NA	3.00 U	3.00 U	260	NA
Selenium	NA	0.20 U	0.20 U	1.00 U	NA
Silver	NA	1.00 U	1.00 U	29.0	NA
Thallium	NA	5.00 U	5.00 U	100 U	NA
Zinc	NA	16.0	13.0	8.00	NA
Dissolved Metals (UG/L)					
Arsenic	NA	NA	NA	1.00	NA
Beryllium	NA	NA	NA	0.20 U	NA
Cadmium	NA	NA	NA	50.0 U	NA
Chromium	NA	NA	NA	500 U	NA
Copper	NA	NA	NA	20.0 U	NA
Lead	NA	NA	NA	100 U	NA
Mercury	NA	NA	NA	0.20	NA
Nickel	NA	NA	NA	50.0	NA
Selenium	NA	NA	NA	1.00	NA
Silver	NA	NA	NA	17.0	NA
Thallium	NA	NA	NA	100 U	NA
Zinc	NA	NA	NA	17.0	NA
Organics (UG/L)					
Ammonia (as N)	NA	NA	NA	100 U	100 U
Phenol	NA	10.0 U	20.0	1.40 U	1.40 U

Table 8-13
Summary of Non-IRP Sediment Data for Locations Near SWMU 7
NAB Little Creek, Virginia Beach, VA

Station:	LC1-04-S-1	LC-8	LC-9	ST-3	ST-3 Replicate	LC1-04	ST-3	ST-3 Replicate
Location:	Desert Cove	Desert Cove	Desert Cove	Desert Cove	Desert Cove	Desert Cove	Desert Cove	Desert Cove
Date:	5/29/1984	11/89-1/90	11/89-1/90	8/12/1992	8/12/1992	10/17/1990	7/30/1996	7/30/1996
Organotin (UG/KG)								
Total organic tin	0.50 U	NA	NA	NA	NA	NA	NA	NA
Total tributyltin	NA	NA	NA	12.9	17.6	52.0	NA	NA
Total dibutyltin	NA	NA	NA	7.03	5.80	63.0	NA	NA
Total monobutyltin	NA	NA	NA	NA	NA	55.0	NA	NA
Inorganics (MG/KG)								
Arsenic	NA	5.00	5.40	12.0	11.8	NA	0.50 U	0.50 U
Beryllium	NA	0.70	0.70	0.62	0.54	NA	0.01 U	0.01 U
Cadmium	NA	0.01 U	0.11	5.60	4.60	NA	0.72	0.29
Chromium	NA	41.6	47.9	35.1	29.8	NA	11.7	6.12
Copper	NA	28.4	99.3	56.0	51.3	NA	36.3	34.5
Cyanide	NA	ND U	0.87	0.61 U	0.57 U	NA	0.25 U	0.25 U
Lead	NA	51.1	105	33.0	33.0	NA	24.0	27.0
Mercury	NA	0.18	0.68	2.82	2.67	NA	0.40	0.30
Nickel	NA	21.7	20.6	14.3	12.4	NA	2.00 U	2.00 U
Selenium	NA	NA	NA	0.46	0.44	NA	0.50 U	0.50 U
Silver	NA	0.10	0.30	2.44	2.32	NA	1.60	0.51
Thallium	NA	0.30	0.50	0.20	0.30	NA	5.00 U	5.00 U
Zinc	NA	102	1,010	183	169	NA	167	142
Semivolatile Organics (UG/KG)								
1,2,4-Trichlorobenzene	NA	NA	NA	291 U	291 U	NA	NA	NA
1,2-Dichlorobenzene	NA	NA	NA	41.5 J	135 U	NA	NA	NA
1,3-Dichlorobenzene	NA	NA	NA	205 U	205 U	NA	NA	NA
1,4-Dichlorobenzene	NA	NA	NA	308 B	302 B	NA	NA	NA
2,4,5-Trichlorophenol	NA	NA	NA	459 U	459 U	NA	NA	NA
2,4,6-Trichlorophenol	NA	NA	NA	323 U	323 U	NA	NA	NA
2,4-Dichlorophenol	NA	NA	NA	296 U	296 U	NA	NA	NA
2,4-Dimethylphenol	NA	NA	NA	124 U	124 U	NA	NA	NA
2,4-Dinitrophenol	NA	NA	NA	469 U	469 U	NA	NA	NA
2,4-Dinitrotoluene	NA	NA	NA	1,440 U	1,440 U	NA	NA	NA
2,6-Dinitrotoluene	NA	NA	NA	521 U	521 U	NA	NA	NA
2-Chloronaphthalene	NA	NA	NA	238 U	238 U	NA	NA	NA
2-Chlorophenol	NA	NA	NA	436 U	436 U	NA	NA	NA
2-Methylnapthalene	NA	NA	NA	53.0 J	7.84 J	NA	NA	NA

Table 8-13
Summary of Non-IRP Sediment Data for Locations Near SWMU 7
NAB Little Creek, Virginia Beach, VA

Station:	LC1-04-S-1	LC-8	LC-9	ST-3	ST-3 Replicate	LC1-04	ST-3	ST-3 Replicate
Location:	Desert Cove	Desert Cove	Desert Cove	Desert Cove	Desert Cove	Desert Cove	Desert Cove	Desert Cove
Date:	5/29/1984	11/89-1/90	11/89-1/90	8/12/1992	8/12/1992	10/17/1990	7/30/1996	7/30/1996
2-Methylphenol	NA	NA	NA	383 U	383 U	NA	NA	NA
2-Nitroaniline	NA	NA	NA	386 U	386 U	NA	NA	NA
2-Nitrophenol	NA	NA	NA	680 U	680 U	NA	NA	NA
3,3'-Dichlorobenzidine	NA	NA	NA	3,330 U	3,330 U	NA	NA	NA
3-Nitroaniline	NA	NA	NA	19.4 U	19.4 U	NA	NA	NA
4,6-Dinitro-2-methylphenol	NA	NA	NA	258 U	258 U	NA	NA	NA
4-Bromophenyl-phenylether	NA	NA	NA	776 U	776 U	NA	NA	NA
4-Chloro-3-methylphenol	NA	NA	NA	494 U	494 U	NA	NA	NA
4-Chloroaniline	NA	NA	NA	871 U	871 U	NA	NA	NA
4-Chlorophenylphenylether	NA	NA	NA	276 U	276 U	NA	NA	NA
4-Methylphenol	NA	NA	NA	379 U	379 U	NA	NA	NA
4-Nitroaniline	NA	NA	NA	9,210 U	9,210 U	NA	NA	NA
4-Nitrophenol	NA	NA	NA	186 U	186 U	NA	NA	NA
Acenaphthylene	NA	NA	NA	195 U	195 U	NA	NA	NA
Acenaphthene	NA	NA	NA	86.3 J	225 U	NA	NA	NA
Aniline	NA	NA	NA	479 U	479 U	NA	NA	NA
Anthracene	NA	NA	NA	91.0 J	265 U	NA	NA	NA
Azobenzene	NA	NA	NA	241 U	241 U	NA	NA	NA
Benzidine	NA	NA	NA	805 U	805 U	NA	NA	NA
Benzo(a)anthracene	NA	NA	NA	246 J	245 J	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	324 J	240 J	NA	NA	NA
Benzo(b)fluoranthene	NA	ND U	ND U	459 U	580	NA	NA	NA
Benzo(g,h,i)perylene	NA	NA	NA	211 J	209 J	NA	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	459 U	459 U	NA	NA	NA
Benzoic acid	NA	NA	NA	611 U	611 U	NA	NA	NA
Benzyl alcohol	NA	NA	NA	228 U	228 U	NA	NA	NA
bis(2-chloroethoxy)methane	NA	NA	NA	147 U	147 U	NA	NA	NA
bis(2-chloroethyl)ether	NA	NA	NA	370 U	370 U	NA	NA	NA
bis(2-chloroisopropyl)ether	NA	NA	NA	195 U	195 U	NA	NA	NA
bis(2-ethylhexyl)phthalate	NA	ND U	ND U	2790 B	617 B	NA	NA	NA
Butylbenzylphthalate	NA	NA	NA	191 U	191 U	NA	NA	NA
Chrysene	NA	ND U	ND U	378 J	339 J	NA	NA	NA
Dibenz(a,h)anthracene	NA	NA	NA	587 U	587 U	NA	NA	NA
Dibenzofuran	NA	NA	NA	149 U	149 U	NA	NA	NA

Table 8-13
Summary of Non-IRP Sediment Data for Locations Near SWMU 7
NAB Little Creek, Virginia Beach, VA

Station:	LC1-04-S-1	LC-8	LC-9	ST-3	ST-3 Replicate	LC1-04	ST-3	ST-3 Replicate
Location:	Desert Cove	Desert Cove	Desert Cove	Desert Cove	Desert Cove	Desert Cove	Desert Cove	Desert Cove
Date:	5/29/1984	11/89-1/90	11/89-1/90	8/12/1992	8/12/1992	10/17/1990	7/30/1996	7/30/1996
Diethylphthalate	NA	NA	NA	108 J	33.6 J	NA	NA	NA
Dimethylphthalate	NA	NA	NA	177 U	177 U	NA	NA	NA
Di-n-butylphthalate	NA	NA	NA	195 U	195 U	NA	NA	NA
Di-n-octylphthalate	NA	NA	NA	241 U	241 U	NA	NA	NA
Fluoranthene	NA	ND U	ND U	372	499	NA	NA	NA
Fluorene	NA	NA	NA	57.5 J	227 U	NA	NA	NA
Hexachlorobenzene	NA	NA	NA	752 U	752 U	NA	NA	NA
Hexachlorobutadiene	NA	NA	NA	594 U	594 U	NA	NA	NA
Hexachlorocyclopentadiene	NA	NA	NA	267 U	267 U	NA	NA	NA
Hexachloroethane	NA	NA	NA	33.8 J	154 U	NA	NA	NA
Indeno(1,2,3-cd)pyrene	NA	NA	NA	545 U	545 U	NA	NA	NA
Isophorone	NA	NA	NA	54.9 J	103 U	NA	NA	NA
Naphthalene	NA	NA	NA	57.2 J	152 U	NA	NA	NA
Nitrobenzene	NA	NA	NA	71.0 U	71.0 U	NA	NA	NA
N-Nitrosodi-n-propylamine	NA	NA	NA	274 U	274 U	NA	NA	NA
N-Nitrosodiphenylamine	NA	NA	NA	630 U	630 U	NA	NA	NA
Pentachlorophenol	NA	NA	NA	521 U	521 U	NA	NA	NA
Phenanthrene	NA	NA	NA	109 J	115 J	NA	NA	NA
Phenol	NA	NA	NA	305 U	305 U	NA	NA	NA
Pyrene	NA	ND U	1,000	498	539	NA	NA	NA
Total phenols	NA	NA	NA	1,190	1,230	NA	1,000 UJ	1,000 U
Pesticides/PCBs (UG/KG)								
2,4,5-T	NA	NA	NA	NA	NA	NA	3.12 U	3.12 UJ
2,4,5-TP (Silvex)	NA	NA	NA	1.00 U	1.00 U	NA	3.12 U	3.12 UJ
2,4-D	NA	NA	NA	1.00 U	1.00 U	NA	6.25 UJ	6.25 UJ
4,4'-DDD	NA	7.00	0.20 U	0.53 U	0.53 U	NA	5.00 UJ	5.00 UJ
4,4'-DDE	NA	0.20 U	1.60	0.59 U	0.59 U	NA	5.00 UJ	5.00 UJ
4,4'-DDT	NA	0.20 U	3.00	3.83 U	11.2 C	NA	5.00 UJ	5.00 UJ
Aldrin	NA	NA	NA	0.66 U	0.66 U	NA	7.00 J	7.00 J
alpha-BHC	NA	NA	NA	0.79 U	0.79 U	NA	5.00 UJ	5.00 UJ
alpha-Chlordane	NA	NA	NA	0.83 U	0.83 U	NA	5.00 UJ	5.00 UJ
beta-BHC	NA	NA	NA	0.63 U	0.63 U	NA	5.00 UJ	5.00 UJ
Chlordane	NA	NA	NA	NA	NA	NA	500 UJ	500 UJ
Chlorpyrifos	NA	NA	NA	6.70 U	11.1 C	NA	NA	NA

Table 8-13
Summary of Non-IRP Sediment Data for Locations Near SWMU 7
NAB Little Creek, Virginia Beach, VA

Station:	LC1-04-S-1	LC-8	LC-9	ST-3	ST-3 Replicate	LC1-04	ST-3	ST-3 Replicate
Location:	Desert Cove	Desert Cove	Desert Cove	Desert Cove	Desert Cove	Desert Cove	Desert Cove	Desert Cove
Date:	5/29/1984	11/89-1/90	11/89-1/90	8/12/1992	8/12/1992	10/17/1990	7/30/1996	7/30/1996
delta-BHC	NA	ND U	ND U	0.69 U	0.69 U	NA	5.00 UJ	5.00 UJ
Demeton	NA	NA	NA	667 U	667 U	NA	NA	NA
Dieldrin	NA	0.20 U	0.20 U	1.42 U	1.42 U	NA	5.00 UJ	5.00 UJ
Dinoseb	NA	NA	NA	NA	NA	NA	6.25 U	6.25 UJ
Endosulfan I	NA	1.30	0.20 U	0.99 U	0.99 U	NA	5.00 UJ	5.00 UJ
Endosulfan II	NA	NA	NA	0.83 U	0.83 U	NA	5.00 UJ	5.00 UJ
Endosulfan sulfate	NA	NA	NA	0.66 U	0.66 U	NA	5.00 UJ	5.00 UJ
Endrin	NA	0.20 U	0.20 U	1.39 U	1.39 U	NA	5.00 UJ	5.00 UJ
Endrin aldehyde	NA	0.20 U	0.20 U	2.67 U	2.67 U	NA	5.00 UJ	5.00 UJ
Endrin ketone	NA	NA	NA	0.83 U	0.83 U	NA	26.0 J	28.0 J
gamma-Chlordane	NA	NA	NA	0.83 U	0.83 U	NA	5.00 UJ	5.00 UJ
Guthion	NA	NA	NA	6.70 U	6.70 U	NA	NA	NA
Heptachlor	NA	1.00	1.10	0.92 U	0.92 U	NA	5.00 UJ	5.00 UJ
Heptachlor epoxide	NA	0.20 U	0.20 U	0.63 U	0.63 U	NA	5.00 UJ	5.00 UJ
Lindane	NA	NA	NA	1.19 U	1.19 U	NA	5.00 UJ	5.00 UJ
Malathion	NA	NA	NA	66.7 U	66.7 U	NA	NA	NA
Methoxylchlor	NA	0.20 U	0.20 U	50.0 U	50.0 U	NA	5.00 UJ	5.00 UJ
Mirex	NA	NA	NA	10.0 U	10.0 U	NA	NA	NA
Parathion	NA	NA	NA	6.70 U	6.70 U	NA	NA	NA
Toxaphene	NA	NA	NA	100 U	100 U	NA	500 UJ	500 UJ
Aroclor-1016	NA	NA	NA	NA	NA	NA	500 UJ	500 UJ
Aroclor-1221	NA	NA	NA	NA	NA	NA	500 UJ	500 UJ
Aroclor-1232	NA	NA	NA	NA	NA	NA	500 UJ	500 UJ
Aroclor-1242	NA	NA	NA	NA	NA	NA	500 UJ	500 UJ
Aroclor-1248	NA	NA	NA	NA	NA	NA	500 UJ	500 UJ
Aroclor-1254	NA	5.00	2.00 U	NA	NA	NA	500 UJ	500 UJ
Aroclor-1260	NA	2.00 U	2.00 U	NA	NA	NA	500 UJ	500 UJ
Total PCBs	NA	NA	NA	20.6 U	20.6 U	NA	NA	NA
Other (MG/KG)								
Total Available Hydrosulfide	NA	NA	NA	NA	NA	NA	150	130
Total Organic Carbon	NA	44,000	45,000	15,800	15,800	NA	110	110
TPH (diesel range)	NA	NA	NA	NA	NA	NA	42.0	16.0
TPH (gasoline range)	NA	NA	NA	NA	NA	NA	0.50 U	0.50 U
Oil and Grease	NA	NA	NA	256	223	NA	NA	NA

Table 8-14
Summary Statistics - Surface Soil
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Inorganics (MG/KG)						
Aluminum	30.8 - 47.7	25 / 25	12,100	LW07-SS09-00	4,863	3,264
Antimony	9.20 - 14.3	7 / 25	2.70	LW07-SS25-00	0.42	0.52
Arsenic	1.50 - 2.40	21 / 25	27.7	LW07-SS01-00	3.03	5.34
Barium	30.8 - 47.7	25 / 25	263	LW07-SS09-00	53.9	64.5
Beryllium	0.80 - 1.20	21 / 25	0.77	LW07-SS09-00	0.24	0.19
Cadmium	0.80 - 1.90	8 / 25	0.33	LW07-SS24-00	0.10	0.10
Calcium	769 - 1,192	24 / 25	36,700	LW07-SS07-00	3,532	7,302
Chromium	1.50 - 2.40	25 / 25	79.3	LW07-SS24-00	17.5	15.2
Cobalt	7.70 - 11.9	14 / 25	13.2	LW07-SS09-00	3.36	3.47
Copper	3.80 - 6.00	21 / 25	518	LW07-SS24-00	55.2	108
Cyanide	0.50 - 0.57	1 / 11	0.17	LW07-SS18-00	0.05	0.04
Iron	15.4 - 23.8	25 / 25	26,600	LW07-SS09-00	10,521	7,543
Lead	0.50 - 0.70	25 / 25	1,240	LW07-SS24-00	102	242
Magnesium	769 - 1,192	25 / 25	8,300	LW07-SS09-00	2,339	2,659
Manganese	2.30 - 3.60	25 / 25	617	LW07-SS09-00	171	181
Mercury	0.07 - 0.10	10 / 25	0.99	LW07-SS24-00	0.12	0.24
Nickel	6.20 - 9.50	17 / 25	25.0	LW07-SS09-00	6.57	6.13
Potassium	769 - 1,192	25 / 25	8,650	LW07-SS09-00	1,995	2,419
Selenium	0.80 - 1.90	3 / 25	0.75	LW07-SS17-00	0.30	0.13
Silver	1.50 - 2.40	11 / 25	6.70	LW07-SS09-00	1.40	1.89
Sodium	769 - 1,192	8 / 25	501	LW07-SS21-00	144	153
Thallium	1.50 - 2.40	1 / 25	1.30	LW07-SS17-00	0.31	0.22
Vanadium	7.70 - 11.9	25 / 25	43.2	LW07-SS09-00	16.9	12.0
Zinc	3.10 - 4.80	25 / 25	602	LW07-SS04-00	165	171
Pesticide/Polychlorinated Biphenyls (UG/KG)						
4,4'-DDD	3.55 - 4.33	0 / 3	--	--	1.94	0.20
4,4'-DDE	3.55 - 4.30	1 / 3	23.0	LW07-SS01-00	8.89	12.2
4,4'-DDT	3.55 - 4.30	1 / 3	10.0	LW07-SS01-00	4.55	4.72
Aldrin	1.83 - 2.23	0 / 3	--	--	1.00	0.10

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Table 8-14
Summary Statistics - Surface Soil
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Aroclor-1016	35.5 - 43.3	0 / 3	--	--	19.4	2.00
Aroclor-1221	72.0 - 87.9	0 / 3	--	--	39.4	4.06
Aroclor-1232	35.5 - 43.3	0 / 3	--	--	19.4	2.00
Aroclor-1242	35.5 - 43.3	0 / 3	--	--	19.4	2.00
Aroclor-1248	35.5 - 43.3	0 / 3	--	--	19.4	2.00
Aroclor-1254	35.5 - 43.3	0 / 3	--	--	19.4	2.00
Aroclor-1260	35.5 - 43.3	0 / 3	--	--	19.4	2.00
Dieldrin	3.55 - 4.33	0 / 3	--	--	1.94	0.20
Endosulfan I	1.83 - 2.23	0 / 3	--	--	1.00	0.10
Endosulfan II	3.55 - 4.33	0 / 3	--	--	1.94	0.20
Endosulfan sulfate	3.55 - 4.33	0 / 3	--	--	1.94	0.20
Endrin	3.55 - 4.33	0 / 3	--	--	1.94	0.20
Endrin aldehyde	3.55 - 4.33	0 / 3	--	--	1.94	0.20
Endrin ketone	3.55 - 4.33	0 / 3	--	--	1.94	0.20
Heptachlor	1.83 - 2.23	0 / 3	--	--	1.00	0.10
Heptachlor epoxide	1.83 - 2.23	0 / 3	--	--	1.00	0.10
Methoxychlor	18.3 - 22.3	0 / 3	--	--	10.0	1.03
Toxaphene	183 - 223	0 / 3	--	--	100	10.3
alpha-BHC	1.83 - 2.23	0 / 3	--	--	1.00	0.10
alpha-Chlordane	1.83 - 2.20	1 / 3	24.0	LW07-SS01-00	8.63	13.3
beta-BHC	1.83 - 2.23	0 / 3	--	--	1.00	0.10
delta-BHC	1.83 - 2.23	0 / 3	--	--	1.00	0.10
gamma-BHC (Lindane)	1.83 - 2.23	0 / 3	--	--	1.00	0.10
gamma-Chlordane	1.83 - 2.23	0 / 3	--	--	1.00	0.10
Semivolatile Organic Compounds (UG/KG)						
1,2,4-Trichlorobenzene	358 - 10,963	0 / 3	--	--	1,949	3,059
1,2-Dichlorobenzene	358 - 10,963	0 / 3	--	--	1,949	3,059
1,3-Dichlorobenzene	358 - 10,963	0 / 3	--	--	1,949	3,059
1,4-Dichlorobenzene	358 - 10,963	0 / 3	--	--	1,949	3,059
1-Methylnaphthalene	18.0 - 55.0	0 / 10	--	--	12.0	6.13

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Table 8-14
Summary Statistics - Surface Soil
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
2,2'-Oxybis(1-chloropropane)	358 - 10,963	0 / 3	--	--	1,949	3,059
2,4,5-Trichlorophenol	894 - 27,409	0 / 3	--	--	4,873	7,648
2,4,6-Trichlorophenol	358 - 10,963	0 / 3	--	--	1,949	3,059
2,4-Dichlorophenol	358 - 10,963	0 / 3	--	--	1,949	3,059
2,4-Dimethylphenol	358 - 10,963	0 / 3	--	--	1,949	3,059
2,4-Dinitrophenol	894 - 27,409	0 / 3	--	--	4,873	7,648
2,4-Dinitrotoluene	358 - 10,963	0 / 3	--	--	1,949	3,059
2,6-Dinitrotoluene	358 - 10,963	0 / 3	--	--	1,949	3,059
2-Chloronaphthalene	358 - 10,963	0 / 3	--	--	1,949	3,059
2-Chlorophenol	358 - 10,963	0 / 3	--	--	1,949	3,059
2-Methylnaphthalene	18.0 - 10,963	0 / 13	--	--	459	1,510
2-Methylphenol	358 - 10,963	0 / 3	--	--	1,949	3,059
2-Nitroaniline	894 - 27,409	0 / 3	--	--	4,873	7,648
2-Nitrophenol	358 - 10,963	0 / 3	--	--	1,949	3,059
3,3'-Dichlorobenzidine	358 - 10,963	0 / 3	--	--	1,949	3,059
3-Nitroaniline	894 - 27,409	0 / 3	--	--	4,873	7,648
4,6-Dinitro-2-methylphenol	894 - 27,409	0 / 3	--	--	4,873	7,648
4-Bromophenyl-phenylether	358 - 10,963	0 / 3	--	--	1,949	3,059
4-Chloro-3-methylphenol	358 - 10,963	0 / 3	--	--	1,949	3,059
4-Chloroaniline	358 - 10,963	0 / 3	--	--	1,949	3,059
4-Chlorophenyl-phenylether	358 - 10,963	0 / 3	--	--	1,949	3,059
4-Methylphenol	358 - 10,963	0 / 3	--	--	1,949	3,059
4-Nitroaniline	894 - 27,409	0 / 3	--	--	4,873	7,648
4-Nitrophenol	894 - 27,409	0 / 3	--	--	4,873	7,648
Acenaphthene	18.0 - 10,963	1 / 24	14.0	LW07-SS21-00	322	1,102
Acenaphthylene	35.0 - 10,963	2 / 24	2,700	LW07-SS01-00	211	536
Anthracene	1.80 - 10,963	8 / 24	4,700	LW07-SS01-00	279	946
Benzo(a)anthracene	1.80 - 10,963	17 / 25	12,000	LW07-SS01-00	568	2,383
Benzo(a)pyrene	1.80 - 10,963	19 / 25	14,000	LW07-SS01-00	628	2,787
Benzo(b)fluoranthene	3.50 - 10,963	17 / 25	30,000	LW07-SS01-00	1,291	5,982

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Table 8-14
Summary Statistics - Surface Soil
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Benzo(g,h,i)perylene	3.50 - 10,963	12 / 25	16,000	LW07-SS01-00	742	3,179
Benzo(k)fluoranthene	1.80 - 10,963	17 / 25	27,000	LW07-SS01-00	1,156	5,385
Butylbenzylphthalate	358 - 10,963	0 / 3	--	--	1,949	3,059
Carbazole	358 - 10,963	0 / 3	--	--	1,949	3,059
Chrysene	1.80 - 10,963	19 / 25	24,000	LW07-SS01-00	1,047	4,783
Di-n-butylphthalate	358 - 10,963	1 / 3	65.0	LW07-SS02-00	1,911	3,093
Di-n-octylphthalate	358 - 10,963	0 / 3	--	--	1,949	3,059
Dibenz(a,h)anthracene	3.50 - 10,963	3 / 24	6,600	LW07-SS01-00	359	1,332
Dibenzofuran	358 - 10,963	0 / 3	--	--	1,949	3,059
Diethylphthalate	358 - 10,963	0 / 3	--	--	1,949	3,059
Dimethyl phthalate	358 - 10,963	0 / 3	--	--	1,949	3,059
Fluoranthene	3.50 - 10,963	19 / 25	9,600	LW07-SS01-00	484	1,901
Fluorene	3.50 - 10,963	2 / 24	14.0	LW07-SS21-00	318	1,103
Hexachlorobenzene	358 - 10,963	0 / 3	--	--	1,949	3,059
Hexachlorobutadiene	358 - 10,963	0 / 3	--	--	1,949	3,059
Hexachlorocyclopentadiene	358 - 10,963	0 / 3	--	--	1,949	3,059
Hexachloroethane	358 - 10,963	0 / 3	--	--	1,949	3,059
Indeno(1,2,3-cd)pyrene	1.80 - 10,963	18 / 25	17,000	LW07-SS01-00	751	3,386
Isophorone	358 - 10,963	0 / 3	--	--	1,949	3,059
Naphthalene	18.0 - 10,963	0 / 24	--	--	329	1,101
Nitrobenzene	358 - 10,963	0 / 3	--	--	1,949	3,059
PAH (total)	-- - --	20 / 25	220,490	LW07-SS01-00	10,268	43,808
Pentachlorophenol	894 - 27,409	0 / 3	--	--	4,873	7,648
Phenanthrene	1.80 - 10,963	15 / 25	190	LW07-SS21-00	304	1,081
Phenol	358 - 10,963	0 / 3	--	--	1,949	3,059
Pyrene	1.80 - 10,963	18 / 25	24,000	LW07-SS01-00	1,080	4,776
bis(2-Chloroethoxy)methane	358 - 10,963	0 / 3	--	--	1,949	3,059
bis(2-Chloroethyl)ether	358 - 10,963	0 / 3	--	--	1,949	3,059
bis(2-Ethylhexyl)phthalate	358 - 10,963	2 / 3	74.0	LW07-SS03-00	1,868	3,129
n-Nitroso-di-n-propylamine	358 - 10,963	0 / 3	--	--	1,949	3,059

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Table 8-14
Summary Statistics - Surface Soil
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
n-Nitrosodiphenylamine	358 - 10,963	0 / 3	--	--	1,949	3,059
Volatile Organic Compounds (UG/KG)						
1,1,1-Trichloroethane	10.7 - 13.3	0 / 3	--	--	5.91	0.68
1,1,2,2-Tetrachloroethane	10.7 - 13.3	0 / 3	--	--	5.91	0.68
1,1,2-Trichloroethane	10.7 - 13.3	0 / 3	--	--	5.91	0.68
1,1-Dichloroethane	10.7 - 13.3	0 / 3	--	--	5.91	0.68
1,1-Dichloroethene	10.7 - 13.3	0 / 3	--	--	5.91	0.68
1,2-Dichloroethane	10.7 - 13.3	0 / 3	--	--	5.91	0.68
1,2-Dichloroethene (total)	10.7 - 13.3	0 / 3	--	--	5.91	0.68
1,2-Dichloropropane	10.7 - 13.3	0 / 3	--	--	5.91	0.68
2-Butanone	10.7 - 13.3	0 / 3	--	--	5.91	0.68
2-Hexanone	10.7 - 13.3	0 / 3	--	--	5.91	0.68
4-Methyl-2-pentanone	10.7 - 13.3	0 / 3	--	--	5.91	0.68
Acetone	10.7 - 13.3	0 / 3	--	--	3.42	1.60
Benzene	10.7 - 13.3	0 / 3	--	--	5.91	0.68
Bromodichloromethane	10.7 - 13.3	0 / 3	--	--	5.91	0.68
Bromoform	10.7 - 13.3	0 / 3	--	--	5.91	0.68
Bromomethane	10.7 - 13.3	0 / 3	--	--	5.91	0.68
Carbon disulfide	10.7 - 13.3	0 / 3	--	--	5.91	0.68
Carbon tetrachloride	10.7 - 13.3	0 / 3	--	--	5.91	0.68
Chlorobenzene	10.7 - 13.3	0 / 3	--	--	5.91	0.68
Chloroethane	10.7 - 13.3	0 / 3	--	--	5.91	0.68
Chloroform	10.7 - 13.3	0 / 3	--	--	5.91	0.68
Chloromethane	10.7 - 13.3	0 / 3	--	--	5.91	0.68
Dibromochloromethane	10.7 - 13.3	0 / 3	--	--	5.91	0.68
Ethylbenzene	10.7 - 13.3	0 / 3	--	--	5.91	0.68
Methylene chloride	10.7 - 13.3	0 / 3	--	--	4.00	1.32
Styrene	10.7 - 13.3	0 / 3	--	--	5.91	0.68
Tetrachloroethene	10.7 - 13.3	0 / 3	--	--	5.91	0.68
Toluene	10.7 - 13.3	0 / 3	--	--	5.91	0.68

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Table 8-14
Summary Statistics - Surface Soil
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Trichloroethene	10.7 - 13.3	0 / 3	--	--	5.91	0.68
Vinyl chloride	10.7 - 13.3	0 / 3	--	--	5.91	0.68
Xylene, total	10.7 - 13.3	0 / 3	--	--	5.91	0.68
cis-1,2-Dichloroethene	10.7 - 13.3	0 / 3	--	--	5.91	0.68
cis-1,3-Dichloropropene	10.7 - 13.3	0 / 3	--	--	5.91	0.68
m- and p-Xylene	10.7 - 13.3	0 / 3	--	--	5.91	0.68
o-Xylene	10.7 - 13.3	0 / 3	--	--	5.91	0.68
trans-1,2-Dichloroethene	10.7 - 13.3	0 / 3	--	--	5.91	0.68
trans-1,3-Dichloropropene	10.7 - 13.3	0 / 3	--	--	5.91	0.68
Other Parameters						
Total organic carbon (MG/KG)	102 - 115	11 / 11	29,210	LW07-SS16-00	5,063	8,153
pH	2.00 - 2.00	11 / 11	9.45	LW07-SS23-00	7.87	1.18

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Table 8-15
Summary Statistics - Subsurface Soil
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Inorganics (MG/KG)						
Aluminum	29.3 - 55.5	36 / 36	9,140	LW07-SB16-01	2,499	2,208
Antimony	8.80 - 16.6	7 / 36	1.30	LW07-SB23-01	0.27	0.21
Arsenic	1.50 - 2.80	28 / 36	6.30	LW07-SB18-02	1.81	1.60
Barium	29.3 - 55.5	32 / 36	96.0	LW07-SB16-01	14.3	16.2
Beryllium	0.70 - 1.40	23 / 36	0.91	LW07-SB23-01	0.13	0.16
Cadmium	0.70 - 1.40	6 / 36	0.49	LW07-SB23-01	0.06	0.09
Calcium	732 - 1,390	26 / 36	2,310	LW07-SB16-01	635	651
Chromium	1.50 - 2.80	35 / 36	89.2	LW07-SB16-01	9.40	14.9
Cobalt	7.30 - 13.9	21 / 36	6.40	LW07-SB16-01	1.12	1.40
Copper	3.70 - 6.90	29 / 36	148	LW07-SB23-01	18.3	31.3
Cyanide	0.50 - 0.69	0 / 22	--	--	0.04	0.004
Iron	14.6 - 27.7	36 / 36	22,300	LW07-SB17-01	4,802	4,652
Lead	0.40 - 0.83	36 / 36	145	LW07-SB01-01	25.8	34.6
Magnesium	732 - 1,390	35 / 36	7,700	LW07-SB16-01	593	1,258
Manganese	2.20 - 4.20	36 / 36	391	LW07-SB16-01	46.8	74.3
Mercury	0.07 - 0.14	9 / 36	0.37	LW07-SB24-01	0.04	0.07
Nickel	5.90 - 11.1	25 / 36	24.4	LW07-SB23-01	3.11	4.69
Potassium	732 - 1,390	36 / 36	5,070	LW07-SB16-01	470	831
Selenium	0.70 - 1.40	1 / 36	1.00	LW07-SB19-02	0.26	0.14
Silver	1.50 - 2.80	3 / 36	2.20	LW07-SB01-01	0.31	0.44
Sodium	732 - 1,390	10 / 36	573	LW07-SB23-01	70.5	98.6
Thallium	1.50 - 2.80	0 / 36	--	--	0.28	0.11
Vanadium	7.30 - 13.9	36 / 36	22.0	LW07-SB16-01	7.07	4.68
Zinc	2.90 - 5.50	34 / 36	723	LW07-SB23-01	67.7	134
Pesticide/Polychlorinated Biphenyls (UG/KG)						
4,4'-DDD	3.35 - 3.55	0 / 3	--	--	1.74	0.06
4,4'-DDE	3.35 - 3.55	0 / 3	--	--	1.74	0.06
4,4'-DDT	3.35 - 3.55	0 / 3	--	--	1.74	0.06
Aldrin	1.72 - 1.83	0 / 3	--	--	0.90	0.03
Aroclor-1016	33.5 - 35.5	0 / 3	--	--	17.4	0.57

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Table 8-15
Summary Statistics - Subsurface Soil
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Aroclor-1221	67.9 - 72.1	0 / 3	--	--	35.3	1.16
Aroclor-1232	33.5 - 35.5	0 / 3	--	--	17.4	0.57
Aroclor-1242	33.5 - 35.5	0 / 3	--	--	17.4	0.57
Aroclor-1248	33.5 - 35.5	0 / 3	--	--	17.4	0.57
Aroclor-1254	33.5 - 35.5	0 / 3	--	--	17.4	0.57
Aroclor-1260	33.5 - 35.5	0 / 3	--	--	17.4	0.57
Dieldrin	3.35 - 3.55	0 / 3	--	--	1.74	0.06
Endosulfan I	1.72 - 1.83	0 / 3	--	--	0.90	0.03
Endosulfan II	3.35 - 3.55	0 / 3	--	--	1.74	0.06
Endosulfan sulfate	3.35 - 3.55	0 / 3	--	--	1.74	0.06
Endrin	3.35 - 3.55	0 / 3	--	--	1.74	0.06
Endrin aldehyde	3.35 - 3.55	0 / 3	--	--	1.74	0.06
Endrin ketone	3.35 - 3.55	0 / 3	--	--	1.74	0.06
Heptachlor	1.72 - 1.83	0 / 3	--	--	0.90	0.03
Heptachlor epoxide	1.72 - 1.83	0 / 3	--	--	0.90	0.03
Methoxychlor	17.2 - 18.3	0 / 3	--	--	8.96	0.29
Toxaphene	172 - 183	0 / 3	--	--	89.6	2.95
alpha-BHC	1.72 - 1.83	0 / 3	--	--	0.90	0.03
alpha-Chlordane	1.72 - 1.83	0 / 3	--	--	0.90	0.03
beta-BHC	1.72 - 1.83	0 / 3	--	--	0.90	0.03
delta-BHC	1.72 - 1.83	0 / 3	--	--	0.90	0.03
gamma-BHC (Lindane)	1.72 - 1.83	0 / 3	--	--	0.90	0.03
gamma-Chlordane	1.72 - 1.83	0 / 3	--	--	0.90	0.03
Semivolatile Organic Compounds (UG/KG)						
1,2,4-Trichlorobenzene	350 - 708	0 / 3	--	--	235	103
1,2-Dichlorobenzene	350 - 708	0 / 3	--	--	235	103
1,3-Dichlorobenzene	350 - 708	0 / 3	--	--	235	103
1,4-Dichlorobenzene	350 - 708	0 / 3	--	--	235	103
1-Methylnaphthalene	17.0 - 20.0	0 / 10	--	--	9.15	0.41
2,4,5-Trichlorophenol	875 - 1,770	0 / 3	--	--	588	257
2,4,6-Trichlorophenol	350 - 708	0 / 3	--	--	235	103

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Table 8-15
Summary Statistics - Subsurface Soil
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
2,4-Dichlorophenol	350 - 708	0 / 3	--	--	235	103
2,4-Dimethylphenol	350 - 708	0 / 3	--	--	235	103
2,4-Dinitrophenol	875 - 1,770	0 / 3	--	--	588	257
2,4-Dinitrotoluene	350 - 708	0 / 3	--	--	235	103
2,6-Dinitrotoluene	350 - 708	0 / 3	--	--	235	103
2-Chloronaphthalene	350 - 708	0 / 3	--	--	235	103
2-Chlorophenol	350 - 708	0 / 3	--	--	235	103
2-Methylnaphthalene	17.0 - 708	0 / 13	--	--	61.3	108
2-Methylphenol	350 - 708	0 / 3	--	--	235	103
2-Nitroaniline	875 - 1,770	0 / 3	--	--	588	257
2-Nitrophenol	350 - 708	0 / 3	--	--	235	103
3,3'-Dichlorobenzidine	350 - 708	0 / 3	--	--	235	103
3-Nitroaniline	875 - 1,770	0 / 3	--	--	588	257
4,6-Dinitro-2-methylphenol	875 - 1,770	0 / 3	--	--	588	257
4-Bromophenyl-phenylether	350 - 708	0 / 3	--	--	235	103
4-Chloro-3-methylphenol	350 - 708	0 / 3	--	--	235	103
4-Chloroaniline	350 - 708	0 / 3	--	--	235	103
4-Chlorophenyl-phenylether	350 - 708	0 / 3	--	--	235	103
4-Methylphenol	350 - 708	0 / 3	--	--	235	103
4-Nitroaniline	875 - 1,770	0 / 3	--	--	588	257
4-Nitrophenol	875 - 1,770	0 / 3	--	--	588	257
Acenaphthene	17.0 - 708	2 / 35	49.0	LW07-SB16-02	127	89.6
Acenaphthylene	34.0 - 708	0 / 35	--	--	138	83.4
Anthracene	1.70 - 708	8 / 36	44.0	LW07-SB25-01	113	96.3
Benzo(a)anthracene	1.70 - 708	18 / 36	240	LW07-SB25-01	103	82.7
Benzo(a)pyrene	1.70 - 708	22 / 36	260	LW07-SB01-01	80.4	83.8
Benzo(b)fluoranthene	3.40 - 708	21 / 36	370	LW07-SB01-01	94.9	92.0
Benzo(g,h,i)perylene	3.40 - 708	9 / 36	210	LW07-SB01-01	129	78.6
Benzo(k)fluoranthene	1.70 - 708	17 / 36	270	LW07-SB01-01	97.9	86.0
Butylbenzylphthalate	350 - 708	0 / 3	--	--	235	103
Carbazole	350 - 708	0 / 3	--	--	235	103

1 - One-half of the reporting limit was used for non-detected samples when calculating the mean

Table 8-15
Summary Statistics - Subsurface Soil
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Chrysene	1.70 - 708	21 / 36	350	LW07-SB25-01	91.5	89.8
Di-n-butylphthalate	350 - 708	1 / 3	42.0	LW07-SB02-01	191	156
Di-n-octylphthalate	350 - 708	0 / 3	--	--	235	103
Dibenz(a,h)anthracene	3.40 - 708	2 / 35	41.0	LW07-SB25-01	130	91.3
Dibenzofuran	350 - 708	0 / 3	--	--	235	103
Diethylphthalate	350 - 708	0 / 3	--	--	235	103
Dimethyl phthalate	350 - 708	0 / 3	--	--	235	103
Fluoranthene	3.40 - 708	22 / 36	330	LW07-SB25-01	92.4	84.8
Fluorene	3.40 - 708	2 / 35	14.0	LW07-SB25-01	129	92.2
Hexachlorobenzene	350 - 708	0 / 3	--	--	235	103
Hexachlorobutadiene	350 - 708	0 / 3	--	--	235	103
Hexachlorocyclopentadiene	350 - 708	0 / 3	--	--	235	103
Hexachloroethane	350 - 708	0 / 3	--	--	235	103
Indeno(1,2,3-cd)pyrene	1.70 - 708	18 / 36	210	LW07-SB01-01	92.4	83.9
Isophorone	350 - 708	0 / 3	--	--	235	103
Naphthalene	17.0 - 708	2 / 35	18.0	LW07-SB24-01	126	91.2
Nitrobenzene	350 - 708	0 / 3	--	--	235	103
PAH (total)	-- - --	26 / 36	5,083	LW07-SB01-01	1,791	1,248
Pentachlorophenol	875 - 1,770	0 / 3	--	--	588	257
Phenanthrene	1.70 - 708	16 / 36	170	LW07-SB25-01	111	94.2
Phenol	350 - 708	0 / 3	--	--	235	103
Pyrene	1.70 - 708	23 / 36	560	LW07-SB25-01	102	108
bis(2-Chloroethoxy)methane	350 - 708	0 / 3	--	--	235	103
bis(2-Chloroethyl)ether	350 - 708	0 / 3	--	--	235	103
bis(2-Chloroisopropyl)ether	350 - 708	0 / 3	--	--	235	103
bis(2-Ethylhexyl)phthalate	350 - 708	3 / 3	1,600	LW07-SB02-01	873	740
n-Nitroso-di-n-propylamine	350 - 708	0 / 3	--	--	235	103
n-Nitrosodiphenylamine	350 - 708	0 / 3	--	--	235	103
Volatile Organic Compounds (UG/KG)						
1,1,1-Trichloroethane	10.5 - 10.8	0 / 3	--	--	5.31	0.08
1,1,2,2-Tetrachloroethane	10.5 - 10.8	0 / 3	--	--	5.31	0.08

1 - One-half of the reporting limit was used for non-detected samples when calculating the mean

Table 8-15
Summary Statistics - Subsurface Soil
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
1,1,2-Trichloroethane	10.5 - 10.8	0 / 3	--	--	5.31	0.08
1,1-Dichloroethane	10.5 - 10.8	0 / 3	--	--	5.31	0.08
1,1-Dichloroethene	10.5 - 10.8	0 / 3	--	--	5.31	0.08
1,2-Dichloroethane	10.5 - 10.8	0 / 3	--	--	5.31	0.08
1,2-Dichloroethene (total)	10.5 - 10.8	0 / 3	--	--	5.31	0.08
1,2-Dichloropropane	10.5 - 10.8	0 / 3	--	--	5.31	0.08
2-Butanone	10.5 - 10.8	0 / 3	--	--	5.31	0.08
2-Hexanone	10.5 - 10.8	0 / 3	--	--	5.31	0.08
4-Methyl-2-pentanone	10.5 - 10.8	0 / 3	--	--	5.31	0.08
Acetone	10.5 - 10.8	0 / 3	--	--	7.96	3.17
Benzene	10.5 - 10.8	0 / 3	--	--	5.31	0.08
Bromodichloromethane	10.5 - 10.8	0 / 3	--	--	5.31	0.08
Bromoform	10.5 - 10.8	0 / 3	--	--	5.31	0.08
Bromomethane	10.5 - 10.8	0 / 3	--	--	5.31	0.08
Carbon disulfide	10.5 - 10.8	0 / 3	--	--	5.31	0.08
Carbon tetrachloride	10.5 - 10.8	0 / 3	--	--	5.31	0.08
Chlorobenzene	10.5 - 10.8	0 / 3	--	--	5.31	0.08
Chloroethane	10.5 - 10.8	0 / 3	--	--	5.31	0.08
Chloroform	10.5 - 10.8	0 / 3	--	--	5.31	0.08
Chloromethane	10.5 - 10.8	0 / 3	--	--	5.31	0.08
Dibromochloromethane	10.5 - 10.8	0 / 3	--	--	5.31	0.08
Ethylbenzene	10.5 - 10.8	0 / 3	--	--	5.31	0.08
Methylene chloride	10.5 - 10.8	0 / 3	--	--	3.17	0.76
Styrene	10.5 - 10.8	0 / 3	--	--	5.31	0.08
Tetrachloroethene	10.5 - 10.8	0 / 3	--	--	5.31	0.08
Toluene	10.5 - 10.8	0 / 3	--	--	5.31	0.08
Trichloroethene	10.5 - 10.8	0 / 3	--	--	5.31	0.08
Vinyl chloride	10.5 - 10.8	0 / 3	--	--	5.31	0.08
Xylene, total	10.5 - 10.8	0 / 3	--	--	5.31	0.08
cis-1,2-Dichloroethene	10.5 - 10.8	0 / 3	--	--	5.31	0.08
cis-1,3-Dichloropropene	10.5 - 10.8	0 / 3	--	--	5.31	0.08

1 - One-half of the reporting limit was used for non-detected samples when calculating the mean

Table 8-15
Summary Statistics - Subsurface Soil
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
m- and p-Xylene	10.5 - 10.8	0 / 3	--	--	5.31	0.08
o-Xylene	10.5 - 10.8	0 / 3	--	--	5.31	0.08
trans-1,2-Dichloroethene	10.5 - 10.8	0 / 3	--	--	5.31	0.08
trans-1,3-Dichloropropene	10.5 - 10.8	0 / 3	--	--	5.31	0.08
Other Parameters						
Total organic carbon (MG/KG)	101 - 139	22 / 22	7,746	LW07-SB19-02	1,880	2,008
pH	2.00 - 2.00	22 / 22	8.88	LW07-SB15-01	7.60	0.94

1 - One-half of the reporting limit was used for non-detected samples when calculating the mean

Table 8-16
Summary Statistics - Surface Sediment
NAB Little Creek, Virginia Beach, VA

Chemical	Frequency of Detection	Maximum Non-Detect	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Inorganics (MG/KG)						
Aluminum	24 / 24	--	17,100	LW07-SD05-00	9,566	3,536
Antimony	11 / 24	1.38	19.0	LW07-K4	1.40	3.77
Arsenic	24 / 24	--	12.6	LW07-L2-SD201	8.11	2.91
Barium	23 / 24	21.0	49.1	LW07-SD05-00	28.0	10.2
Beryllium	19 / 24	1.30	0.77	LW07-L2-SD201	0.51	0.18
Cadmium	16 / 24	0.39	0.66	LW07-H1	0.26	0.20
Calcium	24 / 24	--	35,400	LW07-SD04-00	6,951	7,369
Chromium	24 / 24	--	53.9	LW07-SD05-00	29.6	11.2
Cobalt	19 / 24	6.00	6.80	LW07-L2-SD201	4.16	1.68
Copper	24 / 24	--	142	LW07-SD05-00	76.7	33.0
Cyanide	4 / 19	0.21	0.27	LW07-K5	0.10	0.058
Iron	24 / 24	--	31,000	LW07-SD05-00	19,370	6,520
Lead	24 / 24	--	1,810	LW07-SD03-00	137	358
Magnesium	24 / 24	--	8,520	LW07-SD05-00	4,765	1,717
Manganese	24 / 24	--	226	LW07-SD05-00	149	50.5
Mercury	20 / 24	0.56	3.18	LW07-L5	0.38	0.61
Nickel	20 / 24	21.2	21.7	LW07-K5	12.2	5.14
Potassium	24 / 24	--	4,310	LW07-SD05-00	2,206	863
Selenium	8 / 24	1.90	2.38	LW07-H3	0.93	0.56
Silver	7 / 24	1.20	7.80	LW07-SD05-00	1.00	1.94
Sodium	24 / 24	--	20,500	LW07-SD05-00	9,270	4,081
Thallium	1 / 24	1.50	0.55	LW07-SD01-00	0.49	0.11
Tin	19 / 19	--	10.5	LW07-M3	4.54	2.60
Vanadium	24 / 24	--	47.7	LW07-SD05-00	27.8	9.64
Zinc	23 / 24	205	915	LW07-M3	317	190
Pesticide/Polychlorinated Biphenyls (UG/KG)						
4,4'-DDD	0 / 1	4.46	--	--	2.23	--
4,4'-DDE	0 / 1	4.46	--	--	2.23	--
4,4'-DDT	0 / 1	4.46	--	--	2.23	--
Aldrin	0 / 1	2.30	--	--	1.15	--
Aroclor-1016	0 / 1	44.6	--	--	22.3	--

1 - One-half of the reporting limit was used for non-detected samples when calculating the mean

Table 8-16
Summary Statistics - Surface Sediment
NAB Little Creek, Virginia Beach, VA

Chemical	Frequency of Detection	Maximum Non-Detect	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Aroclor-1221	0 / 1	90.6	--	--	45.3	--
Aroclor-1232	0 / 1	44.6	--	--	22.3	--
Aroclor-1242	0 / 1	44.6	--	--	22.3	--
Aroclor-1248	0 / 1	44.6	--	--	22.3	--
Aroclor-1254	0 / 1	44.6	--	--	22.3	--
Aroclor-1260	0 / 1	44.6	--	--	22.3	--
Dieldrin	0 / 1	4.46	--	--	2.23	--
Endosulfan I	0 / 1	2.30	--	--	1.15	--
Endosulfan II	0 / 1	4.46	--	--	2.23	--
Endosulfan sulfate	1 / 1	--	5.80	LW07-SD01-00	5.80	--
Endrin	0 / 1	4.46	--	--	2.23	--
Endrin aldehyde	0 / 1	4.46	--	--	2.23	--
Endrin ketone	0 / 1	4.46	--	--	2.23	--
Heptachlor	0 / 1	2.30	--	--	1.15	--
Heptachlor epoxide	0 / 1	2.30	--	--	1.15	--
Methoxychlor	0 / 1	23.0	--	--	11.5	--
Toxaphene	0 / 1	230	--	--	115	--
alpha-BHC	0 / 1	2.30	--	--	1.15	--
alpha-Chlordane	0 / 1	2.30	--	--	1.15	--
beta-BHC	0 / 1	2.30	--	--	1.15	--
delta-BHC	0 / 1	2.30	--	--	1.15	--
gamma-BHC (Lindane)	0 / 1	2.30	--	--	1.15	--
gamma-Chlordane	0 / 1	2.30	--	--	1.15	--
Semivolatile Organic Compounds (UG/KG)						
1,2,4-Trichlorobenzene	0 / 1	450	--	--	225	--
1,2-Dichlorobenzene	0 / 1	450	--	--	225	--
1,3-Dichlorobenzene	0 / 1	450	--	--	225	--
1,4-Dichlorobenzene	0 / 1	450	--	--	225	--
1-Methylnaphthalene	0 / 4	3,500	--	--	730	740
2,2'-Oxybis(1-chloropropane)	0 / 1	450	--	--	225	--
2,4,5-Trichlorophenol	0 / 1	1,100	--	--	550	--
2,4,6-Trichlorophenol	0 / 1	450	--	--	225	--

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Table 8-16
Summary Statistics - Surface Sediment
NAB Little Creek, Virginia Beach, VA

Chemical	Frequency of Detection	Maximum Non-Detect	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
2,4-Dichlorophenol	0 / 1	450	--	--	225	--
2,4-Dimethylphenol	0 / 1	450	--	--	225	--
2,4-Dinitrophenol	0 / 1	1,100	--	--	550	--
2,4-Dinitrotoluene	0 / 1	450	--	--	225	--
2,6-Dinitrotoluene	0 / 1	450	--	--	225	--
2-Chloronaphthalene	0 / 1	450	--	--	225	--
2-Chlorophenol	0 / 1	450	--	--	225	--
2-Methylnaphthalene	0 / 5	3,500	--	--	629	679
2-Methylphenol	0 / 1	450	--	--	225	--
2-Nitroaniline	0 / 1	1,100	--	--	550	--
2-Nitrophenol	0 / 1	450	--	--	225	--
3,3'-Dichlorobenzidine	0 / 1	450	--	--	225	--
3-Nitroaniline	0 / 1	1,100	--	--	550	--
4,6-Dinitro-2-methylphenol	0 / 1	1,100	--	--	550	--
4-Bromophenyl-phenylether	0 / 1	450	--	--	225	--
4-Chloro-3-methylphenol	0 / 1	450	--	--	225	--
4-Chloroaniline	0 / 1	450	--	--	225	--
4-Chlorophenyl-phenylether	0 / 1	450	--	--	225	--
4-Methylphenol	0 / 1	450	--	--	225	--
4-Nitroaniline	0 / 1	1,100	--	--	550	--
4-Nitrophenol	0 / 1	1,100	--	--	550	--
Acenaphthene	13 / 24	3,500	3,000	LW07-SD05-00	493	726
Acenaphthylene	20 / 24	6,900	520	LW07-M3	351	737
Anthracene	24 / 24	--	2,300	LW07-SD04-00	516	599
Benzo(a)anthracene	24 / 24	--	5,925	LW07-L5	1,263	1,506
Benzo(a)pyrene	24 / 24	--	4,250	LW07-L5	1,051	1,096
Benzo(b)fluoranthene	23 / 24	320	9,950	LW07-L5	1,967	2,422
Benzo(g,h,i)perylene	22 / 24	605	1,800	LW07-SD04-00	574	521
Benzo(k)fluoranthene	24 / 24	--	9,175	LW07-L5	1,648	2,122
Butylbenzylphthalate	0 / 1	450	--	--	225	--
Carbazole	1 / 1	--	130	LW07-SD01-00	130	--
Chrysene	24 / 24	--	16,575	LW07-L5	2,517	3,612

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Table 8-16
Summary Statistics - Surface Sediment
NAB Little Creek, Virginia Beach, VA

Chemical	Frequency of Detection	Maximum Non-Detect	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Di-n-butylphthalate	1 / 1	--	83.0	LW07-SD01-00	83.0	--
Di-n-octylphthalate	0 / 1	450	--	--	225	--
Dibenz(a,h)anthracene	22 / 24	765	993	LW07-L5	207	233
Dibenzofuran	0 / 1	450	--	--	225	--
Diethylphthalate	0 / 1	450	--	--	225	--
Dimethyl phthalate	0 / 1	450	--	--	225	--
Fluoranthene	24 / 24	--	25,970	LW07-SD04-00	2,831	5,514
Fluorene	17 / 24	793	2,100	LW07-SD04-00	293	422
Hexachlorobenzene	0 / 1	450	--	--	225	--
Hexachlorobutadiene	0 / 1	450	--	--	225	--
Hexachlorocyclopentadiene	0 / 1	450	--	--	225	--
Hexachloroethane	0 / 1	450	--	--	225	--
Indeno(1,2,3-cd)pyrene	24 / 24	--	2,198	LW07-L5	584	573
Isophorone	0 / 1	450	--	--	225	--
Naphthalene	8 / 24	3,500	430	LW07-SD02-00	340	356
Nitrobenzene	0 / 1	450	--	--	225	--
PAH (total)	24 / 24	--	105,690	LW07-SD04-00	19,847	24,668
Pentachlorophenol	0 / 1	1,100	--	--	550	--
Phenanthrene	24 / 24	--	18,360	LW07-SD04-00	1,285	3,710
Phenol	0 / 1	450	--	--	225	--
Pyrene	24 / 24	--	22,300	LW07-SD04-00	3,666	5,079
bis(2-Chloroethoxy)methane	0 / 1	450	--	--	225	--
bis(2-Chloroethyl)ether	0 / 1	450	--	--	225	--
bis(2-Ethylhexyl)phthalate	1 / 1	--	66.0	LW07-SD01-00	66.0	--
n-Nitroso-di-n-propylamine	0 / 1	450	--	--	225	--
n-Nitrosodiphenylamine	0 / 1	450	--	--	225	--
Other Parameters						
Ammonia (MG/KG)	17 / 19	3.63	40.8	LW07-K1	14.6	10.3
Total organic carbon (MG/KG)	24 / 24	--	30,200	LW07-D5	16,617	6,954
pH	24 / 24	--	8.35	LW07-K1	7.95	0.17

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Table 8-17
Summary Statistics - Subsurface Sediment
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Inorganics (MG/KG)						
Aluminum	47.1 - 115	19 / 19	28,700	LW07-H3-SD201-02-02C	11,357	5,817
Antimony	14.1 - 34.6	10 / 19	2.00	LW07-M1-SD201-02-02C	0.55	0.52
Arsenic	2.40 - 5.80	18 / 19	15.4	LW07-M3-SD201-02-02C	7.38	3.62
Barium	47.1 - 115	19 / 19	55.3	LW07-M3-SD201-02-02C	27.1	13.1
Beryllium	1.20 - 2.90	19 / 19	1.50	LW07-M1-SD201-02-02C	0.62	0.35
Cadmium	1.20 - 2.90	7 / 19	1.10	LW07-M1-SD201-02-02C	0.26	0.33
Calcium	1,180 - 2,880	19 / 19	16,200	LW07-K6-SD201-02-02C	2,724	3,503
Chromium	2.40 - 5.80	19 / 19	53.2	LW07-M3-SD201-02-02C	27.3	14.2
Cobalt	11.8 - 28.8	19 / 19	10.4	LW07-H3-SD201-02-02C	5.01	2.54
Copper	5.90 - 14.4	19 / 19	220	LW07-M1-SD201-02-02C	46.7	61.5
Cyanide	0.58 - 1.60	6 / 19	0.38	LW07-M1-SD201-02-02C	0.12	0.10
Iron	23.5 - 57.7	19 / 19	48,500	LW07-M3-SD201-02-02C	20,858	11,105
Lead	0.71 - 1.70	19 / 19	156	LW07-M3-SD201-02-02C	43.2	52.5
Magnesium	1,180 - 2,880	19 / 19	9,330	LW07-H3-SD201-02-02C	4,617	2,241
Manganese	3.50 - 8.70	19 / 19	275	LW07-M3-SD201-02-02C	141	69.2
Mercury	0.08 - 0.27	15 / 19	1.50	LW07-M1-SD201-02-02C	0.30	0.42
Nickel	9.40 - 23.1	18 / 19	43.9	LW07-M3-SD201-02-02C	14.9	11.3
Potassium	1,180 - 2,880	19 / 19	5,210	LW07-H3-SD201-02-02C	2,258	1,158
Selenium	1.20 - 2.90	10 / 19	1.70	LW07-H1-SD201-02-02C	0.97	0.44
Silver	2.40 - 5.80	0 / 19	--	--	0.17	0.09
Sodium	1,180 - 2,880	19 / 19	15,900	LW07-M3-SD201-02-02C	7,202	3,386
Thallium	2.40 - 5.80	0 / 19	--	--	0.43	0.11
Tin	11.8 - 28.8	14 / 19	23.5	LW07-M1-SD201-02-02C	4.09	6.00
Vanadium	11.8 - 28.8	19 / 19	60.3	LW07-M3-SD201-02-02C	29.5	13.9
Zinc	4.70 - 11.5	18 / 19	1,390	LW07-M1-SD201-02-02C	243	364
Semivolatile Organic Compounds (UG/KG)						
Acenaphthene	390 - 11,000	4 / 19	11,000	LW07-K6-SD201-02-02C	862	2,462
Acenaphthylene	390 - 1,000	8 / 19	510	LW07-K6-SD201-02-02C	228	145
Anthracene	390 - 1,000	11 / 19	1,700	LW07-M1-SD201-02-02C	298	386
Benzo(a)anthracene	390 - 11,000	13 / 19	8,400	LW07-K6-SD201-02-02C	720	1,890

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Table 8-17
Summary Statistics - Subsurface Sediment
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Benzo(a)pyrene	390 - 1,000	15 / 19	3,000	LW07-K6-SD201-02-02C	392	686
Benzo(b)fluoranthene	390 - 1,000	13 / 19	4,500	LW07-K6-SD201-02-02C	593	1,037
Benzo(g,h,i)perylene	390 - 1,000	7 / 19	950	LW07-K6-SD201-02-02C	307	186
Benzo(k)fluoranthene	390 - 1,000	13 / 19	3,400	LW07-K6-SD201-02-02C	495	784
Chrysene	390 - 1,000	13 / 19	6,000	LW07-K6-SD201-02-02C	688	1,386
Dibenz(a,h)anthracene	390 - 1,000	7 / 19	320	LW07-K6-SD201-02-02C	226	125
Fluoranthene	390 - 11,000	15 / 19	56,000	LW07-K6-SD201-02-02C	3,678	12,800
Fluorene	390 - 11,000	4 / 19	16,000	LW07-K6-SD201-02-02C	1,101	3,610
Indeno(1,2,3-cd)pyrene	390 - 1,000	13 / 19	1,200	LW07-K6-SD201-02-02C	261	283
Naphthalene	390 - 1,000	3 / 19	97.0	LW07-K6-SD201-02-02C	264	125
PAH (total)	-- - --	17 / 19	217,752	LW07-K6-SD201-02-02C	17,038	49,042
Phenanthrene	390 - 11,000	8 / 19	62,000	LW07-K6-SD201-02-02C	3,707	14,151
Pyrene	390 - 11,000	17 / 19	44,000	LW07-K6-SD201-02-02C	3,279	10,067
Other Parameters						
Ammonia (MG/KG)	2.38 - 6.23	13 / 19	91.3	LW07-H1-SD201-02-02C	15.2	21.0
Total organic carbon (MG/KG)	119 - 312	19 / 19	34,450	LW07-M3-SD201-02-02C	14,624	8,349
pH	2.00 - 2.00	19 / 19	8.65	LW07-K1-SD201-02-02C	8.25	0.23

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Table 8-18
Summary Statistics - Groundwater (On-Site)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Inorganics (UG/L)						
Aluminum	200 - 200	6 / 7	2,910	LW07-MW05-02C	1,664	921
Antimony	60.0 - 60.0	0 / 7	--	--	0.99	0.24
Arsenic	10.0 - 10.0	4 / 7	18.4	LW07-MW05-02C	6.55	6.27
Barium	200 - 200	7 / 7	117	LW07-MW01-00B	73.7	37.0
Beryllium	5.00 - 5.00	0 / 7	--	--	0.17	0.13
Cadmium	5.00 - 5.00	0 / 7	--	--	0.28	0.15
Calcium	5,000 - 5,000	7 / 7	159,000	LW07-MW01-02C	75,760	57,417
Chromium	10.0 - 10.0	5 / 7	22.1	LW07-MW01-00B	9.64	7.25
Cobalt	50.0 - 50.0	2 / 7	28.3	LW07-MW01-02C	6.99	9.97
Copper	25.0 - 25.0	1 / 7	30.2	LW07-MW01-02C	8.46	9.66
Cyanide	10.0 - 10.0	0 / 5	--	--	0.75	0.0
Iron	100 - 100	7 / 7	56,500	LW07-MW05-02C	31,064	21,687
Lead	3.00 - 3.00	4 / 7	3.40	LW07-MW01-00B	1.94	1.07
Magnesium	5,000 - 5,000	7 / 7	160,000	LW07-MW01-02C	53,149	59,561
Manganese	15.0 - 15.0	7 / 7	5,710	LW07-MW01-02C	2,093	2,265
Mercury	0.20 - 0.30	0 / 7	--	--	0.053	0.0049
Nickel	40.0 - 40.0	2 / 7	9.60	LW07-MW05-02C	5.52	4.05
Potassium	5,000 - 5,000	7 / 7	62,100	LW07-MW01-02C	18,710	22,163
Selenium	5.00 - 5.00	0 / 7	--	--	0.99	0.24
Silver	10.0 - 10.0	1 / 7	8.30	LW07-MW03-00B	1.77	3.04
Sodium	5,000 - 50,000	7 / 7	1,120,000	LW07-MW01-02C	411,514	440,250
Thallium	10.0 - 10.0	0 / 7	--	--	1.80	0.51
Vanadium	50.0 - 50.0	7 / 7	10.0	LW07-MW05-02C	6.30	2.67
Zinc	20.0 - 20.0	3 / 7	70.3	LW07-MW01-02C	26.8	22.9
Dissolved Metals (UG/L)						
Aluminum	200 - 200	1 / 7	235	LW07-MW01-02C	63.8	80.3
Antimony	60.0 - 60.0	0 / 7	--	--	1.15	0.25
Arsenic	10.0 - 10.0	3 / 7	12.3	LW07-MW05-02C	4.47	4.27
Barium	200 - 200	6 / 7	120	LW07-MW01-00B	68.5	37.8
Beryllium	5.00 - 5.00	0 / 7	--	--	0.18	0.12

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Table 8-18
Summary Statistics - Groundwater (On-Site)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Cadmium	5.00 - 5.00	0 / 7	--	--	0.27	0.086
Calcium	5,000 - 5,000	7 / 7	165,000	LW07-MW01-02C	76,893	60,910
Chromium	10.0 - 10.0	0 / 7	--	--	1.53	1.83
Cobalt	50.0 - 50.0	2 / 7	28.2	LW07-MW01-02C	6.56	10.0
Copper	25.0 - 25.0	0 / 7	--	--	2.16	2.13
Iron	100 - 100	7 / 7	52,800	LW07-MW01-02C	29,191	21,491
Lead	3.00 - 3.00	0 / 7	--	--	0.77	0.19
Magnesium	5,000 - 5,000	7 / 7	167,000	LW07-MW01-02C	55,911	64,203
Manganese	15.0 - 15.0	7 / 7	5,910	LW07-MW01-02C	2,236	2,501
Mercury	0.20 - 0.30	0 / 7	--	--	0.049	0.0019
Nickel	40.0 - 40.0	1 / 7	4.50	LW07-MW01-02C	2.26	1.72
Potassium	5,000 - 5,000	7 / 7	63,800	LW07-MW01-02C	18,686	22,697
Selenium	5.00 - 5.00	1 / 7	5.00	LW07-MW06-02C	1.79	1.43
Silver	10.0 - 10.0	0 / 7	--	--	0.99	1.27
Sodium	5,000 - 50,000	7 / 7	1,210,000	LW07-MW01-02C	440,657	481,817
Thallium	10.0 - 10.0	0 / 7	--	--	1.80	0.51
Vanadium	50.0 - 50.0	2 / 7	3.10	LW07-MW04-02C	1.18	1.27
Zinc	20.0 - 20.0	2 / 7	37.0	LW07-MW01-02C	17.0	12.1
Pesticide/Polychlorinated Biphenyls (UG/L)						
4,4'-DDD	0.10 - 0.10	0 / 2	--	--	0.05	0.0
4,4'-DDE	0.10 - 0.10	0 / 2	--	--	0.05	0.0
4,4'-DDT	0.10 - 0.10	0 / 2	--	--	0.05	0.0
Aldrin	0.05 - 0.05	0 / 2	--	--	0.025	0.0
Aroclor-1016	1.00 - 1.00	0 / 2	--	--	0.50	0.0
Aroclor-1221	2.00 - 2.00	0 / 2	--	--	1.00	0.0
Aroclor-1232	1.00 - 1.00	0 / 2	--	--	0.50	0.0
Aroclor-1242	1.00 - 1.00	0 / 2	--	--	0.50	0.0
Aroclor-1248	1.00 - 1.00	0 / 2	--	--	0.50	0.0
Aroclor-1254	1.00 - 1.00	0 / 2	--	--	0.50	0.0
Aroclor-1260	1.00 - 1.00	0 / 2	--	--	0.26	0.34
Dieldrin	0.10 - 0.10	0 / 2	--	--	0.05	0.0

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Table 8-18
Summary Statistics - Groundwater (On-Site)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Endosulfan I	0.05 - 0.05	0 / 2	--	--	0.025	0.0
Endosulfan II	0.10 - 0.10	0 / 2	--	--	0.05	0.0
Endosulfan sulfate	0.10 - 0.10	0 / 2	--	--	0.05	0.0
Endrin	0.10 - 0.10	0 / 2	--	--	0.05	0.0
Endrin aldehyde	0.10 - 0.10	0 / 2	--	--	0.05	0.0
Endrin ketone	0.10 - 0.10	0 / 2	--	--	0.05	0.0
Heptachlor	0.05 - 0.05	0 / 2	--	--	0.025	0.0
Heptachlor epoxide	0.05 - 0.05	0 / 2	--	--	0.025	0.0
Methoxychlor	0.50 - 0.50	0 / 2	--	--	0.25	0.0
Toxaphene	5.00 - 5.00	0 / 2	--	--	2.50	0.0
alpha-BHC	0.05 - 0.05	0 / 2	--	--	0.025	0.0
alpha-Chlordane	0.05 - 0.05	0 / 2	--	--	0.025	0.0
beta-BHC	0.05 - 0.05	0 / 2	--	--	0.025	0.0
delta-BHC	0.05 - 0.05	0 / 2	--	--	0.025	0.0
gamma-BHC (Lindane)	0.05 - 0.05	0 / 2	--	--	0.025	0.0
gamma-Chlordane	0.05 - 0.05	0 / 2	--	--	0.025	0.0
Semivolatile Organic Compounds (UG/L)						
1,1-Biphenyl	10.0 - 10.0	0 / 5	--	--	5.00	0.0
1,2,4-Trichlorobenzene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
1,2-Dichlorobenzene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
1,3-Dichlorobenzene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
1,4-Dichlorobenzene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
2,2'-Oxybis(1-chloropropane)	10.0 - 10.0	0 / 7	--	--	5.00	0.0
2,4,5-Trichlorophenol	25.0 - 25.0	0 / 7	--	--	12.5	0.0
2,4,6-Trichlorophenol	10.0 - 10.0	0 / 7	--	--	5.00	0.0
2,4-Dichlorophenol	10.0 - 10.0	0 / 7	--	--	5.00	0.0
2,4-Dimethylphenol	10.0 - 10.0	0 / 7	--	--	5.00	0.0
2,4-Dinitrophenol	25.0 - 25.0	0 / 7	--	--	12.5	0.0
2,4-Dinitrotoluene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
2,6-Dinitrotoluene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
2-Chloronaphthalene	10.0 - 10.0	0 / 7	--	--	5.00	0.0

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Table 8-18
Summary Statistics - Groundwater (On-Site)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
2-Chlorophenol	10.0 - 10.0	0 / 7	--	--	5.00	0.0
2-Methylnaphthalene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
2-Methylphenol	10.0 - 10.0	0 / 7	--	--	5.00	0.0
2-Nitroaniline	25.0 - 25.0	0 / 7	--	--	12.5	0.0
2-Nitrophenol	10.0 - 10.0	0 / 7	--	--	5.00	0.0
3,3'-Dichlorobenzidine	10.0 - 10.0	0 / 7	--	--	5.00	0.0
3-Nitroaniline	25.0 - 25.0	0 / 7	--	--	12.5	0.0
4,6-Dinitro-2-methylphenol	25.0 - 25.0	0 / 7	--	--	12.5	0.0
4-Bromophenyl-phenylether	10.0 - 10.0	0 / 7	--	--	5.00	0.0
4-Chloro-3-methylphenol	10.0 - 10.0	0 / 7	--	--	5.00	0.0
4-Chloroaniline	10.0 - 10.0	0 / 7	--	--	5.00	0.0
4-Chlorophenyl-phenylether	10.0 - 10.0	0 / 7	--	--	5.00	0.0
4-Methylphenol	10.0 - 10.0	0 / 7	--	--	5.00	0.0
4-Nitroaniline	25.0 - 25.0	0 / 7	--	--	12.5	0.0
4-Nitrophenol	25.0 - 25.0	0 / 7	--	--	12.5	0.0
Acenaphthene	10.0 - 10.0	1 / 7	0.30	LW07-MW01-02C	4.33	1.78
Acenaphthylene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Acetophenone	10.0 - 10.0	0 / 5	--	--	5.00	0.0
Anthracene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Atrazine	10.0 - 10.0	0 / 5	--	--	5.00	0.0
Benzaldehyde	10.0 - 10.0	0 / 5	--	--	5.00	0.0
Benzo(a)anthracene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Benzo(a)pyrene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Benzo(b)fluoranthene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Benzo(g,h,i)perylene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Benzo(k)fluoranthene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Butylbenzylphthalate	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Caprolactam	10.0 - 10.0	1 / 5	2.00	LW07-MW06-02C	4.40	1.34
Carbazole	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Chrysene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Di-n-butylphthalate	10.0 - 10.0	3 / 7	0.60	LW07-MW05-02C	3.06	2.42

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Table 8-18
Summary Statistics - Groundwater (On-Site)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Di-n-octylphthalate	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Dibenz(a,h)anthracene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Dibenzofuran	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Diethylphthalate	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Dimethyl phthalate	10.0 - 10.0	2 / 7	4.00	LW07-MW05-02C	4.71	0.49
Fluoranthene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Fluorene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Hexachlorobenzene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Hexachlorobutadiene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Hexachlorocyclopentadiene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Hexachloroethane	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Indeno(1,2,3-cd)pyrene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Isophorone	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Naphthalene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Nitrobenzene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Pentachlorophenol	25.0 - 25.0	0 / 7	--	--	12.5	0.0
Phenanthrene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Phenol	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Pyrene	10.0 - 10.0	0 / 7	--	--	5.00	0.0
bis(2-Chloroethoxy)methane	10.0 - 10.0	0 / 7	--	--	5.00	0.0
bis(2-Chloroethyl)ether	10.0 - 10.0	0 / 7	--	--	5.00	0.0
bis(2-Ethylhexyl)phthalate	10.0 - 10.0	0 / 7	--	--	3.43	3.08
n-Nitroso-di-n-propylamine	10.0 - 10.0	0 / 7	--	--	5.00	0.0
n-Nitrosodiphenylamine	10.0 - 10.0	0 / 7	--	--	5.00	0.0
Volatile Organic Compounds (UG/L)						
1,1,1-Trichloroethane	0.50 - 10.0	0 / 7	--	--	1.61	2.32
1,1,2,2-Tetrachloroethane	0.50 - 10.0	0 / 7	--	--	1.61	2.32
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	0.50 - 0.50	0 / 5	--	--	0.25	0.0
1,1,2-Trichloroethane	0.50 - 10.0	0 / 7	--	--	1.61	2.32
1,1-Dichloroethane	0.50 - 10.0	0 / 7	--	--	1.61	2.32
1,1-Dichloroethene	0.50 - 10.0	0 / 7	--	--	1.61	2.32

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Table 8-18
Summary Statistics - Groundwater (On-Site)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
1,2,3-Trichlorobenzene	0.50 - 0.50	0 / 5	--	--	0.25	0.0
1,2,4-Trichlorobenzene	0.50 - 0.50	0 / 5	--	--	0.25	0.0
1,2-Dibromo-3-chloropropane	0.50 - 0.50	0 / 5	--	--	0.25	0.0
1,2-Dibromoethane	0.50 - 0.50	0 / 5	--	--	0.25	0.0
1,2-Dichlorobenzene	0.50 - 0.50	0 / 5	--	--	0.25	0.0
1,2-Dichloroethane	0.50 - 10.0	0 / 7	--	--	1.61	2.32
1,2-Dichloroethene (total)	10.0 - 10.0	0 / 2	--	--	5.00	0.0
1,2-Dichloropropane	0.50 - 10.0	0 / 7	--	--	1.61	2.32
1,3-Dichlorobenzene	0.50 - 0.50	0 / 5	--	--	0.25	0.0
1,4-Dichlorobenzene	0.50 - 0.50	0 / 5	--	--	0.25	0.0
2-Butanone	5.00 - 10.0	0 / 7	--	--	3.21	1.22
2-Hexanone	5.00 - 10.0	0 / 7	--	--	3.21	1.22
4-Methyl-2-pentanone	5.00 - 10.0	0 / 7	--	--	3.21	1.22
Acetone	5.00 - 10.0	0 / 7	--	--	3.16	1.27
Benzene	0.50 - 10.0	0 / 7	--	--	1.61	2.32
Bromochloromethane	0.50 - 0.50	0 / 5	--	--	0.25	0.0
Bromodichloromethane	0.50 - 10.0	0 / 7	--	--	1.61	2.32
Bromoform	0.50 - 10.0	0 / 7	--	--	1.53	2.37
Bromomethane	0.50 - 10.0	0 / 7	--	--	1.61	2.32
Carbon disulfide	0.50 - 10.0	0 / 7	--	--	1.61	2.32
Carbon tetrachloride	0.50 - 10.0	0 / 7	--	--	1.61	2.32
Chlorobenzene	0.50 - 10.0	0 / 7	--	--	1.61	2.32
Chloroethane	0.50 - 10.0	0 / 7	--	--	1.61	2.32
Chloroform	0.50 - 10.0	1 / 7	14.0	LW07-MW01-00B	2.89	5.21
Chloromethane	0.50 - 10.0	0 / 7	--	--	1.61	2.32
Cumene	0.50 - 0.50	0 / 5	--	--	0.25	0.0
Cyclohexane	0.50 - 0.50	0 / 5	--	--	0.25	0.0
Dibromochloromethane	0.50 - 10.0	0 / 7	--	--	1.61	2.32
Dichlorodifluoromethane(Freon-12)	0.50 - 0.50	0 / 5	--	--	0.25	0.0
Ethylbenzene	0.50 - 10.0	0 / 7	--	--	1.61	2.32
Methyl acetate	0.50 - 0.50	0 / 5	--	--	0.25	0.0

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Table 8-18
Summary Statistics - Groundwater (On-Site)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Methyl-tert-butyl ether (MTBE)	0.50 - 0.96	3 / 5	25.0	LW07-MW03-02C	5.57	10.9
Methylcyclohexane	0.50 - 0.50	0 / 5	--	--	0.25	0.0
Methylene chloride	0.50 - 10.0	0 / 7	--	--	1.25	1.77
Styrene	0.50 - 10.0	0 / 7	--	--	1.61	2.32
Tetrachloroethene	0.50 - 10.0	1 / 7	0.14	LW07-MW03-02C	1.59	2.33
Toluene	0.50 - 10.0	0 / 7	--	--	1.57	2.35
Trichloroethene	0.50 - 10.0	0 / 7	--	--	1.61	2.32
Trichlorofluoromethane(Freon-11)	0.50 - 0.50	0 / 5	--	--	0.25	0.0
Vinyl chloride	0.50 - 10.0	0 / 7	--	--	1.61	2.32
Xylene, total	0.50 - 10.0	0 / 7	--	--	1.58	2.34
cis-1,2-Dichloroethene	0.50 - 10.0	0 / 7	--	--	1.61	2.32
cis-1,3-Dichloropropene	0.50 - 10.0	0 / 7	--	--	1.61	2.32
m- and p-Xylene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
o-Xylene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
trans-1,2-Dichloroethene	0.50 - 10.0	0 / 7	--	--	1.61	2.32
trans-1,3-Dichloropropene	0.50 - 10.0	0 / 7	--	--	1.61	2.32

1 - One-half of the reporting limit was used for non-detected samples when calculating the mean

Table 8-19
Summary Statistics - Groundwater (Upgradient)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Inorganics (UG/L)						
Aluminum	200 - 200	2 / 2	3,380	LW07-MW02-00B	3,170	297
Antimony	60.0 - 60.0	0 / 2	--	--	1.10	0.35
Arsenic	10.0 - 10.0	1 / 2	4.80	LW07-MW02-02C	3.18	2.30
Barium	200 - 200	2 / 2	81.9	LW07-MW02-00B	72.4	13.5
Beryllium	5.00 - 5.00	0 / 2	--	--	0.45	0.35
Cadmium	5.00 - 5.00	0 / 2	--	--	0.24	0.05
Calcium	5,000 - 5,000	2 / 2	84,700	LW07-MW02-00B	81,650	4,313
Chromium	10.0 - 10.0	2 / 2	14.0	LW07-MW02-00B	13.9	0.14
Cobalt	50.0 - 50.0	2 / 2	44.4	LW07-MW02-00B	39.1	7.50
Copper	25.0 - 25.0	1 / 2	50.0	LW07-MW02-02C	26.4	33.4
Cyanide	10.0 - 10.0	0 / 1	--	--	0.75	--
Iron	100 - 100	2 / 2	17,600	LW07-MW02-02C	15,700	2,687
Lead	3.00 - 3.00	1 / 2	4.40	LW07-MW02-02C	2.73	2.37
Magnesium	5,000 - 5,000	2 / 2	51,900	LW07-MW02-00B	47,850	5,728
Manganese	15.0 - 15.0	2 / 2	4,900	LW07-MW02-00B	4,315	827
Mercury	0.20 - 0.30	0 / 2	--	--	0.06	0.01
Nickel	40.0 - 40.0	1 / 2	14.7	LW07-MW02-02C	14.1	0.88
Potassium	5,000 - 5,000	2 / 2	16,000	LW07-MW02-02C	10,970	7,113
Selenium	5.00 - 5.00	0 / 2	--	--	1.10	0.35
Silver	10.0 - 10.0	0 / 2	--	--	1.55	1.84
Sodium	5,000 - 5,000	2 / 2	458,000	LW07-MW02-02C	362,000	135,765
Thallium	10.0 - 10.0	0 / 2	--	--	1.58	0.74
Vanadium	50.0 - 50.0	2 / 2	11.4	LW07-MW02-00B	9.35	2.90
Zinc	20.0 - 20.0	1 / 2	67.5	LW07-MW02-02C	42.8	34.9
Dissolved Metals (UG/L)						
Aluminum	200 - 200	0 / 2	--	--	67.3	11.7
Antimony	60.0 - 60.0	0 / 2	--	--	1.28	0.11
Arsenic	10.0 - 10.0	0 / 2	--	--	1.40	0.21
Barium	200 - 200	1 / 2	55.9	LW07-MW02-02C	44.4	16.2
Beryllium	5.00 - 5.00	0 / 2	--	--	0.27	0.17

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Table 8-19
Summary Statistics - Groundwater (Upgradient)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Cadmium	5.00 - 5.00	0 / 2	--	--	0.27	0.004
Calcium	5,000 - 5,000	2 / 2	82,800	LW07-MW02-00B	80,900	2,687
Chromium	10.0 - 10.0	0 / 2	--	--	2.48	2.44
Cobalt	50.0 - 50.0	2 / 2	34.5	LW07-MW02-00B	33.6	1.27
Copper	25.0 - 25.0	1 / 2	14.6	LW07-MW02-02C	8.65	8.41
Iron	100 - 100	2 / 2	8,790	LW07-MW02-00B	6,605	3,090
Lead	3.00 - 3.00	0 / 2	--	--	0.85	0.28
Magnesium	5,000 - 5,000	2 / 2	52,600	LW07-MW02-00B	47,750	6,859
Manganese	15.0 - 15.0	2 / 2	4,980	LW07-MW02-00B	4,305	955
Mercury	0.20 - 0.30	0 / 2	--	--	0.07	0.02
Nickel	40.0 - 40.0	1 / 2	10.3	LW07-MW02-02C	7.15	4.45
Potassium	5,000 - 5,000	2 / 2	15,500	LW07-MW02-02C	10,800	6,647
Selenium	5.00 - 5.00	0 / 2	--	--	1.55	0.28
Silver	10.0 - 10.0	0 / 2	--	--	1.55	1.84
Sodium	5,000 - 5,000	2 / 2	438,000	LW07-MW02-02C	356,500	115,258
Thallium	10.0 - 10.0	0 / 2	--	--	1.58	0.74
Vanadium	50.0 - 50.0	0 / 2	--	--	1.18	1.45
Zinc	20.0 - 20.0	1 / 2	34.8	LW07-MW02-02C	28.2	9.37
Pesticide/Polychlorinated Biphenyls (UG/L)						
4,4'-DDD	0.10 - 0.10	0 / 1	--	--	0.05	--
4,4'-DDE	0.10 - 0.10	0 / 1	--	--	0.05	--
4,4'-DDT	0.10 - 0.10	0 / 1	--	--	0.05	--
Aldrin	0.05 - 0.05	0 / 1	--	--	0.025	--
Aroclor-1016	1.00 - 1.00	0 / 1	--	--	0.50	--
Aroclor-1221	2.00 - 2.00	0 / 1	--	--	1.00	--
Aroclor-1232	1.00 - 1.00	0 / 1	--	--	0.50	--
Aroclor-1242	1.00 - 1.00	0 / 1	--	--	0.50	--
Aroclor-1248	1.00 - 1.00	0 / 1	--	--	0.50	--
Aroclor-1254	1.00 - 1.00	0 / 1	--	--	0.50	--
Aroclor-1260	1.00 - 1.00	0 / 1	--	--	0.50	--
Dieldrin	0.10 - 0.10	0 / 1	--	--	0.05	--

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Table 8-19
Summary Statistics - Groundwater (Upgradient)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Endosulfan I	0.05 - 0.05	0 / 1	--	--	0.025	--
Endosulfan II	0.10 - 0.10	0 / 1	--	--	0.05	--
Endosulfan sulfate	0.10 - 0.10	0 / 1	--	--	0.05	--
Endrin	0.10 - 0.10	0 / 1	--	--	0.05	--
Endrin aldehyde	0.10 - 0.10	0 / 1	--	--	0.05	--
Endrin ketone	0.10 - 0.10	0 / 1	--	--	0.05	--
Heptachlor	0.05 - 0.05	0 / 1	--	--	0.025	--
Heptachlor epoxide	0.05 - 0.05	0 / 1	--	--	0.025	--
Methoxychlor	0.50 - 0.50	0 / 1	--	--	0.25	--
Toxaphene	5.00 - 5.00	0 / 1	--	--	2.50	--
alpha-BHC	0.05 - 0.05	0 / 1	--	--	0.025	--
alpha-Chlordane	0.05 - 0.05	0 / 1	--	--	0.025	--
beta-BHC	0.05 - 0.05	0 / 1	--	--	0.025	--
delta-BHC	0.05 - 0.05	0 / 1	--	--	0.025	--
gamma-BHC (Lindane)	0.05 - 0.05	0 / 1	--	--	0.025	--
gamma-Chlordane	0.05 - 0.05	0 / 1	--	--	0.025	--
Semivolatile Organic Compounds (UG/L)						
1,1-Biphenyl	10.0 - 10.0	0 / 1	--	--	5.00	--
1,2,4-Trichlorobenzene	10.0 - 10.0	0 / 1	--	--	5.00	--
1,2-Dichlorobenzene	10.0 - 10.0	0 / 1	--	--	5.00	--
1,3-Dichlorobenzene	10.0 - 10.0	0 / 1	--	--	5.00	--
1,4-Dichlorobenzene	10.0 - 10.0	0 / 1	--	--	5.00	--
2,2'-Oxybis(1-chloropropane)	10.0 - 10.0	0 / 2	--	--	5.00	0.0
2,4,5-Trichlorophenol	25.0 - 25.0	0 / 2	--	--	12.5	0.0
2,4,6-Trichlorophenol	10.0 - 10.0	0 / 2	--	--	5.00	0.0
2,4-Dichlorophenol	10.0 - 10.0	0 / 2	--	--	5.00	0.0
2,4-Dimethylphenol	10.0 - 10.0	0 / 2	--	--	5.00	0.0
2,4-Dinitrophenol	25.0 - 25.0	0 / 2	--	--	12.5	0.0
2,4-Dinitrotoluene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
2,6-Dinitrotoluene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
2-Chloronaphthalene	10.0 - 10.0	0 / 2	--	--	5.00	0.0

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Table 8-19
Summary Statistics - Groundwater (Upgradient)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
2-Chlorophenol	10.0 - 10.0	0 / 2	--	--	5.00	0.0
2-Methylnaphthalene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
2-Methylphenol	10.0 - 10.0	0 / 2	--	--	5.00	0.0
2-Nitroaniline	25.0 - 25.0	0 / 2	--	--	12.5	0.0
2-Nitrophenol	10.0 - 10.0	0 / 2	--	--	5.00	0.0
3,3'-Dichlorobenzidine	10.0 - 10.0	0 / 2	--	--	5.00	0.0
3-Nitroaniline	25.0 - 25.0	0 / 2	--	--	12.5	0.0
4,6-Dinitro-2-methylphenol	25.0 - 25.0	0 / 2	--	--	12.5	0.0
4-Bromophenyl-phenylether	10.0 - 10.0	0 / 2	--	--	5.00	0.0
4-Chloro-3-methylphenol	10.0 - 10.0	0 / 2	--	--	5.00	0.0
4-Chloroaniline	10.0 - 10.0	0 / 2	--	--	5.00	0.0
4-Chlorophenyl-phenylether	10.0 - 10.0	0 / 2	--	--	5.00	0.0
4-Methylphenol	10.0 - 10.0	0 / 2	--	--	5.00	0.0
4-Nitroaniline	25.0 - 25.0	0 / 2	--	--	12.5	0.0
4-Nitrophenol	25.0 - 25.0	0 / 2	--	--	12.5	0.0
Acenaphthene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Acenaphthylene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Acetophenone	10.0 - 10.0	0 / 1	--	--	5.00	--
Anthracene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Atrazine	10.0 - 10.0	0 / 1	--	--	5.00	--
Benzaldehyde	10.0 - 10.0	0 / 1	--	--	5.00	--
Benzo(a)anthracene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Benzo(a)pyrene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Benzo(b)fluoranthene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Benzo(g,h,i)perylene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Benzo(k)fluoranthene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Butylbenzylphthalate	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Caprolactam	10.0 - 10.0	0 / 1	--	--	5.00	--
Carbazole	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Chrysene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Di-n-butylphthalate	10.0 - 10.0	0 / 2	--	--	5.00	0.0

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Table 8-19
Summary Statistics - Groundwater (Upgradient)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Di-n-octylphthalate	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Dibenz(a,h)anthracene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Dibenzofuran	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Diethylphthalate	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Dimethyl phthalate	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Fluoranthene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Fluorene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Hexachlorobenzene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Hexachlorobutadiene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Hexachlorocyclopentadiene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Hexachloroethane	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Indeno(1,2,3-cd)pyrene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Isophorone	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Naphthalene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Nitrobenzene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Pentachlorophenol	25.0 - 25.0	0 / 2	--	--	12.5	0.0
Phenanthrene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Phenol	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Pyrene	10.0 - 10.0	0 / 2	--	--	5.00	0.0
bis(2-Chloroethoxy)methane	10.0 - 10.0	0 / 2	--	--	5.00	0.0
bis(2-Chloroethyl)ether	10.0 - 10.0	0 / 2	--	--	5.00	0.0
bis(2-Ethylhexyl)phthalate	10.0 - 10.0	0 / 2	--	--	2.68	3.29
n-Nitroso-di-n-propylamine	10.0 - 10.0	0 / 2	--	--	5.00	0.0
n-Nitrosodiphenylamine	10.0 - 10.0	0 / 2	--	--	5.00	0.0
Volatile Organic Compounds (UG/L)						
1,1,1-Trichloroethane	0.50 - 10.0	0 / 2	--	--	2.63	3.36
1,1,2,2-Tetrachloroethane	0.50 - 10.0	0 / 2	--	--	2.63	3.36
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	0.50 - 0.50	0 / 1	--	--	0.25	--
1,1,2-Trichloroethane	0.50 - 10.0	0 / 2	--	--	2.63	3.36
1,1-Dichloroethane	0.50 - 10.0	0 / 2	--	--	2.63	3.36
1,1-Dichloroethene	0.50 - 10.0	0 / 2	--	--	2.63	3.36

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Table 8-19
Summary Statistics - Groundwater (Upgradient)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
1,2,3-Trichlorobenzene	0.50 - 0.50	0 / 1	--	--	0.25	--
1,2,4-Trichlorobenzene	0.50 - 0.50	0 / 1	--	--	0.25	--
1,2-Dibromo-3-chloropropane	0.50 - 0.50	0 / 1	--	--	0.25	--
1,2-Dibromoethane	0.50 - 0.50	0 / 1	--	--	0.25	--
1,2-Dichlorobenzene	0.50 - 0.50	0 / 1	--	--	0.25	--
1,2-Dichloroethane	0.50 - 10.0	0 / 2	--	--	2.63	3.36
1,2-Dichloroethene (total)	10.0 - 10.0	0 / 1	--	--	5.00	--
1,2-Dichloropropane	0.50 - 10.0	0 / 2	--	--	2.63	3.36
1,3-Dichlorobenzene	0.50 - 0.50	0 / 1	--	--	0.25	--
1,4-Dichlorobenzene	0.50 - 0.50	0 / 1	--	--	0.25	--
2-Butanone	5.00 - 10.0	0 / 2	--	--	3.75	1.77
2-Hexanone	5.00 - 10.0	0 / 2	--	--	3.75	1.77
4-Methyl-2-pentanone	5.00 - 10.0	0 / 2	--	--	3.75	1.77
Acetone	5.00 - 10.0	0 / 2	--	--	1.00	0.71
Benzene	0.50 - 10.0	0 / 2	--	--	2.63	3.36
Bromochloromethane	0.50 - 0.50	0 / 1	--	--	0.25	--
Bromodichloromethane	0.50 - 10.0	0 / 2	--	--	2.63	3.36
Bromoform	0.50 - 10.0	0 / 2	--	--	2.53	3.50
Bromomethane	0.50 - 10.0	0 / 2	--	--	2.63	3.36
Carbon disulfide	0.50 - 10.0	0 / 2	--	--	2.63	3.36
Carbon tetrachloride	0.50 - 10.0	0 / 2	--	--	2.63	3.36
Chlorobenzene	0.50 - 10.0	0 / 2	--	--	2.63	3.36
Chloroethane	0.50 - 10.0	0 / 2	--	--	2.63	3.36
Chloroform	0.50 - 10.0	0 / 2	--	--	2.63	3.36
Chloromethane	0.50 - 10.0	0 / 2	--	--	2.53	3.49
Cumene	0.50 - 0.50	0 / 1	--	--	0.25	--
Cyclohexane	0.50 - 0.50	0 / 1	--	--	0.25	--
Dibromochloromethane	0.50 - 10.0	0 / 2	--	--	2.63	3.36
Dichlorodifluoromethane(Freon-12)	0.50 - 0.50	0 / 1	--	--	0.25	--
Ethylbenzene	0.50 - 10.0	0 / 2	--	--	2.63	3.36
Methyl acetate	0.50 - 0.50	0 / 1	--	--	0.25	--

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Table 8-19
Summary Statistics - Groundwater (Upgradient)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Methyl-tert-butyl ether (MTBE)	0.50 - 0.50	0 / 1	--	--	0.25	--
Methylcyclohexane	0.50 - 0.50	0 / 1	--	--	0.25	--
Methylene chloride	0.50 - 10.0	0 / 2	--	--	1.85	2.33
Styrene	0.50 - 10.0	0 / 2	--	--	2.63	3.36
Tetrachloroethene	0.50 - 10.0	0 / 2	--	--	2.63	3.36
Toluene	0.50 - 10.0	0 / 2	--	--	2.58	3.43
Trichloroethene	0.50 - 10.0	0 / 2	--	--	2.63	3.36
Trichlorofluoromethane(Freon-11)	0.50 - 0.50	0 / 1	--	--	0.25	--
Vinyl chloride	0.50 - 10.0	0 / 2	--	--	2.63	3.36
Xylene, total	0.50 - 10.0	0 / 2	--	--	2.53	3.49
cis-1,2-Dichloroethene	0.50 - 10.0	0 / 2	--	--	2.63	3.36
cis-1,3-Dichloropropene	0.50 - 10.0	0 / 2	--	--	2.63	3.36
m- and p-Xylene	10.0 - 10.0	0 / 1	--	--	5.00	--
o-Xylene	10.0 - 10.0	0 / 1	--	--	5.00	--
trans-1,2-Dichloroethene	0.50 - 10.0	0 / 2	--	--	2.63	3.36
trans-1,3-Dichloropropene	0.50 - 10.0	0 / 2	--	--	2.63	3.36

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Table 8-20
Samples Used in the ERA
NAB Little Creek, Virginia Beach, VA

Station ID	Sample ID	Sample Date	Type	Depth	Area
Surface Soil					
LW07-MW01	LW07-SS01-00	5/22/2000	Discrete	0 - 6 inches	South
LW07-MW02	LW07-SS02-00	5/22/2000	Discrete	0 - 6 inches	South
LW07-MW02	LW07-SS02-00P	5/22/2000	Discrete	0 - 6 inches	South
LW07-MW03	LW07-SS03-00	5/22/2000	Discrete	0 - 6 inches	East
LW07-DP04	LW07-SS04-00	5/23/2000	Discrete	0 - 6 inches	South
LW07-DP05	LW07-SS05-00	5/23/2000	Discrete	0 - 6 inches	South
LW07-DP06	LW07-SS06-00	5/22/2000	Discrete	0 - 6 inches	South
LW07-DP07	LW07-SS07-00	5/22/2000	Discrete	0 - 6 inches	South
LW07-DP08	LW07-SS08-00	5/22/2000	Discrete	0 - 6 inches	South
LW07-DP08	LW07-SS08-00P	5/22/2000	Discrete	0 - 6 inches	South
LW07-DP09	LW07-SS09-00	5/22/2000	Discrete	0 - 6 inches	South
LW07-DP10	LW07-SS10-00	5/22/2000	Discrete	0 - 6 inches	South
LW07-DP11	LW07-SS11-00	5/22/2000	Discrete	0 - 6 inches	East
LW07-DP12	LW07-SS12-00	5/22/2000	Discrete	0 - 6 inches	East
LW07-DP13	LW07-SS13-00	5/22/2000	Discrete	0 - 6 inches	North
LW07-DP14	LW07-SS14-00	5/23/2000	Discrete	0 - 6 inches	North
LW07-DP14	LW07-SS14-00P	5/23/2000	Discrete	0 - 6 inches	North
LW07-SO15	LW07-SS15-00	8/26/2002	Discrete	0 - 6 inches	South
LW07-SO16	LW07-SS16-00	8/26/2002	Discrete	0 - 6 inches	South
LW07-SO17	LW07-SS17-00	9/5/2002	Discrete	0 - 6 inches	South
LW07-SO18	LW07-SS18-00	8/26/2002	Discrete	0 - 6 inches	South
LW07-SO19	LW07-SS19-00	8/26/2002	Discrete	0 - 6 inches	South
LW07-SO20	LW07-SS20-00	8/26/2002	Discrete	0 - 6 inches	South
LW07-SO21	LW07-SS21-00	8/26/2002	Discrete	0 - 6 inches	South
LW07-SO22	LW07-SS22-00	8/26/2002	Discrete	0 - 6 inches	South
LW07-SO23	LW07-SS23-00	8/26/2002	Discrete	0 - 6 inches	East
LW07-SO24	LW07-SS24-00	8/26/2002	Discrete	0 - 6 inches	North
LW07-SO25	LW07-SS25-00	8/26/2002	Discrete	0 - 6 inches	North
Subsurface Soil					
LW07-MW01	LW07-SB01-01	5/22/2000	Discrete	12 - 36 inches	South
LW07-MW02	LW07-SB02-01	5/22/2000	Discrete	12 - 36 inches	South
LW07-MW03	LW07-SB03-01	5/22/2000	Discrete	12 - 36 inches	East
LW07-DP04	LW07-SB04-01	5/23/2000	Discrete	12 - 36 inches	South
LW07-DP05	LW07-SB05-01	5/23/2000	Discrete	12 - 36 inches	South
LW07-DP06	LW07-SB06-01	5/22/2000	Discrete	12 - 36 inches	South
LW07-DP07	LW07-SB07-01	5/22/2000	Discrete	12 - 36 inches	South
LW07-DP08	LW07-SB08-01	5/22/2000	Discrete	12 - 36 inches	South
LW07-DP09	LW07-SB09-01	5/22/2000	Discrete	12 - 36 inches	South
LW07-DP10	LW07-SB10-01	5/22/2000	Discrete	12 - 36 inches	South
LW07-DP11	LW07-SB11-01	5/22/2000	Discrete	12 - 36 inches	East
LW07-DP12	LW07-SB12-01	5/22/2000	Discrete	12 - 36 inches	East
LW07-DP13	LW07-SB13-01	5/22/2000	Discrete	12 - 36 inches	North
LW07-DP14	LW07-SB14-01	5/23/2000	Discrete	12 - 36 inches	North
LW07-SO15	LW07-SB15-01	8/26/2002	Discrete	6 - 12 inches	South
LW07-SO15	LW07-SB15-02	8/26/2002	Discrete	12 - 24 inches	South
LW07-SO16	LW07-SB16-01	8/26/2002	Discrete	6 - 12 inches	South
LW07-SO16	LW07-SB16-02	8/26/2002	Discrete	12 - 24 inches	South
LW07-SO16	LW07-SB16P-02	8/26/2002	Discrete	12 - 24 inches	South
LW07-SO17	LW07-SB17-01	8/26/2002	Discrete	6 - 12 inches	South

Table 8-20
Samples Used in the ERA
NAB Little Creek, Virginia Beach, VA

LW07-SO17	LW07-SB17-02	8/26/2002	Discrete	12 - 24 inches	South
LW07-SO18	LW07-SB18-01	8/26/2002	Discrete	6 - 12 inches	South
LW07-SO18	LW07-SB18-02	8/26/2002	Discrete	12 - 24 inches	South
LW07-SO18	LW07-SB18P-02	8/26/2002	Discrete	12 - 24 inches	South
LW07-SO19	LW07-SB19-01	8/26/2002	Discrete	6 - 12 inches	South
LW07-SO19	LW07-SB19-02	8/26/2002	Discrete	12 - 24 inches	South
LW07-SO20	LW07-SB20-01	8/26/2002	Discrete	6 - 12 inches	South
LW07-SO20	LW07-SB20-02	8/26/2002	Discrete	12 - 24 inches	South
LW07-SO20	LW07-SB20P-02	8/26/2002	Discrete	12 - 24 inches	South
LW07-SO21	LW07-SB21-01	8/26/2002	Discrete	6 - 12 inches	South
LW07-SO21	LW07-SB21-02	8/26/2002	Discrete	12 - 24 inches	South
LW07-SO21	LW07-SB21P-02	8/26/2002	Discrete	12 - 24 inches	South
LW07-SO22	LW07-SB22-01	8/26/2002	Discrete	6 - 12 inches	South
LW07-SO22	LW07-SB22-02	8/26/2002	Discrete	12 - 24 inches	South
LW07-SO23	LW07-SB23-01	8/26/2002	Discrete	6 - 12 inches	East
LW07-SO23	LW07-SB23-02	8/26/2002	Discrete	12 - 24 inches	East
LW07-SO24	LW07-SB24-01	8/26/2002	Discrete	6 - 12 inches	North
LW07-SO24	LW07-SB24-02	8/26/2002	Discrete	12 - 24 inches	North
LW07-SO25	LW07-SB25-01	8/26/2002	Discrete	6 - 12 inches	North
LW07-SO25	LW07-SB25-02	8/26/2002	Discrete	12 - 24 inches	North
Surface Sediment					
LW07-B5-SD201	LW07-B5-SD201-00-02C	9/27/2002	Discrete	0 - 4 inches	Connector Channel
LW07-B5-SD201	LW07-B5-SD201P-00-02C	9/27/2002	Discrete	0 - 4 inches	Connector Channel
LW07-B5-SD202	LW07-B5-SD202-00-02C	9/27/2002	Composite	0 - 4 inches	Connector Channel
LW07-B7-SD201	LW07-B7-SD201-00-02C	9/27/2002	Discrete	0 - 4 inches	Connector Channel
LW07-B7-SD202	LW07-B7-SD202-00-02C	9/27/2002	Composite	0 - 4 inches	Connector Channel
LW07-D5-SD201	LW07-D5-SD201-00-02C	9/27/2002	Discrete	0 - 4 inches	Connector Channel
LW07-D5-SD202	LW07-D5-SD202-00-02C	9/27/2002	Composite	0 - 4 inches	Connector Channel
LW07-F3-SD201	LW07-F3-SD201-00-02C	9/27/2002	Discrete	0 - 4 inches	Connector Channel
LW07-F3-SD202	LW07-F3-SD202-00-02C	9/27/2002	Composite	0 - 4 inches	Connector Channel
LW07-F5-SD201	LW07-F5-SD201-00-02C	9/27/2002	Discrete	0 - 4 inches	Connector Channel
LW07-F5-SD202	LW07-F5-SD202-00-02C	9/27/2002	Composite	0 - 4 inches	Connector Channel
LW07-H1-SD201	LW07-H1-SD201-00-02C	9/27/2002	Discrete	0 - 4 inches	Pier Area
LW07-H1-SD201	LW07-H1-SD201P-00-02C	9/27/2002	Discrete	0 - 4 inches	Pier Area
LW07-H1-SD202	LW07-H1-SD202-00-02C	9/27/2002	Composite	0 - 4 inches	Pier Area
LW07-H3-SD201	LW07-H3-SD201-00-02C	9/27/2002	Discrete	0 - 4 inches	Desert Cove
LW07-H3-SD201	LW07-H3-SD201P-00-02C	9/27/2002	Discrete	0 - 4 inches	Desert Cove
LW07-H3-SD202	LW07-H3-SD202-00-02C	9/27/2002	Composite	0 - 4 inches	Desert Cove
LW07-H5-SD201	LW07-H5-SD201-00-02C	9/26/2002	Discrete	0 - 4 inches	Pier Area
LW07-H5-SD202	LW07-H5-SD202-00-02C	9/26/2002	Composite	0 - 4 inches	Pier Area
LW07-J4-SD201	LW07-J4-SD201-00-02C	9/28/2002	Discrete	0 - 4 inches	Desert Cove
LW07-J4-SD202	LW07-J4-SD202-00-02C	9/28/2002	Composite	0 - 4 inches	Desert Cove
LW07-K1-SD201	LW07-K1-SD201-00-02C	9/27/2002	Discrete	0 - 4 inches	Pier Area
LW07-K1-SD202	LW07-K1-SD202-00-02C	9/27/2002	Composite	0 - 4 inches	Pier Area
LW07-K3-SD201	LW07-K3-SD201-00-02C	9/28/2002	Discrete	0 - 4 inches	Desert Cove
LW07-K3-SD202	LW07-K3-SD202-00-02C	9/28/2002	Composite	0 - 4 inches	Desert Cove
LW07-K4-SD201	LW07-K4-SD201-00-02C	9/28/2002	Discrete	0 - 4 inches	Desert Cove
LW07-K4-SD202	LW07-K4-SD202-00-02C	9/28/2002	Composite	0 - 4 inches	Desert Cove
LW07-K5-SD201	LW07-K5-SD201-00-02C	9/28/2002	Discrete	0 - 4 inches	Desert Cove
LW07-K5-SD202	LW07-K5-SD202-00-02C	9/28/2002	Composite	0 - 4 inches	Desert Cove
LW07-K6-SD201	LW07-K6-SD201-00-02C	9/28/2002	Discrete	0 - 4 inches	Pier Area

Table 8-20
Samples Used in the ERA
NAB Little Creek, Virginia Beach, VA

LW07-K6-SD202	LW07-K6-SD202-00-02C	9/28/2002	Composite	0 - 4 inches	Pier Area
LW07-L2-SD201	LW07-L2-SD201-00-02C	10/1/2002	Discrete	0 - 4 inches	Desert Cove
LW07-L5-SD201	LW07-L5-SD201-00-02C	9/28/2002	Discrete	0 - 4 inches	Desert Cove
LW07-L5-SD202	LW07-L5-SD202-00-02C	9/28/2002	Composite	0 - 4 inches	Desert Cove
LW07-L6-SD201	LW07-L6-SD201-00-02C	10/1/2002	Discrete	0 - 4 inches	Pier Area
LW07-M1-SD201	LW07-M1-SD201-00-02C	9/27/2002	Discrete	0 - 4 inches	Pier Area
LW07-M1-SD202	LW07-M1-SD202-00-02C	9/27/2002	Composite	0 - 4 inches	Pier Area
LW07-M3-SD201	LW07-M3-SD201-00-02C	9/28/2002	Discrete	0 - 4 inches	Pier Area
LW07-M3-SD202	LW07-M3-SD202-00-02C	9/28/2002	Composite	0 - 4 inches	Pier Area
LW07-SD01	LW07-SD01-00	6/2/2000	Discrete	0 - 4 inches	Connector Channel
LW07-SD02	LW07-SD02-00	6/1/2000	Discrete	0 - 4 inches	Pier Area
LW07-SD03	LW07-SD03-00	6/1/2000	Discrete	0 - 4 inches	Pier Area
LW07-SD04	LW07-SD04-00	6/1/2000	Discrete	0 - 4 inches	Pier Area
LW07-SD05	LW07-SD05-00	6/1/2000	Discrete	0 - 4 inches	Pier Area
LW07-SD05	LW07-SD05-00P	6/1/2000	Discrete	0 - 4 inches	Pier Area
Subsurface Sediment					
LW07-B5-SD201	LW07-B5-SD201-02-02C	9/30/2002	Discrete	6 - 12 inches	Connector Channel
LW07-B5-SD201	LW07-B5-SD201P-02-02C	9/30/2002	Discrete	6 - 12 inches	Connector Channel
LW07-B7-SD201	LW07-B7-SD201-02-02C	9/29/2002	Discrete	12 - 18 inches	Connector Channel
LW07-D5-SD201	LW07-D5-SD201-02-02C	9/30/2002	Discrete	7 - 13 inches	Connector Channel
LW07-F3-SD201	LW07-F3-SD201-02-02C	9/29/2002	Discrete	12 - 18 inches	Connector Channel
LW07-F5-SD201	LW07-F5-SD201-02-02C	9/29/2002	Discrete	9 - 16 inches	Connector Channel
LW07-H1-SD201	LW07-H1-SD201-02-02C	9/29/2002	Discrete	12 - 16 inches	Pier Area
LW07-H3-SD201	LW07-H3-SD201-02-02C	9/30/2002	Discrete	7 - 13 inches	Desert Cove
LW07-H5-SD201	LW07-H5-SD201-02-02C	9/26/2002	Discrete	7 - 13 inches	Pier Area
LW07-J4-SD201	LW07-J4-SD201-02-02C	9/30/2002	Discrete	7 - 13 inches	Desert Cove
LW07-K1-SD201	LW07-K1-SD201-02-02C	9/28/2002	Discrete	6 - 12 inches	Pier Area
LW07-K3-SD201	LW07-K3-SD201-02-02C	9/29/2002	Discrete	8 - 15 inches	Desert Cove
LW07-K3-SD201	LW07-K3-SD201P-02-02C	9/29/2002	Discrete	8 - 15 inches	Desert Cove
LW07-K4-SD201	LW07-K4-SD201-02-02C	9/30/2002	Discrete	7 - 13 inches	Desert Cove
LW07-K4-SD201	LW07-K4-SD201P-02-02C	9/30/2002	Discrete	7 - 13 inches	Desert Cove
LW07-K5-SD201	LW07-K5-SD201-02-02C	9/30/2002	Discrete	7 - 20 inches	Desert Cove
LW07-K6-SD201	LW07-K6-SD201-02-02C	9/28/2002	Discrete	6 - 12 inches	Pier Area
LW07-L2-SD201	LW07-L2-SD201-02-02C	10/1/2002	Discrete	7 - 13 inches	Desert Cove
LW07-L5-SD201	LW07-L5-SD201-02-02C	9/29/2002	Discrete	13 - 20 inches	Desert Cove
LW07-L6-SD201	LW07-L6-SD201-02-02C	10/1/2002	Discrete	6 - 12 inches	Pier Area
LW07-M1-SD201	LW07-M1-SD201-02-02C	9/29/2002	Discrete	17 - 25 inches	Pier Area
LW07-M3-SD201	LW07-M3-SD201-02-02C	9/29/2002	Discrete	11 - 18 inches	Pier Area
Groundwater					
LW07-MW01	LW07-MW01-00B	5/31/2000	--	--	
LW07-MW01	LW07-MW01-02C	9/4/2002	--	--	
LW07-MW02	LW07-MW02-00B	5/31/2000	--	--	Upgradient
LW07-MW02	LW07-MW02-02C	9/4/2002	--	--	Upgradient
LW07-MW03	LW07-MW03-00B	5/31/2000	--	--	
LW07-MW03	LW07-MW03-02C	9/4/2002	--	--	
LW07-MW04	LW07-MW04-02C	9/3/2002	--	--	
LW07-MW04	LW07-MW04P-02C	9/3/2002	--	--	
LW07-MW05	LW07-MW05-02C	9/4/2002	--	--	
LW07-MW06	LW07-MW06-02C	9/3/2002	--	--	

Table 8-21
Preliminary Assessment Endpoints, Risk Hypotheses, and Measurement Endpoints
NAB Little Creek, Virginia Beach, VA

Assessment Endpoint	Risk Hypothesis	Measurement Endpoint	Receptor
Terrestrial Habitats			
Survival, growth, and reproduction of terrestrial soil invertebrate communities	Are site-related chemical concentrations in surface soil sufficient to adversely effect soil invertebrate communities?	Comparison of maximum chemical concentrations in surface soil with soil screening values.	Soil invertebrates (earthworms)
Survival, growth, and reproduction of terrestrial plant communities	Are site-related chemical concentrations in surface soil sufficient to adversely effect terrestrial plant communities?	Comparison of maximum chemical concentrations in surface soil with soil screening values.	Terrestrial plants
Survival, growth, and reproduction of terrestrial reptile populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to terrestrial reptile populations?	Evidence of potential risk to other upper trophic level terrestrial receptors evaluated in the ERA.	--
Survival, growth, and reproduction of avian terrestrial invertivore/omnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume terrestrial plants and soil invertebrates from the site?	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum surface soil concentrations.	Killdeer
Survival, growth, and reproduction of avian terrestrial carnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume small mammals from the site?	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum surface soil concentrations.	American kestrel
Survival, growth, and reproduction of mammalian terrestrial omnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume terrestrial plants and soil invertebrates from the site?	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum surface soil concentrations.	Deer mouse

Table 8-21
Preliminary Assessment Endpoints, Risk Hypotheses, and Measurement Endpoints
NAB Little Creek, Virginia Beach, VA

Assessment Endpoint	Risk Hypothesis	Measurement Endpoint	Receptor
Survival, growth, and reproduction of mammalian terrestrial carnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume small mammals from the site?	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum surface soil concentrations.	Red fox
Aquatic Habitats			
Survival, growth, and reproduction of benthic invertebrate communities	Are site-related chemical concentrations in sediment sufficient to adversely effect benthic invertebrate communities?	Comparison of maximum chemical concentrations in sediment with medium-specific screening values.	Benthic invertebrates
Survival, growth, and reproduction of aquatic and wetland plant communities	Are site-related chemical concentrations in sediment sufficient to adversely effect aquatic or wetland plant communities?	Comparison of maximum chemical concentrations in sediment with medium-specific screening values.	Aquatic plants
Survival, growth, and reproduction of fish communities	Are site-related chemical concentrations in sediment sufficient to adversely effect fish communities?	Comparison of maximum chemical concentrations in sediment with medium-specific screening values.	Fish
Survival, growth, and reproduction of aquatic/wetland reptile populations	Are site-related chemical concentrations in sediment sufficient to adversely effect reptilian populations?	Comparison of maximum chemical concentrations in sediment with medium-specific screening values.	Reptiles
	Are site-related chemical concentrations in sediment sufficient to cause adverse effects (on growth, survival, or reproduction) to aquatic/wetland reptile populations?	Evidence of potential risk to other upper trophic level aquatic and wetland receptors evaluated in the ERA.	
Survival, growth, and reproduction of avian aquatic/wetland piscivore populations	Are site-related chemical concentrations in sediment sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume fish from the site?	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum sediment concentrations.	Osprey

Table 8-22
Bioaccumulative Chemicals List and Log K_{ow} Values for Relevant Chemicals
NAB Little Creek, Virginia Beach, VA

Chemical	Log K_{ow} Range	Selected log K_{ow}	Reference
Inorganics			
Arsenic	-- - --	--	--
Cadmium	-- - --	--	--
Chromium	-- - --	--	--
Copper	-- - --	--	--
Lead	-- - --	--	--
Mercury	-- - --	--	--
Nickel	-- - --	--	--
Selenium	-- - --	--	--
Silver	-- - --	--	--
Tin	-- - --	--	--
Zinc	-- - --	--	--
Pesticides/PCBs			
4,4'-DDD	5.90 - 6.65	6.10	USEPA 1995b
4,4'-DDE	5.63 - 6.96	6.76	USEPA 1995b
4,4'-DDT	5.56 - 7.01	6.53	USEPA 1995b
Aldrin	5.11 - 7.50	6.50	USEPA 1995b
alpha-BHC	3.75 - 3.81	3.80	USEPA 1995b
alpha-Chlordane	5.80 - 6.41	6.32	USEPA 1995b
Aroclor-1016	-- - --	5.60	Sample et al. 1996
Aroclor-1221	-- - --	4.70	Jones et al. 1997
Aroclor-1232	-- - --	5.10	Jones et al. 1997
Aroclor-1242	-- - --	5.60	Jones et al. 1997
Aroclor-1248	-- - --	6.20	Jones et al. 1997
Aroclor-1254	-- - --	6.50	Jones et al. 1997
Aroclor-1260	-- - --	6.80	Jones et al. 1997
beta-BHC	3.75 - 3.84	3.81	USEPA 1995b
delta-BHC	-- - --	4.10	USEPA 1996a
Dieldrin	3.63 - 6.20	5.37	USEPA 1995b
Endosulfan I	3.55 - 3.85	3.83	USEPA 1995b
Endosulfan II	3.62 - 4.52	4.52	USEPA 1995b
Endrin	2.92 - 5.20	5.06	USEPA 1995b
gamma-BHC (Lindane)	3.61 - 3.90	3.73	USEPA 1995b

Table 8-22
Bioaccumulative Chemicals List and Log K_{ow} Values for Relevant Chemicals
NAB Little Creek, Virginia Beach, VA

Chemical	Log K_{ow} Range	Selected log K_{ow}	Reference
gamma-Chlordane	5.80 - 6.41	6.32	USEPA 1995b
Heptachlor	4.93 - 6.26	6.26	USEPA 1995b
Heptachlor epoxide	3.50 - 5.40	5.00	USEPA 1995b
Methoxychlor	4.20 - 5.60	5.08	USEPA 1995b
Toxaphene	4.33 - 5.56	5.50	USEPA 1995b
Volatile and Semivolatile Organics			
1,1,2,2-Tetrachloroethane	2.31 - 2.64	2.39	USEPA 1995b
1,2,4-Trichlorobenzene	3.89 - 4.23	4.01	USEPA 1995b
1,2-Dichlorobenzene	3.20 - 3.61	3.43	USEPA 1995b
1,3-Dichlorobenzene	-- - --	3.50	USEPA 1996a
1,4-Dichlorobenzene	3.26 - 3.62	3.42	USEPA 1995b
4-Bromophenyl-phenylether	4.89 - 5.24	5.00	USEPA 1995b
4-Chlorophenyl-phenylether	4.08 - 5.09	4.95	USEPA 1995b
Acenaphthene	3.77 - 4.49	3.92	USEPA 1995b
Acenaphthylene	-- - --	4.10	USEPA 1996a
Anthracene	4.44 - 4.80	4.55	USEPA 1995b
Benzo(a)anthracene	5.61 - 5.79	5.70	USEPA 1995b
Benzo(a)pyrene	5.98 - 6.34	6.11	USEPA 1995b
Benzo(b)fluoranthene	5.79 - 6.40	6.20	USEPA 1995b
Benzo(g,h,i)perylene	6.58 - 7.05	6.70	USEPA 1995b
Benzo(k)fluoranthene	6.12 - 6.27	6.20	USEPA 1995b
Chrysene	5.41 - 5.79	5.70	USEPA 1995b
Dibenz(a,h)anthracene	6.50 - 6.88	6.69	USEPA 1995b
Fluoranthene	4.84 - 5.39	5.12	USEPA 1995b
Fluorene	4.04 - 4.40	4.21	USEPA 1995b
Hexachlorobenzene	5.23 - 6.92	5.89	USEPA 1995b
Hexachlorobutadiene	4.74 - 5.16	4.81	USEPA 1995b
Hexachlorocyclopentadiene	5.05 - 5.51	5.39	USEPA 1995b
Hexachloroethane	3.82 - 4.14	4.00	USEPA 1995b
Indeno(1,2,3-cd)pyrene	6.58 - 6.72	6.65	USEPA 1995b
Pentachlorophenol	5.01 - 5.24	5.09	USEPA 1995b
Phenanthrene	4.37 - 4.57	4.55	USEPA 1995b
Pyrene	4.76 - 5.52	5.11	USEPA 1995b

Table 8-23
Soil Bioconcentration and Bioaccumulation Factors For Plants and Soil Invertebrates - Step 2
NAB Little Creek, Virginia Beach, VA

Chemical	Soil-Plant BCF (dry weight)		Soil-Invertebrate BAF (dry weight)	
	Value	Reference	Value	Reference
Inorganics				
Arsenic	1.10	Bechtel Jacobs 1998a	0.52	Sample et al. 1998a
Cadmium	3.25	Bechtel Jacobs 1998a	40.7	Sample et al. 1998a
Chromium	0.08	Bechtel Jacobs 1998a	3.16	Sample et al. 1998a
Copper	0.63	Bechtel Jacobs 1998a	1.53	Sample et al. 1998a
Lead	0.47	Bechtel Jacobs 1998a	1.52	Sample et al. 1998a
Mercury	5.00	Bechtel Jacobs 1998a	20.6	Sample et al. 1998a
Nickel	1.41	Bechtel Jacobs 1998a	4.73	Sample et al. 1998a
Selenium	3.01	Bechtel Jacobs 1998a	1.34	Sample et al. 1998a
Silver	0.04	Bechtel Jacobs 1998a	15.3	Sample et al. 1998a
Zinc	1.82	Bechtel Jacobs 1998a	12.9	Sample et al. 1998a
Pesticides/PCBs				
4,4'-DDD	0.0151	Travis and Arms 1988	2.00	Menzie et al. 1992
4,4'-DDE	0.0216	Travis and Arms 1988	10.6	Menzie et al. 1992
4,4'-DDT	0.0237	Travis and Arms 1988	0.70	Menzie et al. 1992
Aldrin	0.0431	Travis and Arms 1988	3.30	Edwards and Bohlen 1992
alpha-BHC	0.2633	Travis and Arms 1988	1.00	--
alpha-Chlordane	0.0172	Travis and Arms 1988	4.00	Edwards and Bohlen 1992
Aroclor-1016	0.0224	Travis and Arms 1988	15.9	Sample et al. 1998a
Aroclor-1221	0.0744	Travis and Arms 1988	15.9	Sample et al. 1998a
Aroclor-1232	0.0437	Travis and Arms 1988	15.9	Sample et al. 1998a
Aroclor-1242	0.0224	Travis and Arms 1988	15.9	Sample et al. 1998a
Aroclor-1248	0.0101	Travis and Arms 1988	15.9	Sample et al. 1998a
Aroclor-1254	0.0068	Travis and Arms 1988	15.9	Sample et al. 1998a
Aroclor-1260	0.0045	Travis and Arms 1988	15.9	Sample et al. 1998a
beta-BHC	0.2633	Travis and Arms 1988	1.00	--
delta-BHC	0.1653	Travis and Arms 1988	1.00	--
Dieldrin	0.3089	Travis and Arms 1988	8.00	Beyer and Gish 1980
Endosulfan I	0.3436	Travis and Arms 1988	1.00	--
Endosulfan II	0.3131	Travis and Arms 1988	1.00	--
Endrin	0.7948	Travis and Arms 1988	3.60	Edwards and Bohlen 1992
gamma-BHC (Lindane)	0.3173	Travis and Arms 1988	1.00	--
gamma-Chlordane	0.0172	Travis and Arms 1988	4.00	Edwards and Bohlen 1992

Table 8-23
Soil Bioconcentration and Bioaccumulation Factors For Plants and Soil Invertebrates - Step 2
NAB Little Creek, Virginia Beach, VA

Chemical	Soil-Plant BCF (dry weight)		Soil-Invertebrate BAF (dry weight)	
	Value	Reference	Value	Reference
Heptachlor	0.0548	Travis and Arms 1988	3.00	Edwards and Bohlen 1992
Heptachlor epoxide	0.3673	Travis and Arms 1988	8.39	USEPA 1999c
Methoxychlor	0.1447	Travis and Arms 1988	1.00	--
Toxaphene	0.1217	Travis and Arms 1988	1.00	--
Volatile and Semivolatile Organics				
1,1,2,2-Tetrachloroethane	1.7899	Travis and Arms 1988	1.00	--
1,2,4-Trichlorobenzene	0.2186	Travis and Arms 1988	0.56	Beyer 1996
1,2-Dichlorobenzene	0.5475	Travis and Arms 1988	1.00	--
1,3-Dichlorobenzene	0.3673	Travis and Arms 1988	1.00	--
1,4-Dichlorobenzene	0.5055	Travis and Arms 1988	1.00	--
4-Bromophenyl-phenylether	0.0578	Travis and Arms 1988	1.00	--
4-Chlorophenyl-phenylether	0.1697	Travis and Arms 1988	1.00	--
Acenaphthene	0.2564	Travis and Arms 1988	0.30	Beyer and Stafford 1993
Acenaphthylene	0.1653	Travis and Arms 1988	0.22	Beyer and Stafford 1993
Anthracene	0.1051	Travis and Arms 1988	0.32	Beyer and Stafford 1993
Benzo(a)anthracene	0.0222	Travis and Arms 1988	0.27	Beyer and Stafford 1993
Benzo(a)pyrene	0.0135	Travis and Arms 1988	0.34	Beyer and Stafford 1993
Benzo(b)fluoranthene	0.0174	Travis and Arms 1988	0.21	Beyer and Stafford 1993
Benzo(g,h,i)perylene	0.0061	Travis and Arms 1988	0.15	Beyer and Stafford 1993
Benzo(k)fluoranthene	0.0112	Travis and Arms 1988	0.21	Beyer and Stafford 1993
Chrysene	0.0289	Travis and Arms 1988	0.44	Beyer and Stafford 1993
Dibenz(a,h)anthracene	0.0068	Travis and Arms 1988	0.49	Beyer and Stafford 1993
Fluoranthene	0.0617	Travis and Arms 1988	0.37	Beyer and Stafford 1993
Fluorene	0.1790	Travis and Arms 1988	0.20	Beyer and Stafford 1993
Hexachlorobenzene	0.0367	Travis and Arms 1988	1.69	Beyer 1996
Hexachlorobutadiene	0.0705	Travis and Arms 1988	1.00	--
Hexachlorocyclopentadiene	0.0467	Travis and Arms 1988	1.00	--
Hexachloroethane	0.2399	Travis and Arms 1988	1.00	--
Indeno(1,2,3-cd)pyrene	0.0061	Travis and Arms 1988	0.41	Beyer and Stafford 1993
Pentachlorophenol	0.0492	Travis and Arms 1988	8.00	van Gestel and Ma 1988
Phenanthrene	0.1154	Travis and Arms 1988	0.28	Beyer and Stafford 1993
Pyrene	0.0687	Travis and Arms 1988	0.39	Beyer and Stafford 1993

Table 8-24
Soil Bioaccumulation Factors For Small Mammals - Step 2
NAB Little Creek, Virginia Beach, VA

Chemical	Soil-Mouse BAF (dry weight)		Soil-Vole BAF (dry weight)		Soil-Shrew BAF (dry weight)	
	Value	Reference	Value	Reference	Value	Reference
Inorganics						
Arsenic	0.014	Sample et al. 1998b	0.016	Sample et al. 1998b	0.015	Sample et al. 1998b
Cadmium	0.462	Sample et al. 1998b	0.448	Sample et al. 1998b	7.017	Sample et al. 1998b
Chromium	0.349	Sample et al. 1998b	0.309	Sample et al. 1998b	0.333	Sample et al. 1998b
Copper	0.554	Sample et al. 1998b	1.290	Sample et al. 1998b	1.117	Sample et al. 1998b
Lead	0.286	Sample et al. 1998b	0.187	Sample et al. 1998b	0.339	Sample et al. 1998b
Mercury	0.130	Sample et al. 1998b	0.192	Sample et al. 1998b	0.192	Sample et al. 1998b
Nickel	0.589	Sample et al. 1998b	0.898	Sample et al. 1998b	0.578	Sample et al. 1998b
Selenium	1.263	Sample et al. 1998b	1.187	Sample et al. 1998b	1.187	Sample et al. 1998b
Silver	0.810	Sample et al. 1998b	0.007	Sample et al. 1998b	0.501	Sample et al. 1998b
Zinc	2.782	Sample et al. 1998b	2.317	Sample et al. 1998b	2.901	Sample et al. 1998b
Pesticides/PCBs						
4,4'-DDD	--	see text	--	see text	--	see text
4,4'-DDE	--	see text	--	see text	--	see text
4,4'-DDT	--	see text	--	see text	--	see text
Aldrin	--	see text	--	see text	--	see text
alpha-BHC	--	see text	--	see text	--	see text
alpha-Chlordane	--	see text	--	see text	--	see text
Aroclor-1016	--	see text	--	see text	--	see text
Aroclor-1221	--	see text	--	see text	--	see text
Aroclor-1232	--	see text	--	see text	--	see text
Aroclor-1242	--	see text	--	see text	--	see text
Aroclor-1248	--	see text	--	see text	--	see text
Aroclor-1254	--	see text	--	see text	--	see text
Aroclor-1260	--	see text	--	see text	--	see text
beta-BHC	--	see text	--	see text	--	see text
delta-BHC	--	see text	--	see text	--	see text
Dieldrin	--	see text	--	see text	--	see text
Endosulfan I	--	see text	--	see text	--	see text
Endosulfan II	--	see text	--	see text	--	see text
Endrin	--	see text	--	see text	--	see text
gamma-BHC (Lindane)	--	see text	--	see text	--	see text
gamma-Chlordane	--	see text	--	see text	--	see text

Table 8-24
Soil Bioaccumulation Factors For Small Mammals - Step 2
NAB Little Creek, Virginia Beach, VA

Chemical	Soil-Mouse BAF (dry weight)		Soil-Vole BAF (dry weight)		Soil-Shrew BAF (dry weight)	
	Value	Reference	Value	Reference	Value	Reference
Heptachlor	--	see text	--	see text	--	see text
Heptachlor epoxide	--	see text	--	see text	--	see text
Methoxychlor	--	see text	--	see text	--	see text
Toxaphene	--	see text	--	see text	--	see text
Volatile and Semivolatile Organics						
1,1,2,2-Tetrachloroethane	--	see text	--	see text	--	see text
1,2,4-Trichlorobenzene	--	see text	--	see text	--	see text
1,2-Dichlorobenzene	--	see text	--	see text	--	see text
1,3-Dichlorobenzene	--	see text	--	see text	--	see text
1,4-Dichlorobenzene	--	see text	--	see text	--	see text
4-Bromophenyl-phenylether	--	see text	--	see text	--	see text
4-Chlorophenyl-phenylether	--	see text	--	see text	--	see text
Acenaphthene	--	see text	--	see text	--	see text
Acenaphthylene	--	see text	--	see text	--	see text
Anthracene	--	see text	--	see text	--	see text
Benzo(a)anthracene	--	see text	--	see text	--	see text
Benzo(a)pyrene	--	see text	--	see text	--	see text
Benzo(b)fluoranthene	--	see text	--	see text	--	see text
Benzo(g,h,i)perylene	--	see text	--	see text	--	see text
Benzo(k)fluoranthene	--	see text	--	see text	--	see text
Chrysene	--	see text	--	see text	--	see text
Dibenz(a,h)anthracene	--	see text	--	see text	--	see text
Fluoranthene	--	see text	--	see text	--	see text
Fluorene	--	see text	--	see text	--	see text
Hexachlorobenzene	--	see text	--	see text	--	see text
Hexachlorobutadiene	--	see text	--	see text	--	see text
Hexachlorocyclopentadiene	--	see text	--	see text	--	see text
Hexachloroethane	--	see text	--	see text	--	see text
Indeno(1,2,3-cd)pyrene	--	see text	--	see text	--	see text
Pentachlorophenol	--	see text	--	see text	--	see text
Phenanthrene	--	see text	--	see text	--	see text
Pyrene	--	see text	--	see text	--	see text

Table 8-25
Sediment Bioaccumulation Factors For Benthic Invertebrates and Fish - Step 2
NAB Little Creek, Virginia Beach, VA

Chemical	Sediment-Invertebrate BAF (dry weight)		Sediment-Fish BAF (dry weight)	
	Value	Reference	Value	Reference
Inorganics				
Arsenic	0.69	Bechtel Jacobs 1998b	0.13	Pascoe et al. 1996
Cadmium	3.07	Bechtel Jacobs 1998b	0.16	Pascoe et al. 1996
Chromium	0.19	Bechtel Jacobs 1998b	0.04	Krantzberg and Boyd 1992
Copper	7.96	Bechtel Jacobs 1998b	0.10	Krantzberg and Boyd 1992
Lead	0.33	Bechtel Jacobs 1998b	0.07	Krantzberg and Boyd 1992
Mercury	2.87	Bechtel Jacobs 1998b	4.58	Cope et al. 1990
Nickel	0.21	Bechtel Jacobs 1998b	1.00	--
Selenium	1.00	--	1.00	--
Silver	0.18	Hirsch 1998	1.00	--
Tin	1.00	--	1.00	--
Zinc	4.76	Bechtel Jacobs 1998b	0.15	Pascoe et al. 1996
Pesticides/PCBs				
4,4'-DDD	0.35	Oliver and Niimi 1988	2.25	Oliver and Niimi 1988
4,4'-DDE	3.36	Oliver and Niimi 1988	26.2	Oliver and Niimi 1988
4,4'-DDT	2.28	Oliver and Niimi 1988	8.80	Oliver and Niimi 1988
Aldrin	1.00	--	1.00	--
alpha-BHC	1.00	--	1.00	--
alpha-Chlordane	1.00	--	1.00	--
Aroclor-1016	21.9	Bechtel Jacobs 1998b	12.9	Oliver and Niimi 1988
Aroclor-1221	21.9	Bechtel Jacobs 1998b	12.9	Oliver and Niimi 1988
Aroclor-1232	21.9	Bechtel Jacobs 1998b	12.9	Oliver and Niimi 1988
Aroclor-1242	21.9	Bechtel Jacobs 1998b	12.9	Oliver and Niimi 1988
Aroclor-1248	21.9	Bechtel Jacobs 1998b	12.9	Oliver and Niimi 1988
Aroclor-1254	21.9	Bechtel Jacobs 1998b	12.9	Oliver and Niimi 1988
Aroclor-1260	21.9	Bechtel Jacobs 1998b	12.9	Oliver and Niimi 1988
beta-BHC	1.00	--	1.00	--
delta-BHC	1.00	--	1.00	--
Dieldrin	4.52	Standley 1997	1.00	--
Endosulfan I	1.00	--	1.00	--
Endosulfan II	1.00	--	1.00	--
Endrin	1.00	--	1.00	--
gamma-BHC (Lindane)	1.00	--	6.20	Oliver and Niimi 1988
gamma-Chlordane	1.00	--	1.00	--

Table 8-25
Sediment Bioaccumulation Factors For Benthic Invertebrates and Fish - Step 2
NAB Little Creek, Virginia Beach, VA

Chemical	Sediment-Invertebrate BAF (dry weight)		Sediment-Fish BAF (dry weight)	
	Value	Reference	Value	Reference
Heptachlor	1.00	--	1.00	--
Heptachlor epoxide	1.00	--	1.00	--
Methoxychlor	1.00	--	1.00	--
Toxaphene	1.00	--	1.00	--
Volatile and Semivolatile Organics				
1,1,2,2-Tetrachloroethane	1.00	--	1.00	--
1,2,4-Trichlorobenzene	0.48	Oliver and Niimi 1988	0.07	Parkerton et al. 1993
1,2-Dichlorobenzene	1.00	--	0.09	Parkerton et al. 1993
1,3-Dichlorobenzene	1.00	--	0.09	Parkerton et al. 1993
1,4-Dichlorobenzene	1.00	--	0.09	Parkerton et al. 1993
4-Bromophenyl-phenylether	1.00	--	1.00	--
4-Chlorophenyl-phenylether	1.00	--	1.00	--
Acenaphthene	2.04	Maruya et al. 1997	1.00	--
Acenaphthylene	2.04	Acenaphthene value	1.00	--
Anthracene	0.27	Maruya et al. 1997	1.00	--
Benzo(a)anthracene	1.40	Maruya et al. 1997	1.00	--
Benzo(a)pyrene	0.19	Maruya et al. 1997	1.00	--
Benzo(b)fluoranthene	0.16	Maruya et al. 1997	1.00	--
Benzo(g,h,i)perylene	0.30	Maruya et al. 1997	1.00	--
Benzo(k)fluoranthene	0.42	Maruya et al. 1997	1.00	--
Chrysene	0.34	Maruya et al. 1997	1.00	--
Dibenz(a,h)anthracene	0.27	Anthracene value	1.00	--
Fluoranthene	0.31	Maruya et al. 1997	1.00	--
Fluorene	1.13	Maruya et al. 1997	1.00	--
Hexachlorobenzene	0.86	Oliver and Niimi 1988	0.94	Oliver and Niimi 1988
Hexachlorobutadiene	0.61	Oliver and Niimi 1988	0.38	Parkerton et al. 1993
Hexachlorocyclopentadiene	1.00	--	1.00	--
Hexachloroethane	1.00	--	1.00	--
Indeno(1,2,3-cd)pyrene	0.36	Maruya et al. 1997	1.00	--
Pentachlorophenol	1.00	--	1.00	--
Phenanthrene	0.65	Maruya et al. 1997	1.00	--
Pyrene	0.80	Maruya et al. 1997	1.00	--

Table 8-26
Exposure Parameters for Upper Trophic Level Ecological Receptors - Step 2
NAB Little Creek, Virginia Beach, VA

Receptor	Body Weight (kg)		Water Ingestion Rate (L/day)		Food Ingestion Rate (kg/day - dry)	
	Value	Reference	Value	Reference	Value	Reference
Birds						
American kestrel	0.083	Palmer 1988	0.0168	allometric equation	0.0119	USEPA 1993
Killdeer	0.086	Dunning 1993	0.0139	allometric equation	0.0142	allometric equation
Osprey	1.235	Dunning 1993	0.0858	allometric equation	0.0919	USEPA 1993
Mammals						
Deer mouse	0.012	Silva and Downing 1995	0.0040	USEPA 1993	0.0007	USEPA 1993
Red fox	3.170	Silva and Downing 1995	0.4115	allometric equation	0.1476	Sample and Suter 1994

Table 8-26
Exposure Parameters for Upper Trophic Level Ecological Receptors - Step 2
NAB Little Creek, Virginia Beach, VA

Receptor	Dietary Composition (percent)							Soil/ Sediment Ingestion (percent)	
	Terr. Plants	Soil Invert.	Small Mammals	Fish	Aquatic Plants	Benthic Invert.	Reference	Value	Reference
Birds									
American kestrel	0	38.0	60.0	0	0	0	USEPA 1993	2.0	Assumed based on diet
Killdeer	2.0	93.0	0.0	0	0	0	Robbins and Blom 1996	5.0	Assumed based on diet
Osprey	0	0	0	100	0	0	USEPA 1993	0	Assumed based on diet
Mammals									
Deer mouse	53.0	45.0	0	0	0	0	Martin et al. 1951	2.0	Beyer et al. 1994
Red fox	7.0	2.8	87.4	0	0	0	USEPA 1993	2.8	Beyer et al. 1994

Table 8-27
Medium-Specific Screening Values
NAB Little Creek, Virginia Beach, VA

Chemical	Screening Value	Units	Reference	Type	TOC (%)
Surface Water (Groundwater)					
1,1,1-Trichloroethane	3,120	ug/L	USEPA 1995a (with safety factor of 10)		
1,1,2,2-Tetrachloroethane	623	ug/L	USEPA 1995a (with safety factor of 10)		
1,1,2-Trichloroethane	3,120	ug/L	USEPA 1995a (with safety factor of 10)		
1,1-Dichloroethane	3,200	ug/L	USEPA 1995a (with safety factor of 100)		
1,1-Dichloroethene	22,400	ug/L	USEPA 1995a (with safety factor of 10)		
1,2,4-Trichlorobenzene	129	ug/L	USEPA 1995a		
1,2-Dichlorobenzene	129	ug/L	USEPA 1995a		
1,2-Dichloroethane	1,130	ug/L	USEPA 1995a (with safety factor of 100)		
1,2-Dichloroethene (total)	22,400	ug/L	USEPA 1995a (with safety factor of 10)		
1,2-Dichloropropane	3,040	ug/L	USEPA 1995a		
1,3-Dichlorobenzene	129	ug/L	USEPA 1994		
1,4-Dichlorobenzene	129	ug/L	USEPA 1995a		
2,4,5-Trichlorophenol	11.0	ug/L	USEPA 1995a		
2,4-Dimethylphenol	110	ug/L	Federal Register 59:3762 (1994)		
2,4-Dinitrophenol	485	ug/L	USEPA 1995a (with safety factor of 10)		
2,4-Dinitrotoluene	370	ug/L	USEPA 1995a		
2-Chloronaphthalene	0.75	ug/L	USEPA 1995a (with safety factor of 10)		
2-Methylnaphthalene	30.0	ug/L	USEPA 1995a (with safety factor of 10)		
2-Nitrophenol	485	ug/L	USEPA 1994		
4,4'-DDD	0.025	ug/L	USEPA 1999a		
4,4'-DDE	1.40	ug/L	USEPA 1995a (with safety factor of 10)		
4,4'-DDT	0.001	ug/L	USEPA 1995a		
4-Chloroaniline	129	ug/L	Buchman 1999		
4-Nitrophenol	485	ug/L	USEPA 1995a (with safety factor of 10)		
Acenaphthene	710	ug/L	USEPA 1995a		
Acenaphthylene	30.0	ug/L	USEPA 1995a (with safety factor of 10)		
Aldrin	0.13	ug/L	USEPA 1995a (with safety factor of 10)		
alpha-BHC	0.034	ug/L	USEPA 1995a (with safety factor of 10)		
alpha-Chlordane	0.004	ug/L	USEPA 1995a		
Aluminum*	87.0	ug/L	USEPA 1999b		
Anthracene	30.0	ug/L	USEPA 1995a (with safety factor of 10)		
Antimony	500	ug/L	USEPA 1995a		
Aroclor-1016	0.03	ug/L	USEPA 1995a		

Table 8-27
Medium-Specific Screening Values
NAB Little Creek, Virginia Beach, VA

Chemical	Screening Value	Units	Reference	Type	TOC (%)
Aroclor-1221	0.03	ug/L	USEPA 1995a		
Aroclor-1232	0.03	ug/L	USEPA 1995a		
Aroclor-1242	0.03	ug/L	USEPA 1995a		
Aroclor-1248	0.03	ug/L	USEPA 1995a		
Aroclor-1254	0.03	ug/L	USEPA 1995a		
Aroclor-1260	0.03	ug/L	USEPA 1995a		
Arsenic	36.0	ug/L	USEPA 2002		
Barium	1,000	ug/L	USEPA 1995a (with safety factor of 10)		
Benzene	700	ug/L	USEPA 1995a		
Benzo(a)anthracene	8.13	ug/L	USEPA 1995a		
Benzo(a)pyrene	0.021	ug/L	USEPA 1995a (with safety factor of 10)		
Benzo(b)fluoranthene	30.0	ug/L	USEPA 1995a (with safety factor of 10)		
Benzo(g,h,i)perylene	30.0	ug/L	USEPA 1995a (with safety factor of 10)		
Benzo(k)fluoranthene	30.0	ug/L	USEPA 1995a (with safety factor of 10)		
Beryllium	1,500	ug/L	USEPA 1995a		
beta-BHC	0.034	ug/L	USEPA 1995a (with safety factor of 10)		
bis(2-Chloroethoxy)methane	6,400	ug/L	USEPA 1995a		
bis(2-Ethylhexyl)phthalate	360	ug/L	USEPA 1995a		
Bromochloromethane	6,400	ug/L	USEPA 1995a		
Bromodichloromethane	6,400	ug/L	USEPA 1995a		
Bromoform	640	ug/L	USEPA 1999a		
Bromomethane (methyl bromide)	120	ug/L	USEPA 1999a		
Butylbenzylphthalate	29.4	ug/L	USEPA 1999a		
Cadmium	8.85	ug/L	USEPA 2002	Total	
Cadmium	8.80	ug/L	USEPA 2002	Dissolved	
Carbon disulfide	2.00	ug/L	USEPA 1995a		
Carbon tetrachloride	5,000	ug/L	USEPA 1995a (with safety factor of 10)		
Chlorobenzene	129	ug/L	USEPA 1995a		
Chloroform	815	ug/L	USEPA 1999a		
Chloromethane	2,700	ug/L	USEPA 1999a		
Chromium	50.4	ug/L	USEPA 2002	Total	
Chromium	50.0	ug/L	USEPA 2002	Dissolved	
Chrysene	30.0	ug/L	USEPA 1995a (with safety factor of 10)		
cis-1,2-Dichloroethene	22,400	ug/L	USEPA 1995a (with safety factor of 10)		

Table 8-27
Medium-Specific Screening Values
NAB Little Creek, Virginia Beach, VA

Chemical	Screening Value	Units	Reference	Type	TOC (%)
cis-1,3-Dichloropropene	79.0	ug/L	USEPA 1995a (with safety factor of 10)		
Cobalt*	23.0	ug/L	Suter and Tsao 1996		
Copper	3.70	ug/L	USEPA 2002	Total	
Copper	3.10	ug/L	USEPA 2002	Dissolved	
Cyanide	1.00	ug/L	USEPA 1995a		
delta-BHC	0.034	ug/L	USEPA 1995a (with safety factor of 10)		
Dibenz(a,h)anthracene	30.0	ug/L	USEPA 1995a (with safety factor of 10)		
Dibromochloromethane	6,400	ug/L	USEPA 1995a		
Dichlorodifluoromethane	6,400	ug/L	USEPA 1995a		
Dieldrin	0.11	ug/L	USEPA 1996b		
Diethylphthalate	75.9	ug/L	USEPA 1999a		
Dimethyl phthalate	580	ug/L	USEPA 1999a		
Di-n-butylphthalate	3.40	ug/L	USEPA 1995a		
Di-n-octyl phthalate	3.40	ug/L	USEPA 1995a		
Endosulfan I	0.0087	ug/L	USEPA 1995a		
Endosulfan II	0.0087	ug/L	USEPA 1995a		
Endosulfan sulfate	0.0087	ug/L	USEPA 1995a		
Endrin	0.01	ug/L	USEPA 1996b		
Endrin aldehyde	0.01	ug/L	USEPA 1996b		
Endrin ketone	0.01	ug/L	USEPA 1996b		
Ethylbenzene	43.0	ug/L	USEPA 1995a (with safety factor of 10)		
Fluoranthene	16.0	ug/L	USEPA 1995a		
Fluorene	30.0	ug/L	USEPA 1995a (with safety factor of 10)		
gamma-BHC (Lindane)	0.016	ug/L	USEPA 1995a (with safety factor of 10)		
gamma-Chlordane	0.004	ug/L	USEPA 1995a		
Heptachlor	0.0036	ug/L	USEPA 1995a		
Heptachlor epoxide	0.0036	ug/L	USEPA 1995a		
Hexachlorobenzene	129	ug/L	USEPA 1995a		
Hexachlorobutadiene	3.20	ug/L	USEPA 1995a (with safety factor of 10)		
Hexachlorocyclopentadiene	0.70	ug/L	USEPA 1995a (with safety factor of 10)		
Hexachloroethane	94.0	ug/L	USEPA 1995a (with safety factor of 10)		
Indeno(1,2,3-cd)pyrene	30.0	ug/L	USEPA 1995a (with safety factor of 10)		
Iron*	1,000	ug/L	USEPA 2002		
Isophorone	1,290	ug/L	USEPA 1995a (with safety factor of 10)		

Table 8-27
Medium-Specific Screening Values
NAB Little Creek, Virginia Beach, VA

Chemical	Screening Value	Units	Reference	Type	TOC (%)
Lead	8.50	ug/L	USEPA 2002	Total	
Lead	8.10	ug/L	USEPA 2002	Dissolved	
Manganese	10.0	ug/L	USEPA 1995a		
Mercury	1.10	ug/L	USEPA 2002	Total	
Mercury	0.94	ug/L	USEPA 2002	Dissolved	
Methoxychlor	0.03	ug/L	USEPA 1995a		
Methylene chloride	6,400	ug/L	USEPA 1995a		
Naphthalene	230	ug/L	USEPA 1995a (with safety factor of 10)		
Nickel	8.30	ug/L	USEPA 2002	Total	
Nickel	8.20	ug/L	USEPA 2002	Dissolved	
Nitrobenzene	668	ug/L	USEPA 1995a (with safety factor of 10)		
n-Nitrosodiphenylamine	330,000	ug/L	USEPA 1995a (with safety factor of 10)		
Pentachlorophenol	7.90	ug/L	USEPA 1995a		
Phenanthrene	4.60	ug/L	USEPA 1995a		
Phenol	580	ug/L	USEPA 1995a (with safety factor of 10)		
Pyrene	30.0	ug/L	USEPA 1995a (with safety factor of 10)		
Selenium	71.1	ug/L	USEPA 2002	Total	
Selenium	71.0	ug/L	USEPA 2002	Dissolved	
Silver	0.92	ug/L	Buchman 1999		
Tetrachloroethene	450	ug/L	USEPA 1995a		
Thallium	213	ug/L	USEPA 1995a (with safety factor of 10)		
Toluene	37.0	ug/L	USEPA 1999a		
Toxaphene	0.21	ug/L	USEPA 1996b		
trans-1,2-Dichloroethene	22,400	ug/L	USEPA 1995a (with safety factor of 10)		
trans-1,3-Dichloropropene	79.0	ug/L	USEPA 1995a (with safety factor of 10)		
Trichloroethene	200	ug/L	USEPA 1995a (with safety factor of 10)		
Trichlorofluoromethane	6,400	ug/L	USEPA 1995a		
Vanadium	10,000	ug/L	USEPA 1995a		
Vinyl chloride	22,400	ug/L	USEPA 1995a (with safety factor of 10)		
Xylene, total	135	ug/L	USEPA 1995a		
Zinc	86.0	ug/L	USEPA 2002	Total	
Zinc	81.0	ug/L	USEPA 2002	Dissolved	
Sediment					
1,2,4-Trichlorobenzene	40.0	ug/kg	USEPA 1995a		

Table 8-27
Medium-Specific Screening Values
NAB Little Creek, Virginia Beach, VA

Chemical	Screening Value	Units	Reference	Type	TOC (%)
1,2-Dichlorobenzene	35.0	ug/kg	USEPA 1995a		
1,4-Dichlorobenzene	110	ug/kg	USEPA 1995a		
2,4-Dimethylphenol	29.0	ug/kg	USEPA 1995a		
2-Methylnaphthalene	70.0	ug/kg	USEPA 1995a		
2-Methylphenol	63.0	ug/kg	USEPA 1995a		
4,4'-DDD	16.0	ug/kg	USEPA 1995a		
4,4'-DDE	2.20	ug/kg	USEPA 1995a		
4,4'-DDT	1.58	ug/kg	USEPA 1995a		
4-Methylphenol	670	ug/kg	USEPA 1995a		
Acenaphthene	16.0	ug/kg	USEPA 1995a		
Acenaphthylene	44.0	ug/kg	USEPA 1995a		
Aldrin	9.50	ug/kg	Buchman 1999		
alpha-BHC	6.00	ug/kg	Ontario Ministry of the Environment 1993		
alpha-Chlordane	7.00	ug/kg	Ontario Ministry of the Environment 1993		
Aluminum	18,000	mg/kg	Buchman 1999		
Ammonia	100	mg/kg	Ontario Ministry of the Environment 1993		
Anthracene	85.3	ug/kg	USEPA 1995a		
Antimony	150	mg/kg	USEPA 1995a		
Aroclor-1016	22.7	ug/kg	USEPA 1995a		
Aroclor-1221	22.7	ug/kg	USEPA 1995a		
Aroclor-1232	22.7	ug/kg	USEPA 1995a		
Aroclor-1242	22.7	ug/kg	USEPA 1995a		
Aroclor-1248	22.7	ug/kg	USEPA 1995a		
Aroclor-1254	22.7	ug/kg	USEPA 1995a		
Aroclor-1260	22.7	ug/kg	USEPA 1995a		
Arsenic	8.20	mg/kg	USEPA 1995a		
Barium	48.0	mg/kg	Buchman 1999		
Benzo(a)anthracene	261	ug/kg	USEPA 1995a		
Benzo(a)pyrene	430	ug/kg	USEPA 1995a		
Benzo(b)fluoranthene	3,200	ug/kg	USEPA 1995a		
Benzo(g,h,i)perylene	670	ug/kg	USEPA 1995a		

Table 8-27
Medium-Specific Screening Values
NAB Little Creek, Virginia Beach, VA

Chemical	Screening Value	Units	Reference	Type	TOC (%)
Benzo(k)fluoranthene	1,800	ug/kg	Buchman 1999		
beta-BHC	5.00	ug/kg	Ontario Ministry of the Environment 1993		
bis(2-Ethylhexyl)phthalate	1,300	ug/kg	USEPA 1995a		
Butylbenzylphthalate	63.0	ug/kg	USEPA 1995a		
Cadmium	1.20	mg/kg	USEPA 1995a		
Carbazole	1,800	ug/kg	Cubbage et al. 1997		
Chromium	81.0	mg/kg	USEPA 1995a		
Chrysene	384	ug/kg	USEPA 1995a		
Cobalt	10.0	mg/kg	Buchman 1999		
Copper	34.0	mg/kg	USEPA 1995a		
delta-BHC	5.00	ug/kg	Beta-BHC value		
Dibenz(a,h)anthracene	63.4	ug/kg	USEPA 1995a		
Dibenzofuran	540	ug/kg	USEPA 1995a		
Dieldrin	0.72	ug/kg	Buchman 1999		
Diethylphthalate	200	ug/kg	USEPA 1995a		
Dimethyl phthalate	71.0	ug/kg	USEPA 1995a		
Di-n-butylphthalate	1,400	ug/kg	USEPA 1995a		
Di-n-octyl phthalate	6,200	ug/kg	USEPA 1995a		
Endosulfan I	10.0	ug/kg	Chandler and Scott 1991		
Endosulfan II	10.0	ug/kg	Chandler and Scott 1991		
Endosulfan sulfate	10.0	ug/kg	Chandler and Scott 1991		
Endrin	3.00	ug/kg	Ontario Ministry of the Environment 1993		
Endrin aldehyde	3.00	ug/kg	Endrin value		
Endrin ketone	3.00	ug/kg	Endrin value		
Fluoranthene	600	ug/kg	USEPA 1995a		
Fluorene	19.0	ug/kg	USEPA 1995a		
gamma-BHC (Lindane)	3.00	ug/kg	Ontario Ministry of the Environment 1993		
gamma-Chlordane	7.00	ug/kg	Ontario Ministry of the Environment 1993		
Heptachlor	5.00	ug/kg	Heptachlor epoxide value		

Table 8-27
Medium-Specific Screening Values
NAB Little Creek, Virginia Beach, VA

Chemical	Screening Value	Units	Reference	Type	TOC (%)
Heptachlor epoxide	5.00	ug/kg	Ontario Ministry of the Environment 1993		
Hexachlorobenzene	22.0	ug/kg	USEPA 1995a		
Hexachlorobutadiene	11.0	ug/kg	USEPA 1995a		
Indeno(1,2,3-cd)pyrene	600	ug/kg	USEPA 1995a		
Iron	220,000	mg/kg	Buchman 1999		
Lead	46.7	mg/kg	USEPA 1995a		
Manganese	260	mg/kg	Buchman 1999		
Mercury	0.15	mg/kg	USEPA 1995a		
Naphthalene	160	ug/kg	USEPA 1995a		
Nickel	20.9	mg/kg	USEPA 1995a		
n-Nitrosodiphenylamine	28.0	ug/kg	USEPA 1995a		
PAH (total)	4,022	ug/kg	Buchman 1999		
Pentachlorophenol	360	ug/kg	USEPA 1995a		
Phenanthrene	240	ug/kg	USEPA 1995a		
Phenol	420	ug/kg	USEPA 1995a		
Pyrene	665	ug/kg	USEPA 1995a		
Selenium	1.00	mg/kg	Buchman 1999		
Silver	1.00	mg/kg	USEPA 1995a		
Tin (as TBT)	3.40	mg/kg	Buchman 1999		
Vanadium	57.0	mg/kg	Buchman 1999		
Zinc	150	mg/kg	USEPA 1995a		
Surface Soil					
1,1,1-Trichloroethane	300	ug/kg	USEPA 1995a		
1,1,2,2-Tetrachloroethane	300	ug/kg	USEPA 1995a		
1,1,2-Trichloroethane	300	ug/kg	USEPA 1995a		
1,1-Dichloroethane	300	ug/kg	USEPA 1995a		
1-Methylnaphthalene	100	ug/kg	USEPA 1995a (value for other PAHs)		
1,2,4-Trichlorobenzene	1,270	ug/kg	Efroymson et al. 1997b	Fauna	
1,2-Dichlorobenzene	100	ug/kg	USEPA 1995a		
1,2-Dichloroethane	401	ug/kg	MHSPE 1994		2
1,2-Dichloroethene (total)	300	ug/kg	USEPA 1995a		
1,2-Dichloropropane	38,800	ug/kg	Efroymson et al. 1997b	Fauna	
1,3-Dichlorobenzene	1,280	ug/kg	1,4-Dichlorobenzene value	Fauna	

Table 8-27
Medium-Specific Screening Values
NAB Little Creek, Virginia Beach, VA

Chemical	Screening Value	Units	Reference	Type	TOC (%)
1,4-Dichlorobenzene	1,280	ug/kg	Efroymson et al. 1997b	Fauna	
2,4,5-Trichlorophenol	430	ug/kg	Efroymson et al. 1997a	Flora	
2,4,6-Trichlorophenol	580	ug/kg	Efroymson et al. 1997b	Fauna	
2,4-Dichlorophenol	13,400	ug/kg	Efroymson et al. 1997b	Fauna	
2,4-Dimethylphenol	100	ug/kg	USEPA 1995a		
2,4-Dinitrophenol	20,000	ug/kg	Efroymson et al. 1997a	Flora	
2-Chloronaphthalene	1,033	ug/kg	MHSPE 1994		2
2-Chlorophenol	100	ug/kg	USEPA 1995a		
2-Methylnaphthalene	100	ug/kg	USEPA 1995a (value for other PAHs)		
2-Methylphenol	100	ug/kg	USEPA 1995a		
4,4'-DDD	100	ug/kg	USEPA 1995a		
4,4'-DDE	100	ug/kg	USEPA 1995a		
4,4'-DDT	100	ug/kg	USEPA 1995a		
4-Methyl-2-pentanone	10,000	ug/kg	USEPA 1995a (with safety factor of 10)		
4-Methylphenol	100	ug/kg	USEPA 1995a		
4-Nitrophenol	380	ug/kg	Efroymson et al. 1997b	Fauna	
Acenaphthene	2,500	ug/kg	Efroymson et al. 1997a	Flora	
Acenaphthylene	100	ug/kg	USEPA 1995a		
Aldrin	100	ug/kg	USEPA 1995a		
alpha-BHC	100,000	ug/kg	USEPA 1995a		
alpha-Chlordane	100	ug/kg	USEPA 1995a		
Aluminum	50.0	mg/kg	Efroymson et al. 1997a	Flora	
Anthracene	100	ug/kg	USEPA 1995a		
Antimony	5.00	mg/kg	Efroymson et al. 1997a	Flora	
Aroclor-1016	100	ug/kg	USEPA 1995a		
Aroclor-1221	100	ug/kg	USEPA 1995a		
Aroclor-1232	100	ug/kg	USEPA 1995a		
Aroclor-1242	100	ug/kg	USEPA 1995a		
Aroclor-1248	100	ug/kg	USEPA 1995a		
Aroclor-1254	100	ug/kg	USEPA 1995a		
Aroclor-1260	100	ug/kg	USEPA 1995a		
Arsenic	60.0	mg/kg	Efroymson et al. 1997b	Fauna	
Barium	500	mg/kg	Efroymson et al. 1997a	Flora	
Benzene	105	ug/kg	MHSPE 1994		2

Table 8-27
Medium-Specific Screening Values
NAB Little Creek, Virginia Beach, VA

Chemical	Screening Value	Units	Reference	Type	TOC (%)
Benzo(a)anthracene	100	ug/kg	USEPA 1995a		
Benzo(a)pyrene	100	ug/kg	USEPA 1995a		
Benzo(b)fluoranthene	100	ug/kg	USEPA 1995a		
Benzo(g,h,i)perylene	100	ug/kg	USEPA 1995a		
Benzo(k)fluoranthene	100	ug/kg	USEPA 1995a		
Beryllium	10.0	mg/kg	Efroymson et al. 1997a	Flora	
beta-BHC	100,000	ug/kg	USEPA 1995a		
bis(2-Ethylhexyl)phthalate	10,000	ug/kg	IPCS 1992		
Bromodichloromethane	45,000	ug/kg	USEPA 1995a (with safety factor of 10)		
Bromoform	114,700	ug/kg	USEPA 1995a (with safety factor of 10)		
Cadmium	4.00	mg/kg	Efroymson et al. 1997a	Flora	
Carbon tetrachloride	1,000,000	ug/kg	Efroymson et al. 1997b	Fauna	
Chlorobenzene	2,400	ug/kg	Efroymson et al. 1997b	Fauna	
Chloroform	1,000	ug/kg	MHSPE 1994		2
Chromium	0.40	mg/kg	Efroymson et al. 1997b	Fauna	
Chrysene	100	ug/kg	USEPA 1995a		
cis-1,2-Dichloroethene	300	ug/kg	USEPA 1995a		
cis-1,3-Dichloropropene	300	ug/kg	USEPA 1995a		
Cobalt	100	mg/kg	USEPA 1995a	Flora	
Copper	50.0	mg/kg	Efroymson et al. 1997b	Fauna	
Cyanide	27.5	mg/kg	MHSPE 1994		
delta-BHC	100,000	ug/kg	USEPA 1995a		
Dibenz(a,h)anthracene	100	ug/kg	USEPA 1995a		
Dieldrin	100	ug/kg	USEPA 1995a		
Diethylphthalate	13,400	ug/kg	Efroymson et al. 1997a	Flora	
Dimethyl phthalate	10,640	ug/kg	Efroymson et al. 1997b	Fauna	
Di-n-butylphthalate	200,000	ug/kg	Efroymson et al. 1997a	Flora	
Endosulfan I	100	ug/kg	USEPA 1995a (value for other pesticides)		
Endosulfan II	100	ug/kg	USEPA 1995a (value for other pesticides)		
Endosulfan sulfate	100	ug/kg	USEPA 1995a (value for other pesticides)		
Endrin	100	ug/kg	USEPA 1995a		

Table 8-27
Medium-Specific Screening Values
NAB Little Creek, Virginia Beach, VA

Chemical	Screening Value	Units	Reference	Type	TOC (%)
Endrin aldehyde	100	ug/kg	USEPA 1995a		
Endrin ketone	100	ug/kg	USEPA 1995a		
Ethylbenzene	5,005	ug/kg	MHSPE 1994		2
Fluoranthene	100	ug/kg	USEPA 1995a		
Fluorene	1,700	ug/kg	Efroymson et al. 1997b	Fauna	
gamma-BHC (Lindane)	100	ug/kg	USEPA 1995a		
gamma-Chlordane	100	ug/kg	USEPA 1995a		
Heptachlor	100	ug/kg	Heptachlor epoxide value		
Heptachlor epoxide	100	ug/kg	USEPA 1995a		
Hexachlorocyclopentadiene	1,000	ug/kg	Efroymson et al. 1997a	Flora	
Indeno(1,2,3-cd)pyrene	100	ug/kg	USEPA 1995a		
Iron	200	mg/kg	Efroymson et al. 1997b	Fauna	
Lead	50.0	mg/kg	Efroymson et al. 1997a	Flora	
Manganese	500	mg/kg	Efroymson et al. 1997a	Flora	
Mercury	0.10	mg/kg	Efroymson et al. 1997b	Fauna	
Methoxychlor	100	ug/kg	USEPA 1995a		
Methylene chloride	1,001	ug/kg	MHSPE 1994		2
Naphthalene	100	ug/kg	USEPA 1995a		
Nickel	30.0	mg/kg	Efroymson et al. 1997a	Flora	
Nitrobenzene	2,260	ug/kg	Efroymson et al. 1997b	Fauna	
n-Nitrosodiphenylamine	1,090	ug/kg	Efroymson et al. 1997b	Fauna	
PAH (total)	4,100	ug/kg	MHSPE 1994		2
Pentachlorophenol	3,000	ug/kg	Efroymson et al. 1997a	Flora	
Phenanthrene	100	ug/kg	USEPA 1995a		
Phenol	1,880	ug/kg	Efroymson et al. 1997b	Fauna	
Pyrene	100	ug/kg	USEPA 1995a		
Selenium	1.80	mg/kg	USEPA 1995a		
Silver	2.00	mg/kg	Efroymson et al. 1997a	Flora	
Styrene	10,010	ug/kg	MHSPE 1994		2
Tetrachloroethene	401	ug/kg	MHSPE 1994		2
Thallium	1.00	mg/kg	Efroymson et al. 1997a	Flora	
Toluene	13,005	ug/kg	MHSPE 1994		2
trans-1,2-Dichloroethene	300	ug/kg	USEPA 1995a		
trans-1,3-Dichloropropene	300	ug/kg	USEPA 1995a		

Table 8-27
Medium-Specific Screening Values
NAB Little Creek, Virginia Beach, VA

Chemical	Screening Value	Units	Reference	Type	TOC (%)
Trichloroethene	6,000	ug/kg	MHSPE 1994		2
Vanadium	2.00	mg/kg	Efroymson et al. 1997a	Flora	
Vinyl chloride	300	ug/kg	USEPA 1995a		
Xylene, total	2,505	ug/kg	MHSPE 1994		2
Zinc	50.0	mg/kg	Efroymson et al. 1997a	Flora	

* Marine value not available; freshwater value used

Table 8-28
Ingestion Screening Values for Mammals
NAB Little Creek, Virginia Beach, VA

Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	NOAEL (mg/kg/d)	Reference
Inorganics								
Arsenic	mouse	0.03	3 generations	oral in water	reproduction	1.26	0.13	Sample et al. 1996
Arsenic	dog	10.0	2 years	oral in diet	systemic	12.0	1.20	ATSDR 1993a
Cadmium	rat	0.30	6 weeks	oral (gavage)	reproduction	10.0	1.00	Sample et al. 1996
Cadmium	dog	10.0	3 months	oral in diet	reproduction	7.50	0.75	ATSDR 1999a
Chromium	rat	0.35	1 year	oral in water	body weight/intake	32.8	3.28	Sample et al. 1996
Copper	mouse	0.03	1 month + GD 0-19	oral in diet	developmental	104	78.0	ATSDR 1990a
Copper	mink	1.00	357 days	oral in diet	reproduction	15.1	11.7	Sample et al. 1996
Lead	rat	0.35	3 generations	oral in diet	reproduction	80.0	8.00	Sample et al. 1996
Mercury	rat	0.35	3 generations	oral in diet	reproduction	0.16	0.032	Sample et al. 1996
Mercury	mink	1.00	93 days	oral in diet	survival/weight loss	0.25	0.15	Sample et al. 1996
Nickel	rat	0.35	3 generations	oral in diet	reproduction	80.0	40.0	Sample et al. 1996
Nickel	dog	10.0	2 years	oral in diet	systemic	62.5	25.0	ATSDR 1997a
Selenium	rat	0.35	1 year	oral in water	reproduction	0.33	0.20	Sample et al. 1996
Silver	rat	0.35	2 weeks	oral in water	survival	90.6	9.06	ATSDR 1990b
Tin	mouse	0.03	GD 6-15	oral (gavage)	reproduction	35.0	23.4	Sample et al. 1996
Zinc	rat	0.35	GD 1-16	oral in diet	reproduction	320	160	Sample et al. 1996
Zinc	mink	1.00	25 weeks	oral	reproduction	208	20.8	ATSDR 1994a
Pesticides/PCBs								
4,4'-DDD	rat	0.35	2 years	oral in diet	reproduction	4.00	0.80	Sample et al. 1996
4,4'-DDD	dog	10.0	2 generations	oral in diet	reproduction	5.00	1.00	ATSDR 1994b
4,4'-DDE	rat	0.35	2 years	oral in diet	reproduction	4.00	0.80	Sample et al. 1996
4,4'-DDE	dog	10.0	2 generations	oral in diet	reproduction	5.00	1.00	ATSDR 1994b
4,4'-DDT	rat	0.35	2 years	oral in diet	reproduction	4.00	0.80	Sample et al. 1996
4,4'-DDT	dog	10.0	2 generations	oral in diet	reproduction	5.00	1.00	ATSDR 1994b
Aldrin	rat	0.35	3 generations	oral in diet	reproduction	1.00	0.20	Sample et al. 1996
alpha-BHC	rat	0.35	4 generations	oral in diet	reproduction	3.20	1.60	Sample et al. 1996
alpha-Chlordane	mouse	0.03	6 generations	oral in diet	reproduction	9.16	4.58	Sample et al. 1996
Aroclor-1016	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.68	0.068	Sample et al. 1996
Aroclor-1016	mink	1.00	18 months	oral in diet	reproduction	3.43	1.37	Sample et al. 1996
Aroclor-1221	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.68	0.068	Sample et al. 1996
Aroclor-1221	mink	1.00	7 months	oral in diet	reproduction	0.69	0.069	Sample et al. 1996

Table 8-28
Ingestion Screening Values for Mammals
NAB Little Creek, Virginia Beach, VA

Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	NOAEL (mg/kg/d)	Reference
Aroclor-1232	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.68	0.068	Sample et al. 1996
Aroclor-1232	mink	1.00	7 months	oral in diet	reproduction	0.69	0.069	Sample et al. 1996
Aroclor-1242	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.68	0.068	Sample et al. 1996
Aroclor-1242	mink	1.00	7 months	oral in diet	reproduction	0.69	0.069	Sample et al. 1996
Aroclor-1248	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.68	0.068	Sample et al. 1996
Aroclor-1248	mink	1.00	4.5 months	oral in diet	reproduction	0.69	0.14	Sample et al. 1996
Aroclor-1254	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.68	0.068	Sample et al. 1996
Aroclor-1254	mink	1.00	4.5 months	oral in diet	reproduction	0.69	0.14	Sample et al. 1996
Aroclor-1260	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.68	0.068	Sample et al. 1996
Aroclor-1260	mink	1.00	4.5 months	oral in diet	reproduction	0.69	0.14	Sample et al. 1996
beta-BHC	rat	0.35	4 generations	oral in diet	reproduction	3.20	1.60	Sample et al. 1996
delta-BHC	rat	0.35	4 generations	oral in diet	reproduction	3.20	1.60	Sample et al. 1996
Dieldrin	rat	0.35	3 generations	oral in diet	reproduction	0.20	0.02	Sample et al. 1996
Dieldrin	dog	10.0	15.7 months	oral in diet	systemic	0.14	0.014	ATSDR 1993b
Endosulfan I	rat	0.35	30 days	oral (gavage)	fertility	15.0	1.50	Sample et al. 1996
Endosulfan I	dog	10.0	2 years	oral in diet	systemic	10.0	1.00	ATSDR 1993c
Endosulfan II	rat	0.35	30 days	oral (gavage)	fertility	15.0	1.50	Sample et al. 1996
Endosulfan II	dog	10.0	2 years	oral in diet	systemic	10.0	1.00	ATSDR 1993c
Endrin	mouse	0.03	120 days	oral in diet	reproduction	0.92	0.092	Sample et al. 1996
gamma-BHC (Lindane)	rat	0.35	3 generations	oral in diet	reproduction	80.0	8.00	Sample et al. 1996
gamma-Chlordane	mouse	0.03	6 generations	oral in diet	reproduction	9.16	4.58	Sample et al. 1996
Heptachlor	mouse	0.03	70 days	oral in diet	reproduction	3.25	0.33	ATSDR 1993d
Heptachlor	mink	1.00	181 days	oral in diet	reproduction	1.00	0.10	Sample et al. 1996
Heptachlor epoxide	mouse	0.03	70 days	oral in diet	reproduction	3.25	0.33	ATSDR 1993d
Heptachlor epoxide	mink	1.00	181 days	oral in diet	reproduction	1.00	0.10	Sample et al. 1996
Methoxychlor	rat	0.35	11 months	oral in diet	reproduction	8.00	4.00	Sample et al. 1996
Toxaphene	rat	0.35	3 generations	oral in diet	reproduction	80.0	8.00	Sample et al. 1996
Volatile and Semivolatile Organics								
1,1,2,2-Tetrachloroethane	rat	0.35	78 weeks	oral (gavage)	reproduction	760	76.0	ATSDR 1996a
1,2,4-Trichlorobenzene	rat	0.35	3 generations	oral in water	reproduction	106	53.0	Coulston and Kolbye 1994
1,2-Dichlorobenzene	rat	0.35	chronic	oral (gavage)	liver/kidney	857	85.7	Coulston and Kolbye 1994
1,3-Dichlorobenzene	rat	0.35	chronic	oral (gavage)	liver/kidney	857	85.7	Coulston and Kolbye 1994

Table 8-28
Ingestion Screening Values for Mammals
NAB Little Creek, Virginia Beach, VA

Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	NOAEL (mg/kg/d)	Reference
1,4-Dichlorobenzene	rat	0.35	GD 6-15	oral (gavage)	developmental	500	250	ATSDR 1998
4-Bromophenyl-phenylether	--	--	--	--	--	NA	NA	--
4-Chlorophenyl-phenylether	--	--	--	--	--	NA	NA	--
Acenaphthene	mouse	0.03	13 weeks	oral (gavage)	reproduction	700	350	ATSDR 1995
Acenaphthylene	mouse	0.03	13 weeks	oral (gavage)	reproduction	700	350	ATSDR 1995
Anthracene	mouse	0.03	13 weeks	oral (gavage)	reproduction	10,000	1,000	ATSDR 1995
Benzo(a)anthracene	mouse	0.03	GD 7-16	oral (gavage)	reproduction	10.0	1.00	Sample et al. 1996
Benzo(a)pyrene	mouse	0.03	GD 7-16	oral (gavage)	reproduction	10.0	1.00	Sample et al. 1996
Benzo(b)fluoranthene	mouse	0.03	GD 7-16	oral (gavage)	reproduction	10.0	1.00	Sample et al. 1996
Benzo(g,h,i)perylene	mouse	0.03	GD 7-16	oral (gavage)	reproduction	10.0	1.00	Sample et al. 1996
Benzo(k)fluoranthene	mouse	0.03	GD 7-16	oral (gavage)	reproduction	10.0	1.00	Sample et al. 1996
Chrysene	mouse	0.03	GD 7-16	oral (gavage)	reproduction	10.0	1.00	Sample et al. 1996
Dibenz(a,h)anthracene	mouse	0.03	GD 7-16	oral (gavage)	reproduction	10.0	1.00	Sample et al. 1996
Fluoranthene	mouse	0.03	13 weeks	oral (gavage)	reproduction	5,000	500	ATSDR 1995
Fluorene	mouse	0.03	13 weeks	oral (gavage)	reproduction	5,000	500	ATSDR 1995
Hexachlorobenzene	rat	0.35	4 generations	oral in diet	reproduction	2.00	1.00	ATSDR 1996b
Hexachlorobenzene	dog	10.0	1 year	oral	systemic	12.0	1.20	ATSDR 1996b
Hexachlorobutadiene	rat	0.35	90 days +	oral in diet	reproduction	20.0	2.00	ATSDR 1994c
Hexachlorocyclopentadiene	mouse	0.03	GD 6-15	oral (gavage)	developmental	750	75.0	ATSDR 1999b
Hexachloroethane	rat	0.35	GD 6-16	oral (gavage)	reproduction	500	100	ATSDR 1997b
Indeno(1,2,3-cd)pyrene	mouse	0.03	GD 7-16	oral (gavage)	reproduction	10.0	1.00	Sample et al. 1996
Pentachlorophenol	rat	0.35	2 generations	oral in diet	developmental	25.0	2.50	ATSDR 1994d
Phenanthrene	mouse	0.03	13 weeks	oral (gavage)	reproduction	5,000	500	ATSDR 1995
Pyrene	mouse	0.03	GD 7-16	oral (gavage)	reproduction	10.0	1.00	Sample et al. 1996

Table 8-29
Ingestion Screening Values for Birds
NAB Little Creek, Virginia Beach, VA

Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	NOAEL (mg/kg/d)	Reference
Inorganics								
Arsenic	brown-headed cowbird	0.05	7 months	oral in diet	survival	7.38	2.46	Sample et al. 1996
Arsenic	mallard	1.00	128 days	oral in diet	survival	12.8	5.14	Sample et al. 1996
Cadmium	mallard	1.15	90 days	oral in diet	reproduction	20.0	1.45	Sample et al. 1996
Chromium	American black duck	1.25	10 months	oral in diet	reproduction	5.00	1.00	Sample et al. 1996
Copper	chicken (chicks)	0.53	10 weeks	oral in diet	growth/survival	61.7	47.0	Sample et al. 1996
Lead	Japanese quail	0.15	12 weeks	oral in diet	reproduction	11.3	1.13	Sample et al. 1996
Lead	American kestrel	0.13	7 months	oral in diet	reproduction	38.5	3.85	Sample et al. 1996
Mercury	red-tailed hawk	1.10	12 weeks	oral in diet	survival/neurological	1.20	0.49	USEPA 1995c
Mercury	mallard	1.00	3 generations	oral in diet	reproduction	0.078	0.026	USEPA 1997b
Nickel	mallard	0.78	90 days	oral in diet	growth/survival	107	77.4	Sample et al. 1996
Selenium	black-crowned night-heron	0.88	94 days	oral in diet	reproduction	18.0	1.80	Sample et al. 1996
Selenium	mallard	1.00	100 days	oral in diet	reproduction	0.80	0.40	Sample et al. 1996
Selenium	screech owl	0.20	13.7 weeks	oral in diet	reproduction	1.50	0.44	Sample et al. 1996
Silver	mallard	1.10	14 days	oral in diet	survival	356	35.6	USEPA 1999c
Silver	chicken (chicks)	0.80	not specified	oral in diet	growth	35.0	3.50	Eisler 1996
Tin	Japanese quail	0.15	6 weeks	oral in diet	reproduction	16.9	6.76	Sample et al. 1996
Zinc	chicken	1.94	44 weeks	oral in diet	reproduction	131	14.5	Sample et al. 1996
Pesticides/PCBs								
4,4'-DDD	mallard	1.00	2 years	oral in diet	reproduction	0.60	0.12	USEPA 1995c
4,4'-DDD	barn owl	0.47	2 years	oral in diet	reproduction	0.80	0.08	Blus 1996
4,4'-DDD	Japanese quail	0.11	3 generations	oral in diet	reproduction	5.00	0.50	USEPA 1995c
4,4'-DDD	bald eagle	4.74	112 days	oral in diet	survival	3.00	0.30	USEPA 1995c
4,4'-DDE	mallard	1.00	2 years	oral in diet	reproduction	0.60	0.12	USEPA 1995c
4,4'-DDE	barn owl	0.47	2 years	oral in diet	reproduction	0.80	0.08	Blus 1996
4,4'-DDE	Japanese quail	0.11	3 generations	oral in diet	reproduction	5.00	0.50	USEPA 1995c
4,4'-DDE	bald eagle	4.74	112 days	oral in diet	survival	3.00	0.30	USEPA 1995c
4,4'-DDT	mallard	1.00	2 years	oral in diet	reproduction	1.50	0.60	USEPA 1995c
4,4'-DDT	barn owl	0.47	2 years	oral in diet	reproduction	0.80	0.08	Blus 1996
4,4'-DDT	Japanese quail	0.11	3 generations	oral in diet	reproduction	5.00	0.50	USEPA 1995c
4,4'-DDT	bald eagle	4.74	112 days	oral in diet	survival	3.00	0.30	USEPA 1995c
Aldrin	ring-necked pheasant	1.14	5 days	oral in diet	survival	0.70	0.07	Hill et al. 1975

Table 8-29
Ingestion Screening Values for Birds
NAB Little Creek, Virginia Beach, VA

Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	NOAEL (mg/kg/d)	Reference
Aldrin	mallard	1.00	5 days	oral in diet	survival	1.55	0.16	Hill et al. 1975
alpha-BHC	Japanese quail	0.15	90 days	oral in diet	reproduction	2.25	0.56	Sample et al. 1996
alpha-Chlordane	red-winged blackbird	0.06	84 days	oral in diet	survival	10.7	2.14	Sample et al. 1996
alpha-Chlordane	mallard	1.00	not specified	oral in diet	reproduction	8.00	0.80	Wiemeyer 1996
Aroclor-1016	screech owl	0.18	2 generations	oral in diet	reproduction	4.10	0.41	Sample et al. 1996
Aroclor-1016	mallard	1.00	1 month	oral in diet	reproduction	15.0	1.50	USEPA 1995c
Aroclor-1221	screech owl	0.18	2 generations	oral in diet	reproduction	4.10	0.41	Sample et al. 1996
Aroclor-1221	mallard	1.00	1 month	oral in diet	reproduction	15.0	1.50	USEPA 1995c
Aroclor-1232	screech owl	0.18	2 generations	oral in diet	reproduction	4.10	0.41	Sample et al. 1996
Aroclor-1232	mallard	1.00	1 month	oral in diet	reproduction	15.0	1.50	USEPA 1995c
Aroclor-1242	screech owl	0.18	2 generations	oral in diet	reproduction	4.10	0.41	Sample et al. 1996
Aroclor-1242	mallard	1.00	1 month	oral in diet	reproduction	15.0	1.50	USEPA 1995c
Aroclor-1248	screech owl	0.18	2 generations	oral in diet	reproduction	4.10	0.41	Sample et al. 1996
Aroclor-1248	mallard	1.00	1 month	oral in diet	reproduction	15.0	1.50	USEPA 1995c
Aroclor-1254	screech owl	0.18	2 generations	oral in diet	reproduction	4.10	0.41	Sample et al. 1996
Aroclor-1254	mallard	1.00	1 month	oral in diet	reproduction	15.0	1.50	USEPA 1995c
Aroclor-1260	screech owl	0.18	2 generations	oral in diet	reproduction	4.10	0.41	Sample et al. 1996
Aroclor-1260	mallard	1.00	1 month	oral in diet	reproduction	15.0	1.50	USEPA 1995c
beta-BHC	Japanese quail	0.15	90 days	oral in diet	reproduction	2.25	0.56	Sample et al. 1996
delta-BHC	Japanese quail	0.15	90 days	oral in diet	reproduction	2.25	0.56	Sample et al. 1996
Dieldrin	barn owl	0.47	2 years	oral in diet	reproduction	0.77	0.08	Sample et al. 1996
Endosulfan I	gray partridge	0.40	4 weeks	oral in diet	reproduction	100	10.0	Sample et al. 1996
Endosulfan II	gray partridge	0.40	4 weeks	oral in diet	reproduction	100	10.0	Sample et al. 1996
Endrin	mallard	1.15	>200 days	oral in diet	reproduction	3.00	0.30	Sample et al. 1996
Endrin	screech owl	0.18	>83 days	oral in diet	reproduction	0.10	0.01	Sample et al. 1996
gamma-BHC (Lindane)	mallard	1.00	8 weeks	oral (gavage)	reproduction	20.0	2.00	Sample et al. 1996
gamma-Chlordane	red-winged blackbird	0.06	84 days	oral in diet	survival	10.7	2.14	Sample et al. 1996
gamma-Chlordane	mallard	1.00	not specified	oral in diet	reproduction	8.00	0.80	Wiemeyer 1996
Heptachlor	ring-necked pheasant	1.14	5 days	oral in diet	survival	2.75	0.28	Hill et al. 1975
Heptachlor	mallard	1.00	5 days	oral in diet	survival	4.80	0.48	Hill et al. 1975
Heptachlor epoxide	ring-necked pheasant	1.14	5 days	oral in diet	survival	2.75	0.28	Hill et al. 1975
Heptachlor epoxide	mallard	1.00	5 days	oral in diet	survival	4.80	0.48	Hill et al. 1975

Table 8-29
Ingestion Screening Values for Birds
NAB Little Creek, Virginia Beach, VA

Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	NOAEL (mg/kg/d)	Reference
Methoxychlor	chicken	1.50	16 weeks	oral in diet	reproduction	3,550	355	Wiemeyer 1996
Toxaphene	American black duck	1.00	2 seasons	oral in diet	reproduction	5.00	1.00	Wiemeyer 1996
Volatile and Semivolatile Organics								
1,1,2,2-Tetrachloroethane	--	--	--	--	--	NA	NA	--
1,2,4-Trichlorobenzene	northern bobwhite	0.19	14 days	oral	survival	322	32.2	TERRETOX 2002
1,2-Dichlorobenzene	northern bobwhite	0.19	14 days	oral	survival	322	32.2	TERRETOX 2002
1,3-Dichlorobenzene	northern bobwhite	0.19	14 days	oral	survival	322	32.2	TERRETOX 2002
1,4-Dichlorobenzene	northern bobwhite	0.19	14 days	oral	survival	322	32.2	TERRETOX 2002
4-Bromophenyl-phenylether	--	--	--	--	--	NA	NA	--
4-Chlorophenyl-phenylether	--	--	--	--	--	NA	NA	--
Acenaphthene	chicken	1.50	35 days	oral in diet	reproduction	710	71.0	Rigdon and Neal 1963
Acenaphthylene	chicken	1.50	35 days	oral in diet	reproduction	710	71.0	Rigdon and Neal 1963
Anthracene	chicken	1.50	35 days	oral in diet	reproduction	710	71.0	Rigdon and Neal 1963
Benzo(a)anthracene	chicken	1.50	35 days	oral in diet	reproduction	710	71.0	Rigdon and Neal 1963
Benzo(a)pyrene	chicken	1.50	35 days	oral in diet	reproduction	710	71.0	Rigdon and Neal 1963
Benzo(b)fluoranthene	chicken	1.50	35 days	oral in diet	reproduction	710	71.0	Rigdon and Neal 1963
Benzo(g,h,i)perylene	chicken	1.50	35 days	oral in diet	reproduction	710	71.0	Rigdon and Neal 1963
Benzo(k)fluoranthene	chicken	1.50	35 days	oral in diet	reproduction	710	71.0	Rigdon and Neal 1963
Chrysene	chicken	1.50	35 days	oral in diet	reproduction	710	71.0	Rigdon and Neal 1963
Dibenz(a,h)anthracene	chicken	1.50	35 days	oral in diet	reproduction	710	71.0	Rigdon and Neal 1963
Fluoranthene	chicken	1.50	35 days	oral in diet	reproduction	710	71.0	Rigdon and Neal 1963
Fluorene	chicken	1.50	35 days	oral in diet	reproduction	710	71.0	Rigdon and Neal 1963
Hexachlorobenzene	Japanese quail	0.15	90 days	oral in diet	reproduction	0.57	0.11	Coulston and Kolbye 1994; TERRETOX 2002
Hexachlorobutadiene	Japanese quail	0.15	90 days	oral in diet	reproduction	33.9	3.39	Coulston and Kolbye 1994; TERRETOX 2002
Hexachlorocyclopentadiene	--	--	--	--	--	NA	NA	--
Hexachloroethane	--	--	--	--	--	NA	NA	--
Indeno(1,2,3-cd)pyrene	chicken	1.50	35 days	oral in diet	reproduction	710	71.0	Rigdon and Neal 1963
Pentachlorophenol	chicken	1.50	8 weeks	oral in diet	systemic/growth	85.2	42.6	Eisler 1989
Phenanthrene	chicken	1.50	35 days	oral in diet	reproduction	710	71.0	Rigdon and Neal 1963
Pyrene	chicken	1.50	35 days	oral in diet	reproduction	710	71.0	Rigdon and Neal 1963

Table 8-30
Step 2 Screening Statistics - Surface Soil
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	COPC?
Inorganics (MG/KG)								
Aluminum	30.8 - 47.7	25 / 25	12,100	LW07-SS09-00	50.0	25 / 25	242	YES
Antimony	9.20 - 14.3	7 / 25	2.70	LW07-SS25-00	5.00	0 / 25	0.54	NO
Arsenic	1.50 - 2.40	21 / 25	27.7	LW07-SS01-00	60.0	0 / 25	0.46	NO
Barium	30.8 - 47.7	25 / 25	263	LW07-SS09-00	500	0 / 25	0.53	NO
Beryllium	0.80 - 1.20	21 / 25	0.77	LW07-SS09-00	10.0	0 / 25	0.08	NO
Cadmium	0.80 - 1.90	8 / 25	0.33	LW07-SS24-00	4.00	0 / 25	0.08	NO
Calcium [2]	769 - 1,192	24 / 25	36,700	LW07-SS07-00	NSV	-- / --	NSV	NO
Chromium	1.50 - 2.40	25 / 25	79.3	LW07-SS24-00	0.40	25 / 25	198	YES
Cobalt	7.70 - 11.9	14 / 25	13.2	LW07-SS09-00	100	0 / 25	0.13	NO
Copper	3.80 - 6.00	21 / 25	518	LW07-SS24-00	50.0	5 / 25	10.4	YES
Cyanide	0.50 - 0.57	1 / 11	0.17	LW07-SS18-00	27.5	0 / 11	0.01	NO
Iron	15.4 - 23.8	25 / 25	26,600	LW07-SS09-00	200	25 / 25	133	YES
Lead	0.50 - 0.70	25 / 25	1,240	LW07-SS24-00	50.0	11 / 25	24.8	YES
Magnesium [2]	769 - 1,192	25 / 25	8,300	LW07-SS09-00	NSV	-- / --	NSV	NO
Manganese	2.30 - 3.60	25 / 25	617	LW07-SS09-00	500	2 / 25	1.23	YES
Mercury	0.07 - 0.10	10 / 25	0.99	LW07-SS24-00	0.10	5 / 25	9.90	YES
Nickel	6.20 - 9.50	17 / 25	25.0	LW07-SS09-00	30.0	0 / 25	0.83	NO
Potassium [2]	769 - 1,192	25 / 25	8,650	LW07-SS09-00	NSV	-- / --	NSV	NO
Selenium	0.80 - 1.90	3 / 25	0.75	LW07-SS17-00	1.80	0 / 25	0.42	NO
Silver	1.50 - 2.40	11 / 25	6.70	LW07-SS09-00	2.00	6 / 25	3.35	YES
Sodium [2]	769 - 1,192	8 / 25	501	LW07-SS21-00	NSV	-- / --	NSV	NO
Thallium	1.50 - 2.40	1 / 25	1.30	LW07-SS17-00	1.00	1 / 25	1.30	YES
Vanadium	7.70 - 11.9	25 / 25	43.2	LW07-SS09-00	2.00	25 / 25	21.6	YES
Zinc	3.10 - 4.80	25 / 25	602	LW07-SS04-00	50.0	21 / 25	12.0	YES
Pesticide/Polychlorinated Biphenyls (UG/KG)								
4,4'-DDD	3.55 - 4.33	0 / 3	--	--	100	-- / --	0.04	NO

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits
2 - Macronutrient - Not considered to be a COPC
3 - See Section 8.5 (uncertainties)

Table 8-30
Step 2 Screening Statistics - Surface Soil
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	COPC?
4,4'-DDE	3.55 - 4.30	1 / 3	23.0	LW07-SS01-00	100	0 / 3	0.23	NO
4,4'-DDT	3.55 - 4.30	1 / 3	10.0	LW07-SS01-00	100	0 / 3	0.10	NO
Aldrin	1.83 - 2.23	0 / 3	--	--	100	-- / --	0.02	NO
Aroclor-1016	35.5 - 43.3	0 / 3	--	--	100	-- / --	0.43	NO
Aroclor-1221	72.0 - 87.9	0 / 3	--	--	100	-- / --	0.88	NO
Aroclor-1232	35.5 - 43.3	0 / 3	--	--	100	-- / --	0.43	NO
Aroclor-1242	35.5 - 43.3	0 / 3	--	--	100	-- / --	0.43	NO
Aroclor-1248	35.5 - 43.3	0 / 3	--	--	100	-- / --	0.43	NO
Aroclor-1254	35.5 - 43.3	0 / 3	--	--	100	-- / --	0.43	NO
Aroclor-1260	35.5 - 43.3	0 / 3	--	--	100	-- / --	0.43	NO
Dieldrin	3.55 - 4.33	0 / 3	--	--	100	-- / --	0.04	NO
Endosulfan I	1.83 - 2.23	0 / 3	--	--	100	-- / --	0.02	NO
Endosulfan II	3.55 - 4.33	0 / 3	--	--	100	-- / --	0.04	NO
Endosulfan sulfate	3.55 - 4.33	0 / 3	--	--	100	-- / --	0.04	NO
Endrin	3.55 - 4.33	0 / 3	--	--	100	-- / --	0.04	NO
Endrin aldehyde	3.55 - 4.33	0 / 3	--	--	100	-- / --	0.04	NO
Endrin ketone	3.55 - 4.33	0 / 3	--	--	100	-- / --	0.04	NO
Heptachlor	1.83 - 2.23	0 / 3	--	--	100	-- / --	0.02	NO
Heptachlor epoxide	1.83 - 2.23	0 / 3	--	--	100	-- / --	0.02	NO
Methoxychlor	18.3 - 22.3	0 / 3	--	--	100	-- / --	0.22	NO
Toxaphene	183 - 223	0 / 3	--	--	NSV	-- / --	NSV	NO
alpha-BHC	1.83 - 2.23	0 / 3	--	--	100,000	-- / --	0.00002	NO
alpha-Chlordane	1.83 - 2.20	1 / 3	24.0	LW07-SS01-00	100	0 / 3	0.24	NO
beta-BHC	1.83 - 2.23	0 / 3	--	--	100,000	-- / --	0.00002	NO
delta-BHC	1.83 - 2.23	0 / 3	--	--	100,000	-- / --	0.00002	NO
gamma-BHC (Lindane)	1.83 - 2.23	0 / 3	--	--	100	-- / --	0.02	NO
gamma-Chlordane	1.83 - 2.23	0 / 3	--	--	100	-- / --	0.02	NO

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits
2 - Macronutrient - Not considered to be a COPC
3 - See Section 8.5 (uncertainties)

Table 8-30
Step 2 Screening Statistics - Surface Soil
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	COPC?
Semivolatile Organic Compounds (UG/KG)								
1,2,4-Trichlorobenzene	358 - 10,963	0 / 3	--	--	1,270	-- / --	8.63	--[3]
1,2-Dichlorobenzene	358 - 10,963	0 / 3	--	--	100	-- / --	110	--[3]
1,3-Dichlorobenzene	358 - 10,963	0 / 3	--	--	1,280	-- / --	8.57	--[3]
1,4-Dichlorobenzene	358 - 10,963	0 / 3	--	--	1,280	-- / --	8.57	--[3]
1-Methylnaphthalene	18.0 - 55.0	0 / 10	--	--	100	-- / --	0.55	NO
2,2'-Oxybis(1-chloropropane)	358 - 10,963	0 / 3	--	--	NSV	-- / --	NSV	NO
2,4,5-Trichlorophenol	894 - 27,409	0 / 3	--	--	430	-- / --	63.7	--[3]
2,4,6-Trichlorophenol	358 - 10,963	0 / 3	--	--	580	-- / --	18.9	--[3]
2,4-Dichlorophenol	358 - 10,963	0 / 3	--	--	13,400	-- / --	0.82	NO
2,4-Dimethylphenol	358 - 10,963	0 / 3	--	--	100	-- / --	110	--[3]
2,4-Dinitrophenol	894 - 27,409	0 / 3	--	--	20,000	-- / --	1.37	--[3]
2,4-Dinitrotoluene	358 - 10,963	0 / 3	--	--	NSV	-- / --	NSV	NO
2,6-Dinitrotoluene	358 - 10,963	0 / 3	--	--	NSV	-- / --	NSV	NO
2-Chloronaphthalene	358 - 10,963	0 / 3	--	--	1,033	-- / --	10.6	--[3]
2-Chlorophenol	358 - 10,963	0 / 3	--	--	100	-- / --	110	--[3]
2-Methylnaphthalene	18.0 - 10,963	0 / 13	--	--	100	-- / --	110	--[3]
2-Methylphenol	358 - 10,963	0 / 3	--	--	100	-- / --	110	--[3]
2-Nitroaniline	894 - 27,409	0 / 3	--	--	NSV	-- / --	NSV	NO
2-Nitrophenol	358 - 10,963	0 / 3	--	--	NSV	-- / --	NSV	NO
3,3'-Dichlorobenzidine	358 - 10,963	0 / 3	--	--	NSV	-- / --	NSV	NO
3-Nitroaniline	894 - 27,409	0 / 3	--	--	NSV	-- / --	NSV	NO
4,6-Dinitro-2-methylphenol	894 - 27,409	0 / 3	--	--	NSV	-- / --	NSV	NO
4-Bromophenyl-phenylether	358 - 10,963	0 / 3	--	--	NSV	-- / --	NSV	NO
4-Chloro-3-methylphenol	358 - 10,963	0 / 3	--	--	NSV	-- / --	NSV	NO
4-Chloroaniline	358 - 10,963	0 / 3	--	--	NSV	-- / --	NSV	NO

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits
2 - Macronutrient - Not considered to be a COPC
3 - See Section 8.5 (uncertainties)

Table 8-30
Step 2 Screening Statistics - Surface Soil
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	COPC?
4-Chlorophenyl-phenylether	358 - 10,963	0 / 3	--	--	NSV	-- / --	NSV	NO
4-Methylphenol	358 - 10,963	0 / 3	--	--	100	-- / --	110	--[3]
4-Nitroaniline	894 - 27,409	0 / 3	--	--	NSV	-- / --	NSV	NO
4-Nitrophenol	894 - 27,409	0 / 3	--	--	380	-- / --	72.1	--[3]
Acenaphthene	18.0 - 10,963	1 / 24	14.0	LW07-SS21-00	2,500	0 / 24	0.01	NO
Acenaphthylene	35.0 - 10,963	2 / 24	2,700	LW07-SS01-00	100	1 / 24	27.0	YES
Anthracene	1.80 - 10,963	8 / 24	4,700	LW07-SS01-00	100	1 / 24	47.0	YES
Benzo(a)anthracene	1.80 - 10,963	17 / 25	12,000	LW07-SS01-00	100	3 / 25	120	YES
Benzo(a)pyrene	1.80 - 10,963	19 / 25	14,000	LW07-SS01-00	100	2 / 25	140	YES
Benzo(b)fluoranthene	3.50 - 10,963	17 / 25	30,000	LW07-SS01-00	100	5 / 25	300	YES
Benzo(g,h,i)perylene	3.50 - 10,963	12 / 25	16,000	LW07-SS01-00	100	3 / 25	160	YES
Benzo(k)fluoranthene	1.80 - 10,963	17 / 25	27,000	LW07-SS01-00	100	3 / 25	270	YES
Butylbenzylphthalate	358 - 10,963	0 / 3	--	--	NSV	-- / --	NSV	NO
Carbazole	358 - 10,963	0 / 3	--	--	NSV	-- / --	NSV	NO
Chrysene	1.80 - 10,963	19 / 25	24,000	LW07-SS01-00	100	3 / 25	240	YES
Di-n-butylphthalate	358 - 10,963	1 / 3	65.0	LW07-SS02-00	200,000	0 / 3	0.0003	NO
Di-n-octylphthalate	358 - 10,963	0 / 3	--	--	NSV	-- / --	NSV	NO
Dibenz(a,h)anthracene	3.50 - 10,963	3 / 24	6,600	LW07-SS01-00	100	1 / 24	66.0	YES
Dibenzofuran	358 - 10,963	0 / 3	--	--	NSV	-- / --	NSV	NO
Diethylphthalate	358 - 10,963	0 / 3	--	--	13,400	-- / --	0.82	NO
Dimethyl phthalate	358 - 10,963	0 / 3	--	--	10,640	-- / --	1.03	--[3]
Fluoranthene	3.50 - 10,963	19 / 25	9,600	LW07-SS01-00	100	4 / 25	96.0	YES
Fluorene	3.50 - 10,963	2 / 24	14.0	LW07-SS21-00	1,700	0 / 24	0.01	NO
Hexachlorobenzene	358 - 10,963	0 / 3	--	--	NSV	-- / --	NSV	NO
Hexachlorobutadiene	358 - 10,963	0 / 3	--	--	NSV	-- / --	NSV	NO
Hexachlorocyclopentadiene	358 - 10,963	0 / 3	--	--	1,000	-- / --	11.0	--[3]
Hexachloroethane	358 - 10,963	0 / 3	--	--	NSV	-- / --	NSV	NO

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits
2 - Macronutrient - Not considered to be a COPC
3 - See Section 8.5 (uncertainties)

Table 8-30
Step 2 Screening Statistics - Surface Soil
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	COPC?
Indeno(1,2,3-cd)pyrene	1.80 - 10,963	18 / 25	17,000	LW07-SS01-00	100	1 / 25	170	YES
Isophorone	358 - 10,963	0 / 3	--	--	NSV	-- / --	NSV	NO
Naphthalene	18.0 - 10,963	0 / 24	--	--	100	-- / --	110	--[3]
Nitrobenzene	358 - 10,963	0 / 3	--	--	2,260	-- / --	4.85	--[3]
PAH (total)	-- - --	20 / 25	220,490	LW07-SS01-00	4,100	1 / 25	53.8	YES
Pentachlorophenol	894 - 27,409	0 / 3	--	--	3,000	-- / --	9.14	--[3]
Phenanthrene	1.80 - 10,963	15 / 25	190	LW07-SS21-00	100	1 / 25	1.90	YES
Phenol	358 - 10,963	0 / 3	--	--	1,880	-- / --	5.83	--[3]
Pyrene	1.80 - 10,963	18 / 25	24,000	LW07-SS01-00	100	5 / 25	240	YES
bis(2-Chloroethoxy)methane	358 - 10,963	0 / 3	--	--	NSV	-- / --	NSV	NO
bis(2-Chloroethyl)ether	358 - 10,963	0 / 3	--	--	NSV	-- / --	NSV	NO
bis(2-Ethylhexyl)phthalate	358 - 10,963	2 / 3	74.0	LW07-SS03-00	10,000	0 / 3	0.01	NO
n-Nitroso-di-n-propylamine	358 - 10,963	0 / 3	--	--	NSV	-- / --	NSV	NO
n-Nitrosodiphenylamine	358 - 10,963	0 / 3	--	--	1,090	-- / --	10.1	--[3]
Volatile Organic Compounds (UG/KG)								
1,1,1-Trichloroethane	10.7 - 13.3	0 / 3	--	--	300	-- / --	0.04	NO
1,1,2,2-Tetrachloroethane	10.7 - 13.3	0 / 3	--	--	300	-- / --	0.04	NO
1,1,2-Trichloroethane	10.7 - 13.3	0 / 3	--	--	300	-- / --	0.04	NO
1,1-Dichloroethane	10.7 - 13.3	0 / 3	--	--	300	-- / --	0.04	NO
1,1-Dichloroethene	10.7 - 13.3	0 / 3	--	--	NSV	-- / --	NSV	NO
1,2-Dichloroethane	10.7 - 13.3	0 / 3	--	--	401	-- / --	0.03	NO
1,2-Dichloroethene (total)	10.7 - 13.3	0 / 3	--	--	300	-- / --	0.04	NO
1,2-Dichloropropane	10.7 - 13.3	0 / 3	--	--	38,800	-- / --	0.0003	NO
2-Butanone	10.7 - 13.3	0 / 3	--	--	NSV	-- / --	NSV	NO
2-Hexanone	10.7 - 13.3	0 / 3	--	--	NSV	-- / --	NSV	NO
4-Methyl-2-pentanone	10.7 - 13.3	0 / 3	--	--	10,000	-- / --	0.001	NO
Acetone	10.7 - 13.3	0 / 3	--	--	NSV	-- / --	NSV	NO

NSV - No Screening Value
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3 - See Section 8.5 (uncertainties)

Table 8-30
Step 2 Screening Statistics - Surface Soil
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	COPC?
Benzene	10.7 - 13.3	0 / 3	--	--	105	-- / --	0.13	NO
Bromodichloromethane	10.7 - 13.3	0 / 3	--	--	45,000	-- / --	0.0003	NO
Bromoform	10.7 - 13.3	0 / 3	--	--	114,700	-- / --	0.0001	NO
Bromomethane	10.7 - 13.3	0 / 3	--	--	NSV	-- / --	NSV	NO
Carbon disulfide	10.7 - 13.3	0 / 3	--	--	NSV	-- / --	NSV	NO
Carbon tetrachloride	10.7 - 13.3	0 / 3	--	--	1,000,000	-- / --	0.00001	NO
Chlorobenzene	10.7 - 13.3	0 / 3	--	--	2,400	-- / --	0.01	NO
Chloroethane	10.7 - 13.3	0 / 3	--	--	NSV	-- / --	NSV	NO
Chloroform	10.7 - 13.3	0 / 3	--	--	1,000	-- / --	0.01	NO
Chloromethane	10.7 - 13.3	0 / 3	--	--	NSV	-- / --	NSV	NO
Dibromochloromethane	10.7 - 13.3	0 / 3	--	--	NSV	-- / --	NSV	NO
Ethylbenzene	10.7 - 13.3	0 / 3	--	--	5,005	-- / --	0.003	NO
Methylene chloride	10.7 - 13.3	0 / 3	--	--	1,001	-- / --	0.01	NO
Styrene	10.7 - 13.3	0 / 3	--	--	10,010	-- / --	0.001	NO
Tetrachloroethene	10.7 - 13.3	0 / 3	--	--	401	-- / --	0.03	NO
Toluene	10.7 - 13.3	0 / 3	--	--	13,005	-- / --	0.001	NO
Trichloroethene	10.7 - 13.3	0 / 3	--	--	6,000	-- / --	0.002	NO
Vinyl chloride	10.7 - 13.3	0 / 3	--	--	300	-- / --	0.04	NO
Xylene, total	10.7 - 13.3	0 / 3	--	--	2,505	-- / --	0.01	NO
cis-1,2-Dichloroethene	10.7 - 13.3	0 / 3	--	--	300	-- / --	0.04	NO
cis-1,3-Dichloropropene	10.7 - 13.3	0 / 3	--	--	300	-- / --	0.04	NO
m- and p-Xylene	10.7 - 13.3	0 / 3	--	--	2,505	-- / --	0.01	NO
o-Xylene	10.7 - 13.3	0 / 3	--	--	2,505	-- / --	0.01	NO
trans-1,2-Dichloroethene	10.7 - 13.3	0 / 3	--	--	300	-- / --	0.04	NO
trans-1,3-Dichloropropene	10.7 - 13.3	0 / 3	--	--	300	-- / --	0.04	NO

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits
2 - Macronutrient - Not considered to be a COPC
3 - See Section 8.5 (uncertainties)

Table 8-31
Step 2 Screening Statistics - Surface Sediment
NAB Little Creek, Virginia Beach, VA

Chemical	Frequency of Detection	Maximum Non-Detect	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	COPC?
Inorganics (MG/KG)								
Aluminum	24 / 24	--	17,100	LW07-SD05-00	18,000	0 / 24	0.95	NO
Antimony	11 / 24	1.38	19.0	LW07-K4	150	0 / 24	0.13	NO
Arsenic	24 / 24	--	12.6	LW07-L2-SD201	8.20	11 / 24	1.54	YES
Barium	23 / 24	21.0	49.1	LW07-SD05-00	48.0	1 / 24	1.02	YES
Beryllium	19 / 24	1.30	0.77	LW07-L2-SD201	NSV	-- / --	NSV	YES
Cadmium	16 / 24	0.39	0.66	LW07-H1	1.20	0 / 24	0.55	NO
Calcium [2]	24 / 24	--	35,400	LW07-SD04-00	NSV	-- / --	NSV	NO
Chromium	24 / 24	--	53.9	LW07-SD05-00	81.0	0 / 24	0.67	NO
Cobalt	19 / 24	6.00	6.80	LW07-L2-SD201	10.0	0 / 24	0.68	NO
Copper	24 / 24	--	142	LW07-SD05-00	34.0	21 / 24	4.18	YES
Cyanide	4 / 19	0.21	0.27	LW07-K5	NSV	-- / --	NSV	YES
Iron	24 / 24	--	31,000	LW07-SD05-00	220,000	0 / 24	0.14	NO
Lead	24 / 24	--	1,810	LW07-SD03-00	46.7	17 / 24	38.8	YES
Magnesium [2]	24 / 24	--	8,520	LW07-SD05-00	NSV	-- / --	NSV	NO
Manganese	24 / 24	--	226	LW07-SD05-00	260	0 / 24	0.87	NO
Mercury	20 / 24	0.56	3.18	LW07-L5	0.15	16 / 24	21.2	YES
Nickel	20 / 24	21.2	21.7	LW07-K5	20.9	1 / 24	1.04	YES
Potassium [2]	24 / 24	--	4,310	LW07-SD05-00	NSV	-- / --	NSV	NO
Selenium	8 / 24	1.90	2.38	LW07-H3	1.00	8 / 24	2.38	YES
Silver	7 / 24	1.20	7.80	LW07-SD05-00	1.00	4 / 24	7.80	YES
Sodium [2]	24 / 24	--	20,500	LW07-SD05-00	NSV	-- / --	NSV	NO
Thallium	1 / 24	1.50	0.55	LW07-SD01-00	NSV	-- / --	NSV	YES
Tin	19 / 19	--	10.5	LW07-M3	3.40	10 / 19	3.07	YES
Vanadium	24 / 24	--	47.7	LW07-SD05-00	57.0	0 / 24	0.84	NO
Zinc	23 / 24	205	915	LW07-M3	150	20 / 24	6.10	YES

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits
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3 - See Section 8.5 (uncertainties)

Table 8-31
Step 2 Screening Statistics - Surface Sediment
NAB Little Creek, Virginia Beach, VA

Chemical	Frequency of Detection	Maximum Non-Detect	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	COPC?
Pesticide/Polychlorinated Biphenyls (UG/KG)								
4,4'-DDD	0 / 1	4.46	--	--	16.0	-- / --	0.28	NO
4,4'-DDE	0 / 1	4.46	--	--	2.20	-- / --	2.03	--[3]
4,4'-DDT	0 / 1	4.46	--	--	1.58	-- / --	2.82	--[3]
Aldrin	0 / 1	2.30	--	--	9.50	-- / --	0.24	NO
Aroclor-1016	0 / 1	44.6	--	--	22.7	-- / --	1.97	--[3]
Aroclor-1221	0 / 1	90.6	--	--	22.7	-- / --	3.99	--[3]
Aroclor-1232	0 / 1	44.6	--	--	22.7	-- / --	1.97	--[3]
Aroclor-1242	0 / 1	44.6	--	--	22.7	-- / --	1.97	--[3]
Aroclor-1248	0 / 1	44.6	--	--	22.7	-- / --	1.97	--[3]
Aroclor-1254	0 / 1	44.6	--	--	22.7	-- / --	1.97	--[3]
Aroclor-1260	0 / 1	44.6	--	--	22.7	-- / --	1.97	--[3]
Dieldrin	0 / 1	4.46	--	--	0.72	-- / --	6.20	--[3]
Endosulfan I	0 / 1	2.30	--	--	10.0	-- / --	0.23	NO
Endosulfan II	0 / 1	4.46	--	--	10.0	-- / --	0.45	NO
Endosulfan sulfate	1 / 1	--	5.80	LW07-SD01-00	10.0	0 / 1	0.58	NO
Endrin	0 / 1	4.46	--	--	3.00	-- / --	1.49	--[3]
Endrin aldehyde	0 / 1	4.46	--	--	3.00	-- / --	1.49	--[3]
Endrin ketone	0 / 1	4.46	--	--	3.00	-- / --	1.49	--[3]
Heptachlor	0 / 1	2.30	--	--	5.00	-- / --	0.46	NO
Heptachlor epoxide	0 / 1	2.30	--	--	5.00	-- / --	0.46	NO
Methoxychlor	0 / 1	23.0	--	--	NSV	-- / --	NSV	NO
Toxaphene	0 / 1	230	--	--	NSV	-- / --	NSV	NO
alpha-BHC	0 / 1	2.30	--	--	6.00	-- / --	0.38	NO
alpha-Chlordane	0 / 1	2.30	--	--	7.00	-- / --	0.33	NO

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits
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3 - See Section 8.5 (uncertainties)

Table 8-31
Step 2 Screening Statistics - Surface Sediment
NAB Little Creek, Virginia Beach, VA

Chemical	Frequency of Detection	Maximum Non-Detect	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	COPC?
beta-BHC	0 / 1	2.30	--	--	5.00	-- / --	0.46	NO
delta-BHC	0 / 1	2.30	--	--	5.00	-- / --	0.46	NO
gamma-BHC (Lindane)	0 / 1	2.30	--	--	3.00	-- / --	0.77	NO
gamma-Chlordane	0 / 1	2.30	--	--	7.00	-- / --	0.33	NO
Semivolatile Organic Compounds (UG/KG)								
1,2,4-Trichlorobenzene	0 / 1	450	--	--	40.0	-- / --	11.3	--[3]
1,2-Dichlorobenzene	0 / 1	450	--	--	35.0	-- / --	12.9	--[3]
1,3-Dichlorobenzene	0 / 1	450	--	--	NSV	-- / --	NSV	NO
1,4-Dichlorobenzene	0 / 1	450	--	--	110	-- / --	4.09	--[3]
1-Methylnaphthalene	0 / 4	3,500	--	--	NSV	-- / --	NSV	NO
2,2'-Oxybis(1-chloropropane)	0 / 1	450	--	--	NSV	-- / --	NSV	NO
2,4,5-Trichlorophenol	0 / 1	1,100	--	--	NSV	-- / --	NSV	NO
2,4,6-Trichlorophenol	0 / 1	450	--	--	NSV	-- / --	NSV	NO
2,4-Dichlorophenol	0 / 1	450	--	--	NSV	-- / --	NSV	NO
2,4-Dimethylphenol	0 / 1	450	--	--	29.0	-- / --	15.5	--[3]
2,4-Dinitrophenol	0 / 1	1,100	--	--	NSV	-- / --	NSV	NO
2,4-Dinitrotoluene	0 / 1	450	--	--	NSV	-- / --	NSV	NO
2,6-Dinitrotoluene	0 / 1	450	--	--	NSV	-- / --	NSV	NO
2-Chloronaphthalene	0 / 1	450	--	--	NSV	-- / --	NSV	NO
2-Chlorophenol	0 / 1	450	--	--	NSV	-- / --	NSV	NO
2-Methylnaphthalene	0 / 5	3,500	--	--	70.0	-- / --	50.0	--[3]
2-Methylphenol	0 / 1	450	--	--	63.0	-- / --	7.14	--[3]
2-Nitroaniline	0 / 1	1,100	--	--	NSV	-- / --	NSV	NO
2-Nitrophenol	0 / 1	450	--	--	NSV	-- / --	NSV	NO
3,3'-Dichlorobenzidine	0 / 1	450	--	--	NSV	-- / --	NSV	NO
3-Nitroaniline	0 / 1	1,100	--	--	NSV	-- / --	NSV	NO

NSV - No Screening Value
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Table 8-31
Step 2 Screening Statistics - Surface Sediment
NAB Little Creek, Virginia Beach, VA

Chemical	Frequency of Detection	Maximum Non-Detect	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	COPC?
4,6-Dinitro-2-methylphenol	0 / 1	1,100	--	--	NSV	-- / --	NSV	NO
4-Bromophenyl-phenylether	0 / 1	450	--	--	NSV	-- / --	NSV	NO
4-Chloro-3-methylphenol	0 / 1	450	--	--	NSV	-- / --	NSV	NO
4-Chloroaniline	0 / 1	450	--	--	NSV	-- / --	NSV	NO
4-Chlorophenyl-phenylether	0 / 1	450	--	--	NSV	-- / --	NSV	NO
4-Methylphenol	0 / 1	450	--	--	670	-- / --	0.67	NO
4-Nitroaniline	0 / 1	1,100	--	--	NSV	-- / --	NSV	NO
4-Nitrophenol	0 / 1	1,100	--	--	NSV	-- / --	NSV	NO
Acenaphthene	13 / 24	3,500	3,000	LW07-SD05-00	16.0	12 / 24	188	YES
Acenaphthylene	20 / 24	6,900	520	LW07-M3	44.0	14 / 24	11.8	YES
Anthracene	24 / 24	--	2,300	LW07-SD04-00	85.3	20 / 24	27.0	YES
Benzo(a)anthracene	24 / 24	--	5,925	LW07-L5	261	15 / 24	22.7	YES
Benzo(a)pyrene	24 / 24	--	4,250	LW07-L5	430	15 / 24	9.88	YES
Benzo(b)fluoranthene	23 / 24	320	9,950	LW07-L5	3,200	3 / 24	3.11	YES
Benzo(g,h,i)perylene	22 / 24	605	1,800	LW07-SD04-00	670	10 / 24	2.69	YES
Benzo(k)fluoranthene	24 / 24	--	9,175	LW07-L5	1,800	8 / 24	5.10	YES
Butylbenzylphthalate	0 / 1	450	--	--	63.0	-- / --	7.14	--[3]
Carbazole	1 / 1	--	130	LW07-SD01-00	1,800	0 / 1	0.07	NO
Chrysene	24 / 24	--	16,575	LW07-L5	384	19 / 24	43.2	YES
Di-n-butylphthalate	1 / 1	--	83.0	LW07-SD01-00	1,400	0 / 1	0.06	NO
Di-n-octylphthalate	0 / 1	450	--	--	6,200	-- / --	0.07	NO
Dibenz(a,h)anthracene	22 / 24	765	993	LW07-L5	63.4	16 / 24	15.7	YES
Dibenzofuran	0 / 1	450	--	--	540	-- / --	0.83	NO
Diethylphthalate	0 / 1	450	--	--	200	-- / --	2.25	--[3]
Dimethyl phthalate	0 / 1	450	--	--	71.0	-- / --	6.34	--[3]
Fluoranthene	24 / 24	--	25,970	LW07-SD04-00	600	14 / 24	43.3	YES
Fluorene	17 / 24	793	2,100	LW07-SD04-00	19.0	16 / 24	111	YES

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits
2 - Macronutrient - Not considered to be a COPC
3 - See Section 8.5 (uncertainties)

Table 8-31
Step 2 Screening Statistics - Surface Sediment
NAB Little Creek, Virginia Beach, VA

Chemical	Frequency of Detection	Maximum Non-Detect	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	COPC?
Hexachlorobenzene	0 / 1	450	--	--	22.0	-- / --	20.5	--[3]
Hexachlorobutadiene	0 / 1	450	--	--	11.0	-- / --	40.9	--[3]
Hexachlorocyclopentadiene	0 / 1	450	--	--	NSV	-- / --	NSV	NO
Hexachloroethane	0 / 1	450	--	--	NSV	-- / --	NSV	NO
Indeno(1,2,3-cd)pyrene	24 / 24	--	2,198	LW07-L5	600	9 / 24	3.66	YES
Isophorone	0 / 1	450	--	--	NSV	-- / --	NSV	NO
Naphthalene	8 / 24	3,500	430	LW07-SD02-00	160	2 / 24	2.69	YES
Nitrobenzene	0 / 1	450	--	--	NSV	-- / --	NSV	NO
PAH (total)	24 / 24	--	105,690	LW07-SD04-00	4,022	17 / 24	26.3	YES
Pentachlorophenol	0 / 1	1,100	--	--	360	-- / --	3.06	--[3]
Phenanthrene	24 / 24	--	18,360	LW07-SD04-00	240	13 / 24	76.5	YES
Phenol	0 / 1	450	--	--	420	-- / --	1.07	--[3]
Pyrene	24 / 24	--	22,300	LW07-SD04-00	665	16 / 24	33.5	YES
bis(2-Chloroethoxy)methane	0 / 1	450	--	--	NSV	-- / --	NSV	NO
bis(2-Chloroethyl)ether	0 / 1	450	--	--	NSV	-- / --	NSV	NO
bis(2-Ethylhexyl)phthalate	1 / 1	--	66.0	LW07-SD01-00	1,300	0 / 1	0.05	NO
n-Nitroso-di-n-propylamine	0 / 1	450	--	--	NSV	-- / --	NSV	NO
n-Nitrosodiphenylamine	0 / 1	450	--	--	28.0	-- / --	16.1	--[3]
Other Parameters (MG/KG)								
Ammonia	17 / 19	3.63	40.8	LW07-K1	100	0 / 19	0.41	NO

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits
2 - Macronutrient - Not considered to be a COPC
3 - See Section 8.5 (uncertainties)

Table 8-32
Step 2 Screening Statistics - Groundwater (On-Site)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	COPC?
Inorganics (UG/L)								
Aluminum	200 - 200	6 / 7	2,910	LW07-MW05-02C	87.0	6 / 7	33.4	YES
Antimony	60.0 - 60.0	0 / 7	--	--	500	-- / --	0.12	NO
Arsenic	10.0 - 10.0	4 / 7	18.4	LW07-MW05-02C	36.0	0 / 7	0.51	NO
Barium	200 - 200	7 / 7	117	LW07-MW01-00B	1,000	0 / 7	0.12	NO
Beryllium	5.00 - 5.00	0 / 7	--	--	1,500	-- / --	0.003	NO
Cadmium	5.00 - 5.00	0 / 7	--	--	8.85	-- / --	0.56	NO
Calcium [2]	5,000 - 5,000	7 / 7	159,000	LW07-MW01-02C	NSV	-- / --	NSV	NO
Chromium	10.0 - 10.0	5 / 7	22.1	LW07-MW01-00B	50.4	0 / 7	0.44	NO
Cobalt	50.0 - 50.0	2 / 7	28.3	LW07-MW01-02C	23.0	1 / 7	1.23	YES
Copper	25.0 - 25.0	1 / 7	30.2	LW07-MW01-02C	3.70	1 / 7	8.16	YES
Cyanide	10.0 - 10.0	0 / 5	--	--	1.00	-- / --	10.0	--[3]
Iron	100 - 100	7 / 7	56,500	LW07-MW05-02C	1,000	7 / 7	56.5	YES
Lead	3.00 - 3.00	4 / 7	3.40	LW07-MW01-00B	8.50	0 / 7	0.40	NO
Magnesium [2]	5,000 - 5,000	7 / 7	160,000	LW07-MW01-02C	NSV	-- / --	NSV	NO
Manganese	15.0 - 15.0	7 / 7	5,710	LW07-MW01-02C	10.0	7 / 7	571	YES
Mercury	0.20 - 0.30	0 / 7	--	--	1.10	-- / --	0.27	NO
Nickel	40.0 - 40.0	2 / 7	9.60	LW07-MW05-02C	8.30	1 / 7	1.16	YES
Potassium [2]	5,000 - 5,000	7 / 7	62,100	LW07-MW01-02C	NSV	-- / --	NSV	NO
Selenium	5.00 - 5.00	0 / 7	--	--	71.1	-- / --	0.07	NO
Silver	10.0 - 10.0	1 / 7	8.30	LW07-MW03-00B	0.92	1 / 7	9.02	YES
Sodium [2]	5,000 - 50,000	7 / 7	1,120,000	LW07-MW01-02C	NSV	-- / --	NSV	NO
Thallium	10.0 - 10.0	0 / 7	--	--	213	-- / --	0.05	NO
Vanadium	50.0 - 50.0	7 / 7	10.0	LW07-MW05-02C	10,000	0 / 7	0.001	NO
Zinc	20.0 - 20.0	3 / 7	70.3	LW07-MW01-02C	86.0	0 / 7	0.82	NO
Dissolved Metals (UG/L)								
Aluminum	200 - 200	1 / 7	235	LW07-MW01-02C	87.0	1 / 7	2.70	YES
Antimony	60.0 - 60.0	0 / 7	--	--	500	-- / --	0.12	NO

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Table 8-32
Step 2 Screening Statistics - Groundwater (On-Site)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	COPC?
Arsenic	10.0 - 10.0	3 / 7	12.3	LW07-MW05-02C	36.0	0 / 7	0.34	NO
Barium	200 - 200	6 / 7	120	LW07-MW01-00B	1,000	0 / 7	0.12	NO
Beryllium	5.00 - 5.00	0 / 7	--	--	1,500	-- / --	0.003	NO
Cadmium	5.00 - 5.00	0 / 7	--	--	8.80	-- / --	0.57	NO
Calcium [2]	5,000 - 5,000	7 / 7	165,000	LW07-MW01-02C	NSV	-- / --	NSV	NO
Chromium	10.0 - 10.0	0 / 7	--	--	50.0	-- / --	0.20	NO
Cobalt	50.0 - 50.0	2 / 7	28.2	LW07-MW01-02C	23.0	1 / 7	1.23	YES
Copper	25.0 - 25.0	0 / 7	--	--	3.10	-- / --	8.06	--[3]
Iron	100 - 100	7 / 7	52,800	LW07-MW01-02C	1,000	7 / 7	52.8	YES
Lead	3.00 - 3.00	0 / 7	--	--	8.10	-- / --	0.37	NO
Magnesium [2]	5,000 - 5,000	7 / 7	167,000	LW07-MW01-02C	NSV	-- / --	NSV	NO
Manganese	15.0 - 15.0	7 / 7	5,910	LW07-MW01-02C	10.0	7 / 7	591	YES
Mercury	0.20 - 0.30	0 / 7	--	--	0.94	-- / --	0.32	NO
Nickel	40.0 - 40.0	1 / 7	4.50	LW07-MW01-02C	8.20	0 / 7	0.55	NO
Potassium [2]	5,000 - 5,000	7 / 7	63,800	LW07-MW01-02C	NSV	-- / --	NSV	NO
Selenium	5.00 - 5.00	1 / 7	5.00	LW07-MW06-02C	71.0	0 / 7	0.07	NO
Silver	10.0 - 10.0	0 / 7	--	--	0.92	-- / --	10.9	--[3]
Sodium [2]	5,000 - 50,000	7 / 7	1,210,000	LW07-MW01-02C	NSV	-- / --	NSV	NO
Thallium	10.0 - 10.0	0 / 7	--	--	213	-- / --	0.05	NO
Vanadium	50.0 - 50.0	2 / 7	3.10	LW07-MW04-02C	10,000	0 / 7	0.0003	NO
Zinc	20.0 - 20.0	2 / 7	37.0	LW07-MW01-02C	81.0	0 / 7	0.46	NO
Pesticide/Polychlorinated Biphenyls (UG/L)								
4,4'-DDD	0.10 - 0.10	0 / 2	--	--	0.025	-- / --	4.00	--[3]
4,4'-DDE	0.10 - 0.10	0 / 2	--	--	1.40	-- / --	0.07	NO
4,4'-DDT	0.10 - 0.10	0 / 2	--	--	0.001	-- / --	100	--[3]
Aldrin	0.050 - 0.050	0 / 2	--	--	0.13	-- / --	0.38	NO
Aroclor-1016	1.00 - 1.00	0 / 2	--	--	0.03	-- / --	33.3	--[3]

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Table 8-32
Step 2 Screening Statistics - Groundwater (On-Site)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	COPC?
Aroclor-1221	2.00 - 2.00	0 / 2	--	--	0.03	-- / --	66.7	--[3]
Aroclor-1232	1.00 - 1.00	0 / 2	--	--	0.03	-- / --	33.3	--[3]
Aroclor-1242	1.00 - 1.00	0 / 2	--	--	0.03	-- / --	33.3	--[3]
Aroclor-1248	1.00 - 1.00	0 / 2	--	--	0.03	-- / --	33.3	--[3]
Aroclor-1254	1.00 - 1.00	0 / 2	--	--	0.03	-- / --	33.3	--[3]
Aroclor-1260	1.00 - 1.00	0 / 2	--	--	0.03	-- / --	33.3	--[3]
Dieldrin	0.10 - 0.10	0 / 2	--	--	0.11	-- / --	0.91	NO
Endosulfan I	0.050 - 0.050	0 / 2	--	--	0.0087	-- / --	5.75	--[3]
Endosulfan II	0.10 - 0.10	0 / 2	--	--	0.0087	-- / --	11.5	--[3]
Endosulfan sulfate	0.10 - 0.10	0 / 2	--	--	0.0087	-- / --	11.5	--[3]
Endrin	0.10 - 0.10	0 / 2	--	--	0.01	-- / --	10.0	--[3]
Endrin aldehyde	0.10 - 0.10	0 / 2	--	--	0.01	-- / --	10.0	--[3]
Endrin ketone	0.10 - 0.10	0 / 2	--	--	0.01	-- / --	10.0	--[3]
Heptachlor	0.050 - 0.050	0 / 2	--	--	0.0036	-- / --	13.9	--[3]
Heptachlor epoxide	0.050 - 0.050	0 / 2	--	--	0.0036	-- / --	13.9	--[3]
Methoxychlor	0.50 - 0.50	0 / 2	--	--	0.03	-- / --	16.7	--[3]
Toxaphene	5.00 - 5.00	0 / 2	--	--	0.21	-- / --	23.8	--[3]
alpha-BHC	0.050 - 0.050	0 / 2	--	--	0.034	-- / --	1.47	--[3]
alpha-Chlordane	0.050 - 0.050	0 / 2	--	--	0.004	-- / --	12.5	--[3]
beta-BHC	0.050 - 0.050	0 / 2	--	--	0.034	-- / --	1.47	--[3]
delta-BHC	0.050 - 0.050	0 / 2	--	--	0.034	-- / --	1.47	--[3]
gamma-BHC (Lindane)	0.050 - 0.050	0 / 2	--	--	0.016	-- / --	3.13	--[3]
gamma-Chlordane	0.050 - 0.050	0 / 2	--	--	0.004	-- / --	12.5	--[3]
Semivolatile Organic Compounds (UG/L)								
1,1-Biphenyl	10.0 - 10.0	0 / 5	--	--	NSV	-- / --	NSV	NO

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Table 8-32
Step 2 Screening Statistics - Groundwater (On-Site)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	COPC?
1,2,4-Trichlorobenzene	10.0 - 10.0	0 / 2	--	--	129	-- / --	0.08	NO
1,2-Dichlorobenzene	10.0 - 10.0	0 / 2	--	--	129	-- / --	0.08	NO
1,3-Dichlorobenzene	10.0 - 10.0	0 / 2	--	--	129	-- / --	0.08	NO
1,4-Dichlorobenzene	10.0 - 10.0	0 / 2	--	--	129	-- / --	0.08	NO
2,2'-Oxybis(1-chloropropane)	10.0 - 10.0	0 / 7	--	--	NSV	-- / --	NSV	NO
2,4,5-Trichlorophenol	25.0 - 25.0	0 / 7	--	--	11.0	-- / --	2.27	--[3]
2,4,6-Trichlorophenol	10.0 - 10.0	0 / 7	--	--	NSV	-- / --	NSV	NO
2,4-Dichlorophenol	10.0 - 10.0	0 / 7	--	--	NSV	-- / --	NSV	NO
2,4-Dimethylphenol	10.0 - 10.0	0 / 7	--	--	110	-- / --	0.09	NO
2,4-Dinitrophenol	25.0 - 25.0	0 / 7	--	--	485	-- / --	0.05	NO
2,4-Dinitrotoluene	10.0 - 10.0	0 / 7	--	--	370	-- / --	0.03	NO
2,6-Dinitrotoluene	10.0 - 10.0	0 / 7	--	--	NSV	-- / --	NSV	NO
2-Chloronaphthalene	10.0 - 10.0	0 / 7	--	--	0.75	-- / --	13.3	--[3]
2-Chlorophenol	10.0 - 10.0	0 / 7	--	--	NSV	-- / --	NSV	NO
2-Methylnaphthalene	10.0 - 10.0	0 / 7	--	--	30.0	-- / --	0.33	NO
2-Methylphenol	10.0 - 10.0	0 / 7	--	--	NSV	-- / --	NSV	NO
2-Nitroaniline	25.0 - 25.0	0 / 7	--	--	NSV	-- / --	NSV	NO
2-Nitrophenol	10.0 - 10.0	0 / 7	--	--	485	-- / --	0.02	NO
3,3'-Dichlorobenzidine	10.0 - 10.0	0 / 7	--	--	NSV	-- / --	NSV	NO
3-Nitroaniline	25.0 - 25.0	0 / 7	--	--	NSV	-- / --	NSV	NO
4,6-Dinitro-2-methylphenol	25.0 - 25.0	0 / 7	--	--	NSV	-- / --	NSV	NO
4-Bromophenyl-phenylether	10.0 - 10.0	0 / 7	--	--	NSV	-- / --	NSV	NO
4-Chloro-3-methylphenol	10.0 - 10.0	0 / 7	--	--	NSV	-- / --	NSV	NO
4-Chloroaniline	10.0 - 10.0	0 / 7	--	--	129	-- / --	0.08	NO
4-Chlorophenyl-phenylether	10.0 - 10.0	0 / 7	--	--	NSV	-- / --	NSV	NO
4-Methylphenol	10.0 - 10.0	0 / 7	--	--	NSV	-- / --	NSV	NO
4-Nitroaniline	25.0 - 25.0	0 / 7	--	--	NSV	-- / --	NSV	NO
4-Nitrophenol	25.0 - 25.0	0 / 7	--	--	485	-- / --	0.05	NO

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Table 8-32
Step 2 Screening Statistics - Groundwater (On-Site)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	COPC?
Acenaphthene	10.0 - 10.0	1 / 7	0.30	LW07-MW01-02C	710	0 / 7	0.0004	NO
Acenaphthylene	10.0 - 10.0	0 / 7	--	--	30.0	-- / --	0.33	NO
Acetophenone	10.0 - 10.0	0 / 5	--	--	NSV	-- / --	NSV	NO
Anthracene	10.0 - 10.0	0 / 7	--	--	30.0	-- / --	0.33	NO
Atrazine	10.0 - 10.0	0 / 5	--	--	NSV	-- / --	NSV	NO
Benzaldehyde	10.0 - 10.0	0 / 5	--	--	NSV	-- / --	NSV	NO
Benzo(a)anthracene	10.0 - 10.0	0 / 7	--	--	8.13	-- / --	1.23	--[3]
Benzo(a)pyrene	10.0 - 10.0	0 / 7	--	--	0.021	-- / --	476	--[3]
Benzo(b)fluoranthene	10.0 - 10.0	0 / 7	--	--	30.0	-- / --	0.33	NO
Benzo(g,h,i)perylene	10.0 - 10.0	0 / 7	--	--	30.0	-- / --	0.33	NO
Benzo(k)fluoranthene	10.0 - 10.0	0 / 7	--	--	30.0	-- / --	0.33	NO
Butylbenzylphthalate	10.0 - 10.0	0 / 7	--	--	29.4	-- / --	0.34	NO
Caprolactam	10.0 - 10.0	1 / 5	2.00	LW07-MW06-02C	NSV	-- / --	NSV	YES
Carbazole	10.0 - 10.0	0 / 7	--	--	NSV	-- / --	NSV	NO
Chrysene	10.0 - 10.0	0 / 7	--	--	30.0	-- / --	0.33	NO
Di-n-butylphthalate	10.0 - 10.0	3 / 7	0.60	LW07-MW05-02C	3.40	0 / 7	0.18	NO
Di-n-octylphthalate	10.0 - 10.0	0 / 7	--	--	3.40	-- / --	2.94	--[3]
Dibenz(a,h)anthracene	10.0 - 10.0	0 / 7	--	--	30.0	-- / --	0.33	NO
Dibenzofuran	10.0 - 10.0	0 / 7	--	--	NSV	-- / --	NSV	NO
Diethylphthalate	10.0 - 10.0	0 / 7	--	--	75.9	-- / --	0.13	NO
Dimethyl phthalate	10.0 - 10.0	2 / 7	4.00	LW07-MW05-02C	580	0 / 7	0.01	NO
Fluoranthene	10.0 - 10.0	0 / 7	--	--	16.0	-- / --	0.63	NO
Fluorene	10.0 - 10.0	0 / 7	--	--	30.0	-- / --	0.33	NO
Hexachlorobenzene	10.0 - 10.0	0 / 7	--	--	129	-- / --	0.08	NO
Hexachlorobutadiene	10.0 - 10.0	0 / 7	--	--	3.20	-- / --	3.13	--[3]
Hexachlorocyclopentadiene	10.0 - 10.0	0 / 7	--	--	0.70	-- / --	14.3	--[3]
Hexachloroethane	10.0 - 10.0	0 / 7	--	--	94.0	-- / --	0.11	NO
Indeno(1,2,3-cd)pyrene	10.0 - 10.0	0 / 7	--	--	30.0	-- / --	0.33	NO

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Step 2 Screening Statistics - Groundwater (On-Site)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	COPC?
Isophorone	10.0 - 10.0	0 / 7	--	--	1,290	-- / --	0.01	NO
Naphthalene	10.0 - 10.0	0 / 7	--	--	230	-- / --	0.04	NO
Nitrobenzene	10.0 - 10.0	0 / 7	--	--	668	-- / --	0.01	NO
Pentachlorophenol	25.0 - 25.0	0 / 7	--	--	7.90	-- / --	3.16	--[3]
Phenanthrene	10.0 - 10.0	0 / 7	--	--	4.60	-- / --	2.17	--[3]
Phenol	10.0 - 10.0	0 / 7	--	--	580	-- / --	0.02	NO
Pyrene	10.0 - 10.0	0 / 7	--	--	30.0	-- / --	0.33	NO
bis(2-Chloroethoxy)methane	10.0 - 10.0	0 / 7	--	--	6,400	-- / --	0.002	NO
bis(2-Chloroethyl)ether	10.0 - 10.0	0 / 7	--	--	NSV	-- / --	NSV	NO
bis(2-Ethylhexyl)phthalate	10.0 - 10.0	0 / 7	--	--	360	-- / --	0.03	NO
n-Nitroso-di-n-propylamine	10.0 - 10.0	0 / 7	--	--	NSV	-- / --	NSV	NO
n-Nitrosodiphenylamine	10.0 - 10.0	0 / 7	--	--	330,000	-- / --	0.00003	NO
Volatile Organic Compounds (UG/L)								
1,1,1-Trichloroethane	0.50 - 10.0	0 / 7	--	--	3,120	-- / --	0.003	NO
1,1,2,2-Tetrachloroethane	0.50 - 10.0	0 / 7	--	--	623	-- / --	0.02	NO
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	0.50 - 0.50	0 / 5	--	--	NSV	-- / --	NSV	NO
1,1,2-Trichloroethane	0.50 - 10.0	0 / 7	--	--	3,120	-- / --	0.003	NO
1,1-Dichloroethane	0.50 - 10.0	0 / 7	--	--	3,200	-- / --	0.003	NO
1,1-Dichloroethene	0.50 - 10.0	0 / 7	--	--	22,400	-- / --	0.0004	NO
1,2,3-Trichlorobenzene	0.50 - 0.50	0 / 5	--	--	NSV	-- / --	NSV	NO
1,2,4-Trichlorobenzene	0.50 - 0.50	0 / 5	--	--	129	-- / --	0.004	NO
1,2-Dibromo-3-chloropropane	0.50 - 0.50	0 / 5	--	--	NSV	-- / --	NSV	NO
1,2-Dibromoethane	0.50 - 0.50	0 / 5	--	--	NSV	-- / --	NSV	NO
1,2-Dichlorobenzene	0.50 - 0.50	0 / 5	--	--	129	-- / --	0.004	NO
1,2-Dichloroethane	0.50 - 10.0	0 / 7	--	--	1,130	-- / --	0.009	NO
1,2-Dichloroethene (total)	10.0 - 10.0	0 / 2	--	--	22,400	-- / --	0.0004	NO
1,2-Dichloropropane	0.50 - 10.0	0 / 7	--	--	3,040	-- / --	0.003	NO
1,3-Dichlorobenzene	0.50 - 0.50	0 / 5	--	--	129	-- / --	0.004	NO

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Step 2 Screening Statistics - Groundwater (On-Site)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	COPC?
1,4-Dichlorobenzene	0.50 - 0.50	0 / 5	--	--	129	-- / --	0.004	NO
2-Butanone	5.00 - 10.0	0 / 7	--	--	NSV	-- / --	NSV	NO
2-Hexanone	5.00 - 10.0	0 / 7	--	--	NSV	-- / --	NSV	NO
4-Methyl-2-pentanone	5.00 - 10.0	0 / 7	--	--	NSV	-- / --	NSV	NO
Acetone	5.00 - 10.0	0 / 7	--	--	NSV	-- / --	NSV	NO
Benzene	0.50 - 10.0	0 / 7	--	--	700	-- / --	0.01	NO
Bromochloromethane	0.50 - 0.50	0 / 5	--	--	6,400	-- / --	0.0001	NO
Bromodichloromethane	0.50 - 10.0	0 / 7	--	--	6,400	-- / --	0.002	NO
Bromoform	0.50 - 10.0	0 / 7	--	--	640	-- / --	0.02	NO
Bromomethane	0.50 - 10.0	0 / 7	--	--	120	-- / --	0.08	NO
Carbon disulfide	0.50 - 10.0	0 / 7	--	--	2.00	-- / --	5.00	--[3]
Carbon tetrachloride	0.50 - 10.0	0 / 7	--	--	5,000	-- / --	0.002	NO
Chlorobenzene	0.50 - 10.0	0 / 7	--	--	129	-- / --	0.08	NO
Chloroethane	0.50 - 10.0	0 / 7	--	--	NSV	-- / --	NSV	NO
Chloroform	0.50 - 10.0	1 / 7	14.0	LW07-MW01-00B	815	0 / 7	0.02	NO
Chloromethane	0.50 - 10.0	0 / 7	--	--	2,700	-- / --	0.004	NO
Cumene	0.50 - 0.50	0 / 5	--	--	NSV	-- / --	NSV	NO
Cyclohexane	0.50 - 0.50	0 / 5	--	--	NSV	-- / --	NSV	NO
Dibromochloromethane	0.50 - 10.0	0 / 7	--	--	6,400	-- / --	0.002	NO
Dichlorodifluoromethane(Freon-12)	0.50 - 0.50	0 / 5	--	--	6,400	-- / --	0.0001	NO
Ethylbenzene	0.50 - 10.0	0 / 7	--	--	43.0	-- / --	0.23	NO
Methyl acetate	0.50 - 0.50	0 / 5	--	--	NSV	-- / --	NSV	NO
Methyl-tert-butyl ether (MTBE)	0.50 - 0.96	3 / 5	25.0	LW07-MW03-02C	NSV	-- / --	NSV	YES
Methylcyclohexane	0.50 - 0.50	0 / 5	--	--	NSV	-- / --	NSV	NO
Methylene chloride	0.50 - 10.0	0 / 7	--	--	6,400	-- / --	0.002	NO
Styrene	0.50 - 10.0	0 / 7	--	--	NSV	-- / --	NSV	NO
Tetrachloroethene	0.50 - 10.0	1 / 7	0.14	LW07-MW03-02C	450	0 / 7	0.0003	NO
Toluene	0.50 - 10.0	0 / 7	--	--	37.0	-- / --	0.27	NO

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Step 2 Screening Statistics - Groundwater (On-Site)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	COPC?
Trichloroethene	0.50 - 10.0	0 / 7	--	--	200	-- / --	0.05	NO
Trichlorofluoromethane(Freon-11)	0.50 - 0.50	0 / 5	--	--	6,400	-- / --	0.0001	NO
Vinyl chloride	0.50 - 10.0	0 / 7	--	--	22,400	-- / --	0.0004	NO
Xylene, total	0.50 - 10.0	0 / 7	--	--	135	-- / --	0.07	NO
cis-1,2-Dichloroethene	0.50 - 10.0	0 / 7	--	--	22,400	-- / --	0.0004	NO
cis-1,3-Dichloropropene	0.50 - 10.0	0 / 7	--	--	79.0	-- / --	0.13	NO
m- and p-Xylene	10.0 - 10.0	0 / 2	--	--	135	-- / --	0.07	NO
o-Xylene	10.0 - 10.0	0 / 2	--	--	135	-- / --	0.07	NO
trans-1,2-Dichloroethene	0.50 - 10.0	0 / 7	--	--	22,400	-- / --	0.0004	NO
trans-1,3-Dichloropropene	0.50 - 10.0	0 / 7	--	--	79.0	-- / --	0.13	NO

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits
2 - Macronutrient - Not considered to be a COPC
3 - See Section 8.5 (uncertainties)

Table 8-33
Summary of Hazard Quotients for Upper Trophic Level Receptors - Step 2
NAB Little Creek, Virginia Beach, VA

Chemical	Deer mouse		Red fox		Killdeer		American kestrel		Osprey	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Inorganics										
Arsenic	10.2	1.02	0.14	0.01	1.04	0.35	0.37	0.12	0.02	<0.01
Cadmium	0.37	0.04	0.04	<0.01	1.43	0.10	0.51	0.04	<0.01	<0.01
Chromium	1.98	0.20	0.48	0.05	39.4	7.88	16.3	3.26	0.15	0.03
Copper	0.38	0.29	1.23	0.95	2.72	2.07	1.48	1.13	0.02	0.02
Lead	8.15	0.81	2.55	0.26	78.8	7.88	35.6	3.56	2.45	0.24
Mercury	20.4	4.08	0.33	0.20	6.48	2.65	2.30	0.94	2.21	0.90
Nickel	0.10	0.05	0.04	0.01	0.24	0.17	0.10	0.07	0.02	0.02
Selenium	0.46	0.28	0.24	0.15	0.38	0.11	0.31	0.09	0.10	<0.01
Silver	0.28	0.03	0.04	<0.01	4.55	0.45	1.74	0.17	0.02	<0.01
Tin	--	--	--	--	--	--	--	--	0.12	0.05
Zinc	1.41	0.70	3.97	0.40	83.2	9.20	39.3	4.35	0.69	0.08
Pesticides/PCBs										
4,4'-DDD	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4,4'-DDE	<0.01	<0.01	<0.01	<0.01	0.08	<0.01	0.19	0.02	0.03	<0.01
4,4'-DDT	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aldrin	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01
alpha-BHC	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
alpha-Chlordane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aroclor-1016	0.25	0.03	<0.01	<0.01	0.26	0.03	0.10	0.01	0.10	0.01
Aroclor-1221	0.51	0.05	0.09	<0.01	0.53	0.05	0.21	0.02	0.21	0.02
Aroclor-1232	0.25	0.03	0.05	<0.01	0.26	0.03	0.10	0.01	0.10	0.01
Aroclor-1242	0.25	0.03	0.05	<0.01	0.26	0.03	0.10	0.01	0.10	0.01
Aroclor-1248	0.25	0.03	0.02	<0.01	0.26	0.03	0.10	0.01	0.10	0.01
Aroclor-1254	0.25	0.03	0.02	<0.01	0.26	0.03	0.10	0.01	0.10	0.01
Aroclor-1260	0.25	0.03	0.02	<0.01	0.26	0.03	0.10	0.01	0.10	0.01
beta-BHC	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
delta-BHC	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dieldrin	0.05	<0.01	0.01	<0.01	0.07	<0.01	0.03	<0.01	<0.01	<0.01
Endosulfan I	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan II	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endrin	<0.01	<0.01	<0.01	<0.01	0.25	0.02	0.10	<0.01	0.03	<0.01

Table 8-33
Summary of Hazard Quotients for Upper Trophic Level Receptors - Step 2
NAB Little Creek, Virginia Beach, VA

Chemical	Deer mouse		Red fox		Killdeer		American kestrel		Osprey	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
gamma-BHC (Lindane)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
gamma-Chlordane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor epoxide	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methoxychlor	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Toxaphene	<0.01	<0.01	<0.01	<0.01	0.04	<0.01	0.01	<0.01	0.02	<0.01
Volatile and Semivolatile Organics										
1,1,2,2-Tetrachloroethane	<0.01	<0.01	<0.01	<0.01	NA	NA	NA	NA	--	--
1,2,4-Trichlorobenzene	<0.01	<0.01	<0.01	<0.01	0.03	<0.01	0.01	<0.01	<0.01	<0.01
1,2-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	0.06	<0.01	0.02	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	0.06	<0.01	0.02	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	0.06	<0.01	0.02	<0.01	<0.01	<0.01
4-Bromophenyl-phenylether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(a)anthracene	0.10	0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(a)pyrene	0.14	0.01	0.04	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	0.20	0.02	0.08	<0.01	0.02	<0.01	<0.01	<0.01	0.01	<0.01
Benzo(g,h,i)perylene	0.08	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	0.18	0.02	0.07	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01
Chrysene	0.31	0.03	0.09	<0.01	0.03	<0.01	0.01	<0.01	0.02	<0.01
Dibenz(a,h)anthracene	0.09	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	<0.01
Fluorene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Hexachlorobenzene	0.48	0.24	0.08	<0.01	26.1	5.22	10.4	2.08	0.28	0.06
Hexachlorobutadiene	0.15	0.02	0.04	<0.01	0.53	0.05	0.21	0.02	<0.01	<0.01
Hexachlorocyclopentadiene	<0.01	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA
Hexachloroethane	<0.01	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.19	0.02	0.06	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01
Pentachlorophenol	2.21	0.22	0.41	0.04	0.80	0.40	0.32	0.16	<0.01	<0.01

Table 8-33
Summary of Hazard Quotients for Upper Trophic Level Receptors - Step 2
NAB Little Creek, Virginia Beach, VA

Chemical	Deer mouse		Red fox		Killdeer		American kestrel		Osprey	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Phenanthrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01
Pyrene	0.31	0.03	0.09	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01

Table 8-34
Summary of COPCs - Step 2
NAB Little Creek, Virginia Beach, VA

Chemical	Surface Soil		Surface Sediment		Groundwater		Food Web[1]	
	MD[2]	NSV	MD	NSV	MD	NSV	MD	NSV
Inorganics								
Aluminum	X				X			
Arsenic			X				T	
Barium			X					
Beryllium				X				
Cadmium							T	
Chromium	X						T	
Cobalt					X			
Copper	X		X		X		T	
Cyanide				X				
Iron	X				X			
Lead	X		X				T,A	
Manganese	X				X			
Mercury	X		X				T,A	
Nickel			X		X			
Selenium			X					
Silver	X		X		X		T	
Thallium	X			X				
Tin			X					
Vanadium	X							
Zinc	X		X				T	
Semivolatile Organic Compounds								
Acenaphthene			X					
Acenaphthylene	X		X					
Anthracene	X		X					
Benzo(a)anthracene	X		X					
Benzo(a)pyrene	X		X					
Benzo(b)fluoranthene	X		X					
Benzo(g,h,i)perylene	X		X					
Benzo(k)fluoranthene	X		X					
Caprolactam						X		
Chrysene	X		X					
Dibenz(a,h)anthracene	X		X					
Fluoranthene	X		X					
Fluorene			X					
Indeno(1,2,3-cd)pyrene	X		X					
Naphthalene			X					
PAH (total)	X		X					
Phenanthrene	X		X					
Pyrene	X		X					
Volatile Organic Compounds								
Methyl-tert-butyl ether (MTBE)						X		

1 - T = Terrestrial; A = Aquatic
2 - MD = Maximum Detection; NSV = Detected Chemical With No Screening Value

Table 8-35
Soil Bioconcentration and Bioaccumulation Factors For Plants and Soil Invertebrates - Step 3
NAB Little Creek, Virginia Beach, VA

Chemical	Soil-Plant BCF (dry weight)		Soil-Invertebrate BAF (dry weight)	
	Value	Reference	Value	Reference
Inorganics				
Arsenic	0.04	Bechtel Jacobs 1998a	0.26	Sample et al. 1998a
Cadmium	0.51	Bechtel Jacobs 1998a	7.66	Sample et al. 1998a
Chromium	0.05	Bechtel Jacobs 1998a	0.32	Sample et al. 1998a
Copper	0.12	Bechtel Jacobs 1998a	0.47	Sample et al. 1998a
Lead	0.04	Bechtel Jacobs 1998a	0.31	Sample et al. 1998a
Mercury	0.34	Bechtel Jacobs 1998a	1.19	Sample et al. 1998a
Silver	0.01	Bechtel Jacobs 1998a	2.05	Sample et al. 1998a
Zinc	0.36	Bechtel Jacobs 1998a	2.48	Sample et al. 1998a

Table 8-36
Soil Bioaccumulation Factors For Small Mammals - Step 3
NAB Little Creek, Virginia Beach, VA

Chemical	Soil-Mouse BAF (dry weight)		Soil-Vole BAF (dry weight)		Soil-Shrew BAF (dry weight)	
	Value	Reference	Value	Reference	Value	Reference
Inorganics						
Arsenic	0.003	Sample et al. 1998b	0.005	Sample et al. 1998b	0.004	Sample et al. 1998b
Cadmium	0.144	Sample et al. 1998b	0.134	Sample et al. 1998b	2.212	Sample et al. 1998b
Chromium	0.092	Sample et al. 1998b	0.088	Sample et al. 1998b	0.094	Sample et al. 1998b
Copper	0.111	Sample et al. 1998b	0.109	Sample et al. 1998b	0.502	Sample et al. 1998b
Lead	0.055	Sample et al. 1998b	0.041	Sample et al. 1998b	0.148	Sample et al. 1998b
Mercury	0.054	Sample et al. 1998b	0.067	Sample et al. 1998b	0.067	Sample et al. 1998b
Silver	0.151	Sample et al. 1998b	0.006	Sample et al. 1998b	0.036	Sample et al. 1998b
Zinc	0.509	Sample et al. 1998b	0.293	Sample et al. 1998b	0.862	Sample et al. 1998b

Table 8-37
Sediment Bioaccumulation Factors For Benthic Invertebrates and Fish - Step 3
NAB Little Creek, Virginia Beach, VA

Chemical	Sediment-Invertebrate BAF (dry weight)		Sediment-Fish BAF (dry weight)	
	Value	Reference	Value	Reference
Inorganics				
Lead	0.08	Bechtel Jacobs 1998b	0.07	Krantzberg and Boyd 1992
Mercury	1.08	Bechtel Jacobs 1998b	3.25	Cope et al. 1990

Table 8-38
Exposure Parameters for Upper Trophic Level Ecological Receptors - Step 3
NAB Little Creek, Virginia Beach, VA

Receptor	Body Weight (kg)		Water Ingestion Rate (L/day)		Food Ingestion Rate (kg/day - dry)	
	Value	Reference	Value	Reference	Value	Reference
Birds						
American kestrel	0.114	USEPA 1993	0.0138	allometric equation	0.0088	USEPA 1993
Killdeer	0.097	Dunning 1993	0.0123	allometric equation	0.0127	allometric equation
Osprey	1.49	Dunning 1993	0.0769	allometric equation	0.0780	USEPA 1993
Mammals						
Deer mouse	0.017	Silva and Downing 1995	0.0030	USEPA 1993	0.0005	USEPA 1993
Red fox	4.06	Silva and Downing 1995	0.3494	allometric equation	0.1231	Sample and Suter 1994

Table 8-38
Exposure Parameters for Upper Trophic Level Ecological Receptors - Step 3
NAB Little Creek, Virginia Beach, VA

Receptor	Dietary Composition (percent)							Soil/ Sediment Ingestion (percent)	
	Terr. Plants	Soil Invert.	Small Mammals	Fish	Aquatic Plants	Benthic Invert.	Reference	Value	Reference
Birds									
American kestrel	0	38.0	60.0	0	0	0	USEPA 1993	2.0	Assumed based on diet
Killdeer	2.0	93.0	0	0	0	0	Robbins and Blom 1996	5.0	Assumed based on diet
Osprey	0	0	0	100	0	0	USEPA 1993	0	Assumed based on diet
Mammals									
Deer mouse	53.0	45.0	0	0	0	0	Martin et al. 1951	2.0	Beyer et al. 1994
Red fox	7.0	2.8	87.4	0	0	0	USEPA 1993	2.8	Beyer et al. 1994

Table 8-39
Assessment Endpoints, Risk Hypotheses, and Measurement Endpoints - Step 3
NAB Little Creek, Virginia Beach, VA

Assessment Endpoint	Risk Hypothesis	Measurement Endpoint	Receptor
Terrestrial Habitats			
Survival, growth, and reproduction of terrestrial soil invertebrate communities	Are site-related chemical concentrations in surface soil sufficient to adversely effect soil invertebrate communities?	Comparison of mean chemical concentrations in surface soil with soil screening values.	Soil invertebrates (earthworms)
Survival, growth, and reproduction of terrestrial plant communities	Are site-related chemical concentrations in surface soil sufficient to adversely effect terrestrial plant communities?	Comparison of mean chemical concentrations in surface soil with soil screening values.	Terrestrial plants
Survival, growth, and reproduction of terrestrial reptile populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to terrestrial reptile populations?	Evidence of potential risk to other upper trophic level terrestrial receptors evaluated in the ERA.	--
Survival, growth, and reproduction of avian terrestrial invertivore/omnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume terrestrial plants and soil invertebrates from the site?	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) and Lowest Observed Adverse Effect Level (LOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on mean surface soil concentrations.	Killdeer
Survival, growth, and reproduction of avian terrestrial carnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume small mammals from the site?	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) and Lowest Observed Adverse Effect Level (LOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on mean surface soil concentrations.	American kestrel
Survival, growth, and reproduction of mammalian terrestrial omnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume terrestrial plants and soil invertebrates from the site?	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) and Lowest Observed Adverse Effect Level (LOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on mean surface soil concentrations.	Deer Mouse

Table 8-39
Assessment Endpoints, Risk Hypotheses, and Measurement Endpoints - Step 3
NAB Little Creek, Virginia Beach, VA

Assessment Endpoint	Risk Hypothesis	Measurement Endpoint	Receptor
Survival, growth, and reproduction of mammalian terrestrial carnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume small mammals from the site?	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) and Lowest Observed Adverse Effect Level (LOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on mean surface soil concentrations.	Red fox

Table 8-39
Assessment Endpoints, Risk Hypotheses, and Measurement Endpoints - Step 3
NAB Little Creek, Virginia Beach, VA

Assessment Endpoint	Risk Hypothesis	Measurement Endpoint	Receptor
Aquatic Habitats			
Survival, growth, and reproduction of benthic invertebrate communities	Are site-related chemical concentrations in sediment sufficient to adversely effect benthic invertebrate communities?	Comparison of mean chemical concentrations in sediment with medium-specific screening values.	Benthic invertebrates
Survival, growth, and reproduction of aquatic and wetland plant communities	Are site-related chemical concentrations in sediment sufficient to adversely effect aquatic or wetland plant communities?	Comparison of mean chemical concentrations in sediment with medium-specific screening values.	Aquatic plants
Survival, growth, and reproduction of fish communities	Are site-related chemical concentrations in sediment sufficient to adversely effect fish communities?	Comparison of mean chemical concentrations in sediment with medium-specific screening values.	Fish
Survival, growth, and reproduction of aquatic/wetland reptile populations	Are site-related chemical concentrations in sediment sufficient to adversely effect reptilian populations?	Comparison of mean chemical concentrations in sediment with medium-specific screening values.	Reptiles
	Are site-related chemical concentrations in sediment sufficient to cause adverse effects (on growth, survival, or reproduction) to aquatic/wetland reptile populations?	Evidence of potential risk to other upper trophic level aquatic and wetland receptors evaluated in the ERA.	
Survival, growth, and reproduction of avian aquatic/wetland piscivore populations	Are site-related chemical concentrations in sediment sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume fish from the site?	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) and Lowest Observed Adverse Effect Level (LOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on mean sediment concentrations.	Osprey

Table 8-40
Step 3 Screening Statistics - Surface Soil (Southern Area)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient	Mean Hazard Quotient
Inorganics (MG/KG)									
Aluminum	31.0 - 47.7	17 / 17	12,100	LW07-SS09-00	5,637	50.0	17 / 17	242	113
Chromium	1.60 - 2.40	17 / 17	33.3	LW07-SS01-00	15.7	0.40	17 / 17	83.3	39.3
Copper	3.90 - 6.00	14 / 17	55.4	LW07-SS04-00	18.7	50.0	1 / 17	1.11	0.37
Iron	15.5 - 23.8	17 / 17	26,600	LW07-SS09-00	12,530	200	17 / 17	133	62.7
Lead	0.50 - 0.70	17 / 17	93.0	LW07-SS04-00	37.7	50.0	4 / 17	1.86	0.75
Manganese	2.30 - 3.60	17 / 17	617	LW07-SS09-00	229	500	2 / 17	1.23	0.46
Mercury	0.07 - 0.10	4 / 17	0.19	LW07-SS08-00	0.034	0.10	1 / 17	1.90	0.34
Silver	1.60 - 2.40	8 / 17	6.70	LW07-SS09-00	1.61	2.00	5 / 17	3.35	0.81
Thallium	1.60 - 2.40	1 / 17	1.30	LW07-SS17-00	0.32	1.00	1 / 17	1.30	0.32
Vanadium	7.80 - 11.9	17 / 17	43.2	LW07-SS09-00	21.4	2.00	17 / 17	21.6	10.7
Zinc	3.10 - 4.80	17 / 17	602	LW07-SS04-00	132	50.0	14 / 17	12.0	2.64
Semivolatile Organic Compounds (UG/KG)									
Acenaphthylene	35.0 - 10,963	2 / 16	2,700	LW07-SS01-00	268	100	1 / 16	27.0	2.68
Anthracene	1.80 - 10,963	5 / 16	4,700	LW07-SS01-00	385	100	1 / 16	47.0	3.85
Benzo(a)anthracene	1.80 - 10,963	11 / 17	12,000	LW07-SS01-00	787	100	2 / 17	120	7.87
Benzo(a)pyrene	1.80 - 10,963	13 / 17	14,000	LW07-SS01-00	890	100	2 / 17	140	8.90
Benzo(b)fluoranthene	3.50 - 10,963	11 / 17	30,000	LW07-SS01-00	1,851	100	4 / 17	300	18.5
Benzo(g,h,i)perylene	3.50 - 10,963	8 / 17	16,000	LW07-SS01-00	1,035	100	2 / 17	160	10.4
Benzo(k)fluoranthene	1.80 - 10,963	11 / 17	27,000	LW07-SS01-00	1,664	100	3 / 17	270	16.6
Chrysene	1.80 - 10,963	13 / 17	24,000	LW07-SS01-00	1,489	100	2 / 17	240	14.9
Dibenz(a,h)anthracene	3.50 - 10,963	2 / 16	6,600	LW07-SS01-00	504	100	1 / 16	66.0	5.04
Fluoranthene	3.50 - 10,963	13 / 17	9,600	LW07-SS01-00	648	100	2 / 17	96.0	6.48
Indeno(1,2,3-cd)pyrene	1.80 - 10,963	12 / 17	17,000	LW07-SS01-00	1,071	100	1 / 17	170	10.7
PAH (total)	-- - --	14 / 17	220,490	LW07-SS01-00	14,370	4,100	1 / 17	53.8	3.50
Phenanthrene	1.80 - 10,963	9 / 17	190	LW07-SS21-00	415	100	1 / 17	1.90	--
Pyrene	1.80 - 10,963	12 / 17	24,000	LW07-SS01-00	1,519	100	3 / 17	240	15.2

Table 8-41
Step 3 Screening Statistics - Surface Soil (Eastern Area)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient	Mean Hazard Quotient
Inorganics (MG/KG)									
Aluminum	30.8 - 38.9	4 / 4	4,620	LW07-SS12-00	3,293	50.0	4 / 4	92.4	65.9
Chromium	1.50 - 1.90	4 / 4	17.0	LW07-SS12-00	12.3	0.40	4 / 4	42.5	30.6
Copper	3.80 - 4.90	3 / 4	141	LW07-SS03-00	46.5	50.0	1 / 4	2.82	0.93
Iron	15.4 - 19.5	4 / 4	11,100	LW07-SS03-00	7,030	200	4 / 4	55.5	35.2
Lead	0.50 - 0.58	4 / 4	122	LW07-SS03-00	64.1	50.0	3 / 4	2.44	1.28
Manganese	2.30 - 2.90	4 / 4	86.4	LW07-SS03-00	62.9	500	0 / 4	0.17	0.13
Mercury	0.07 - 0.10	2 / 4	0.15	LW07-SS03-00	0.05	0.10	1 / 4	1.50	0.54
Silver	1.50 - 1.90	3 / 4	3.20	LW07-SS03-00	1.59	2.00	1 / 4	1.60	0.79
Thallium	1.50 - 1.90	0 / 4	--	--	0.27	1.00	-- / --	--	0.27
Vanadium	7.70 - 9.70	4 / 4	11.2	LW07-SS11-00	8.38	2.00	4 / 4	5.60	4.19
Zinc	3.10 - 3.90	4 / 4	488	LW07-SS03-00	199	50.0	3 / 4	9.76	3.98
Semivolatile Organic Compounds (UG/KG)									
Acenaphthylene	36.0 - 374	0 / 4	--	--	98.7	100	-- / --	--	0.99
Anthracene	1.80 - 374	2 / 4	3.70	LW07-SS11-00	90.5	100	0 / 4	0.04	--
Benzo(a)anthracene	1.80 - 374	2 / 4	34.0	LW07-SS11-00	103	100	0 / 4	0.34	--
Benzo(a)pyrene	1.80 - 374	2 / 4	37.0	LW07-SS11-00	101	100	0 / 4	0.37	--
Benzo(b)fluoranthene	3.60 - 374	2 / 4	52.0	LW07-SS11-00	109	100	0 / 4	0.52	--
Benzo(g,h,i)perylene	3.60 - 374	2 / 4	58.0	LW07-SS11-00	111	100	0 / 4	0.58	--
Benzo(k)fluoranthene	1.80 - 374	2 / 4	21.0	LW07-SS11-00	97.3	100	0 / 4	0.21	--
Chrysene	1.80 - 374	2 / 4	35.0	LW07-SS11-00	102	100	0 / 4	0.35	--
Dibenz(a,h)anthracene	3.60 - 374	0 / 4	--	--	90.2	100	-- / --	--	0.90
Fluoranthene	3.60 - 374	2 / 4	81.0	LW07-SS11-00	120	100	0 / 4	0.81	--
Indeno(1,2,3-cd)pyrene	1.80 - 374	2 / 4	29.0	LW07-SS11-00	101	100	0 / 4	0.29	--
PAH (total)	-- - --	2 / 4	514	LW07-SS11-00	1,721	4,100	0 / 4	0.13	--
Phenanthrene	1.80 - 374	2 / 4	31.0	LW07-SS11-00	101	100	0 / 4	0.31	--
Pyrene	1.80 - 374	2 / 4	69.0	LW07-SS11-00	114	100	0 / 4	0.69	--

Table 8-42
Step 3 Screening Statistics - Surface Soil (Northern Area)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient	Mean Hazard Quotient
Inorganics (MG/KG)									
Aluminum	37.4 - 40.9	4 / 4	6,730	LW07-SS13-00	3,145	50.0	4 / 4	135	62.9
Chromium	1.90 - 2.00	4 / 4	79.3	LW07-SS24-00	30.3	0.40	4 / 4	198	75.7
Copper	4.70 - 5.10	4 / 4	518	LW07-SS24-00	219	50.0	3 / 4	10.4	4.38
Iron	18.7 - 20.4	4 / 4	9,290	LW07-SS24-00	5,475	200	4 / 4	46.5	27.4
Lead	0.59 - 0.61	4 / 4	1,240	LW07-SS24-00	415	50.0	4 / 4	24.8	8.29
Manganese	2.80 - 3.10	4 / 4	54.5	LW07-SS24-00	33.5	500	0 / 4	0.11	0.07
Mercury	0.07 - 0.10	4 / 4	0.99	LW07-SS24-00	0.55	0.10	3 / 4	9.90	5.50
Silver	1.90 - 2.00	0 / 4	--	--	0.30	2.00	-- / --	--	0.15
Thallium	1.90 - 2.00	0 / 4	--	--	0.31	1.00	-- / --	--	0.31
Vanadium	9.30 - 10.2	4 / 4	9.00	LW07-SS13-00	6.15	2.00	4 / 4	4.50	3.08
Zinc	3.70 - 4.10	4 / 4	590	LW07-SS24-00	273	50.0	4 / 4	11.8	5.46
Semivolatile Organic Compounds (UG/KG)									
Acenaphthylene	36.0 - 350	0 / 4	--	--	95.5	100	-- / --	--	0.96
Anthracene	1.80 - 350	1 / 4	14.0	LW07-SS25-00	46.5	100	0 / 4	0.14	--
Benzo(a)anthracene	1.90 - 350	4 / 4	250	LW07-SS14-00	101	100	1 / 4	2.50	1.01
Benzo(a)pyrene	1.90 - 350	4 / 4	83.0	LW07-SS14-00	43.0	100	0 / 4	0.83	0.43
Benzo(b)fluoranthene	3.80 - 350	4 / 4	240	LW07-SS14-00	89.8	100	1 / 4	2.40	0.90
Benzo(g,h,i)perylene	3.80 - 350	2 / 4	150	LW07-SS14-00	129	100	1 / 4	1.50	1.29
Benzo(k)fluoranthene	1.90 - 350	4 / 4	96.0	LW07-SS14-00	53.8	100	0 / 4	0.96	0.54
Chrysene	1.90 - 350	4 / 4	280	LW07-SS14-00	112	100	1 / 4	2.80	1.12
Dibenz(a,h)anthracene	3.60 - 350	1 / 4	15.0	LW07-SS25-00	47.2	100	0 / 4	0.15	--
Fluoranthene	3.80 - 350	4 / 4	370	LW07-SS14-00	148	100	2 / 4	3.70	1.48
Indeno(1,2,3-cd)pyrene	1.90 - 350	4 / 4	80.0	LW07-SS14-00	40.8	100	0 / 4	0.80	0.41
PAH (total)	-- - --	4 / 4	2,025	LW07-SS14-00	1,384	4,100	0 / 4	0.49	0.34
Phenanthrene	1.90 - 350	4 / 4	51.0	LW07-SS25-00	34.8	100	0 / 4	0.51	0.35
Pyrene	1.90 - 350	4 / 4	430	LW07-SS14-00	178	100	2 / 4	4.30	1.78

Table 8-43
Step 3 Screening Statistics - Surface Sediment (Connector Channel)
NAB Little Creek, Virginia Beach, VA

Chemical	Frequency of Detection	Maximum Non-Detect	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient	Mean Hazard Quotient
Inorganics (MG/KG)									
Arsenic	6 / 6	--	9.20	LW07-D5	6.28	8.20	1 / 6	1.12	0.77
Barium	6 / 6	--	30.8	LW07-D5	20.4	48.0	0 / 6	0.64	0.43
Beryllium	5 / 6	0.35	0.58	LW07-D5	0.40	NSV	-- / --	NSV	NSV
Copper	6 / 6	--	70.9	LW07-D5	51.0	34.0	5 / 6	2.08	1.50
Cyanide	0 / 5	0.17	--	--	0.07	NSV	-- / --	NSV	NSV
Lead	6 / 6	--	38.4	LW07-D5	30.9	46.7	0 / 6	0.82	0.66
Mercury	5 / 6	0.090	0.24	LW07-D5	0.15	0.15	3 / 6	1.57	0.99
Nickel	6 / 6	--	13.9	LW07-D5	9.00	20.9	0 / 6	0.67	0.43
Selenium	4 / 6	1.06	1.70	LW07-B5	1.12	1.00	4 / 6	1.70	1.12
Silver	0 / 6	1.20	--	--	0.22	1.00	-- / --	--	0.22
Thallium	1 / 6	1.00	0.55	LW07-SD01-00	0.44	NSV	-- / --	NSV	NSV
Tin	5 / 5	--	2.63	LW07-D5	1.97	3.40	0 / 5	0.77	0.58
Zinc	6 / 6	--	222	LW07-D5	164	150	5 / 6	1.48	1.09
Semivolatile Organic Compounds (UG/KG)									
Acenaphthene	1 / 6	765	130	LW07-SD01-00	280	16.0	1 / 6	8.13	--
Acenaphthylene	6 / 6	--	60.0	LW07-SD01-00	37.3	44.0	2 / 6	1.36	0.85
Anthracene	6 / 6	--	430	LW07-SD01-00	127	85.3	3 / 6	5.04	1.48
Benzo(a)anthracene	6 / 6	--	1,600	LW07-SD01-00	373	261	1 / 6	6.13	1.43
Benzo(a)pyrene	6 / 6	--	890	LW07-SD01-00	303	430	1 / 6	2.07	0.70
Benzo(b)fluoranthene	6 / 6	--	1,200	LW07-SD01-00	443	3,200	0 / 6	0.38	0.14
Benzo(g,h,i)perylene	5 / 6	605	300	LW07-SD01-00	170	670	0 / 6	0.45	0.25
Benzo(k)fluoranthene	6 / 6	--	1,300	LW07-SD01-00	413	1,800	0 / 6	0.72	0.23
Chrysene	6 / 6	--	2,300	LW07-SD01-00	598	384	2 / 6	5.99	1.56
Dibenz(a,h)anthracene	5 / 6	765	170	LW07-SD01-00	121	63.4	1 / 6	2.68	1.91
Fluoranthene	6 / 6	--	4,300	LW07-SD01-00	893	600	1 / 6	7.17	1.49
Fluorene	2 / 6	765	110	LW07-SD01-00	238	19.0	2 / 6	5.79	--
Indeno(1,2,3-cd)pyrene	6 / 6	--	380	LW07-SD01-00	164	600	0 / 6	0.63	0.27
Naphthalene	0 / 6	765	--	--	295	160	-- / --	--	1.85
PAH (total)	6 / 6	--	18,175	LW07-SD01-00	5,536	4,022	1 / 6	4.52	1.38

Table 8-43
Step 3 Screening Statistics - Surface Sediment (Connector Channel)
NAB Little Creek, Virginia Beach, VA

Chemical	Frequency of Detection	Maximum Non-Detect	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient	Mean Hazard Quotient
Phenanthrene	6 / 6	--	830	LW07-SD01-00	178	240	1 / 6	3.46	0.74
Pyrene	6 / 6	--	3,500	LW07-SD01-00	828	665	1 / 6	5.26	1.24

Table 8-44
Step 3 Screening Statistics - Surface Sediment (Pier Area)
NAB Little Creek, Virginia Beach, VA

Chemical	Frequency of Detection	Maximum Non-Detect	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient	Mean Hazard Quotient
Inorganics (MG/KG)									
Arsenic	11 / 11	--	12.0	LW07-M3	8.10	8.20	5 / 11	1.46	0.99
Barium	10 / 11	21.0	49.1	LW07-SD05-00	29.3	48.0	1 / 11	1.02	0.61
Beryllium	7 / 11	1.30	0.74	LW07-H1	0.50	NSV	-- / --	NSV	NSV
Copper	11 / 11	--	142	LW07-SD05-00	86.3	34.0	9 / 11	4.18	2.54
Cyanide	1 / 7	0.21	0.20	LW07-H1	0.097	NSV	-- / --	NSV	NSV
Lead	11 / 11	--	1,810	LW07-SD03-00	233	46.7	10 / 11	38.8	4.98
Mercury	8 / 11	0.56	0.50	LW07-M1	0.27	0.15	6 / 11	3.35	1.83
Nickel	7 / 11	21.2	20.1	LW07-M3	11.5	20.9	0 / 11	0.96	0.55
Selenium	3 / 11	1.90	1.83	LW07-K1	0.86	1.00	3 / 11	1.83	0.86
Silver	6 / 11	0.44	7.80	LW07-SD05-00	1.94	1.00	4 / 11	7.80	1.94
Thallium	0 / 11	1.50	--	--	0.51	NSV	-- / --	NSV	NSV
Tin	7 / 7	--	10.5	LW07-M3	5.06	3.40	4 / 7	3.07	1.49
Zinc	10 / 11	205	915	LW07-M3	381	150	8 / 11	6.10	2.54
Semivolatile Organic Compounds (UG/KG)									
Acenaphthene	8 / 11	3,500	3,000	LW07-SD05-00	783	16.0	7 / 11	188	48.9
Acenaphthylene	7 / 11	6,900	520	LW07-M3	636	44.0	5 / 11	11.8	--
Anthracene	11 / 11	--	2,300	LW07-SD04-00	664	85.3	11 / 11	27.0	7.78
Benzo(a)anthracene	11 / 11	--	4,400	LW07-SD04-00	1,630	261	9 / 11	16.9	6.24
Benzo(a)pyrene	11 / 11	--	3,775	LW07-M3	1,320	430	9 / 11	8.78	3.07
Benzo(b)fluoranthene	10 / 11	320	7,650	LW07-M3	2,198	3,200	2 / 11	2.39	0.69
Benzo(g,h,i)perylene	10 / 11	600	1,800	LW07-SD04-00	750	670	7 / 11	2.69	1.12
Benzo(k)fluoranthene	11 / 11	--	6,475	LW07-M3	1,713	1,800	4 / 11	3.60	0.95
Chrysene	11 / 11	--	7,925	LW07-M3	2,838	384	10 / 11	20.6	7.39
Dibenz(a,h)anthracene	10 / 11	320	773	LW07-M3	205	63.4	8 / 11	12.2	3.23
Fluoranthene	11 / 11	--	25,970	LW07-SD04-00	4,981	600	9 / 11	43.3	8.30
Fluorene	10 / 11	675	2,100	LW07-SD04-00	384	19.0	10 / 11	111	20.2
Indeno(1,2,3-cd)pyrene	11 / 11	--	1,950	LW07-M3	709	600	5 / 11	3.25	1.18
Naphthalene	5 / 11	3,500	430	LW07-SD02-00	407	160	1 / 11	2.69	2.54
PAH (total)	11 / 11	--	105,690	LW07-SD04-00	27,864	4,022	9 / 11	26.3	6.93

Table 8-44
Step 3 Screening Statistics - Surface Sediment (Pier Area)
NAB Little Creek, Virginia Beach, VA

Chemical	Frequency of Detection	Maximum Non-Detect	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient	Mean Hazard Quotient
Phenanthrene	11 / 11	--	18,360	LW07-SD04-00	2,418	240	8 / 11	76.5	10.1
Pyrene	11 / 11	--	22,300	LW07-SD04-00	5,698	665	9 / 11	33.5	8.57

Table 8-45
Step 3 Screening Statistics - Surface Sediment (Desert Cove)
NAB Little Creek, Virginia Beach, VA

Chemical	Frequency of Detection	Maximum Non-Detect	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient	Mean Hazard Quotient
Inorganics (MG/KG)									
Arsenic	7 / 7	--	12.6	LW07-L2-SD201	9.71	8.20	5 / 7	1.54	1.18
Barium	7 / 7	--	42.2	LW07-L5	32.5	48.0	0 / 7	0.88	0.68
Beryllium	7 / 7	--	0.77	LW07-L2-SD201	0.62	NSV	-- / --	NSV	NSV
Copper	7 / 7	--	117	LW07-L2-SD201	83.6	34.0	7 / 7	3.44	2.46
Cyanide	3 / 7	0.17	0.27	LW07-K5	0.13	NSV	-- / --	NSV	NSV
Lead	7 / 7	--	125	LW07-L5	76.4	46.7	7 / 7	2.67	1.64
Mercury	7 / 7	--	3.18	LW07-L5	0.76	0.15	7 / 7	21.2	5.07
Nickel	7 / 7	--	21.7	LW07-K5	16.0	20.9	1 / 7	1.04	0.77
Selenium	1 / 7	1.35	2.38	LW07-H3	0.87	1.00	1 / 7	2.38	0.87
Silver	1 / 7	0.37	0.38	LW07-L5	0.20	1.00	0 / 7	0.38	0.20
Thallium	0 / 7	1.13	--	--	0.51	NSV	-- / --	NSV	NSV
Tin	7 / 7	--	8.25	LW07-K5	5.86	3.40	6 / 7	2.43	1.72
Zinc	7 / 7	--	491	LW07-L2-SD201	348	150	7 / 7	3.27	2.32
Semivolatile Organic Compounds (UG/KG)									
Acenaphthene	4 / 7	793	367	LW07-K5	220	16.0	4 / 7	23.0	13.8
Acenaphthylene	7 / 7	--	455	LW07-L5	170	44.0	7 / 7	10.3	3.87
Anthracene	7 / 7	--	1,808	LW07-L5	618	85.3	6 / 7	21.2	7.24
Benzo(a)anthracene	7 / 7	--	5,925	LW07-L5	1,451	261	5 / 7	22.7	5.56
Benzo(a)pyrene	7 / 7	--	4,250	LW07-L5	1,269	430	5 / 7	9.88	2.95
Benzo(b)fluoranthene	7 / 7	--	9,950	LW07-L5	2,909	3,200	1 / 7	3.11	0.91
Benzo(g,h,i)perylene	7 / 7	--	1,793	LW07-L5	643	670	3 / 7	2.68	0.96
Benzo(k)fluoranthene	7 / 7	--	9,175	LW07-L5	2,605	1,800	4 / 7	5.10	1.45
Chrysene	7 / 7	--	16,575	LW07-L5	3,655	384	7 / 7	43.2	9.52
Dibenz(a,h)anthracene	7 / 7	--	993	LW07-L5	285	63.4	7 / 7	15.7	4.50
Fluoranthene	7 / 7	--	3,525	LW07-L5	1,112	600	4 / 7	5.88	1.85
Fluorene	5 / 7	793	350	LW07-K5	196	19.0	4 / 7	18.4	10.3
Indeno(1,2,3-cd)pyrene	7 / 7	--	2,198	LW07-L5	749	600	4 / 7	3.66	1.25
Naphthalene	3 / 7	793	399	LW07-K5	272	160	1 / 7	2.49	1.70
PAH (total)	7 / 7	--	67,441	LW07-L5	19,515	4,022	7 / 7	16.8	4.85

Table 8-45
Step 3 Screening Statistics - Surface Sediment (Desert Cove)
NAB Little Creek, Virginia Beach, VA

Chemical	Frequency of Detection	Maximum Non-Detect	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient	Mean Hazard Quotient
Phenanthrene	7 / 7	--	1,400	LW07-K5	453	240	4 / 7	5.83	1.89
Pyrene	7 / 7	--	9,575	LW07-L5	2,907	665	6 / 7	14.4	4.37

Table 8-46
Step 3 Screening Statistics - Groundwater (On-Site)
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean	Screening Value	Frequency of Exceedance	Mean HQ Without Dilution	Mean HQ With Dilution
Inorganics (UG/L)									
Aluminum	200 - 200	6 / 7	2,910	LW07-MW05-02C	1,664	87.0	6 / 7	19.1	1.91
Cobalt	50.0 - 50.0	2 / 7	28.3	LW07-MW01-02C	6.99	23.0	1 / 7	0.30	0.03
Copper	25.0 - 25.0	1 / 7	30.2	LW07-MW01-02C	8.46	3.70	1 / 7	2.29	0.23
Iron	100 - 100	7 / 7	56,500	LW07-MW05-02C	31,064	1,000	7 / 7	31.1	3.11
Manganese	15.0 - 15.0	7 / 7	5,710	LW07-MW01-02C	2,093	10.0	7 / 7	209	20.9
Nickel	40.0 - 40.0	2 / 7	9.60	LW07-MW05-02C	5.52	8.30	1 / 7	0.66	0.07
Silver	10.0 - 10.0	1 / 7	8.30	LW07-MW03-00B	1.77	0.92	1 / 7	1.93	0.19
Dissolved Metals (UG/L)									
Aluminum	200 - 200	1 / 7	235	LW07-MW01-02C	63.8	87.0	1 / 7	0.73	0.07
Cobalt	50.0 - 50.0	2 / 7	28.2	LW07-MW01-02C	6.56	23.0	1 / 7	0.29	0.03
Copper	25.0 - 25.0	0 / 7	--	--	2.16	3.10	-- / --	0.70	0.07
Iron	100 - 100	7 / 7	52,800	LW07-MW01-02C	29,191	1,000	7 / 7	29.2	2.92
Manganese	15.0 - 15.0	7 / 7	5,910	LW07-MW01-02C	2,236	10.0	7 / 7	224	22.4
Nickel	40.0 - 40.0	1 / 7	4.50	LW07-MW01-02C	2.26	8.20	0 / 7	0.28	0.03
Silver	10.0 - 10.0	0 / 7	--	--	0.99	0.92	-- / --	1.08	0.11
Semivolatile Organic Compounds (UG/L)									
Caprolactam	10.0 - 10.0	1 / 5	2.00	LW07-MW06-02C	4.40	NSV	-- / --	NSV	NSV
Volatile Organic Compounds (UG/L)									
Methyl-tert-butyl ether (MTBE)	0.50 - 0.96	3 / 5	25.0	LW07-MW03-02C	5.57	NSV	-- / --	NSV	NSV

Table 8-47
Summary of Hazard Quotients for Upper Trophic Level Receptors - Step 3
NAB Little Creek, Virginia Beach, VA

Chemical	Deer mouse		Red fox		Killdeer		American kestrel		Osprey	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Inorganics										
Arsenic	0.11	0.01	<0.01	<0.01	0.05	0.02	0.01	<0.01	--	--
Cadmium	0.01	<0.01	<0.01	<0.01	0.07	<0.01	0.02	<0.01	--	--
Chromium	0.03	<0.01	0.02	<0.01	0.80	0.16	0.27	0.05	--	--
Copper	<0.01	<0.01	0.02	0.02	0.08	0.06	0.02	0.02	--	--
Lead	0.07	<0.01	0.03	<0.01	1.17	0.12	0.35	0.03	0.13	0.01
Mercury	0.08	0.02	<0.01	<0.01	0.04	0.02	<0.01	<0.01	0.13	0.05
Silver	<0.01	<0.01	<0.01	<0.01	0.10	0.01	0.03	<0.01	--	--
Zinc	0.04	0.02	0.14	0.01	3.55	0.39	1.12	0.12	--	--

Table 8-48
Summary of PCOCs
NAB Little Creek, Virginia Beach, VA

Chemical	Surface Soil												Terrestrial Food Web		
	Southern Area				Eastern Area				Northern Area						
	FOD	FOE	Maximum HQ	Mean HQ	FOD	FOE	Maximum HQ	Mean HQ	FOD	FOE	Maximum HQ	Mean HQ	Receptor	Endpoint	Mean HQ
Detected Chemicals With Screening Values															
Aluminum	17 / 17	17 / 17	242	113	4 / 4	4 / 4	92.4	65.9	4 / 4	4 / 4	135	62.9			
Chromium	17 / 17	17 / 17	83.3	39.3	4 / 4	4 / 4	42.5	30.6	4 / 4	4 / 4	198	75.7			
Copper					3 / 4	1 / 4	2.82	0.93	4 / 4	3 / 4	10.4	4.38			
Iron	17 / 17	17 / 17	133	62.7	4 / 4	4 / 4	55.5	35.2	4 / 4	4 / 4	46.5	27.4			
Lead	17 / 17	4 / 17	1.86	0.75	4 / 4	3 / 4	2.44	1.28	4 / 4	4 / 4	24.8	8.29	Killdeer	NOAEL	1.17
Mercury									4 / 4	3 / 4	9.90	5.50			
Silver	8 / 17	5 / 17	3.35	0.81											
Thallium															
Vanadium	17 / 17	17 / 17	21.6	10.7	4 / 4	4 / 4	5.60	4.19	4 / 4	4 / 4	4.50	3.08			
Zinc	17 / 17	14 / 17	12.0	2.64	4 / 4	3 / 4	9.76	3.98	4 / 4	4 / 4	11.8	5.46	Killdeer	NOAEL	3.55
													Kestrel	NOAEL	1.12
Acenaphthylene	2 / 16	1 / 16	27.0	2.68											
Anthracene	5 / 16	1 / 16	47.0	3.85											
Benzo(a)anthracene	11 / 17	2 / 17	120	7.87					4 / 4	1 / 4	2.50	1.01			
Benzo(a)pyrene	13 / 17	2 / 17	140	8.90											
Benzo(b)fluoranthene	11 / 17	4 / 17	300	18.5											
Benzo(g,h,i)perylene	8 / 17	2 / 17	160	10.4					2 / 4	1 / 4	1.50	1.29			
Benzo(k)fluoranthene	11 / 17	3 / 17	270	16.6											
Chrysene	13 / 17	2 / 17	240	14.9					4 / 4	1 / 4	2.80	1.12			
Dibenz(a,h)anthracene	2 / 16	1 / 16	66.0	5.04											
Fluoranthene	13 / 17	2 / 17	96.0	6.48					4 / 4	2 / 4	3.70	1.48			
Indeno(1,2,3-cd)pyrene	12 / 17	1 / 17	170	10.7											
PAH (total)	14 / 17	1 / 17	53.8	3.50											
Phenanthrene	9 / 17	1 / 17	1.90	--											
Pyrene	12 / 17	3 / 17	240	15.2					4 / 4	2 / 4	4.30	1.78			

FOD - Frequency of Detection
FOE - Frequency of Exceedance

Table 8-48
Summary of PCOCs
NAB Little Creek, Virginia Beach, VA

Chemical	Surface Sediment											
	Connector Channel				Pier Area				Desert Cove			
	FOD	FOE	Maximum HQ or Conc	Mean HQ or Conc	FOD	FOE	Maximum HQ or Conc	Mean HQ or Conc	FOD	FOE	Maximum HQ or Conc	Mean HQ or Conc
Detected Chemicals With Screening Values												
Arsenic					11 / 11	5 / 11	1.46	0.99	7 / 7	5 / 7	1.54	1.18
Copper	6 / 6	5 / 6	2.08	1.50	11 / 11	9 / 11	4.18	2.54	7 / 7	7 / 7	3.44	2.46
Lead					11 / 11	10 / 11	38.8	4.98	7 / 7	7 / 7	2.67	1.64
Mercury	5 / 6	3 / 6	1.57	0.99	8 / 11	6 / 11	3.35	1.83	7 / 7	7 / 7	21.2	5.07
Selenium	4 / 6	4 / 6	1.70	1.12	3 / 11	3 / 11	1.83	0.86	1 / 7	1 / 7	2.38	0.87
Silver					6 / 11	4 / 11	7.80	1.94				
Tin					7 / 7	4 / 7	3.07	1.49	7 / 7	6 / 7	2.43	1.72
Zinc	6 / 6	5 / 6	1.48	1.09	10 / 11	8 / 11	6.10	2.54	7 / 7	7 / 7	3.27	2.32
Acenaphthene	1 / 6	1 / 6	8.13	--	8 / 11	7 / 11	188	48.9	4 / 7	4 / 7	23.0	13.8
Acenaphthylene					7 / 11	5 / 11	11.8	--	7 / 7	7 / 7	10.3	3.87
Anthracene	6 / 6	3 / 6	5.04	1.48	11 / 11	11 / 11	27.0	7.78	7 / 7	6 / 7	21.2	7.24
Benzo(a)anthracene	6 / 6	1 / 6	6.13	1.43	11 / 11	9 / 11	16.9	6.24	7 / 7	5 / 7	22.7	5.56
Benzo(a)pyrene	6 / 6	1 / 6	2.07	0.70	11 / 11	9 / 11	8.78	3.07	7 / 7	5 / 7	9.88	2.95
Benzo(b)fluoranthene									7 / 7	1 / 7	3.11	0.91
Benzo(g,h,i)perylene					10 / 11	7 / 11	2.69	1.12	7 / 7	3 / 7	2.68	0.96
Benzo(k)fluoranthene					11 / 11	4 / 11	3.60	0.95	7 / 7	4 / 7	5.10	1.45
Chrysene	6 / 6	2 / 6	5.99	1.56	11 / 11	10 / 11	20.6	7.39	7 / 7	7 / 7	43.2	9.52
Dibenz(a,h)anthracene	5 / 6	1 / 6	2.68	1.91	10 / 11	8 / 11	12.2	3.23	7 / 7	7 / 7	15.7	4.50
Fluoranthene	6 / 6	1 / 6	7.17	1.49	11 / 11	9 / 11	43.3	8.30	7 / 7	4 / 7	5.88	1.85
Fluorene	2 / 6	2 / 6	5.79	--	10 / 11	10 / 11	111	20.2	5 / 7	4 / 7	18.4	10.3
Indeno(1,2,3-cd)pyrene					11 / 11	5 / 11	3.25	1.18	7 / 7	4 / 7	3.66	1.25
Naphthalene					5 / 11	1 / 11	2.69	2.54	3 / 7	1 / 7	2.49	1.70
PAH (total)	6 / 6	1 / 6	4.52	1.38	11 / 11	9 / 11	26.3	6.93	7 / 7	7 / 7	16.8	4.85
Phenanthrene					11 / 11	8 / 11	76.5	10.1	7 / 7	4 / 7	5.83	1.89
Pyrene	6 / 6	1 / 6	5.26	1.24	11 / 11	9 / 11	33.5	8.57	7 / 7	6 / 7	14.4	4.37
Detected Chemicals Without Screening Values												
Beryllium	5 / 6	--	0.58 mg/kg	0.40 mg/kg	7 / 11	--	0.74 mg/kg	0.50 mg/kg	7 / 7	--	0.77 mg/kg	0.62 mg/kg
Cyanide					1 / 7	--	0.20 mg/kg	0.10 mg/kg	3 / 7	--	0.17 mg/kg	0.13 mg/kg
Thallium	1 / 6	--	0.55 mg/kg	0.44 mg/kg								

FOD - Frequency of Detection
FOE - Frequency of Exceedance

Table 8-48
Summary of PCOCs
NAB Little Creek, Virginia Beach, VA

Chemical	Aquatic Food Web			Groundwater			
	Receptor	Endpoint	Mean HQ	FOD	FOE	Maximum HQ or Conc	Mean HQ or Conc
Detected Chemicals With Screening Values							
Iron (total)				7 / 7	7 / 7	5.65	3.11
Iron (dissolved)				7 / 7	7 / 7	5.28	2.92
Manganese (total)				7 / 7	7 / 7	57.1	20.9
Manganese (dissolved)				7 / 7	7 / 7	59.1	22.4
Detected Chemicals Without Screening Values							
Caprolactam				1 / 5	--	2.00 ug/L	--
Methyl-tert-butyl ether (MTBE)				3 / 5	--	25.0 ug/L	5.57 ug/L

FOD - Frequency of Detection
FOE - Frequency of Exceedance

Table 8-49
Comparison of Inorganic PCOC Surface Soil Concentrations to Background Concentrations
NAB Little Creek, Virginia Beach, VA

Chemical	SWMU 7 Surface Soil (mg/kg)			Background Upper Tolerance Limit (UTL)	Frequency of UTL Exceedance	Maximum Ratio of Site Soils to Background UTL	Background (mg/kg)		Ratio of Maximums	Ratio of Means
	Frequency of Detection	Maximum Detected Concentration	Arithmetic Mean				Maximum	Arithmetic Mean		
SOUTHERN AREA										
Urban Background										
Aluminum	17 / 17	12,100	5,637	8,500	5 / 17	1.42	--	--	--	--
Chromium	17 / 17	33.3	15.7	20.0	5 / 17	1.67	--	--	--	--
Iron	17 / 17	26,600	12,530	15,000	7 / 17	1.77	--	--	--	--
Lead	17 / 17	93.0	37.7	110	0 / 17	0.85	--	--	--	--
Silver	8 / 17	6.70	1.61	--	-- - --	--	--	0.14	--	11.5
Vanadium	17 / 17	43.2	21.4	34.3	3 / 17	1.26	--	--	--	--
Zinc	17 / 17	602	132	123	5 / 17	4.89	--	--	--	--
Native Background										
Aluminum	17 / 17	12,100	5,637	12,000	1 / 17	1.01	--	--	--	--
Chromium	17 / 17	33.3	15.7	14.0	8 / 17	2.38	--	--	--	--
Iron	17 / 17	26,600	12,530	13,000	8 / 17	2.05	--	--	--	--
Lead	17 / 17	93.0	37.7	110	0 / 17	0.85	--	--	--	--
Silver	8 / 17	6.70	1.61	--	-- - --	--	--	0.10	--	16.6
Vanadium	17 / 17	43.2	21.4	22.4	8 / 17	1.93	--	--	--	--
Zinc	17 / 17	602	132	123	5 / 17	4.89	--	--	--	--
EASTERN AREA										
Urban Background										
Aluminum	4 / 4	4,620	3,293	8,500	0 / 4	0.54	--	--	--	--
Chromium	4 / 4	17.0	12.3	20.0	0 / 4	0.85	--	--	--	--
Copper	3 / 4	141	46.5	--	-- - --	--	20.2	6.83	6.98	6.81
Iron	4 / 4	11,100	7,030	15,000	0 / 4	0.74	--	--	--	--
Lead	4 / 4	122	64.1	110	1 / 4	1.11	--	--	--	--
Vanadium	4 / 4	11.2	8.38	34.3	0 / 4	0.33	--	--	--	--
Zinc	4 / 4	488	199	123	2 / 4	3.97	--	--	--	--
Native Background										
Aluminum	4 / 4	4,620	3,293	12,000	0 / 4	0.39	--	--	--	--
Chromium	4 / 4	17.0	12.3	14.0	2 / 4	1.21	--	--	--	--
Copper	3 / 4	141	46.5	--	-- - --	--	13.3	6.82	10.60	6.82

Table 8-49
Comparison of Inorganic PCOC Surface Soil Concentrations to Background Concentrations
NAB Little Creek, Virginia Beach, VA

Chemical	SWMU 7 Surface Soil (mg/kg)			Background Upper Tolerance Limit (UTL)	Frequency of UTL Exceedance	Maximum Ratio of Site Soils to Background UTL	Background (mg/kg)		Ratio of Maximums	Ratio of Means
	Frequency of Detection	Maximum Detected Concentration	Arithmetic Mean				Maximum	Arithmetic Mean		
Iron	4 / 4	11,100	7,030	13,000	0 / 4	0.85	--	--	--	--
Lead	4 / 4	122	64.1	110	1 / 4	1.11	--	--	--	--
Vanadium	4 / 4	11.2	8.38	22.4	0 / 4	0.50	--	--	--	--
Zinc	4 / 4	488	199	123	2 / 4	3.97	--	--	--	--
NORTHERN AREA										
Urban Background										
Aluminum	4 / 4	6,730	3,145	8,500	0 / 4	0.79	--	--	--	--
Chromium	4 / 4	79.3	30.3	20.0	1 / 4	3.97	--	--	--	--
Copper	4 / 4	518	219	--	-- - --	--	20.2	6.83	25.6	32.1
Iron	4 / 4	9,290	5,475	15,000	0 / 4	0.62	--	--	--	--
Lead	4 / 4	1,240	415	110	3 / 4	11.3	--	--	--	--
Mercury	4 / 4	0.99	0.55	--	-- - --	--	0.63	0.10	1.57	5.50
Vanadium	4 / 4	9.00	6.15	34.3	0 / 4	0.26	--	--	--	--
Zinc	4 / 4	590	273	123	2 / 4	4.80	--	--	--	--
Native Background										
Aluminum	4 / 4	6,730	3,145	12,000	0 / 4	0.56	--	--	--	--
Chromium	4 / 4	79.3	30.3	14.0	2 / 4	5.66	--	--	--	--
Copper	4 / 4	518	219	--	-- - --	--	13.3	6.82	38.9	32.1
Iron	4 / 4	9,290	5,475	13,000	0 / 4	0.71	--	--	--	--
Lead	4 / 4	1,240	415	110	3 / 4	11.3	--	--	--	--
Mercury	4 / 4	0.99	0.55	--	-- - --	--	0.25	0.10	3.96	5.56
Vanadium	4 / 4	9.00	6.15	22.4	0 / 4	0.40	--	--	--	--
Zinc	4 / 4	590	273	123	2 / 4	4.80	--	--	--	--

Table 8-50
Comparison of Organic PCOC Surface Soil Concentrations to Urban Background Concentrations
NAB Little Creek, Virginia Beach, VA

Chemical	SWMU 7 Surface Soils (UG/KG)			Urban Background (UG/KG)		Ratio of Maximums	Ratio of Means
	Frequency of Detection	Maximum Detected Concentration	Arithmetic Mean	Maximum	Arithmetic Mean		
SOUTHERN AREA							
Acenaphthylene	2 / 16	2,700	268	--	197	--	1.36
Anthracene	5 / 16	4,700	385	--	197	--	1.95
Benzo(a)anthracene	11 / 17	12,000	787	350	208	34.3	3.78
Benzo(a)pyrene	13 / 17	14,000	890	300	205	46.7	4.35
Benzo(b)fluoranthene	11 / 17	30,000	1,851	640	229	46.9	8.09
Benzo(g,h,i)perylene	8 / 17	16,000	1,035	--	197	--	5.25
Benzo(k)fluoranthene	11 / 17	27,000	1,664	430	214	62.8	7.78
Chrysene	13 / 17	24,000	1,489	480	218	50.0	6.85
Dibenz(a,h)anthracene	2 / 16	6,600	504	--	197	--	2.56
Fluoranthene	13 / 17	9,600	648	350	211	27.4	3.07
Indeno(1,2,3-cd)pyrene	12 / 17	17,000	1,071	270	203	63.0	5.29
Phenanthrene	9 / 17	190	415	--	197	--	2.10
Pyrene	12 / 17	24,000	1,519	650	240	36.9	6.34
NORTHERN AREA							
Benzo(a)anthracene	4 / 4	250	101	350	208	0.71	0.49
Benzo(g,h,i)perylene	2 / 4	150	129	--	197	--	0.66
Chrysene	4 / 4	280	112	480	218	0.58	0.52
Fluoranthene	4 / 4	370	148	350	211	1.06	0.70
Pyrene	4 / 4	430	178	650	240	0.66	0.74

Table 8-51
Comparison of Surface and Subsurface Soil Concentrations
NAB Little Creek, Virginia Beach, VA

Chemical	Surface Soils			Subsurface Soils			Ratio of Maximums	Ratio of Means
	Frequency of Detection	Maximum Concentration Detected	Arithmetic Mean	Frequency of Detection	Maximum Concentration Detected	Arithmetic Mean		
Inorganics (MG/KG)								
Aluminum	25 / 25	12,100	4,863	36 / 36	9,140	2,499	1.32	1.95
Antimony	7 / 25	2.70	0.42	7 / 36	1.30	0.27	2.08	1.52
Arsenic	21 / 25	27.7	3.03	28 / 36	6.30	1.81	4.40	1.67
Barium	25 / 25	263	53.9	32 / 36	96.0	14.3	2.74	3.78
Beryllium	21 / 25	0.77	0.24	23 / 36	0.91	0.13	0.85	1.83
Cadmium	8 / 25	0.33	0.10	6 / 36	0.49	0.06	0.67	1.71
Calcium	24 / 25	36,700	3,532	26 / 36	2,310	635	15.9	5.57
Chromium	25 / 25	79.3	17.5	35 / 36	89.2	9.40	0.89	1.86
Cobalt	14 / 25	13.2	3.36	21 / 36	6.40	1.12	2.06	3.01
Copper	21 / 25	518	55.2	29 / 36	148	18.3	3.50	3.02
Cyanide	1 / 11	0.17	0.05	0 / 22	--	0.04	--	1.31
Iron	25 / 25	26,600	10,521	36 / 36	22,300	4,802	1.19	2.19
Lead	25 / 25	1,240	102	36 / 36	145	25.8	8.55	3.96
Magnesium	25 / 25	8,300	2,339	35 / 36	7,700	593	1.08	3.95
Manganese	25 / 25	617	171	36 / 36	391	46.8	1.58	3.66
Mercury	10 / 25	0.99	0.12	9 / 36	0.37	0.04	2.68	2.72
Nickel	17 / 25	25.0	6.57	25 / 36	24.4	3.11	1.02	2.11
Potassium	25 / 25	8,650	1,995	36 / 36	5,070	470	1.71	4.25
Selenium	3 / 25	0.75	0.30	1 / 36	1.00	0.26	0.75	1.16
Silver	11 / 25	6.70	1.40	3 / 36	2.20	0.31	3.05	4.50
Sodium	8 / 25	501	144	10 / 36	573	70.5	0.87	2.04
Thallium	1 / 25	1.30	0.31	0 / 36	--	0.28	--	1.09
Vanadium	25 / 25	43.2	16.9	36 / 36	22.0	7.07	1.96	2.39
Zinc	25 / 25	602	165	34 / 36	723	67.7	0.83	2.44
Pesticide/Polychlorinated Biphenyls (UG/KG)								
4,4'-DDE	1 / 3	23.0	8.89	0 / 3	--	1.74	--	5.11
4,4'-DDT	1 / 3	10.0	4.55	0 / 3	--	1.74	--	2.62
alpha-Chlordane	1 / 3	24.0	8.63	0 / 3	--	0.90	--	9.63

Table 8-51
Comparison of Surface and Subsurface Soil Concentrations
NAB Little Creek, Virginia Beach, VA

Chemical	Surface Soils			Subsurface Soils			Ratio of Maximums	Ratio of Means
	Frequency of Detection	Maximum Concentration Detected	Arithmetic Mean	Frequency of Detection	Maximum Concentration Detected	Arithmetic Mean		
Semivolatile Organic Compounds (UG/KG)								
Acenaphthene	1 / 24	14.0	322	2 / 35	49.0	127	0.29	2.53
Acenaphthylene	2 / 24	2,700	211	0 / 35	--	138	--	1.53
Anthracene	8 / 24	4,700	279	8 / 36	44.0	113	107	2.48
Benzo(a)anthracene	17 / 25	12,000	568	18 / 36	240	103	50.0	5.49
Benzo(a)pyrene	19 / 25	14,000	628	22 / 36	260	80.4	53.8	7.81
Benzo(b)fluoranthene	17 / 25	30,000	1,291	21 / 36	370	94.9	81.1	13.6
Benzo(g,h,i)perylene	12 / 25	16,000	742	9 / 36	210	129	76.2	5.77
Benzo(k)fluoranthene	17 / 25	27,000	1,156	17 / 36	270	97.9	100	11.8
Chrysene	19 / 25	24,000	1,047	21 / 36	350	91.5	68.6	11.4
Di-n-butylphthalate	1 / 3	65.0	1,911	1 / 3	42.0	191	1.55	10.0
Dibenz(a,h)anthracene	3 / 24	6,600	359	2 / 35	41.0	130	161	2.77
Fluoranthene	19 / 25	9,600	484	22 / 36	330	92.4	29.1	5.23
Fluorene	2 / 24	14.0	318	2 / 35	14.0	129	1.00	2.47
Indeno(1,2,3-cd)pyrene	18 / 25	17,000	751	18 / 36	210	92.4	81.0	8.13
Naphthalene	0 / 24	--	329	2 / 35	18.0	126	--	2.61
PAH (total)	20 / 25	220,490	10,268	26 / 36	5,083	1,791	43.4	5.73
Phenanthrene	15 / 25	190	304	16 / 36	170	111	1.12	2.74
Pyrene	18 / 25	24,000	1,080	23 / 36	560	102	42.9	10.5
bis(2-Ethylhexyl)phthalate	2 / 3	74.0	1,868	3 / 3	1,600	873	0.05	2.14
Other Parameters								
Total organic carbon (MG/KG)	11 / 11	29,210	5,063	22 / 22	7,746	1,880	3.77	2.69
pH	11 / 11	9.45	7.87	22 / 22	8.88	7.60	1.06	1.04

Table 8-52
Comparison of Surface and Subsurface Sediment Concentrations
NAB Little Creek, Virginia Beach, VA

Chemical	Surface Sediment			Subsurface Sediment			Ratio of Maximums	Ratio of Means
	Frequency of Detection	Maximum Concentration Detected	Arithmetic Mean	Frequency of Detection	Maximum Concentration Detected	Arithmetic Mean		
Inorganics (MG/KG)								
Aluminum	24 / 24	17,100	9,566	19 / 19	28,700	11,357	0.60	0.84
Antimony	11 / 24	19.0	1.40	10 / 19	2.00	0.55	9.50	2.53
Arsenic	24 / 24	12.6	8.11	18 / 19	15.4	7.38	0.82	1.10
Barium	23 / 24	49.1	28.0	19 / 19	55.3	27.1	0.89	1.04
Beryllium	19 / 24	0.77	0.51	19 / 19	1.50	0.62	0.51	0.82
Cadmium	16 / 24	0.66	0.26	7 / 19	1.10	0.26	0.60	1.01
Calcium	24 / 24	35,400	6,951	19 / 19	16,200	2,724	2.19	2.55
Chromium	24 / 24	53.9	29.6	19 / 19	53.2	27.3	1.01	1.08
Cobalt	19 / 24	6.80	4.16	19 / 19	10.4	5.01	0.65	0.83
Copper	24 / 24	142	76.7	19 / 19	220	46.7	0.65	1.64
Cyanide	4 / 19	0.27	0.10	6 / 19	0.38	0.12	0.71	0.87
Iron	24 / 24	31,000	19,370	19 / 19	48,500	20,858	0.64	0.93
Lead	24 / 24	1,810	137	19 / 19	156	43.2	11.6	3.17
Magnesium	24 / 24	8,520	4,765	19 / 19	9,330	4,617	0.91	1.03
Manganese	24 / 24	226	149	19 / 19	275	141	0.82	1.05
Mercury	20 / 24	3.18	0.38	15 / 19	1.50	0.30	2.12	1.30
Nickel	20 / 24	21.7	12.2	18 / 19	43.9	14.9	0.49	0.82
Potassium	24 / 24	4,310	2,206	19 / 19	5,210	2,258	0.83	0.98
Selenium	8 / 24	2.38	0.93	10 / 19	1.70	0.97	1.40	0.96
Silver	7 / 24	7.80	1.00	0 / 19	--	0.17	--	6.01
Sodium	24 / 24	20,500	9,270	19 / 19	15,900	7,202	1.29	1.29
Thallium	1 / 24	0.55	0.49	0 / 19	--	0.43	--	1.14
Tin	19 / 19	10.5	4.54	14 / 19	23.5	4.09	0.44	1.11
Vanadium	24 / 24	47.7	27.8	19 / 19	60.3	29.5	0.79	0.94
Zinc	23 / 24	915	317	18 / 19	1,390	243	0.66	1.31
Pesticide/Polychlorinated Biphenyls (UG/KG)								
Endosulfan sulfate	1 / 1	5.80	5.80	-- - --	--	--	--	--
Semivolatile Organic Compounds (UG/KG)								
Acenaphthene	13 / 24	3,000	493	4 / 19	11,000	862	0.27	0.57

Table 8-52
Comparison of Surface and Subsurface Sediment Concentrations
NAB Little Creek, Virginia Beach, VA

Chemical	Surface Sediment			Subsurface Sediment			Ratio of Maximums	Ratio of Means
	Frequency of Detection	Maximum Concentration Detected	Arithmetic Mean	Frequency of Detection	Maximum Concentration Detected	Arithmetic Mean		
Acenaphthylene	20 / 24	520	351	8 / 19	510	228	1.02	1.54
Anthracene	24 / 24	2,300	516	11 / 19	1,700	298	1.35	1.73
Benzo(a)anthracene	24 / 24	5,925	1,263	13 / 19	8,400	720	0.71	1.76
Benzo(a)pyrene	24 / 24	4,250	1,051	15 / 19	3,000	392	1.42	2.68
Benzo(b)fluoranthene	23 / 24	9,950	1,967	13 / 19	4,500	593	2.21	3.32
Benzo(g,h,i)perylene	22 / 24	1,800	574	7 / 19	950	307	1.89	1.87
Benzo(k)fluoranthene	24 / 24	9,175	1,648	13 / 19	3,400	495	2.70	3.33
Carbazole	1 / 1	130	130	-- - --	--	--	--	--
Chrysene	24 / 24	16,575	2,517	13 / 19	6,000	688	2.76	3.66
Di-n-butylphthalate	1 / 1	83.0	83.0	-- - --	--	--	--	--
Dibenz(a,h)anthracene	22 / 24	993	207	7 / 19	320	226	3.10	0.92
Fluoranthene	24 / 24	25,970	2,831	15 / 19	56,000	3,678	0.46	0.77
Fluorene	17 / 24	2,100	293	4 / 19	16,000	1,101	0.13	0.27
Indeno(1,2,3-cd)pyrene	24 / 24	2,198	584	13 / 19	1,200	261	1.83	2.24
Naphthalene	8 / 24	430	340	3 / 19	97.0	264	4.43	1.29
PAH (total)	24 / 24	105,690	19,847	17 / 19	217,752	17,038	0.49	1.16
Phenanthrene	24 / 24	18,360	1,285	8 / 19	62,000	3,707	0.30	0.35
Pyrene	24 / 24	22,300	3,666	17 / 19	44,000	3,279	0.51	1.12
bis(2-Ethylhexyl)phthalate	1 / 1	66.0	66.0	-- - --	--	--	--	--
Other Parameters								
Ammonia (MG/KG)	17 / 19	40.8	14.6	13 / 19	91.3	15.2	0.45	0.96
Total organic carbon (MG/KG)	24 / 24	30,200	16,617	19 / 19	34,450	14,624	0.88	1.14
pH	24 / 24	8.35	7.95	19 / 19	8.65	8.25	0.97	0.96

Table 8-53
Screening Statistics - Subsurface Sediment
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient	Mean Hazard Quotient
Inorganics (MG/KG)									
Aluminum	47.1 - 115	19 / 19	28,700	LW07-H3-SD201-02-02C	11,357	18,000	2 / 19	1.59	0.63
Antimony	14.1 - 34.6	10 / 19	2.00	LW07-M1-SD201-02-02C	0.55	150	0 / 19	0.01	0.004
Arsenic	2.40 - 5.80	18 / 19	15.4	LW07-M3-SD201-02-02C	7.38	8.20	6 / 19	1.88	0.90
Barium	47.1 - 115	19 / 19	55.3	LW07-M3-SD201-02-02C	27.1	48.0	2 / 19	1.15	0.56
Beryllium	1.20 - 2.90	19 / 19	1.50	LW07-M1-SD201-02-02C	0.62	NSV	-- / --	NSV	NSV
Cadmium	1.20 - 2.90	7 / 19	1.10	LW07-M1-SD201-02-02C	0.26	1.20	0 / 19	0.92	0.22
Chromium	2.40 - 5.80	19 / 19	53.2	LW07-M3-SD201-02-02C	27.3	81.0	0 / 19	0.66	0.34
Cobalt	11.8 - 28.8	19 / 19	10.4	LW07-H3-SD201-02-02C	5.01	10.0	2 / 19	1.04	0.50
Copper	5.90 - 14.4	19 / 19	220	LW07-M1-SD201-02-02C	46.7	34.0	6 / 19	6.47	1.37
Cyanide	0.58 - 1.60	6 / 19	0.38	LW07-M1-SD201-02-02C	0.12	NSV	-- / --	NSV	NSV
Iron	23.5 - 57.7	19 / 19	48,500	LW07-M3-SD201-02-02C	20,858	220,000	0 / 19	0.22	0.09
Lead	0.71 - 1.70	19 / 19	156	LW07-M3-SD201-02-02C	43.2	46.7	6 / 19	3.34	0.92
Manganese	3.50 - 8.70	19 / 19	275	LW07-M3-SD201-02-02C	141	260	2 / 19	1.06	0.54
Mercury	0.08 - 0.27	15 / 19	1.50	LW07-M1-SD201-02-02C	0.30	0.15	7 / 19	10.0	1.97
Nickel	9.40 - 23.1	18 / 19	43.9	LW07-M3-SD201-02-02C	14.9	20.9	4 / 19	2.10	0.71
Selenium	1.20 - 2.90	10 / 19	1.70	LW07-H1-SD201-02-02C	0.97	1.00	8 / 19	1.70	0.97
Tin	11.8 - 28.8	14 / 19	23.5	LW07-M1-SD201-02-02C	4.09	3.40	5 / 19	6.91	1.20
Vanadium	11.8 - 28.8	19 / 19	60.3	LW07-M3-SD201-02-02C	29.5	57.0	2 / 19	1.06	0.52
Zinc	4.70 - 11.5	18 / 19	1,390	LW07-M1-SD201-02-02C	243	150	6 / 19	9.27	1.62
Semivolatile Organic Compounds (UG/KG)									
Acenaphthene	390 - 11,000	4 / 19	11,000	LW07-K6-SD201-02-02C	862	16.0	4 / 19	688	53.9
Acenaphthylene	390 - 1,000	8 / 19	510	LW07-K6-SD201-02-02C	228	44.0	5 / 19	11.6	5.19
Anthracene	390 - 1,000	11 / 19	1,700	LW07-M1-SD201-02-02C	298	85.3	3 / 19	19.9	3.49
Benzo(a)anthracene	390 - 11,000	13 / 19	8,400	LW07-K6-SD201-02-02C	720	261	4 / 19	32.2	2.76
Benzo(a)pyrene	390 - 1,000	15 / 19	3,000	LW07-K6-SD201-02-02C	392	430	4 / 19	6.98	0.91
Benzo(b)fluoranthene	390 - 1,000	13 / 19	4,500	LW07-K6-SD201-02-02C	593	3,200	1 / 19	1.41	0.19
Benzo(g,h,i)perylene	390 - 1,000	7 / 19	950	LW07-K6-SD201-02-02C	307	670	1 / 19	1.42	0.46
Benzo(k)fluoranthene	390 - 1,000	13 / 19	3,400	LW07-K6-SD201-02-02C	495	1,800	1 / 19	1.89	0.27
Chrysene	390 - 1,000	13 / 19	6,000	LW07-K6-SD201-02-02C	688	384	4 / 19	15.6	1.79

NSV - No Screening Value

Table 8-53
Screening Statistics - Subsurface Sediment
NAB Little Creek, Virginia Beach, VA

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient	Mean Hazard Quotient
Dibenz(a,h)anthracene	390 - 1,000	7 / 19	320	LW07-K6-SD201-02-02C	226	63.4	4 / 19	5.05	3.56
Fluoranthene	390 - 11,000	15 / 19	56,000	LW07-K6-SD201-02-02C	3,678	600	4 / 19	93.3	6.13
Fluorene	390 - 11,000	4 / 19	16,000	LW07-K6-SD201-02-02C	1,101	19.0	4 / 19	842	57.9
Indeno(1,2,3-cd)pyrene	390 - 1,000	13 / 19	1,200	LW07-K6-SD201-02-02C	261	600	1 / 19	2.00	0.44
Naphthalene	390 - 1,000	3 / 19	97.0	LW07-K6-SD201-02-02C	264	160	0 / 19	0.61	1.65
PAH (total)	-- - --	17 / 19	217,752	LW07-K6-SD201-02-02C	17,038	4,022	6 / 19	54.1	4.24
Phenanthrene	390 - 11,000	8 / 19	62,000	LW07-K6-SD201-02-02C	3,707	240	3 / 19	258	15.4
Pyrene	390 - 11,000	17 / 19	44,000	LW07-K6-SD201-02-02C	3,279	665	5 / 19	66.2	4.93

NSV - No Screening Value

Table 8-54
Benthic Invertebrate Sampling Results
NAB Little Creek, Virginia Beach, VA

Group	Species	Pollution sensitivity	B5-201	B7-201	D5-201	F3-201	F5-201	H1-201	H3-201	H5-201	J4-201	K1-204	K3-201	K4-201	K5-201	K6-201	L2-201	L5-201	L6-201	M1-201	M3-201	Total
Bivalvia	Gemma gemma (Totten)	OP	0	0	0	2	1	0	0	0	0	0	0	0	0	3	0	0	0	0	1	7
Bivalvia	Mercenaria mercenaria (Linnaeus)	PS,EQ	0	0	0	3	2	0	0	1	0	0	13	0	0	0	0	0	0	0	0	19
Bivalvia	Tagelus divisus (Spengler)	PS,EQ	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Cumacea	Leucon americanus Zimmer	--	0	0	0	0	0	0	1	0	0	0	0	3	1	0	0	0	0	1	6	12
Gastropoda	Acteocina canaliculata (Say)	--	0	0	3	1	2	0	0	0	0	0	0	0	0	0	0	1	2	0	0	9
Gastropoda	Ilyanassa obsoleta (Say)	--	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Mysidacea	Mysidopsis bigelowi Tattersall	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Nemertea	Nemertea spp.	--	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Oligochaeta	Tubificoides spp. Group I	OP	5	1	0	1	8	1	1	2	0	1	4	0	1	0	3	0	0	1	1	30
Oligochaeta	Tubificoides wasselli Brinkhurst	OP	0	0	0	0	0	0	0	0	0	0	18	0	0	0	0	0	0	0	0	18
Phoronida	Phoronis psammophila Cori	--	3	3	0	4	14	0	0	0	1	0	0	1	0	0	2	1	1	1	0	31
Polychaeta	Apoprionospio pygmaea (Hartman)	--	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2
Polychaeta	Capitella capitata (Fabricius)	PI,OP	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Polychaeta	Clymenella torquata (Leidy)	PS,EQ	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Polychaeta	Eteone heteropoda Hartman	PI,OP	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Polychaeta	Glycinde solitaria (Webster)	PS,OP	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Polychaeta	Gyptis brevipalpa (Hartmann-Schrode	--	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3
Polychaeta	Heteromastus filiformis (Claparede)	OP	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	4
Polychaeta	Leitoscoloplos spp.	PI,OP	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	2
Polychaeta	Mediomastus ambiseta (Hartman)	PS,OP	3	3	1	7	39	2	3	0	0	0	15	3	0	0	1	1	0	1	1	80
Polychaeta	Nephtys picta Ehlers	PS	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3
Polychaeta	Nephtys sp.	PS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Notomastus sp.	--	3	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Polychaeta	Paleanotus heteroseta Hartman	PS	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Polychaeta	Parahesione luteola (Webster)	--	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Polychaeta	Paraprionospio pinnata (Ehlers)	PI,OP	13	8	2	2	1	7	2	0	12	4	0	9	7	0	2	7	3	4	2	85
Polychaeta	Phyllodoce arenae Webster	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Polydora cornuta Bosc	OP	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Polychaeta	Prionospio heterobranchia Moore	--	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2
Polychaeta	Sigambra tentaculata (Treadwell)	--	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Polychaeta	Spiochaetopterus oculatus Webster	PS	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	3
Polychaeta	Streblospio benedicti Webster	PI,OP	31	39	12	66	41	29	11	25	19	18	25	18	0	3	19	24	9	36	54	479
	Total Organisms		61	55	19	90	114	39	19	29	32	23	80	35	13	8	27	36	15	47	65	807
	Number of Taxa		9	6	5	11	14	4	6	4	3	3	8	6	5	4	5	7	4	8	6	
	Percent Dominant Taxa		50.8	70.9	63.2	73.3	36.0	74.4	57.9	86.2	59.4	78.3	31.3	51.4	53.8	37.5	70.4	66.7	60.0	76.6	83.1	
	Percent Mediomastus and Streblospio		55.7	76.4	68.4	81.1	70.2	79.5	73.7	86.2	59.4	78.3	50.0	60.0	0.00	37.5	74.1	69.4	60.0	78.7	84.6	
	Percent spionids		72.1	85.5	73.7	75.6	37.7	92.3	68.4	86.2	96.9	95.7	35.0	77.1	53.8	37.5	77.8	86.1	80.0	85.1	86.2	

Notes:
Identifiable headless fragments were included with an abundance value of zero (0). These are highlighted yellow in the tables.
Pollution sensitivity rankings:
EQ - Equilibrium (large deep dwelling and long lived taxa that tend to dominate unstressed habitats; generally correlates to pollution-sensitive)
OP - Opportunistic (relatively stress tolerant, short lived taxa with an ability to rapidly colonize stressed habitats; generally correlates to pollution-indicative)
PI - Pollution Indicative (relatively stress tolerant, short lived taxa; based on correlations of taxa with sediment contaminants and dissolved oxygen)
PS - Pollution Sensitive (large deep dwelling and long lived taxa; based on correlations of taxa with sediment contaminants and dissolved oxygen)
Not all taxa have available ratings

Table 8-55
Benthic Invertebrate Sampling Results - Summary By Area
NAB Little Creek, Virginia Beach, VA

	Channel (n=5)			Cove (n=7)			Piers (n=7)		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Total Organisms	19	114	67.8	13	80	34.6	8	65	32.3
Number of Taxa	5	14	9.00	3	8	5.71	3	8	4.71
Percent Dominant Taxa	36.0	73.3	58.8	31.3	70.4	55.8	37.5	86.2	70.9
Percent Mediomastus and Streblospio	55.7	81.1	70.4	0.00	74.1	55.2	37.5	86.2	72.1
Percent spionids	37.7	85.5	68.9	35.0	96.9	70.7	37.5	95.7	80.4

Table 8-56
Physical Parameter Measurements - Sediment
NAB Little Creek, Virginia Beach, VA

Sample	Total Organic Carbon (percent)	pH	Cation Exchange Capacity (meq/100g)	SEM/AVS Ratio	Percent Fines
Surface Sediment					
LW07-B5-SD201-00-02C	1.68	7.94	10.2	0.41	62.2
LW07-B5-SD201P-00-02C	NS	7.85	NS	NS	NS
LW07-B5-SD202-00-02C	2.42	7.85	NS	NS	65.6
LW07-B7-SD201-00-02C	0.31	8.18	5.90	NS	NS
LW07-B7-SD202-00-02C	1.87	7.86	NS	NS	58.9
LW07-D5-SD201-00-02C	2.93	7.78	9.60	0.22	89.2
LW07-D5-SD202-00-02C	3.05	7.69	NS	NS	82.5
LW07-F3-SD201-00-02C	1.29	8.05	15.0	0.21	30.6
LW07-F3-SD202-00-02C	2.22	8.06	NS	NS	58.3
LW07-F5-SD201-00-02C	2.42	8.14	11.5	0.58	29.5
LW07-F5-SD202-00-02C	0.80	7.96	NS	NS	36.0
LW07-H1-SD201-00-02C	2.03	7.90	10.6	0.24	65.9
LW07-H1-SD201P-00-02C	2.18	7.93	NS	NS	NS
LW07-H1-SD202-00-02C	2.18	7.95	NS	NS	80.6
LW07-H3-SD201-00-02C	2.23	7.98	15.0	0.15	75.3
LW07-H3-SD201P-00-02C	NS	8.08	NS	NS	NS
LW07-H3-SD202-00-02C	2.33	8.13	NS	NS	NS
LW07-H5-SD201-00-02C	0.35	8.35	5.40	2.40	11.1
LW07-H5-SD202-00-02C	1.56	8.03	NS	NS	NS
LW07-J4-SD201-00-02C	1.50	8.00	14.0	0.14	74.3
LW07-J4-SD202-00-02C	1.59	7.86	NS	NS	75.8
LW07-K1-SD201-00-02C	2.89	8.36	9.70	0.10	92.0
LW07-K1-SD202-00-02C	2.34	8.35	NS	NS	NS
LW07-K3-SD201-00-02C	1.08	7.89	18.6	0.29	40.6
LW07-K3-SD202-00-02C	1.08	7.80	NS	NS	42.9
LW07-K4-SD201-00-02C	1.39	7.80	17.6	0.36	46.7
LW07-K4-SD202-00-02C	1.39	7.79	NS	NS	51.7
LW07-K5-SD201-00-02C	2.24	7.92	13.4	0.15	86.9
LW07-K5-SD202-00-02C	1.85	7.82	NS	NS	76.2
LW07-K6-SD201-00-02C	0.22	8.20	4.70	0.13	32.6
LW07-K6-SD202-00-02C	0.29	8.04	NS	NS	14.9
LW07-L2-SD201-00-02C	2.22	7.80	8.90	0.28	80.1
LW07-L5-SD201-00-02C	2.04	7.89	8.00	0.13	82.0
LW07-L5-SD202-00-02C	1.99	8.01	NS	NS	64.5

NS - Not Sampled

Table 8-56
Physical Parameter Measurements - Sediment
NAB Little Creek, Virginia Beach, VA

Sample	Total Organic Carbon (percent)	pH	Cation Exchange Capacity (meq/100g)	SEM/AVS Ratio	Percent Fines
LW07-L6-SD201-00-02C	2.38	7.65	8.30	0.16	86.8
LW07-M1-SD201-00-02C	2.01	8.32	7.80	0.30	63.4
LW07-M1-SD202-00-02C	1.70	7.86	NS	NS	NS
LW07-M3-SD201-00-02C	2.01	7.81	14.2	0.24	48.3
LW07-M3-SD202-00-02C	1.91	7.92	NS	NS	69.4
LW07-SD01-00	0.44	8.25	NS	NS	NS
LW07-SD02-00	0.79	8.09	NS	NS	NS
LW07-SD03-00	0.76	7.88	NS	NS	NS
LW07-SD04-00	1.06	8.04	NS	NS	NS
LW07-SD05-00	2.12	7.60	NS	NS	NS
LW07-SD05-00P	1.89	7.64	NS	NS	NS
Subsurface Sediment					
LW07-B5-SD201-02-02C	1.47	8.15	NS	NS	60.0
LW07-B5-SD201P-02-02C	NS	8.24	NS	NS	NS
LW07-B7-SD201-02-02C	0.56	8.15	NS	NS	24.6
LW07-D5-SD201-02-02C	0.77	8.18	NS	NS	63.1
LW07-F3-SD201-02-02C	1.29	8.52	NS	NS	53.7
LW07-F5-SD201-02-02C	0.13	7.99	NS	NS	17.9
LW07-H1-SD201-02-02C	2.44	8.58	NS	NS	NS
LW07-H3-SD201-02-02C	2.18	8.15	NS	NS	93.5
LW07-H5-SD201-02-02C	0.84	8.17	NS	NS	71.5
LW07-J4-SD201-02-02C	1.52	8.05	NS	NS	37.3
LW07-K1-SD201-02-02C	0.96	8.65	NS	NS	NS
LW07-K3-SD201-02-02C	0.90	8.36	NS	NS	83.1
LW07-K3-SD201P-02-02C	NS	8.12	NS	NS	NS
LW07-K4-SD201-02-02C	0.63	8.15	NS	NS	32.1
LW07-K4-SD201P-02-02C	NS	8.26	NS	NS	NS
LW07-K5-SD201-02-02C	1.27	8.15	NS	NS	68.8
LW07-K6-SD201-02-02C	2.17	8.44	NS	NS	58.1
LW07-L2-SD201-02-02C	1.28	8.12	NS	NS	72.5
LW07-L5-SD201-02-02C	1.71	7.80	NS	NS	67.0
LW07-L6-SD201-02-02C	1.43	8.14	NS	NS	80.4
LW07-M1-SD201-02-02C	2.79	8.64	NS	NS	67.6
LW07-M3-SD201-02-02C	3.45	8.16	NS	NS	NS

NS - Not Sampled

Table 8-57
Comparison of Surface Sediment Concentrations With Equilibrium Partitioning-Based Marine Sediment Values
NAB Little Creek, Virginia Beach, VA

Chemical	Maximum Concentration Detected (ug/kg)	Arithmetic Mean (ug/kg)	Mean TOC	EqP-Based Value (ug/kg)[1]	Reference	Frequency of Exceedance	Maximum Ratio	Mean Ratio
Connector Channel								
Acenaphthene	130	280	1.73	1,903	USEPA 1996b	0 / 6	0.07	0.15
Fluoranthene	4,300	893	1.73	2,422	USEPA 1996b	1 / 6	1.78	0.37
Phenanthrene	830	178	1.73	1,903	USEPA 1996b	0 / 6	0.44	0.09
Pier Area								
Acenaphthene	3,000	783	1.55	1,705	USEPA 1996b	2 / 11	1.76	0.46
Fluoranthene	25,970	4,981	1.55	2,170	USEPA 1996b	5 / 11	12.0	2.30
Phenanthrene	18,360	2,418	1.55	1,705	USEPA 1996b	3 / 11	10.8	1.42
Desert Cove								
Acenaphthene	367	220	1.79	1,969	USEPA 1996b	0 / 7	0.19	0.11
Fluoranthene	3,525	1,112	1.79	2,506	USEPA 1996b	1 / 7	1.41	0.44
Phenanthrene	1,400	453	1.79	1,969	USEPA 1996b	0 / 7	0.71	0.23

[1] Normalized using the mean area-specific total organic carbon (TOC) concentration.

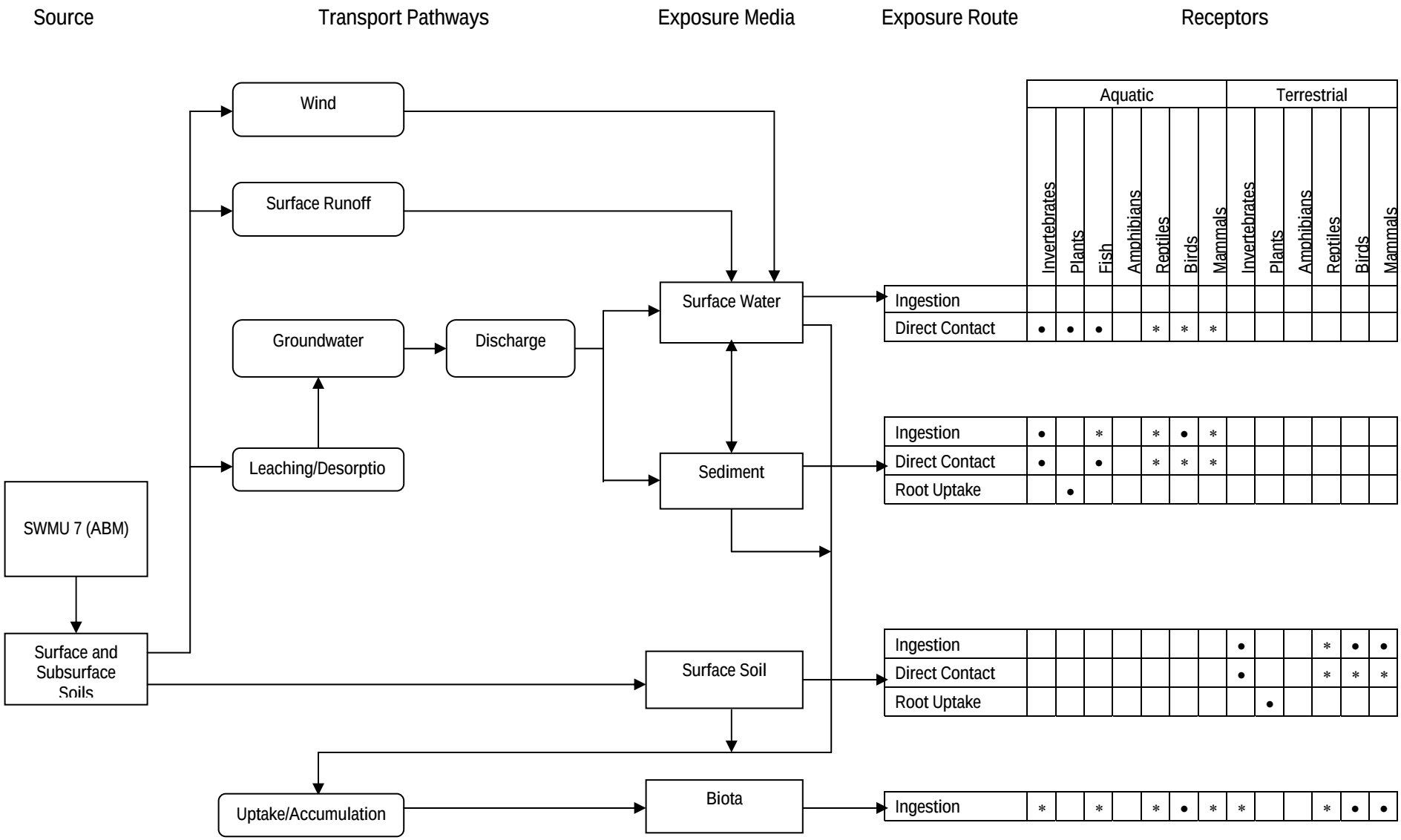
Table 8-58
Comparison of Groundwater PCOC Concentrations to Upgradient and Background Concentrations
NAB Little Creek, Virginia Beach, VA

Chemical	On-Site/Downgradient			Upgradient				Background					
	Frequency of Detection	Maximum	Arithmetic Mean	Maximum	Arithmetic Mean	Ratio of Maximums	Ratio of Means	Upper Tolerance Limit	Ratio of Maximum to UTL	Maximum	Arithmetic Mean	Ratio of Maximums	Ratio of Means
Inorganics (UG/L)													
Aluminum (total)	6 / 7	2,910	1,664	3,380	3,170	0.86	0.52	713	4.08	713	185	4.08	8.99
Iron (total)	7 / 7	56,500	31,064	17,600	15,700	3.21	1.98	70,800	0.80	70,800	17,136	0.80	1.81
Iron (dissolved)	7 / 7	52,800	29,191	8,790	6,605	6.01	4.42	29,800	1.77	29,800	7,140	1.77	4.09
Manganese (total)	7 / 7	5,710	2,093	4,900	4,315	1.17	0.49	1,500	3.81	1,500	469	3.81	4.46
Manganese (dissolved)	7 / 7	5,910	2,236	4,980	4,305	1.19	0.52	1,510	3.91	1,510	450	3.91	4.97

Table 8-59
Summary of COCs
NAB Little Creek, Virginia Beach, VA

Chemical	Surface Soil			Sediment			Groundwater	Food Web	
	South	East	North	Channel	Pier	Cove		Terrestrial	Aquatic
Inorganics									
Arsenic					x	x			
Chromium	x								
Copper		x	x	X	X	X			
Lead			x		X	X		x	
Mercury			x	X	X	X			
Selenium				x	x	x			
Silver					X				
Tin					X	X			
Vanadium	x								
Zinc	x	x	x	x	X	X		x	
Organics									
PAHs	x			x	X	X			

X - Primary potential risk drivers; x - secondary potential risk drivers
Shaded cells indicate chemicals that are not likely to be site related



Complete pathway
Incomplete pathway

FIGURE 8-1
PRELIMINARY DIAGRAMMATIC CONCEPTUAL MODEL
NAB LITTLE CREEK - SWMU 7

• - Receptor evaluated quantitatively
* - Receptor not evaluated quantitatively

SECTION 9

Conclusions and Recommendations

9.1 Nature and Extent of Contamination

The following conclusions regarding the nature and extent of contamination per media have been derived from the data collected at SWMU 7.

9.1.1 Soil

In surface soils, several PAHs and metals may pose a potential risk based on comparisons to human health and ecological screening criteria. The highest concentrations of detected constituents were generally near the current indoor sandblasting facility and near Buildings 3884 and 3869. PAHs exceeding screening criteria were primarily found in one sample, SS21. Fluoranthene exceeded the screening criteria but was not analyzed during the background investigation; therefore, a UTL was not established. The remaining PAHs detected in exceedance of the screening criteria were not detected during the background investigation. The soil samples with metals concentrations exceeding screening criteria and the background UTL were collected from locations along the bulkhead to the north and south of Desert Cove. Only chromium and vanadium exceeded screening criteria and the background UTL in samples collected to the west and south beyond the indoor sandblasting facility.

Only arsenic and benzo(a)pyrene exceeded screening criteria in subsurface soil samples. Arsenic exceeded screening criteria in a number of subsurface soil samples, but only exceeded the background UTL in four samples from three locations near the indoor sandblasting facility. Benzo(a)pyrene exceeded screening criteria in one sample located north of Desert Cove.

9.1.2 Groundwater

In shallow groundwater, methyl-tert-butyl ether (MW03) was the only organic constituent to exceed screening criteria (human health). The downgradient monitoring well (MW01) and the upgradient monitoring well (MW02) near the sandblast facility had similar concentrations of total and dissolved metals. Samples collected from monitoring wells MW01 and MW02 had the greatest number of total and dissolved metals concentrations exceeding screening criteria and the background UTL.

9.2 Sediment

In sediment, several PAHs, and inorganics pose a potential risk based on human health and ecological screening. Arsenic was the only inorganic constituent in exceedance of both the human health and ecological screening values. Iron was found in exceedance of the residential soil RBC, but the levels were not elevated above the ecological screening value. Constituents exceeding only the ecological screening criteria include barium, copper, lead, mercury, nickel, selenium, silver, tin, and zinc. Organic and inorganic analytes were elevated in samples collected near the bulkhead surrounding the cove. Concentrations of analytes

generally decreased west toward Little Creek Channel. PAHs were not as abundant in the subsurface sediment; however, arsenic and iron concentrations were similar in both the surface and subsurface samples.

9.3 Fate and Transport of Contamination

Based on the SWMU 7 chemical and physical data, releases from surface soil to the atmosphere are not likely due to surface cover and constituents that do not readily volatilize (i.e., metals and organics with little tendency to volatilize). Metals and SVOCs present in SWMU 7 surface soils appear to be a source to sediment as suspended particles or dissolved in stormwater drainage and overland flow. Additionally, inorganic contaminants present in soils appear to be a source to groundwater via leaching through the soil column.

Shallow groundwater is not a likely source of contaminants found in sediment. Likewise, sediment and surface water are not likely sources of contaminants to groundwater.

9.4 Human Health Risk Assessment

Based on the baseline HHRA, future exposure to groundwater used as a potable water supply by an adult and child resident may result in a noncarcinogenic hazard above USEPA's target hazard level, where ingestion of arsenic, iron, and manganese contribute the greatest hazard. The carcinogenic risk associated with the resident child/adult is due to the ingestion of arsenic. However, it is extremely unlikely that the Columbia Aquifer groundwater will be used as a future source of potable water, due to the low yield and availability of better water supplies.

Future exposure to groundwater used as a potable water supply (ingestion only) by an adult industrial worker may result in a noncarcinogenic hazard above USEPA's target hazard due to ingestion of iron and manganese.

Future exposure to groundwater during excavation activities by an adult construction worker may result in a noncarcinogenic hazard above USEPA's target hazard due to dermal contact with manganese.

9.5 Ecological Risk Assessment

The developed nature of the terrestrial portions of the site and the resulting low quality of the habitat present (gravel or hard-packed dirt with low and sparse herbaceous plants) is likely to significantly reduce potential exposures. Additionally, the possibility of continued transport to Desert Cove and the Connector Channel via wind and surface runoff, particularly for chromium, copper, lead, mercury, and zinc (possible ABM/paint residue components) from the northern area of the site, was eliminated through the interim removal action completed in September 2004.. There were no exceedances (based upon LOAELs) for terrestrial-based food web exposures.

There were no exceedances (based upon NOAELs) for aquatic-based food web exposures. In surface sediment, a number of metals (particularly copper, lead, mercury, tin, and zinc) and PAHs were identified as COCs. A comparison of surface and subsurface sediment

concentrations suggests some mixing within the top foot or two of the sediment column. In general, sediment concentrations were highest in the pier area of Desert Cove and lowest in the Connector Channel. This pattern was also reflected in the benthic invertebrate community data and is also consistent with the known site history and proximity to source areas. SEM/AVS ratios from surface sediment samples, however, suggest that metal bioavailability is relatively low, with only one of 18 ratios exceeding one. A comparison of surface sediment concentrations to equilibrium partitioning-based sediment values, which provide a measure of bioavailability, for the three PAHs with available values suggests that potential exposures and risks are high in the pier area and low elsewhere. Groundwater does not appear to be a significant transport route from the site to the Desert Cove system.

In summary, the highest site-related risks were associated with metals (primarily copper, lead, mercury, tin, and zinc) and PAHs in Desert Cove sediments, particularly in the pier areas.

9.6 Risk Management for SWMU 7a

This section presents a summary of potential risks identified in the RI and the rationale for risk management consideration for soil and groundwater at SWMU 7a.

9.6.1 Soil

Human health risk associated with exposure to soil at SWMU 7a are acceptable. While, the noncarcinogenic hazard associated with exposure to combined surface and subsurface soil for the future child resident scenario is above USEPA's target hazard index of 1.0 (1.4), none of the individual constituents in soil contribute HQs above 0.5, and there are no target organs with HIs above 1 due to soil exposure. The risks for all other human health scenarios from exposure to surface soil and combined surface and subsurface soil are within USEPA's acceptable risk range.

The potential site-related ecological risks associated with SWMU 7a are acceptable. PAH exceedances of the ecological screening values were restricted to a small area near CB-125, and are not related to ABM (CERCLA) activities. The developed nature of the terrestrial portions of the site and the resulting low quality of the habitat present (gravel or hard-packed dirt with low and sparse herbaceous plants) is likely to significantly reduce potential exposures. The potential for transport of metals to Desert Cove from the northern area of the site was eliminated through the interim removal action completed in September 2004. There were no exceedances (based upon LOAELs) for terrestrial-based food web exposures.

Therefore the Navy in partnership with the EPA and VDEQ agree that no further CERCLA actions are warranted for soil at SWMU 7a.

9.6.2 Groundwater

Potential human health risks associated with exposure to groundwater are limited to potable use by future residents from ingestion of arsenic, iron, and manganese, and potential dermal contact of a future construction worker to manganese in groundwater. Arsenic only slightly exceeds (18.4 µg/L) the MCL (10 µg/L) in one of six samples. Based on

a population to population statistical comparison, arsenic concentrations are statistically similar to the background groundwater samples.

While iron and manganese concentrations are statistically different than background, they only exceed their respective background UTLs in three of the six samples. Although, there is a slight potential risk (HI=1.7) to the future construction worker from dermal exposure to manganese in groundwater, there is no risk (HI=0.4) based on a more realistic central tendency exposure scenario.

Although arsenic, iron, and manganese in groundwater indicate a potential human health risk for potable use, these metals are not believed to be related to a CERCLA release associated with sandblasting activities at SWMU 7a based on the following:

- Concentrations of typical ABM related metals such as lead, copper, chromium, and zinc are not elevated in soil or groundwater; these metals would be expected to also be elevated if arsenic, iron, manganese were related to ABM activities as well.
- LW07-MW01, where the highest iron and manganese concentrations are present in groundwater, is located adjacent to the rip-rap shoreline of the connector channel entering Desert Cove and may be tidally influenced as evidenced by elevated conductivity and salinity measurements. Concentrations of iron and manganese may be reflective of this tidal influence.
- There is no correlation between higher concentrations of arsenic, iron, and manganese in groundwater with concentrations of iron and manganese in soil. If arsenic, iron, and manganese in groundwater were the result of leaching from surface ABM, it would be expected that these metals would also be elevated in the overlying soil.
- Desert Cove is a bulkheaded pier area created though backfill material potentially pulled from the Cove and Connector channel during dredging activities. Epic photos (1937, 1949, and 1954) indicate beach exposed land area where bulkhead piers are currently situated with at least 10 feet of fill. SWMU 7 monitoring wells are screened within this dredge fill material. Arsenic, iron, and manganese concentrations in groundwater could be reflective of the dredge fill components rather than surface ABM activities.

Therefore, the Navy in partnership with the EPA and VDEQ agree that no further CERCLA actions are warranted for groundwater at SWMU 7a.

9.7 Recommendations

9.7.1 SWMU 7a

Based on results from previous investigations, conclusions of the human health and ecological risk assessments, and interim removal actions completed at SWMU 7a, the Navy in partnership with the EPA and VDEQ agree that no further CERCLA actions are warranted for SWMU 7a. The proposed path forward for SWMU 7a is to complete a Proposed Remedial Action Plan (PRAP) and Record of Decision (ROD) for no further action and site closeout with unrestricted use/unrestricted exposure.

9.7.2 SWMU 7b

Potential risks in the Desert Cove system are high in some areas (such as near the piers). The current plans to replace the piers and dredge the cove and channel in 2006 are likely to address these potential risks. While the depth of dredging is not yet known, it is likely that at least several feet of sediment will be removed during this activity. If this activity takes place, the collection and evaluation of post-dredging surface sediment samples is recommended to confirm that concentrations of chemicals have been reduced to acceptable levels. If the activity does not take place, it is recommended that the risk evaluation for SWMU 7 be continued.

Appendix A
Summary of Analytical Results

Table A-1
Groundwater Analytical Results from the 2000 SI
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-MW01	LW07-MW02	LW07-MW03
Sample ID	LW07-MW01-00B	LW07-MW02-00B	LW07-MW03-00B
Sample Date	05/31/00	05/31/00	05/31/00
Chemical Name			
Volatile Organic Compounds (UG/L)			
1,1,1-Trichloroethane	10 U	10 U	10 U
1,1,2,2-Tetrachloroethane	10 U	10 U	10 U
1,1,2-Trichloroethane	10 U	10 U	10 U
1,1-Dichloroethane	10 U	10 U	10 U
1,1-Dichloroethene	10 U	10 U	10 U
1,2-Dichloroethane	10 U	10 U	10 U
1,2-Dichloroethene (total)	10 U	10 U	10 U
1,2-Dichloropropane	10 U	10 U	10 U
2-Butanone	10 U	10 U	10 U
2-Hexanone	10 U	10 U	10 U
4-Methyl-2-pentanone	10 U	10 U	10 U
Acetone	10 U	1 B	10 U
Benzene	10 U	10 U	10 U
Bromodichloromethane	10 U	10 U	10 U
Bromoform	10 U	10 U	10 U
Bromomethane	10 U	10 U	10 U
Carbon disulfide	10 U	10 U	10 U
Carbon tetrachloride	10 U	10 U	10 U
Chlorobenzene	10 U	10 U	10 U
Chloroethane	10 U	10 U	10 U
Chloroform	14	10 U	10 U
Chloromethane	10 U	10 U	10 U
Dibromochloromethane	10 U	10 U	10 U
Ethylbenzene	10 U	10 U	10 U
Methylene chloride	9 B	7 B	6 B
Styrene	10 U	10 U	10 U
Tetrachloroethene	10 U	10 U	10 U
Toluene	10 U	10 U	10 U
Trichloroethene	10 U	10 U	10 U
Vinyl chloride	10 U	10 U	10 U
Xylene, total	10 U	10 U	10 U
cis-1,2-Dichloroethene	10 U	10 U	10 U
cis-1,3-Dichloropropene	10 U	10 U	10 U
m- and p-Xylene	10 U	10 U	10 U
o-Xylene	10 U	10 U	10 U
trans-1,2-Dichloroethene	10 U	10 U	10 U
trans-1,3-Dichloropropene	10 U	10 U	10 U
Semi-volatile Organic Compounds (UG/L)			
1,2,4-Trichlorobenzene	10 U	10 U	10 U
1,2-Dichlorobenzene	10 U	10 U	10 U
1,3-Dichlorobenzene	10 U	10 U	10 U
1,4-Dichlorobenzene	10 U	10 U	10 U
2,4,5-Trichlorophenol	25 U	25 U	25 U
2,4,6-Trichlorophenol	10 U	10 U	10 U
2,4-Dichlorophenol	10 U	10 U	10 U
2,4-Dimethylphenol	10 U	10 U	10 U
2,4-Dinitrophenol	25 U	25 U	25 U
2,4-Dinitrotoluene	10 U	10 U	10 U
2,6-Dinitrotoluene	10 U	10 U	10 U
2-Chloronaphthalene	10 U	10 U	10 U
2-Chlorophenol	10 U	10 U	10 U
2-Methylnaphthalene	10 U	10 U	10 U
2-Methylphenol	10 U	10 U	10 U
2-Nitroaniline	25 U	25 U	25 U
2-Nitrophenol	10 U	10 U	10 U
3,3'-Dichlorobenzidine	10 U	10 U	10 U
3-Nitroaniline	25 U	25 U	25 U
4,6-Dinitro-2-methylphenol	25 U	25 U	25 U
4-Bromophenyl-phenylether	10 U	10 U	10 U
4-Chloro-3-methylphenol	10 U	10 U	10 U
4-Chloroaniline	10 U	10 U	10 U
4-Chlorophenyl-phenylether	10 U	10 U	10 U
4-Methylphenol	10 U	10 U	10 U
4-Nitroaniline	25 U	25 U	25 U
4-Nitrophenol	25 U	25 U	25 U
Acenaphthene	10 U	10 U	10 U
Acenaphthylene	10 U	10 U	10 U

NA - Not analyzed
B - Analyte not detected above associated blank
J - Reported value is estimated
U - Analyte not detected
UL - Not detected, quantitation limit is probably higher

Table A-1
Groundwater Analytical Results from the 2000 SI
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-MW01	LW07-MW02	LW07-MW03
Sample ID	LW07-MW01-00B	LW07-MW02-00B	LW07-MW03-00B
Sample Date	05/31/00	05/31/00	05/31/00
Chemical Name			
Anthracene	10 U	10 U	10 U
Benzo(a)anthracene	10 U	10 U	10 U
Benzo(a)pyrene	10 U	10 U	10 U
Benzo(b)fluoranthene	10 U	10 U	10 U
Benzo(g,h,i)perylene	10 U	10 U	10 U
Benzo(k)fluoranthene	10 U	10 U	10 U
Bis(2-chloro-1-methylethyl) ether	10 U	10 U	10 U
Butylbenzylphthalate	10 U	10 U	10 U
Carbazole	10 U	10 U	10 U
Chrysene	10 U	10 U	10 U
Di-n-butylphthalate	10 U	10 U	10 U
Di-n-octylphthalate	10 U	10 U	10 U
Dibenz(a,h)anthracene	10 U	10 U	10 U
Dibenzofuran	10 U	10 U	10 U
Diethylphthalate	10 U	10 U	10 U
Dimethyl phthalate	10 U	10 U	10 U
Fluoranthene	10 U	10 U	10 U
Fluorene	10 U	10 U	10 U
Hexachlorobenzene	10 U	10 U	10 U
Hexachlorobutadiene	10 U	10 U	10 U
Hexachlorocyclopentadiene	10 U	10 U	10 U
Hexachloroethane	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	10 U	10 U	10 U
Isophorone	10 U	10 U	10 U
Naphthalene	10 U	10 U	10 U
Nitrobenzene	10 U	10 U	10 U
Pentachlorophenol	25 U	25 U	25 U
Phenanthrene	10 U	10 U	10 U
Phenol	10 U	10 U	10 U
Pyrene	10 U	10 U	10 U
bis(2-Chloroethoxy)methane	10 U	10 U	10 U
bis(2-Chloroethyl)ether	10 U	10 U	10 U
bis(2-Ethylhexyl)phthalate	10 U	10 U	10 U
n-Nitroso-di-n-propylamine	10 U	10 U	10 U
n-Nitrosodiphenylamine	10 U	10 U	10 U
Pesticide/Polychlorinated Biphenyls (UG/L)			
4,4'-DDD	0.1 U	0.1 U	0.1 U
4,4'-DDE	0.1 U	0.1 U	0.1 U
4,4'-DDT	0.1 U	0.1 U	0.1 U
Aldrin	0.05 U	0.05 U	0.05 U
Aroclor-1016	1 U	1 U	1 U
Aroclor-1221	2 U	2 U	2 U
Aroclor-1232	1 U	1 U	1 U
Aroclor-1242	1 U	1 U	1 U
Aroclor-1248	1 U	1 U	1 U
Aroclor-1254	1 U	1 U	1 U
Aroclor-1260	1 U	1 U	0.049 U
Dieldrin	0.1 U	0.1 U	0.1 U
Endosulfan I	0.05 U	0.05 U	0.05 U
Endosulfan II	0.1 U	0.1 U	0.1 U
Endosulfan sulfate	0.1 U	0.1 U	0.1 U
Endrin	0.1 U	0.1 U	0.1 U
Endrin aldehyde	0.1 U	0.1 U	0.1 U
Endrin ketone	0.1 U	0.1 U	0.1 U
Heptachlor	0.05 U	0.05 U	0.05 U
Heptachlor epoxide	0.05 U	0.05 U	0.05 U
Methoxychlor	0.5 U	0.5 U	0.5 U
Toxaphene	5 U	5 U	5 U
alpha-BHC	0.05 U	0.05 U	0.05 U
alpha-Chlordane	0.05 U	0.05 U	0.05 U
beta-BHC	0.05 U	0.05 U	0.05 U
delta-BHC	0.05 U	0.05 U	0.05 U
gamma-BHC (Lindane)	0.05 U	0.05 U	0.05 U
gamma-Chlordane	0.05 U	0.05 U	0.05 U
Total Metals (UG/L)			
Aluminum	908 B	3,380	2,030
Antimony	2.7 U	2.7 U	2.7 U
Arsenic	3.1 UL	3.1 UL	3.1 UL

NA - Not analyzed
B - Analyte not detected above associated blank
J - Reported value is estimated
U - Analyte not detected
UL - Not detected, quantitation limit is probably higher

Table A-1
Groundwater Analytical Results from the 2000 SI
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-MW01	LW07-MW02	LW07-MW03
Sample ID	LW07-MW01-00B	LW07-MW02-00B	LW07-MW03-00B
Sample Date	05/31/00	05/31/00	05/31/00
Chemical Name			
Barium	117 J	81.9 J	103 J
Beryllium	0.6 U	1.4 B	0.81 B
Cadmium	0.54 U	0.54 U	0.54 U
Calcium	132,000 J	84,700 J	63,600 J
Chromium	22.1	14	8.4 U
Cobalt	20.1 B	44.4 J	9.5 B
Copper	6.2 B	5.4 U	8.4 B
Iron	42,500	13,800	23,600
Lead	3.4	2.1 U	3
Magnesium	106,000	51,900	17,900
Manganese	4,860	4,900	983
Mercury	0.12 B	0.13 B	0.12 B
Nickel	21.5 B	26.9 B	10.8 B
Potassium	18,400	5,940	3,120 J
Selenium	2.7 U	2.7 U	2.7 U
Silver	5.7 U	5.7 U	8.3 J
Sodium	729,000 J	266,000 J	118,000 J
Thallium	2.1 U	2.1 U	2.1 U
Vanadium	5.7 J	11.4 J	9.5 J
Zinc	43.2 B	36.3 B	15.5 B
Dissolved Metals (UG/L)			
Aluminum	89.8 B	118 B	66 U
Antimony	2.7 U	2.7 U	2.7 U
Arsenic	3.1 UL	3.1 UL	3.1 UL
Barium	120 J	65.9 B	83.3 J
Beryllium	0.6 U	0.78 B	0.78 B
Cadmium	0.54 U	0.54 U	0.54 U
Calcium	142,000 J	82,800 J	59,700 J
Chromium	8.4 U	8.4 U	8.4 U
Cobalt	18.9 B	34.5 J	5.2 U
Copper	10.3 B	5.4 U	9.2 B
Iron	44,800	8,790	20,200
Lead	2.1 U	2.1 U	2.1 U
Magnesium	121,000	52,600	17,100
Manganese	5,690	4,980	959
Mercury	0.1 B	0.17 B	0.09 B
Nickel	7.7 U	8 B	7.7 U
Potassium	19,800	6,100	2,680 J
Selenium	2.7 U	2.7 U	2.7 U
Silver	5.7 U	5.7 U	5.7 U
Sodium	847,000 J	275,000 J	114,000 J
Thallium	2.1 U	2.1 U	2.1 U
Vanadium	4.4 U	4.4 U	4.4 U
Zinc	55 B	43.1 B	16.1 B

NA - Not analyzed
B - Analyte not detected above associated blank
J - Reported value is estimated
U - Analyte not detected
UL - Not detected, quantitation limit is probably higher

Table A-2
Soil Analytical Results from the 2000 SI
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-DP04		LW07-DP05		LW07-DP06		LW07-DP07		LW07-DP08			LW07-DP09		LW07-DP10		LW07-DP11		LW07-DP12		LW07-DP13		
Sample ID	LW07-SB04-01	LW07-SS04-00	LW07-SB05-01	LW07-SS05-00	LW07-SB06-01	LW07-SS06-00	LW07-SB07-01	LW07-SS07-00	LW07-SB08-01	LW07-SS08-00	LW07-SS08-00P	LW07-SB09-01	LW07-SS09-00	LW07-SB10-01	LW07-SS10-00	LW07-SB11-01	LW07-SS11-00	LW07-SB12-01	LW07-SS12-00	LW07-SB13-01	LW07-SS13-00	LW07-SB14-01
Sample Date	05/23/00	05/23/00	05/23/00	05/23/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/23/00
Chemical Name																						
Volatile Organic Compounds (UG/KG)																						
1,1,1-Trichloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethene (total)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Butanone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Methyl-2-pentanone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acetone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromodichloromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromoform	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromomethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon disulfide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibromochloromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Xylene, total	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
m- and p-Xylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
o-Xylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Semi-volatile Organic Compounds (UG/KG)																						
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1-Methylnaphthalene	18 R	19 R	18 UJ	19 U	19 U	18 UJ	18 U	55 UJ	18 U	18 UJ	18 UJ	17 U	18 UJ	18 U	36 UJ	18 U	20 UJ	19 UJ	18 U	18 U	19 UJ	20 U
2,4,5-Trichlorophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dimethylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Chlorophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	18 R	19 R	18 UJ	19 U	19 U	18 UJ	18 U	55 UJ	18 U	18 UJ	18 UJ	17 U	18 UJ	18 U	36 UJ	18 U	20 UJ	19 UJ	18 U	18 U	19 UJ	20 U
2-Methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitroaniline	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitrophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Nitroaniline	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Bromophenyl-phenylether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chloroaniline	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitroaniline	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitrophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

NA - Not analyzed
B - Analyte not detected above associated blank
J - Reported value is estimated
L - Reported value may be biased low
R - Unreliable result

U - Analyte not detected
UJ - Not detected, quantitation limit may be inaccurate
UL

Table A-2
Soil Analytical Results from the 2000 SI
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-DP14		LW07-MW01		LW07-MW02			LW07-MW03	
Sample ID	LW07-SS14-00	LW07-SS14-00P	LW07-SB01-01	LW07-SS01-00	LW07-SB02-01	LW07-SS02-00	LW07-SS02-00P	LW07-SB03-01	LW07-SS03-00
Sample Date	05/23/00	05/23/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00
Chemical Name									
Volatile Organic Compounds (UG/KG)									
1,1,1-Trichloroethane	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
1,1,2,2-Tetrachloroethane	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
1,1,2-Trichloroethane	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
1,1-Dichloroethane	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
1,1-Dichloroethene	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
1,2-Dichloroethane	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
1,2-Dichloroethene (total)	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
1,2-Dichloropropane	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
2-Butanone	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
2-Hexanone	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
4-Methyl-2-pentanone	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
Acetone	NA	NA	23 B	5 B	10.8 U	10.5 U	3 B	14 B	5 B
Benzene	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
Bromodichloromethane	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
Bromoform	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
Bromomethane	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
Carbon disulfide	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
Carbon tetrachloride	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
Chlorobenzene	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
Chloroethane	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
Chloroform	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
Chloromethane	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
Dibromochloromethane	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
Ethylbenzene	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
Methylene chloride	NA	NA	8 B	11 B	6 B	7 B	6 B	5 B	6 B
Styrene	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
Tetrachloroethene	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
Toluene	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
Trichloroethene	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
Vinyl chloride	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
Xylene, total	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
cis-1,2-Dichloroethene	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
cis-1,3-Dichloropropene	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
m- and p-Xylene	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
o-Xylene	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
trans-1,2-Dichloroethene	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
trans-1,3-Dichloropropene	NA	NA	10.5 U	13.3 U	10.8 U	10.5 U	10.7 U	10.7 U	11.5 U
Semi-volatile Organic Compounds (UG/KG)									
1,2,4-Trichlorobenzene	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
1,2-Dichlorobenzene	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
1,3-Dichlorobenzene	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
1,4-Dichlorobenzene	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
1-Methylnaphthalene	18 UJ	55 R	NA	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	NA	NA	1,770 U	27,409 U	875 U	878 U	894 U	885 U	936 U
2,4,6-Trichlorophenol	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
2,4-Dichlorophenol	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
2,4-Dimethylphenol	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
2,4-Dinitrophenol	NA	NA	1,770 U	27,409 U	875 U	878 U	894 U	885 U	936 U
2,4-Dinitrotoluene	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
2,6-Dinitrotoluene	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
2-Chloronaphthalene	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
2-Chlorophenol	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
2-Methylnaphthalene	18 UJ	55 R	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
2-Methylphenol	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
2-Nitroaniline	NA	NA	1,770 U	27,409 U	875 U	878 U	894 U	885 U	936 U
2-Nitrophenol	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
3,3'-Dichlorobenzidine	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
3-Nitroaniline	NA	NA	1,770 U	27,409 U	875 U	878 U	894 U	885 U	936 U
4,6-Dinitro-2-methylphenol	NA	NA	1,770 U	27,409 U	875 U	878 U	894 U	885 U	936 U
4-Bromophenyl-phenylether	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
4-Chloro-3-methylphenol	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
4-Chloroaniline	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
4-Chlorophenyl-phenylether	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
4-Methylphenol	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
4-Nitroaniline	NA	NA	1,770 U	27,409 U	875 U	878 U	894 U	885 U	936 U
4-Nitrophenol	NA	NA	1,770 U	27,409 U	875 U	878 U	894 U	885 U	936 U

NA - Not analyzed
B - Analyte not detected above associated blank
J - Reported value is estimated
L - Reported value may be biased low
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Table A-2
Soil Analytical Results from the 2000 SI
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-DP04		LW07-DP05		LW07-DP06		LW07-DP07		LW07-DP08			LW07-DP09		LW07-DP10		LW07-DP11		LW07-DP12		LW07-DP13		
Sample ID	LW07-SB04-01	LW07-SS04-00	LW07-SB05-01	LW07-SS05-00	LW07-SB06-01	LW07-SS06-00	LW07-SB07-01	LW07-SS07-00	LW07-SB08-01	LW07-SS08-00	LW07-SS08-00P	LW07-SB09-01	LW07-SS09-00	LW07-SB10-01	LW07-SS10-00	LW07-SB11-01	LW07-SS11-00	LW07-SB12-01	LW07-SS12-00	LW07-SB13-01	LW07-SS13-00	LW07-SB14-01
Sample Date	05/23/00	05/23/00	05/23/00	05/23/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/23/00
Chemical Name																						
Acenaphthene	18 R	19 R	18 UJ	19 U	19 U	18 UJ	18 U	55 UJ	18 U	18 UJ	18 UJ	17 U	18 UJ	18 U	36 UJ	18 U	20 UJ	19 UJ	18 U	18 U	19 UJ	20 U
Acenaphthylene	35 R	37 R	36 UJ	38 U	37 U	36 UJ	35 U	110 UJ	36 U	35 UJ	35 UJ	34 U	35 UJ	35 U	72 UJ	35 U	39 UJ	38 UJ	36 U	35 U	38 UJ	40 U
Anthracene	2.9 L	1.9 R	13 J	1.9 U	1.9 U	1.8 UJ	1.8 U	7.9 J	1.8 U	1.4 J	1.7 J	1.7 U	4.3 J	1.8 U	3.6 UJ	1.8 U	3.7 J	1.3 J	1.3 J	1.8	1.9 UJ	2 U
Benzo(a)anthracene	89 L	60 L	22 J	3.1	1.9	14 J	7.1	32 J	1.8 U	20 J	20 J	5	9.1 J	0.91 J	36 J	1.5 J	34 J	17 J	21	13	64 J	4.6
Benzo(a)pyrene	71 L	83 L	13 J	2.7	1.9 U	13 J	12	47 J	1.8 U	30 J	20 J	9.1	11 J	1.1 J	27 J	1.6 J	37 J	12 J	11	20	18 J	4.4
Benzo(b)fluoranthene	120 L	170 L	15 J	3.8 U	3.7 U	17 J	4.9	43 J	3.6 U	31 J	32 J	8.9	11 J	1.5 J	37 J	1.8 J	52 J	14 J	26	18	38 J	13
Benzo(g,h,i)perylene	120 L	110 L	9.7 J	7.2	3.7 U	17 J	3.5 U	11 UJ	3.6 U	45 J	37 J	11	12 J	3.5 U	7.2 UJ	8.1	58 J	14 J	30	31	22 J	8.1
Benzo(k)fluoranthene	60 L	110 L	17 J	2.5	3.2	7.8 J	1.8 U	5.5 UJ	1.8 U	22 J	14 J	8.5	6.4 J	1.8 U	15 J	1.8 U	21 J	5.8 J	11	7.8	14 J	4.9
Bis(2-chloro-1-methylethyl) ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Butylbenzylphthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbazole	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	60 L	60 L	53 J	4.9	1.9	31 J	6.3	53 J	1.8 U	19 J	23 J	4.1	8.5 J	1.8 U	46 J	1.4 J	35 J	16 J	17	10	32 J	2 J
Di-n-butylphthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-octylphthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	3.5 R	3.7 R	3.6 UJ	3.8 U	3.7 U	3.6 UJ	3.5 U	11 UJ	3.6 U	3.5 UJ	3.5 UJ	3.4 U	3.5 UJ	3.5 U	7.2 UJ	3.5 U	3.9 UJ	3.8 UJ	3.6 U	1.8 J	3.8 UJ	4 U
Dibenzofuran	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diethylphthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	89 L	58 L	22 J	12	9.4	75 J	13	70 J	3.6 U	37 J	43 J	9	27 J	1.3 J	99 J	3 J	81 J	24 J	41	17	71 J	14
Fluorene	3.5 R	3.7 R	2.3 J	3.8 U	3.7 U	3.6 UJ	3.5 U	11 UJ	3.6 U	3.6 J	3.5 UJ	3.4 U	3.5 UJ	3.5 U	7.2 UJ	3.5 U	3.9 UJ	3.8 UJ	3.6 U	3.5 U	3.8 UJ	4 U
Hexachlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorocyclopentadiene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	65 L	71 L	5.6 J	3.5	2.3	8.6 J	1.8 U	27 J	1.8 U	18 J	16 J	6.1	7.2 J	1.8 U	19 J	3	29 J	7.3 J	19	20	17 J	5.5
Isophorone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	18 R	19 R	18 UJ	19 U	19 U	18 UJ	18 U	55 UJ	18 U	18 UJ	18 UJ	17 U	18 UJ	18 U	36 UJ	18 U	20 UJ	19 UJ	18 U	5.5 J	19 UJ	20 U
Nitrobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	7.2 L	21 L	14 J	4.2	1.6 J	19 J	5.7	25 J	1 J	13 J	18 J	3.9	19 J	1.8 U	32 J	2.2	31 J	3.6 J	15	8.3	16 J	7
Phenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	170 L	65 L	17 J	7.4	8	210 J	12	73 J	1.8 U	44 J	51 J	6.7	22 J	1.1 J	71 J	3.6	69 J	27 J	31	21	70 J	4
bis(2-Chloroethoxy)methane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Chloroethyl)ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitroso-di-n-propylamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosodiphenylamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pesticide/Polychlorinated Biphenyls (UG/KG)																						
4,4'-DDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aldrin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1016	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1221	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1232	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1242	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1248	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1254	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan I	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan II	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan sulfate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin aldehyde	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin ketone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor epoxide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methoxychlor	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toxaphene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
alpha-BHC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
alpha-Chlordane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
beta-BHC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
delta-BHC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
gamma-BHC (Lindane)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
gamma-Chlordane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Metals (MG/KG)																						

NA - Not analyzed
B - Analyte not detected above associated blank
J - Reported value is estimated
L - Reported value may be biased low
R - Unreliable result

U - Analyte not detected
UJ - Not detected, quantitation limit may be inaccurate
UL

Table A-2
Soil Analytical Results from the 2000 SI
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-DP14		LW07-MW01		LW07-MW02			LW07-MW03	
Sample ID	LW07-SS14-00	LW07-SS14-00P	LW07-SB01-01	LW07-SS01-00	LW07-SB02-01	LW07-SS02-00	LW07-SS02-00P	LW07-SB03-01	LW07-SS03-00
Sample Date	05/23/00	05/23/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00
Chemical Name									
Acenaphthene	18 UJ	55 R	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
Acenaphthylene	36 UJ	110 R	708 U	2,700 J	350 U	351 U	358 U	354 U	374 U
Anthracene	1.8 UJ	5.5 R	708 U	4,700 J	350 U	351 U	358 U	354 U	374 U
Benzo(a)anthracene	16 J	250 L	97 J	12,000	350 U	351 U	358 U	354 U	374 U
Benzo(a)pyrene	3.7 J	83 L	260 J	14,000	350 U	84 J	358 U	354 U	374 U
Benzo(b)fluoranthene	21 J	240 L	370 J	30,000	52 J	110 J	358 U	354 U	374 U
Benzo(g,h,i)perylene	24 J	150 L	210 J	16,000	350 U	86 J	358 U	354 U	374 U
Benzo(k)fluoranthene	22 J	96 L	270 J	27,000	38 J	84 J	358 U	354 U	374 U
Bis(2-chloro-1-methylethyl) ether	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
Butylbenzylphthalate	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
Carbazole	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
Chrysene	19 J	280 L	190 J	24,000	350 U	74 J	358 U	354 U	374 U
Di-n-butylphthalate	NA	NA	708 U	10,963 U	42 J	351 U	65 J	354 U	374 U
Di-n-octylphthalate	NA	NA	708 UJ	10,963 UJ	350 UJ	351 UJ	358 UJ	354 UJ	374 UJ
Dibenz(a,h)anthracene	3.6 UJ	11 R	708 U	6,600 J	350 U	351 U	358 U	354 U	374 U
Dibenzofuran	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
Diethylphthalate	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
Dimethyl phthalate	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
Fluoranthene	28 J	370 L	120 J	9,600 J	350 U	351 U	358 U	354 U	374 U
Fluorene	3.6 UJ	11 R	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
Hexachlorobenzene	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
Hexachlorobutadiene	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
Hexachlorocyclopentadiene	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
Hexachloroethane	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
Indeno(1,2,3-cd)pyrene	14 J	80 L	210 J	17,000	350 U	79 J	358 U	354 U	374 U
Isophorone	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
Naphthalene	18 UJ	55 R	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
Nitrobenzene	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
Pentachlorophenol	NA	NA	1,770 U	27,409 U	875 U	878 U	894 U	885 U	936 U
Phenanthrene	7.7 J	46 L	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
Phenol	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
Pyrene	28 J	430 L	170 J	24,000	37 J	351 U	358 U	354 U	374 U
bis(2-Chloroethoxy)methane	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
bis(2-Chloroethyl)ether	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
bis(2-Ethylhexyl)phthalate	NA	NA	900	10,963 U	1,600	49 J	43 J	120 J	74 J
n-Nitroso-di-n-propylamine	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
n-Nitrosodiphenylamine	NA	NA	708 U	10,963 U	350 U	351 U	358 U	354 U	374 U
Pesticide/Polychlorinated Biphenyls (UG/KG)									
4,4'-DDD	NA	NA	3.55 U	4.33 UJ	3.54 U	3.55 U	3.54 U	3.35 U	3.78 U
4,4'-DDE	NA	NA	3.55 U	23 J	3.54 U	3.55 U	3.54 U	3.35 U	3.78 U
4,4'-DDT	NA	NA	3.55 U	10 J	3.54 U	3.55 U	3.54 U	3.35 U	3.78 U
Aldrin	NA	NA	1.83 U	2.23 UJ	1.82 U	1.83 U	1.82 U	1.72 U	1.95 U
Aroclor-1016	NA	NA	35.5 U	43.3 UJ	35.4 U	35.5 U	35.4 U	33.5 U	37.8 U
Aroclor-1221	NA	NA	72.1 U	87.9 UJ	71.8 U	72.0 U	71.9 U	67.9 U	76.8 U
Aroclor-1232	NA	NA	35.5 U	43.3 UJ	35.4 U	35.5 U	35.4 U	33.5 U	37.8 U
Aroclor-1242	NA	NA	35.5 U	43.3 UJ	35.4 U	35.5 U	35.4 U	33.5 U	37.8 U
Aroclor-1248	NA	NA	35.5 U	43.3 UJ	35.4 U	35.5 U	35.4 U	33.5 U	37.8 U
Aroclor-1254	NA	NA	35.5 U	43.3 UJ	35.4 U	35.5 U	35.4 U	33.5 U	37.8 U
Aroclor-1260	NA	NA	35.5 U	43.3 UJ	35.4 U	35.5 U	35.4 U	33.5 U	37.8 U
Dieldrin	NA	NA	3.55 U	4.33 UJ	3.54 U	3.55 U	3.54 U	3.35 U	3.78 U
Endosulfan I	NA	NA	1.83 U	2.23 UJ	1.82 U	1.83 U	1.82 U	1.72 U	1.95 U
Endosulfan II	NA	NA	3.55 U	4.33 UJ	3.54 U	3.55 U	3.54 U	3.35 U	3.78 U
Endosulfan sulfate	NA	NA	3.55 U	4.33 UJ	3.54 U	3.55 U	3.54 U	3.35 U	3.78 U
Endrin	NA	NA	3.55 U	4.33 UJ	3.54 U	3.55 U	3.54 U	3.35 U	3.78 U
Endrin aldehyde	NA	NA	3.55 U	4.33 UJ	3.54 U	3.55 U	3.54 U	3.35 U	3.78 U
Endrin ketone	NA	NA	3.55 U	4.33 UJ	3.54 U	3.55 U	3.54 U	3.35 U	3.78 U
Heptachlor	NA	NA	1.83 U	2.23 UJ	1.82 U	1.83 U	1.82 U	1.72 U	1.95 U
Heptachlor epoxide	NA	NA	1.83 U	2.23 UJ	1.82 U	1.83 U	1.82 U	1.72 U	1.95 U
Methoxychlor	NA	NA	18.3 U	22.3 UJ	18.2 U	18.3 U	18.2 U	17.2 U	19.5 U
Toxaphene	NA	NA	183 U	223 UJ	182 U	183 U	182 U	172 U	195 U
alpha-BHC	NA	NA	1.83 U	2.23 UJ	1.82 U	1.83 U	1.82 U	1.72 U	1.95 U
alpha-Chlordane	NA	NA	1.83 U	24 J	1.82 U	1.83 U	1.82 U	1.72 U	1.95 U
beta-BHC	NA	NA	1.83 U	2.23 UJ	1.82 U	1.83 U	1.82 U	1.72 U	1.95 U
delta-BHC	NA	NA	1.83 U	2.23 UJ	1.82 U	1.83 U	1.82 U	1.72 U	1.95 U
gamma-BHC (Lindane)	NA	NA	1.83 U	2.23 UJ	1.82 U	1.83 U	1.82 U	1.72 U	1.95 U
gamma-Chlordane	NA	NA	1.83 U	2.23 UJ	1.82 U	1.83 U	1.82 U	1.72 U	1.95 U
Total Metals (MG/KG)									

NA - Not analyzed
B - Analyte not detected above associated blank
J - Reported value is estimated
L - Reported value may be biased low
R - Unreliable result

U - Analyte not detected
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UL

Table A-2
Soil Analytical Results from the 2000 SI
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-DP04		LW07-DP05		LW07-DP06		LW07-DP07		LW07-DP08			LW07-DP09		LW07-DP10		LW07-DP11		LW07-DP12		LW07-DP13		
Sample ID	LW07-SB04-01	LW07-SS04-00	LW07-SB05-01	LW07-SS05-00	LW07-SB06-01	LW07-SS06-00	LW07-SB07-01	LW07-SS07-00	LW07-SB08-01	LW07-SS08-00	LW07-SS08-00P	LW07-SB09-01	LW07-SS09-00	LW07-SB10-01	LW07-SS10-00	LW07-SB11-01	LW07-SS11-00	LW07-SB12-01	LW07-SS12-00	LW07-SB13-01	LW07-SS13-00	LW07-SB14-01
Sample Date	05/23/00	05/23/00	05/23/00	05/23/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/23/00
Chemical Name																						
Aluminum	2,490	6,510	2,960	2,820	1,130	8,860	2,910	5,290	467	1,030	1,120	1,620	12,100	1,010 J	1,410 J	612	4,150	2,750 J	4,620 J	3,170 J	6,730 J	1,900
Antimony	0.49 UL	0.71 L	0.44 UL	0.52 UL	0.43 UL	0.42 UL	0.44 UL	0.52 UL	0.46 UL	0.48 UL	0.51 L	0.42 UL	0.73 L	0.47 UL	0.48 UL	0.45 UL	0.46 UL	0.56 UL	0.46 UL	0.42 UL	0.5 UL	0.4 UL
Arsenic	1.3 J	0.58 U	1.4 J	1 J	0.7 J	3.9	0.88 J	2.4	0.52 U	2.1	3.7	0.78 J	0.59 U	0.54 UL	0.56 UL	0.63 J	2.9	1.6 L	1.5 L	0.55 L	4.9	2.2
Barium	12.4 J	132	17.7 J	15.5 J	3.5 B	63	17.7 J	64.4	1.3 B	21.4 J	18.6 J	12.5 J	263	4.7 B	15.4 J	4.3 B	24 J	17 J	24.2 J	10.5 J	26 J	9.5 J
Beryllium	0.11 UL	0.39 L	0.1 UL	0.12 UL	0.1 U	0.6 J	0.1 J	0.41 J	0.1 U	0.11 U	0.09 J	0.09 U	0.77 J	0.11 U	0.11 U	0.1 U	0.11 J	0.41 J	0.25 J	0.09 U	0.11 U	0.09 UL
Cadmium	0.1 U	0.2 U	0.09 U	0.1 U	0.09 U	0.17 U	0.09 U	0.1 U	0.09 U	0.1 U	0.08 U	0.17 J	0.21 U	0.09 U	0.1 U	0.09 U	0.32 J	0.11 U	0.09 U	0.08 U	0.12 J	0.08 U
Calcium	111 L	3,700	353 L	755 J	210 B	10,500	1,470	36,700	162 B	359 B	306 B	841	6,330	190	604 J	415 B	1,350	486 J	1,240	585 J	1,340	467 L
Chromium	3.5	23.5	5.1	8	3.1	11.2	4.8	13.1	1.4 U	6.9	6.8	5.5	30.2	1.8	6.8	2.8	9.8	10.7	17	3.6	11.1	3.7
Cobalt	0.94 U	8 J	1.2 B	2.1 B	0.82 U	8.7	2.9 B	5.3 B	0.88 U	1.2 B	0.99 B	1.3 B	13.2	1.4 B	2.5 B	0.86 U	1.9 B	3 B	2.7 B	1.6 B	2.6 B	0.81 B
Copper	2.4 L	55.4 L	7.3 L	15.9 L	0.86 U	16.4	5 B	14.6 B	0.91 U	10.4 B	10.3 B	10.1 B	18.4	2 J	14	1.4 B	13.9 B	58.5	33.5	11.9	21.6	13.5 L
Iron	2,650	17,000	3,980	5,230	1,450	19,000	4,900	9,230	813	2,160	2,330	2,630	26,600	1,770 J	4,220 J	1,170	5,770	7,070 J	7,830 J	3,160 J	4,490 J	1,740
Lead	3.3	93	13.6	71.8	2.3	7.9	16.4	9.8	1.3	45.3	45	27.2	19.7	2.9	35.5	4.2	51.9	57.6	74.4	10.2	122	10
Magnesium	266 J	4,530	354 J	689 J	211 J	5,250	1,320	3,030	96.7 J	189 J	208 J	367 J	8,300	137 J	644 J	136 J	605 J	359 J	632 J	237 J	501 J	126 J
Manganese	15.5	280	26.1	54.2	8.9	363	79	191	6.3	14.4	15.1	27	617	6.7 J	55.7 J	6.4	58.9	47.9 J	76 J	21.7 J	39 J	3.4 L
Mercury	0.09	0.07 J	0.08 J	0.07 J	0.02 UL	0.01 UL	0.02 UL	0.02 UL	0.02 UL	0.13	0.19	0.02 L	0.02 UL	0.02 UL	0.02 UL	0.02 UL	0.04 L	0.05 L	0.02 UL	0.02 UL	0.07 J	0.09
Nickel	1.4 U	15.5	1.5 J	2.8 J	1.8 B	11.2 B	2.8 B	9.4 B	1.3 U	2.6 B	3 B	1.9 B	25	1.3 U	5.1 J	1.3 U	6.1 B	10.6	10.4	1.7 J	3.7 J	1.1 U
Potassium	242 J	4,160	337 J	610 J	243 J	5,240	1,450	3,540	115 J	127	154 J	291 J	8,650	187 J	516 J	171 J	391 J	309 J	456 J	232 J	367 J	299 J
Selenium	0.49 UL	1 UL	0.44 UL	0.52 UL	0.53 B	0.42 U	0.44 U	0.52 U	0.46 U	0.72 B	0.39 U	0.6 B	0.51 U	0.47 UL	0.48 UL	0.45 U	0.59 B	0.56 UL	0.46 UL	0.42 UL	0.5 UL	0.4 UL
Silver	1 U	4.8	0.94 U	1.2 J	0.9 U	5.2	1.2 J	2.2	0.96 U	1 U	0.93 J	0.89 U	6.7	1 U	1 U	0.95 U	1.5 J	1.2 J	1.6 J	0.89 U	1.1 U	0.83 U
Sodium	26.9 B	147 J	74.8 B	54.3 B	45.3 B	130 B	53.8 B	380 B	37.3 B	83.7 B	69.9 B	62.2 B	280 B	32.5 B	29.3 B	62.1 B	83.3 B	61.7 B	359 J	16.3 B	41.6 B	11.7 B
Thallium	0.38 U	0.39 U	0.35 U	0.4 U	0.33 U	0.36 B	0.41 B	0.41 U	0.36 U	0.38 U	0.3 U	0.43 B	0.56 B	0.37 U	0.38 U	0.38 B	0.46 B	0.44 U	0.36 U	0.33 U	0.39 U	0.31 U
Vanadium	4.6 J	22.8	6.7 J	7.5 J	4.4 L	27.7	12.7	19.9	1.7 L	5.2 J	6 J	4.1 L	43.2	2.8 J	7.4 J	2.2 L	11.2	8 J	10.5	5.6 J	9 J	7.2 J
Zinc	11.8 L	602 L	24 L	82.9 L	9.7	322 J	37 J	174 J	20.1 J	50 J	61.9 J	51.2 J	64.8 J	5.6 J	84.4 J	11.8 J	93.1 J	431 J	184 J	24.7 J	105 J	20.7 L

NA - Not analyzed
B - Analyte not detected above associated blank
J - Reported value is estimated
L - Reported value may be biased low
R - Unreliable result

U - Analyte not detected
UJ - Not detected, quantitation limit may be inaccurate
UL

Table A-2
Soil Analytical Results from the 2000 SI
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-DP14		LW07-MW01		LW07-MW02			LW07-MW03	
Sample ID	LW07-SS14-00	LW07-SS14-00P	LW07-SB01-01	LW07-SS01-00	LW07-SB02-01	LW07-SS02-00	LW07-SS02-00P	LW07-SB03-01	LW07-SS03-00
Sample Date	05/23/00	05/23/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00	05/22/00
Chemical Name									
Aluminum	2,040	456	2,570	5,920	2,050	2,450	2,280	1,960	2,950
Antimony	0.52 UL	0.47 UL	0.51 UL	0.64 UL	0.47 UL	0.46 UL	0.41 UL	0.5 UL	0.64 L
Arsenic	1.2 J	0.54 U	1.2 J	27.7	1 J	0.79 J	0.96 J	1 J	1 J
Barium	10.1 J	2.9 B	17 J	36.2 J	13.1 J	14.8 J	12.1 J	9.5 J	22 J
Beryllium	0.12 UL	0.1 UL	0.11 U	0.2 J	0.15 J	0.1 U	0.13 J	0.11 U	0.36 J
Cadmium	0.12 J	0.09 U	0.1 U	0.13 U	0.09 U	0.09 U	0.08 U	0.1 U	0.08 U
Calcium	535 J	148 L	898 J	1,430	543 B	504 B	680 J	962	1,710
Chromium	11.7	4.1	15.9	33.3	7.2	5.9	6.7	3.9	15.8
Cobalt	1.8 B	0.91 U	2.6 B	3.3 B	2.1 B	1.4 B	0.82 B	0.96 U	3.4 B
Copper	181 L	78.3 L	38.8	44.6	16.8	9.1 B	7.6 B	1 U	141
Iron	3,040	714	8,250	13,900	3,620	6,270	3,090	2,290	11,100
Lead	66.8	16.7	145	57.5	50.9	35.6	33.1	3.2	122
Magnesium	166 J	59.6 J	784 J	2,160	380 J	374 J	390 J	188 J	602 J
Manganese	16.8	4.5 L	75.7	80.3	28.7	195	28	12.5	86.4
Mercury	0.74	0.28	0.02 UL	0.05 L	0.02 UL	0.02 UL	0.02 UL	0.02 UL	0.15
Nickel	1.5 U	1.3 U	4.1 B	6.4 B	4 B	3.2 B	2.2 B	1.4 U	14.3 B
Potassium	317 L	110 J	637 J	1,930	395 J	349 J	403 J	207 J	406 J
Selenium	0.52 UL	0.47 UL	0.51 U	0.64 U	0.47 U	0.46 U	0.41 U	0.5 U	0.42 U
Silver	1.1 U	0.99 U	2.2	3.8	0.99 U	1.6 J	1.1 J	1.1 U	3.2
Sodium	11.3 U	21.6 B	100 B	281 B	52.1 B	39.9 B	72.1 B	69.1 B	101 B
Thallium	0.4 U	0.37 U	0.39 U	0.5 U	0.36 U	0.48 B	0.32 U	0.39 U	0.55 B
Vanadium	5.9 J	1.3 J	10.1	20.6	7.5 J	7.1 J	6.6 J	4 L	7.2 J
Zinc	76.1 L	26 L	122 J	83.6 J	74.8 J	33.6 J	29.1 J	7.9 B	488 J

NA - Not analyzed
B - Analyte not detected above associated blank
J - Reported value is estimated
L - Reported value may be biased low
R - Unreliable result

U - Analyte not detected
UJ - Not detected, quantitation limit may be inaccurate
UL

Table A-3
Sediment Analytical Results from the 2000 SI
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-SD01	LW07-SD02	LW07-SD03	LW07-SD04	LW07-SD05	
Sample ID	LW07-SD01-00	LW07-SD02-00	LW07-SD03-00	LW07-SD04-00	LW07-SD05-00	LW07-SD05-00P
Sample Date	06/02/00	06/01/00	06/01/00	06/01/00	06/01/00	06/01/00
Chemical Name						
Semi-volatile Organic Compounds (UG/KG)						
1,2,4-Trichlorobenzene	450 U	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	450 U	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	450 U	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	450 U	NA	NA	NA	NA	NA
1-Methylnaphthalene	NA	450 UJ	290 UJ	3,500 U	1,600 U	1,300 U
2,4,5-Trichlorophenol	1,100 U	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol	450 U	NA	NA	NA	NA	NA
2,4-Dichlorophenol	450 U	NA	NA	NA	NA	NA
2,4-Dimethylphenol	450 U	NA	NA	NA	NA	NA
2,4-Dinitrophenol	1,100 UJ	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	450 U	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	450 U	NA	NA	NA	NA	NA
2-Chloronaphthalene	450 U	NA	NA	NA	NA	NA
2-Chlorophenol	450 U	NA	NA	NA	NA	NA
2-Methylnaphthalene	450 U	450 UJ	290 UJ	3,500 U	1,600 U	1,300 U
2-Methylphenol	450 U	NA	NA	NA	NA	NA
2-Nitroaniline	1,100 U	NA	NA	NA	NA	NA
2-Nitrophenol	450 U	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine	450 U	NA	NA	NA	NA	NA
3-Nitroaniline	1,100 U	NA	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol	1,100 U	NA	NA	NA	NA	NA
4-Bromophenyl-phenylether	450 U	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	450 U	NA	NA	NA	NA	NA
4-Chloroaniline	450 U	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	450 U	NA	NA	NA	NA	NA
4-Methylphenol	450 U	NA	NA	NA	NA	NA
4-Nitroaniline	1,100 U	NA	NA	NA	NA	NA
4-Nitrophenol	1,100 U	NA	NA	NA	NA	NA
Acenaphthene	130 J	720 J	230 J	3,500 U	3,000	2,400
Acenaphthylene	60 J	890 UJ	570 UJ	6,900 U	3,200 U	2,600 U
Anthracene	430 J	370 J	410 J	2,300	950	760
Benzo(a)anthracene	1,600	1,400 J	1,200 J	4,400	2,700	2,100
Benzo(a)pyrene	890	940 J	1,100 J	2,700	1,200	970
Benzo(b)fluoranthene	1,200	1,400 J	1,500 J	4,500	320 U	260 U
Benzo(g,h,i)perylene	300 J	680 J	760 J	1,800	780	560
Benzo(k)fluoranthene	1,300	510 J	750 J	2,000	1,000	750
Bis(2-chloro-1-methylethyl) ether	450 U	NA	NA	NA	NA	NA
Butylbenzylphthalate	450 U	NA	NA	NA	NA	NA
Carbazole	130 J	NA	NA	NA	NA	NA
Chrysene	2,300	1,800 J	2,100 J	7,100	3,100	2,300
Di-n-butylphthalate	83 J	NA	NA	NA	NA	NA
Di-n-octylphthalate	450 U	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	170 J	81 J	120 J	210 J	320 U	260 U
Dibenzofuran	450 U	NA	NA	NA	NA	NA
Diethylphthalate	450 U	NA	NA	NA	NA	NA
Dimethyl phthalate	450 U	NA	NA	NA	NA	NA
Fluoranthene	4,300	2,600 J	1,500 J	25,970	10,350	8,600
Fluorene	110 J	270 J	75 J	2,100	400	340
Hexachlorobenzene	450 U	NA	NA	NA	NA	NA
Hexachlorobutadiene	450 U	NA	NA	NA	NA	NA
Hexachlorocyclopentadiene	450 U	NA	NA	NA	NA	NA
Hexachloroethane	450 U	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	380 J	460 J	590 J	1,500	520	380
Isophorone	450 U	NA	NA	NA	NA	NA
Naphthalene	450 U	430 J	290 UJ	3,500 U	1,600 U	1,300 U
Nitrobenzene	450 U	NA	NA	NA	NA	NA
Pentachlorophenol	1,100 U	NA	NA	NA	NA	NA
Phenanthrene	830	870 J	490 J	18,360	2,400	890
Phenol	450 U	NA	NA	NA	NA	NA
Pyrene	3,500	3,800 J	2,400 J	22,300	8,900	7,800
bis(2-Chloroethoxy)methane	450 U	NA	NA	NA	NA	NA
bis(2-Chloroethyl)ether	450 U	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	66 J	NA	NA	NA	NA	NA
n-Nitroso-di-n-propylamine	450 U	NA	NA	NA	NA	NA
n-Nitrosodiphenylamine	450 U	NA	NA	NA	NA	NA

Table A-3
Sediment Analytical Results from the 2000 SI
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-SD01	LW07-SD02	LW07-SD03	LW07-SD04	LW07-SD05	
Sample ID	LW07-SD01-00	LW07-SD02-00	LW07-SD03-00	LW07-SD04-00	LW07-SD05-00	LW07-SD05-00P
Sample Date	06/02/00	06/01/00	06/01/00	06/01/00	06/01/00	06/01/00
Chemical Name						
Pesticide/Polychlorinated Biphenyls (UG/KG)						
4,4'-DDD	4.46 U	NA	NA	NA	NA	NA
4,4'-DDE	4.46 U	NA	NA	NA	NA	NA
4,4'-DDT	4.46 U	NA	NA	NA	NA	NA
Aldrin	2.30 U	NA	NA	NA	NA	NA
Aroclor-1016	44.6 U	NA	NA	NA	NA	NA
Aroclor-1221	90.6 U	NA	NA	NA	NA	NA
Aroclor-1232	44.6 U	NA	NA	NA	NA	NA
Aroclor-1242	44.6 U	NA	NA	NA	NA	NA
Aroclor-1248	44.6 U	NA	NA	NA	NA	NA
Aroclor-1254	44.6 U	NA	NA	NA	NA	NA
Aroclor-1260	44.6 U	NA	NA	NA	NA	NA
Dieldrin	4.46 U	NA	NA	NA	NA	NA
Endosulfan I	2.30 U	NA	NA	NA	NA	NA
Endosulfan II	4.46 U	NA	NA	NA	NA	NA
Endosulfan sulfate	5.8 J	NA	NA	NA	NA	NA
Endrin	4.46 U	NA	NA	NA	NA	NA
Endrin aldehyde	4.46 U	NA	NA	NA	NA	NA
Endrin ketone	4.46 U	NA	NA	NA	NA	NA
Heptachlor	2.30 U	NA	NA	NA	NA	NA
Heptachlor epoxide	2.30 U	NA	NA	NA	NA	NA
Methoxychlor	23.0 U	NA	NA	NA	NA	NA
Toxaphene	230 U	NA	NA	NA	NA	NA
alpha-BHC	2.30 U	NA	NA	NA	NA	NA
alpha-Chlordane	2.30 U	NA	NA	NA	NA	NA
beta-BHC	2.30 U	NA	NA	NA	NA	NA
delta-BHC	2.30 U	NA	NA	NA	NA	NA
gamma-BHC (Lindane)	2.30 U	NA	NA	NA	NA	NA
gamma-Chlordane	2.30 U	NA	NA	NA	NA	NA
Total Metals (MG/KG)						
Aluminum	1,450	10,500	6,190	8,690	17,100	16,400
Antimony	0.55 UL	0.77 UL	0.81 UL	1 L	1.7 UL	2.1 L
Arsenic	1.7 J	5.4 L	6.1	6.7 L	11.9 L	11.6 L
Barium	8.5 J	22.7 J	21 B	32.4 J	49 J	49.1 J
Beryllium	0.35 B	0.37 B	0.63 B	0.82 B	0.83 B	1.3 B
Cadmium	0.11 U	0.15 U	0.16 U	0.19 U	0.35 U	0.39 U
Calcium	22,900	3,280	3,690	35,400	6,230	6,350
Chromium	6.1	23.8	20.8	26.7	49.3	53.9
Cobalt	1.1 U	3.6 B	5 B	4.4 B	5.4 B	6 B
Copper	30.9	55.2	80.9	87.9	141	142
Iron	3,630 L	16,800	13,500	18,700	31,000	30,600
Lead	19	48.5	1,810	78.7	90.3	76.9
Magnesium	1,330	4,160	3,280	5,300	8,520	8,250
Manganese	36.7	115	94.2	154	226	221
Mercury	0.09 B	0.36	0.17 B	0.3 B	0.44 B	0.56 B
Nickel	2.6 J	10.1 B	10.4 B	16.7 B	16.2 B	21.2 B
Potassium	469 J	2,240	1,610	2,030	4,310	4,300
Selenium	0.55 UL	0.77 U	0.81 U	0.95 U	1.7 U	1.9 U
Silver	1.2 U	3.9	3.6	4.5	7.8	7.4
Sodium	2,620	8,140	5,850	8,030	20,400	20,500
Thallium	0.55 J	0.6 U	1.2 B	0.74 U	1.3 U	1.5 U
Vanadium	5.9 J	30	20	27	44.7	47.7
Zinc	64.2	205 B	284	497	532	534
Wet Chemistry (MG/KG)						
Carbon	NA	7,880	7,580	10,600	21,200	18,900
Total organic carbon (TOC)	4,400	NA	NA	NA	NA	NA
pH	8.25	8.09	7.88	8.04	7.6	7.64

Notes:
NA - Not analyzed
J - Analyte present. Reported result may not be accurate or precise.
B - Possible blank contamination
L - Analyte present. Reported value may be biased low.
U - Not detected

Table A-4
QA/QC Analytical Results from the 2000 SI
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Station ID	LC-QC			
Sample ID	LW07-EB053100	LW07-EB053100F	LW07-TB053100	LW07-EB060100
Sample Date	05/31/00	05/31/00	05/31/00	06/01/00
Chemical Name				
Volatile Organic Compounds (UG/L)				
1,1,1-Trichloroethane	10 U	NA	10 U	NA
1,1,2,2-Tetrachloroethane	10 U	NA	10 U	NA
1,1,2-Trichloroethane	10 U	NA	10 U	NA
1,1-Dichloroethane	10 U	NA	10 U	NA
1,1-Dichloroethene	10 U	NA	10 U	NA
1,2-Dichloroethane	10 U	NA	10 U	NA
1,2-Dichloroethene (total)	10 U	NA	10 U	NA
1,2-Dichloropropane	10 U	NA	10 U	NA
2-Butanone	10 U	NA	10 U	NA
2-Hexanone	10 U	NA	10 U	NA
4-Methyl-2-pentanone	10 U	NA	10 U	NA
Acetone	19	NA	10 U	NA
Benzene	10 U	NA	10 U	NA
Bromodichloromethane	10 U	NA	10 U	NA
Bromoform	10 U	NA	10 U	NA
Bromomethane	10 U	NA	10 U	NA
Carbon disulfide	10 U	NA	10 U	NA
Carbon tetrachloride	10 U	NA	10 U	NA
Chlorobenzene	10 U	NA	10 U	NA
Chloroethane	10 U	NA	10 U	NA
Chloroform	10 U	NA	10 U	NA
Chloromethane	10 U	NA	10 U	NA
Dibromochloromethane	10 U	NA	10 U	NA
Ethylbenzene	10 U	NA	10 U	NA
Methylene chloride	16	NA	9 J	NA
Styrene	10 U	NA	10 U	NA
Tetrachloroethene	10 U	NA	10 U	NA
Toluene	10 U	NA	10 U	NA
Trichloroethene	10 U	NA	10 U	NA
Vinyl chloride	10 U	NA	10 U	NA
Xylene, total	10 U	NA	10 U	NA
cis-1,2-Dichloroethene	10 U	NA	10 U	NA
cis-1,3-Dichloropropene	10 U	NA	10 U	NA
m- and p-Xylene	10 U	NA	10 U	NA
o-Xylene	10 U	NA	10 U	NA
trans-1,2-Dichloroethene	10 U	NA	10 U	NA
trans-1,3-Dichloropropene	10 U	NA	10 U	NA
Semi-volatile Organic Compounds (UG/L)				
1,2,4-Trichlorobenzene	10 U	NA	NA	NA
1,2-Dichlorobenzene	10 U	NA	NA	NA
1,3-Dichlorobenzene	10 U	NA	NA	NA
1,4-Dichlorobenzene	10 U	NA	NA	NA
1-Methylnaphthalene	NA	NA	NA	0.5 U
2,4,5-Trichlorophenol	25 U	NA	NA	NA
2,4,6-Trichlorophenol	10 U	NA	NA	NA
2,4-Dichlorophenol	10 U	NA	NA	NA
2,4-Dimethylphenol	10 U	NA	NA	NA
2,4-Dinitrophenol	25 U	NA	NA	NA
2,4-Dinitrotoluene	10 U	NA	NA	NA
2,6-Dinitrotoluene	10 U	NA	NA	NA
2-Chloronaphthalene	10 U	NA	NA	NA
2-Chlorophenol	10 U	NA	NA	NA
2-Methylnaphthalene	10 U	NA	NA	0.5 U
2-Methylphenol	10 U	NA	NA	NA
2-Nitroaniline	25 U	NA	NA	NA
2-Nitrophenol	10 U	NA	NA	NA
3,3'-Dichlorobenzidine	10 U	NA	NA	NA
3-Nitroaniline	25 U	NA	NA	NA
4,6-Dinitro-2-methylphenol	25 U	NA	NA	NA
4-Bromophenyl-phenylether	10 U	NA	NA	NA
4-Chloro-3-methylphenol	10 U	NA	NA	NA
4-Chloroaniline	10 U	NA	NA	NA
4-Chlorophenyl-phenylether	10 U	NA	NA	NA
4-Methylphenol	10 U	NA	NA	NA

Table A-4
QA/QC Analytical Results from the 2000 SI
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Station ID	LC-QC			
Sample ID	LW07-EB053100	LW07-EB053100F	LW07-TB053100	LW07-EB060100
Sample Date	05/31/00	05/31/00	05/31/00	06/01/00
Chemical Name				
4-Nitroaniline	25 U	NA	NA	NA
4-Nitrophenol	25 U	NA	NA	NA
Acenaphthene	10 U	NA	NA	0.5 U
Acenaphthylene	10 U	NA	NA	1 U
Anthracene	10 U	NA	NA	0.05 U
Benzo(a)anthracene	10 U	NA	NA	0.05 U
Benzo(a)pyrene	10 U	NA	NA	0.05 U
Benzo(b)fluoranthene	10 U	NA	NA	0.1 U
Benzo(g,h,i)perylene	10 U	NA	NA	0.1 U
Benzo(k)fluoranthene	10 U	NA	NA	0.05 U
Bis(2-chloro-1-methylethyl) ether	10 U	NA	NA	NA
Butylbenzylphthalate	10 U	NA	NA	NA
Carbazole	10 U	NA	NA	NA
Chrysene	10 U	NA	NA	0.05 U
Di-n-butylphthalate	10 U	NA	NA	NA
Di-n-octylphthalate	10 U	NA	NA	NA
Dibenz(a,h)anthracene	10 U	NA	NA	0.1 U
Dibenzofuran	10 U	NA	NA	NA
Diethylphthalate	10 U	NA	NA	NA
Dimethyl phthalate	10 U	NA	NA	NA
Fluoranthene	10 U	NA	NA	0.1 U
Fluorene	10 U	NA	NA	0.1 U
Hexachlorobenzene	10 U	NA	NA	NA
Hexachlorobutadiene	10 U	NA	NA	NA
Hexachlorocyclopentadiene	10 U	NA	NA	NA
Hexachloroethane	10 U	NA	NA	NA
Indeno(1,2,3-cd)pyrene	10 U	NA	NA	0.05 U
Isophorone	10 U	NA	NA	NA
Naphthalene	10 U	NA	NA	0.5 U
Nitrobenzene	10 U	NA	NA	NA
Pentachlorophenol	25 U	NA	NA	NA
Phenanthrene	10 U	NA	NA	0.03 J
Phenol	10 U	NA	NA	NA
Pyrene	10 U	NA	NA	0.05 U
bis(2-Chloroethoxy)methane	10 U	NA	NA	NA
bis(2-Chloroethyl)ether	10 U	NA	NA	NA
bis(2-Ethylhexyl)phthalate	10 U	NA	NA	NA
n-Nitroso-di-n-propylamine	10 U	NA	NA	NA
n-Nitrosodiphenylamine	10 U	NA	NA	NA
Pesticide/Polychlorinated Biphenyls (UG/L)				
4,4'-DDD	0.1 U	NA	NA	NA
4,4'-DDE	0.1 U	NA	NA	NA
4,4'-DDT	0.1 U	NA	NA	NA
Aldrin	0.05 U	NA	NA	NA
Aroclor-1016	1 U	NA	NA	NA
Aroclor-1221	2 U	NA	NA	NA
Aroclor-1232	1 U	NA	NA	NA
Aroclor-1242	1 U	NA	NA	NA
Aroclor-1248	1 U	NA	NA	NA
Aroclor-1254	1 U	NA	NA	NA
Aroclor-1260	1 U	NA	NA	NA
Dieldrin	0.1 U	NA	NA	NA
Endosulfan I	0.05 U	NA	NA	NA
Endosulfan II	0.1 U	NA	NA	NA
Endosulfan sulfate	0.1 U	NA	NA	NA
Endrin	0.1 U	NA	NA	NA
Endrin aldehyde	0.1 U	NA	NA	NA
Endrin ketone	0.1 U	NA	NA	NA
Heptachlor	0.05 U	NA	NA	NA
Heptachlor epoxide	0.05 U	NA	NA	NA
Methoxychlor	0.5 U	NA	NA	NA
Toxaphene	5 U	NA	NA	NA
alpha-BHC	0.05 U	NA	NA	NA
alpha-Chlordane	0.05 U	NA	NA	NA
beta-BHC	0.05 U	NA	NA	NA
delta-BHC	0.05 U	NA	NA	NA

Table A-4
QA/QC Analytical Results from the 2000 SI
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Station ID	LC-QC			
Sample ID	LW07-EB053100	LW07-EB053100F	LW07-TB053100	LW07-EB060100
Sample Date	05/31/00	05/31/00	05/31/00	06/01/00
Chemical Name				
gamma-BHC (Lindane)	0.05 U	NA	NA	NA
gamma-Chlordane	0.05 U	NA	NA	NA
Total Metals (UG/L)				
Aluminum	66 U	66 U	NA	83.3 J
Antimony	2.7 U	2.7 U	NA	2.7 U
Arsenic	3.1 U	3.1 U	NA	3.1 U
Barium	4.5 U	4.5 U	NA	4.5 U
Beryllium	1.1 J	0.6 U	NA	0.6 U
Cadmium	0.54 U	0.54 U	NA	0.54 U
Calcium	165 U	165 U	NA	165 U
Chromium	8.4 U	8.4 U	NA	8.4 U
Cobalt	5.2 U	5.2 U	NA	5.2 U
Copper	5.4 U	5.4 U	NA	5.4 U
Iron	88 J	52.3 J	NA	51 J
Lead	2.1 U	2.1 U	NA	2.1 U
Magnesium	113 U	113 U	NA	113 U
Manganese	3.5 U	3.5 U	NA	3.5 U
Mercury	0.1 J	0.1 J	NA	0.11 J
Nickel	7.7 U	7.7 U	NA	7.7 U
Potassium	364 U	364 U	NA	364 U
Selenium	2.7 U	2.7 U	NA	2.7 U
Silver	5.7 U	5.7 U	NA	5.7 U
Sodium	560 J	460 J	NA	146 J
Thallium	2.1 U	2.1 U	NA	2.1 U
Vanadium	4.4 U	4.4 U	NA	4.4 U
Zinc	9.3 J	7 J	NA	9.3 J

Notes:
NA - Not Analyzed
J - Analyte present. Reported result may not be accurate or precise.
U - not detected

Table A-5
Groundwater Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-MW01	LW07-MW02	LW07-MW03	LW07-MW04		LW07-MW05	LW07-MW06
Sample ID	LW07-MW01-02C	LW07-MW02-02C	LW07-MW03-02C	LW07-MW04P-02C	LW07-MW04-02C	LW07-MW05-02C	LW07-MW06-02C
Sample Date	09/04/02	09/04/02	09/04/02	09/03/02	09/03/02	09/04/02	09/03/02
Chemical Name							
Volatile Organic Compounds (UG/L)							
1,1,1-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-Tetrachloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 U
1,1,2-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethene	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 U
1,2,3-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,4-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromo-3-chloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromoethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,3-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-Butanone	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-Hexanone	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-pentanone	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Acetone	5 U	3 B	5 U	5 U	2.9 B	5 U	4.2 B
Benzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromochloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromodichloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromoform	0.5 U	0.11 B	0.11 B	0.12 B	0.14 B	0.5 U	0.11 B
Bromomethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Carbon disulfide	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Carbon tetrachloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroform	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloromethane	0.5 U	0.12 B	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Cumene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Cyclohexane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Dibromochloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Dichlorodifluoromethane(Freon-12)	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ
Ethylbenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methyl acetate	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ
Methyl-tert-butyl ether (MTBE)	0.96	0.5 U	25	0.5 U	0.5 U	1.4	0.5 U
Methylcyclohexane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylene chloride	0.51 B	0.41 B	0.37 B	0.79 B	0.39 B	0.36 B	0.4 B
Styrene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene	0.5 U	0.5 U	0.14 J	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	0.63 B	0.31 B	0.24 B	0.35 B	0.24 B	0.28 B	0.42 B
Trichloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

Table A-5
Groundwater Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-MW01	LW07-MW02	LW07-MW03	LW07-MW04		LW07-MW05	LW07-MW06
Sample ID	LW07-MW01-02C	LW07-MW02-02C	LW07-MW03-02C	LW07-MW04P-02C	LW07-MW04-02C	LW07-MW05-02C	LW07-MW06-02C
Sample Date	09/04/02	09/04/02	09/04/02	09/03/02	09/03/02	09/04/02	09/03/02
Chemical Name							
Trichlorofluoromethane(Freon-11)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl chloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Xylene, total	0.5 U	0.12 B	0.5 U	0.15 B	0.5 U	0.11 B	0.5 U
cis-1,2-Dichloroethene	0.5 U	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ
cis-1,3-Dichloropropene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
trans-1,2-Dichloroethene	0.5 U	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ
trans-1,3-Dichloropropene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Semivolatile Organic Compounds (UG/L)							
1,1-Biphenyl	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,2'-Oxybis(1-chloropropane)	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4,5-Trichlorophenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U
2,4,6-Trichlorophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dichlorophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dimethylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dinitrophenol	25 U	25 U	25 U	25 UJ	25 UJ	25 UJ	25 UJ
2,4-Dinitrotoluene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,6-Dinitrotoluene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Chloronaphthalene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Chlorophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylnaphthalene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Nitroaniline	25 U	25 U	25 U	25 UJ	25 UJ	25 UJ	25 UJ
2-Nitrophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3,3'-Dichlorobenzidine	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U	25 U
4,6-Dinitro-2-methylphenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U
4-Bromophenyl-phenylether	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloro-3-methylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloroaniline	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chlorophenyl-phenylether	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Methylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U	25 U
4-Nitrophenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Acenaphthene	0.3 J	10 U	10 U	10 U	10 U	10 U	10 U
Acenaphthylene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acetophenone	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Anthracene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Atrazine	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzaldehyde	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U

Table A-5
Groundwater Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-MW01	LW07-MW02	LW07-MW03	LW07-MW04		LW07-MW05	LW07-MW06
Sample ID	LW07-MW01-02C	LW07-MW02-02C	LW07-MW03-02C	LW07-MW04P-02C	LW07-MW04-02C	LW07-MW05-02C	LW07-MW06-02C
Sample Date	09/04/02	09/04/02	09/04/02	09/03/02	09/03/02	09/04/02	09/03/02
Chemical Name							
Butylbenzylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Caprolactam	10 U	10 U	10 U	10 U	10 U	10 U	2 J
Carbazole	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chrysene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Di-n-butylphthalate	10 U	10 U	10 U	10 U	0.5 J	0.6 J	0.3 J
Di-n-octylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenzofuran	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Diethylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dimethyl phthalate	10 U	10 U	10 U	10 U	10 U	4 J	4 J
Fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluorene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobutadiene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorocyclopentadiene	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ
Hexachloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Isophorone	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Naphthalene	10 U	10 U	10 U	10 U	0.8 B	10 U	10 U
Nitrobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pentachlorophenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Phenanthrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Phenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pyrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroethoxy)methane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroethyl)ether	10 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Ethylhexyl)phthalate	10 U	0.7 B	0.6 B	10 U	16 B	0.7 B	0.7 B
n-Nitroso-di-n-propylamine	10 U	10 U	10 U	10 U	10 U	10 U	10 U
n-Nitrosodiphenylamine	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Total Metals (UG/L)							
Aluminum	1,740 J	2,960 J	1,780 J	412 J	431 J	2,910 J	2,300 J
Antimony	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
Arsenic	10.4	4.8 J	7.5 J	2.5 U	2.5 U	18.4	5.2 J
Barium	82.7 J	62.8 J	91.1 J	6.1 J	6.3 J	53.4 J	62.5 J
Beryllium	0.2 U	0.41 B	0.2 U	0.2 U	0.21 B	0.2 U	0.2 U
Cadmium	1.2 B	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Calcium	159,000	78,600	60,700	4,820 J	4,710 J	13,700	96,500
Chromium	7.6 J	13.8	8.3 J	2.4 B	2.6 B	16.7	7.3 J
Cobalt	28.3 J	33.8 J	3.3 J	0.4 U	0.4 U	2 B	2.7 B
Copper	30.2	50	7.8 B	6.1 B	10.9 B	12.8 B	12 B
Cyanide	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
Iron	52,400	17,600	35,200	1,220	1,340	56,500	5,910
Lead	3 B	4.4	2.1 J	1.3 U	1.3 U	2.3 J	1.3 U
Magnesium	160,000	43,800	17,900	3,890 J	3,840 J	7,050	59,300

Table A-5
Groundwater Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-MW01	LW07-MW02	LW07-MW03	LW07-MW04		LW07-MW05	LW07-MW06
Sample ID	LW07-MW01-02C	LW07-MW02-02C	LW07-MW03-02C	LW07-MW04P-02C	LW07-MW04-02C	LW07-MW05-02C	LW07-MW06-02C
Sample Date	09/04/02	09/04/02	09/04/02	09/03/02	09/03/02	09/04/02	09/03/02
Chemical Name							
Manganese	5,710	3,730	1,170	43.2	43.2	202	1,680
Mercury	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ
Nickel	8 J	14.7 J	3.8 B	0.81 B	0.6 U	9.6 J	5.1 B
Potassium	62,100 J	16,000 J	4,350 J	4,060 J	4,000 J	5,340 J	33,600 J
Selenium	1.7 U	1.7 B	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
Silver	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Sodium	1,120,000 J	458,000 J	123,000 J	23,800 J	23,900 J	37,700 J	729,000 J
Thallium	4.2 U	4.2 U	4.2 U	4.2 U	4.2 U	4.2 U	4.2 U
Vanadium	3.6 J	7.3 J	4.4 J	3.7 J	3.6 J	10 J	7.2 J
Zinc	70.3	67.5	19.3 B	10 B	16.2 B	41	29.2
Dissolved Metals (UG/L)							
Aluminum	235	151 B	43.5 B	179 B	164 B	37.5 B	7.6 U
Antimony	1.8 B	2.4 B	2.4 B	2.9 B	1.8 B	1.9 B	1.7 U
Arsenic	6.4 J	2.5 U	7 J	2.5 U	2.5 U	12.3	2.5 U
Barium	85.6 J	55.9 J	86.5 J	5.6 B	5.4 B	43.1 J	58.4 J
Beryllium	0.2 U	0.3 B	0.2 U	0.27 B	0.2 U	0.2 U	0.2 U
Cadmium	0.88 B	0.55 B	0.43 B	0.4 U	0.4 U	0.64 B	0.4 U
Calcium	165,000	79,000	58,900	5,050	4,900 B	12,500	95,100
Chromium	0.62 B	1.5 B	0.74 B	1.7 B	1.5 B	0.4 U	1.2 B
Cobalt	28.2 J	32.7 J	2.9 B	0.4 U	0.4 U	1.7 B	3.2 J
Copper	1 B	14.6 J	0.8 U	0.83 B	1.1 B	1.1 B	6.7 B
Iron	52,800	4,420	33,500	1,040	1,040	49,000	3,000
Lead	1.3 U	1.3 U	1.4 B	1.3 U	1.3 U	1.3 U	1.3 U
Magnesium	167,000	42,900	17,400	3,950 J	3,920 J	6,330	58,600
Manganese	5,910	3,630	1,190	43.2	42.8	169	1,690
Mercury	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nickel	4.5 J	10.3 J	1.5 B	1.1 B	0.6 U	1.7 B	3 B
Potassium	63,800 J	15,500 J	4,080 J	4,140 J	4,050 J	4,500 J	31,800 J
Selenium	1.9 B	3.5 B	3.3 B	2 B	1.7 U	2.5 B	5
Silver	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Sodium	1,210,000 J	438,000 J	119,000 J	24,000 J	23,600 J	34,600 J	736,000 J
Thallium	4.2 U	4.2 U	4.2 U	4.2 U	4.2 U	4.2 U	4.2 U
Vanadium	0.34 J	0.3 U	0.3 U	3 J	3.1 J	0.3 U	0.3 U
Zinc	37	34.8	16.1 B	12.8 B	11.3 B	18.6 B	22.9

Notes:
U - Not detected
J - Analyte present. Reported result may not be accurate or precise.
B - Possible blank contamination.

Table A-6
Direct Push Groundwater Analytical Results
SWMU 7 Remedial Investigation Report
NAB LIttle Creek
Virginia Beach, Virginia

Station ID	LW07-DP101			LW07-DP102		LW07-DP103	
Sample ID	LW07-DP101-10	LW07-DP101-17	LW07-DP101P-17	LW07-DP102-10	LW07-DP102-17	LW07-DP103-10	LW07-DP103-17
Sample Date	08/25/02	08/25/02	08/25/02	08/25/02	08/25/02	08/25/02	08/25/02
Chemical Name							
Volatile Organic Compounds (UG/L)							
1,1,1-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-Tetrachloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,4-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromo-3-chloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromoethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,3-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-Butanone	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-Hexanone	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-pentanone	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Acetone	4.8 J	4.2 J	3.4 J	5.8	3.9 J	3.2 J	2.5 J
Benzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromochloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromodichloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromoform	0.13 B	0.5 U	0.5 U	0.5 U	0.14 B	0.11 B	0.15 B
Bromomethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Carbon disulfide	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Carbon tetrachloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroform	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Cumene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Cyclohexane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Dibromochloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Dichlorodifluoromethane(Freon-12)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Ethylbenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methyl acetate	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methyl-tert-butyl ether (MTBE)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylcyclohexane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylene chloride	1.2 B	1.2 B	1.1 B	1.2 B	1.2 B	1.5 B	1.2 B
Styrene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	0.32 B	0.35 B	0.31 B	0.27 B	0.27 B	0.34 B	0.38 B
Trichloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

Table A-6
Direct Push Groundwater Analytical Results
SWMU 7 Remedial Investigation Report
NAB LIttle Creek
Virginia Beach, Virginia

Station ID	LW07-DP101			LW07-DP102		LW07-DP103	
Sample ID	LW07-DP101-10	LW07-DP101-17	LW07-DP101P-17	LW07-DP102-10	LW07-DP102-17	LW07-DP103-10	LW07-DP103-17
Sample Date	08/25/02	08/25/02	08/25/02	08/25/02	08/25/02	08/25/02	08/25/02
Chemical Name							
Trichlorofluoromethane(Freon-11)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl chloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Xylene, total	0.5 U	0.12 B	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,3-Dichloropropene	0.5 U	0.5 U	0.12 J	0.5 U	0.5 U	0.5 U	0.5 U
trans-1,2-Dichloroethene	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
trans-1,3-Dichloropropene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Semivolatile Organic Compounds (UG/L)							
1,1-Biphenyl	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,2'-Oxybis(1-chloropropane)	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4,5-Trichlorophenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U
2,4,6-Trichlorophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dichlorophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dimethylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dinitrophenol	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ
2,4-Dinitrotoluene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,6-Dinitrotoluene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Chloronaphthalene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Chlorophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylnaphthalene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U	25 U
2-Nitrophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3,3'-Dichlorobenzidine	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U	25 U
4,6-Dinitro-2-methylphenol	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ
4-Bromophenyl-phenylether	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloro-3-methylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloroaniline	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chlorophenyl-phenylether	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Methylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U	25 U
4-Nitrophenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Acenaphthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acenaphthylene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acetophenone	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Anthracene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Atrazine	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzaldehyde	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U

Table A-6
Direct Push Groundwater Analytical Results
SWMU 7 Remedial Investigation Report
NAB LIttle Creek
Virginia Beach, Virginia

Station ID	LW07-DP101			LW07-DP102		LW07-DP103	
Sample ID	LW07-DP101-10	LW07-DP101-17	LW07-DP101P-17	LW07-DP102-10	LW07-DP102-17	LW07-DP103-10	LW07-DP103-17
Sample Date	08/25/02	08/25/02	08/25/02	08/25/02	08/25/02	08/25/02	08/25/02
Chemical Name							
Butylbenzylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Caprolactam	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbazole	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chrysene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Di-n-butylphthalate	10 U	0.4 B	0.4 B	10 U	10 U	10 U	10 U
Di-n-octylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenzofuran	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Diethylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dimethyl phthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluorene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobutadiene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorocyclopentadiene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Isophorone	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Naphthalene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Nitrobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pentachlorophenol	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ
Phenanthrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Phenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pyrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroethoxy)methane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroethyl)ether	10 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Ethylhexyl)phthalate	1 B	2 B	1 B	1 B	3 B	10 U	3 B
n-Nitroso-di-n-propylamine	10 U	10 U	10 U	10 U	10 U	10 U	10 U
n-Nitrosodiphenylamine	10 U	10 U	10 U	10 U	10 U	10 U	10 U

Notes:
U - Not detected
J - Analyte present. Reported result may not be accurate or precise.
B - Possible blank contamination.

Table A-7
Surface Soil Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-SO15	LW07-SO16	LW07-SO17	LW07-SO18	LW07-SO19	LW07-SO20	LW07-SO21	LW07-SO22	LW07-SO23	LW07-SO24	LW07-SO25
Sample ID	LW07-SS15-00	LW07-SS16-00	LW07-SS17-00	LW07-SS18-00	LW07-SS19-00	LW07-SS20-00	LW07-SS21-00	LW07-SS22-00	LW07-SS23-00	LW07-SS24-00	LW07-SS25-00
Sample Date	08/26/02	08/26/02	09/05/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02
Chemical Name											
Semivolatile Organic Compounds (UG/KG)											
Acenaphthene	350 U	340 U	380 U	340 U	340 U	390 U	14 J	340 U	340 U	340 U	350 U
Acenaphthylene	350 U	340 U	380 U	340 U	340 U	390 U	13 J	340 U	340 U	340 U	350 U
Anthracene	350 U	340 U	380 U	340 U	340 U	390 U	21 J	340 U	340 U	340 U	14 J
Benzo(a)anthracene	350 U	340 U	12 J	340 U	340 U	18 J	140 J	340 U	340 U	14 J	77 J
Benzo(a)pyrene	350 U	340 U	10 J	340 U	340 U	15 J	110 J	11 J	340 U	11 J	60 J
Benzo(b)fluoranthene	350 U	340 U	27 J	340 U	340 U	31 J	140 J	340 U	340 U	24 J	57 J
Benzo(g,h,i)perylene	350 U	340 U	380 U	340 U	340 U	390 U	73 J	340 U	340 U	340 U	350 U
Benzo(k)fluoranthene	350 U	340 U	26 J	340 U	340 U	20 J	140 J	340 U	340 U	27 J	78 J
Chrysene	350 U	340 U	42 J	340 U	340 UJ	28 J	250 J	15 J	340 U	39 J	98 J
Dibenz(a,h)anthracene	350 U	340 U	380 U	340 U	340 U	390 U	30 J	340 U	340 U	340 U	15 J
Fluoranthene	350 U	340 U	42 J	8 J	340 U	32 J	240 J	17 J	340 U	42 J	110 J
Fluorene	350 U	340 U	380 U	340 U	340 U	390 U	14 J	340 U	340 U	340 U	350 U
Indeno(1,2,3-cd)pyrene	350 U	340 U	13 J	340 U	340 U	16 J	85 J	340 U	340 U	14 J	52 J
Naphthalene	350 U	340 U	380 U	340 U	340 U	390 U	340 U	340 U	340 U	340 U	350 U
Phenanthrene	350 U	340 U	380 U	340 U	340 U	19 J	190 J	340 U	340 U	26 J	51 J
Pyrene	350 U	340 U	31 J	340 U	340 U	31 J	380 J	19 J	340 U	53 J	160 J
Total Metals (MG/KG)											
Aluminum	8,750	8,600	11,400 J	3,960	2,870 J	8,390	4,040 J	1,340	1,450 J	2,340 J	1,470 J
Antimony	0.34 U	0.32 U	0.36 U	0.38 J	0.32 U	0.34 U	0.34 U	0.32 U	0.33 U	0.93 J	2.7 J
Arsenic	3.3	4.1	1.7 J	4.2	0.87 J	3.7	1.3 J	2.6	0.49 J	1.1 J	0.51 U
Barium	66	68.2	222	26.2 J	20.9 J	89.4	66.9	5.7 J	8.2 J	18.4 J	23.8 J
Beryllium	0.15 J	0.23 J	0.5 J	0.21 J	0.15 J	0.29 J	0.16 J	0.06 J	0.15 J	0.42 J	0.18 J
Cadmium	0.04 U	0.03 U	0.3 J	0.03 U	0.08 J	0.04 U	0.22 J	0.04 U	0.07 U	0.33 J	0.3 J
Calcium	2,020 J	2,180 J	4,370	1,150 J	5,460	2,470 J	1,150	80 J	550 J	1,250	572 J
Chromium	14.9	16.7	28	8.4	18.7	27.6	8.8	4.6	6.4	79.3	19
Cobalt	4.8 J	5.8 J	9.2 J	2.2 J	1.4 J	8.3 J	1.5 J	0.31 J	1.7 J	3.5 J	1.2 J
Copper	16.2 J	22.1 J	22.6	10.9 J	8.6	34.7 J	9.8	10.6 J	4.7 J	518	156
Cyanide	0.08 U	0.07 U	0.08 U	0.17 J	0.07 U	0.08 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U
Iron	18,300	18,000	25,500 J	8,590	5,680 J	23,900	6,470 J	2,790	3,420 J	9,290 J	5,080 J
Lead	2.2 J	18.6 J	47	35.3 J	28.8	31.2 J	32.1	69.9 J	8	1,240	230
Magnesium	6,290	5,910	7,340	1,710	1,080	6,260	1,110	176 J	301 J	358 J	236 J
Manganese	348	443	515 J	104	76.8 J	460	93.8 J	6	30.2 J	54.5 J	23.8 J
Mercury	0.04 U	0.04 U	0.05 U	0.04 U	0.04 U	0.04 U	0.04 U	0.03 U	0.03 U	0.99	0.4
Nickel	4.8 J	7.2 J	20.1	3.8 J	3.1 J	13.5	3.8 J	1.5 J	2.5 J	10.5	3.3 J
Potassium	3,580	3,900	7,800	1,280	1,080	3,070	1,040	120 J	324 J	281 J	254 J
Selenium	0.61 U	0.57 U	0.75 J	0.56 U	0.32 UJ	0.62 U	0.34 UJ	0.59 U	0.33 UJ	0.57 J	0.45 J
Silver	0.15 U	0.14 U	0.11 U	0.13 U	0.09 U	0.15 U	0.1 U	0.14 U	0.09 U	0.09 U	0.1 U
Sodium	32.2 U	355 B	455 J	29.1 U	133 J	335 B	501 J	30.8 U	87.5 J	465 J	276 J
Thallium	0.55 UJ	0.51 UJ	1.3 J	0.5 UJ	0.8 U	0.56 UJ	0.84 U	0.53 UJ	0.82 U	0.82 U	0.86 U
Vanadium	26.7	35.4	39.3	14.9	12.7	32.1	10.4	30	4.6 J	5.6 J	4.1 J

Table A-7
Surface Soil Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-SO15	LW07-SO16	LW07-SO17	LW07-SO18	LW07-SO19	LW07-SO20	LW07-SO21	LW07-SO22	LW07-SO23	LW07-SO24	LW07-SO25
Sample ID	LW07-SS15-00	LW07-SS16-00	LW07-SS17-00	LW07-SS18-00	LW07-SS19-00	LW07-SS20-00	LW07-SS21-00	LW07-SS22-00	LW07-SS23-00	LW07-SS24-00	LW07-SS25-00
Sample Date	08/26/02	08/26/02	09/05/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02
Chemical Name											
Zinc	59.5	68.3	229	52.6	42.1	198	78.2	10	30.9	590	320
Wet Chemistry (MG/KG)											
Total organic carbon (TOC)	1,639	29,210	2,354	3,590	2,199	3,243	1,050	1,719	1,365	6,619	2,705
pH	8.11	7.49	8.52	7.84	8.28	8.07	8.06	4.65	9.45	8.1	8.01

Notes:
U - Not detected
J - Analyte present. Reported result may not be accurate or precise.
B - Possible blank contamination.

Table A-8
Subsurface Soil Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-SO15		LW07-SO16			LW07-SO17		LW07-SO18			LW07-SO19		LW07-SO20		
Sample ID	LW07-SB15-01	LW07-SB15-02	LW07-SB16-01	LW07-SB16-02	LW07-SB16P-02	LW07-SB17-01	LW07-SB17-02	LW07-SB18-01	LW07-SB18-02	LW07-SB18P-02	LW07-SB19-01	LW07-SB19-02	LW07-SB20-01	LW07-SB20-02	LW07-SB20P-02
Sample Date	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02
Chemical Name															
Semivolatile Organic Compounds (UG/KG)															
Acenaphthene	380 U	400 U	360 U	42 J	49 J	350 U	350 U	340 U	340 U	430 U	350 U	460 U	340 U	340 U	340 U
Acenaphthylene	380 U	400 U	360 U	360 U	350 U	350 U	350 U	340 U	340 U	430 U	350 U	460 U	340 U	340 U	340 U
Anthracene	380 U	400 U	360 U	11 J	350 U	350 U	350 U	340 U	340 U	430 U	350 U	460 U	10 J	340 U	340 U
Benzo(a)anthracene	380 U	400 U	360 U	13 J	350 U	350 U	350 U	340 U	340 U	430 U	350 U	18 J	53 J	340 U	340 U
Benzo(a)pyrene	380 U	400 U	360 U	360 U	12 J	20 J	12 J	10 J	340 U	11 J	350 U	13 J	59 J	340 U	340 U
Benzo(b)fluoranthene	380 U	400 U	360 U	360 U	350 U	34 J	29 J	15 J	340 U	18 J	350 U	460 U	77 J	340 U	340 U
Benzo(g,h,i)perylene	380 U	400 U	360 U	360 U	350 U	350 U	350 U	340 U	340 U	430 U	350 U	460 U	340 U	340 U	340 U
Benzo(k)fluoranthene	380 U	400 U	360 U	360 U	350 U	29 J	32 J	340 U	340 U	430 U	350 U	24 J	46 J	340 U	340 U
Chrysene	380 U	400 U	360 U	11 J	13 J	20 J	12 J	14 J	340 U	13 J	350 UJ	26 J	60 J	340 U	340 U
Dibenz(a,h)anthracene	380 U	400 U	360 U	360 U	350 U	350 U	350 U	340 U	340 U	430 U	350 U	460 U	340 U	340 U	340 U
Fluoranthene	380 U	400 U	360 U	42 J	28 J	11 J	17 J	16 J	340 U	16 J	350 U	30 J	97 J	340 U	340 U
Fluorene	380 U	400 U	360 U	360 U	350 U	350 U	350 U	340 U	340 U	430 U	350 U	460 U	340 U	340 U	340 U
Indeno(1,2,3-cd)pyrene	380 U	400 U	360 U	360 U	350 U	23 J	10 J	340 U	340 U	430 U	350 U	16 J	44 J	340 U	340 U
Naphthalene	380 U	400 U	360 U	15 B	16 B	350 U	350 U	340 U	340 U	430 U	350 U	460 U	340 U	340 U	340 U
Phenanthrene	380 U	400 U	360 U	12 J	13 J	350 U	350 U	340 U	340 U	430 U	350 U	460 U	43 J	340 U	340 U
Pyrene	380 U	400 U	360 U	33 J	41 J	14 J	17 J	18 J	340 U	33 J	350 U	58 J	110 J	340 U	340 U
Total Metals (MG/KG)															
Aluminum	7,870	8,580	9,140	2,050	2,530	987	1,040	2,380	1,070	5,490	1,070 J	4,310 J	1,840	862	926
Antimony	0.36 U	0.35 U	0.53 J	0.34 U	0.34 J	0.32 U	0.34 U	0.42 J	0.31 U	0.39 U	0.34 U	0.47 U	0.31 U	0.31 U	0.31 U
Arsenic	4.9	5	3.6	2.9	4.2	3.3	2.6	4.1	2.9	6.3	0.49 U	1.9 J	2.3	2.1	2.3
Barium	33.7 J	28.2 J	96	12.2 J	15.5 J	8.6 J	7.8 J	12.5 J	4.1 J	18.8 J	5.1 J	19.7 J	13.7 J	4.7 J	4.5 J
Beryllium	0.25 J	0.18 J	0.12 J	0.12 J	0.16 J	0.06 J	0.11 J	0.12 J	0.09 J	0.3 J	0.07 J	0.25 J	0.16 J	0.06 J	0.08 J
Cadmium	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 J	0.04 U	0.03 U	0.04 U	0.07 U	0.16 J	0.03 U	0.03 U	0.03 U
Calcium	2,200 J	637 J	2,310 J	432 J	809 J	300 J	292 J	371 J	170 J	529 J	406 J	613 J	651 J	251 J	204 J
Chromium	12.2	10.8	89.2	6.2	7	19.5	4.7	10.5	3.5	12.5	4.4	9.8	4.7	2.5	2.6
Cobalt	2.2 J	1.7 J	6.4 J	0.81 J	1.2 J	0.94 J	0.38 J	0.9 J	0.35 J	2.4 J	0.56 J	0.69 J	0.54 J	0.23 J	0.45 J
Copper	5.3 J	3.3 J	8.6 J	7 J	16.2 J	15.9 J	7.5 J	24.4 J	0.87 B	12.9 J	9.5	1.3 J	5.2 J	0.85 B	0.79 B
Cyanide	0.08 U	0.08 U	0.08 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.09 U	0.07 U	0.1 U	0.07 U	0.07 U	0.07 U
Iron	8,720	7,580	16,900	4,040	5,580	22,300	2,870	7,290	2,570	7,330	2,140 J	6,810 J	3,660	1,570	1,630
Lead	10.9 J	5.7 J	2.3 J	20.7 J	26.7 J	25.7 J	8.5 J	75.6 J	3.2 J	17.7 J	31.9	6.2	19.2 J	6.9 J	2.7 J
Magnesium	1,150	676 J	7,700	518 J	603 J	246 J	228 J	501 J	289 J	1,060 J	215 J	708 J	667 J	219 J	216 J
Manganese	73.4	22.8	391	25.9	72.4	251	23.4	39.8	11.8	36.1	9.6 J	24.1 J	63.2	13.6	11.2
Mercury	0.04 U	0.04 U	0.03 U	0.04 U	0.04 U	0.07 J	0.09 J	0.04 U	0.04 U	0.06 U	0.03 U	0.06 U	0.03 U	0.04 U	0.04 U
Nickel	5.3 J	6 J	14.9	2.4 J	3.3 J	3.9 J	1.5 J	2.6 J	1.2 J	5 J	1.1 J	2.4 J	1.7 J	0.86 J	0.9 J
Potassium	639 J	460 J	5,070	309 J	354 J	149 J	140 J	374 J	180 J	767 J	239 J	713 J	423 J	138 J	145 J
Selenium	0.65 U	0.64 U	0.58 U	0.62 U	0.58 U	0.58 U	0.61 U	0.6 U	0.57 U	0.7 U	0.34 UJ	1 J	0.55 U	0.56 U	0.56 U
Silver	0.16 U	0.15 U	0.14 U	0.15 U	0.14 U	0.14 U	0.15 U	0.14 U	0.14 U	0.17 U	0.09 U	0.14 U	0.13 U	0.14 U	0.14 U
Sodium	143 B	182 B	168 B	32.6 U	30.6 U	30.7 U	32.2 U	31.4 U	29.7 U	159 B	95.7 J	153 J	249 B	29.6 U	46.5 B
Thallium	0.58 UJ	0.57 UJ	0.52 UJ	0.56 UJ	0.52 UJ	0.53 UJ	0.55 UJ	0.54 UJ	0.51 UJ	0.63 UJ	0.83 U	1.2 U	0.5 UJ	0.51 UJ	0.51 UJ
Vanadium	15.1	13.5	22	7.8 J	11	7.1 J	4.2 J	9.7 J	3.4 J	14.7	5.1 J	13.9	5.4 J	2.5 J	2.8 J
Zinc	17.9	9.4	51.9	19.7	46.8	79.4	65.6	65.5	13.5	51.1	36.9	11.4	21.9	5	3.8 J
Wet Chemistry (MG/KG)															
Total organic carbon (TOC)	2,872	1,467	283	3,237	6,185	997	922	3,118	601	2,030	1,652	7,746	464	811	2,544
pH	8.88	7.86	8.6	7.69	7.15	7.83	7.77	7.73	5.18	7.46	7.43	5.93	7.27	7.61	6.45

Notes:
U - Not detected
J - Analyte present. Reported result may not be accurate or precise.
B - Possible blank contamination.

Table A-8
Subsurface Soil Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-SO21			LW07-SO22		LW07-SO23		LW07-SO24		LW07-SO25	
Sample ID	LW07-SB21-01	LW07-SB21-02	LW07-SB21P-02	LW07-SB22-01	LW07-SB22-02	LW07-SB23-02	LW07-SB23-01	LW07-SB24-01	LW07-SB24-02	LW07-SB25-01	LW07-SB25-02
Sample Date	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02	08/26/02
Chemical Name											
Semivolatile Organic Compounds (UG/KG)											
Acenaphthene	350 U	340 U	340 U	330 U	340 U	350 U	350 U	340 U	340 U	21 J	340 U
Acenaphthylene	350 U	340 U	340 U	330 U	340 U	350 U	350 U	340 U	340 U	350 U	340 U
Anthracene	350 U	340 U	340 U	330 U	340 U	350 U	9 J	340 U	340 U	44 J	340 U
Benzo(a)anthracene	18 J	340 U	52 J	330 U	340 U	350 U	46 J	340 U	340 U	240 J	340 U
Benzo(a)pyrene	12 J	340 U	34 J	330 U	340 U	11 J	23 J	340 U	340 U	160 J	340 U
Benzo(b)fluoranthene	15 J	340 U	43 J	330 U	340 U	18 J	39 J	340 U	340 U	160 J	340 U
Benzo(g,h,i)perylene	350 U	340 U	340 U	330 U	340 U	350 U	350 U	340 U	340 U	92 J	340 U
Benzo(k)fluoranthene	350 U	340 U	53 J	330 U	340 U	16 J	40 J	340 U	340 U	190 J	340 U
Chrysene	350 UJ	12 J	69 J	330 U	340 U	18 J	67 J	340 U	340 U	350 J	340 U
Dibenz(a,h)anthracene	350 U	340 U	340 U	330 U	340 U	350 U	350 U	340 U	340 U	41 J	340 U
Fluoranthene	26 J	13 J	73 J	330 U	340 U	350 U	59 J	340 U	340 U	330 J	340 U
Fluorene	350 U	340 U	340 U	330 U	340 U	350 U	350 U	340 U	340 U	14 J	340 U
Indeno(1,2,3-cd)pyrene	10 J	340 U	31 J	330 U	340 U	30 J	18 J	340 U	340 U	140 J	340 U
Naphthalene	350 U	340 U	340 U	330 U	340 U	350 U	350 U	18 J	340 U	350 U	340 U
Phenanthrene	20 J	340 U	50 J	330 U	340 U	350 U	35 J	340 U	340 U	170 J	340 U
Pyrene	45 J	21 J	99 J	330 U	340 U	350 U	100 J	340 U	340 U	560 J	340 U
Total Metals (MG/KG)											
Aluminum	2,140 J	980 J	784 J	667	516	1,260 J	3,300 J	1,510 J	491 J	4,640 J	704 J
Antimony	0.34 U	0.34 U	0.33 U	0.44 J	0.3 U	0.35 U	1.3 J	0.37 J	0.32 U	0.35 U	0.66 J
Arsenic	0.5 J	0.49 U	0.48 U	2.6	2.6	0.51 U	2.5	0.47 U	0.47 U	1.1 J	0.51 U
Barium	16.9 J	5 J	4.2 J	2.9 J	3.3 J	8 J	26.8 J	11.5 J	3.6 J	23.2 J	4 J
Beryllium	0.17 J	0.04 J	0.07 J	0.05 J	0.04 J	0.13 J	0.91 J	0.09 J	0.03 U	0.19 J	0.04 U
Cadmium	0.21 J	0.07 U	0.07 U	0.03 U	0.03 U	0.08 U	0.49 J	0.09 J	0.07 U	0.08 U	0.08 U
Calcium	2,020	483 J	277 B	32.3 B	42 B	271 B	2,190	1,260	130 B	369 B	145 B
Chromium	6.5	2.4	2.2	2.5	2.4	6.7	29.9	14.6	3.7	7.5	2.1
Cobalt	0.9 J	0.4 J	0.32 J	0.14 J	0.07 U	0.8 J	6.3 J	1.4 J	0.11 J	0.88 J	0.14 J
Copper	14.6	0.63 J	0.66 J	5.4 J	2.1 J	32.2	148	65.8	3.1 J	107	8.4
Cyanide	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.08 U	0.07 U
Iron	4,080 J	1,510 J	1,270 J	1,470	908	3,700 J	13,300 J	2,800 J	741 J	5,050 J	1,010 J
Lead	33.8	2.6	2.2	45.8 J	10.9 J	18.8	144	59.8	12.2	15.3	1.8
Magnesium	525 J	169 J	152 J	76 J	64.4 J	156 J	618 J	256 J	62.6 B	386 J	116 J
Manganese	64.2 J	11.7 J	9.7 J	3.1	5.1	30.2 J	111 J	31.1 J	8.1 J	27.7 J	5.9 J
Mercury	0.04 U	0.05 U	0.04 U	0.04 U	0.05 U	0.04 U	0.27	0.37	0.03 U	0.04 U	0.04 U
Nickel	3 J	0.76 J	0.61 J	0.81 J	0.59 J	3.9 J	24.4	1.8 J	0.26 J	2.6 J	0.37 J
Potassium	453 J	197 J	174 J	68.6 J	67.4 J	153 J	548 J	232 J	67.5 J	354 J	175 J
Selenium	0.34 UJ	0.34 UJ	0.33 UJ	0.55 U	0.55 U	0.35 UJ	0.33 UJ	0.32 UJ	0.32 UJ	0.35 UJ	0.35 UJ
Silver	0.09 U	0.09 U	0.09 U	0.13 U	0.13 U	0.1 U	0.09 U	0.09 U	0.09 U	0.1 U	0.1 U
Sodium	200 J	88.4 J	70.9 J	29.1 U	29 U	119 J	573 J	132 J	53.9 J	111 J	91.6 J
Thallium	0.83 U	0.83 U	0.81 U	0.5 UJ	0.5 UJ	0.86 U	0.82 U	0.8 U	0.79 U	0.87 U	0.86 U
Vanadium	6.5 J	2.7 J	2.3 J	6.8 J	1.9 J	3.4 J	9.7 J	4.3 J	1.7 J	9 J	2.3 J
Zinc	59.7	5	4.2	3.8 B	4.1	94.4	723	132	18.2	71.6	17.4
Wet Chemistry (MG/KG)											
Total organic carbon (TOC)	559	629	494	294	113	554	3,885	968	353	3,345	379
pH	8.16	8.09	8.29	5.36	6.01	8.52	8.37	8.87	7.68	7.36	6.45

Notes:
U - Not detected
J - Analyte present. Reported result may not be acc
B - Possible blank contamination.

Table A-9
Subsurface Sediment Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-B5-SD201		LW07-B7-SD201	LW07-D5-SD201	LW07-F3-SD201	LW07-F5-SD201	LW07-H1-SD201	LW07-H3-SD201	LW07-H5-SD201	LW07-J4-SD201	LW07-K1-SD201
Sample ID	LW07-B5-SD201-02-02C	LW07-B5-SD201P-02-02C	LW07-B7-SD201-02-02C	LW07-D5-SD201-02-02C	LW07-F3-SD201-02-02C	LW07-F5-SD201-02-02C	LW07-H1-SD201-02-02C	LW07-H3-SD201-02-02C	LW07-H5-SD201-02-02C	LW07-J4-SD201-02-02C	LW07-K1-SD201-02-02C
Sample Date	09/30/02	09/30/02	09/29/02	09/30/02	09/29/02	09/29/02	09/29/02	09/30/02	09/26/02	09/30/02	09/28/02
Chemical Name											
Semivolatile Organic Compounds (UG/KG)											
Acenaphthene	630 U	490 U	510 U	430 U	580 U	390 U	27 J	970 U	580 U	720 U	520 U
Acenaphthylene	630 U	490 U	510 U	430 U	22 J	390 U	150 J	970 U	580 U	720 U	15 J
Anthracene	85 J	490 U	16 J	430 U	36 J	390 U	530 J	970 U	580 U	720 U	14 J
Benzo(a)anthracene	120 J	17 J	510 U	430 U	23 J	390 U	1,000	970 U	21 J	720 U	32 J
Benzo(a)pyrene	110 J	13 J	25 J	10 J	36 J	390 U	830	970 U	32 J	720 U	41 J
Benzo(b)fluoranthene	120 J	23 J	38 J	430 U	81 J	390 U	1,300	970 U	47 J	720 U	48 J
Benzo(g,h,i)perylene	130 J	490 U	510 U	430 U	580 U	390 U	420 J	970 U	580 U	720 U	520 U
Benzo(k)fluoranthene	120 J	23 J	31 J	430 U	55 J	390 U	1,200	970 U	50 J	720 U	48 J
Chrysene	130 J	19 J	510 U	430 U	45 J	390 U	1,600	970 U	27 J	720 U	45 J
Dibenz(a,h)anthracene	110 J	490 U	510 U	430 U	580 U	390 U	120 J	970 U	580 U	720 U	520 U
Fluoranthene	120 J	23 J	21 J	430 U	45 J	390 U	1,300	970 U	24 J	720 U	62 J
Fluorene	630 U	490 U	510 U	430 U	580 U	390 U	24 J	970 U	580 U	720 U	520 U
Indeno(1,2,3-cd)pyrene	120 J	490 U	26 J	430 U	30 J	390 U	550 J	970 U	25 J	720 U	29 J
Naphthalene	630 U	490 U	510 U	430 U	580 U	390 U	720 U	970 U	580 U	720 U	520 U
Phenanthrene	71 J	490 U	510 U	430 U	580 U	390 U	200 J	970 U	580 U	720 U	32 J
Pyrene	150 J	49 J	240 J	34 J	170 J	390 U	2,100	68 J	310 J	720 U	140 J
Total Metals (MG/KG)											
Aluminum	11,300 J	9,530 J	4,300	9,280 J	7,540	815	13,100	28,700 J	11,400	11,400 J	6,460
Antimony	0.58 J	0.5 J	0.34 UJ	0.38 J	0.42 UJ	0.28 UJ	0.49 UJ	0.82 J	0.48 J	0.52 UJ	0.35 UJ
Arsenic	6.3	4.7	2.7 J	4.7	5.3	0.71 U	8.8	15.1	7	5.6	5.3
Barium	25.8 J	19.8 J	11.5 J	18.7 J	18.2 J	2.9 J	33.3 J	51.8 J	26.2 J	24 J	16.9 J
Beryllium	0.59 J	0.45 J	0.22 J	0.48 J	0.41 J	0.06 J	0.72 J	1.2 J	0.63 J	0.53 J	0.29 J
Cadmium	0.11 U	0.08 U	0.08 U	0.07 U	0.19 J	0.07 U	0.66 J	0.17 U	0.09 U	0.13 U	0.08 U
Calcium	1,730 J	1,340 J	1,260 J	1,240 J	1,160 J	544 J	3,840	2,710 J	5,220	1,450 J	707 J
Chromium	23.7	18.8	9.4	18.3	18.4	2.7	37	52	22.6	23.6	13.9
Cobalt	5.1 J	3.8 J	1.7 J	4 J	3.4 J	0.39 J	5.2 J	10.4 J	5.9 J	4.6 J	2.3 J
Copper	9.7	7.9	9.3	7.4	31.9	3.5 J	105	21.3	20.3	7.5 J	8.2
Cyanide	0.14 U	0.11 U	0.11 U	0.09 U	0.15 J	0.08 U	0.18 J	0.21 U	0.12 U	0.16 U	0.14 J
Iron	19,200	14,600	7,250	14,500	13,400	1,560	24,100	40,600	21,500	19,900	10,100
Lead	11.6	8.4	8.1	8.2	20.1	1.6	104	24.4	19.3	8.7	6.8
Magnesium	4,580	3,480	1,780	3,620	3,140	444 J	5,580	9,330	4,340	4,720	2,230
Manganese	150	114	51.9	122	89.7	9	162	273	137	143	62.3
Mercury	0.09 U	0.05 U	0.11 B	0.04 J	0.35	0.04 J	0.42	0.12 U	0.09 J	0.11 J	0.06 J
Nickel	12.3 J	9.4 J	4.5 J	9.4 J	8.9 J	0.69 B	15.8 J	25	11.9 J	11.5 J	5.8 J
Potassium	2,380 J	1,820 J	828 J	1,910 J	1,460 J	199 J	2,800 J	5,210 J	2,150 J	2,230 J	1,180 J
Selenium	1.2 J	0.86 J	0.86 U	0.75 U	1.3 J	0.71 U	1.7 J	1.7 U	1.6 B	1.3 U	1.3 J
Silver	0.29 U	0.23 U	0.23 U	0.2 U	0.28 U	0.19 U	0.33 U	0.44 U	0.26 U	0.34 U	0.24 U
Sodium	6,980	5,140	3,330	5,080	5,110	2,030	10,000	13,300	7,020	6,760	3,780
Thallium	0.86 UJ	0.68 UJ	0.69 UJ	0.6 UJ	0.84 UJ	0.56 UJ	0.98 UJ	1.3 UJ	0.78 UJ	1 UJ	0.71 UJ
Tin	2.3 J	1.1 U	1.1 U	1.4 J	2.2 J	1.5 J	2.6 J	3.2 J	1.3 U	3.4 J	1.4 J
Vanadium	29	23.1	12.3 J	21.4	22.6	3.5 J	36.7	60.1	27.1	26	18.6
Zinc	42.7	32.9	31.9	32	127	1.3 B	375	87.5	81.4	36.3	21.6
Wet Chemistry (MG/KG)											
Ammonia	3.87 U	NA	3.06 U	2.61 U	25.8	2.38 U	91.3	5.83 U	6.13	12.7	26.5
Total organic carbon (TOC)	14,690	NA	5,591	7,718	12,870	1,337	24,430	21,800	8,387	15,150	9,591
pH	8.15	8.24	8.15	8.18	8.52	7.99	8.58	8.15	8.17	8.05	8.65

Notes:
U - Not detected
J - Analyte Present. Reported value may not be accurate or precise.

Table A-9
Subsurface Sediment Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-B5-SD201		LW07-B7-SD201	LW07-D5-SD201	LW07-F3-SD201	LW07-F5-SD201	LW07-H1-SD201	LW07-H3-SD201	LW07-H5-SD201	LW07-J4-SD201	LW07-K1-SD201
Sample ID	LW07-B5-SD201-02-02C	LW07-B5-SD201P-02-02C	LW07-B7-SD201-02-02C	LW07-D5-SD201-02-02C	LW07-F3-SD201-02-02C	LW07-F5-SD201-02-02C	LW07-H1-SD201-02-02C	LW07-H3-SD201-02-02C	LW07-H5-SD201-02-02C	LW07-J4-SD201-02-02C	LW07-K1-SD201-02-02C
Sample Date	09/30/02	09/30/02	09/29/02	09/30/02	09/29/02	09/29/02	09/29/02	09/30/02	09/26/02	09/30/02	09/28/02
Chemical Name											

NA- Duplicate sample result not analyzed.

Table A-9
Subsurface Sediment Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-K3-SD201		LW07-K4-SD201		LW07-K5-SD201	LW07-K6-SD201	LW07-L2-SD201	LW07-L5-SD201	LW07-L6-SD201	LW07-M1-SD201	LW07-M3-SD201
Sample ID	LW07-K3-SD201-02-02C	LW07-K3-SD201P-02-02C	LW07-K4-SD201-02-02C	LW07-K4-SD201P-02-02C	LW07-K5-SD201-02-02C	LW07-K6-SD201-02-02C	LW07-L2-SD201-02-02C	LW07-L5-SD201-02-02C	LW07-L6-SD201-02-02C	LW07-M1-SD201-02-02C	LW07-M3-SD201-02-02C
Sample Date	09/29/02	09/29/02	09/30/02	09/30/02	09/30/02	09/28/02	10/01/02	09/29/02	10/01/02	09/29/02	09/28/02
Chemical Name											
Semivolatile Organic Compounds (UG/KG)											
Acenaphthene	400 U	600 U	540 U	520 U	430 U	11,000 JD	500 U	730 U	610 U	930	47 J
Acenaphthylene	400 U	600 U	540 U	520 U	430 U	510 J	26 J	730 U	53 J	170 J	130 J
Anthracene	400 U	600 U	540 U	26 J	16 J	750 U	50 J	730 U	65 J	1,700	530 J
Benzo(a)anthracene	13 J	600 U	540 U	32 J	41 J	8,400 JD	51 J	730 U	150 J	1,100	820 J
Benzo(a)pyrene	11 J	600 U	24 J	44 J	33 J	3,000	140 J	730 U	310 J	660	770 J
Benzo(b)fluoranthene	400 U	600 U	24 J	52 J	37 J	4,500	220 J	730 U	400 J	1,100	1,400
Benzo(g,h,i)perylene	400 U	600 U	540 U	520 U	430 U	950	61 J	730 U	150 J	270 J	350 J
Benzo(k)fluoranthene	400 U	600 U	29 J	47 J	40 J	3,400	170 J	730 U	430 J	890	1,000 J
Chrysene	11 J	600 U	15 J	31 J	48 J	6,000	73 J	730 U	290 J	1,600	1,300
Dibenz(a,h)anthracene	400 U	600 U	540 U	520 U	31 J	320 J	500 U	730 U	42 J	52 J	84 J
Fluoranthene	17 J	600 U	19 J	30 J	26 J	56,000 D	49 J	21 J	120 J	7,600 D	3,200
Fluorene	400 U	600 U	540 U	520 U	430 U	16,000 D	500 U	730 U	610 U	440 J	80 J
Indeno(1,2,3-cd)pyrene	400 U	600 U	19 J	23 J	40 J	1,200	87 J	730 U	200 J	340 J	370 J
Naphthalene	400 U	600 U	540 U	520 U	430 U	97 J	500 U	31 J	610 U	24 J	1,000 U
Phenanthrene	400 U	600 U	540 U	520 U	430 U	62,000 D	20 J	730 U	45 J	4,500	330 J
Pyrene	33 J	29 J	89 J	85 J	48 J	44,000 D	550	31 J	790	5,400 D	7,600
Total Metals (MG/KG)											
Aluminum	8,630	11,900	12,700 J	8,560 J	9,720 J	13,600	10,200 J	10,600	9,960 J	12,100	20,700
Antimony	0.33 J	0.42 UJ	0.36 UJ	0.36 UJ	0.44 J	1.3 J	0.79 J	0.53 UJ	0.41 UJ	2 J	1.5 J
Arsenic	5.2	6.3	6.3	4.7	7.1	9.9	7.6	9.2	7.5	9.8	15.4
Barium	17.7 J	24.4 J	24.8 J	18 J	21.1 J	39.1 J	24.1 J	21.5 J	29.9 J	44.7 J	55.3 J
Beryllium	0.42 J	0.57 J	0.55 J	0.42 J	0.4 J	0.81 J	0.62 J	0.52 J	0.48 J	1.5 J	1.2 J
Cadmium	0.07 U	0.1 U	0.09 U	0.09 U	0.07 U	0.66 J	0.38 J	0.13 U	0.56 J	1.1 J	0.82 J
Calcium	1,290	1,460 J	1,540 J	1,210 J	763 J	16,200	1,520 J	1,570 J	2,160 J	2,130	4,550
Chromium	17.5	24.6	24.6	19.2	18.6	45.2	30.6	22.5	27.3	49.9	53.2
Cobalt	3.5 J	4.8 J	4.8 J	3.6 J	4.1 J	6.5 J	4.5 J	4.6 J	4.2 J	8.6 J	10.1 J
Copper	5.6 J	8.2 J	11.1	8.9	9.4	135	54.7	7.7 J	71.5	220	145
Cyanide	0.08 U	0.12 U	0.12 U	0.12 U	0.09 U	0.2 J	0.11 U	0.17 U	0.14 U	0.38 J	0.36 J
Iron	16,400	21,200	18,800	15,200	13,300	29,700	17,600	22,500	20,400	32,200	48,500
Lead	6.5	8.9	12.6	10.1	8.7	135	52.7	8.9	85.3	139	156
Magnesium	3,610	4,890	4,920	3,480	2,430	7,910	4,040	4,440	4,750	6,210	8,370
Manganese	109	147	150	118	68.5	213	141	137	141	212	275
Mercury	0.05 J	0.08 J	0.06 U	0.05 J	0.06 U	1.1	0.28	0.1 J	0.24	1.5	0.96
Nickel	9 J	12.4 J	12.1	10.1 J	7.6 J	22.6	14.3	11.7 J	11.7 J	41.5	43.9
Potassium	1,680 J	2,220 J	2,560 J	1,670 J	1,470 J	2,860 J	2,090 J	1,890 J	2,280 J	2,570 J	4,620 J
Selenium	0.76 J	1.1 U	1.6	0.9 U	0.79 U	1.5 J	0.92 J	1.3 U	1.4 J	1.3 J	1.7 U
Silver	0.19 U	0.28 U	0.24 U	0.24 U	0.21 U	0.33 U	0.22 U	0.35 U	0.27 U	0.85 B	0.78 B
Sodium	4,280	6,070	6,930	4,700	4,180	9,060	6,830	6,230	9,710	8,530	15,900
Thallium	0.57 UJ	0.84 UJ	0.72 UJ	0.72 UJ	0.63 UJ	1 UJ	0.67 UJ	1.1 UJ	0.81 UJ	0.88 UJ	1.4 UJ
Tin	0.96 U	1.4 U	2 J	1.7 J	1 U	7 J	5.6 J	1.8 U	1.7 J	23.5	16.7 J
Vanadium	19.8	26.2	28.9	21.7	22.5	40.5	25.7	32.3	27.5	39.2	60.3
Zinc	27.6	38.3	45.1	34.7	29.3	633	382	33.9	398	1,390	828
Wet Chemistry (MG/KG)											
Ammonia	8.83	NA	8.19	NA	15.8	38.8	5.96	17.3	8.06	11.9	6.23 U
Total organic carbon (TOC)	9,016	NA	6,321	NA	12,710	21,690	12,820	17,070	14,280	27,940	34,450
pH	8.36	8.12	8.15	8.26	8.15	8.44	8.12	7.8	8.14	8.64	8.16

Notes:
U - Not detected
J - Analyte Present. Reported value may not be acc

Table A-9
Subsurface Sediment Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-K3-SD201		LW07-K4-SD201		LW07-K5-SD201	LW07-K6-SD201	LW07-L2-SD201	LW07-L5-SD201	LW07-L6-SD201	LW07-M1-SD201	LW07-M3-SD201
Sample ID	LW07-K3-SD201-02-02C	LW07-K3-SD201P-02-02C	LW07-K4-SD201-02-02C	LW07-K4-SD201P-02-02C	LW07-K5-SD201-02-02C	LW07-K6-SD201-02-02C	LW07-L2-SD201-02-02C	LW07-L5-SD201-02-02C	LW07-L6-SD201-02-02C	LW07-M1-SD201-02-02C	LW07-M3-SD201-02-02C
Sample Date	09/29/02	09/29/02	09/30/02	09/30/02	09/30/02	09/28/02	10/01/02	09/29/02	10/01/02	09/29/02	09/28/02
Chemical Name											

NA- Duplicate sample result not analyzed.

Table A-10
Surface Sediment Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-B5-SD201		LW07-B5-SD202	LW07-B7-SD201	LW07-B7-SD202	LW07-D5-SD201	LW07-D5-SD202	LW07-F3-SD201	LW07-F3-SD202	LW07-F5-SD201	LW07-F5-SD202	LW07-H1-SD201		LW07-H1-SD202
Sample ID	LW07-B5-SD201-00-02C	LW07-B5-SD201P-00-02C	LW07-B5-SD202-00-02C	LW07-B7-SD201-00-02C	LW07-B7-SD202-00-02C	LW07-D5-SD201-00-02C	LW07-D5-SD202-00-02C	LW07-F3-SD201-00-02C	LW07-F3-SD202-00-02C	LW07-F5-SD201-00-02C	LW07-F5-SD202-00-02C	LW07-H1-SD201-00-02C	LW07-H1-SD201P-00-02C	LW07-H1-SD202-00-02C
Sample Date	09/27/02	09/27/02	09/27/02	09/27/02	09/27/02	09/27/02	09/27/02	09/27/02	09/27/02	09/27/02	09/27/02	09/27/02	09/27/02	09/27/02
Chemical Name														
Semivolatile Organic Compounds (UG/KG)														
Acenaphthene	590 U	580 U	610 U	410 U	700 U	750 U	770 U	510 U	620 U	520 U	500 U	27 J	27 J	800 U
Acenaphthylene	22 J	22 J	24 J	410 U	27 J	24 J	42 J	35 J	50 J	41 J	26 J	250 J	310 J	180 J
Anthracene	45 J	55 J	42 J	11 J	47 J	47 J	70 J	86 J	100 J	140 J	68 J	350 J	340 J	320 J
Benzo(a)anthracene	75 J	92 J	73 J	26 J	100 J	84 J	120 J	140 J	190 J	300 J	150 J	1,300	1,800	1,000
Benzo(a)pyrene	110 J	120 J	120 J	25 J	150 J	130 J	230 J	220 J	310 J	310 J	160 J	1,800	1,800	1,300
Benzo(b)fluoranthene	170 J	190 J	190 J	42 J	270 J	190 J	350 J	360 J	470 J	440 J	260 J	4,100 J	4,100 J	2,800 J
Benzo(g,h,i)perylene	590 U	580 U	610 U	410 U	88 J	750 U	120 J	110 J	130 J	120 J	69 J	820	900	660 J
Benzo(k)fluoranthene	120 J	160 J	180 J	37 J	180 J	180 J	340 J	280 J	350 J	330 J	190 J	3,900 J	3,900 J	2,700 J
Chrysene	150 J	220 J	160 J	48 J	180 J	160 J	230 J	280 J	400 J	640	300 J	3,400	3,300	3,000
Dibenz(a,h)anthracene	28 J	34 J	24 J	410 U	41 J	750 U	770 U	54 J	54 J	59 J	48 J	480 J	480 J	290 J
Fluoranthene	84 J	130 J	100 J	59 J	140 J	100 J	190 J	170 J	240 J	420 J	450 J	970	880	770 J
Fluorene	590 U	580 U	610 U	410 U	700 U	750 U	770 U	510 U	620 U	22 J	500 U	54 J	47 J	40 J
Indeno(1,2,3-cd)pyrene	78 J	85 J	82 J	18 J	120 J	94 J	160 J	140 J	180 J	170 J	97 J	1,000	1,100	750 J
Naphthalene	590 U	580 U	610 U	410 U	700 U	750 U	770 U	510 U	620 U	520 U	500 U	21 J	750 U	800 U
Phenanthrene	29 J	54 J	26 J	410 U	36 J	32 J	52 J	42 J	65 J	100 J	50 J	300 J	320 J	250 J
Pyrene	150 J	190 J	190 J	49 J	250 J	170 J	390 J	250 J	360 J	440 J	400 J	4,400	3,900	2,800
Total Metals (MG/KG)														
Aluminum	8,170	8,450	9,140	1,230	11,400	12,300	12,000	4,510	7,560	4,930	6,510	10,600	9,220	12,300
Antimony	0.78 J	0.39 U	0.44 U	0.27 U	0.99 J	0.5 U	0.51 U	0.53 J	0.6 J	0.59 J	0.74 J	0.85 B	0.64 B	1.2 B
Arsenic	6.6	7.4	7.3	1.1 J	9.2	9.5	9.1	4.4	7.4	4.8	5.9	10.6	8.9	11.3
Barium	20.5 J	21.2 J	23.5 J	4.2 J	30.4 J	32.1 J	30.3 J	16.5 J	21.1 J	13.6 J	17.5 J	32.2 J	27.3 J	36.7 J
Beryllium	0.42 J	0.45 J	0.45 J	0.07 J	0.63 J	0.62 J	0.57 J	0.3 J	0.4 J	0.28 J	0.34 J	0.79 J	0.55 J	0.72 J
Cadmium	0.1 U	0.09 U	0.11 U	0.06 U	0.12 J	0.12 U	0.16 J	0.11 J	0.1 U	0.08 U	0.09 J	0.88 J	0.57 J	0.59 J
Calcium	3,620 J	4,040 J	3,900 J	2,050 J	11,600 J	4,330 J	3,870 J	22,100 J	7,300 J	2,380 J	2,250 J	3,700	3,710	5,660
Chromium	19.9	21.5	22.6	3.9	28.1	30.3	29.5	12.4	22.8	15	18.2	36	33.1	39
Cobalt	3.8 J	3.9 J	4.2 J	0.62 J	5.1 J	5.2 J	5 J	2.3 J	3.4 J	2.2 J	2.8 J	5.6 J	4.7 J	6.3 J
Copper	39.7	48.9	53.5	9.2	68.7	72.5	70.3	42.7	55.9	37.6	47.7	110	108	134
Cyanide	0.13 U	0.12 U	0.14 U	0.08 U	0.16 U	0.17 U	0.17 U	0.12 U	0.13 U	0.11 U	0.11 U	0.17 U	0.17 U	0.2 J
Iron	16,300	17,400	18,500	2,360	22,100	24,700	23,200	9,180	15,500	10,400	13,300	22,000	18,800	25,200
Lead	20.2	27.9	28.4	5.7	37.8	38.1	38.5	30.1	38.1	36.2	32.9	58.9	69.1	70.1
Magnesium	3,860	4,010	4,350	757 J	5,350	5,660	5,480	2,620	3,650	2,300	2,880	5,700	5,090	6,520
Manganese	126	132	151	26.1	184	208	196	91.1	123	76.3	93.8	183	157	204
Mercury	0.13 J	0.12 J	0.15	0.04 U	0.16	0.25	0.23	0.12 J	0.19	0.12	0.14	0.46	0.33	0.46
Nickel	9.8 J	10.8 J	10.8 J	1.6 J	14.2 J	14.3 J	13.8 J	5.5 J	8.9 J	6.3 J	8 J	15.4 J	13 J	17.6 J
Potassium	1,720 J	1,740 J	1,870 J	328 J	2,360 J	2,610 J	2,510 J	1,140 J	1,650 J	1,010 J	1,350 J	2,680	2,330	3,100
Selenium	1.7 J	0.97 U	1.1 U	0.68 U	1.4 J	1.3 U	1.5 J	0.92 U	1.1 U	0.87 U	1.3 J	1.4 U	1.3 U	1.3 U
Silver	0.28 U	0.26 U	0.29 U	0.18 U	0.32 U	0.33 U	0.34 U	0.24 U	0.28 U	0.23 U	0.23 U	0.39 J	0.35 U	0.36 U
Sodium	6,840	6,690	7,470	2,490	8,620	10,000	10,800	5,270	7,430	4,290	5,400	11,500	11,400	12,600
Thallium	0.83 UJ	0.78 UJ	0.87 UJ	0.55 UJ	0.95 UJ	1 UJ	1 UJ	0.74 UJ	0.84 UJ	0.7 UJ	0.68 UJ	1.1 U	1 U	1.1 U
Tin	1.4 U	1.3 J	2.1 J	1 J	1.6 J	3 J	2.5 J	1.6 J	1.7 J	1.8 J	2.3 J	6.2 J	5.5 J	6.7 J
Vanadium	22.4	24.6	25.5	4.2 J	32.7	32.7	32.6	13.3 J	21.6	13.9 J	18.3	32.7	28.4	36.7
Zinc	139	149	174	34.8	223	223	222	146	212	142	162	397	351	445
Wet Chemistry (MG/KG)														
Ammonia	3.9	NA	4.56	2.48 U	9.18	12.7	10.1	4.54	10.5	3.17 U	3.02 U	20.2	NA	23.8
Total organic carbon (TOC)	16,830	NA	24,160	3,125	18,670	29,330	30,490	12,900	22,230	24,170	8,024	20,310	21,790	21,790
pH	7.94	7.85	7.85	8.18	7.86	7.78	7.69	8.05	8.06	8.14	7.96	7.9	7.93	7.95
Acid Volatile Sulfide/Simultaneously Extractable Metals (UMOLE/G)														
Cadmium	0.0014 J	NA	NA	3.60E-04 J	NA	0.0023 J	NA	0.0015 J	NA	0.0012 J	NA	0.003 J	NA	NA
Copper	0.35 J	NA	NA	0.093 J	NA	0.51 J	NA	0.34 J	NA	0.26 J	NA	0.53 J	NA	NA
Lead	0.073 J	NA	NA	0.033 J	NA	0.092 J	NA	0.084 J	NA	0.06 J	NA	0.13 J	NA	NA
Mercury	3.40E-05 B	NA	NA	1.50E-05 B	NA	8.50E-05 J	NA	6.00E-05 J	NA	1.20E-04 J	NA	2.10E-05 B	NA	NA
Nickel	0.036 J	NA	NA	0.01 B	NA	0.056 J	NA	0.029 J	NA	0.027 J	NA	0.068 J	NA	NA
Zinc	1.4 J	NA	NA	0.59 J	NA	2 J	NA	1.9 J	NA	1.2 J	NA	3 J	NA	NA
Cation Exchange Capacity (MEQ/100G)														
Cation Exchange Capacity	10.2	NS	NS	5.9	NS	9.6	NS	15	NS	11.5	NS	10.6	NS	NS

Notes:
J - Analyte Present
B - Possible blank contamination

Table A-10
Surface Sediment Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-H3-SD201		LW07-H3-SD202	LW07-H5-SD201	LW07-H5-SD202	LW07-J4-SD201	LW07-J4-SD202	LW07-K1-SD201	LW07-K1-SD202	LW07-K3-SD201	LW07-K3-SD202	LW07-K4-SD201	LW07-K4-SD202	LW07-K5-SD201
Sample ID	LW07-H3-SD201-00-02C	LW07-H3-SD201P-00-02C	LW07-H3-SD202-00-02C	LW07-H5-SD201-00-02C	LW07-H5-SD202-00-02C	LW07-J4-SD201-00-02C	LW07-J4-SD202-00-02C	LW07-K1-SD201-00-02C	LW07-K1-SD202-00-02C	LW07-K3-SD201-00-02C	LW07-K3-SD202-00-02C	LW07-K4-SD201-00-02C	LW07-K4-SD202-00-02C	LW07-K5-SD201-00-02C
Sample Date	09/27/02	09/27/02	09/27/02	09/26/02	09/26/02	09/28/02	09/28/02	09/27/02	09/27/02	09/28/02	09/28/02	09/28/02	09/28/02	09/28/02
Chemical Name														
Semivolatile Organic Compounds (UG/KG)														
Acenaphthene	800 U	790 U	790 U	420 U	660 U	720 U	700 U	970 U	2,000	540 U	650 U	26 J	600 U	1,400
Acenaphthylene	74 J	89 J	55 J	16 J	660 U	43 J	56 J	120 J	160 J	77 J	96 J	210 J	140 J	340 J
Anthracene	150 J	150 J	100 J	320 J	87 J	120 J	73 J	430 J	1,000	94 J	280 J	440 J	320 J	1,000
Benzo(a)anthracene	260 J	330 J	210 J	120 J	170 J	180 J	210 J	1,000	2,000	300 J	360 J	2,700	550 J	1,400
Benzo(a)pyrene	440 J	520 J	320 J	100 J	140 J	270 J	280 J	1,000	1,300	470 J	630 J	1,800	830	1,600
Benzo(b)fluoranthene	670 J	860	500 J	160 J	170 J	730 J	750 J	1,600	1,900	1,100 J	1,600 J	3,600 J	2,000 J	2,800 J
Benzo(g,h,i)perylene	200 J	220 J	160 J	420 U	660 U	170 J	180 J	400 J	440 J	300 J	350 J	950	530 J	1,100
Benzo(k)fluoranthene	560 J	600 J	380 J	140 J	170 J	710 J	730 J	1,200	1,700	1,100 J	1,500 J	3,100 J	1,700 J	2,300 J
Chrysene	660 J	700 J	400 J	260 J	340 J	320 J	470 J	2,200	2,800	580	980	4,400 J	1,300 J	3,000 J
Dibenz(a,h)anthracene	89 J	95 J	62 J	23 J	24 J	70 J	70 J	170 J	210 J	110 J	150 J	340 J	210 J	330 J
Fluoranthene	300 J	330 J	230 J	190 J	270 J	200 J	450 J	990	8,900 D	210 J	410 J	4,200	610	1,700
Fluorene	800 U	790 U	790 U	59 J	660 U	720 U	700 U	970 U	690 J	16 J	650 U	39 J	27 J	620 J
Indeno(1,2,3-cd)pyrene	270 J	320 J	210 J	66 J	72 J	170 J	210 J	510 J	660 J	310 J	390 J	1,100 J	620 J	990 J
Naphthalene	800 U	790 U	790 U	13 J	660 U	720 U	700 U	970 U	940 U	540 U	650 U	23 J	600 U	1,500
Phenanthrene	110 J	100 J	85 J	130 J	80 J	87 J	56 J	360 J	3,600	67 J	130 J	270 J	230 J	3,200
Pyrene	600 J	710 J	390 J	340 J	350 J	1,200	730	3,900	6,800	600	940	7,100 D	1,300	5,100
Total Metals (MG/KG)														
Aluminum	11,000	12,000	11,300	1,910	12,200	12,700	11,200	14,800	13,100	5,980	8,190	7,860	6,990	12,600
Antimony	0.54 U	0.61 J	0.53 U	0.33 J	0.46 U	1.1 B	0.79 B	0.98 J	0.97 J	0.74 B	0.52 B	0.57 B	19 J	0.94 B
Arsenic	9.2	10.4	9	1.5 J	7.6	10.6	8.7	11.4	9.6	6.2	7.3	8.2	7.4	10.7
Barium	28.3 J	30.6 J	29.3 J	9.2 J	27.2 J	33.1 J	30.4 J	38.6 J	33.8 J	20.1 J	24.9 J	23.7 J	28.1 J	35.4 J
Beryllium	0.6 J	0.64 J	0.57 J	0.14 J	0.6 J	0.68 J	0.66 J	0.73 J	0.64 J	0.49 J	0.52 J	0.49 J	0.5 J	0.67 J
Cadmium	0.45 J	0.26 J	0.33 J	0.07 U	0.11 U	0.6 J	0.22 J	0.31 J	0.28 J	0.35 J	0.33 J	0.34 J	0.33 J	0.38 J
Calcium	4,180 J	3,450 J	4,080 J	2,820 J	6,520 J	3,560	2,720	4,040 J	4,390 J	2,270	4,510	3,640	2,910	2,900
Chromium	29.1	32.7	30.2	15.9	28.4	34.9	31.3	39.2	37.4	30.4	25.2	28.8	33.1	36
Cobalt	4.7 J	5 J	4.6 J	0.99 J	5.3 J	6.1 J	5.8 J	6 J	5.2 J	4 J	4.2 J	4.4 J	3.9 J	6.1 J
Copper	78.7	90	83.5	35.2	21.6	65.7	55	118	102	65	63.2	70.1	58.6	90
Cyanide	0.18 U	0.17 B	0.17 U	0.09 U	0.15 U	0.16 U	0.16 U	0.22 U	0.2 U	0.12 U	0.15 U	0.22 J	0.16 J	0.27 J
Iron	22,700	25,200	23,200	6,080	21,600	23,200	20,900	29,300	25,100	13,400	17,100	17,100	15,400	25,100
Lead	56.9	53.5	50.8	56.4	63.1	50.7	46.9	65.2	67.6	255	40.1	152	49.5	51.1
Magnesium	5,350	5,610	5,340	1,030 J	5,230	5,710	5,380	7,090	6,260	3,130	4,160	4,000	3,550	6,390
Manganese	173	185	172	42.8	167	188	180	209	175	112	143	137	125	204
Mercury	0.27	0.27	0.76	0.05 J	0.14	0.66	0.24	0.3	0.31	0.15	0.25	0.19 J	0.19	0.29
Nickel	13.1 J	14.2 J	13.6 J	2.7 J	14 J	16.4 J	16.4 J	16.9 J	15.2 J	15.5	12.9 J	13.8 J	11.1 J	16.6 J
Potassium	2,430 J	2,670 J	2,550 J	386 J	2,330 J	2,890	2,550	3,390 J	2,960 J	1,410 J	1,940	1,840 J	1,580 J	2,950
Selenium	1.8 J	2 J	2.5 J	0.73 U	1.5 J	1.3 U	1.3 U	2.5 J	1.6 J	0.91 U	1.1 U	1.2 U	1.1 U	1.5 U
Silver	0.36 U	0.38 U	0.36 U	0.2 U	0.3 U	0.35 U	0.33 U	0.45 U	0.43 U	0.24 U	0.29 U	0.31 U	0.29 U	0.4 U
Sodium	11,500	10,700	11,000	1,930	7,630	10,500	9,580	15,400	14,900	5,500	7,940	7,640	6,320	12,300
Thallium	1.1 UJ	1.1 UJ	1.1 UJ	0.59 UJ	0.91 UJ	1 U	1 U	1.3 UJ	1.3 UJ	0.73 U	0.88 U	0.93 U	0.86 U	1.2 U
Tin	2.4 J	2.5 J	2.1 J	1.6 J	1.5 U	4.8 J	6.6 J	2.8 J	2.6 J	5.8 J	5.2 J	9.4 J	5 J	6.6 J
Vanadium	29.1	31.5	29.9	5.6 J	29.6	37.4	31.2	38.3	33.9	18.4	24.2	24.2	21.4	36.4
Zinc	299	328	310	157	97	308	299	415	383	402	283	303	299	336
Wet Chemistry (MG/KG)														
Ammonia	8.98	NA	7.41	2.54 U	3.99 U	21	17.5	41.2	40.7	8.17	11.9	11.5	11.8	35.7
Total organic carbon (TOC)	22,280	NA	23,260	3,463	15,590	14,950	15,900	28,880	23,400	10,780	10,800	13,870	13,940	22,360
pH	7.98	8.08	8.13	8.35	8.03	8	7.86	8.36	8.35	7.89	7.8	7.8	7.79	7.92
Acid Volatile Sulfide/Simultaneously Extractable Metals (UMOLE/G)														
Cadmium	0.0031 J	NA	NA	5.50E-04 J	NA	0.0023 J	NA	0.0041 J	NA	0.002 J	NA	0.0023 J	NA	0.0028 J
Copper	0.68 J	NA	NA	0.24 J	NA	0.34 J	NA	0.93 J	NA	0.51 J	NA	0.39 J	NA	0.56 J
Lead	0.14 J	NA	NA	0.25 J	NA	0.09 J	NA	0.19 J	NA	0.14 J	NA	0.24 J	NA	0.16 J
Mercury	1.00E-04 J	NA	NA	1.00E-04 J	NA	6.00E-05 J	NA	1.30E-04 J	NA	3.80E-05 B	NA	6.00E-05 J	NA	4.10E-05 B
Nickel	0.061 J	NA	NA	0.027 J	NA	0.051 J	NA	0.075 J	NA	0.072 J	NA	0.048 J	NA	0.063 J
Zinc	3 J	NA	NA	4.1 J	NA	2 J	NA	4.1 J	NA	2.8 J	NA	2.7 J	NA	3 J
Cation Exchange Capacity (MEQ/100G)														
Cation Exchange Capacity	15	NS	NS	5.4	NS	14	NS	9.7	NS	18.6	NS	17.6	NS	13.4

Notes:
J - Analyte Present
B - Possible blank contamination

Table A-10
Surface Sediment Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LW07-K5-SD202	LW07-K6-SD201	LW07-K6-SD202	LW07-L2-SD201	LW07-L5-SD201	LW07-L5-SD202	LW07-L6-SD201	LW07-M1-SD201	LW07-M1-SD202	LW07-M3-SD201	LW07-M3-SD202
Sample ID	LW07-K5-SD202-00-02C	LW07-K6-SD201-00-02C	LW07-K6-SD202-00-02C	LW07-L2-SD201-00-02C	LW07-L5-SD201-00-02C	LW07-L5-SD202-00-02C	LW07-L6-SD201-00-02C	LW07-M1-SD201-00-02C	LW07-M1-SD202-00-02C	LW07-M3-SD201-00-02C	LW07-M3-SD202-00-02C
Sample Date	09/28/02	09/28/02	09/28/02	10/01/02	09/28/02	09/28/02	10/01/02	09/27/02	09/27/02	09/28/02	09/28/02
Chemical Name											
Semivolatile Organic Compounds (UG/KG)											
Acenaphthene	23 J	20 J	13 J	24 J	29 J	78 J	890 U	38 J	19 J	170 J	82 J
Acenaphthylene	130 J	23 J	21 J	190 J	260 J	520 J	190 J	170 J	91 J	790 J	430 J
Anthracene	1,500	92 J	85 J	360 J	630 J	2,200	500 J	410 J	160 J	2,000	840
Benzo(a)anthracene	680 J	190 J	260 J	1,500	1,200	7,500 D	960	660 J	270 J	4,900	3,100
Benzo(a)pyrene	830	190 J	200 J	1,300	1,700	5,100	1,300	850	420 J	6,100	3,000
Benzo(b)fluoranthene	2,000 J	440 J	300 J	3,000	3,800 J	12,000 J	2,700 J	1,300	660	7,800 D	7,600 J
Benzo(g,h,i)perylene	530 J	110 J	91 J	710 J	870	2,100	790 J	330 J	180 J	2,500	1,400
Benzo(k)fluoranthene	1,700 J	420 J	280 J	2,600	3,700 J	11,000 J	2,400 J	1,000	540 J	6,700 D	6,400 J
Chrysene	1,600 J	370 J	440	3,200 J	3,300	21,000 J	2,100 J	1,000	470 J	14,000 J	5,900
Dibenz(a,h)anthracene	160 J	34 J	32 J	280 J	370 J	1,200 J	220 J	140 J	79 J	1,200 J	630 J
Fluoranthene	500 J	280 J	330 J	950	1,200	4,300	1,600	830	700	4,700	3,400
Fluorene	260 J	21 J	20 J	44 J	85 J	220 J	42 J	750 U	650 U	280 J	150 J
Indeno(1,2,3-cd)pyrene	570 J	110 J	110 J	820 J	990	2,600	840 J	450 J	250 J	3,000	1,600
Naphthalene	32 J	410 U	32 J	790 U	790 U	29 J	890 U	750 U	650 U	34 J	26 J
Phenanthrene	800	140 J	76 J	320 J	460 J	1,100	390 J	220 J	87 J	960	650 J
Pyrene	1,300	470	380 J	3,600	2,300	12,000 D	2,500	1,400	1,200	13,000 D	11,000 D
Total Metals (MG/KG)											
Aluminum	11,300	1,870	1,920	13,700	11,300	11,200	11,400	10,600	9,040	9,520	11,000
Antimony	0.76 B	0.39 B	0.29 U	1.3 B	0.79 B	1.1 B	0.62 U	1.7 J	0.9 J	1 B	1.5 B
Arsenic	10.2	2 J	2.1 J	12.6	11.3	12.1	9.8	8.7	7.6	10.6	12.4
Barium	32.7 J	15.9 J	10.9 J	40.5 J	32.6 J	45.4 J	34 J	33.4 J	27.9 J	37.6 J	39.4 J
Beryllium	0.63 J	0.13 J	0.17 J	0.77 J	0.62 J	0.66 J	0.66 J	0.6 J	0.55 J	0.76 J	0.67 J
Cadmium	0.38 J	0.07 U	0.07 U	0.65 J	0.46 J	0.56 J	0.47 J	0.42 J	0.34 J	0.47 J	0.58 J
Calcium	3,180	1,140 J	7,540	5,280	2,560	7,060	2,800	4,020 J	5,870 J	9,510	6,390
Chromium	34.2	7.6	8.2	43.7	37.2	40.8	33.7	63.1	36.5	35.2	41.9
Cobalt	5.8 J	1.8 J	1.6 J	6.8 J	5.7 J	5.8 J	5.5 J	5 J	4.4 J	6.4 J	6.3 J
Copper	103	24.5	19.4	117	90.1	104	87	109	88	121	124
Cyanide	0.17 U	0.09 U	0.09 U	0.17 U	0.17 J	0.16 U	0.2 U	0.17 U	0.14 U	0.18 U	0.18 U
Iron	23,200	7,710	5,220	27,600	23,500	23,800	22,400	23,600	22,500	23,200	24,700
Lead	59.3	14	12.7	83.9	69.8	143	60	177	143	107	110
Magnesium	5,880	1,040 J	1,130 J	6,640	5,940	5,850	6,350	4,900	4,290	5,480	5,950
Manganese	190	38.5	33.7	220	185	178	167	151	130	177	180
Mercury	0.33	0.07 J	0.08 J	0.43	0.41	4.1	0.29	0.33	0.56	0.45	0.36
Nickel	23.4	4.1 J	4 J	19.1	15.1 J	16.2 J	14.9 J	15.9 J	14.2 J	25.4	18.3 J
Potassium	2,750	425 J	465 J	3,130	2,780	2,660	3,000	2,260 J	1,990 J	2,300	2,660
Selenium	1.3 U	0.73 U	0.71 U	1.3 U	1.3 U	1.3 U	1.6 U	1.3 U	1.4 J	1.3 U	1.4 U
Silver	0.36 U	0.2 U	0.19 U	0.35 U	0.35 U	0.38 J	0.42 U	0.35 U	0.32 J	0.36 U	0.39 U
Sodium	11,700	2,390	2,550	11,700	11,900	9,900	15,200	10,500	8,400	11,200	11,300
Thallium	1.1 U	0.59 U	0.57 U	1.1 U	1 U	1.1 U	1.2 U	1.1 UJ	0.9 UJ	1.1 U	1.2 U
Tin	8.8 J	3.2 J	3.3 J	7.1 J	5.6 J	6 J	5.4 J	6.6 J	5.1 J	14.5 J	9.1 J
Vanadium	33.4	6.8 J	7.6 J	40.2	33.9	34.7	34.2	30.3	26.6	31.7	37.1
Zinc	305	75.9	73.1	491	362	419	354	628	449	1,360	767
Wet Chemistry (MG/KG)											
Ammonia	23.1	3.5	2.6 U	15.8	20.4	21.1	28	11.5	3.92 U	24.4	21.9
Total organic carbon (TOC)	18,450	2,245	2,937	22,230	20,410	19,870	23,790	20,080	17,030	20,080	19,110
pH	7.82	8.2	8.04	7.8	7.89	8.01	7.65	8.32	7.86	7.81	7.92
Acid Volatile Sulfide/Simultaneously Extractable Metals (UMOLE/G)											
Cadmium	NA	5.20E-04 J	NA	0.0039 J	0.0032 J	NA	0.0037 J	0.0042 J	NA	0.0036 J	NA
Copper	NA	0.15 J	NA	0.67 J	0.78 J	NA	0.61 J	0.8 J	NA	0.89 J	NA
Lead	NA	0.052 J	NA	0.15 J	0.15 J	NA	0.15 J	0.59 J	NA	0.33 J	NA
Mercury	NA	4.70E-05 B	NA	6.00E-04 J	6.50E-05 J	NA	6.00E-04 J	2.00E-04 J	NA	1.00E-04 J	NA
Nickel	NA	0.019 J	NA	0.083 J	0.06 J	NA	0.07 J	0.11 J	NA	0.12 J	NA
Zinc	NA	0.77 J	NA	3.2 J	3.5 J	NA	2.9 J	7.3 J	NA	10.7 J	NA
Cation Exchange Capacity (MEQ/100G)											
Cation Exchange Capacity	NS	4.7	NS	8.9	8	NS	8.3	7.8	NS	14.2	NS

Notes:
J - Analyte Present
B - Possible blank contamination

Table A-11
QA/QC Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LC-QC									
Sample ID	LW07-TB082502	LW07-GW-EB082502	LW07-GW-EB082602	LW07-GW-EB090302	LW07-GW-EB090402	LW07-SO-EB090502	LW07-TB090502	LW07-EB092602D	LW07-EB092702D	LW07-EB092802D
Sample Date	08/25/02	08/25/02	08/26/02	09/03/02	09/04/02	09/05/02	09/05/02	09/26/02	09/27/02	09/28/02
Chemical Name										
Volatile Organic Compounds (UG/L)										
1,1,1-Trichloroethane	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
1,1,2,2-Tetrachloroethane	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
1,1,2-Trichloroethane	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
1,1-Dichloroethane	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
1,1-Dichloroethene	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
1,2,3-Trichlorobenzene	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
1,2,4-Trichlorobenzene	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
1,2-Dibromo-3-chloropropane	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
1,2-Dibromoethane	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
1,2-Dichlorobenzene	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
1,2-Dichloroethane	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
1,2-Dichloropropane	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
1,3-Dichlorobenzene	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
1,4-Dichlorobenzene	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
2-Butanone	5 U	5 U	NA	5 U	5 U	NA	5 U	NA	NA	NA
2-Hexanone	5 U	5 U	NA	5 U	5 U	NA	5 U	NA	NA	NA
4-Methyl-2-pentanone	5 U	5 U	NA	5 U	5 U	NA	5 U	NA	NA	NA
Acetone	5 U	5 U	NA	6.5 B	3.3 B	NA	4.4 B	NA	NA	NA
Benzene	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
Bromochloromethane	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
Bromodichloromethane	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
Bromoform	0.13 B	0.5 U	NA	0.14 B	0.5 U	NA	0.12 B	NA	NA	NA
Bromomethane	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
Carbon disulfide	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
Carbon tetrachloride	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
Chlorobenzene	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.12 B	NA	NA	NA
Chloroethane	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
Chloroform	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
Chloromethane	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.15 B	NA	NA	NA
Cumene	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
Cyclohexane	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
Dibromochloromethane	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
Dichlorodifluoromethane(Freon-12)	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
Ethylbenzene	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
Methyl acetate	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
Methyl-tert-butyl ether (MTBE)	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
Methylcyclohexane	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
Methylene chloride	1.5 B	2.2 B	NA	0.43 B	0.74 B	NA	0.42 B	NA	NA	NA
Styrene	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.12 B	NA	NA	NA
Tetrachloroethene	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
Toluene	0.55 B	0.4 B	NA	0.43 B	0.43 B	NA	0.85 B	NA	NA	NA
Trichloroethene	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
Trichlorofluoromethane(Freon-11)	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA

Table A-11
QA/QC Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LC-QC									
Sample ID	LW07-TB082502	LW07-GW-EB082502	LW07-GW-EB082602	LW07-GW-EB090302	LW07-GW-EB090402	LW07-SO-EB090502	LW07-TB090502	LW07-EB092602D	LW07-EB092702D	LW07-EB092802D
Sample Date	08/25/02	08/25/02	08/26/02	09/03/02	09/04/02	09/05/02	09/05/02	09/26/02	09/27/02	09/28/02
Chemical Name										
Vinyl chloride	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
Xylene, total	0.5 U	0.25 B	NA	0.5 U	0.11 B	NA	0.5 U	NA	NA	NA
cis-1,2-Dichloroethene	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
cis-1,3-Dichloropropene	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
trans-1,2-Dichloroethene	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
trans-1,3-Dichloropropene	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA
Semivolatile Organic Compounds (UG/L)										
1,1-Biphenyl	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
2,2'-Oxybis(1-chloropropane)	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
2,4,5-Trichlorophenol	NA	25 U	25 U	25 U	25 U	26 U	NA	NA	NA	NA
2,4,6-Trichlorophenol	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
2,4-Dichlorophenol	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
2,4-Dimethylphenol	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
2,4-Dinitrophenol	NA	25 U	25 U	25 U	25 U	26 U	NA	NA	NA	NA
2,4-Dinitrotoluene	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
2,6-Dinitrotoluene	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
2-Chloronaphthalene	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
2-Chlorophenol	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
2-Methylnaphthalene	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
2-Methylphenol	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
2-Nitroaniline	NA	25 U	25 U	25 U	25 U	26 U	NA	NA	NA	NA
2-Nitrophenol	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
3,3'-Dichlorobenzidine	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
3-Nitroaniline	NA	25 U	25 U	25 U	25 U	26 U	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol	NA	25 U	25 U	25 U	25 U	26 U	NA	NA	NA	NA
4-Bromophenyl-phenylether	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
4-Chloro-3-methylphenol	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
4-Chloroaniline	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
4-Chlorophenyl-phenylether	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
4-Methylphenol	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
4-Nitroaniline	NA	25 U	25 U	25 U	25 U	26 U	NA	NA	NA	NA
4-Nitrophenol	NA	25 U	25 U	25 U	25 U	26 U	NA	NA	NA	NA
Acenaphthene	NA	10 U	10 U	10 U	10 U	10 U	NA	10 U	10 U	10 U
Acenaphthylene	NA	10 U	10 U	10 U	10 U	10 U	NA	10 U	10 U	10 U
Acetophenone	NA	10 U	10 U	0.3 B	10 U	10 U	NA	NA	NA	NA
Anthracene	NA	10 U	10 U	10 U	10 U	10 U	NA	10 U	10 U	10 U
Atrazine	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
Benzaldehyde	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
Benzo(a)anthracene	NA	10 U	10 U	10 U	10 U	10 U	NA	10 U	10 U	10 U
Benzo(a)pyrene	NA	10 U	10 U	10 U	10 U	10 U	NA	10 U	10 U	10 U
Benzo(b)fluoranthene	NA	10 U	10 U	10 U	10 U	10 U	NA	10 U	10 U	10 U
Benzo(g,h,i)perylene	NA	10 U	10 U	10 U	10 U	10 U	NA	10 U	10 U	10 U
Benzo(k)fluoranthene	NA	10 U	10 U	10 U	10 U	10 U	NA	10 U	10 U	10 U
Butylbenzylphthalate	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
Caprolactam	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA

Table A-11
QA/QC Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LC-QC									
Sample ID	LW07-TB082502	LW07-GW-EB082502	LW07-GW-EB082602	LW07-GW-EB090302	LW07-GW-EB090402	LW07-SO-EB090502	LW07-TB090502	LW07-EB092602D	LW07-EB092702D	LW07-EB092802D
Sample Date	08/25/02	08/25/02	08/26/02	09/03/02	09/04/02	09/05/02	09/05/02	09/26/02	09/27/02	09/28/02
Chemical Name										
Carbazole	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
Chrysene	NA	10 U	10 U	10 U	10 U	10 U	NA	10 U	10 U	10 U
Di-n-butylphthalate	NA	0.9 B	10 U	10 U	10 U	10 U	NA	NA	NA	NA
Di-n-octylphthalate	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
Dibenz(a,h)anthracene	NA	10 U	10 U	10 U	10 U	10 U	NA	10 U	10 U	10 U
Dibenzofuran	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
Diethylphthalate	NA	0.7 B	10 U	10 U	10 U	10 U	NA	NA	NA	NA
Dimethyl phthalate	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
Fluoranthene	NA	10 U	10 U	10 U	10 U	10 U	NA	10 U	10 U	10 U
Fluorene	NA	10 U	10 U	10 U	10 U	10 U	NA	10 U	10 U	10 U
Hexachlorobenzene	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
Hexachlorobutadiene	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
Hexachlorocyclopentadiene	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
Hexachloroethane	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	NA	10 U	10 U	10 U	10 U	10 U	NA	10 U	10 U	10 U
Isophorone	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
Naphthalene	NA	10 U	0.3 B	0.4 B	10 U	10 U	NA	10 U	10 U	10 U
Nitrobenzene	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
Pentachlorophenol	NA	25 U	25 U	25 U	25 U	26 U	NA	NA	NA	NA
Phenanthrene	NA	10 U	10 U	10 U	10 U	10 U	NA	10 U	10 U	10 U
Phenol	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
Pyrene	NA	10 U	10 U	10 U	10 U	10 U	NA	10 U	10 U	10 U
bis(2-Chloroethoxy)methane	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
bis(2-Chloroethyl)ether	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	NA	3 B	2 B	1 B	10 U	0.6 B	NA	NA	NA	NA
n-Nitroso-di-n-propylamine	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
n-Nitrosodiphenylamine	NA	10 U	10 U	10 U	10 U	10 U	NA	NA	NA	NA
Total Metals (UG/L)										
Aluminum	NA	NA	7.6 U	46.2 B	31.4 B	22.9 B	NA	85.6 B	56.7 U	56.7 U
Antimony	NA	NA	1.7 U	1.7 U	1.7 U	1.7 U	NA	5.4 B	1.2 U	1.2 U
Arsenic	NA	NA	2.5 U	2.5 U	2.5 U	2.5 U	NA	3 U	3 U	3 U
Barium	NA	NA	1 B	0.73 B	0.62 B	0.46 B	NA	16.5 B	3.8 B	0.3 U
Beryllium	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	0.47 B	0.2 U	0.2 U
Cadmium	NA	NA	0.4 U	0.4 U	0.4 U	0.4 U	NA	0.63 B	0.3 U	0.3 U
Calcium	NA	NA	16.1 B	96 B	50 B	61.8 B	NA	862 B	93.5 B	201 B
Chromium	NA	NA	1 B	1.3 B	1 B	0.4 U	NA	1.5 B	1.5 B	0.8 U
Cobalt	NA	NA	0.4 U	0.4 U	0.4 U	0.4 U	NA	4.9 B	1.8 B	0.7 U
Copper	NA	NA	1.6 B	4.2 B	2.4 B	0.8 U	NA	2.7 B	4.6 B	1.5 U
Cyanide	NA	NA	1.5 U	1.5 U	1.5 U	1.5 B	NA	1.5 U	1.5 U	NA
Iron	NA	NA	19.7 B	44.7 B	30.1 B	8.6 U	NA	25.8 B	77.3 B	12.5 U
Lead	NA	NA	1.3 U	1.3 U	1.3 U	1.3 U	NA	1.2 U	1.2 U	1.2 U
Magnesium	NA	NA	66.7 B	93.1 B	69.8 B	66.3 B	NA	3,050 B	501 B	591 B
Manganese	NA	NA	0.27 B	1.3 B	0.47 B	0.3 B	NA	4 B	1.8 B	1.2 B
Mercury	NA	NA	0.1 U	0.1 UN	0.1 UN	0.1 UN	NA	0.1 U	0.1 U	0.1 U
Nickel	NA	NA	0.81 B	1.1 B	0.6 U	0.6 U	NA	3.7 B	3.5 B	1 U

Table A-11
QA/QC Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LC-QC									
Sample ID	LW07-TB082502	LW07-GW-EB082502	LW07-GW-EB082602	LW07-GW-EB090302	LW07-GW-EB090402	LW07-SO-EB090502	LW07-TB090502	LW07-EB092602D	LW07-EB092702D	LW07-EB092802D
Sample Date	08/25/02	08/25/02	08/26/02	09/03/02	09/04/02	09/05/02	09/05/02	09/26/02	09/27/02	09/28/02
Chemical Name										
Potassium	NA	NA	67.1 U	67.1 U	67.1 U	67.1 U	NA	886 B	115 B	148 B
Selenium	NA	NA	1.7 U	1.7 U	1.7 U	1.7 U	NA	3 U	3 U	3 U
Silver	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	1.4 B	0.84 B	0.8 U
Sodium	NA	NA	133 B	202 B	152 B	127 B	NA	24,200 B	5,000 B	6,080 B
Thallium	NA	NA	4.2 U	4.2 U	4.2 U	4.2 U	NA	2.4 U	2.4 U	2.4 U
Tin	NA	NA	NA	NA	NA	NA	NA	4 U	4 U	4 U
Vanadium	NA	NA	0.4 B	0.3 U	0.3 U	0.3 U	NA	4.9 B	1.9 B	0.7 U
Zinc	NA	NA	8.2 B	9.3 B	8.4 B	1.8 U	NA	1.1 U	1.1 U	1.1 U
Dissolved Metals (UG/L)										
Aluminum	NA	NA	NA	7.6 U	7.6 U	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	1.7 U	1.7 U	NA	NA	NA	NA	NA
Arsenic	NA	NA	NA	2.5 U	2.5 U	NA	NA	NA	NA	NA
Barium	NA	NA	NA	0.55 B	2.3 B	NA	NA	NA	NA	NA
Beryllium	NA	NA	NA	0.2 U	0.2 U	NA	NA	NA	NA	NA
Cadmium	NA	NA	NA	0.4 U	0.4 U	NA	NA	NA	NA	NA
Calcium	NA	NA	NA	213 B	1,370 B	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	0.4 U	0.46 B	NA	NA	NA	NA	NA
Cobalt	NA	NA	NA	0.4 U	0.4 U	NA	NA	NA	NA	NA
Copper	NA	NA	NA	0.8 U	0.94 B	NA	NA	NA	NA	NA
Iron	NA	NA	NA	8.6 U	488	NA	NA	NA	NA	NA
Lead	NA	NA	NA	1.3 U	1.3 U	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	95 B	410 B	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	0.51 B	24.8	NA	NA	NA	NA	NA
Mercury	NA	NA	NA	0.1 U	0.1 U	NA	NA	NA	NA	NA
Nickel	NA	NA	NA	0.6 U	0.6 U	NA	NA	NA	NA	NA
Potassium	NA	NA	NA	67.1 U	67.1 U	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	1.7 B	1.7 U	NA	NA	NA	NA	NA
Silver	NA	NA	NA	0.5 U	0.5 U	NA	NA	NA	NA	NA
Sodium	NA	NA	NA	334 B	2,060 B	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	4.2 U	4.2 U	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	0.3 U	0.3 U	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	8.5 B	9.4 B	NA	NA	NA	NA	NA

Notes:
NA - Not Analyzed
B - Possible blank contamination
U - not detected

Table A-11
QA/QC Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LC-QC			
Sample ID	LW07-FB092902	LW07-EB092902V	LW07-EB093002V	LW07-EB100102D
Sample Date	09/29/02	09/29/02	09/30/02	10/01/02
Chemical Name				
Volatile Organic Compounds (UG/L)				
1,1,1-Trichloroethane	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA
1,1-Dichloroethene	NA	NA	NA	NA
1,2,3-Trichlorobenzene	NA	NA	NA	NA
1,2,4-Trichlorobenzene	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA
1,2-Dichlorobenzene	NA	NA	NA	NA
1,2-Dichloroethane	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA
1,3-Dichlorobenzene	NA	NA	NA	NA
1,4-Dichlorobenzene	NA	NA	NA	NA
2-Butanone	NA	NA	NA	NA
2-Hexanone	NA	NA	NA	NA
4-Methyl-2-pentanone	NA	NA	NA	NA
Acetone	NA	NA	NA	NA
Benzene	NA	NA	NA	NA
Bromochloromethane	NA	NA	NA	NA
Bromodichloromethane	NA	NA	NA	NA
Bromoform	NA	NA	NA	NA
Bromomethane	NA	NA	NA	NA
Carbon disulfide	NA	NA	NA	NA
Carbon tetrachloride	NA	NA	NA	NA
Chlorobenzene	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA
Chloromethane	NA	NA	NA	NA
Cumene	NA	NA	NA	NA
Cyclohexane	NA	NA	NA	NA
Dibromochloromethane	NA	NA	NA	NA
Dichlorodifluoromethane(Freon-12)	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA
Methyl acetate	NA	NA	NA	NA
Methyl-tert-butyl ether (MTBE)	NA	NA	NA	NA
Methylcyclohexane	NA	NA	NA	NA
Methylene chloride	NA	NA	NA	NA
Styrene	NA	NA	NA	NA
Tetrachloroethene	NA	NA	NA	NA
Toluene	NA	NA	NA	NA
Trichloroethene	NA	NA	NA	NA
Trichlorofluoromethane(Freon-11)	NA	NA	NA	NA

Table A-11
QA/QC Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LC-QC			
Sample ID	LW07-FB092902	LW07-EB092902V	LW07-EB093002V	LW07-EB100102D
Sample Date	09/29/02	09/29/02	09/30/02	10/01/02
Chemical Name				
Vinyl chloride	NA	NA	NA	NA
Xylene, total	NA	NA	NA	NA
cis-1,2-Dichloroethene	NA	NA	NA	NA
cis-1,3-Dichloropropene	NA	NA	NA	NA
trans-1,2-Dichloroethene	NA	NA	NA	NA
trans-1,3-Dichloropropene	NA	NA	NA	NA
Semivolatile Organic Compounds (UG/L)				
1,1-Biphenyl	NA	NA	NA	NA
2,2'-Oxybis(1-chloropropane)	NA	NA	NA	NA
2,4,5-Trichlorophenol	NA	NA	NA	NA
2,4,6-Trichlorophenol	NA	NA	NA	NA
2,4-Dichlorophenol	NA	NA	NA	NA
2,4-Dimethylphenol	NA	NA	NA	NA
2,4-Dinitrophenol	NA	NA	NA	NA
2,4-Dinitrotoluene	NA	NA	NA	NA
2,6-Dinitrotoluene	NA	NA	NA	NA
2-Chloronaphthalene	NA	NA	NA	NA
2-Chlorophenol	NA	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	NA
2-Methylphenol	NA	NA	NA	NA
2-Nitroaniline	NA	NA	NA	NA
2-Nitrophenol	NA	NA	NA	NA
3,3'-Dichlorobenzidine	NA	NA	NA	NA
3-Nitroaniline	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol	NA	NA	NA	NA
4-Bromophenyl-phenylether	NA	NA	NA	NA
4-Chloro-3-methylphenol	NA	NA	NA	NA
4-Chloroaniline	NA	NA	NA	NA
4-Chlorophenyl-phenylether	NA	NA	NA	NA
4-Methylphenol	NA	NA	NA	NA
4-Nitroaniline	NA	NA	NA	NA
4-Nitrophenol	NA	NA	NA	NA
Acenaphthene	10 U	10 U	10 U	NA
Acenaphthylene	10 U	10 U	10 U	NA
Acetophenone	NA	NA	NA	NA
Anthracene	10 U	10 U	10 U	NA
Atrazine	NA	NA	NA	NA
Benzaldehyde	NA	NA	NA	NA
Benzo(a)anthracene	10 U	10 U	10 U	NA
Benzo(a)pyrene	10 U	10 U	10 U	NA
Benzo(b)fluoranthene	10 U	10 U	10 U	NA
Benzo(g,h,i)perylene	10 U	10 U	10 U	NA
Benzo(k)fluoranthene	10 U	10 U	10 U	NA
Butylbenzylphthalate	NA	NA	NA	NA
Caprolactam	NA	NA	NA	NA

Table A-11
QA/QC Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LC-QC			
Sample ID	LW07-FB092902	LW07-EB092902V	LW07-EB093002V	LW07-EB100102D
Sample Date	09/29/02	09/29/02	09/30/02	10/01/02
Chemical Name				
Carbazole	NA	NA	NA	NA
Chrysene	10 U	10 U	10 U	NA
Di-n-butylphthalate	NA	NA	NA	NA
Di-n-octylphthalate	NA	NA	NA	NA
Dibenz(a,h)anthracene	10 U	10 U	10 U	NA
Dibenzofuran	NA	NA	NA	NA
Diethylphthalate	NA	NA	NA	NA
Dimethyl phthalate	NA	NA	NA	NA
Fluoranthene	10 U	10 U	10 U	NA
Fluorene	10 U	10 U	10 U	NA
Hexachlorobenzene	NA	NA	NA	NA
Hexachlorobutadiene	NA	NA	NA	NA
Hexachlorocyclopentadiene	NA	NA	NA	NA
Hexachloroethane	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	10 U	10 U	10 U	NA
Isophorone	NA	NA	NA	NA
Naphthalene	10 U	10 U	10 U	NA
Nitrobenzene	NA	NA	NA	NA
Pentachlorophenol	NA	NA	NA	NA
Phenanthrene	10 U	10 U	10 U	NA
Phenol	NA	NA	NA	NA
Pyrene	10 U	10 U	10 U	NA
bis(2-Chloroethoxy)methane	NA	NA	NA	NA
bis(2-Chloroethyl)ether	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA
n-Nitroso-di-n-propylamine	NA	NA	NA	NA
n-Nitrosodiphenylamine	NA	NA	NA	NA
Total Metals (UG/L)				
Aluminum	56.7 U	56.7 U	56.7 U	58.4 B
Antimony	1.2 U	1.2 U	1.2 U	1.2 U
Arsenic	3 U	3 U	3 U	3 U
Barium	1.2 B	1.2 B	0.3 U	0.35 B
Beryllium	0.2 U	0.2 U	0.2 U	0.2 U
Cadmium	0.3 U	0.3 U	0.3 U	0.3 U
Calcium	15 U	15 U	15 U	1,360 B
Chromium	0.8 U	0.8 U	0.8 U	0.8 U
Cobalt	1.6 B	1.2 B	1.1 B	0.7 U
Copper	1.5 U	1.5 U	1.5 U	1.5 U
Cyanide	1.5 U	1.5 U	1.5 U	1.5 U
Iron	19.8 B	12.5 U	22.6 B	12.5 U
Lead	1.2 U	1.2 U	1.2 U	1.2 U
Magnesium	12.3 U	12.3 U	178 B	4,760 B
Manganese	0.2 B	0.2 U	0.81 B	1.8 B
Mercury	0.1 U	0.1 U	0.1 U	0.1 U
Nickel	1 U	1 U	1 U	1 U

Table A-11
QA/QC Analytical Results
SWMU 7 Remedial Investigation Report
NAB Little Creek
Virginia Beach, Virginia

Station ID	LC-QC			
Sample ID	LW07-FB092902	LW07-EB092902V	LW07-EB093002V	LW07-EB100102D
Sample Date	09/29/02	09/29/02	09/30/02	10/01/02
Chemical Name				
Potassium	40.1 U	40.1 U	40.1 U	1,460 B
Selenium	3 U	3 U	3 U	3 U
Silver	2.2 B	0.8 U	0.8 U	0.8 U
Sodium	304 U	304 U	1,710 B	37,700 B
Thallium	2.4 U	2.4 U	2.4 U	2.4 U
Tin	4 U	4 U	4 U	4 U
Vanadium	1.7 B	0.7 U	0.99 B	0.7 U
Zinc	1.1 U	1.1 U	1.1 U	1.1 U
Dissolved Metals (UG/L)				
Aluminum	NA	NA	NA	NA
Antimony	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA
Barium	NA	NA	NA	NA
Beryllium	NA	NA	NA	NA
Cadmium	NA	NA	NA	NA
Calcium	NA	NA	NA	NA
Chromium	NA	NA	NA	NA
Cobalt	NA	NA	NA	NA
Copper	NA	NA	NA	NA
Iron	NA	NA	NA	NA
Lead	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA
Manganese	NA	NA	NA	NA
Mercury	NA	NA	NA	NA
Nickel	NA	NA	NA	NA
Potassium	NA	NA	NA	NA
Selenium	NA	NA	NA	NA
Silver	NA	NA	NA	NA
Sodium	NA	NA	NA	NA
Thallium	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA
Zinc	NA	NA	NA	NA

Notes:
NA - Not Analyzed
B - Possible blank contamination
U - not detected

Table A-12
Analytical Parameters and Reporting Limits
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Volatile Organic Compounds	OLC03.2 Water (ug/L)	OLM04.2 Water (ug/L)	OLM04.2 Low Soil (ug/Kg)	OLM04.2 Medium Soil (ug/Kg)
Dichlorodifluoromethane	0.5	10	10	1200
Chloromethane	0.5	10	10	1200
Bromomethane	0.5	10	10	1200
Vinyl Chloride	0.5	10	10	1200
Chloroethane	0.5	10	10	1200
Trichlorofluoromethane	0.5	10	10	1200
1,1,2-Trichloro-	0.5	10	10	1200
1,2,2-trifluoroethane				
Methylene Chloride	0.5	10	10	1200
Acetone	5	10	10	1200
Carbon Disulfide	0.5	10	10	1200
Methyl Acetate	0.5	10	10	1200
1,1-Dichloroethene	0.5	10	10	1200
1,1-Dichloroethane	0.5	10	10	1200
cis-1,2-Dichloroethene	0.5	10	10	1200
trans-1,2-Dichloroethene	0.5	10	10	1200
Methyl tert-Butyl Ether	0.5	10	10	1200
Chloroform	0.5	10	10	1200
1,2-Dichloroethane	0.5	10	10	1200
2-Butanone	5	10	10	1200
Bromochloromethane	0.5	NA	NA	NA
1,1,1-Trichloroethane	0.5	10	10	1200
Cyclohexane	0.5	10	10	1200
Carbon Tetrachloride	0.5	10	10	1200
Bromodichloromethane	0.5	10	10	1200
1,2-Dichloropropane	0.5	10	10	1200
cis-1,3-Dichloropropene	0.5	10	10	1200
Trichloroethene	0.5	10	10	1200
Methylcyclohexane	0.5	10	10	1200
Dibromochloromethane	0.5	10	10	1200
1,1,2-Trichloroethane	0.5	10	10	1200
Benzene	0.5	10	10	1200
trans-1,3-Dichloropropene	0.5	10	10	1200
Bromoform	0.5	10	10	1200
Isopropylbenzene	0.5	10	10	1200
4-Methyl-2-pentanone	5	10	10	1200
2-Hexanone	5	10	10	1200
Tetrachloroethene	0.5	10	10	1200
1,2-Dibromoethane	0.5	10	10	1200
Toluene	0.5	10	10	1200
1,1,2,2-Tetrachloroethane	0.5	10	10	1200
Chlorobenzene	0.5	10	10	1200
Ethylbenzene	0.5	10	10	1200
Styrene	0.5	10	10	1200
Xylenes (Total)	0.5	10	10	1200
1,2-Dibromo-3-chloropropane	0.5	10	10	1200
1,3-Dichlorobenzene	0.5	10	10	1200
1,4-Dichlorobenzene	0.5	10	10	1200
1,2-Dichlorobenzene	0.5	10	10	1200
1,2,3-Trichlorobenzene	0.5	NA	NA	NA
1,2,4-Trichlorobenzene	0.5	10	10	1200

NA - Not applicable
-- Quantitation limit not established
Low Soil and medium soil based on different extraction methods from the USEPA Contract Laboratory Program Statement of Work for Organic Analysis, May 1999.

Table A-12
Analytical Parameters and Reporting Limits
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

TAL Metals and Cyanide	ICP-AES Water (ug/L)	ICP-AES Soil (mg/kg)
Aluminum	200	40
Antimony	60	12
Arsenic	15	3
Barium	200	40
Beryllium	5	1
Cadmium	5	1
Calcium	5000	1000
Chromium	10	2
Cobalt	50	10
Copper	25	5
Iron	100	20
Lead	10	2
Magnesium	5000	1000
Manganese	15	3
Mercury	0.2	0.1
Nickel	40	8
Potassium	5000	1000
Selenium	35	7
Silver	10	2
Sodium	5000	1000
Thallium	25	5
Vanadium	50	10
Zinc	60	12
Cyanide	10	1

NA - Not applicable
-- Quantitation limit not established
Low Soil and medium soil based on different extraction methods from the USEPA Contract Laboratory Program Statement of Work for Organic Analysis, May 1999.

Table A-12
Analytical Parameters and Reporting Limits
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Pesticide/PCBs	OLC03.2 Water (ug/L)	OLM04.2 Water (ug/L)	OLM04.2 Soil (ug/Kg)
alpha-BHC	0.01	0.05	1.7
beta-BHC	0.01	0.05	1.7
delta-BHC	0.01	0.05	1.7
gamma-BHC (Lindane)	0.01	0.05	1.7
Heptachlor	0.01	0.05	1.7
Aldrin	0.01	0.05	1.7
Heptachlor epoxide	0.01	0.05	1.7
Endosulfan I	0.01	0.05	1.7
Dieldrin	0.02	0.1	3.3
4,4'-DDE	0.02	0.1	3.3
Endrin	0.02	0.1	3.3
Endosulfan II	0.02	0.1	3.3
4,4'-DDD	0.02	0.1	3.3
Endosulfan sulfate	0.02	0.1	3.3
4,4'-DDT	0.02	0.1	3.3
Methoxychlor	0.1	0.5	17
Endrin ketone	0.02	0.1	3.3
Endrin aldehyde	0.02	0.1	3.3
alpha-Chlordane	0.01	0.05	1.7
gamma-Chlordane	0.01	0.05	1.7
Toxaphene	1	5	170
Aroclor-1016	0.2	1	33
Aroclor-1221	0.4	2	67
Aroclor-1232	0.2	1	33
Aroclor-1242	0.2	1	33
Aroclor-1248	0.2	1	33
Aroclor-1254	0.2	1	33
Aroclor-1260	0.2	1	33

NA - Not applicable
-- Quantitation limit not established
Low Soil and medium soil based on different extraction methods from the USEPA Contract Laboratory Program Statement of Work for Organic Analysis, May 1999.

Table A-12
Analytical Parameters and Reporting Limits
SWMU 7 Remedial Investigation
NAB Little Creek
Virginia Beach, Virginia

Semivolatile Organic Compounds	OLC03.2 Water (ug/L)	OLM04.2 Water (ug/L)	OLM04.2[1] Low Soil (ug/Kg)	OLM04.2[1] Medium Soil (ug/Kg)
Benzaldehyde	5	10	330	10000
Phenol	5	10	330	10000
bis(2-Chloroethyl) ether	5	10	330	10000
2-Chlorophenol	5	10	330	10000
2-Methylphenol	5	10	330	10000
2,2'-oxybis(1-Chloropropane)	5	10	330	10000
Acetaphenone	5	10	330	10000
4-Methylphenol	5	10	330	10000
N-Nitroso-di-n-propylamine	5	10	330	10000
Hexachloroethane	5	10	330	10000
Nitrobenzene	5	10	330	10000
Isophorone	5	10	330	10000
2-Nitrophenol	5	10	330	10000
2,4-Dimethylphenol	5	10	330	10000
bis(2-Chloroethoxy) methane	5	10	330	10000
2,4-Dichlorophenol	5	10	330	10000
Naphthalene	5	10	330	10000
4-Chloroaniline	5	10	330	10000
Hexachlorobutadiene	5	10	330	10000
Caprolactam	5	10	330	10000
4-Chloro-3-methylphenol	5	10	330	10000
2-Methylnaphthalene	5	10	330	10000
Hexachlorocyclopentadiene	5	10	330	10000
2,4,6-Trichlorophenol	5	10	330	10000
2,4,5-Trichlorophenol	20	25	830	25000
1,1'-Biphenyl	5	10	330	10000
2-Chloronapthalene	5	10	330	10000
2-Nitroaniline	20	25	830	25000
Dimethylphthalate	5	10	330	10000
Acenaphthylene	5	10	330	10000
2,6-Dinitrotoluene	5	10	330	10000
3-Nitroaniline	20	25	830	25000
Acenaphthene	5	10	330	10000
2,4-Dinitrophenol	20	25	830	25000
4-Nitrophenol	20	25	830	25000
Dibenzofuran	5	10	330	10000
2,4-Dinitrotoluene	5	10	330	10000
Diethylphthalate	5	10	330	10000
4-Chlorophenyl-phenylether	5	10	330	10000
Fluorene	5	10	330	10000
4-Nitroaniline	20	25	830	25000
4,6-Dinitro-2-methylphenol	20	25	830	25000
N-Nitrosodiphenylamine	5	10	330	10000
4-Bromophenyl-phenylether	5	10	330	10000
Hexachlorobenzene	5	10	330	10000
Atrazine	5	10	330	10000
Pentachlorophenol	5	25	830	25000
Phenanthrene	5	10	330	10000
Anthracene	5	10	330	10000
Carbazole	NA	10	330	10000
Di-n-butylphthalate	5	10	330	10000
Fluoranthene	5	10	330	10000
Pyrene	5	10	330	10000
Butylbenzylphthalate	5	10	330	10000
3,3'-Dichlorobenzidine	5	10	330	10000
Benzo(a)anthracene	5	10	330	10000
Chrysene	5	10	330	10000
bis-(2-Ethylhexyl)phthalate	5	10	330	10000
Di-n-octylphthalate	5	10	330	10000
Benzo(b)fluoranthene	5	10	330	10000
Benzo(k)fluoranthene	5	10	330	10000
Benzo(a)pyrene	5	10	330	10000
Indeno(1,2,3-cd)pyrene	5	10	330	10000
Dibenzo(a,h)anthracene	5	10	330	10000
Benzo(g,h,i)perylene	5	10	330	10000
1,2,4,5-Tetrachlorobenzene	5	NA	NA	NA

NA - Not applicable
-- Quantitation limit not established
Low Soil and medium soil based on different extraction methods from the USEPA Contract Laboratory Program Statement of Work for Organic Analysis, May 1999.

Appendix B
Borelogs and Well Construction Diagrams

PROJECT NUMBER	BORING NUMBER	
157234.RI.DF	LW07-MW04	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : CTO-159 | DRILLING CONTRACTOR : Parratt Wolf | LOCATION : SWMU 7, NAB Little Creek

ELEVATION : | NORTHING: 3504016.8449 | EASTING: 12165355.5570

DRILLING METHOD AND EQUIPMENT USED : Hollow Stem Auger

WATER LEVELS 9' bgs | START : 8/22/02 1645 | END : 8/22/02 1845 | LOGGER : E. Mathews

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-4'	48"	1		Coarse to fine sand, (SW), 10YR 6/2, moist, loose, well graded	
5						
	4-8'	48"	2		Same as above	Water table at 9' bgs
10						
	8-12'	24"	3		Same as above, 10YR 6/1, wet, loose	
	12-14'		4		Silty-sandy clay, (CL), Gley 1 3/10Y, wet, medium density	
15						
	14-16'		5		Silty-clayey sand, (SC), Gley 1 3/10Y, wet, loose	
						Boring terminated @ 18' bgs.
20						
25						

PROJECT NUMBER	BORING NUMBER	
157234.RI.DF	LW07-MW05	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : CTO-159 | DRILLING CONTRACTOR : Parratt Wolf | LOCATION : SWMU 7, NAB Little Creek

ELEVATION : | NORTHING: 3502343.8932 | EASTING: 12165131.1330

DRILLING METHOD AND EQUIPMENT USED : Hollow Stem Auger

WATER LEVELS bgs | START : 08/23/02 1110 | END : 08/23/02-1134 | LOGGER : S. Martin

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-4'		1		Medium sand with some pebbles, (SW), 2.5Y 6/2, moist, loose, well graded	
	4-4.5'		2		Same as above	
5						
	4.5-7.5'		3		Clay, (CH), 2.5Y 6/2, soft	
	7.5-8'		4		Same as above with sand, (CL)	
	8-8.5'		5		Same as above, wet	
10						
	8.5-12'		6		Coarse sand, (SP), 2.5 Y 6/2, wet, loose, poorly-graded	
	12-14'		7		Same as above, 10YR 5/6	
15	14-16'		8		Coarse sand, (SW), 10YR 5/6, wet, loose, well-graded	
						Boring terminated @ 16' bgs
20						
25						

PROJECT NUMBER	BORING NUMBER	
157234.RI.DF	LW07-MW06	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : CTO-159 | DRILLING CONTRACTOR : Parratt Wolf | LOCATION : SWMU 7, NAB Little Creek

ELEVATION : | NORTHING: 3502330.3736 | EASTING: 12163665.8303

DRILLING METHOD AND EQUIPMENT USED : Hollow Stem Auger

WATER LEVELS 12' bgs | START : 8/24/02 | END : 8/24/02 | LOGGER : E. Mathews

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
					0-0.5'-Asphalt 0.5-1'-Silty sand with trace nodules of clay, (SM), 2.5Y 4/4, moist, loose	
	0-4'	48"	1		1-4'-Medium sand w/ pebbles, (SW), 2.5Y 6/3, graying with depth 2.5Y 5/1, moist, loose, cobbles at at bottom	
5					4-5'-Same as above 5-5.5'-Clayey sand, (SC), 2.5Y 3/1, moist, loose 5.5-6'-Clay with trace silt, (ML), 2.5Y 5/1, medium-density	TPH odor from 5-5.5'
	4-8'	48"	2		6-6.5'-Clay, (CL), 2.5Y 3/1, dense 6.5-8'-Same as above, 10YR 4/3	
10						
	8-12'	24"	3		Fine sand, (SP), 2.5Y 5/3, loose	Water Table at 12' bgs
15						
	12-16'	24"	4		Well sorted sand, (SW), 2.5Y 5/6, wet at 12' bgs	
20	16-20'	48"	5		Same as above, more orange with depth 10YR 6/8 20-21'- Same as above 7.5 YR 5/8	
	20-24'				Sand grading to clay (CH), Gray, wet	Yorktown Confining Unit
25						Boring terminated at 24' bgs

PROJECT NUMBER	BORING NUMBER	
151767.SI.FI	LW07-MW01	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : Little Creek SWMU 7 Investigation LOCATION : SWMU 7

ELEVATION : DRILLING CONTRACTOR : Parratt Wolff, Inc.

DRILLING METHOD AND EQUIPMENT USED : Hollow Stem Auger, Diedrich 50

WATER LEVELS : START : 22 May 2000; 1400 END : 1600 LOGGER : Laura Cook

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-.5	6		NA	dark greenish gray 10Y3/1 silty sand (SM) mixed with <5% blast grit; loose; dry	sampled with a stainless steel trowel
	1-3	20		7-9-8-8 (17)	greenish gray silty sand (SM); loose; dry; moderately well sorted	
	3-5	18		4-4-3-2 (7)	fine sand (SW); loose; dry; very dark gray N3/N well sorted	
5	5-7	24		2-2-2-2 (4)	dark greenish gray 5GY3/1 silty sand (fine); some clay (ML); loose to cohesive; plastic; dry; light olive brown 2.5Y5/6 in some areas	
	7-9	24		4-4-3-3 (7)	gray 2.5Y5/1 silt; some sand; loose; moist; well graded; sand is fine grained	
10	9-11	18		2-4-2-2 (6)	10GY4/1 greenish gray clayey sand; fat clay last 2" of spoon; medium plasticity; sand grains in sandy clay are quartz and subround	
	11-13	18		12-9-8-4 (17)	same as above with some quartz gravel and pebbles >1"	
	13-15	20		3-3-4-5 (7)	same as above; 1" of clay at 14.5'; fat, very plastic, wet	
15	15-17	6		3-3-3-4 (6)	same as above; saturated	
	17-19	18		6-7-7-9 (14)	light yellowish brown 2.5Y6/4 coarse sand; predominantly quartz; saturated; well sorted; subround grains	Set well at 20' bgs casing 0-5' bgs
20	19-21	18			olive yellow 2.5Y6/6 medium grained sand (SW) loose; saturated; well sorted; mostly quartz	sand pack 3-2-' bgs DSI #1 sand screened interval 5-20' bgs bentonite 1-3' bgs sand filter above bentonite 24" round flush pad flush mount construction

PROJECT NUMBER	BORING NUMBER	
151767.SI.FI	LW07-MW02	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : Little Creek SWMU 7 Investigation LOCATION : SWMU 7

ELEVATION : DRILLING CONTRACTOR : Parratt Wolff, Inc.

DRILLING METHOD AND EQUIPMENT USED : Hollow Stem Auger, Diedrich 50

WATER LEVELS : START : 22 May 2000; 1645 END : 1845 LOGGER : Laura Cook

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-.5	6		NA	10YR4/1 dark gray silty sand; loose; organic; dry	sampled with a stainless steel trowel
	1-3	22		4-3-2-2 (5)	brown 10YR5/3 silty sand (SM); loose; fine to medium grained; dry; predominantly quartz; some feldspar	
	3-5	18		1-1-1-1 (2)	3-4': same as above; 4-5': 5BG5/1; greenish gray same as above	saturated at 3.5' bgs
5	5-7	20		2-1-2-2 (3)	yellowish brown 10YR5/4 silty clay (CL); soft; lean; homogenous; dry	
	7-9	18		2-3-3-4 (6)	2.5Y6/1 gray silt; some clay (ML); medium plastic; soft; moist	
10	9-11	24		2-2-1-1 (3)	same as above	
	11-13	24		4-4-4-4 (8)	11-12': 10YR6/6 brownish yellow sandy clay (SC) moist; medium plasticity; homogenous 12-13': 7/N light gray coarse sand (SW) well sorted; quartz; saturated; subround grains; loose	
	13-15	24		4-5-4-4 (9)	same as above; 10Y6/1 greenish gray	
15	15-17	24		6-8-8-9 (6)	2.5Y7/4 same as above; pale yellow	
	17-19	24		4-4-6-5 (10)	same as above	
20	19-21	24		6-4-4-2 (6)	same as above; 2.5Y5/1 gray clay at tip; silty; soft; plastic; does not look like Yorktown clay	Set well at 20' bgs casing 0-5' bgs sand pack 3-2-' bgs DSI #1 sand screened interval 5-20' bgs bentonite 1-3' bgs sand filter above bentonite 24" round flush pad flush mount construction

PROJECT NUMBER	BORING NUMBER	
151767.SI.FI	LW07-MW03	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : Little Creek Swmu 7 Investigation LOCATION : SWMU 7

ELEVATION : DRILLING CONTRACTOR : Parratt Wolff, Inc.

DRILLING METHOD AND EQUIPMENT USED : Hollow Stem Auger, Diedrich 50

WATER LEVELS : START : 22 May 2000; 1000 END : 1300 LOGGER : Laura Cook

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-0.5	6		NA	silty sand (SM) mixed with pebbles and cobbles; dark grayish brown 2.5YR4/2; moderate loose numerous roots	collected with stainless steel trowel blast grit visible at surface of gravel road
	1-3	24		11-12-13-16 (25)	1-1.5: very dense silt (ML); 10YR5/4; yellowish brown; dry 1.5-3': sand, predominantly quartz, loose; dry; 10YR6/3 light yellowish brown; subround grains; well sorted	
	3-5'	24		13-13-14-17 (27)	Same as above, 2.5YR6/1 gray	
5	5-7'	24		2-2-2-2 (4)	5-6' same as above; light yellowish brown 10YR6/3 6-6.5': dark greenish gray 10Y3/1 silty clay; lean; pieces of charred material inside; firm 6.5-7': dark greenish gray 10YR4/1 clay; medium fat; medium soft; some silt (CL)	hit water at 5' bgs
	7-9'	12		2-2-13-10 (15)	sand; loose; moist; well sorted; greenish gray 5GY6/1; subround grains	wood piece wedged in bottom of spoon Resulted in poor recovery
10	9-11	8		4-2-2-4 (4)	same as above; saturated	
	11-13	24		2-1-2-1 (3)	greenish gray 10GY6/1 clayey sand and sandy clay (SC); saturated; plastic	
	13-15	24		3-4-4-6 (8)	greenish gray 10Y6/1 coarse sand; saturated predominantly quartz; loose; well sorted; subround grains	
15	15-17	24		2-3-5-7 (8)	same as above; color grades from 10YR6/6 brownish yellow to 2.5Y6/2 light brownish gray	
	17-19	24		4-4-6-10 (10)	2.5Y7/4 pale yellow sand; same as above	
20	19-21	24		4-5-7-7 (12)	same as above	
	21-23	22		6-3-2-2 (5)	21-22' yellowish brown 10YR5/8 sand; same as above; 22-23': clay; medium soft (CH); very plastic gray 2.5Y5/1; Yorktown pounded to 24" of	Set well at 20'; DSI #1 sand from 3-20' bgs Screened interval from 5-20' bgs. Bentonite chips from 1-3' bgs

PROJECT NUMBER	WELL NUMBER	
151767.SI.FI	LW07-MW01	SHEET 1 OF 1

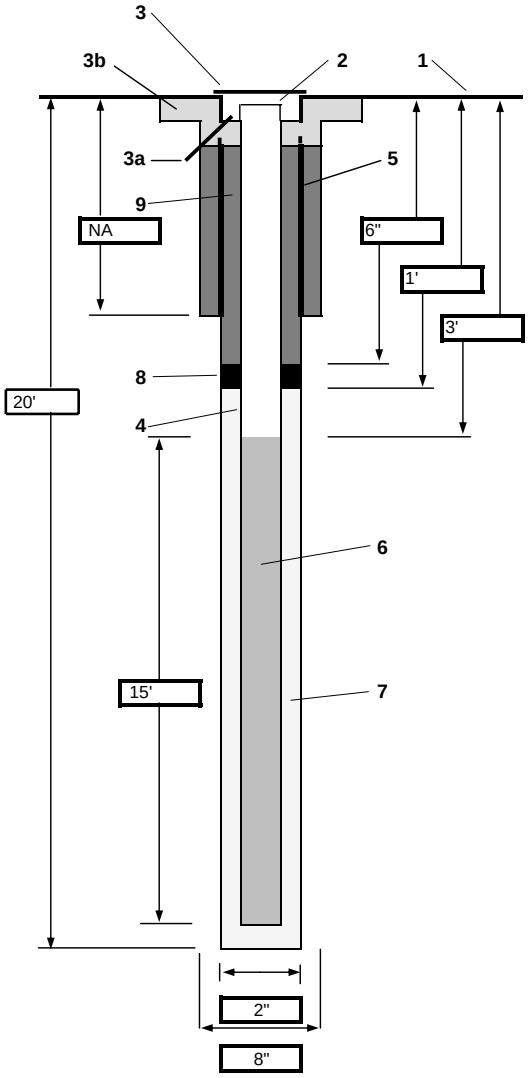
WELL COMPLETION DIAGRAM

PROJECT : Little Creek SWMU 7 Investigation LOCATION : SWMU 7

DRILLING CONTRACTOR : Parratt Wolff, Inc.

DRILLING METHOD AND EQUIPMENT USED : Hollow Stem Auger, Diedrich 50

WATER LEVELS : START : 22 May 2000; 1400 END : 1600 LOGGER : Laura Cook



1- Ground elevation at well: 7.38'

2- Top of casing elevation: 7.17'

3- Wellhead protection cover type: 8" flush mount protective casing
- a) drain tube?: DSI #1 sand filter
- b) concrete pad dimensions: 24" round

4- Dia./type of well casing: 2" PVC

5- Dia./type surface casing: NA

6- Type/slot/size of screen: 10 Slot 2"PVC

7- Type screen filter: DSI #1 sand
- a) Quantity used:

8- Type of seal: hydrated bentonite chips
- a) Quantity used:

9- Grout
- a) Grout mix used: NA
- b) Method of placement:
- c) Vol.of surface casing grout:
- d) Vol. of well casing grout:

Development method: submersible whale pump

Development time: 1 hour

Estimated purge volume: 40 gallons

Comments:

PROJECT NUMBER	WELL NUMBER	
151767.SI.FI	LW07-MW02	SHEET 1 OF 1

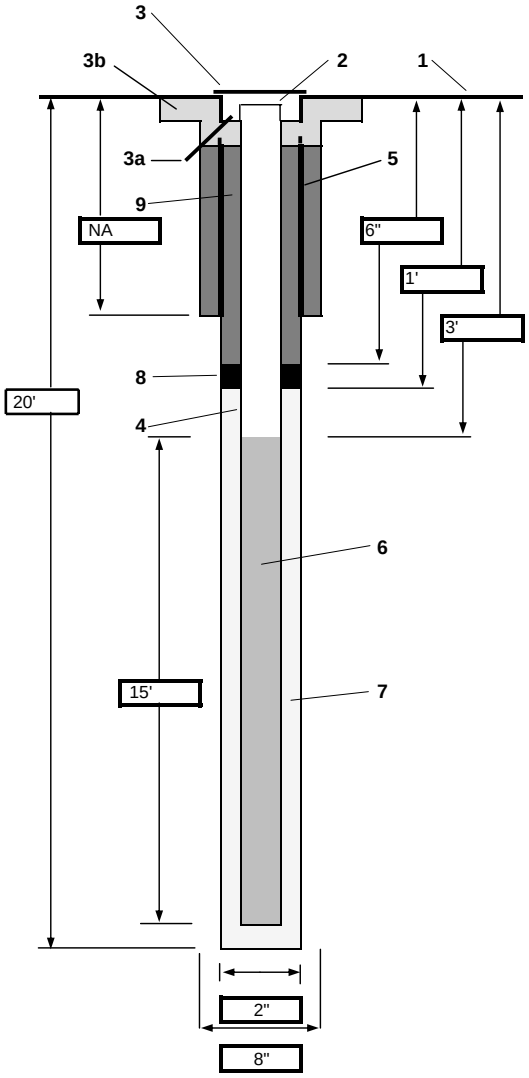
WELL COMPLETION DIAGRAM

PROJECT : Little Creek SWMU 7 Investigation LOCATION : SWMU 7

DRILLING CONTRACTOR : Parratt Wolff, Inc.

DRILLING METHOD AND EQUIPMENT USED : Hollow Stem Auger, Diedrich 50

WATER LEVELS : START : 22 May 2000; 1645 END : 1845 LOGGER : Laura Cook



1- Ground elevation at well: 8.8'

2- Top of casing elevation: 8.75'

3- Wellhead protection cover type: 8" flush mount protective casing
- a) drain tube?: DSI #1 sand filter
- b) concrete pad dimensions: 24" round

4- Dia./type of well casing: 2" PVC

5- Dia./type surface casing: NA

6- Type/slot/size of screen: 10 Slot 2"PVC

7- Type screen filter: DSI #1 sand
- a) Quantity used:

8- Type of seal: hydrated bentonite chips
- a) Quantity used:

9- Grout
- a) Grout mix used: NA
- b) Method of placement:
- c) Vol.of surface casing grout:
- d) Vol. of well casing grout:

Development method: submersible whale pump

Development time: 1 hour

Estimated purge volume: 40 gallons

Comments:

PROJECT NUMBER	WELL NUMBER	
151767.SI.FI	LW07-MW03	SHEET 1 OF 1

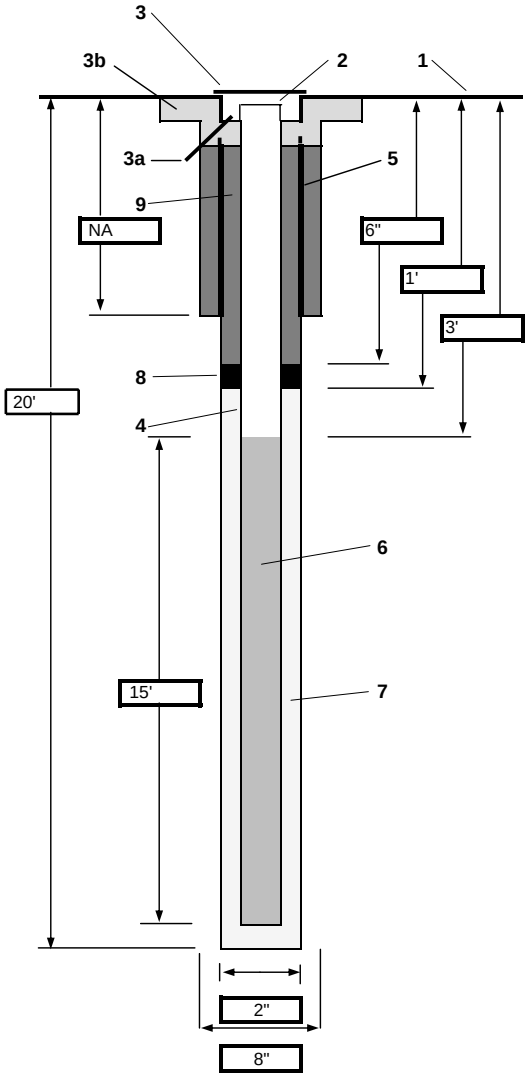
WELL COMPLETION DIAGRAM

PROJECT : Little Creek SWMU 7 Investigation LOCATION : SWMU 7

DRILLING CONTRACTOR : Parratt Wolff, Inc.

DRILLING METHOD AND EQUIPMENT USED : Hollow Stem Auger, Diedrich 50

WATER LEVELS : START : 22 May 2000; 1000 END : 1300 LOGGER : Laura Cook



1- Ground elevation at well: 8.8'

2- Top of casing elevation: 8.52'

3- Wellhead protection cover type: 8" flush mount protective casing
- a) drain tube?: DSI #1 sand filter
- b) concrete pad dimensions: 24" round

4- Dia./type of well casing: 2" PVC

5- Dia./type surface casing: NA

6- Type/slot/size of screen: 10 Slot 2"PVC

7- Type screen filter: DSI #1 sand
- a) Quantity used:

8- Type of seal: hydrated bentonite chips
- a) Quantity used:

9- Grout
- a) Grout mix used: NA
- b) Method of placement:
- c) Vol.of surface casing grout:
- d) Vol. of well casing grout:

Development method: submersible whale pump

Development time: 1 hour

Estimated purge volume: 40 gallons

Comments:

PROJECT NUMBER	WELL NUMBER		
157234.RI.DF	LW07-MW06	SHEET 1	OF 1

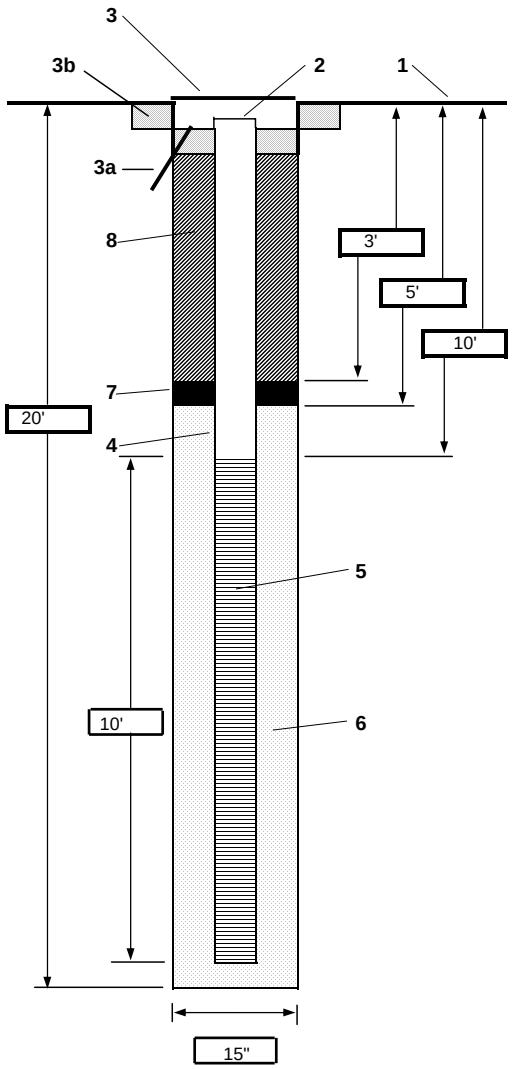
WELL COMPLETION DIAGRAM

PROJECT : CTO-159 LOCATION :SWMU 7, NAB Little Creek

DRILLING CONTRACTOR : Parrat Wolff NORTHING: 3502330.3736 EASTING: 12163665.8303

DRILLING METHOD AND EQUIPMENT USED : Hollow Stem Augur

WATER LEVELS : 12' bgs START : 8/24/02 END : 8/24/02 LOGGER : E. Mathews



1- Ground elevation at well: 8.75'

2- Top of casing elevation: 7.27'

3- Wellhead protection cover type: Flush Mount
a) drain tube?
b) concrete pad dimensions: 2'x2'

4- Dia./type of well casing: 2" Schedule 40 PVC

5- Type/slot size of screen: Machine slotted/0.010 Slot

6- Type screen filter: Silica #1
a) Quantity used: 4 3/4 bags

7- Type of seal: 3/8" Bentonite Pellets
a) Quantity used

8- Grout
a) Grout mix used: Concrete/Portland Cement
b) Method of placement: Tremie on top of sediment
c) Vol. of well casing grout

Development method: Whale Pump

Development time

Estimated purge volume

Comments

Appendix C
Field Parameters

Table C-1
Sediment Node Location Field Parameters
SWMU 7 Remedial Investigation Report
NAB Little Creek, Virginia Beach, Virginia

Sample Location	Field Parameter						
	DO (mg/L)	ORP (mV)	PH (pH)	SAL (%)	SC (ms/cm)	TEMP (C)	TURB (NTU)
LW07-B5-SD201							
Surface	11.2	5	7.71	2.35	37.8	23.64	0
Subsurface	9.61	-78	8.23	2.54	38.8	23.85	0
LW07-B7-SD201							
Surface	10.84	62	5.48	2.57	40	24.23	0
Subsurface	9.26	9	5.7	2.62	40.8	23.61	0
LW07-D5-SD201							
Surface	11.07	88	6.74	2.43	37.7	23.55	0
Subsurface	8.37	-169	9.94	1.65	26.6	23.73	0
LW07-F3-SD201							
Surface	10.06	39	5.5	2.53	39.4	24.01	0
Subsurface	9.4	19	5.63	2.61	40.5	23.62	0
LW07-F5-SD201							
Surface	10.3	86	5.27	2.66	41.3	24.16	0
Subsurface	8.9	71	5.4	2.75	42.4	23.89	0
LW07-H1-SD201							
Surface	8.35	116	5.45	2.63	40.9	23.37	0
Subsurface	8.01	-280	6.93	2.52	39.3	23.7	0
LW07-H3-SD201							
Surface	12.14	88	7.37	2.44	38.7	23.91	0.5
Subsurface	9.76	7	7.64	2.49	38.4	23.78	17
LW07-H5-SD201							
Surface	8.02	289	5.14	2.57	40	23.9	0
Subsurface	7.83	274	5.39	2.59	40.3	23.43	0.9
LW07-J4-SD201							
Surface	13.09	102	7.31	2.44	38.2	23.74	23.74
Subsurface	9.97	-114	9.39	1.87	30	23.93	0
LW07-K1-SD201							
Surface	7.66	73	5.68	2.72	42	24.23	0
Subsurface	6.95	-44	6.05	2.78	42.9	24.15	0
LW07-K3-SD201							
Surface	9.01	-211	6.46	7.6	40.5	23.11	0
Subsurface	7.89	-172	6.22	2.67	41.5	23.93	0
LW07-K4-SD201							
Surface	12.45	83	7.46	2.44	38.1	23.68	0
Subsurface	10.02	23.8	7.61	2.48	38.7	23.8	6
LW07-K5-SD201							
Surface	12.06	89	7.33	2.45	38.3	23.5	0.5
Subsurface	9.87	-70	9.53	2.49	38.7	23.71	24
LW07-K6-SD201							
Surface	7.48	157	5.63	2.54	39.5	24.17	0
Subsurface	6.3	-8	6.08	2.8	43.2	24.04	0
LW07-L2-SD201							
Surface	9.74	101	5.96	1.4	20.6	22.88	0
Subsurface	7.61	-34	6.11	1.83	29	23.83	0
LW07-L5-SD201							
Surface	10.98	103	5.41	2.66	41.2	24.21	0
Subsurface	7.78	-232	7.19	7.93	30.6	24.07	0
LW07-L6-SD201							
Surface	9.18	2.04	5.54	1.69	27.4	22.35	0
Subsurface	7.18	-133	8.77	1.89	27.9	23.74	0
LW07-M1-SD201							
Surface	7.56	114	5.43	2.65	41.9	23.51	0
Subsurface	7.34	-21	5.72	2.27	35	23.72	0
LW07-M3-SD201							
Surface	7.6	70	5.69	2.53	39.3	24.27	0
Subsurface	6.96	-58	6.07	2.65	41.1	24.11	0

Water quality samples were collected from 9/26/2002 to 9/30/2002
DO - Dissolved Oxygen
ORP - Oxidation Reduction Potential
SAL - Salinity
SC - Specific Conductivity
TEMP - Temperature
TURB - Turbidity

Table C-2
Groundwater Field Parameters
SWMU 7 Remedial Investigation Report
NAB Little Creek, Virginia Beach, Virginia

Station ID	LW07-MW01	LW07-MW02	LW07-MW03	LW07-MW04	LW07-MW05	LW07-MW06
Sample ID	LW07-MW01-02C	LW07-MW02-02C	LW07-MW03-02C	LW07-MW04-02C	LW07-MW05-02C	LW07-MW06-02C
Sample Date	9/4/2002	9/4/2002	9/4/2002	9/3/2002	9/4/2002	9/3/2002
Field Parameters						
DO (mg/L)	14.99	19.9	10.9	2.99	13.67	17.17
DW (FT)	6.9	8.56	8.48	7.1	7.31	10.65
EH/ORP (mV)	-30	121	-122	-16	-48	8
FLOW (GPM)	0.087	0.065	0.065	0.054	0.043	0.043
PH (pH)	5.94	5.4	6.24	5.51	5.82	6.16
SAL (%)	0.44	0.14	0.04	0.01	0.02	0.23
SC (ms/cm)	7.99	2.77	0.991	0.226	5.82	4.42
TEMP (C)	24.7	26.2	24.1	25.9	28.4	24.9
TURB (NTU)	27	68.2	42.6	3.9	39	60.6
VOL (GAL)	NA	NA	NA	2.5	NA	4

Appendix D
Benthic Invertebrate Report

Benthic Marcoinvertebrate Taxonomy Report
CTO- 0159
NAB Little Creek, Virginia Beach, Virginia

Anthony J. Rodi, Jr.
Department of Biological Sciences
Old Dominion University
Norfolk, Virginia

Prepared for CH2MHILL
Herndon, Virginia

January 31, 2003

Laboratory Procedures

The contents of each sample jar were individually emptied into a 500 micron sieve; the formalin solution that passed through the sieve was collected for later reuse or disposal. The remaining sediment sample was rinsed to remove residual formalin and fine sediments. All macrobenthos was removed from the sediment and placed into pre-labeled vials with 70% ethyl alcohol. This process is referred to as sorting. The dates of initiation and completion of sorting for each sample was recorded in a sort processing log.

The macrobenthos in the sorted samples were identified to the lowest practical taxon , typically species level, and enumeration. This information was recorded separately for each sample on individual benthic data sheets. The dates of initiation and completion of identification for each sample was recorded in a identification processing log. The taxonomic sources used for identification of the samples are shown in Table 1.

QA/QC

To insure confidence in the accuracy of the results of the macrobenthic taxonomic analysis ten percent of the samples were randomly selected for reanalysis. Four samples were resorted , identified and enumerated. There were no animals found in the resorted samples. Both identification and enumeration of the reanalyzed samples agreed the original results. Copies of the Sorting and identification log are found in Appendix A.

Taxonomic Notes

The validity and acceptance of taxonomic names can vary over time or between researchers. I have used nomenclature that I considered to be the most commonly accepted. However, in reviewing past and even current literature it is useful to be aware of synonymies. Table 2. lists several synonymies that are common in environmental and ecological literature. Taxon identified as *Tubificoides spp*. Group I represent several possible species of *Tubificoides* that posses only bifid chaetae and no papillae.

Results

The result of the macrobenthic taxonomic analysis is present in Table 3. Abundance information in presented on a per sample basis. Two stations, LREF-BI07-02C and LW03-SD205-00-02C, contained no organisms. Since part of the goal of this study was to assess bidiversity at the sample

locations, identifiable headless fragments were included with an abundance value of zero (0).

In marine and estuarine benthic ecology, it is not common to assign pollution sensitivity scores to individual taxa as it is in freshwater systems Lenat (1993). Relatively stress tolerant, short lived taxa with an ability to rapidly colonize stressed habitats are considered opportunistic or pollution-indicative (Pearson and Rosenberg, 1978; Dauer et al., 1992) Conversely, large deep dwelling and long lived tax that tend to dominate unstressed habitats are considered equilibrium or pollution-sensitive. The pollution sensitivity ratings in Table 3. are from Ranasinghe et al. (1994) and Weisberg et al. (1997). Ranasinghe et al. (1994) classifies benthic macrofauna as opportunistic(OP) or equilibrium (EQ) based on the knowledge and best professional judgement of the authors. Weisberg et al. (1997) classifies benthic macrofauna as pollution- indicative (PI) or pollution-sensitive (PS) based on correlations of taxa with sediment contaminants and dissolved oxygen. These are the life history classifications used in the Chesapeake Bay B-IBI. Both approaches leave most taxa as unclassified.

Literature cited

Dauer, D. M., J. A. Ranasinghe, and A. J. Rodi, Jr. 1992**.** Effects of low dissolved oxygen levels on the macrobenthos of the lower Chesapeake Bay. Estuaries 15:384-391.

Pearson , T. H. and R. Rosenberg. 1978. Macrobenthic succession in relation to organic enrichment and pollution of the marine environment. Oceanography and Marine Biology Annual Review 16:229-311.

Ranasinghe, J. A., S. B. Weisberg, D. M. Dauer, L. C. Schaffner, R. J. Diaz, and J. B. Frithsen. 1994. Chesapeake Bay Benthic Community Restoration Goals. Prepared for the U.S. EPA Chesapeake Bay Program Office, the Governor's Council on Chesapeake Bay Research Fund, and the Maryland Department of Natural Resources by Versar, Inc., Columbia, MD.

Weisberg, S.B., J.A. Ranasinghe, D.M. Dauer, L.C. Schaffner, R.J. Diaz, and J.B. Frithsen. 1997. An estuarine benthic index of biotic intergrity (B-IBI) for the Chesapeake Bay. Estuaries 20:149-158.

Table 1. Literature used for taxonomic identifications.

Abbott, R.T. 1974. American Seashells. 663 pp. Van Nostrand Reinhold Company, New York.

Baker, H.R. 1981. A redescription of Tubificoides heterochaetous (Michaelsen) (Oligochaeta:Tubificidae). Proceedings of the Biological Society of Washington 94:564-568.

BHAUD, MICHEL R. 1998. Species of *Spiochaetopterus* (Polychaeta, Chaetopteridae) in the Atlantic-Mediterranean biogeographic area. – *Sarsia* 83:243-263.

Blake, J.A. and N.J. Maciolek. 1987. A redescription of Polydora cornuta Bosc (Polychaeta:Spionidae) and designation of a neotype. Biological Society of Washington Bulletin 7:11-15.

Bousfield, E.L. 1973. Shallow-water Gammaridean Amphipoda of New England. Cornell University Press, Ithica

Brinkhurst, R.O. 1986. Taxonomy of the genus Tubificoides Lastockin (Oligochaeta, Tubificidae): species with bifid setae. Canadian Journal of Zoology 64:1270-1279.

Day, J.H. 1973. New Polychaeta from Beauford with a key to all species recorded from North Carolina. NOAA Technical Report NMFS CIRC-375.

Foster, N.M. 1971. Spionidae (Polychaeta) of the Gulf of Mexico and the Caribbean Sea. Stud. Fauna Curaçao, 36:1-183.

Gardiner, S.L. 1975. Errant Polychaete Annelids from North Carolina. Journal of the Elisha Mitchell Scientific Society 91:77-220.

Gosner, K.L., 1973. Guide to the identification of marine and estuarine invertebrates. 693 pp. Wiley-Interscience, New York.

Maciolek, N.J. 1985. A revision of the genus Prionospio Malmgren, with a special emphasis on species from the Atlantic Ocean, and new reords of species belonging to the genera Foster and Paraprionospio Caullery (Polychaeta,Anenelida,Spionidae). Zoological Journal of the Linnean Society 84:325-383.

Pettibone, M.H. 1963. Marine Polychaete Worms of the New England Region. 365 pp. Smithsonian Institution, Washington, D.C.

Uebelacker, J.M. and P.G. Johnson (eds.) 1984. Taxonomic Guide to the Polychaetes of the Northern Gulf of Mexico. U.S. Department of the Interior, Minerals Management Service .

Table 2. Taxonomic synonymies commonly encountered in ecological and environmental literature.

Eteone heteropoda = *Hypereteone heteropoda*
Nereis succinea = *Neanthes succinea*
Notomastus sp. = *Notomastus latericeus*
Paleanotous heteroseta = *Bhawania heteroseta*
Phoronis psammophila = *Phoronis architecta*
Polydora cornuta = *Polydora ligni*
Spiochaetopterus oculatus = *Spiochaetopterus costarum*
Tubificoides spp. Group I = *Tubificoides diazi, T. brownae, T. maureri*

Table 3. Taxonomic results with pollution sensitivity classifications; OP= opportunistic, EQ= equilibrium, PI= pollution indicative, PS= pollution sensitive. See text for details.

Station	Group	Species	Abundance	Pollution sensitivity
LREF-BI01-02C	Polychaeta	*Heteromastus filiformis* (Claparede)	1	OP
LREF-BI01-02C	Polychaeta	*Lumbrineris tenuis* Verrill	1	
LREF-BI01-02C	Polychaeta	*Phyllodoce arenae* Webster	2	
LREF-BI01-02C	Polychaeta	*Sabella microphthalma* Verrill	13	
LREF-BI01-02C	Polychaeta	*Streblospio benedicti* Webster	1	PI,OP
LREF-BI01-02C	Oligochaeta	*Tubificoides wasselli* Brinkhurst	2	OP
LREF-BI01-02C	Gastropoda	*Turbonilla interrupta* (Totten)	1	
		TOTAL	21	
LREF-BI02-02C	Polychaeta	*Aglaophamus verrilli* (McIntosh)	1	
LREF-BI02-02C	Polychaeta	*Clymenella torquata* (Leidy)	1	PS,EQ
LREF-BI02-02C	Polychaeta	*Leitoscoloplos spp*.	1	PI,OP
LREF-BI02-02C	Polychaeta	*Mediomastus ambiseta* (Hartman)	5	PS,OP
LREF-BI02-02C	Polychaeta	*Nereis succinea* (Frey and Leuckart)	1	OP
LREF-BI02-02C	Polychaeta	*Notomastus sp*.	1	
LREF-BI02-02C	Polychaeta	*Paleanotus heteroseta* Hartman	1	PS
LREF-BI02-02C	Polychaeta	*Paraprionospio pinnata* (Ehlers)	2	PI,OP
LREF-BI02-02C	Polychaeta	*Streblospio benedicti* Webster	2	PI,OP
LREF-BI02-02C	Bivalvia	*Mercenaria mercenaria* (Linnaeus)	1	PS,OP
LREF-BI02-02C	Bivalvia	*Tellina agilis* Stimpson	1	PS
		TOTAL	17	
LREF-BI03-02C	Polychaeta	*Glycinde solitaria* (Webster)	1	PS,OP
LREF-BI03-02C	Bivalvia	*Gemma gemma* (Totten)	1	OP
		TOTAL	2	
LREF-BI04-02C	Polychaeta	*Pectinaria gouldii* (Verrill)	1	
LREF-BI04-02C	Gastropoda	*Nassarius vibex* Say	1	
LREF-BI04-02C	Bivalvia	*Gemma gemma* (Totten)	1	OP
LREF-BI04-02C	Bivalvia	*Mercenaria mercenaria* (Linnaeus)	2	PS,OP
LREF-BI04-02C	Isopoda	*Edotea triloba* (Say)	1	PI
		TOTAL	6	
LREF-BI05-02C	Polychaeta	*Diopatra cuprea* (Bosc)	1	
LREF-BI05-02C	Polychaeta	*Eteone heteropoda* Hartman	1	PI,OP
LREF-BI05-02C	Gastropoda	*Ilyanassa obsoleta* (Say)	1	
		TOTAL	3	
LREF-BI07-02C		No Organisms Found	0	

LREF-BI08-02C	Polychaeta	*Clymenella torquata* (Leidy)	1	PS,EQ
LREF-BI08-02C	Polychaeta	*Drilonereis longa* Webster	1	
LREF-BI08-02C	Polychaeta	*Leitoscoloplos spp*.	1	PI,OP
		TOTAL	3	
LREF-BI09-00-02C	Bivalvia	*Gemma gemma* (Totten)	1	OP
		TOTAL	1	
LREF-BI10-02C	Gastropoda	*Ilyanassa obsoleta* (Say)	6	
		TOTAL	6	
LREF-SD06-00-02C	Polychaeta	*Streblospio benedicti* Webster	1	PI,OP
LREF-SD06-00-02C	Gastropoda	*Acteocina canaliculata* (Say)	1	
		TOTAL	2	
LW03-C-BI203-02C	Polychaeta	*Capitella capitata* (Fabricius)	1	PI,OP
		TOTAL	1	
LW03-D-BI201-02C	Gastropoda	*Nassarius vibex* Say	3	
LW03-D-BI201-02C	Bivalvia	*Mercenaria mercenaria* (Linnaeus)	1	PS,EQ
		TOTAL	4	
LW03-SD205-00-02C		No Organisms Found	0	
LW07-A4-SD201-00-02C	Polychaeta	*Mediomastus ambiseta* (Hartman)	3	PS,OP
LW07-A4-SD201-00-02C	Polychaeta	*Paraprionospio pinnata* (Ehlers)	9	PI,OP
LW07-A4-SD201-00-02C	Polychaeta	*Spiochaetopterus oculatus* Webster	1	PS
LW07-A4-SD201-00-02C	Polychaeta	*Streblospio benedicti* Webster	18	PI,OP
LW07-A4-SD201-00-02C	Cumacea	*Leucon americanus* Zimmer	3	
LW07-A4-SD201-00-02C	Phoronida	*Phoronis psammophila* Cori	1	
		TOTAL	35	
LW07-B1-BI201-00-02C	Polychaeta	*Eteone heteropoda* Hartman	1	PI,OP
LW07-B1-BI201-00-02C	Polychaeta	*Mediomastus ambiseta* (Hartman)	3	PS,OP
LW07-B1-BI201-00-02C	Polychaeta	*Paraprionospio pinnata* (Ehlers)	8	PI,OP
LW07-B1-BI201-00-02C	Polychaeta	*Streblospio benedicti* Webster	39	PI,OP
LW07-B1-BI201-00-02C	Oligochaeta	*Tubificoides spp*. Group I	1	OP
LW07-B1-BI201-00-02C	Phoronida	*Phoronis psammophila* Cori	3	
		TOTAL	55	
LW07-B5-BI201-00-02C	Polychaeta	*Mediomastus ambiseta* (Hartman)	3	PS,OP
LW07-B5-BI201-00-02C	Polychaeta	*Nephtys sp*.	0	PS
LW07-B5-BI201-00-02C	Polychaeta	*Notomastus sp*.	3	

LW07-B5-BI201-00-02C	Polychaeta	*Paleanotus heteroseta* Hartman	1	PS
LW07-B5-BI201-00-02C	Polychaeta	*Paraprionospio pinnata* (Ehlers)	13	PI,OP
LW07-B5-BI201-00-02C	Polychaeta	*Spiochaetopterus oculatus* Webster	1	PS
LW07-B5-BI201-00-02C	Polychaeta	*Streblospio benedicti* Webster	31	PI,OP
LW07-B5-BI201-00-02C	Oligochaeta	*Tubificoides spp*. Group I	5	OP
LW07-B5-BI201-00-02C	Bivalvia	*Tagelus divisus* (Spengler)	1	PS,EQ
LW07-B5-BI201-00-02C	Phoronida	*Phoronis psammophila* Cori	3	
		TOTAL	61	
LW07-B7-SD201-00-02C	Polychaeta	*Apoprionospio pygmaea* (Hartman)	1	
LW07-B7-SD201-00-02C	Polychaeta	*Heteromastus filiformis* (Claparede)	2	OP
LW07-B7-SD201-00-02C	Polychaeta	*Mediomastus ambiseta* (Hartman)	15	PS,OP
LW07-B7-SD201-00-02C	Polychaeta	*Phyllodoce arenae* Webster	0	
LW07-B7-SD201-00-02C	Polychaeta	*Prionospio heterobranchia* Moore	2	
LW07-B7-SD201-00-02C	Polychaeta	*Streblospio benedicti* Webster	25	PI,OP
LW07-B7-SD201-00-02C	Oligochaeta	*Tubificoides spp. Group I*	4	OP
LW07-B7-SD201-00-02C	Oligochaeta	*Tubificoides wasselli* Brinkhurst	18	OP
LW07-B7-SD201-00-02C	Bivalvia	*Mercenaria mercenaria* (Linnaeus)	13	PS,EQ
		TOTAL	80	
LW07-D5-BI201-00-02C	Polychaeta	*Mediomastus ambiseta* (Hartman)	1	PS,OP
LW07-D5-BI201-00-02C	Polychaeta	*Paraprionospio pinnata* (Ehlers)	2	PI,OP
LW07-D5-BI201-00-02C	Polychaeta	*Sigambra tentaculata* (Treadwell)	1	
LW07-D5-BI201-00-02C	Polychaeta	*Streblospio benedicti* Webster	12	PI,OP
LW07-D5-BI201-00-02C	Gastropoda	*Acteocina canaliculata* (Say)	3	
		TOTAL	19	
LW07-F3-BI201-00-02C	Polychaeta	*Clymenella torquata* (Leidy)	1	PS,EQ
LW07-F3-BI201-00-02C	Polychaeta	*Heteromastus filiformis* (Claparede)	2	OP
LW07-F3-BI201-00-02C	Polychaeta	*Mediomastus ambiseta* (Hartman)	7	PS,OP
LW07-F3-BI201-00-02C	Polychaeta	*Notomastus sp*.	1	
LW07-F3-BI201-00-02C	Polychaeta	*Paraprionospio pinnata* (Ehlers)	2	PI,OP
LW07-F3-BI201-00-02C	Polychaeta	*Streblospio benedicti* Webster	66	PI,OP
LW07-F3-BI201-00-02C	Oligochaeta	*Tubificoides spp*. Group I	1	OP
LW07-F3-BI201-00-02C	Gastropoda	*Acteocina canaliculata* (Say)	1	
LW07-F3-BI201-00-02C	Bivalvia	*Gemma gemma* (Totten)	2	OP
LW07-F3-BI201-00-02C	Bivalvia	*Mercenaria mercenaria* (Linnaeus)	3	PS,EQ
LW07-F3-BI201-00-02C	Phoronida	*Phoronis psammophila* Cori	4	
		TOTAL	90	
LW07-F5-BI201-00-02C	Nemertea	*Nemertea spp*.	1	
LW07-F5-BI201-00-02C	Polychaeta	*Apoprionospio pygmaea* (Hartman)	1	
LW07-F5-BI201-00-02C	Polychaeta	*Eteone heteropoda* Hartman	1	PI,OP
LW07-F5-BI201-00-02C	Polychaeta	*Glycinde solitaria* (Webster)	1	PS,OP

LW07-F5-BI201-00-02C	Polychaeta	*Gyptis brevipalpa* (Hartmann-Schroder)	1	
LW07-F5-BI201-00-02C	Polychaeta	*Mediomastus ambiseta* (Hartman)	39	PS,OP
LW07-F5-BI201-00-02C	Polychaeta	*Notomastus sp.*	1	
LW07-F5-BI201-00-02C	Polychaeta	*Paraprionospio pinnata* (Ehlers)	1	PI,OP
LW07-F5-BI201-00-02C	Polychaeta	*Sigambra tentaculata* (Treadwell)	0	
LW07-F5-BI201-00-02C	Polychaeta	*Streblospio benedicti* Webster	41	PI,OP
LW07-F5-BI201-00-02C	Oligochaeta	*Tubificoides spp.* Group I	8	OP
LW07-F5-BI201-00-02C	Gastropoda	*Acteocina canaliculata* (Say)	2	
LW07-F5-BI201-00-02C	Bivalvia	*Gemma gemma* (Totten)	1	
LW07-F5-BI201-00-02C	Bivalvia	*Mercenaria mercenaria* (Linnaeus)	2	PS,EQ
LW07-F5-BI201-00-02C	Phoronida	*Phoronis psammophila* Cori	14	
		Total	114	
LW07-F5-SD201-00-02C	Polychaeta	*Mediomastus ambiseta* (Hartman)	1	PS,OP
LW07-F5-SD201-00-02C	Polychaeta	*Paraprionospio pinnata* (Ehlers)	2	PI,OP
LW07-F5-SD201-00-02C	Polychaeta	*Streblospio benedicti* Webster	54	PI,OP
LW07-F5-SD201-00-02C	Oligochaeta	*Tubificoides spp.* Group I	1	OP
LW07-F5-SD201-00-02C	Bivalvia	*Gemma gemma* (Totten)	1	OP
LW07-F5-SD201-00-02C	Cumacea	*Leucon americanus* Zimmer	6	
		TOTAL	65	
LW07-H1-SD201-00-02C	Polychaeta	*Mediomastus ambiseta* (Hartman)	2	PS,OP
LW07-H1-SD201-00-02C	Polychaeta	*Paraprionospio pinnata* (Ehlers)	7	PI,OP
LW07-H1-SD201-00-02C	Polychaeta	*Streblospio benedicti* Webster	29	PI,OP
LW07-H1-SD201-00-02C	Oligochaeta	*Tubificoides spp.* Group I	1	OP
		TOTAL	39	
LW07-H3-SD201-00-02C	Polychaeta	*Mediomastus ambiseta* (Hartman)	3	PS,OP
LW07-H3-SD201-00-02C	Polychaeta	*Parahesione luteola* (Webster)	1	
LW07-H3-SD201-00-02C	Polychaeta	*Paraprionospio pinnata* (Ehlers)	2	PI,OP
LW07-H3-SD201-00-02C	Polychaeta	*Streblospio benedicti* Webster	11	PI,OP
LW07-H3-SD201-00-02C	Oligochaeta	*Tubificoides spp.* Group I	1	OP
LW07-H3-SD201-00-02C	Cumacea	*Leucon americanus* Zimmer	1	
		TOTAL	19	
LW07-H5-BI201-00-02C	Polychaeta	*Polydora cornuta* Bosc	1	OP
LW07-H5-BI201-00-02C	Polychaeta	*Streblospio benedicti* Webster	25	PI,OP
LW07-H5-BI201-00-02C	Oligochaeta	*Tubificoides spp.* Group I	2	OP
LW07-H5-BI201-00-02C	Bivalvia	*Mercenaria mercenaria* (Linnaeus)	1	PS,OP
		TOTAL	29	
LW07-J4-SD201-00-02C	Polychaeta	*Paraprionospio pinnata* (Ehlers)	12	PI,OP
LW07-J4-SD201-00-02C	Polychaeta	*Streblospio benedicti* Webster	19	PI,OP
LW07-J4-SD201-00-02C	Phoronida	*Phoronis psammophila* Cori	1	

		TOTAL	32	
LW07-K1-SD201-00-02C	Polychaeta	*Paraprionospio pinnata* (Ehlers)	4	PI,OP
LW07-K1-SD201-00-02C	Polychaeta	*Streblospio benedicti* Webster	18	PI,OP
LW07-K1-SD201-00-02C	Oligochaeta	*Tubificoides spp*. Group I	1	OP
		TOTAL	23	
LW07-K5-SD201-00-02C	Polychaeta	*Leitoscoloplos spp*.	1	PI,OP
LW07-K5-SD201-00-02C	Polychaeta	*Nephtys picta* Ehlers	3	PS
LW07-K5-SD201-00-02C	Polychaeta	*Paraprionospio pinnata* (Ehlers)	7	PI,OP
LW07-K5-SD201-00-02C	Oligochaeta	*Tubificoides spp*. Group I	1	OP
LW07-K5-SD201-00-02C	Cumacea	*Leucon americanus* Zimmer	1	
		TOTAL	13	
LW07-K6-SD201-00-02C	Polychaeta	*Capitella capitata* (Fabricius)	1	PI,OP
LW07-K6-SD201-00-02C	Polychaeta	*Streblospio benedicti* Webster	3	PI,OP
LW07-K6-SD201-00-02C	Gastropoda	*Ilyanassa obsoleta* (Say)	1	
LW07-K6-SD201-00-02C	Bivalvia	*Gemma gemma* (Totten)	3	OP
		TOTAL	8	
LW07-L2-BI201-02C	Polychaeta	*Mediomastus ambiseta* (Hartman)	1	PS,OP
LW07-L2-BI201-02C	Polychaeta	*Paraprionospio pinnata* (Ehlers)	2	PI,OP
LW07-L2-BI201-02C	Polychaeta	*Streblospio benedicti* Webster	19	PI,OP
LW07-L2-BI201-02C	Oligochaeta	*Tubificoides spp*. Group I	3	OP
LW07-L2-BI201-02C	Phoronida	*Phoronis psammophila* Cori	2	
		TOTAL	27	
LW07-L5-SD201-00-02C	Polychaeta	*Leitoscoloplos spp*.	1	PI,OP
LW07-L5-SD201-00-02C	Polychaeta	*Mediomastus ambiseta* (Hartman)	1	PS,OP
LW07-L5-SD201-00-02C	Polychaeta	*Paraprionospio pinnata* (Ehlers)	7	PI,OP
LW07-L5-SD201-00-02C	Polychaeta	*Spiochaetopterus oculatus* Webster	1	PS
LW07-L5-SD201-00-02C	Polychaeta	*Streblospio benedicti* Webster	24	PI,OP
LW07-L5-SD201-00-02C	Gastropoda	*Acteocina canaliculata* (Say)	1	
LW07-L5-SD201-00-02C	Phoronida	*Phoronis psammophila* Cori	1	
		TOTAL	36	
LW07-L6-BI201-02C	Polychaeta	*Paraprionospio pinnata* (Ehlers)	3	PI,OP
LW07-L6-BI201-02C	Polychaeta	*Streblospio benedicti* Webster	9	PI,OP
LW07-L6-BI201-02C	Oligochaeta	*Tubificoides spp*. Group I	0	OP
LW07-L6-BI201-02C	Gastropoda	*Acteocina canaliculata* (Say)	2	
LW07-L6-BI201-02C	Phoronida	*Phoronis psammophila* Cori	1	
		TOTAL	15	
LW07-MI-SD201-00-02C	Polychaeta	*Gyptis brevipalpa* (Hartmann-Schroder)	2	

LW07-MI-SD201-00-02C	Polychaeta	*Mediomastus ambiseta* (Hartman)	1	PS,OP
LW07-MI-SD201-00-02C	Polychaeta	*Paraprionospio pinnata* (Ehlers)	4	PI,OP
LW07-MI-SD201-00-02C	Polychaeta	*Streblospio benedicti* Webster	36	PI,OP
LW07-MI-SD201-00-02C	Oligochaeta	*Tubificoides spp*. Group I	1	OP
LW07-MI-SD201-00-02C	Cumacea	*Leucon americanus* Zimmer	1	
LW07-MI-SD201-00-02C	Mysidacea	*Mysidopsis bigelowi* Tattersall	1	
LW07-MI-SD201-00-02C	Phoronida	*Phoronis psammophila* Cori	1	
		TOTAL	47	

QA/QC LOG FOR SAMPLE PROCESSING

PROJECT: CH2MHILL LITTLE CREEK YEAR: 2002 CRUISE: 1

SAMPLE	SORTER (NAME/DATE)	QC TYPE (e.g. SORT)	QC BY (NAME/DATE)	COMMENTS
LW03-C-BI203-02C	A. Rodi 12/13-12/13	Sort	H. Mahon 12/13	Nothing found in QC.
LW07-D5-BI201-00-02C	A. Rodi 12/30 - 12/30	sort	A. Mahon 12/31	Nothing found.
LW07-K1-SD201-00-02C	A. Rodi 12/20 - 12/20	sort	H. Mahon 12/30	Nothing found
LW07-L6-BI201-02C	A. Rodi 12/11 - 12/11	sort	H. Mahon 12/12	Nothing found in QC

Appendix A. Facsimile of sort QA/QC log.

QA/QC LOG FOR SAMPLE PROCESSING

PROJECT: CH2MHILL LITTLE CREEK YEAR: 2002 CRUISE: 1

SAMPLE	Identifier (NAME/DATE)	QC TYPE (e.g. SORT)	QC BY (NAME/DATE)	COMMENTS
LW03-C-BI203-02C	AJR 1/16	ID	HKM 1/22	No discrepancy
LW07-D5-BI201-00-02C	AJR 1/20	ID	HKM 1/22	No discrepancy
LW07-K1-SD201-00-02C	AJR 1/21	ID	HKM 1/22	No discrepancy
LW07-L6-BI201-02C	AJR 1/22	ID	HKM 1/24	No discrepancy

Appendix B. Facsimile of identification QA/QC log.

Station	Group	Species	Abundance	Pollution sensitivity
LREF-BI01-02C	Polychaeta	Heteromastus filiformis (Claparede)	1	OP
LREF-BI01-02C	Polychaeta	Lumbrineris tenuis Verrill	1	
LREF-BI01-02C	Polychaeta	Phyllodoce arenae Webster	2	
LREF-BI01-02C	Polychaeta	Sabella microphthalma Verrill	13	
LREF-BI01-02C	Polychaeta	Streblospio benedicti Webster	1	WI,OP
LREF-BI01-02C	Oligochaeta	Tubificoides wasselli Brinkhurst	2	OP
LREF-BI01-02C	Gastropoda	Turbonilla interrupta (Totten)	1	
		TOTAL	21	
LREF-BI02-02C	Polychaeta	Aglaophamus verrilli (McIntosh)	1	
LREF-BI02-02C	Polychaeta	Clymenella torquata (Leidy)	1	WS,EQ
LREF-BI02-02C	Polychaeta	Leitoscoloplos spp.	1	WI,OP
LREF-BI02-02C	Polychaeta	Mediomastus ambiseta (Hartman)	5	WS,OP
LREF-BI02-02C	Polychaeta	Nereis succinea (Frey and Leuckart)	1	OP
LREF-BI02-02C	Polychaeta	Notomastus sp.	1	
LREF-BI02-02C	Polychaeta	Paleanotus heteroseta Hartman	1	WS
LREF-BI02-02C	Polychaeta	Paraprionospio pinnata (Ehlers)	2	WI,OP
LREF-BI02-02C	Polychaeta	Streblospio benedicti Webster	2	WI,OP
LREF-BI02-02C	Bivalvia	Mercenaria mercenaria (Linnaeus)	1	WS,OP
LREF-BI02-02C	Bivalvia	Tellina agilis Stimpson	1	WS
		TOTAL	17	
LREF-BI03-02C	Polychaeta	Glycinde solitaria (Webster)	1	WS,OP
LREF-BI03-02C	Bivalvia	Gemma gemma (Totten)	1	OP
		TOTAL	2	
LREF-BI04-02C	Polychaeta	Pectinaria gouldii (Verrill)	1	
LREF-BI04-02C	Gastropoda	Nassarius vibex Say	1	
LREF-BI04-02C	Bivalvia	Gemma gemma (Totten)	1	OP
LREF-BI04-02C	Bivalvia	Mercenaria mercenaria (Linnaeus)	2	WS,OP
LREF-BI04-02C	Isopoda	Edotea triloba (Say)	1	WI
		TOTAL	6	
LREF-BI05-02C	Polychaeta	Diopatra cuprea (Bosc)	1	
LREF-BI05-02C	Polychaeta	Eteone heteropoda Hartman	1	WI,OP
LREF-BI05-02C	Gastropoda	Ilyanassa obsoleta (Say)	1	
		TOTAL	3	
LREF-BI07-02C		No Organisms Found	0	
LREF-BI08-02C	Polychaeta	Clymenella torquata (Leidy)	1	WS,EQ
LREF-BI08-02C	Polychaeta	Drilonereis longa Webster	1	
LREF-BI08-02C	Polychaeta	Leitoscoloplos spp.	1	WI,OP
		TOTAL	3	
LREF-BI09-00-02C	Bivalvia	Gemma gemma (Totten)	1	OP
		TOTAL	1	
LREF-BI10-02C	Gastropoda	Ilyanassa obsoleta (Say)	6	
		TOTAL	6	
LREF-SD06-00-02C	Polychaeta	Streblospio benedicti Webster	1	WI,OP
LREF-SD06-00-02C	Gastropoda	Acteocina canaliculata (Say)	1	
		TOTAL	2	
LW03-C-BI203-02C	Polychaeta	Capitella capitata (Fabricius)	1	WI,OP
		TOTAL	1	
LW03-D-BI201-02C	Gastropoda	Nassarius vibex Say	3	
LW03-D-BI201-02C	Bivalvia	Mercenaria mercenaria (Linnaeus)	1	WS,EQ
		TOTAL	4	
LW03-SD205-00-02C		No Organisms Found	0	
LW07-A4-SD201-00-02C	Polychaeta	Mediomastus ambiseta (Hartman)	3	WS,OP
LW07-A4-SD201-00-02C	Polychaeta	Paraprionospio pinnata (Ehlers)	9	WI,OP
LW07-A4-SD201-00-02C	Polychaeta	Spiochaetopterus oculatus Webster	1	WS
LW07-A4-SD201-00-02C	Polychaeta	Streblospio benedicti Webster	18	WI,OP
LW07-A4-SD201-00-02C	Cumacea	Leucon americanus Zimmer	3	
LW07-A4-SD201-00-02C	Phoronida	Phoronis psammophila Cori	1	
		TOTAL	35	
LW07-B1-BI201-00-02C	Polychaeta	Eteone heteropoda Hartman	1	WI,OP
LW07-B1-BI201-00-02C	Polychaeta	Mediomastus ambiseta (Hartman)	3	WS,OP
LW07-B1-BI201-00-02C	Polychaeta	Paraprionospio pinnata (Ehlers)	8	WI,OP

LW07-B1-BI201-00-02C	Polychaeta	Streblospio benedicti Webster	39	WI,OP
LW07-B1-BI201-00-02C	Oligochaeta	Tubificoides spp. Group I	1	OP
LW07-B1-BI201-00-02C	Phoronida	Phoronis psammophila Cori	3	
		TOTAL	55	
LW07-B5-BI201-00-02C	Polychaeta	Mediomastus ambiseta (Hartman)	3	WS,OP
LW07-B5-BI201-00-02C	Polychaeta	Nephtys sp.	0	WS
LW07-B5-BI201-00-02C	Polychaeta	Notomastus sp.	3	
LW07-B5-BI201-00-02C	Polychaeta	Paleanotus heteroseta Hartman	1	WS
LW07-B5-BI201-00-02C	Polychaeta	Paraprionospio pinnata (Ehlers)	13	WI,OP
LW07-B5-BI201-00-02C	Polychaeta	Spiochaetopterus oculatus Webster	1	WS
LW07-B5-BI201-00-02C	Polychaeta	Streblospio benedicti Webster	31	WI,OP
LW07-B5-BI201-00-02C	Oligochaeta	Tubificoides spp. Group I	5	OP
LW07-B5-BI201-00-02C	Bivalvia	Tagelus divisus (Spengler)	1	WS,EQ
LW07-B5-BI201-00-02C	Phoronida	Phoronis psammophila Cori	3	
		TOTAL	61	
LW07-B7-SD201-00-02C	Polychaeta	Apoprionospio pygmaea (Hartman)	1	
LW07-B7-SD201-00-02C	Polychaeta	Heteromastus filiformis (Claparede)	2	OP
LW07-B7-SD201-00-02C	Polychaeta	Mediomastus ambiseta (Hartman)	15	WS,OP
LW07-B7-SD201-00-02C	Polychaeta	Phyllodoce arenae Webster	0	
LW07-B7-SD201-00-02C	Polychaeta	Prionospio heterobranchia Moore	2	
LW07-B7-SD201-00-02C	Polychaeta	Streblospio benedicti Webster	25	WI,OP
LW07-B7-SD201-00-02C	Oligochaeta	Tubificoides spp. Group I	4	OP
LW07-B7-SD201-00-02C	Oligochaeta	Tubificoides wasselli Brinkhurst	18	OP
LW07-B7-SD201-00-02C	Bivalvia	Mercenaria mercenaria (Linnaeus)	13	WS,EQ
		TOTAL	80	
LW07-D5-BI201-00-02C	Polychaeta	Mediomastus ambiseta (Hartman)	1	WS,OP
LW07-D5-BI201-00-02C	Polychaeta	Paraprionospio pinnata (Ehlers)	2	WI,OP
LW07-D5-BI201-00-02C	Polychaeta	Sigambra tentaculata (Treadwell)	1	
LW07-D5-BI201-00-02C	Polychaeta	Streblospio benedicti Webster	12	WI,OP
LW07-D5-BI201-00-02C	Gastropoda	Acteocina canaliculata (Say)	3	
		TOTAL	19	
LW07-F3-BI201-00-02C	Polychaeta	Clymenella torquata (Leidy)	1	WS,EQ
LW07-F3-BI201-00-02C	Polychaeta	Heteromastus filiformis (Claparede)	2	OP
LW07-F3-BI201-00-02C	Polychaeta	Mediomastus ambiseta (Hartman)	7	WS,OP
LW07-F3-BI201-00-02C	Polychaeta	Notomastus sp.	1	
LW07-F3-BI201-00-02C	Polychaeta	Paraprionospio pinnata (Ehlers)	2	WI,OP
LW07-F3-BI201-00-02C	Polychaeta	Streblospio benedicti Webster	66	WI,OP
LW07-F3-BI201-00-02C	Oligochaeta	Tubificoides spp. Group I	1	OP
LW07-F3-BI201-00-02C	Gastropoda	Acteocina canaliculata (Say)	1	
LW07-F3-BI201-00-02C	Bivalvia	Gemma gemma (Totten)	2	OP
LW07-F3-BI201-00-02C	Bivalvia	Mercenaria mercenaria (Linnaeus)	3	WS,EQ
LW07-F3-BI201-00-02C	Phoronida	Phoronis psammophila Cori	4	
		TOTAL	90	
LW07-F5-BI201-00-02C	Nemertea	Nemertea spp.	1	
LW07-F5-BI201-00-02C	Polychaeta	Apoprionospio pygmaea (Hartman)	1	
LW07-F5-BI201-00-02C	Polychaeta	Eteone heteropoda Hartman	1	WI,OP
LW07-F5-BI201-00-02C	Polychaeta	Glycinde solitaria (Webster)	1	WS,OP
LW07-F5-BI201-00-02C	Polychaeta	Gyptis brevipalpa (Hartmann-Schroder)	1	
LW07-F5-BI201-00-02C	Polychaeta	Mediomastus ambiseta (Hartman)	39	WS,OP
LW07-F5-BI201-00-02C	Polychaeta	Notomastus sp.	1	
LW07-F5-BI201-00-02C	Polychaeta	Paraprionospio pinnata (Ehlers)	1	WI,OP
LW07-F5-BI201-00-02C	Polychaeta	Sigambra tentaculata (Treadwell)	0	
LW07-F5-BI201-00-02C	Polychaeta	Streblospio benedicti Webster	41	WI,OP
LW07-F5-BI201-00-02C	Oligochaeta	Tubificoides spp. Group I	8	OP
LW07-F5-BI201-00-02C	Gastropoda	Acteocina canaliculata (Say)	2	
LW07-F5-BI201-00-02C	Bivalvia	Gemma gemma (Totten)	1	
LW07-F5-BI201-00-02C	Bivalvia	Mercenaria mercenaria (Linnaeus)	2	WS,EQ
LW07-F5-BI201-00-02C	Phoronida	Phoronis psammophila Cori	14	
		Total	114	
LW07-F5-SD201-00-02C	Polychaeta	Mediomastus ambiseta (Hartman)	1	WS,OP
LW07-F5-SD201-00-02C	Polychaeta	Paraprionospio pinnata (Ehlers)	2	WI,OP
LW07-F5-SD201-00-02C	Polychaeta	Streblospio benedicti Webster	54	WI,OP
LW07-F5-SD201-00-02C	Oligochaeta	Tubificoides spp. Group I	1	OP
LW07-F5-SD201-00-02C	Bivalvia	Gemma gemma (Totten)	1	OP
LW07-F5-SD201-00-02C	Cumacea	Leucon americanus Zimmer	6	
		TOTAL	65	
LW07-H1-SD201-00-02C	Polychaeta	Mediomastus ambiseta (Hartman)	2	WS,OP
LW07-H1-SD201-00-02C	Polychaeta	Paraprionospio pinnata (Ehlers)	7	WI,OP
LW07-H1-SD201-00-02C	Polychaeta	Streblospio benedicti Webster	29	WI,OP

LW07-H1-SD201-00-02C	Oligochaeta	Tubificoides spp. Group I	1	OP
		TOTAL	39	
LW07-H3-SD201-00-02C	Polychaeta	Mediomastus ambiseta (Hartman)	3	WS,OP
LW07-H3-SD201-00-02C	Polychaeta	Parahesione luteola (Webster)	1	
LW07-H3-SD201-00-02C	Polychaeta	Paraprionospio pinnata (Ehlers)	2	WI,OP
LW07-H3-SD201-00-02C	Polychaeta	Streblospio benedicti Webster	11	WI,OP
LW07-H3-SD201-00-02C	Oligochaeta	Tubificoides spp. Group I	1	OP
LW07-H3-SD201-00-02C	Cumacea	Leucon americanus Zimmer	1	
		TOTAL	19	
LW07-H5-BI201-00-02C	Polychaeta	Polydora cornuta Bosc	1	OP
LW07-H5-BI201-00-02C	Polychaeta	Streblospio benedicti Webster	25	WI,OP
LW07-H5-BI201-00-02C	Oligochaeta	Tubificoides spp. Group I	2	OP
LW07-H5-BI201-00-02C	Bivalvia	Mercenaria mercenaria (Linnaeus)	1	WS,OP
		TOTAL	29	
LW07-J4-SD201-00-02C	Polychaeta	Paraprionospio pinnata (Ehlers)	12	WI,OP
LW07-J4-SD201-00-02C	Polychaeta	Streblospio benedicti Webster	19	WI,OP
LW07-J4-SD201-00-02C	Phoronida	Phoronis psammophila Cori	1	
		TOTAL	32	
LW07-K1-SD201-00-02C	Polychaeta	Paraprionospio pinnata (Ehlers)	4	WI,OP
LW07-K1-SD201-00-02C	Polychaeta	Streblospio benedicti Webster	18	WI,OP
LW07-K1-SD201-00-02C	Oligochaeta	Tubificoides spp. Group I	1	OP
		TOTAL	23	
LW07-K5-SD201-00-02C	Polychaeta	Leitoscoloplos spp.	1	WI,OP
LW07-K5-SD201-00-02C	Polychaeta	Nephtys picta Ehlers	3	WS
LW07-K5-SD201-00-02C	Polychaeta	Paraprionospio pinnata (Ehlers)	7	WI,OP
LW07-K5-SD201-00-02C	Oligochaeta	Tubificoides spp. Group I	1	OP
LW07-K5-SD201-00-02C	Cumacea	Leucon americanus Zimmer	1	
		TOTAL	13	
LW07-K6-SD201-00-02C	Polychaeta	Capitella capitata (Fabricius)	1	WI,OP
LW07-K6-SD201-00-02C	Polychaeta	Streblospio benedicti Webster	3	WI,OP
LW07-K6-SD201-00-02C	Gastropoda	Ilyanassa obsoleta (Say)	1	
LW07-K6-SD201-00-02C	Bivalvia	Gemma gemma (Totten)	3	OP
		TOTAL	8	
LW07-L2-BI201-02C	Polychaeta	Mediomastus ambiseta (Hartman)	1	WS,OP
LW07-L2-BI201-02C	Polychaeta	Paraprionospio pinnata (Ehlers)	2	WI,OP
LW07-L2-BI201-02C	Polychaeta	Streblospio benedicti Webster	19	WI,OP
LW07-L2-BI201-02C	Oligochaeta	Tubificoides spp. Group I	3	OP
LW07-L2-BI201-02C	Phoronida	Phoronis psammophila Cori	2	
		TOTAL	27	
LW07-L5-SD201-00-02C	Polychaeta	Leitoscoloplos spp.	1	WI,OP
LW07-L5-SD201-00-02C	Polychaeta	Mediomastus ambiseta (Hartman)	1	WS,OP
LW07-L5-SD201-00-02C	Polychaeta	Paraprionospio pinnata (Ehlers)	7	WI,OP
LW07-L5-SD201-00-02C	Polychaeta	Spiochaetopterus oculatus Webster	1	WS
LW07-L5-SD201-00-02C	Polychaeta	Streblospio benedicti Webster	24	WI,OP
LW07-L5-SD201-00-02C	Gastropoda	Acteocina canaliculata (Say)	1	
LW07-L5-SD201-00-02C	Phoronida	Phoronis psammophila Cori	1	
		TOTAL	36	
LW07-L6-BI201-02C	Polychaeta	Paraprionospio pinnata (Ehlers)	3	WI,OP
LW07-L6-BI201-02C	Polychaeta	Streblospio benedicti Webster	9	WI,OP
LW07-L6-BI201-02C	Oligochaeta	Tubificoides spp. Group I	0	OP
LW07-L6-BI201-02C	Gastropoda	Acteocina canaliculata (Say)	2	
LW07-L6-BI201-02C	Phoronida	Phoronis psammophila Cori	1	
		TOTAL	15	
LW07-MI-SD201-00-02C	Polychaeta	Gyptis brevipalpa (Hartmann-Schroder)	2	
LW07-MI-SD201-00-02C	Polychaeta	Mediomastus ambiseta (Hartman)	1	WS,OP
LW07-MI-SD201-00-02C	Polychaeta	Paraprionospio pinnata (Ehlers)	4	WI,OP
LW07-MI-SD201-00-02C	Polychaeta	Streblospio benedicti Webster	36	WI,OP
LW07-MI-SD201-00-02C	Oligochaeta	Tubificoides spp. Group I	1	OP
LW07-MI-SD201-00-02C	Cumacea	Leucon americanus Zimmer	1	
LW07-MI-SD201-00-02C	Mysidacea	Mysidopsis bigelowi Tattersall	1	
LW07-MI-SD201-00-02C	Phoronida	Phoronis psammophila Cori	1	
		TOTAL	47	

Appendix E
Data Validation Report

Data Validation Report

Naval Amphibious Base Little Creek
Virginia Beach, Virginia
NAVY C.L.E.A.N. II Contract
CTO-0159

October 28, 2002

Prepared For CH2M HILL

Prepared by E-Data, Inc.
300 N. Carlyle, Suite 100
Arlington Heights, IL 60004

Overview

The CH2M HILL Inc. conducted multimedia sampling and analysis as part of site screening activities at Naval Amphibious Base Little Creek, Virginia Beach, VA. This report describes the validation of analytical data. E-Data Inc., located in Arlington Heights, IL provided the data validation services.

On August 25th to September 5th, 2002, CH2MHILL collected soil, and groundwater samples and associated field quality control samples. Environmental samples were taken at 11surface soil sampling locations, 22 subsurface soil sampling locations, 6 monitoring well locations, and 6 borehole water sampling locations. Six field duplicate samples, five equipment blank samples, and two trip blank samples were included. A summary of the samples collected is shown in Table 1. The laboratory prepared project-specific samples for matrix spike/matrix spike duplicate (MS/MSD) analyses.

TABLE 1
Sample Cross-Reference Summary
(Naval Amphibious Base Little Creek, CTO-159)

Lab Sample ID	Sample ID	Date/Time Collected	Date Received
C2709-01	LW07-SS15-00 (N)	8/26/02 7:50 AM	28-Aug-02
C2709-02	LW07-SB15-01 (N)	8/26/02 7:52 AM	28-Aug-02
C2709-03	LW07-SB15-02 (N)	8/26/02 7:54 AM	28-Aug-02
C2709-04	LW07-SS16-00 (N)	8/26/02 8:20 AM	28-Aug-02
C2709-05	LW07-SB16-01 (N)	8/26/02 8:27 AM	28-Aug-02
C2709-06	LW07-SB16-02 (N)	8/26/02 8:29 AM	28-Aug-02
C2709-07	LW07-SB16P-02 (FD)	8/26/02 8:29 AM	28-Aug-02
C2709-08	LW07-SB17-01 (N)	8/26/02 9:07 AM	28-Aug-02
C2709-09	LW07-SB17-02 (N)	8/26/02 9:09 AM	28-Aug-02
C2709-10	LW07-SS18-00 (N)	8/26/02 9:35 AM	28-Aug-02
C2709-11	LW07-SB18-01 (N)	8/26/02 9:37 AM	28-Aug-02
C2709-12	LW07-SB18-02 (N)	8/26/02 9:39 AM	28-Aug-02
C2709-13	LW07-SB18P-02 (FD)	8/26/02 9:39 AM	28-Aug-02
C2709-14	LW07-SS20-00 (N)	8/26/02 10:35 AM	28-Aug-02
C2709-15	LW07-SB20-01 (N)	8/26/02 10:37 AM	28-Aug-02
C2709-16	LW07-SB20-02 (N)	8/26/02 10:39 AM	28-Aug-02
C2709-17	LW07-SB20P-02 (FD)	8/26/02 10:39 AM	28-Aug-02
C2709-18	LW07-SS22-00 (N)	8/26/02 11:25 AM	28-Aug-02
C2709-19	LW07-SB22-01 (N)	8/26/02 11:27 AM	28-Aug-02
C2709-20	LW07-SB22-02 (N)	8/26/02 11:29 AM	28-Aug-02
D2709-01	LW07-SS19-00 (N)	8/26/02 10:02 AM	28-Aug-02
D2709-02	LW07-SB19-01 (N)	8/26/02 10:04 AM	28-Aug-02
D2709-03	LW07-SB19-02 (N)	8/26/02 10:06 AM	28-Aug-02
D2709-04	LW07-SS21-00 (N)	8/26/02 10:45 AM	28-Aug-02
D2709-05	LW07-SB21-01 (N)	8/26/02 10:47 AM	28-Aug-02
D2709-06	LW07-SB21-02 (N)	8/26/02 10:49 AM	28-Aug-02
D2709-07	LW07-SB21P-02 (FD)	8/26/02 10:49 AM	28-Aug-02
D2709-08	LW07-SS23-00 (N)	8/26/02 1:00 PM	28-Aug-02
D2709-09	LW07-SB23-01 (N)	8/26/02 1:02 PM	28-Aug-02
D2709-10	LW07-SB23-02 (N)	8/26/02 1:04 PM	28-Aug-02

TABLE 1
Sample Cross-Reference Summary
(Naval Amphibious Base Little Creek, CTO-159)

Lab Sample ID	Sample ID	Date/Time Collected	Date Received
D2709-11	LW07-SS24-00 (N)	8/26/02 1:15 PM	28-Aug-02
D2709-12	LW07-SB24-01 (N)	8/26/02 1:17 PM	28-Aug-02
D2709-13	LW07-SB24-02 (N)	8/26/02 1:19 PM	28-Aug-02
D2709-14	LW07-SS25-00 (N)	8/26/02 1:35 PM	28-Aug-02
D2709-15	LW07-SB25-01 (N)	8/26/02 1:37 PM	28-Aug-02
D2709-16	LW07-SB25-02 (N)	8/26/02 1:39 PM	28-Aug-02
D2709-17	LW07-SS17-00 (N)	9/5/02 12:20 PM	06-Sep-02
L2709-10	LW07-SO-EB090502 (EB)	9/5/02 11:15 AM	06-Sep-02
E2709-01	LW07-DP101-10 (N)	8/25/02 9:30 AM	28-Aug-02
E2709-02	LW07-DP101-17 (N)	8/25/02 10:00 AM	28-Aug-02
E2709-03	LW07-DP102-10 (N)	8/25/02 1:00 PM	28-Aug-02
E2709-04	LW07-DP103-10 (N)	8/25/02 3:20 PM	28-Aug-02
E2709-05	LW07-DP103-17 (N)	8/25/02 4:30 PM	28-Aug-02
E2709-06	LW07-DP101P-17 (FD)	8/25/02 10:00 AM	28-Aug-02
E2709-07	LW07-DP102-17 (N)	8/25/02 2:10 PM	28-Aug-02
E2709-08	LW07-GW-EB082502 (EB)	8/25/02 5:15 PM	28-Aug-02
E2709-10	LW07-TB082502 (TB)	8/25/02 12:00 AM	28-Aug-02
L2709-01	LW07-MW06-02C (N)	9/3/02 3:20 PM	06-Sep-02
L2709-03	LW07-MW04-02C (N)	9/3/02 5:00 PM	06-Sep-02
L2709-04	LW07-MW04-02CP (FD)	9/3/02 5:00 PM	06-Sep-02
L2709-05	LW07-MW05-02C (N)	9/4/02 9:35 AM	06-Sep-02
L2709-06	LW07-MW02-02C (N)	9/4/02 11:00 AM	06-Sep-02
L2709-07	LW07-MW03-02C (N)	9/4/02 3:35 PM	06-Sep-02
L2709-09	LW07-MW01-02C (N)	9/4/02 5:15 PM	06-Sep-02
L2709-02	LW07-GW-EB090302 (EB)	9/3/02 3:50 PM	06-Sep-02
L2709-08	LW07-GW-EB090402 (EB)	9/4/02 4:00 PM	06-Sep-02
L2709-11	LW07-TB090502 (TB)	9/5/02 4:30 PM	06-Sep-02

Overnight carrier delivered samples to CompuChem Laboratories located in Cary, NC for analytical testing. Analyses for total metals and total cyanide were performed using the Contract Laboratory Program Inorganic Statement of Work (CLP/SOW) CLP ILM04.1. Analyses for dissolved metals were performed using the Contract Laboratory Program Inorganic Statement of Work (CLP/SOW) CLP ILM04.0. Analyses for volatiles were performed using the Contract Laboratory Program Organic Statement of Work (CLP/SOW) CLP OLC03.2. Analyses for semivolatiles were performed using the Contract Laboratory Program Organic Statement of Work (CLP/SOW) CLP OLM04.2. Analyses for Total Organic Carbon were performed using U.S. EPA SW-846 method 9060. Analyses for soil pH were performed using U.S. EPA SW-846 method 9045C. All analyses were conducted at the Cary, NC facility.

After laboratory analyses were completed and reviewed, CompuChem assembled a hardcopy data package and electronic data deliverable (EDD), which were delivered to CH2M HILL and forwarded to E-Data. CompuChem provided six data packages with EDDs, which include laboratory work group ID numbers C2709, D2709, E2709, E2709A, L2709, and M2709.

Data validation was conducted as described in the EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, and U.S. EPA SW-846. A copy of the laboratory reports with data qualifiers applied as a result of data validation are provided in Appendix A. Appendix B contains results of all tentatively identified compounds. Appendix C contains copies of the completed checklists used to document the data validation effort.

At least ten percent of the final validated-laboratory reports were compared to the electronic data. Project data validation, qualifiers were entered in the data field labeled as "Validation Qualifier" and validation qualifier summary codes were entered in the data field labeled as "Qualifier Code".

Summary of Sample Analyses

Hardcopy Data Packages

Project completeness is calculated at 100 percent. The EDD consists of 4079 valid results of 4079 total results (excluding laboratory quality control samples and re-analyzed data) of the data undergoing data validation. Rejected data was due to re-analysis where one sample result was selected in preference to another. No major issues were identified as a result of data validation. Minor issues are described below. Project data qualifiers are added to the laboratory Form 1 reports. A list of project data qualifiers is shown in Table 2.

TABLE 2
List of Project Qualifiers
(Naval Amphibious Base Little Creek, CTO-159)

Qualifier	Description
[=]	The analyte was positively identified.
J	The analyte was positively identified; however, the concentration value is an estimate. Also used if a results was measured at a concentration below the Contract Required Quantification Limit (CRQL) or Contract Required Detection Limit (CRDL).
U	The analyte was analyzed for, but not detected.
UJ	The analyte was analyzed for, but not detected. The associated numerical value is an estimate.

Qualification codes explain why data qualifiers have been applied and identify possible limitations of data use. Table 3 presents all data qualifier codes used in data validation.

TABLE 3
Data Qualifier Code Reference
(Naval Amphibious Base Little Creek, CTO-159)

Code	Inorganic	Organic
$	The laboratory incorrectly reported data in either the hard copy report or EDD submittal	The laboratory incorrectly reported data in either the hard copy report or EDD submittal
<	Concentration measurement is less than the laboratory limit of reporting, but greater than the method detection limit.	Concentration measurement is less than the laboratory limit of reporting, but greater than the method detection limit.
B	Parameter detected in the associated laboratory method or preparation blank. Presumed contamination.	Parameter detected in the associated laboratory method or preparation blank. Presumed contamination.
C	The C code was not used with inorganic analyses	Parameter is associated with a calibration deficiency.
D	The D code was not used with inorganic analyses	A more appropriate analytical value is available, usually associated with dilution results..
H	The H code was not used with inorganic analyses	Analytical holding times exceeded the method requirements.
I	The I code was not used with inorganic analyses	The internal standard areas were outside the recommended criterion.
L	The Laboratory Control Sample recovery (%R) was not within control limits	The L code is not used with organic analyses
M	Parameter is associated with a matrix spike or matrix spike duplicate sample that recovered outside the laboratory control limits.	Parameter is associated with a matrix spike or matrix spike duplicate sample that recovered outside the laboratory control limits.
P	The laboratory and/or field duplicate precision goals were not achieved.	The laboratory and/or field duplicate precision goals were not achieved.
S	The laboratory serial dilution goal was not achieved.	Parameter is associated with a surrogate that recovered outside the laboratory control limits.

Field samples are qualified for the introduction of contaminants resulting from laboratory and field activities as measured in the laboratory method blank, field blank, and trip blank audit samples.

A summary of all qualified results is shown on Table D-1 (Appendix D).

Electronic Data Deliverable

A subset of approximately 10 percent of the sample results from the electronic data deliverable was verified by comparing the results to the validated laboratory Form 1's. Table E-1 (Appendix E) summarizes the 420 sample results that were verified. The database contained a total of 6312 results.

Major Issues

Organic Analysis by GC\MS

No major issues were identified during the data validation effort.

Inorganic Analysis by ICP and CVAA

No major issues were identified during the data validation effort.

General Chemistry Analysis

No major issues were identified during the data validation effort.

Minor Issues

Organic Analysis by GC\MS

VOCs

SDG E2709

The 1,1-Dichloroethene-d2 surrogate recovery in sample LW07-DP101-17 was low at 64%. VOC results in sample LW07-DP101-17 for the associated compounds are considered estimated and flagged "UJ" for non-detects.

Methylene chloride was detected in the laboratory method blank samples and field blank samples up to 2.2 ug/L. Water sample detections for methylene chloride less than the blank action level of 22 ug/L are qualified as "B" due to possible sample contamination.

Toluene was detected in the laboratory method blank samples and field blank samples up to 0.55 ug/L. Water sample detections for toluene less than the blank action level of 2.75 ug/L are qualified as "B" due to possible sample contamination.

Bromoform was detected in field blank sample LW07-TB082502 at 0.13 ug/L. Water sample detections for bromoform less than the blank action level of 0.65 ug/L are qualified as "B" due to possible sample contamination.

Xylenes were detected in field blank sample LW07-GW-EB082502 at 0.25 ug/L. Water sample detections for xylenes less than the blank action level of 1.25 ug/L are qualified as "B" due to possible sample contamination.

SDG L2709

The 1,1-Dichloroethene-d2 surrogate recovery in sample LW07-MW06 was low at 62%. VOC results in sample LW07- MW06 for the associated compounds are considered estimated and flagged "UJ" for non-detects.

The 1,1-Dichloroethene-d2 surrogate recovery in sample LW07-MW04 was low at 62%. VOC results in sample LW07- MW04 for the associated compounds are considered estimated and flagged "UJ" for non-detects.

The 1,1-Dichloroethene-d2 surrogate recovery in sample LW07-MW05 was low at 62%. VOC results in sample LW07- MW05 for the associated compounds are considered estimated and flagged "UJ" for non-detects.

The 1,1-Dichloroethene-d2 surrogate recovery in sample LW07-MW02 was low at 62%. VOC results in sample LW07- MW02 for the associated compounds are considered estimated and flagged "UJ" for non-detects.

The 1,1-Dichloroethene-d2 surrogate recovery in sample LW07-MW03 was low at 60%. VOC results in sample LW07- MW03 for the associated compounds are considered estimated and flagged "UJ" for non-detects.

Methylene chloride was detected in the laboratory method blank samples and field blank samples up to 0.9 ug/L. Water sample detections for methylene chloride less than the blank action level of 9 ug/L are qualified as "B" due to possible sample contamination.

Acetone was detected in the laboratory method blank samples and field blank samples up to 6.5 ug/L. Water sample detections for acetone less than the blank action level of 65 ug/L are qualified as "B" due to possible sample contamination.

Toluene was detected in the laboratory method blank samples and field blank samples up to 0.85 ug/L. Water sample detections for toluene less than the blank action level of 4.25 ug/L are qualified as "B" due to possible sample contamination.

Bromoform was detected in the laboratory method blank samples and field blank samples up to 0.21 ug/L. Water sample detections for bromoform less than the blank action level of 1.05 ug/L are qualified as "B" due to possible sample contamination.

Xylenes were detected in the laboratory method blank samples and field blank samples up to 0.11 ug/L. Water sample detections for xylenes less than the blank action level of 0.55 ug/L are qualified as "B" due to possible sample contamination.

Chloromethane was detected in the laboratory method blank samples and field blank samples up to 0.15 ug/L. Water sample detections for chloromethane less than the blank action level of 0.75 ug/L are qualified as "B" due to possible sample contamination.

Chlorobenzene was detected in the laboratory method blank samples and field blank samples up to 0.12 ug/L. Water sample detections for chlorobenzene less than the blank action level of 0.6 ug/L are qualified as "B" due to possible sample contamination.

Styrene was detected in the laboratory method blank samples and field blank samples up to 0.12 ug/L. Water sample detections for styrene less than the blank action level of 0.6 ug/L are qualified as "B" due to possible sample contamination.

1,4-Dichlorobenzene was detected in the laboratory method blank samples and field blank samples up to 0.12 ug/L. Water sample detections for 1,4-dichlorobenzene less than the blank action level of 0.6 ug/L are qualified as "B" due to possible sample contamination.

1,2,4-Trichlorobenzene was detected in the laboratory method blank samples and field blank samples up to 0.1 ug/L. Water sample detections for 1,2,4-trichlorobenzene less than the blank action level of 0.5 ug/L are qualified as "B" due to possible sample contamination.

cis-1,3-Dichloropropene was detected in the laboratory method blank samples and field blank samples up to 0.1 ug/L. Water sample detections for cis-1,3-dichloropropene less than the blank action level of 0.5 ug/L are qualified as "B" due to possible sample contamination.

trans-1,3-Dichloropropene was detected in the laboratory method blank samples and field blank samples up to 0.11 ug/L. Water sample detections for trans-1,3-dichloropropene less than the blank action level of 0.55 ug/L are qualified as "B" due to possible sample contamination.

The %D during continuing calibration on instrument 5972HP71 on 9/10/02 at 8:32 was high for dichlorodifluoromethane at 50%. Water sample results run with this calibration are considered estimated and flagged "UJ" for non-detects (no detects were noted).

The %D during continuing calibration on instrument 5972HP71 on 9/10/02 at 8:32 was high for methyl acetate at 45%. Water sample results run with this calibration are considered estimated and flagged "UJ" for non-detects (no detects were noted).

The %D during continuing calibration on instrument 5972HP71 on 9/10/02 at 20:46 was high for dichlorodifluoromethane at 53%. Water sample results run with this calibration are considered estimated and flagged "UJ" for non-detects (no detects were noted).

The %D during continuing calibration on instrument 5972HP71 on 9/10/02 at 20:46 was high for methyl acetate at 48%. Water sample results run with this calibration are considered estimated and flagged "UJ" for non-detects (no detects were noted).

The %D during continuing calibration on instrument 5972HP71 on 9/11/02 at 09:15 was high for dichlorodifluoromethane at 53%. Water sample results run with this calibration are considered estimated and flagged "UJ" for non-detects (no detects were noted).

The %D during continuing calibration on instrument 5972HP71 on 9/11/02 at 09:15 was high for methyl acetate at 38%. Water sample results run with this calibration are considered estimated and flagged "UJ" for non-detects (no detects were noted).

The %D during continuing calibration on instrument 5972HP71 on 9/11/02 at 09:15 was high for 1,1-dichloroethene at 39%. Water sample results run with this calibration are considered estimated and flagged "UJ" for non-detects (no detects were noted).

The %D during continuing calibration on instrument 5972HP71 on 9/11/02 at 09:15 was high for 1,1,2-Trichloro-1,2,2-trifluoroethane at 37%. Water sample results run with this calibration are considered estimated and flagged "UJ" for non-detects (no detects were noted).

The %D during continuing calibration on instrument 5972HP71 on 9/12/02 at 08:09 was high for dichlorodifluoromethane at 67%. Water sample results run with this calibration are considered estimated and flagged "UJ" for non-detects (no detects were noted).

The %D during continuing calibration on instrument 5972HP71 on 9/12/02 at 08:09 was high for methyl acetate at 57%. Water sample results run with this calibration are considered estimated and flagged "UJ" for non-detects (no detects were noted).

The %D during continuing calibration on instrument 5972HP71 on 9/12/02 at 08:09 was high for 1,1-dichloroethene at 32%. Water sample results run with this calibration are considered estimated and flagged "UJ" for non-detects (no detects were noted).

The %D during continuing calibration on instrument 5972HP71 on 9/12/02 at 08:09 was high for 1,1,2-Trichloro-1,2,2-trifluoroethane at 33%. Water sample results run with this calibration are considered estimated and flagged "UJ" for non-detects (no detects were noted).

SVOCs

SDG C2709

SVOC analyses were for PAHs only.

Naphthalene was detected in laboratory method blank sample SBLKBL at 12 ug/Kg. Soil sample detections for naphthalene less than the corrected blank action level are qualified as "B" due to possible sample contamination.

LCS samples were not run with this SDG. MS/MSD recoveries were acceptable. No action was taken.

SDG D2709

SVOC analyses were for PAHs only.

The terphenyl-d14 surrogate recovery in sample LW07-SS21-00 was high at 141%. Positive PAH detections in sample LW07-SS21-00 are considered estimated and flagged "J" for detects.

The terphenyl-d14 surrogate recovery in sample LW07-SB19-02 was high at 157%. Positive PAH detections in sample LW07-SB19-02 are considered estimated and flagged "J" for detects.

The terphenyl-d14 surrogate recovery in sample LW07-SB23-01 was high at 144%. Positive PAH detections in sample LW07-SB23-01 are considered estimated and flagged "J" for detects.

The terphenyl-d14 surrogate recovery in sample LW07-SB23-02 was high at 139%. Positive PAH detections in sample LW07-SB23-02 are considered estimated and flagged "J" for detects.

The terphenyl-d14 surrogate recovery in sample LW07-SB24-01 was high at 141%. Positive PAH detections in sample LW07-SB24-01 are considered estimated and flagged "J" for detects.

The terphenyl-d14 surrogate recovery in sample LW07-SB25-01 was high at 150%. Positive PAH detections in sample LW07-SB25-01 are considered estimated and flagged "J" for detects.

Naphthalene was detected in laboratory method blank sample SBLKDY at 12 ug/Kg. Naphthalene was not detected in sample LW07-SS17-00. No action was taken.

Numerous deficiencies were noted for MS/MSD recoveries and RPDs. No action was taken based on MS/MSD recoveries alone.

LCS samples were not run with this SDG. No action was taken.

The %D during the continuing calibration of chrysene on instrument 5972HP60 9/4/02 at 08:32 was high at 28%. Soil sample results for chrysene run at this time are considered estimated and flagged "J" for detects and "UJ" for non-detects.

SDG E2709

The 2,4,6-tribromophenol surrogate recovery in sample LW07-DP101-10 was high at 129%. No qualification was applied, as only one surrogate recovery was out-of-control.

Numerous deficiencies were noted for MS/MSD recoveries and RPDs. No action was taken based on MS/MSD recoveries alone.

LCS samples were not run with this SDG. No action was taken.

Bis(2-ethylhexyl)phthalate was detected in laboratory method blank sample SBLKBG and field blank sample LW07-GW-082502 up to 3 ug/L. Positive detects for bis(2-ethylhexyl)phthalate less than the blank action level of 30 ug/L are qualified as "B" due to possible sample contamination.

Diethylphthalate was detected in field blank sample LW07-GW-082502 at 0.7 ug/L. No water sample detects were noted. No action was taken.

Di-n-butylphthalate was detected in field blank sample LW07-GW-082502 at 0.9 ug/L. Water sample detects less than the blank action level of 4.5 ug/L are qualified as "B" due to possible sample contamination.

The %D during the continuing calibration of 2,4-dinitrophenol on instrument 5972HP60 9/4/02 at 20:15 was high at 65.3%. Water sample results for 2,4-dinitrophenol run at this time are considered estimated and flagged "UJ" for non-detects (no detects were noted).

The %D during the continuing calibration of 4,6-dinitro-2-methylphenol on instrument 5972HP60 9/4/02 at 20:15 was high at 38.2%. Water sample results for 4,6-dinitro-2-methylphenol run at this time are considered estimated and flagged "UJ" for non-detects (no detects were noted).

The %D during the continuing calibration of pentachlorophenol on instrument 5972HP60 9/4/02 at 20:15 was high at 38.1%. Water sample results for pentachlorophenol run at this time are considered estimated and flagged "UJ" for non-detects (no detects were noted).

SDG L2709

The 2,4,6-tribromophenol surrogate recovery in sample LW07-MW02-02C was high at 125%. No qualification was applied, as only one surrogate recovery was out-of-control.

Numerous deficiencies were noted for MS/MSD recoveries and RPDs. No action was taken based on MS/MSD recoveries alone.

LCS samples were not run with this SDG. No action was taken.

Bis(2-ethylhexyl)phthalate was detected in laboratory method blank sample SBLKDV and field blank sample LW07-GW-EB090302 up to 4 ug/L. Positive detects for bis(2-ethylhexyl)phthalate less than the blank action level of 40 ug/L are qualified as "B" due to possible sample contamination.

Acetophenone was detected in field blank sample LW07-GW-EB090302 at 0.3 ug/L. No water sample detects were noted. No action was taken.

Naphthalene was detected in field blank sample LW07-GW-EB090302 at 0.4 ug/L. Water sample detects less than the blank action level of 2 ug/L are qualified as "B" due to possible sample contamination.

The %D during the continuing calibration of 2,4-dinitrophenol on instrument 5972HP66 9/11/02 at 09:10 was high at 27.6%. Water sample results for 2,4-dinitrophenol run at this time are considered estimated and flagged "UJ" for non-detects (no detects were noted).

The %D during the continuing calibration of hexachlorocyclopentadiene on instrument 5972HP60 9/11/02 at 09:10 was high at 27.4%. Water sample results for hexachlorocyclopentadiene run at this time are considered estimated and flagged "UJ" for non-detects (no detects were noted).

The %D during the continuing calibration of 2-nitroaniline on instrument 5972HP60 9/11/02 at 09:10 was high at 31.3%. Water sample results for 2-nitroaniline run at this time are considered estimated and flagged "UJ" for non-detects (no detects were noted).

Inorganic Analysis by ICP and CVAA

SDG C2709

All metals and cyanide except mercury were detected in laboratory and field blank samples. Soil sample detects less than five times the corrected blank action level are qualified "B" due to possible sample contamination.

The laboratory replicate RPDs were high for copper (100.4%), lead (62.8%), and cyanide (200%) in sample LW07-SB17-02. Results for copper, lead, and cyanide in this SDG are considered estimated and flagged "J" for detects. Non-detect values were not qualified.

The MS recovery for lead was high at 229%. Detected results for lead are considered estimated and flagged "J" (see above).

The MS recovery for thallium was low at 61%. Soil results for thallium in this SDG are considered estimated and flagged "UJ" for non-detects (No positive detects were noted).

The ICP serial dilution RPD for calcium was high at 16.1%. Positive detects for calcium in this SDG are considered estimated and flagged "J".

The ICP serial dilution RPD for copper was high at 25.7%. Positive detects for copper in this SDG are considered estimated and flagged "J" (see above).

SDG D2709

Aluminum, antimony, barium, beryllium, cadmium, calcium, iron, magnesium, manganese, mercury, potassium, sodium, vanadium, zinc, and cyanide were detected in laboratory and field blank samples. Soil sample detects less than five times the corrected blank action level are qualified "B" due to possible sample contamination.

The laboratory replicate RPDs were high for aluminum (36.4%), iron (34.2%), and manganese (43.8%) in sample LW07-SB19-02. Results for aluminum, iron, and manganese in this SDG are considered estimated and flagged "J" for detects. Non-detect values were not noted for this SDG.

The MS recovery for selenium was low at 73.6%. Soil results for selenium in this SDG are considered estimated and flagged "J" for detects and "UJ" for non-detects.

SDG L2709

Aluminum, antimony, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, sodium, thallium, vanadium, and zinc were detected in laboratory and field blank samples. Water sample detects less than five times the corrected blank action level are qualified "B" due to possible sample contamination.

The MS recovery for aluminum was high at 212.6%. Water results for aluminum in this SDG are considered estimated and flagged "J" for detects only (no non-detects were noted).

The MS recovery for mercury was low at 67.5%. Water results for mercury in this SDG are considered estimated and flagged "UJ" for non-detects (no detects were noted).

The %D for the ICP serial dilution of potassium in sample LW07-MW02-02C was high at 27%. Potassium results in this SDG are considered estimated and flagged "J" for detects only.

The %D for the ICP serial dilution of sodium in sample LW07-MW02-02C was high at 23.4%. Sodium results in this SDG are considered estimated and flagged "J" for detects only.

SDG M2709

Aluminum, antimony, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, sodium, and zinc were detected in laboratory and field blank samples. Water sample detects less than five times the corrected blank action level are qualified "B" due to possible sample contamination.

The %D for the ICP serial dilution of potassium in sample LW07-MW02-02C was high at 26.8%. Potassium results in this SDG are considered estimated and flagged "J" for detects only.

The %D for the ICP serial dilution of sodium in sample LW07-MW02-02C was high at 25.2%. Sodium results in this SDG are considered estimated and flagged "J" for detects only.

General Chemistry Parameters

SDG C2709

The MS/MSD recoveries for TOC were high at 147% and 160.8%. LCS recovery was acceptable. No qualification was applied based on MS/MSD recoveries alone.

SDG D2709

No discrepancies were noted.

Data Validation Report

Naval Amphibious Base Little Creek
Virginia Beach, Virginia
NAVY C.L.E.A.N. II Contract
CTO-0159

November 21, 2002

Prepared For CH2M HILL

Prepared by E-Data, Inc.
300 N. Carlyle, Suite 100
Arlington Heights, IL 60004

Overview

The CH2M HILL Inc. conducted multimedia sampling and analysis as part of site screening activities at Naval Amphibious Base Little Creek, Virginia Beach, VA. This report describes the validation of analytical data. E-Data Inc., located in Arlington Heights, IL provided the data validation services.

On September 26th to October 1st, 2002, CH2MHILL collected sediment samples and associated field quality control samples. Environmental samples were taken at 75 sediment sampling locations. Five field duplicate samples, six equipment blank samples, and one field blank sample were included. A summary of the samples collected is shown in Table 1. The laboratory prepared project-specific samples for matrix spike/matrix spike duplicate (MS/MSD) analyses.

TABLE 1
Sample Cross-Reference Summary
(Naval Amphibious Base Little Creek, CTO-159)

Lab Sample ID	Sample ID	Date/Time Collected	Date Received
N2709-01	LW07-H5-SD201-00-02C (N)	9/26/02 3:30 PM	28-Sep-02
N2709-02	LW07-H5-SD202-00-02C (N)	9/26/02 3:40 PM	28-Sep-02
N2709-03	LW07-F5-SD201-00-02C (N)	9/27/02 8:40 AM	28-Sep-02
N2709-04	LW07-F5-SD202-00-02C (N)	9/27/02 8:50 AM	28-Sep-02
N2709-05	LW07-B7-SD201-00-02C (N)	9/27/02 9:15 AM	28-Sep-02
N2709-06	LW07-B7-SD202-00-02C (N)	9/27/02 9:35 AM	28-Sep-02
N2709-07	LW07-B5-SD201-00-02C (N)	9/27/02 10:00 AM	28-Sep-02
N2709-08	LW07-B5-SD201P-00-02C (FD)	9/27/02 10:00 AM	28-Sep-02
N2709-09	LW07-B5-SD202-00-02C (N)	9/27/02 10:15 AM	28-Sep-02
N2709-10	LW07-D5-SD201-00-02C (N)	9/27/02 10:40 AM	28-Sep-02
N2709-11	LW07-D5-SD202-00-02C (N)	9/27/02 10:50 AM	28-Sep-02
N2709-12	LW07-F3-SD201-00-02C (N)	9/27/02 11:00 AM	28-Sep-02
N2709-13	LW07-F3-SD202-00-02C (N)	9/27/02 11:15 AM	28-Sep-02
N2709-14	LW07-H3-SD201-00-02C (N)	9/27/02 2:40 PM	28-Sep-02
N2709-15	LW07-H3-SD201P-00-02C (FD)	9/27/02 2:40 PM	28-Sep-02
N2709-16	LW07-H3-SD202-00-02C (N)	9/27/02 2:45 PM	28-Sep-02
N2709-17	LW07-K1-SD201-00-02C (N)	9/27/02 3:35 PM	28-Sep-02
N2709-18	LW07-K1-SD202-00-02C (N)	9/27/02 3:50 PM	28-Sep-02
N2709-19	LW07-M1-SD201-00-02C (N)	9/27/02 4:10 PM	28-Sep-02
N2709-20	LW07-M1-SD202-00-02C (N)	9/27/02 4:15 PM	28-Sep-02
O2709-01	LW07-H1-SD201-00-02C (N)	9/27/02 3:05 PM	28-Sep-02
O2709-02	LW07-H1-SD201P-00-02C (FD)	9/27/02 3:05 PM	28-Sep-02
O2709-03	LW07-H1-SD202-00-02C (N)	9/27/02 3:20 PM	28-Sep-02
O2709-04	LW07-L5-SD201-00-02C (N)	9/28/02 11:34 AM	01-Oct-02
O2709-05	LW07-L5-SD202-00-02C (N)	9/28/02 11:57 AM	01-Oct-02
O2709-06	LW07-K6-SD201-00-02C (N)	9/28/02 12:24 PM	01-Oct-02
O2709-07	LW07-K6-SD202-00-02C (N)	9/28/02 12:26 PM	01-Oct-02
O2709-08	LW07-M3-SD201-00-02C (N)	9/28/02 8:32 AM	01-Oct-02
O2709-09	LW07-M3-SD202-00-02C (N)	9/28/02 8:43 AM	01-Oct-02
O2709-10	LW07-K3-SD201-00-02C (N)	9/28/02 9:05 AM	01-Oct-02
O2709-11	LW07-K3-SD202-00-02C (N)	9/28/02 9:09 AM	01-Oct-02
O2709-12	LW07-J4-SD201-00-02C (N)	9/28/02 9:31 AM	01-Oct-02

TABLE 1
Sample Cross-Reference Summary
(Naval Amphibious Base Little Creek, CTO-159)

Lab Sample ID	Sample ID	Date/Time Collected	Date Received
O2709-13	LW07-J4-SD202-00-02C (N)	9/28/02 9:37 AM	01-Oct-02
O2709-14	LW07-K5-SD201-00-02C (N)	9/28/02 10:28 AM	01-Oct-02
O2709-15	LW07-K5-SD202-00-02C (N)	9/28/02 10:32 AM	01-Oct-02
O2709-16	LW07-K4-SD201-00-02C (N)	9/28/02 10:00 AM	01-Oct-02
O2709-17	LW07-K4-SD202-00-02C (N)	9/28/02 10:05 AM	01-Oct-02
O2709-18	LW07-L6-SD201-00-02C (N)	10/1/02 9:00 AM	02-Oct-02
O2709-19	LW07-L2-SD201-00-02C (N)	10/1/02 10:10 AM	02-Oct-02
QR2709-01	LW07-H5-SD201-02-02C (N)	9/26/02 2:20 PM	01-Oct-02
QR2709-02	LW07-M1-SD201-02-02C (N)	9/29/02 8:25 AM	01-Oct-02
QR2709-03	LW07-H1-SD201-02-02C (N)	9/29/02 9:25 AM	01-Oct-02
QR2709-04	LW07-K3-SD201-02-02C (N)	9/29/02 10:15 AM	01-Oct-02
QR2709-05	LW07-K3-SD201-02-02C (N)	9/29/02 10:15 AM	01-Oct-02
QR2709-06	LW07-F3-SD201-02-02C (N)	9/29/02 12:17 PM	01-Oct-02
QR2709-07	LW07-B7-SD201-02-02C (N)	9/29/02 1:13 PM	01-Oct-02
QR2709-08	LW07-F5-SD201-02-02C (N)	9/29/02 2:05 PM	01-Oct-02
QR2709-09	LW07-L5-SD201-02-02C (N)	9/29/02 3:50 PM	01-Oct-02
QR2709-10	LW07-K6-SD201-02-02C (N)	9/28/02 1:50 PM	01-Oct-02
QR2709-11	LW07-M3-SD201-02-02C (N)	9/28/02 2:42 PM	01-Oct-02
QR2709-12	LW07-K1-SD201-02-02C (N)	9/28/02 3:55 PM	01-Oct-02
QT2709-01	LW07-L6-SD201-02-02C (N)	10/1/02 8:35 AM	02-Oct-02
QT2709-02	LW07-L2-SD201-02-02C (N)	10/1/02 9:55 AM	02-Oct-02
QT2709-03	LW07-D5-SD201-02-02C (N)	9/30/02 10:10 AM	02-Oct-02
QT2709-04	LW07-B5-SD201-02-02C (N)	9/30/02 11:05 AM	02-Oct-02
QT2709-05	LW07-B5-SD201P-02-02C (FD)	9/30/02 11:05 AM	02-Oct-02
QT2709-06	LW07-K5-SD201-02-02C (N)	9/30/02 1:00 PM	02-Oct-02
QT2709-07	LW07-K4-SD201-02-02C (N)	9/30/02 2:00 PM	02-Oct-02
QT2709-08	LW07-K4-SD201P-02-02C (FD)	9/30/02 2:00 PM	02-Oct-02
QT2709-09	LW07-J4-SD201-02-02C (N)	9/30/02 2:50 PM	02-Oct-02
QT2709-10	LW07-H3-SD201-02-02C (N)	9/30/02 3:40 PM	02-Oct-02
P2709-01	LW07-EB092602D (EB)	9/26/02 4:25 PM	28-Sep-02
P2709-02	LW07-EB092702D (EB)	9/27/02 4:30 PM	28-Sep-02
P2709-03	LW07-FB092902 (FB)	9/29/02 3:00 PM	01-Oct-02
P2709-04	LW07-EB092902V (EB)	9/29/02 2:51 PM	01-Oct-02
P2709-05	LW07-EB092802D (EB)	9/28/02 4:30 PM	01-Oct-02
P2709-06	LW07-EB093002V (EB)	9/30/02 4:15 PM	02-Oct-02
P2709-07	LW07-EB100102D (EB)	10/1/02 3:00 PM	02-Oct-02

Overnight carrier delivered samples to CompuChem Laboratories located in Cary, NC for analytical testing. Analyses for total metals and total cyanide were performed using the Contract Laboratory Program Inorganic Statement of Work (CLP/SOW) CLP ILM04.1. Analyses for semivolatiles were performed using the Contract Laboratory Program Organic Statement of Work (CLP/SOW) CLP OLM04.2. Analyses for Total Organic Carbon were performed using U.S. EPA SW-846 method 9060. Analyses for soil pH were performed using U.S. EPA SW-846 method 9045C. Analyses for ammonia were performed using U.S. EPA method 350.1. Analyses for SEM metals were performed using U.S. EPA SW-846 method 6010B and 7470A. Analyses for

AVS were performed using U.S. EPA SW-846 method 9034. Analyses for CEC were performed using U.S. EPA SW-846 method 9081. All analyses were conducted at the Cary, NC facility except SEM metals, CEC, and AVS which were conducted by Severn Trent Laboratories, Inc., Colchester, VT.

After laboratory analyses were completed and reviewed, CompuChem assembled a hardcopy data package and electronic data deliverable (EDD), which were delivered to CH2M HILL and forwarded to E-Data. CompuChem provided six data packages with EDDs, which include laboratory work group ID numbers N2709, O2709, P2709, QR2709, and 90079.

Data validation was conducted as described in the EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, and U.S. EPA SW-846. A copy of the laboratory reports with data qualifiers applied as a result of data validation are provided in Appendix A. Appendix B contains results of all tentatively identified compounds. Appendix C contains copies of the completed checklists used to document the data validation effort.

At least ten percent of the final validated-laboratory reports were compared to the electronic data. Project data validation, qualifiers were entered in the data field labeled as "Validation Qualifier" and validation qualifier summary codes were entered in the data field labeled as "Qualifier Code".

Summary of Sample Analyses

Hardcopy Data Packages

Project completeness is calculated at 100 percent. The EDD consists of 2834 valid results of 2834 total results (excluding laboratory quality control samples and re-analyzed data) of the data undergoing data validation. Rejected data was due to re-analysis where one sample result was selected in preference to another. No major issues were identified as a result of data validation. Minor issues are described below. Project data qualifiers are added to the laboratory Form 1 reports. A list of project data qualifiers is shown in Table 2.

TABLE 2
List of Project Qualifiers
(Naval Amphibious Base Little Creek, CTO-159)

Qualifier	Description
[=]	The analyte was positively identified.
B	Parameter detected in the associated laboratory method or preparation blank. Presumed contamination.
J	The analyte was positively identified; however, the concentration value is an estimate. Also used if a results was measured at a concentration below the Contract Required Quantification Limit (CRQL) or Contract Required Detection Limit (CRDL).
U	The analyte was analyzed for, but not detected.
UJ	The analyte was analyzed for, but not detected. The associated numerical value is an estimate.

Qualification codes explain why data qualifiers have been applied and identify possible limitations of data use. Table 3 presents all data qualifier codes used in data validation.

TABLE 3
Data Qualifier Code Reference
(Naval Amphibious Base Little Creek, CTO-159)

Code	Inorganic	Organic
$	The laboratory incorrectly reported data in either the hard copy report or EDD submittal	The laboratory incorrectly reported data in either the hard copy report or EDD submittal
<	Concentration measurement is less than the laboratory limit of reporting, but greater than the method detection limit.	Concentration measurement is less than the laboratory limit of reporting, but greater than the method detection limit.
B	Parameter detected in the associated laboratory method or preparation blank. Presumed contamination.	Parameter detected in the associated laboratory method or preparation blank. Presumed contamination.
C	The C code was not used with inorganic analyses	Parameter is associated with a calibration deficiency.
D	The D code was not used with inorganic analyses	A more appropriate analytical value is available, usually associated with dilution results..
H	Analytical holding times exceeded the method requirements.	Analytical holding times exceeded the method requirements.
I	The I code was not used with inorganic analyses	The internal standard areas were outside the recommended criterion.
L	The Laboratory Control Sample recovery (%R) was not within control limits	Sample result may be biased low due to unresolved chromatographic peaks.
M	Parameter is associated with a matrix spike or matrix spike duplicate sample that recovered outside the laboratory control limits.	Parameter is associated with a matrix spike or matrix spike duplicate sample that recovered outside the laboratory control limits.
P	The laboratory and/or field duplicate precision goals were not achieved.	The laboratory and/or field duplicate precision goals were not achieved.
S	The laboratory serial dilution goal was not achieved.	Parameter is associated with a surrogate that recovered outside the laboratory control limits.

Field samples are qualified for the introduction of contaminants resulting from laboratory and field activities as measured in the laboratory method blank, field blank, and trip blank audit samples.

A summary of all qualified results is shown on Table D-1 (Appendix D).

Electronic Data Deliverable

A subset of approximately 10 percent of the sample results from the electronic data deliverable was verified by comparing the results to the validated laboratory Form 1's. Table E-1 (Appendix E) summarizes the 326 sample results that were verified. The database contained a total of 3811 results.

Major Issues

Organic Analysis by GC\MS

No major issues were identified during the data validation effort.

Inorganic Analysis by ICP and CVAA

No major issues were identified during the data validation effort.

General Chemistry Analysis

No major issues were identified during the data validation effort.

Minor Issues

Organic Analysis by GC\MS

SVOCs

SDG N2709

SVOC analyses were for PAHs only.

The MS recovery for 2,4-dinitrophenol was high at 96%. The MSD recovery for 2,4-dinitrophenol was high at 100%. The MSD recovery for 4-nitrophenol was high at 121%. No action was taken based on MS/MSD recoveries alone. Out-of-control spike recoveries were not PAH compounds.

LCS samples were not run with this SDG. PAH MS/MSD recoveries were acceptable. No action was taken.

SDG O2709

SVOC analyses were for PAHs only.

The LCS recovery for phenol was high at 96%. The LCS recovery for 4-chloro-3-methylphenol was high at 104%. The LCS recovery for 2,4-dinitrotoluene was high at 112%. LCS recoveries in sample WG20609-2 were acceptable. No action was taken.

MS/MSD samples were not run with this SDG. No action was taken.

The %D during continuing calibration for dibenzo(a,h)anthracene on instrument 5972HP60 on 10/9/02 was high at 27.5%. Sample results for dibenzo(a,h)anthracene analyzed on this date are considered estimated and flagged "J" for detects (no non-detects were noted).

The %D during continuing calibration for dibenzo(a,h)anthracene on instrument 5972HP60 on 10/10/02 was high at 28.6%. Sample results for dibenzo(a,h)anthracene analyzed on this date are considered estimated and flagged "J" for detects (no non-detects were noted).

The %D during continuing calibration for chrysene on instrument 5972HP60 on 10/10/02 was high at 29.8%. Sample results for chrysene analyzed on this date are considered estimated and flagged "J" for detects (no non-detects were noted).

The %D during continuing calibration for indeno(1,2,3-cd)pyrene on instrument 5972HP60 on 10/10/02 was high at 26.8%. Sample results for indeno(1,2,3-cd)pyrene analyzed on this date are considered estimated and flagged "J" for detects (no non-detects were noted).

The case narrative states that the chromatographic peaks for benzo(b)fluoranthene and benzo(k)fluoranthene in numerous samples were not resolved during samples analysis, but were resolved during continuing calibration. Sediment results for benzo(b)fluoranthene and benzo(k)fluoranthene in these samples are considered estimated and flagged "J" due to possible negative bias.

SDG QR2709

SVOC analyses were for PAHs only.

The MS recovery for 2,4-dinitrophenol was high at 97% in sample LW07-F3-SD201-02-02C. The MS/MSD RPD was high at 26% in sample LW07-K5-SD201-02-02C. No action was taken based on MS/MSD recoveries alone.

LCS samples were not run with this SDG. No action was taken.

Inorganic Analysis by ICP and CVAA

SDG N2709

All metals and cyanide except arsenic, lead, mercury, and tin were detected in laboratory and field blank samples. Sediment sample detects less than five times the corrected blank action level are qualified "B" due to possible sample contamination.

The laboratory replicate RPDs were high for calcium (24.9%) and mercury (89.4%) in sample LW07-F3-SD201-00-02C. Results for calcium in this SDG are considered estimated and flagged "J" for detects. No action was taken for mercury results as the sample result was less than 5X the detection limit.

The MS recovery for selenium was high at 128.9%. Detected results for selenium are considered estimated and flagged "J".

The MS recovery for thallium was low at 61.3%. Soil results for thallium in this SDG are considered estimated and flagged "UJ" for non-detects (No positive detects were noted).

The ICP serial dilution RPD for potassium was high at 21.3%. Positive detects for potassium in this SDG are considered estimated and flagged "J".

SDG O2709

All metals and cyanide except arsenic, mercury, and tin were detected in laboratory and field blank samples. Sediment sample detects less than five times the corrected blank action level are qualified "B" due to possible sample contamination.

MS samples were not run with this SDG. LCS recoveries were acceptable. No action was taken.

An ICP serial dilution sample was not run with this SDG. No action was taken.

SDG QR2709

All metals and cyanide except arsenic, mercury, and tin were detected in laboratory and field blank samples. Sediment sample detects less than five times the corrected blank action level are qualified "B" due to possible sample contamination.

The laboratory replicate RPD was high for aluminum at 27.2% in sample LW07-K5-SD201-02-02C. Results for aluminum in this SDG are considered estimated and flagged "J" for detects.

The MS recovery for antimony was low at 68.5%. Sediment results for antimony in this SDG are considered estimated and flagged "J" for detects and "UJ" for non-detects.

The MS recovery for thallium was low at 52%. Sediment results for thallium in this SDG are considered estimated and flagged "UJ" for non-detects (No positive detects were noted).

The ICP serial dilution RPD for potassium was high at 17.8%. Positive detects for potassium in this SDG are considered estimated and flagged "J".

The ICP serial dilution RPD for calcium was high at 10.5%. Positive detects for calcium in this SDG are considered estimated and flagged "J".

Inorganic Analysis by SEM

SDG 90079

Mercury samples were analyzed past the 28 day holding time. Mercury results in this SDG are considered estimated and flagged "J" for detects and "UJ" for non-detects.

Copper, mercury, nickel, and zinc were detected in laboratory blank samples. Sediment sample detects less than five times the corrected blank action level are qualified "B" due to possible sample contamination.

The MS recovery for cadmium was low at 59%. Sediment results for cadmium are considered estimated and flagged "J" for detects (no non-detects were noted).

The MS recovery for mercury was low at 54. Sediment results for mercury in this SDG are considered estimated and flagged "J" for detects (no non-detects were noted).

The MS recovery for nickel was low at 61%. Sediment results for nickel are considered estimated and flagged "J" for detects (no non-detects were noted).

The ICP serial dilution RPD for copper was high at 10.8%. Positive detects for copper in this SDG are considered estimated and flagged "J".

The ICP serial dilution RPD for lead was high at 22%. Positive detects for lead in this SDG are considered estimated and flagged "J".

The ICP serial dilution RPD for zinc was high at 24%. Positive detects for zinc in this SDG are considered estimated and flagged "J".

General Chemistry Parameters

SDG N2709

The MSD recovery for TOC was high at 127.2%. LCS recovery was acceptable. No qualification was applied based on MS/MSD recoveries alone.

SDG O2709

No discrepancies were noted.

SDG QR2709

No discrepancies were noted.

SDG 90079

No discrepancies were noted.

Appendix F
Background Report Analytical Results

Table F-1
Background Groundwater Quality Summary
Background Investigation
NAB Little Creek, Virginia Beach, VA

Groundwater			
Parameter	**Frequency of Detection**	**Mean Concentration**	**95% Upper Tolerance Limit**
Dissolved Metals (ug/L)			
Aluminum	0.50	27.9	58
Antimony	0.63	15.8	49
Arsenic	0.38	13.5	69
Barium	0.50	38.7	136
Calcium	1.00	45250.0	136000
Chromium	0.63	1.3	2.1
Cobalt	0.38	1.2	1.9
Iron	0.63	7145.1	29800
Magnesium	1.00	15787.5	49000
Manganese	1.00	450.1	1510
Nickel	0.38	3.7	6
Potassium	0.86	9538.6	35500
Selenium	0.25	5.4	9
Silver	0.13	1.6	4
Sodium	1.00	66546.3	360000
Thallium	0.25	2.7	4
Vanadium	0.25	1.1	2
Zinc	0.38	20.4	42
Total Metals (ug/L)			
Aluminum	0.88	186.1	713
Arsenic	0.50	16.0	73
Barium	0.25	47.7	130
Beryllium	0.13	0.4	0.5
Cadmium	0.50	0.9	2.1
Calcium	1.00	44375.0	129000
Chromium	0.88	1.9	4.1
Cobalt	1.00	1.5	2.6
Iron	0.75	17135.1	70800
Lead	0.00	2.4	2.4U
Magnesium	0.88	15058.8	45600
Manganese	1.00	469.2	1500
Mercury	0.13	0.2	0.3
Nickel	0.25	4.5	14
Potassium	0.38	10422.5	36800
Selenium	0.25	5.1	8
Silver	0.13	1.3	2
Sodium	0.75	63330.0	337000
Thallium	0.00	2.5	2.5U
Vanadium	0.38	1.7	5
Zinc	0.13	32.3	59
Organics (ug/L)			
Dieldrin	0.13	0.0	0.1
bis(2-Ethylhexyl)phthalake	0.38	4.5	5
Trichloroethene	0.13	0.9	1
Wet Chemistry (mg/L)			
Bicarbonate	1.00	330.0	480
Chloride	1.00	22.2	25
Sulfate	1.00	49.9	54

Table F-2
Background Soil Quality
Background Investigation
NAB LIttle Creek, Virginia Beach, VA

	Native Soil				Urban Soils				Dredged Fill Soils			
Parameter	**Estimate of Central Tendency**	**95% Confidence Interval**	**95% Upper Tolerance Limit**	**95% Confidence Interval**	**Estimate of Central Tendency**	**95% Confidence Interval**	**95% Upper Tolerance Limit**	**95% Confidence Interval**	**Estimate of Central Tendency**	**95% Confidence Interval**	**95% Upper Tolerance Limit**	**95% Confidence Interval**
Surface soil												
Metals (mg/kg)												
aluminum	6195	4768, 7622	12000	8020, 12695	2170	986, 3310	8500	5920, 8500	2170	986, 3310	8500	5920, 8500
arsenic	3	2, 3	5.6	4,6	1	1, 2	5.6	3,6	1	1, 2	5.6	3,6
barium	44	32, 60	154	65, 179	15	8, 28	69	37, 69	15	8, 28	69	37, 69
beryllium	0.4	.4, .5	0.7	0.5, 0.8	0.1	.1, 1.5	0.6	0.4, 0.6	0	.1, 1.5	0.6	0.4, 0.6
calcium	440	346, 607	1817	948, 1957	440	346, 607	1817	948, 1957	440	346, 607	1817	948, 1957
chromium	8	6, 9	14	10, 15	5	3, 6	20	9, 21	5	3, 6	20	9, 21
cobalt	2	2, 4	15	4, 19	3.5	2.5, 5.5	5.1	.6, 1.1	3.5	2.5, 5.5	5.1	.6, 1.1
iron	6543	4656, 8430	31000	8958, 15141	2545	1990, 3225	15000	7452, 16005	2545	1990, 3225	15000	7452, 16005
lead	31	24, 43	110	55, 120	31	24, 43	110	55, 120	31	24, 43	110	55, 120
magnesium	505	387, 623	986	656, 1043	338	266, 468	1347	691, 1456	338	266, 468	1347	691, 1456
manganese	131	62, 200	411	219, 445	25	18, 35	267	106, 299	25	18, 35	267	106, 299
nickel	4	3, 5	8.1	5,9	2	1, 2	9.5	5, 10	2	1, 2	9.5	5, 10
potassium	844	714, 974	1373	1010, 1436	422	356, 501	1435	891, 1517	422	356, 501	1435	891, 1517
sodium	24	24, 43	63	42, 63	60	55, 87	623	225, 623	60	55, 87	623	225, 623
vanadium	12	9, 14	22.4	15, 24	6	5, 8	34.3	17, 69	6	5, 8	34.3	17, 69
zinc	31	23, 45	123	56, 135	31	23, 45	123	56, 135	31	23, 45	123	56, 135
Pesticides (ug/kg)												
4,4 DDE	4	4, 4	240	13, 240	4	4, 4	240	13, 240	4	4, 4	240	13, 240
4,4 DDT	4	4, 5	140	33, 140	4	4, 5	140	33, 140	4	4, 5	140	33, 140
Wet Chemistry												
pH	5.3	5.0, 5.7	7.7	6.4, 7.9	5.3	5.0, 5.7	7.7	6.4, 7.9	5.3	5.0, 5.7	7.7	6.4, 7.9
TOC	1.4	1.1, 1.6	3	2.3, 3.1	1.4	1.1, 1.6	3	2.3, 3.1	1.4	1.1, 1.6	3	2.3, 3.1
Subsurface soil												
Metals (mg/kg)												
aluminum	6195	4768, 7622	12000	8020, 12695	2170	986, 3310	8500	5920, 8500	2170	986, 3310	8500	5920, 8500
arsenic	3	2, 3	5.6	4,6	1	1, 2	5.6	3,6	1	1, 2	5.6	3,6
barium	44	32, 60	154	65, 179	15	8, 28	69	37, 69	15	8, 28	69	37, 69
beryllium	0.4	.4, .5	0.7	0.5, 0.8	0.1	.1, 1.5	0.6	0.4, 0.6	0.1	.1, 1.5	0.6	0.4, 0.6
calcium	440	346, 607	1817	948, 1957	440	346, 607	1817	948, 1957	440	346, 607	1817	948, 1957
chromium	8	6, 9	14	10, 15	5	3, 6	20	9, 21	5	3, 6	20	9, 21
cobalt	2	2, 4	15	4, 19	3.5	2.5, 5.5	5.1	.6, 1.1	3.5	2.5, 5.5	5.1	.6, 1.1
iron	6543	4656, 8430	31000	8958, 15141	2545	1990, 3225	15000	7452, 16005	2545	1990, 3225	15000	7452, 16005
lead	7	3, 9	16.4	12, 17	7	3, 9	16.4	12, 17	7	3, 9	16.4	12, 17
magnesium	505	387, 623	986	656, 1043	338	266, 468	1347	691, 1456	338	266, 468	1347	691, 1456
manganese	131	62, 200	411	219, 445	25	18, 35	267	106, 299	25	18, 35	267	106, 299
nickel	4	3, 5	8.1	5,9	2	1, 2	9.5	5, 10	2	1, 2	9.5	5, 10
potassium	844	714, 974	1373	1010, 1436	422	356, 501	1435	891, 1517	422	356, 501	1435	891, 1517
sodium	24	24, 43	63	42, 63	60	55, 87	623	225, 623	60	55, 87	623	225, 623
vanadium	12	9, 14	22.4	15, 24	6	5, 8	34.3	17, 69	6	5, 8	34.3	17, 69
zinc	13	10, 17	39	21, 43	13	10, 17	39	21, 43	13	10, 17	39	21, 43
Pesticides (ug/kg)												
4,4 DDE	4	4, 4	240	13, 240	4	4, 4	240	13, 240	4	4, 4	240	13, 240
4,4 DDT	4	4, 4	6.2	4,6	4	4, 4	6.2	4,6	4	4, 4	6.2	4,6
Wet Chemistry												
pH	5.3	5.0, 5.7	7.7	6.4, 7.9	5.3	5.0, 57	7.7	6.4, 7.9	5.3	5.0, 5.7	7.7	6.4, 7.9
TOC	1.4	1.1, 1.6	3	2.3, 3.1	1.4	1.1, 1.6	3	2.3, 3.1	1.4	1.1, 1.6	3	2.3, 3.1

Appendix G
Grain Size Analysis

Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.FK, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-SB15-01 Sample Type: Subsurface
Sample Description:	Silty SAND (SM), Tan, Fine to Coarse, With Fine to Coarse Gravel

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.97	**Moisture Content (%):**	**7.6**
Initial Wet Sample Wt.	196.91	**Percent Fines:**	**27.4**
Initial Dry Sample Wt.	183.70		
Dry Wt. After Wash	138.97		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	11.92	93.2
1/2 Inch	12.500	24.18	86.2
3/8 Inch	9.500	28.95	83.4
4	4.750	38.34	78.1
10	2.000	48.43	72.3
20	0.850	59.05	66.2
40	0.425	75.26	56.9
60	0.250	91.46	47.7
100	0.150	101.20	42.1
200	0.075	126.92	27.4
Pan		130.02	OK

* Weigh soil only, zero scale prior to starting.

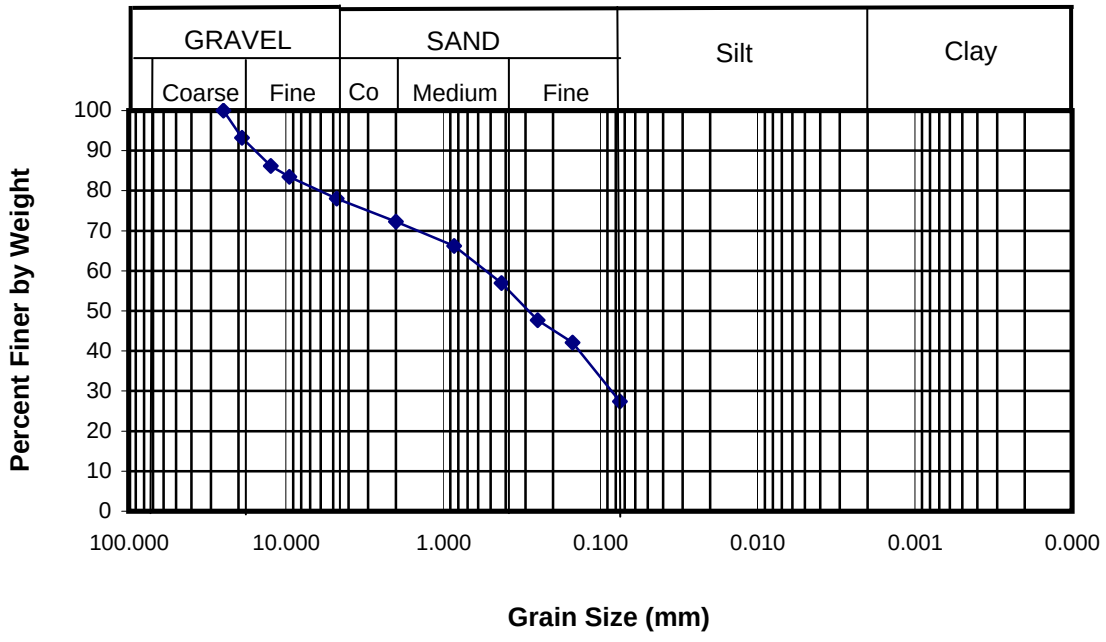
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name: **CH2M HILL - SWMUS 3, 7, & 8**
Project Number: 157234.FI.FK, CTO #: 159
Navy Clean Prime Contract N62470-95-D-6007
Number: 2649-110
Sample Number: LW07-SB15-01
Sample Type: Subsurface
Sample Description: Silty SAND (SM), Tan, Fine to Coarse, With Fine to Coarse Gravel
Test Method: ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	93.2
3/8 Inch	83.4
4	78.1
10	72.3
20	66.2
40	56.9
60	47.7
100	42.1
200	27.4



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.FK, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-SB15-02 Sample Type: Subsurface
Sample Description:	Silty SAND (SM), Tan, Fine to Medium

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.18	**Moisture Content (%):**	**7.1**
Initial Wet Sample Wt.	225.28	**Percent Fines:**	**14.8**
Initial Dry Sample Wt.	210.89		
Dry Wt. After Wash	186.39		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.00	100.0
10	2.000	0.45	99.8
20	0.850	8.27	95.9
40	0.425	48.43	76.1
60	0.250	98.47	51.4
100	0.150	133.83	34.0
200	0.075	172.64	14.8
Pan		177.88	OK

* Weigh soil only, zero scale prior to starting.

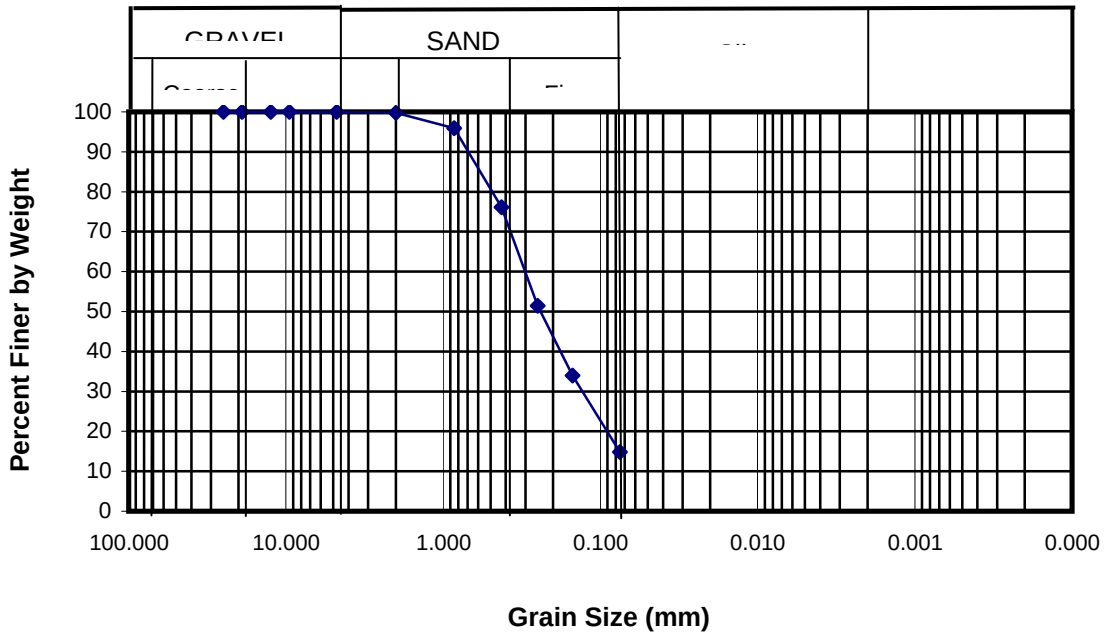
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.FK, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-SB15-02
Sample Type:	Subsurface
Sample Description:	Silty SAND (SM), Tan, Fine to Medium
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	99.8
20	95.9
40	76.1
60	51.4
100	34.0
200	14.8



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.FK, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-SB20-01 Sample Type: Subsurface
Sample Description:	Silty SAND (SM), Tan, Fine to Coarse, With Fine Gravel
Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	9.13	**Moisture Content (%):**	**2.5**
Initial Wet Sample Wt.	267.83	**Percent Fines:**	**12.9**
Initial Dry Sample Wt.	261.45		
Dry Wt. After Wash	230.07		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	30.65	87.9
3/8 Inch	9.500	36.56	85.5
4	4.750	62.53	75.2
10	2.000	87.88	65.2
20	0.850	111.86	55.7
40	0.425	148.12	41.3
60	0.250	182.93	27.5
100	0.150	202.32	19.8
200	0.075	219.85	12.9
Pan		221.18	OK

* Weigh soil only, zero scale prior to starting.

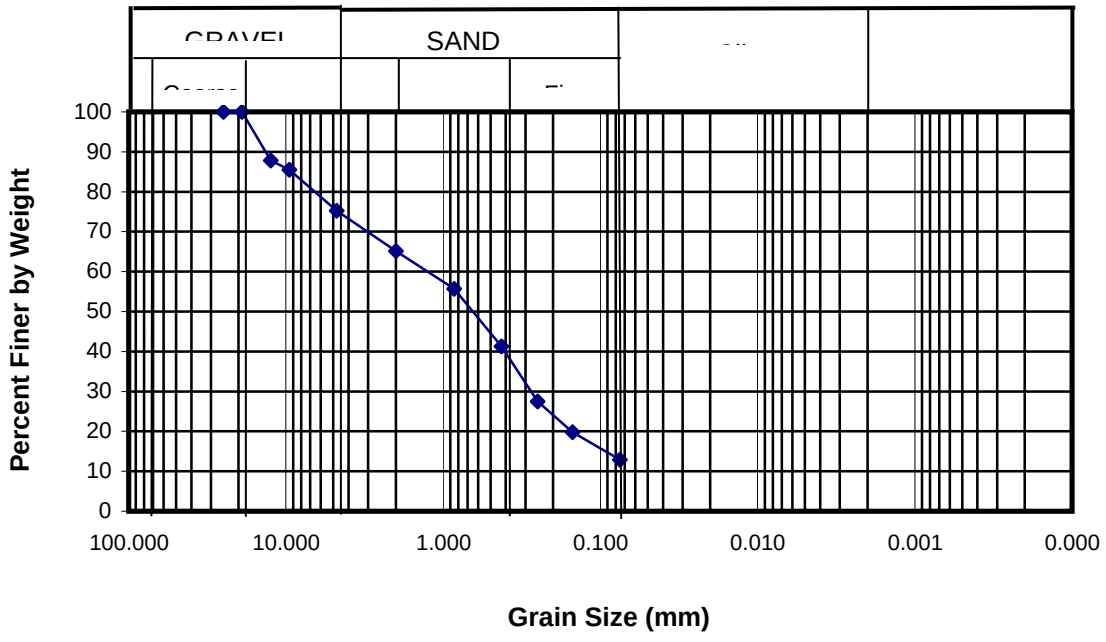
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.FK, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-SB20-01
Sample Type:	Subsurface
Sample Description:	Silty SAND (SM), Tan, Fine to Coarse, With Fine Gravel
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	85.5
4	75.2
10	65.2
20	55.7
40	41.3
60	27.5
100	19.8
200	12.9



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.FK, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-SB20-02 Sample Type: Subsurface
Sample Description:	Slightly Silty SAND (SP-SM), Tan, Fine to Medium

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.91	**Moisture Content (%):**	**2.0**
Initial Wet Sample Wt.	281.96	**Percent Fines:**	**9.0**
Initial Dry Sample Wt.	276.59		
Dry Wt. After Wash	255.40		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.00	100.0
10	2.000	0.82	99.7
20	0.850	12.52	95.3
40	0.425	70.31	73.7
60	0.250	147.24	45.0
100	0.150	202.93	24.2
200	0.075	243.71	9.0
Pan		246.13	OK

* Weigh soil only, zero scale prior to starting.

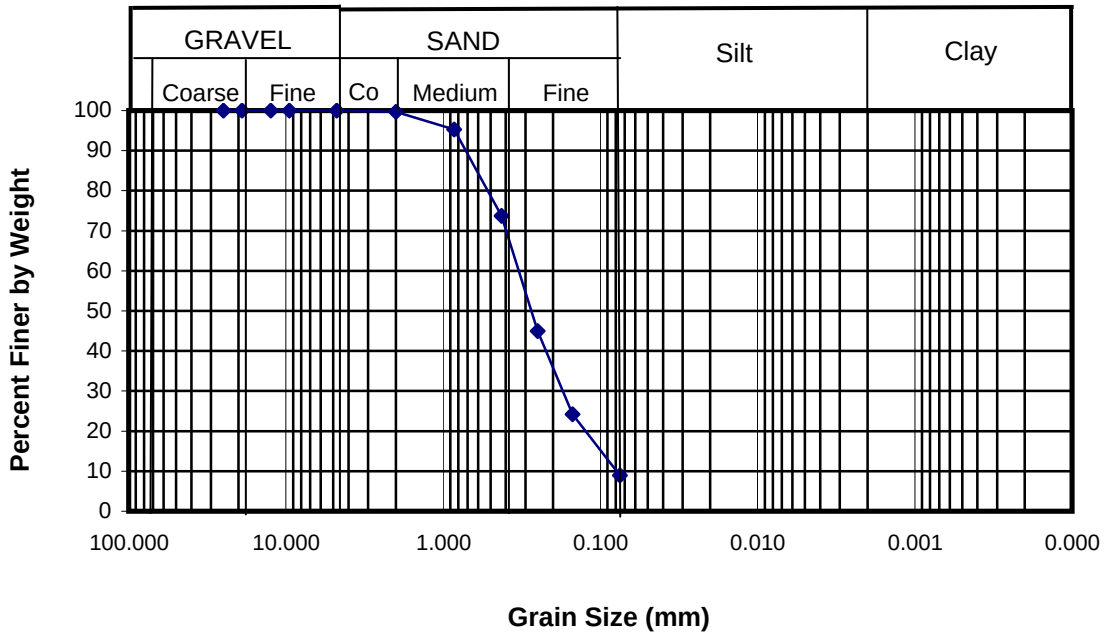
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name: **CH2M HILL - SWMUS 3, 7, & 8**
Project Number: 157234.FI.FK, CTO #: 159
Navy Clean Prime Contract N62470-95-D-6007
Number: 2649-110
Sample Number: LW07-SB20-02
Sample Type: Subsurface
Sample Description: Slightly Silty SAND (SP-SM), Tan, Fine to Medium
Test Method: ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	99.7
20	95.3
40	73.7
60	45.0
100	24.2
200	9.0



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.FK, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-SB23-01 Sample Type: Subsurface
Sample Description:	Silty SAND (SM), Dark Tan, Fine to Coarse, Trace Clay and Fine Gravel

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.93	**Moisture Content (%):**	**6.0**
Initial Wet Sample Wt.	230.53	**Percent Fines:**	**20.7**
Initial Dry Sample Wt.	217.99		
Dry Wt. After Wash	175.57		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	4.45	97.9
4	4.750	16.10	92.3
10	2.000	22.09	89.4
20	0.850	38.07	81.8
40	0.425	82.20	60.7
60	0.250	128.36	38.6
100	0.150	151.11	27.7
200	0.075	165.71	20.7
Pan		166.71	OK

* Weigh soil only, zero scale prior to starting.

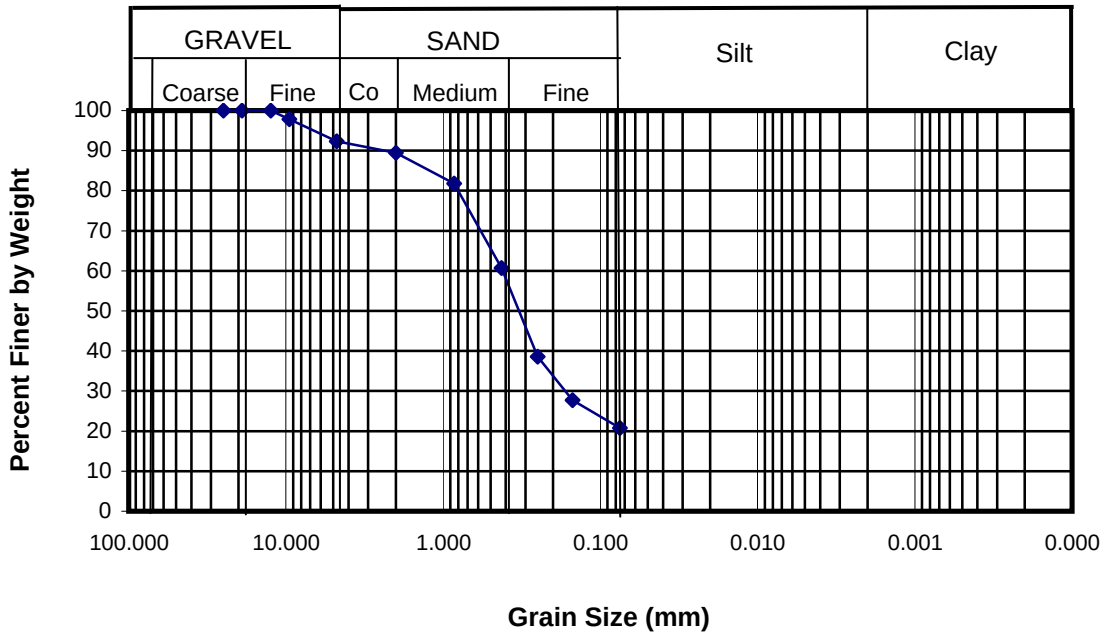
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name: **CH2M HILL - SWMUS 3, 7, & 8**
Project Number: 157234.FI.FK, CTO #: 159
Navy Clean Prime Contract N62470-95-D-6007
Number: 2649-110
Sample Number: LW07-SB23-01
Sample Type: Subsurface
Sample Description: Silty SAND (SM), Dark Tan, Fine to Coarse, Trace Clay and Fine Gravel
Test Method: ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	97.9
4	92.3
10	89.4
20	81.8
40	60.7
60	38.6
100	27.7
200	20.7



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8		
CH2M HILL Project Nu	157234.FI.FK, CTO #: 159		
	Navy Clean Prime Contract N62470-95-D-6007		
Number:	2649-110		
Sample No.:	LW07-SB23-02	Sample Type:	Subsurface
Sample Description:	Slightly Silty SAND (SP-SM), Tan, Fine to Coarse, Trace Fine Gravel		

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.98	**Moisture Content (%):**	**3.0**
Initial Wet Sample Wt.	163.87	**Percent Fines:**	**9.5**
Initial Dry Sample Wt.	159.43		
Dry Wt. After Wash	146.27		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	1.89	98.7
4	4.750	4.83	96.8
10	2.000	5.58	96.3
20	0.850	12.59	91.6
40	0.425	49.76	66.9
60	0.250	98.71	34.4
100	0.150	123.31	18.0
200	0.075	136.20	9.5
Pan		137.19	OK

* Weigh soil only, zero scale prior to starting.

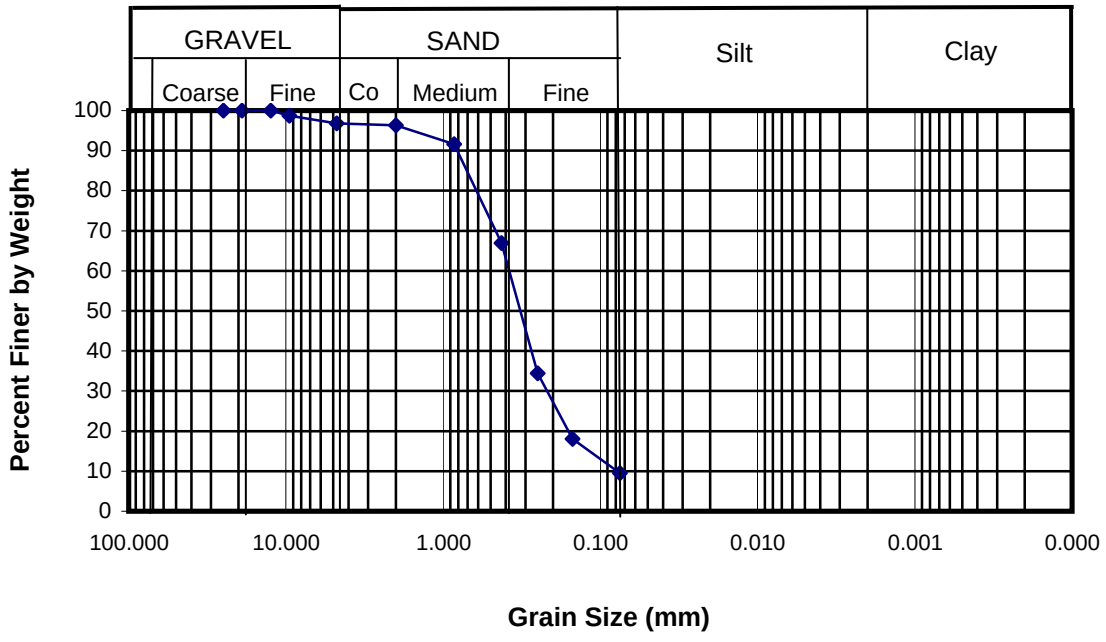
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name: **CH2M HILL - SWMUS 3, 7, & 8**
Project Number: 157234.FI.FK, CTO #: 159
Navy Clean Prime Contract N62470-95-D-6007
Number: 2649-110
Sample Number: LW07-SB23-02
Sample Type: Subsurface
Sample Description: Slightly Silty SAND (SP-SM), Tan, Fine to Coarse, Trace Fine Gravel
Test Method: ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	98.7
4	96.8
10	96.3
20	91.6
40	66.9
60	34.4
100	18.0
200	9.5



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.FK, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-SB25-01 Sample Type: Subsurface
Sample Description:	Silty, Clayey SAND (SC-SM), Tan, Fine to Medium, Trace Fine Gravel

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.96	**Moisture Content (%):**	**4.9**
Initial Wet Sample Wt.	158.29	**Percent Fines:**	**25.8**
Initial Dry Sample Wt.	151.29		
Dry Wt. After Wash	116.41		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	1.35	99.1
10	2.000	2.54	98.2
20	0.850	6.02	95.8
40	0.425	26.43	81.4
60	0.250	69.90	50.9
100	0.150	92.07	35.3
200	0.075	105.59	25.8
Pan		107.42	OK

* Weigh soil only, zero scale prior to starting.

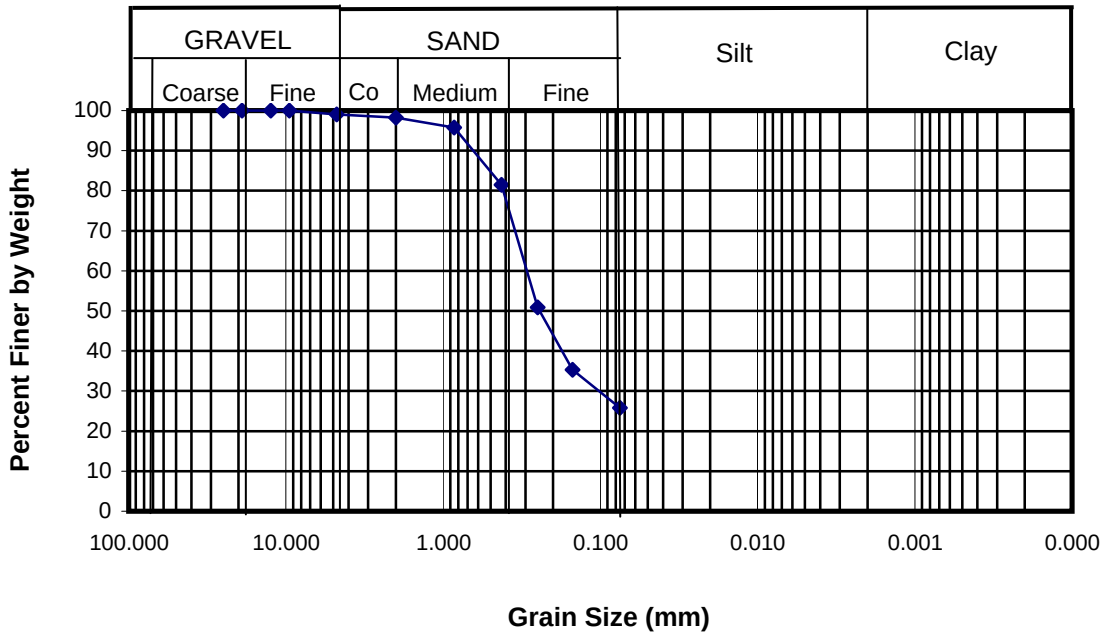
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name: **CH2M HILL - SWMUS 3, 7, & 8**
Project Number: 157234.FI.FK, CTO #: 159
Navy Clean Prime Contract N62470-95-D-6007
Number: 2649-110
Sample Number: LW07-SB25-01
Sample Type: Subsurface
Sample Description: Silty, Clayey SAND (SC-SM), Tan, Fine to Medium, Trace Fine Gravel
Test Method: ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	99.1
10	98.2
20	95.8
40	81.4
60	50.9
100	35.3
200	25.8



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8		
CH2M HILL Project Nu	157234.FI.FK, CTO #: 159		
	Navy Clean Prime Contract N62470-95-D-6007		
Number:	2649-110		
Sample No.:	LW07-SB25-02	Sample Type:	Subsurface
Sample Description:	Slightly Silty SAND (SP-SM), Tan, Fine to Medium, Trace Fine Gravel		

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	9.08	**Moisture Content (%):**	**3.0**
Initial Wet Sample Wt.	255.03	**Percent Fines:**	**5.8**
Initial Dry Sample Wt.	247.92		
Dry Wt. After Wash	234.38		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.82	99.7
10	2.000	2.16	99.1
20	0.850	23.24	90.3
40	0.425	124.15	48.0
60	0.250	195.68	18.1
100	0.150	216.55	9.3
200	0.075	224.94	5.8
Pan		225.32	OK

* Weigh soil only, zero scale prior to starting.

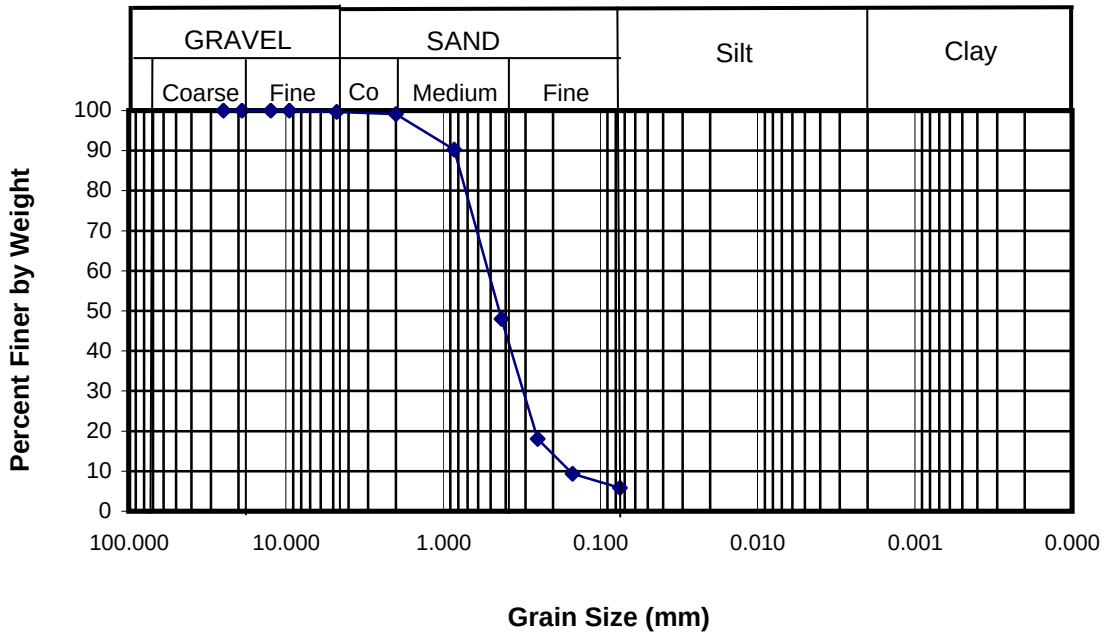
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name: **CH2M HILL - SWMUS 3, 7, & 8**
Project Number: 157234.FI.FK, CTO #: 159
Navy Clean Prime Contract N62470-95-D-6007
Number: 2649-110
Sample Number: LW07-SB25-02
Sample Type: Subsurface
Sample Description: Slightly Silty SAND (SP-SM), Tan, Fine to Medium, Trace Fine Gravel
Test Method: ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	99.7
10	99.1
20	90.3
40	48.0
60	18.1
100	9.3
200	5.8



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-A4-SD201-00-02 Sample Type: Sediment
Sample Description:	Silty, Clayey SAND (SC-SM), Olive Grey, Fine to Coarse,
	Trace Fine Gravel
Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.96	**Moisture Content (%):**	**82.1**
Initial Wet Sample Wt.	231.66	**Percent Fines:**	**46.7**
Initial Dry Sample Wt.	131.24		
Dry Wt. After Wash	74.67		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.58	99.5
3/8 Inch	9.500	0.58	99.5
4	4.750	1.59	98.7
10	2.000	2.70	97.8
20	0.850	4.14	96.6
40	0.425	14.04	88.5
60	0.250	39.54	67.7
100	0.150	52.80	56.8
200	0.075	65.12	46.7
Pan		65.55	OK

* Weigh soil only, zero scale prior to starting.

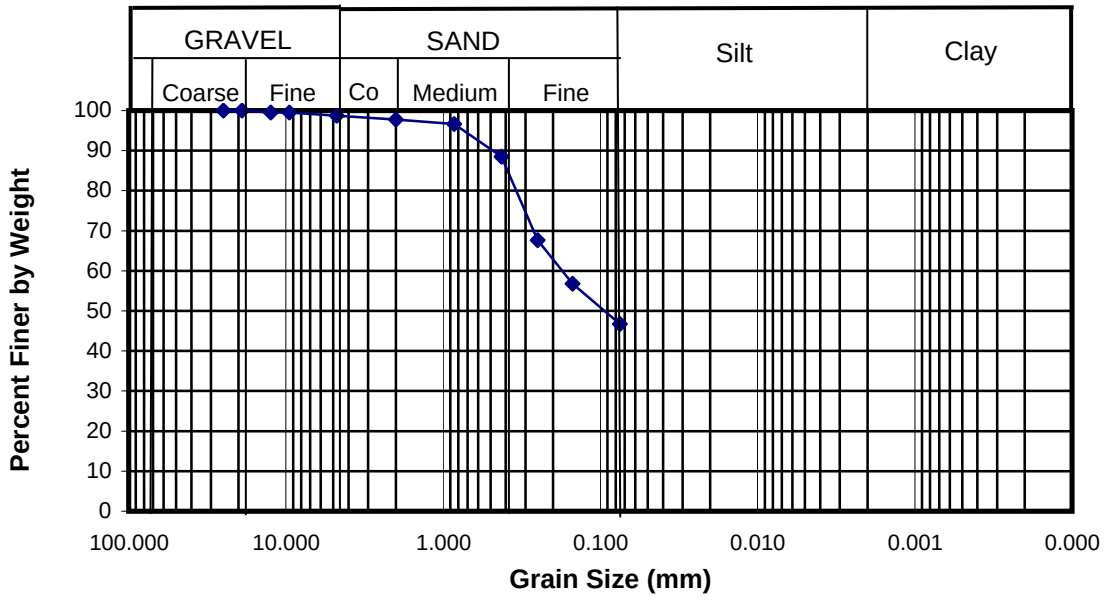
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name: **CH2M HILL - SWMUS 3, 7, & 8**
Project Number: 157234.FI.SS, CTO #: 159
Navy Clean Prime Contract N62470-95-D-6007
Number: 2649-110
Sample Number: LW07-A4-SD201-00-02C
Sample Type: Sediment
Sample Description: Silty, Clayey SAND (SC-SM), Olive Grey, Fine to Coarse, Trace Fine Gravel
Test Method: ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	99.5
4	98.7
10	97.8
20	96.6
40	88.5
60	67.7
100	56.8
200	46.7



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-A4-SD202-00-02C mple Type: Sediment
Sample Description:	Clayey SILT (CL-ML), Olive Grey, With Fine to Medium Sand,
	Trace Fine Gravel
Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.97	**Moisture Content (%):**	**94.7**
Initial Wet Sample Wt.	222.75	**Percent Fines:**	**51.7**
Initial Dry Sample Wt.	118.75		
Dry Wt. After Wash	63.46		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.84	99.2
10	2.000	1.22	98.9
20	0.850	2.65	97.6
40	0.425	11.09	89.9
60	0.250	28.80	73.8
100	0.150	39.39	64.1
200	0.075	53.06	51.7
Pan		54.13	OK

* Weigh soil only, zero scale prior to starting.

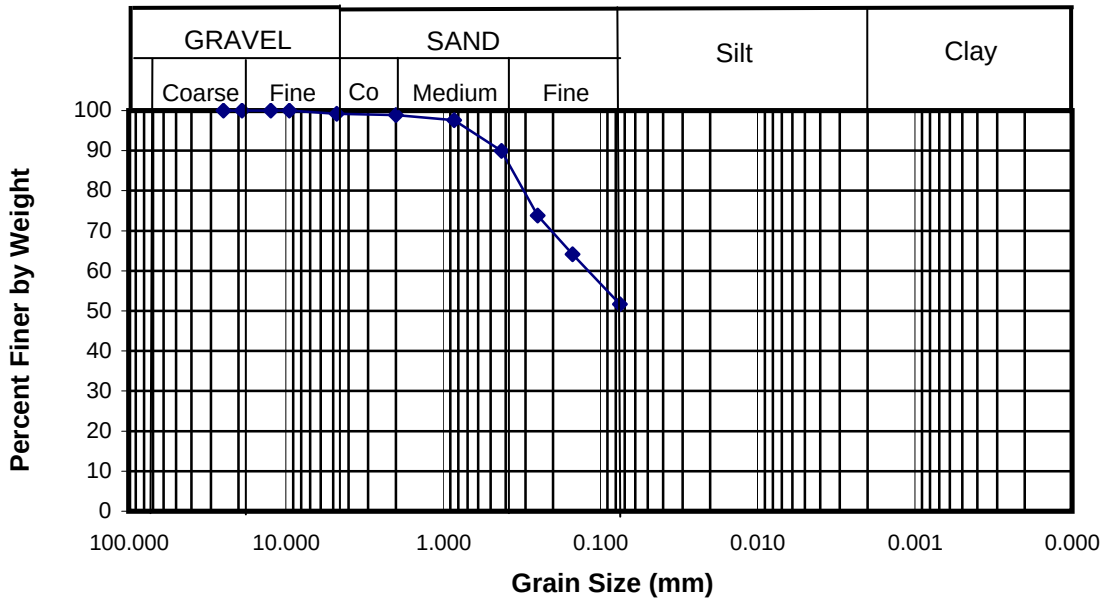
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name: **CH2M HILL - SWMUS 3, 7, & 8**
Project Number: 157234.FI.SS, CTO #: 159
Navy Clean Prime Contract N62470-95-D-6007
Number: 2649-110
Sample Number: LW07-A4-SD202-00-02C
Sample Type: Sediment
Sample Description: Clayey SILT (CL-ML), Olive Grey, With Fine to Medium Sand, Trace Fine Gravel
Test Method: ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	99.2
10	98.9
20	97.6
40	89.9
60	73.8
100	64.1
200	51.7



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-B5-SD201-02-02C mple Type: Sediment
Sample Description:	Clayey SILT (CL-ML), Olive Grey, With Fine to Medium Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	9.04	**Moisture Content (%):**	**41.9**
Initial Wet Sample Wt.	208.83	**Percent Fines:**	**60.0**
Initial Dry Sample Wt.	149.79		
Dry Wt. After Wash	69.21		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.00	100.0
10	2.000	0.02	100.0
20	0.850	0.27	99.8
40	0.425	2.02	98.6
60	0.250	6.52	95.4
100	0.150	11.38	91.9
200	0.075	56.37	60.0
Pan		60.34	OK

* Weigh soil only, zero scale prior to starting.

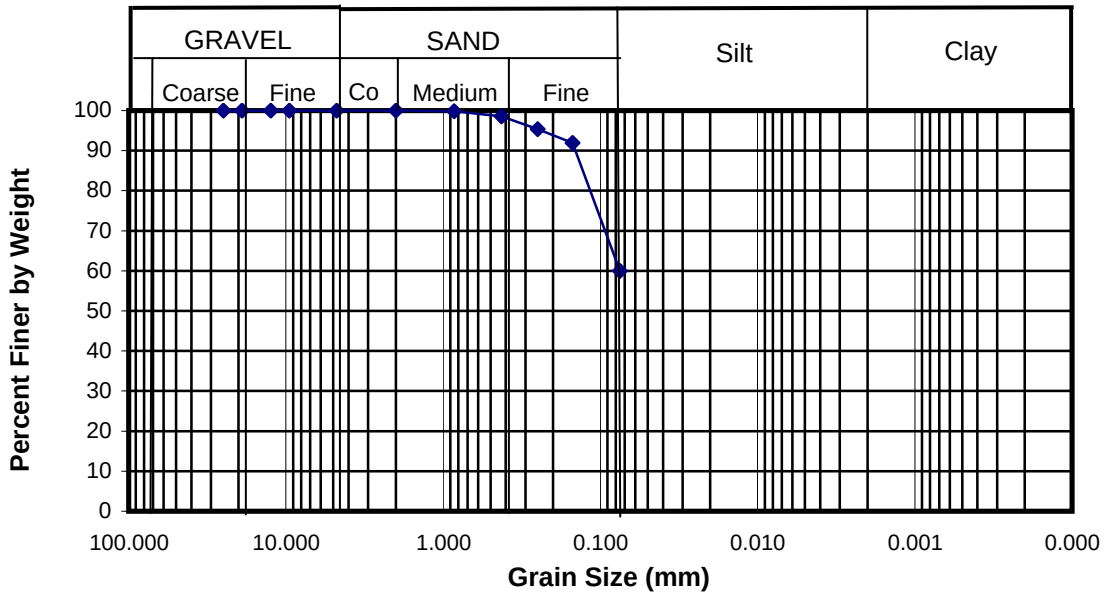
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-B5-SD201-02-02C
Sample Type:	Sediment
Sample Description:	Clayey SILT (CL-ML), Olive Grey, With Fine to Medium Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	100.0
20	99.8
40	98.6
60	95.4
100	91.9
200	60.0



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-B5-SD201 Sample Type: Sediment
Sample Description:	Clayey SILT (CL-ML), Olive Grey, With Fine to Medium Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.93	**Moisture Content (%):**	**81.8**
Initial Wet Sample Wt.	226.22	**Percent Fines:**	**62.2**
Initial Dry Sample Wt.	128.43		
Dry Wt. After Wash	54.20		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.00	100.0
10	2.000	0.09	99.9
20	0.850	1.07	99.1
40	0.425	5.43	95.5
60	0.250	15.17	87.3
100	0.150	24.14	79.8
200	0.075	45.21	62.2
Pan		45.39	OK

* Weigh soil only, zero scale prior to starting.

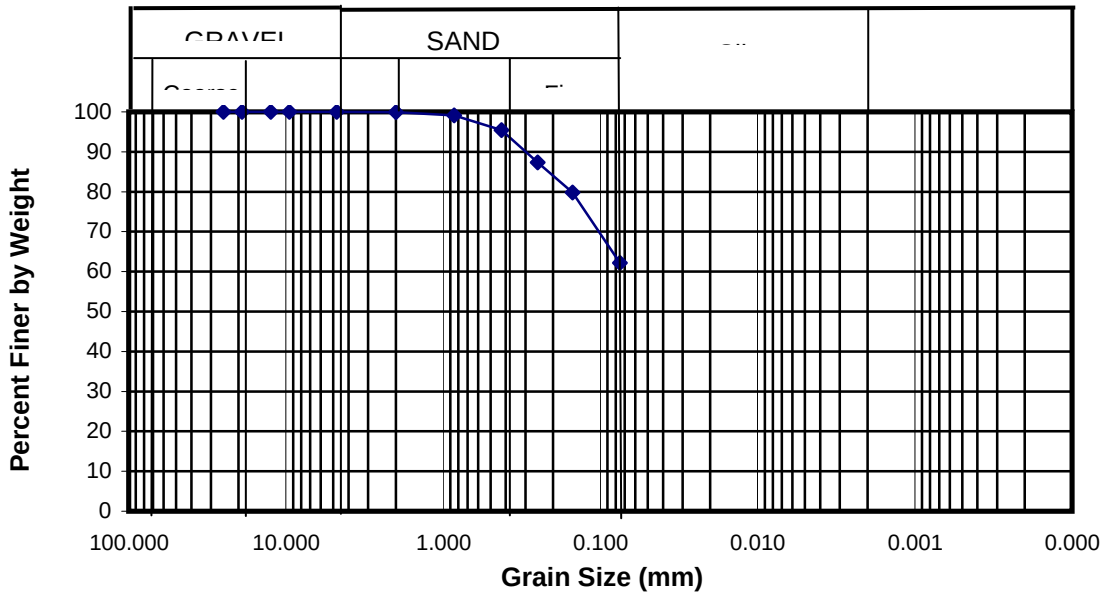
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-B5-SD201
Sample Type:	Sediment
Sample Description:	Clayey SILT (CL-ML), Olive Grey, With Fine to Medium Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	99.9
20	99.1
40	95.5
60	87.3
100	79.8
200	62.2



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-B5-SD202 Sample Type: Sediment
Sample Description:	Clayey SILT (CL-ML), Olive Grey, With Fine to Medium Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.91	**Moisture Content (%):**	**83.7**
Initial Wet Sample Wt.	237.23	**Percent Fines:**	**65.6**
Initial Dry Sample Wt.	133.18		
Dry Wt. After Wash	54.09		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.00	100.0
10	2.000	0.10	99.9
20	0.850	0.94	99.2
40	0.425	5.15	95.9
60	0.250	14.00	88.7
100	0.150	22.85	81.6
200	0.075	42.70	65.6
Pan		45.18	OK

* Weigh soil only, zero scale prior to starting.

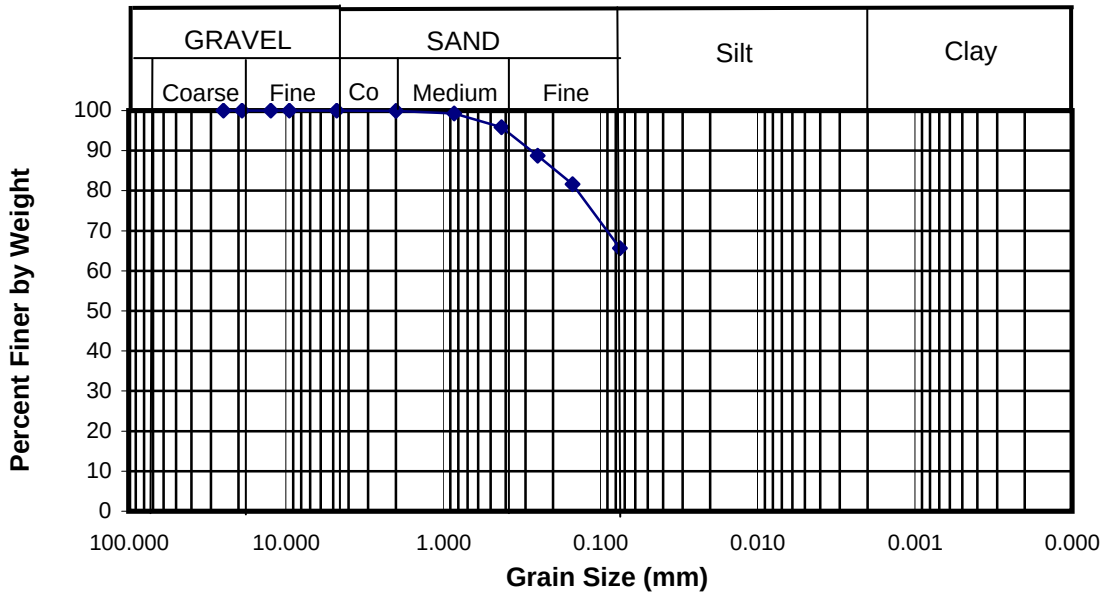
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-B5-SD202
Sample Type:	Sediment
Sample Description:	Clayey SILT (CL-ML), Olive Grey, With Fine to Medium Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	99.9
20	99.2
40	95.9
60	88.7
100	81.6
200	65.6



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-B7-SD201-02-02C mple Type: Sediment
Sample Description:	Silty SAND (SM), Olive Grey, Fine to Medium, Trace Shell Fragr

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.90	**Moisture Content (%):**	**32.3**
Initial Wet Sample Wt.	234.81	**Percent Fines:**	**24.6**
Initial Dry Sample Wt.	179.67		
Dry Wt. After Wash	139.03		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.69	99.6
10	2.000	2.37	98.6
20	0.850	12.37	92.8
40	0.425	56.56	66.9
60	0.250	89.25	47.7
100	0.150	103.13	39.6
200	0.075	128.76	24.6
Pan		130.70	OK

* Weigh soil only, zero scale prior to starting.

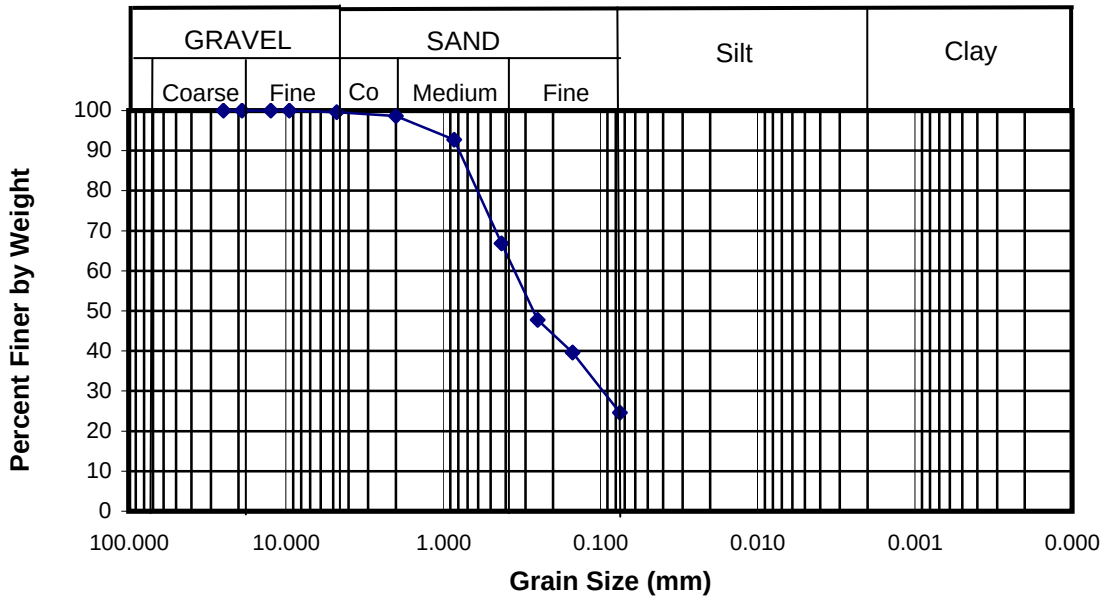
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-B7-SD201-02-02C
Sample Type:	Sediment
Sample Description:	Silty SAND (SM), Olive Grey, Fine to Medium, Trace Shell Fragments
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	99.6
10	98.6
20	92.8
40	66.9
60	47.7
100	39.6
200	24.6



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-B7-SD202
Sample Type:	Sediment
Sample Description:	

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	9.00	**Moisture Content (%):**	**100.8**
Initial Wet Sample Wt.	229.23	**Percent Fines:**	**58.9**
Initial Dry Sample Wt.	118.67		
Dry Wt. After Wash	54.84		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	6.89	93.7
10	2.000	8.43	92.3
20	0.850	9.52	91.3
40	0.425	13.08	88.1
60	0.250	21.88	80.0
100	0.150	29.93	72.7
200	0.075	45.09	58.9
Pan		45.87	OK

* Weigh soil only, zero scale prior to starting.

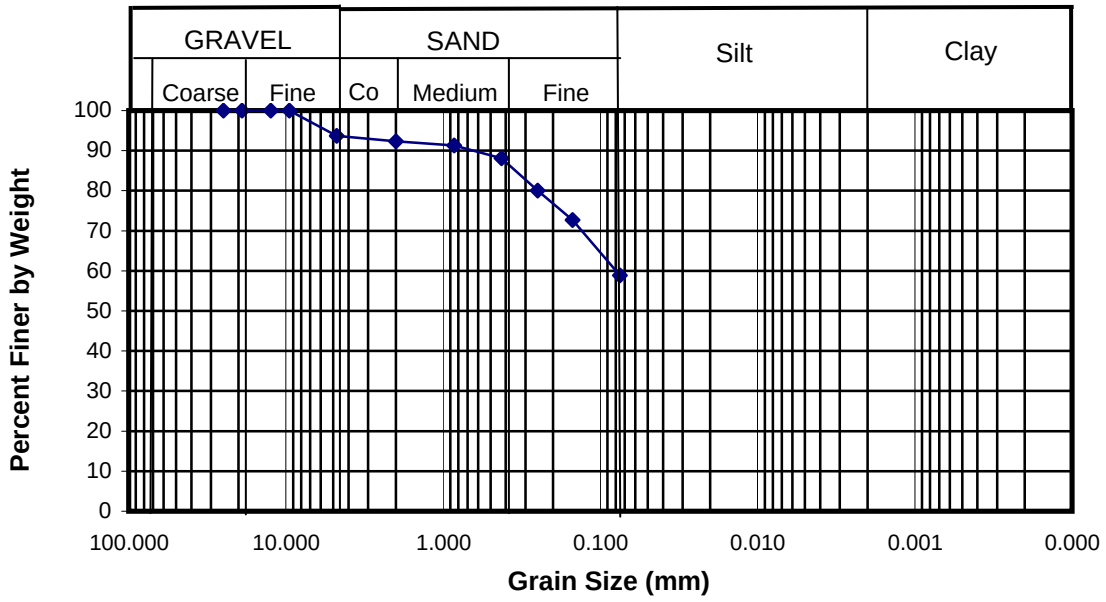
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name: **CH2M HILL - SWMUS 3, 7, & 8**
Project Number: 157234.FI.SS, CTO #: 159
Navy Clean Prime Contract N62470-95-D-6007
Number: 2649-110
Sample Number: LW07-B7-SD202
Sample Type: Sediment
Sample Description: Sandy CLAY (CL) ,Olive Grey, Trace Shell Fragments
Test Method: ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	93.7
10	92.3
20	91.3
40	88.1
60	80.0
100	72.7
200	58.9



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-D5-SD201-02-02 Sample Type: Sediment
Sample Description:	Clayey SILT (CL-ML), Dark Grey, With Fine to Medium Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	9.04	**Moisture Content (%):**	**67.5**
Initial Wet Sample Wt.	236.88	**Percent Fines:**	**63.1**
Initial Dry Sample Wt.	145.10		
Dry Wt. After Wash	59.68		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.00	100.0
10	2.000	0.41	99.7
20	0.850	3.57	97.4
40	0.425	15.61	88.5
60	0.250	34.21	74.9
100	0.150	43.18	68.3
200	0.075	50.20	63.1
Pan		50.41	OK

* Weigh soil only, zero scale prior to starting.

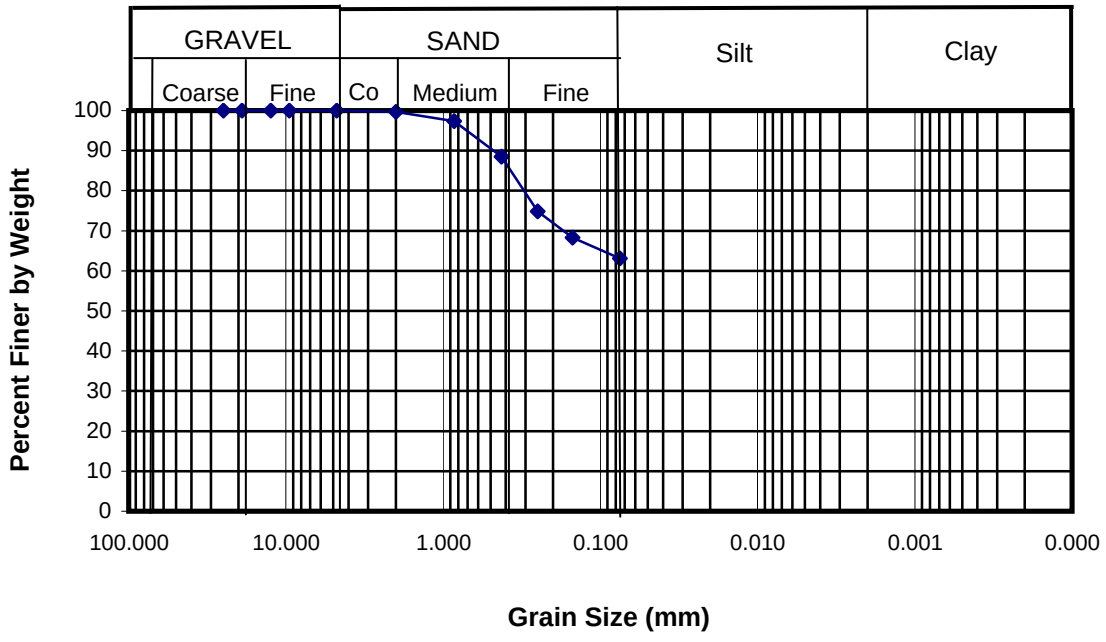
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-D5-SD201-02-02C
Sample Type:	Sediment
Sample Description:	Clayey SILT (CL-ML), Dark Grey, With Fine to Medium Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	99.7
20	97.4
40	88.5
60	74.9
100	68.3
200	63.1



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-D5-SD201 Sample Type: Sediment
Sample Description:	Clayey SILT (CL-ML), Olive Grey, With Fine to Medium Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.98	**Moisture Content (%):**	**141.4**
Initial Wet Sample Wt.	224.53	**Percent Fines:**	**89.2**
Initial Dry Sample Wt.	98.27		
Dry Wt. After Wash	19.53		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.00	100.0
10	2.000	0.10	99.9
20	0.850	0.35	99.6
40	0.425	1.58	98.2
60	0.250	3.38	96.2
100	0.150	4.74	94.7
200	0.075	9.68	89.2
Pan		10.41	OK

* Weigh soil only, zero scale prior to starting.

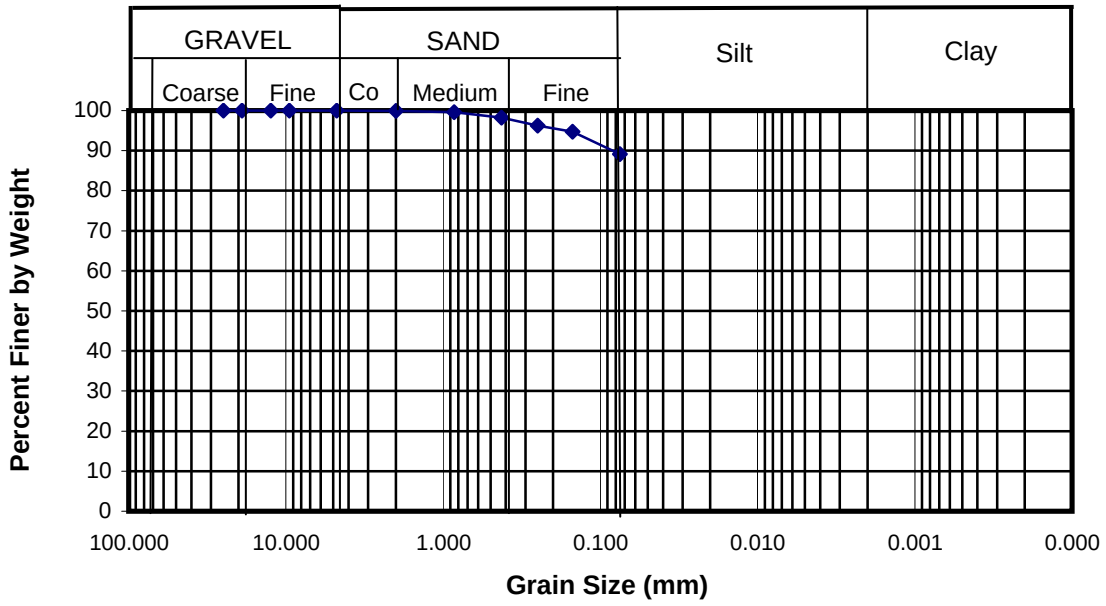
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-D5-SD201
Sample Type:	Sediment
Sample Description:	Clayey SILT (CL-ML), Olive Grey, With Fine to Medium Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	99.9
20	99.6
40	98.2
60	96.2
100	94.7
200	89.2



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-D5-SD202 Sample Type: Sediment
Sample Description:	CLAY With Sand (CL), Olive Grey, Trace Shell Fragments

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	9.08	**Moisture Content (%):**	**136.1**
Initial Wet Sample Wt.	218.41	**Percent Fines:**	**82.5**
Initial Dry Sample Wt.	97.74		
Dry Wt. After Wash	24.74		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.62	99.3
10	2.000	0.74	99.2
20	0.850	1.26	98.6
40	0.425	3.44	96.1
60	0.250	7.52	91.5
100	0.150	9.85	88.9
200	0.075	15.48	82.5
Pan		16.00	OK

* Weigh soil only, zero scale prior to starting.

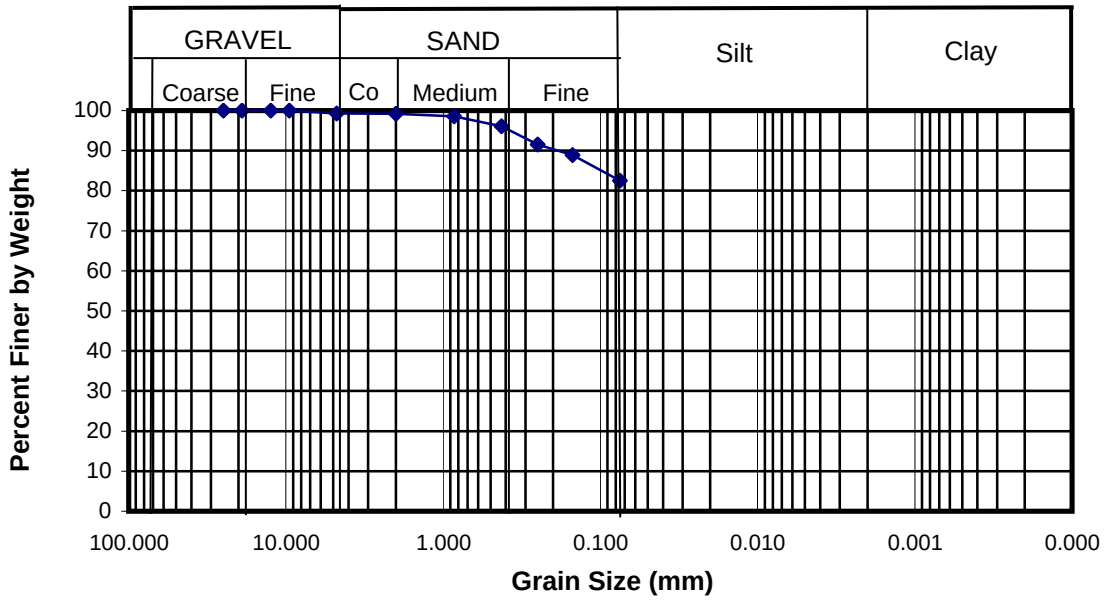
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name: **CH2M HILL - SWMUS 3, 7, & 8**
Project Number: 157234.FI.SS, CTO #: 159
Navy Clean Prime Contract N62470-95-D-6007
Number: 2649-110
Sample Number: LW07-D5-SD202
Sample Type: Sediment
Sample Description: CLAY With Sand (CL), Olive Grey, Trace Shell Fragments
Test Method: ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	99.3
10	99.2
20	98.6
40	96.1
60	91.5
100	88.9
200	82.5



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8		
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159		
	Navy Clean Prime Contract N62470-95-D-6007		
Number:	2649-110		
Sample No.:	LW07-F3-SD201	Sample Type:	Sediment
Sample Description:	Clayey SAND (SC), Olive Grey, Fine to Coarse, Trace Shell Fragments		

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.95	**Moisture Content (%):**	**61.4**
Initial Wet Sample Wt.	243.97	**Percent Fines:**	**30.6**
Initial Dry Sample Wt.	154.53		
Dry Wt. After Wash	110.74		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	7.58	94.8
10	2.000	13.09	91.0
20	0.850	19.36	86.7
40	0.425	36.45	75.0
60	0.250	58.46	59.8
100	0.150	74.24	49.0
200	0.075	101.06	30.6
Pan		101.84	OK

* Weigh soil only, zero scale prior to starting.

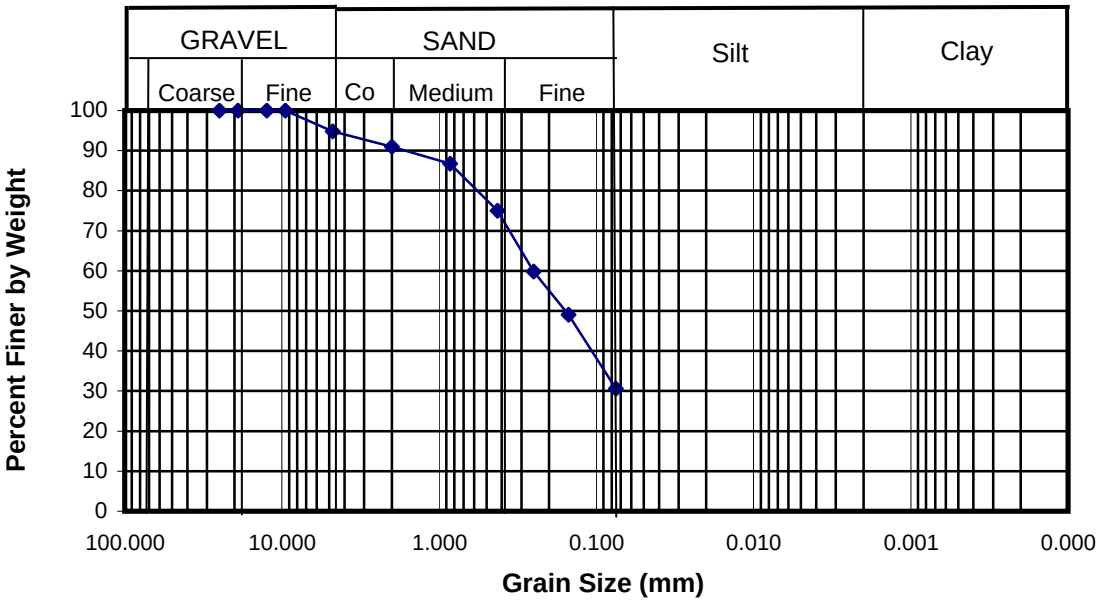
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-F3-SD201
Sample Type:	Sediment
Sample Description:	Clayey SAND (SC), Olive Grey, Fine to Coarse, Trace Shell Fragments
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	94.8
10	91.0
20	86.7
40	75.0
60	59.8
100	49.0
200	30.6



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-F3-SD202-02-02 Sample Type: Sediment
Sample Description:	Sandy CLAY (CL), Olive Grey, With Fine to Medium Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.94	**Moisture Content (%):**	**67.7**
Initial Wet Sample Wt.	226.07	**Percent Fines:**	**53.7**
Initial Dry Sample Wt.	138.44		
Dry Wt. After Wash	69.79		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.00	100.0
10	2.000	0.00	100.0
20	0.850	1.25	99.0
40	0.425	10.45	91.9
60	0.250	27.99	78.4
100	0.150	45.42	64.9
200	0.075	59.97	53.7
Pan		60.72	OK

* Weigh soil only, zero scale prior to starting.

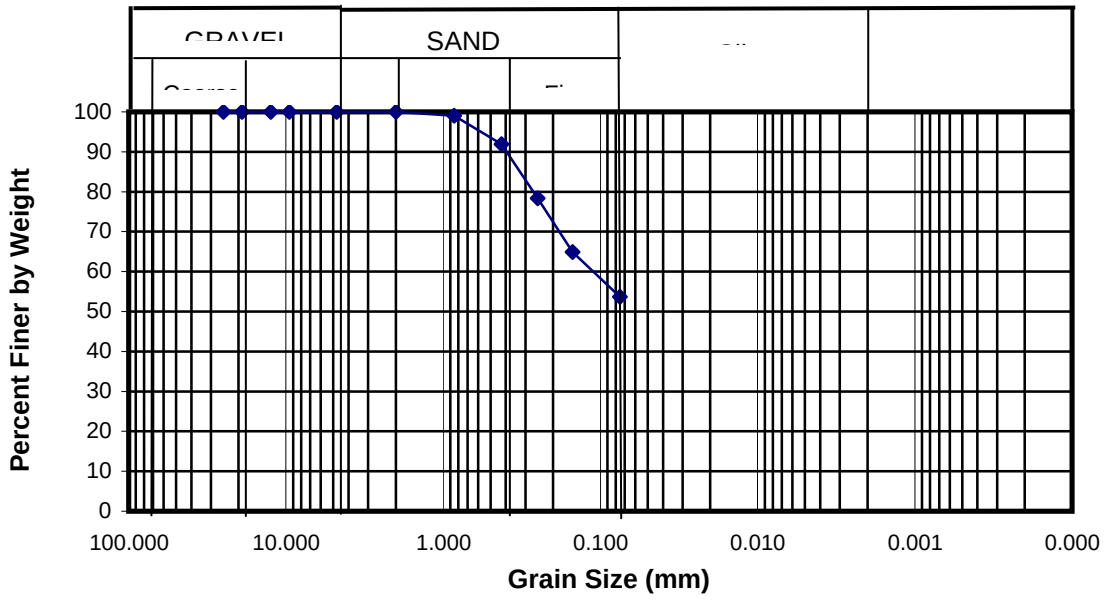
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-F3-SD202-02-02C
Sample Type:	Sediment
Sample Description:	Sandy CLAY (CL), Olive Grey, With Fine to Medium Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	100.0
20	99.0
40	91.9
60	78.4
100	64.9
200	53.7



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-F3-SD202 Sample Type: Sediment
Sample Description:	Sandy Clay (CL), Olive Grey, Trace Shell Fragments
Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.87	**Moisture Content (%):**	**87.1**
Initial Wet Sample Wt.	232.57	**Percent Fines:**	**58.3**
Initial Dry Sample Wt.	128.41		
Dry Wt. After Wash	59.86		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	2.44	98.0
10	2.000	5.42	95.5
20	0.850	7.43	93.8
40	0.425	9.34	92.2
60	0.250	12.75	89.3
100	0.150	19.93	83.3
200	0.075	49.83	58.3
Pan		50.93	OK

* Weigh soil only, zero scale prior to starting.

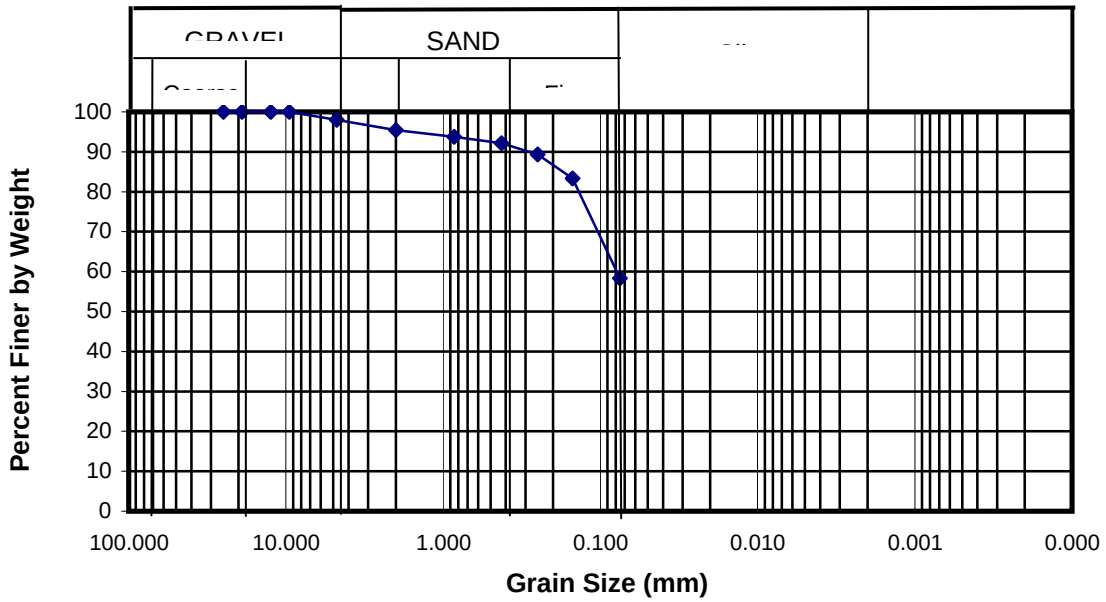
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-F3-SD202
Sample Type:	Sediment
Sample Description:	Sandy Clay (CL), Olive Grey, Trace Shell Fragments
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	98.0
10	95.5
20	93.8
40	92.2
60	89.3
100	83.3
200	58.3



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.SS.FK, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-F5-SD201-00-02 Sample Type: Sediment
Sample Description:	Clayey SAND (SC), Olive Grey, Fine To Medium

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.92	**Moisture Content (%):**	**38.3**
Initial Wet Sample Wt.	214.83	**Percent Fines:**	**29.5**
Initial Dry Sample Wt.	157.77		
Dry Wt. After Wash	115.64		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	1.37	99.1
10	2.000	2.70	98.2
20	0.850	11.11	92.5
40	0.425	36.59	75.4
60	0.250	63.83	57.1
100	0.150	79.72	46.4
200	0.075	104.89	29.5
Pan		106.51	OK

* Weigh soil only, zero scale prior to starting.

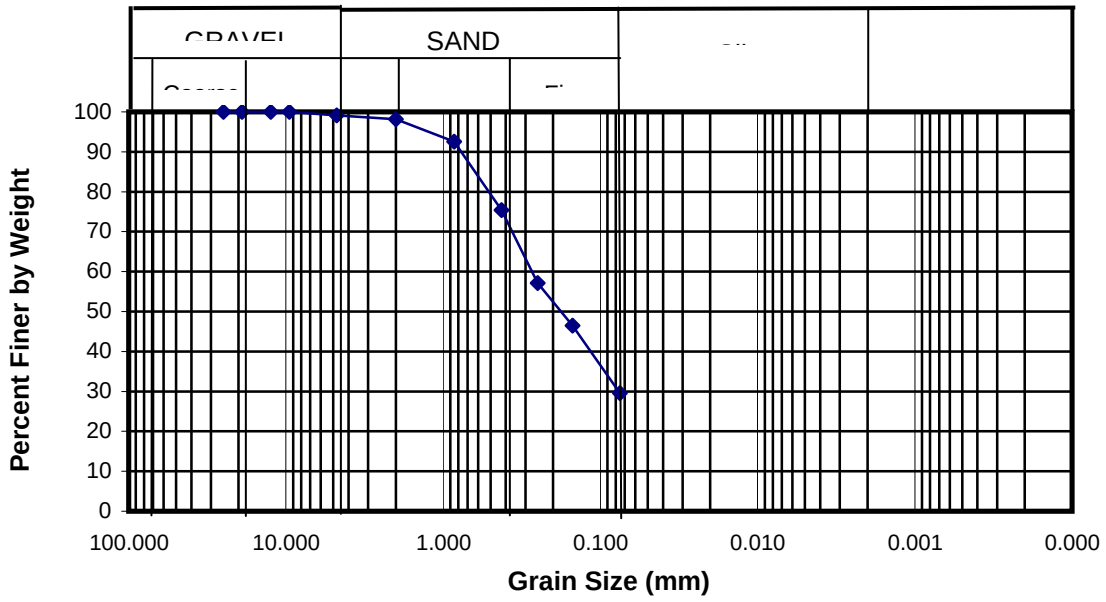
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.SS.FK, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-F5-SD201-00-02C
Sample Type:	Sediment
Sample Description:	Clayey SAND (SC), Olive Grey, Fine To Medium
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	99.1
10	98.2
20	92.5
40	75.4
60	57.1
100	46.4
200	29.5



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-F5-SD202-02-02 Sample Type: Sediment
Sample Description:	Clayey SAND (SC), Olive Grey, Fine to Medium

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.91	**Moisture Content (%):**	**26.5**
Initial Wet Sample Wt.	241.45	**Percent Fines:**	**17.9**
Initial Dry Sample Wt.	192.74		
Dry Wt. After Wash	166.95		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.00	100.0
10	2.000	0.10	99.9
20	0.850	1.16	99.4
40	0.425	6.90	96.2
60	0.250	17.20	90.6
100	0.150	41.97	77.2
200	0.075	150.89	17.9
Pan		157.62	OK

* Weigh soil only, zero scale prior to starting.

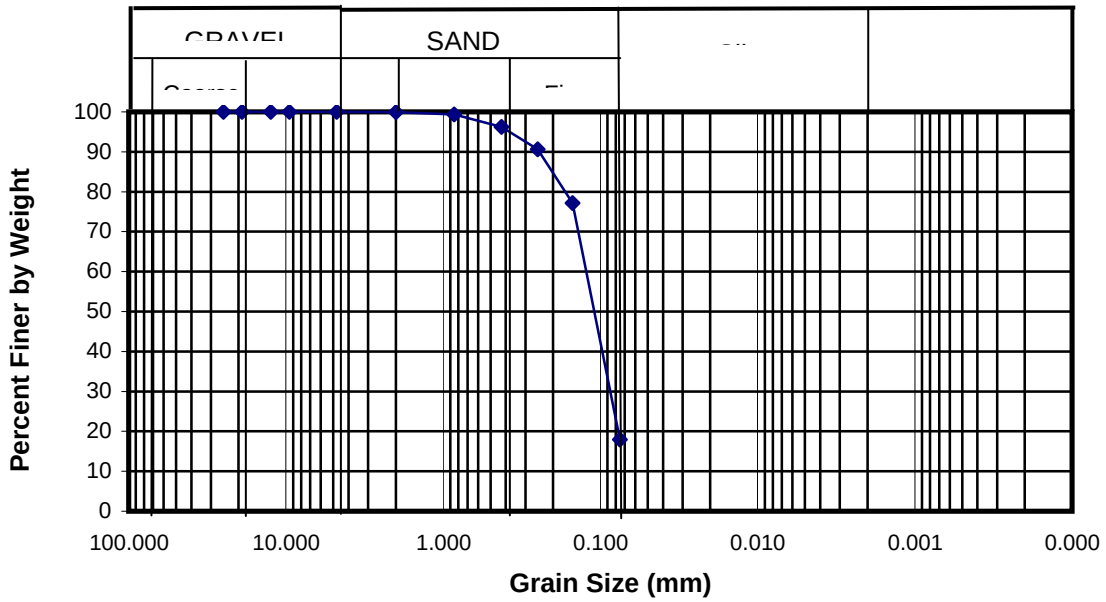
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-F5-SD202-02-02C
Sample Type:	Sediment
Sample Description:	Clayey Sand (SC), Olive Grey, Fine to Medium
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	99.9
20	99.4
40	96.2
60	90.6
100	77.2
200	17.9



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-F5-SD202 Sample Type: Sediment
Sample Description:	Silty SAND (SM), Olive Grey, Fine to Medium

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	9.00	**Moisture Content (%):**	**45.3**
Initial Wet Sample Wt.	246.33	**Percent Fines:**	**36.0**
Initial Dry Sample Wt.	172.38		
Dry Wt. After Wash	115.33		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.09	99.9
10	2.000	1.08	99.3
20	0.850	3.17	98.1
40	0.425	15.72	90.4
60	0.250	48.65	70.2
100	0.150	74.37	54.5
200	0.075	104.51	36.0
Pan		105.54	OK

* Weigh soil only, zero scale prior to starting.

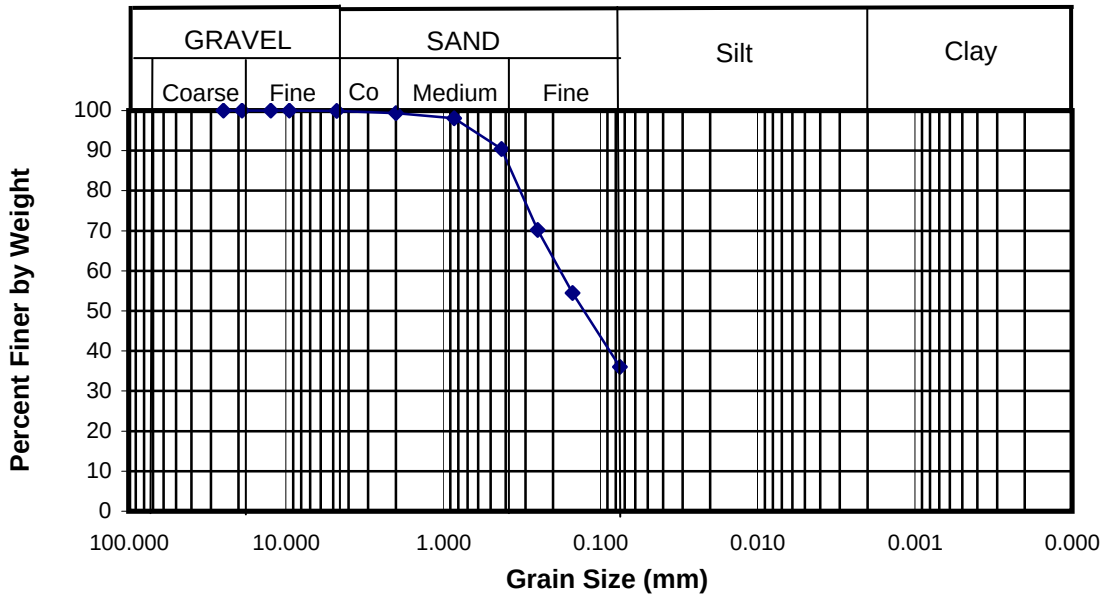
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-F5-SD202
Sample Type:	Sediment
Sample Description:	Silty SAND (SM), Olive Grey, Fine to Medium
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	99.9
10	99.3
20	98.1
40	90.4
60	70.2
100	54.5
200	36.0



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-H1-SD201-00 Sample Type: Sediment
Sample Description:	Silty CLAY (CL-ML), Dark Grey, With Fine to Medium Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.95	**Moisture Content (%):**	**129.6**
Initial Wet Sample Wt.	227.76	**Percent Fines:**	**65.9**
Initial Dry Sample Wt.	104.24		
Dry Wt. After Wash	41.65		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.03	100.0
10	2.000	0.29	99.7
20	0.850	0.82	99.1
40	0.425	6.88	92.8
60	0.250	19.28	79.8
100	0.150	26.70	72.0
200	0.075	32.48	65.9
Pan		32.79	OK

* Weigh soil only, zero scale prior to starting.

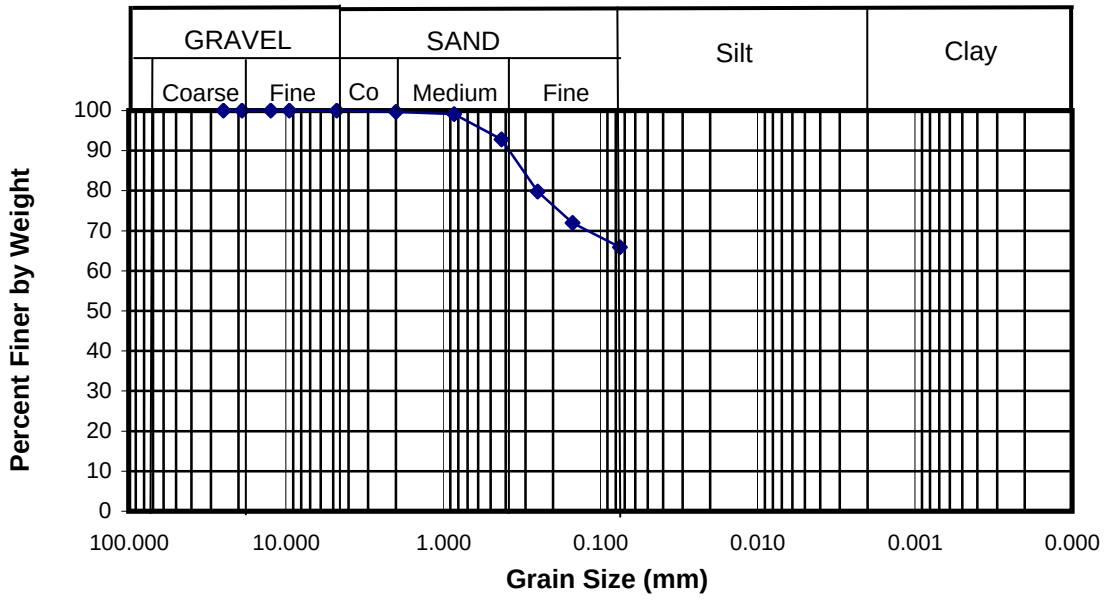
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-H1-SD201-00
Sample Type:	Sediment
Sample Description:	Silty CLAY (CL-ML), Dark Grey, With Fine to Medium Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	99.7
20	99.1
40	92.8
60	79.8
100	72.0
200	65.9



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-H1-SD202-00 Sample Type: Sediment
Sample Description:	Silty CLAY (CL-ML) Olive Grey With Fine Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.93	**Moisture Content (%):**	**152.4**
Initial Wet Sample Wt.	221.58	**Percent Fines:**	**80.6**
Initial Dry Sample Wt.	93.18		
Dry Wt. After Wash	25.47		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.00	100.0
10	2.000	0.22	99.7
20	0.850	0.60	99.3
40	0.425	2.27	97.3
60	0.250	6.30	92.5
100	0.150	10.26	87.8
200	0.075	16.35	80.6
Pan		16.52	OK

* Weigh soil only, zero scale prior to starting.

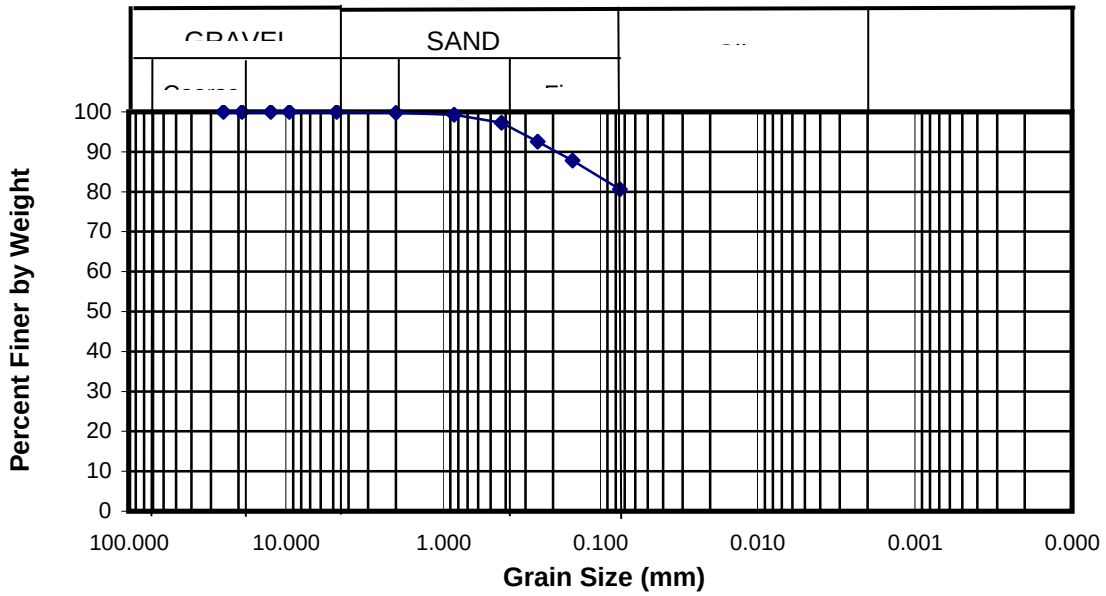
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name: **CH2M HILL - SWMUS 3, 7, & 8**
Project Number: 157234.FI.SS, CTO #: 159
Navy Clean Prime Contract N62470-95-D-6007
Number: 2649-110
Sample Number: LW07-H1-SD202-00
Sample Type: Sediment
Sample Description: Silty CLAY (CL-ML) Olive Grey With Fine Sand
Test Method: ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	99.7
20	99.3
40	97.3
60	92.5
100	87.8
200	80.6



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-H3-SD201-00-02 Sample Type: Sediment
Sample Description:	Silty CLAY (CL-ML), Olive Grey With Fine Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	9.11	**Moisture Content (%):**	**127.1**
Initial Wet Sample Wt.	231.83	**Percent Fines:**	**75.3**
Initial Dry Sample Wt.	107.17		
Dry Wt. After Wash	34.31		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.53	99.5
10	2.000	0.63	99.4
20	0.850	0.91	99.1
40	0.425	1.40	98.6
60	0.250	4.90	95.0
100	0.150	10.97	88.8
200	0.075	24.24	75.3
Pan		25.10	OK

* Weigh soil only, zero scale prior to starting.

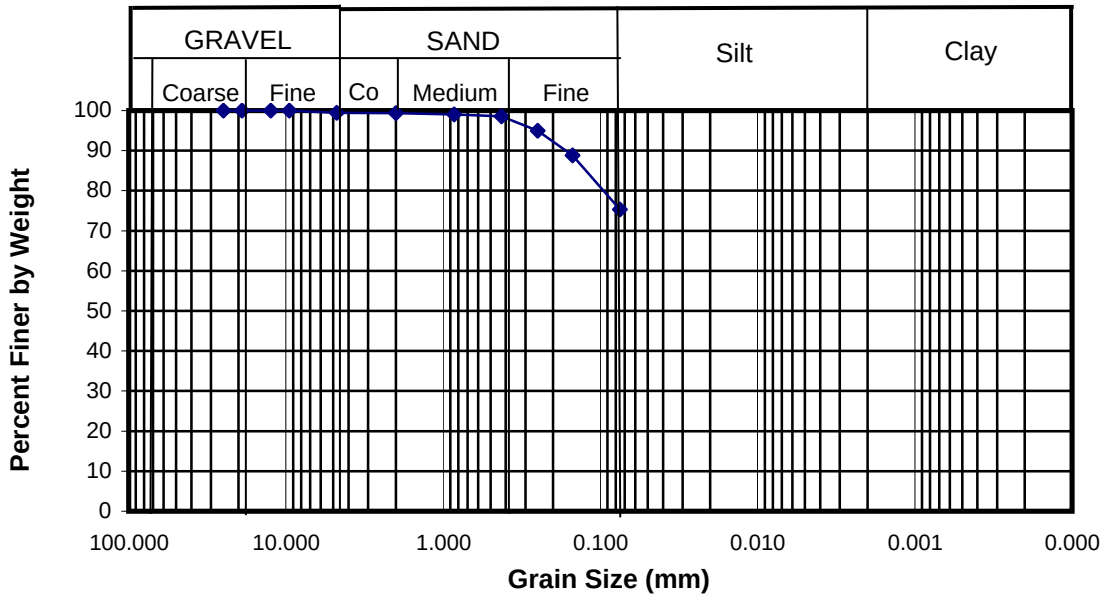
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-H3-SD201-00-02C
Sample Type:	Sediment
Sample Description:	Silty CLAY (CL-ML), Olive Grey With Fine Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	99.5
10	99.4
20	99.1
40	98.6
60	95.0
100	88.8
200	75.3



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-H3-SD201-02-02 Sample Type: Sediment
Sample Description:	Silty CLAY (CL-ML), Olive Grey, With Fine Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	9.07	**Moisture Content (%):**	**88.4**
Initial Wet Sample Wt.	236.52	**Percent Fines:**	**93.5**
Initial Dry Sample Wt.	129.80		
Dry Wt. After Wash	17.07		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.00	100.0
10	2.000	0.09	99.9
20	0.850	0.31	99.7
40	0.425	2.15	98.2
60	0.250	4.45	96.3
100	0.150	5.90	95.1
200	0.075	7.90	93.5
Pan		7.95	OK

* Weigh soil only, zero scale prior to starting.

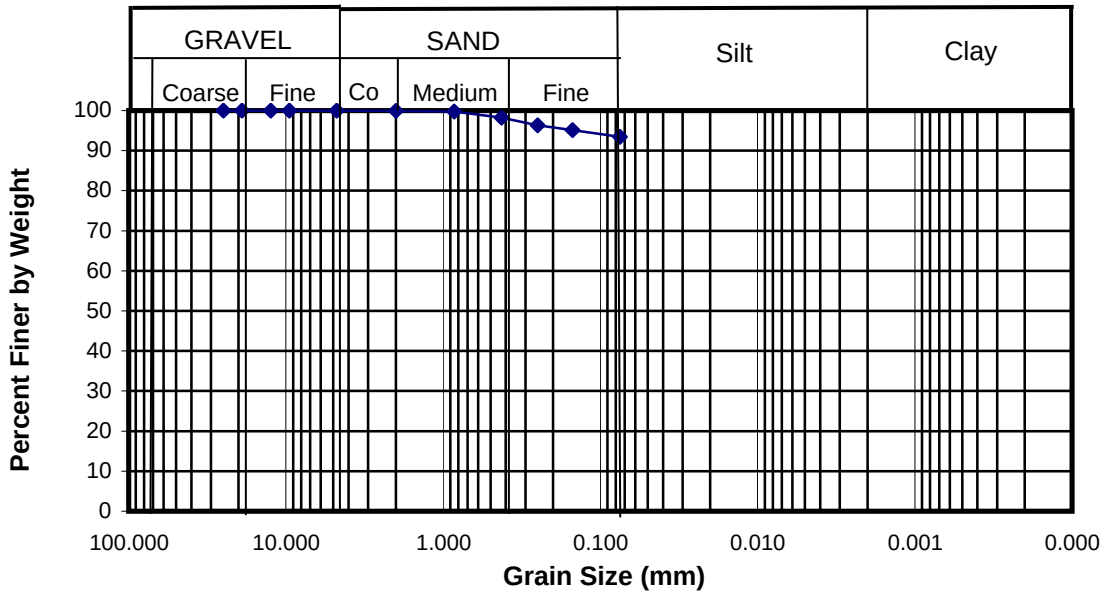
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-H3-SD201-02-02C
Sample Type:	Sediment
Sample Description:	Silty CLAY (CL-ML), Olive Grey, With Fine Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	99.9
20	99.7
40	98.2
60	96.3
100	95.1
200	93.5



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-H5-SD201-00-02 Sample Type: Sediment
Sample Description:	Slightly Silty SAND (SP-SM), Olive Grey, Fine to Coarse, Trace

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.94	**Moisture Content (%):**	**33.7**
Initial Wet Sample Wt.	251.28	**Percent Fines:**	**11.1**
Initial Dry Sample Wt.	190.22		
Dry Wt. After Wash	170.67		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.64	99.6
4	4.750	3.94	97.8
10	2.000	8.51	95.3
20	0.850	20.51	88.7
40	0.425	63.01	65.2
60	0.250	120.25	33.7
100	0.150	147.34	18.7
200	0.075	161.22	11.1
Pan		161.44	OK

* Weigh soil only, zero scale prior to starting.

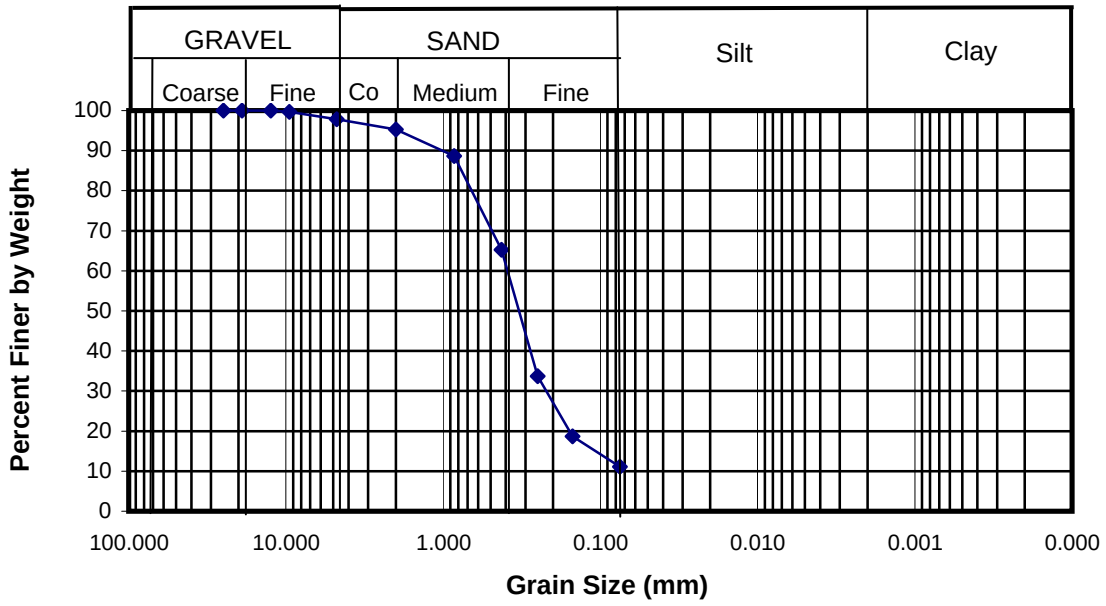
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-H5-SD201-00-02C
Sample Type:	Sediment
Sample Description:	Slightly Silty SAND (SP-SM), Olive Grey, Fine to Coarse, Trace Gravel
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	99.6
4	97.8
10	95.3
20	88.7
40	65.2
60	33.7
100	18.7
200	11.1



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-H5-SD201-02 Sample Type: Sediment
Sample Description:	Silty CLAY (CL-ML), Olive Grey With Fine to Medium Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	9.04	**Moisture Content (%):**	**85.6**
Initial Wet Sample Wt.	218.15	**Percent Fines:**	**71.5**
Initial Dry Sample Wt.	121.69		
Dry Wt. After Wash	41.93		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.09	99.9
10	2.000	0.67	99.4
20	0.850	3.37	97.0
40	0.425	12.93	88.5
60	0.250	19.84	82.4
100	0.150	22.69	79.9
200	0.075	32.06	71.5
Pan		32.68	OK

* Weigh soil only, zero scale prior to starting.

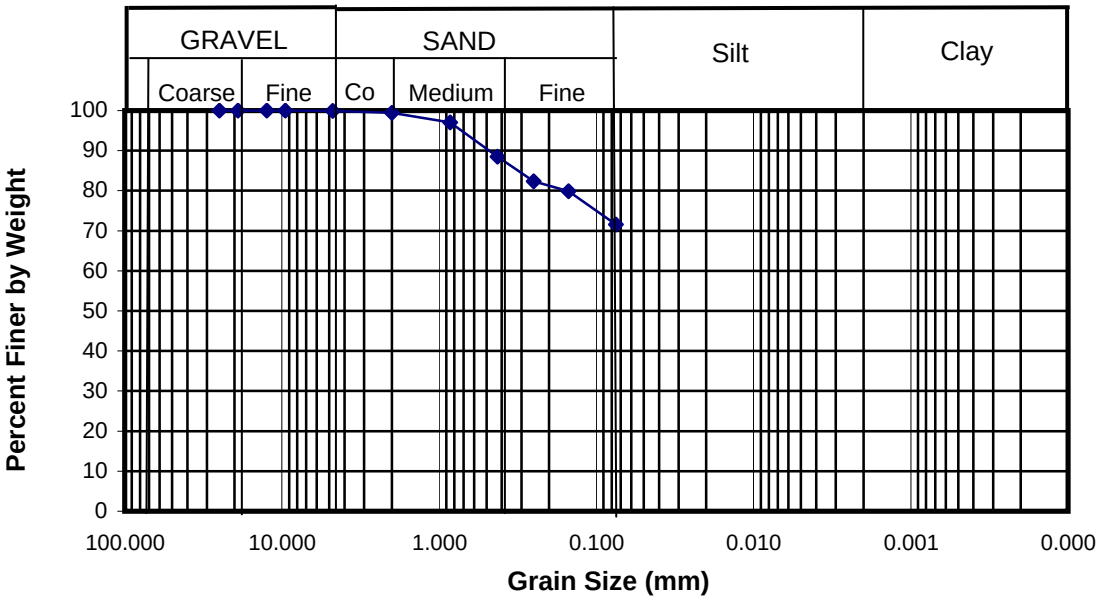
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name: **CH2M HILL - SWMUS 3, 7, & 8**
Project Number: 157234.FI.SS, CTO #: 159
Navy Clean Prime Contract N62470-95-D-6007
Number: 2649-110
Sample Number: LW07-H5-SD201-02
Sample Type: Sediment
Sample Description: Silty CLAY (CL-ML), Olive Grey With Fine to Medium Sand
Test Method: ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	99.9
10	99.4
20	97.0
40	88.5
60	82.4
100	79.9
200	71.5



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-J4-SD201-00-02 Sample Type: Sediment
Sample Description:	Silty Clay (CL-ML), Dark Grey, With Fine Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	9.00	**Moisture Content (%):**	**120.3**
Initial Wet Sample Wt.	254.48	**Percent Fines:**	**74.3**
Initial Dry Sample Wt.	120.45		
Dry Wt. After Wash	38.10		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.00	100.0
10	2.000	0.08	99.9
20	0.850	0.38	99.7
40	0.425	2.87	97.4
60	0.250	10.68	90.4
100	0.150	18.01	83.8
200	0.075	28.67	74.3
Pan		28.88	OK

* Weigh soil only, zero scale prior to starting.

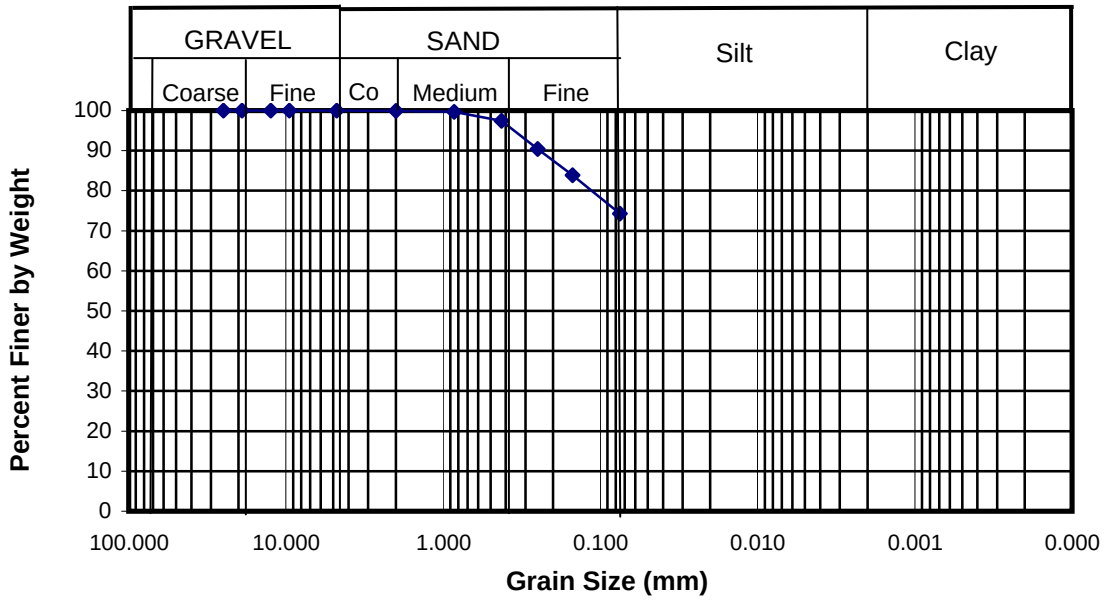
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-J4-SD201-00-02C
Sample Type:	Sediment
Sample Description:	Silty Clay (CL-ML), Dark Grey, With Fine Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	99.9
20	99.7
40	97.4
60	90.4
100	83.8
200	74.3



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-J4-SD201-02-02 Sample Type: Sediment
Sample Description:	Clayey SAND (SC), Dark Grey, Fine

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.89	**Moisture Content (%):**	**42.4**
Initial Wet Sample Wt.	240.24	**Percent Fines:**	**37.3**
Initial Dry Sample Wt.	171.36		
Dry Wt. After Wash	112.26		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.04	100.0
10	2.000	0.07	100.0
20	0.850	0.49	99.7
40	0.425	8.07	95.0
60	0.250	45.99	71.7
100	0.150	78.14	51.9
200	0.075	101.84	37.3
Pan		103.00	OK

* Weigh soil only, zero scale prior to starting.

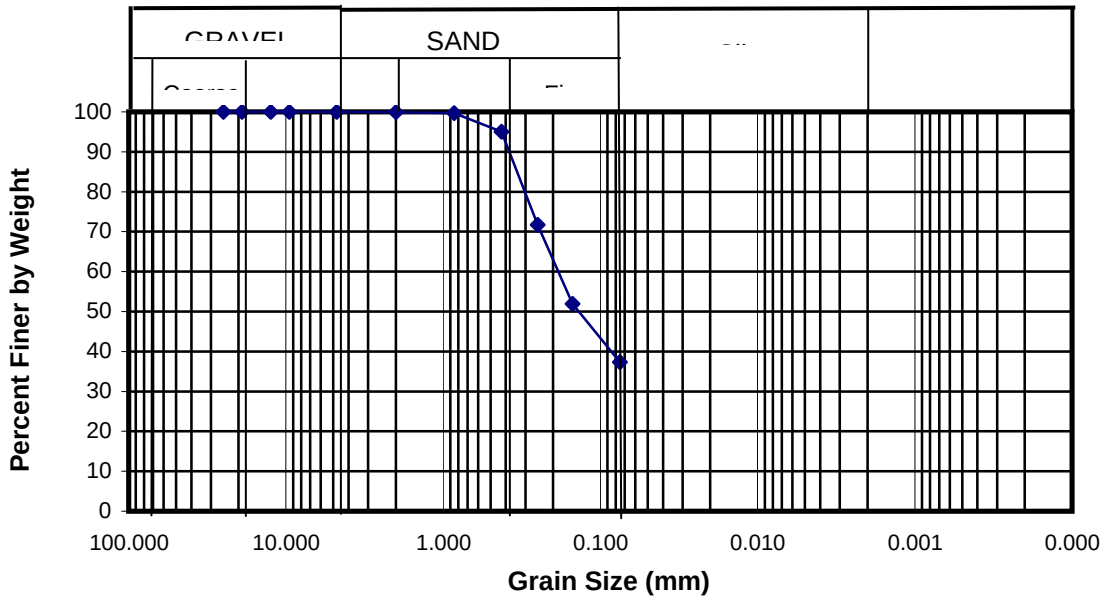
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-J4-SD201-02-02C
Sample Type:	Sediment
Sample Description:	Clayey SAND (SC), Dark Grey, Fine
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	100.0
20	99.7
40	95.0
60	71.7
100	51.9
200	37.3



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-J4-SD202-00-02 Sample Type: Sediment
Sample Description:	Silty CLAY (CL-ML), Olive Grey, With Fine Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.99	**Moisture Content (%):**	**117.8**
Initial Wet Sample Wt.	230.15	**Percent Fines:**	**75.8**
Initial Dry Sample Wt.	110.55		
Dry Wt. After Wash	34.30		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.28	99.7
10	2.000	0.47	99.5
20	0.850	0.76	99.3
40	0.425	2.89	97.2
60	0.250	10.58	89.6
100	0.150	17.17	83.1
200	0.075	24.58	75.8
Pan		24.80	OK

* Weigh soil only, zero scale prior to starting.

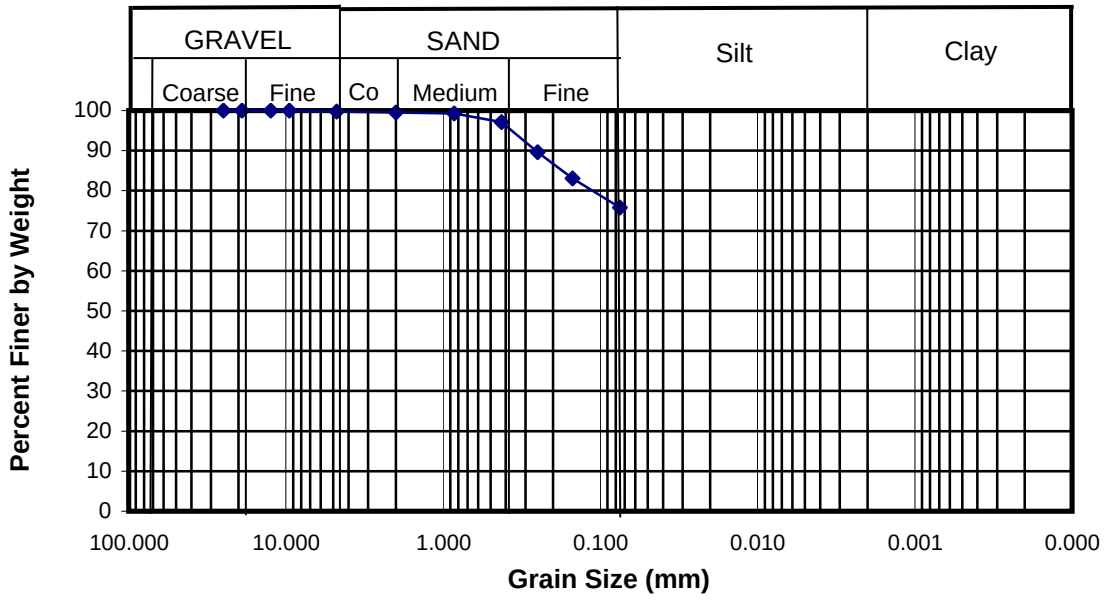
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-J4-SD202-00-02C
Sample Type:	Sediment
Sample Description:	Silty CLAY (CL-ML), Olive Grey, With Fine Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	99.7
10	99.5
20	99.3
40	97.2
60	89.6
100	83.1
200	75.8



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-K1-SD201-00-02 Sample Type: Sediment
Sample Description:	Silty CLAY (CL-ML),Olive Grey, With Fine Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.94	**Moisture Content (%):**	**154.0**
Initial Wet Sample Wt.	215.31	**Percent Fines:**	**92.0**
Initial Dry Sample Wt.	90.18		
Dry Wt. After Wash	15.71		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.01	100.0
10	2.000	0.14	99.8
20	0.850	0.42	99.5
40	0.425	1.08	98.7
60	0.250	2.13	97.4
100	0.150	3.43	95.8
200	0.075	6.53	92.0
Pan		6.62	OK

* Weigh soil only, zero scale prior to starting.

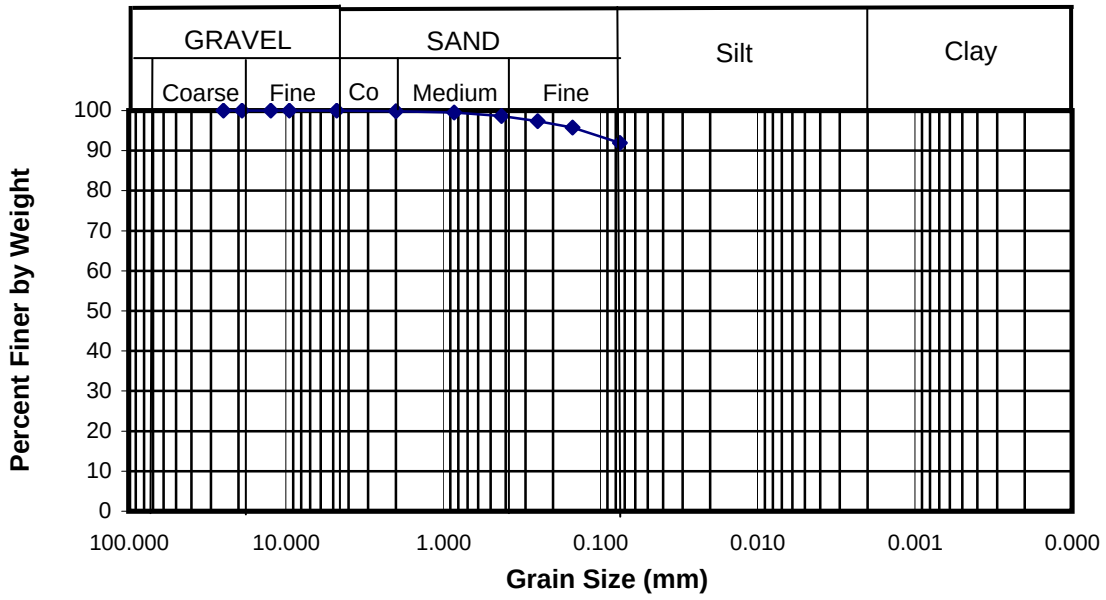
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-K1-SD201-00-02C
Sample Type:	Sediment
Sample Description:	Silty CLAY (CL-ML),Olive Grey, With Fine Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	99.8
20	99.5
40	98.7
60	97.4
100	95.8
200	92.0



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-K3-SD201-00-02 Sample Type: Sediment
Sample Description:	Clayey SAND (SC), Olive Grey, Fine to Medium

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.87	**Moisture Content (%):**	**54.1**
Initial Wet Sample Wt.	263.76	**Percent Fines:**	**40.6**
Initial Dry Sample Wt.	174.29		
Dry Wt. After Wash	107.59		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	1.04	99.4
10	2.000	1.77	98.9
20	0.850	5.09	96.9
40	0.425	26.87	83.8
60	0.250	70.58	57.3
100	0.150	86.32	47.8
200	0.075	98.32	40.6
Pan		98.69	OK

* Weigh soil only, zero scale prior to starting.

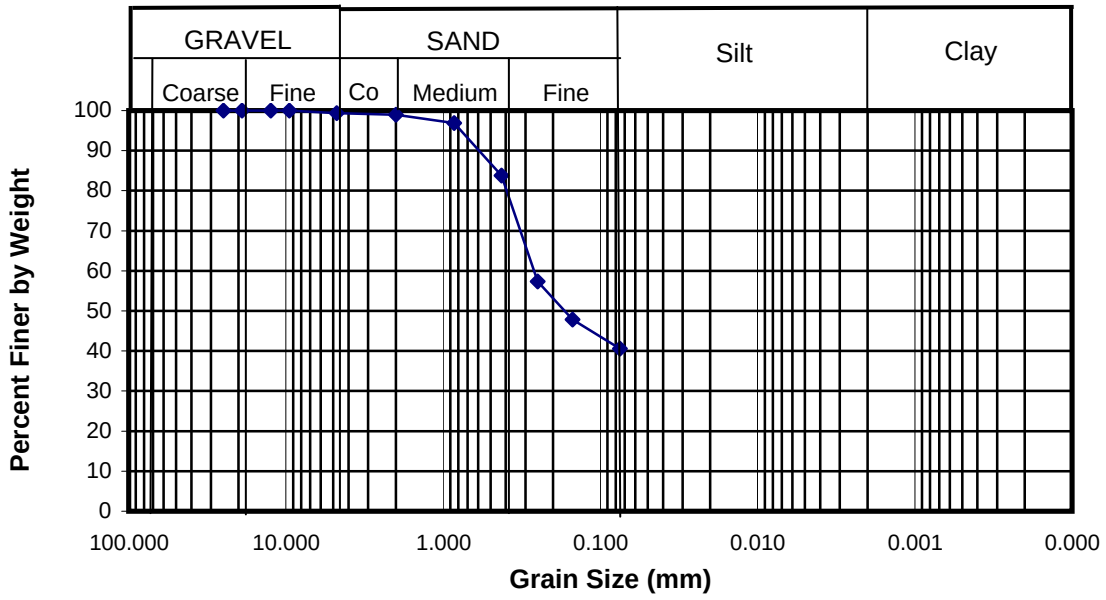
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-K3-SD201-00-02C
Sample Type:	Sediment
Sample Description:	Clayey SAND (SC), Olive Grey, Fine to Medium
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	99.4
10	98.9
20	96.9
40	83.8
60	57.3
100	47.8
200	40.6



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-K3-SD201-02-02C mple Type: Sediment
Sample Description:	Clayey SILT (CL-ML), Dark Grey With Fine Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	9.02	**Moisture Content (%):**	**70.4**
Initial Wet Sample Wt.	237.39	**Percent Fines:**	**83.1**
Initial Dry Sample Wt.	143.04		
Dry Wt. After Wash	31.82		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.00	100.0
10	2.000	0.13	99.9
20	0.850	0.45	99.7
40	0.425	3.23	97.6
60	0.250	10.67	92.0
100	0.150	15.22	88.6
200	0.075	22.71	83.1
Pan		22.90	OK

* Weigh soil only, zero scale prior to starting.

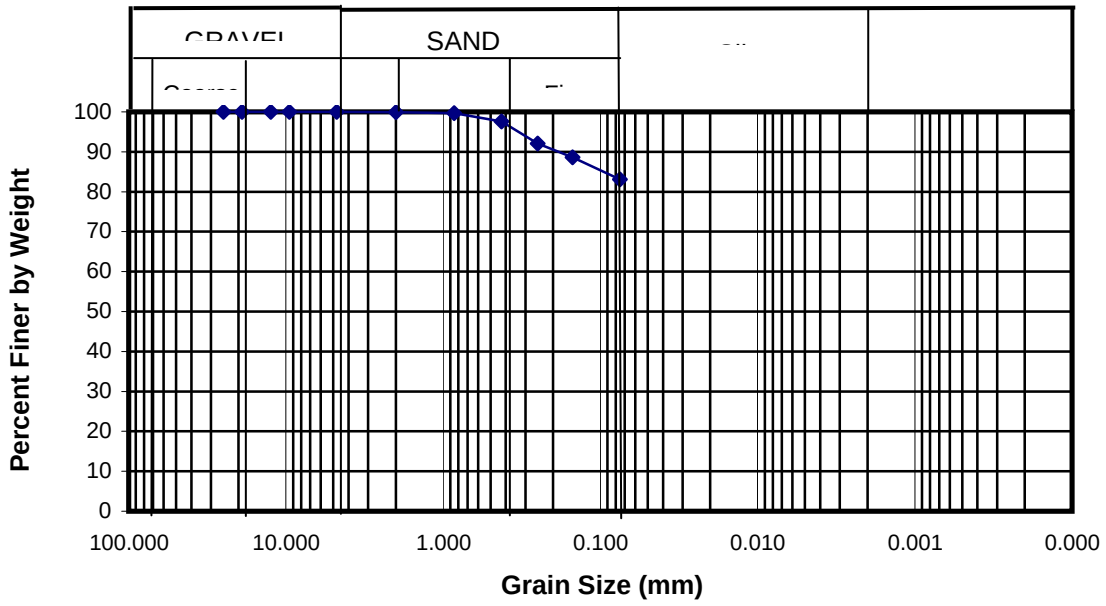
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-K3-SD201-02-02C
Sample Type:	Sediment
Sample Description:	Clayey SILT (CL-ML), Dark Grey With Fine Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	99.9
20	99.7
40	97.6
60	92.0
100	88.6
200	83.1



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-K3-SD202-00-02 Sample Type: Sediment
Sample Description:	Clayey SAND (SC), Olive Grey, Fine to Medium

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.96	**Moisture Content (%):**	**64.2**
Initial Wet Sample Wt.	238.19	**Percent Fines:**	**42.9**
Initial Dry Sample Wt.	148.55		
Dry Wt. After Wash	89.17		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.64	99.5
10	2.000	1.83	98.7
20	0.850	6.60	95.3
40	0.425	33.72	75.8
60	0.250	64.25	54.0
100	0.150	72.99	47.7
200	0.075	79.66	42.9
Pan		79.83	OK

* Weigh soil only, zero scale prior to starting.

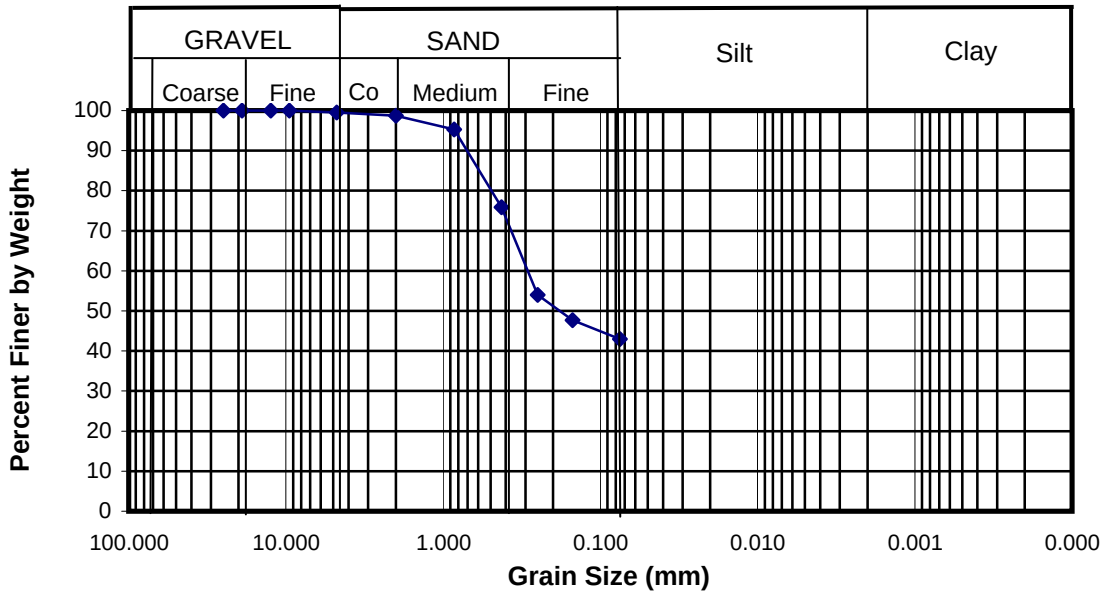
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-K3-SD202-00-02C
Sample Type:	Sediment
Sample Description:	Clayey SAND (SC), Olive Grey, Fine to Medium
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	99.5
10	98.7
20	95.3
40	75.8
60	54.0
100	47.7
200	42.9



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-K4-SD201-02-02 Sample Type: Sediment
Sample Description:	Clayey SAND (SC), Olive Grey, Fine to Medium

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	9.02	**Moisture Content (%):**	**40.7**
Initial Wet Sample Wt.	234.90	**Percent Fines:**	**32.1**
Initial Dry Sample Wt.	169.59		
Dry Wt. After Wash	119.21		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.62	99.6
10	2.000	0.72	99.6
20	0.850	2.71	98.3
40	0.425	27.89	82.6
60	0.250	79.58	50.4
100	0.150	93.04	42.1
200	0.075	109.07	32.1
Pan		109.82	OK

* Weigh soil only, zero scale prior to starting.

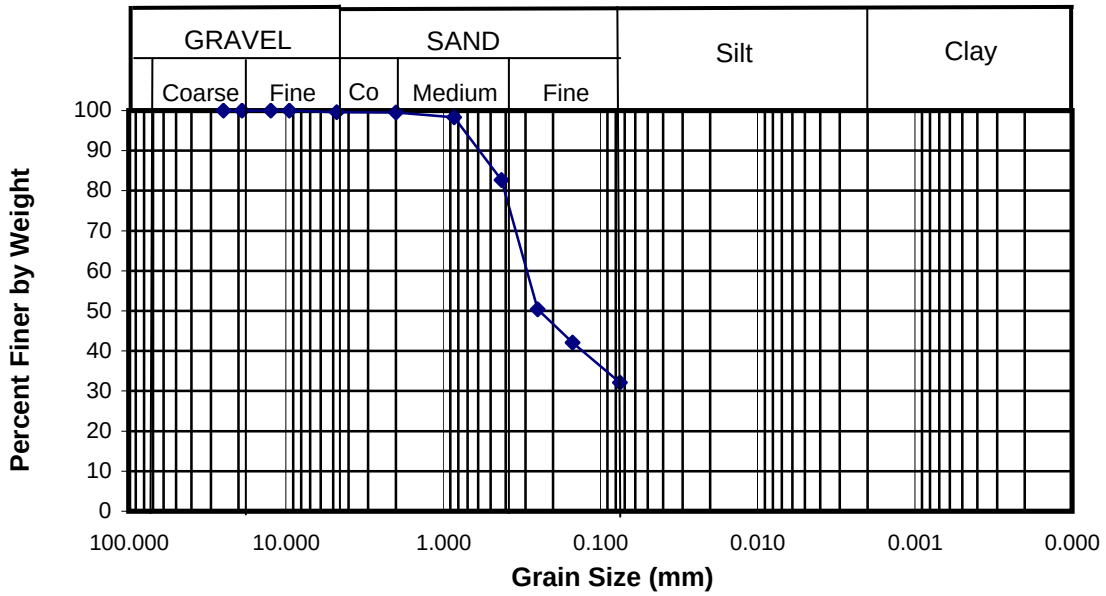
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-K4-SD201-02-02C
Sample Type:	Sediment
Sample Description:	Clayey SAND (SC), Olive Grey, Fine to Medium
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	99.6
10	99.6
20	98.3
40	82.6
60	50.4
100	42.1
200	32.1



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-K5-SD201-00-02 Sample Type: Sediment
Sample Description:	Silty CLAY (CL-ML), Dark Gray, With Fine Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.89	**Moisture Content (%):**	**140.8**
Initial Wet Sample Wt.	222.41	**Percent Fines:**	**86.9**
Initial Dry Sample Wt.	97.56		
Dry Wt. After Wash	20.61		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.00	100.0
10	2.000	0.02	100.0
20	0.850	0.18	99.8
40	0.425	1.16	98.7
60	0.250	3.56	96.0
100	0.150	5.82	93.4
200	0.075	11.63	86.9
Pan		11.81	OK

* Weigh soil only, zero scale prior to starting.

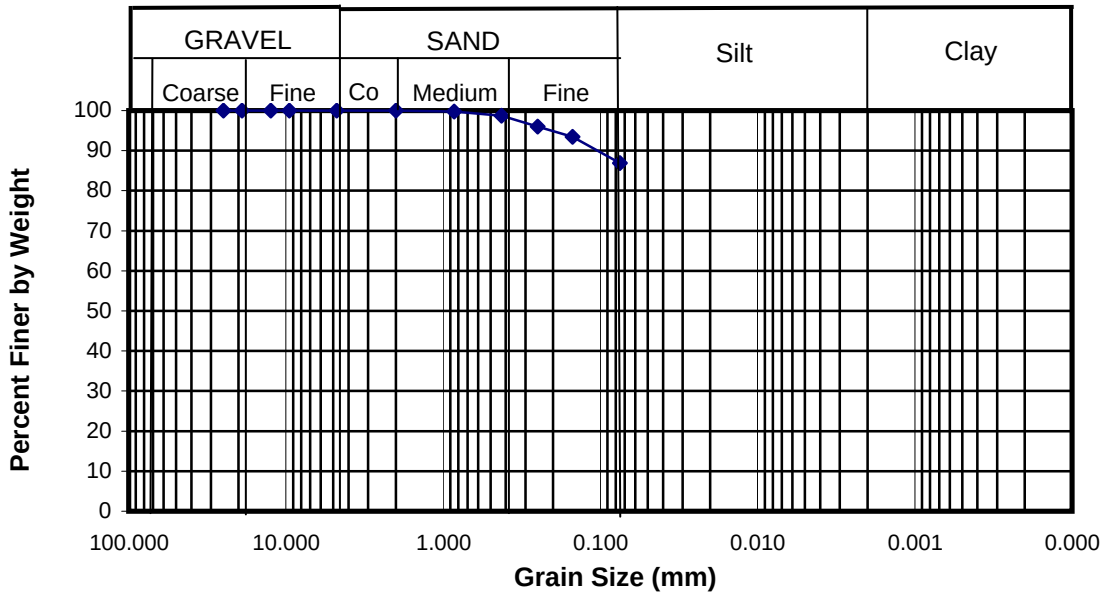
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-K5-SD201-00-02C
Sample Type:	Sediment
Sample Description:	Silty CLAY (CL-ML), Dark Gray, With Fine Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	100.0
20	99.8
40	98.7
60	96.0
100	93.4
200	86.9



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-K5-SD201-02-02 Sample Type: Sediment
Sample Description:	Silty CLAY (CL-ML), Olive Grey With Fine Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	9.04	**Moisture Content (%):**	**61.8**
Initial Wet Sample Wt.	221.24	**Percent Fines:**	**68.8**
Initial Dry Sample Wt.	140.23		
Dry Wt. After Wash	52.47		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.00	100.0
10	2.000	0.02	100.0
20	0.850	0.52	99.6
40	0.425	1.52	98.8
60	0.250	3.68	97.2
100	0.150	8.43	93.6
200	0.075	40.91	68.8
Pan		43.57	OK

* Weigh soil only, zero scale prior to starting.

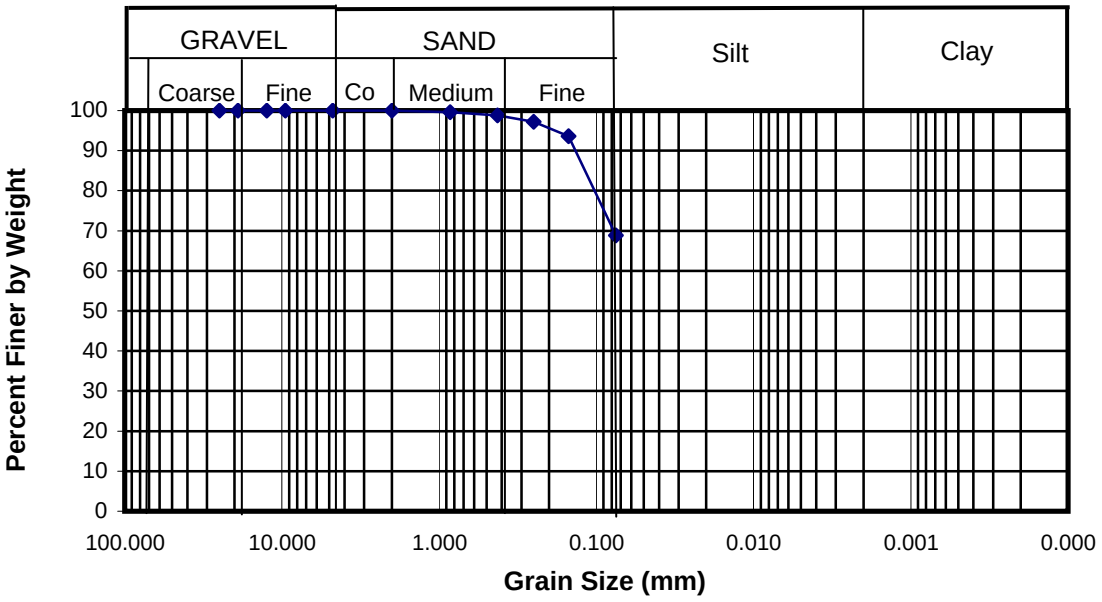
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-K5-SD201-02-02C
Sample Type:	Sediment
Sample Description:	Silty CLAY (CL-ML), Olive Grey With Fine Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	100.0
20	99.6
40	98.8
60	97.2
100	93.6
200	68.8



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-K5-SD202-00-02 Sample Type: Sediment
Sample Description:	Silty CLAY (CL-ML), Olive Grey With Fine to Medium Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.89	**Moisture Content (%):**	**129.4**
Initial Wet Sample Wt.	226.91	**Percent Fines:**	**76.2**
Initial Dry Sample Wt.	103.92		
Dry Wt. After Wash	32.40		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.12	99.9
10	2.000	0.24	99.7
20	0.850	0.71	99.3
40	0.425	2.95	96.9
60	0.250	7.65	91.9
100	0.150	12.32	87.0
200	0.075	22.57	76.2
Pan		23.44	OK

* Weigh soil only, zero scale prior to starting.

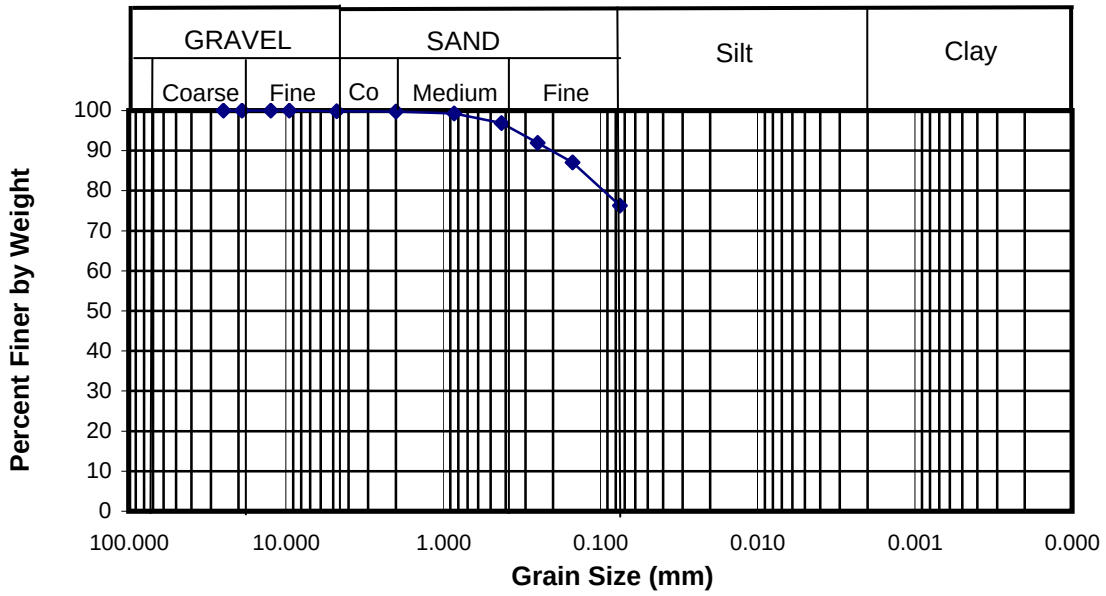
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-K5-SD202-00-02C
Sample Type:	Sediment
Sample Description:	Silty CLAY (CL-ML), Olive Grey With Fine to Medium Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	99.9
10	99.7
20	99.3
40	96.9
60	91.9
100	87.0
200	76.2



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-K6-SD201-00-02 Sample Type: Sediment
Sample Description:	Silty SAND (SM), Olive Grey, Fine to Medium

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.97	**Moisture Content (%):**	**26.8**
Initial Wet Sample Wt.	236.30	**Percent Fines:**	**32.6**
Initial Dry Sample Wt.	188.24		
Dry Wt. After Wash	130.54		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	1.55	99.1
10	2.000	5.99	96.7
20	0.850	13.41	92.5
40	0.425	40.29	77.5
60	0.250	89.56	50.0
100	0.150	110.97	38.1
200	0.075	120.83	32.6
Pan		121.37	OK

* Weigh soil only, zero scale prior to starting.

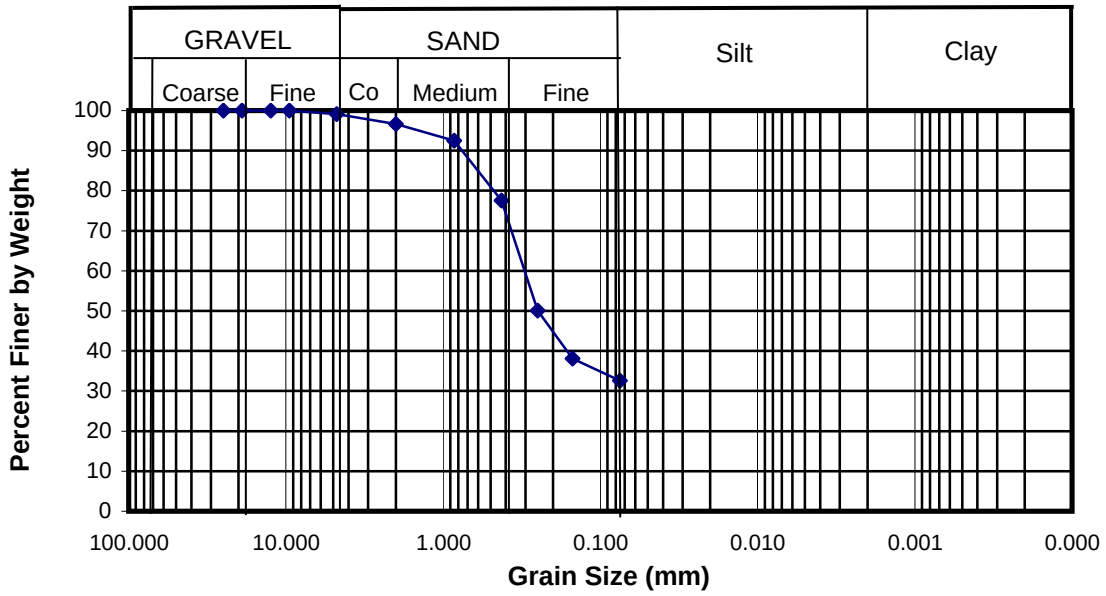
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-K6-SD201-00-02C
Sample Type:	Sediment
Sample Description:	Silty SAND (SM), Olive Grey, Fine to Medium
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	99.1
10	96.7
20	92.5
40	77.5
60	50.0
100	38.1
200	32.6



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-K6-SD201-02-02 Sample Type: Sediment
Sample Description:	Sandy CLAY (SC), Olive Grey

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	9.05	**Moisture Content (%):**	**85.6**
Initial Wet Sample Wt.	234.63	**Percent Fines:**	**58.1**
Initial Dry Sample Wt.	130.57		
Dry Wt. After Wash	60.54		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.62	99.5
10	2.000	2.29	98.1
20	0.850	4.52	96.3
40	0.425	16.20	86.7
60	0.250	35.30	71.0
100	0.150	44.26	63.6
200	0.075	50.88	58.1
Pan		51.23	OK

* Weigh soil only, zero scale prior to starting.

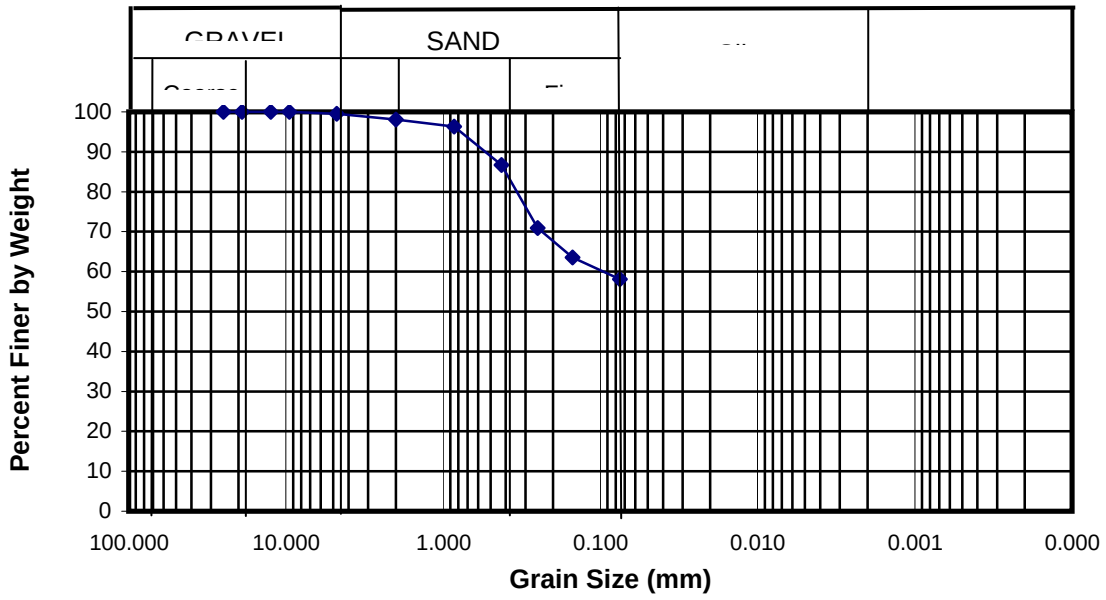
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-K6-SD201-02-02C
Sample Type:	Sediment
Sample Description:	Sandy CLAY (SC), Olive Grey
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	99.5
10	98.1
20	96.3
40	86.7
60	71.0
100	63.6
200	58.1



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-K6-SD202-00-02 Sample Type: Sediment
Sample Description:	Slightly Silty SAND (SP-SM), Grey, Fine to Coarse, With Gravel

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	9.00	**Moisture Content (%):**	**30.6**
Initial Wet Sample Wt.	237.52	**Percent Fines:**	**14.9**
Initial Dry Sample Wt.	183.96		
Dry Wt. After Wash	158.30		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	17.15	90.2
1/2 Inch	12.500	26.06	85.1
3/8 Inch	9.500	27.58	84.2
4	4.750	30.80	82.4
10	2.000	35.51	79.7
20	0.850	44.59	74.5
40	0.425	78.57	55.1
60	0.250	123.27	29.5
100	0.150	140.07	19.9
200	0.075	148.86	14.9
Pan		149.29	OK

* Weigh soil only, zero scale prior to starting.

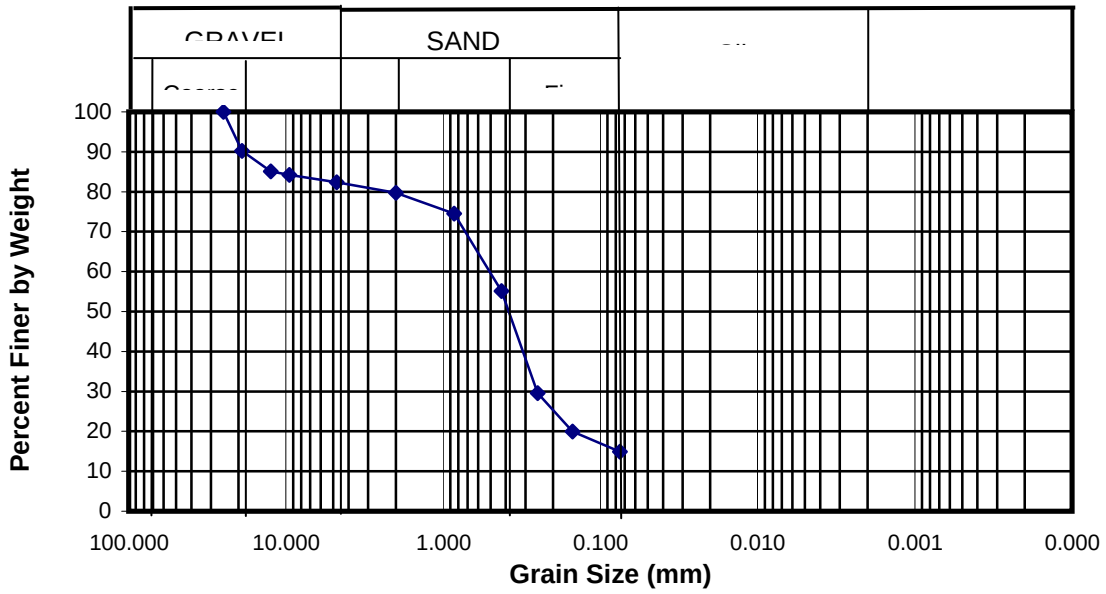
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-K6-SD202-00-02C
Sample Type:	Sediment
Sample Description:	Slightly Silty SAND (SP-SM), Grey, Fine to Coarse, With Gravel
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	90.2
3/8 Inch	84.2
4	82.4
10	79.7
20	74.5
40	55.1
60	29.5
100	19.9
200	14.9



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-L2-SD201-00-02 Sample Type: Sediment
Sample Description:	Silty CLAY (CL-ML), Olive Grey With Fine Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.89	**Moisture Content (%):**	**131.7**
Initial Wet Sample Wt.	236.65	**Percent Fines:**	**80.1**
Initial Dry Sample Wt.	107.18		
Dry Wt. After Wash	28.42		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.00	100.0
10	2.000	0.42	99.6
20	0.850	0.83	99.2
40	0.425	1.58	98.4
60	0.250	4.60	95.3
100	0.150	9.28	90.6
200	0.075	19.52	80.1
Pan		20.08	OK

* Weigh soil only, zero scale prior to starting.

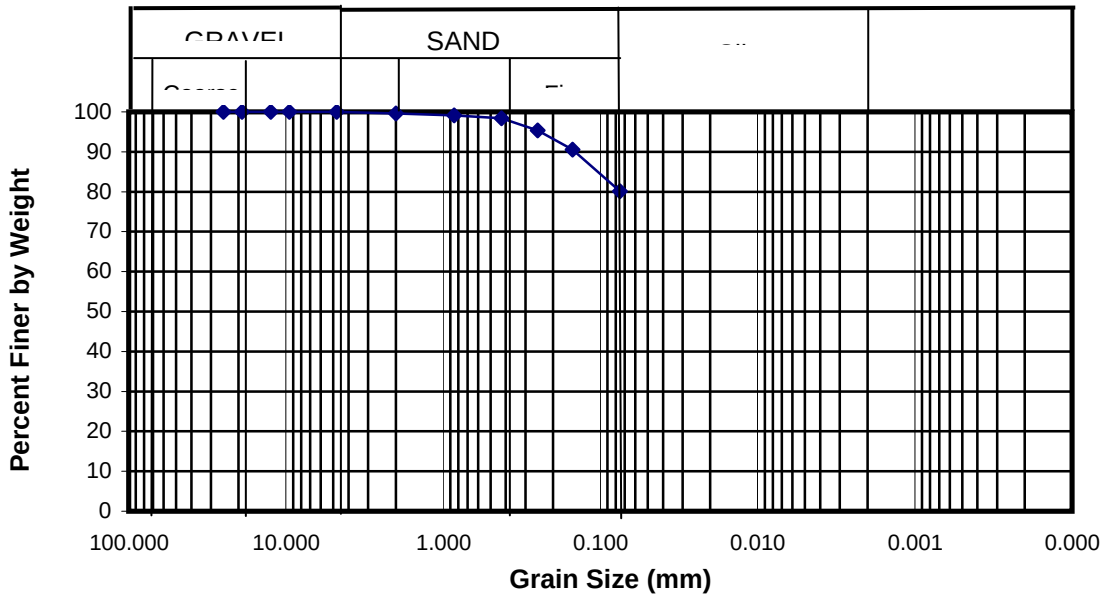
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-L2-SD201-00-02C
Sample Type:	Sediment
Sample Description:	Silty CLAY (CL-ML), Olive Grey With Fine Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	99.6
20	99.2
40	98.4
60	95.3
100	90.6
200	80.1



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-L2-SD201-02-02 Sample Type: Sediment
Sample Description:	CLAY (CL), Grey With Fine to Medium Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	9.04	**Moisture Content (%):**	**91.9**
Initial Wet Sample Wt.	241.95	**Percent Fines:**	**72.5**
Initial Dry Sample Wt.	130.38		
Dry Wt. After Wash	42.65		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.00	100.0
10	2.000	0.10	99.9
20	0.850	1.19	99.0
40	0.425	7.09	94.2
60	0.250	20.31	83.3
100	0.150	27.48	77.4
200	0.075	33.42	72.5
Pan		33.52	OK

* Weigh soil only, zero scale prior to starting.

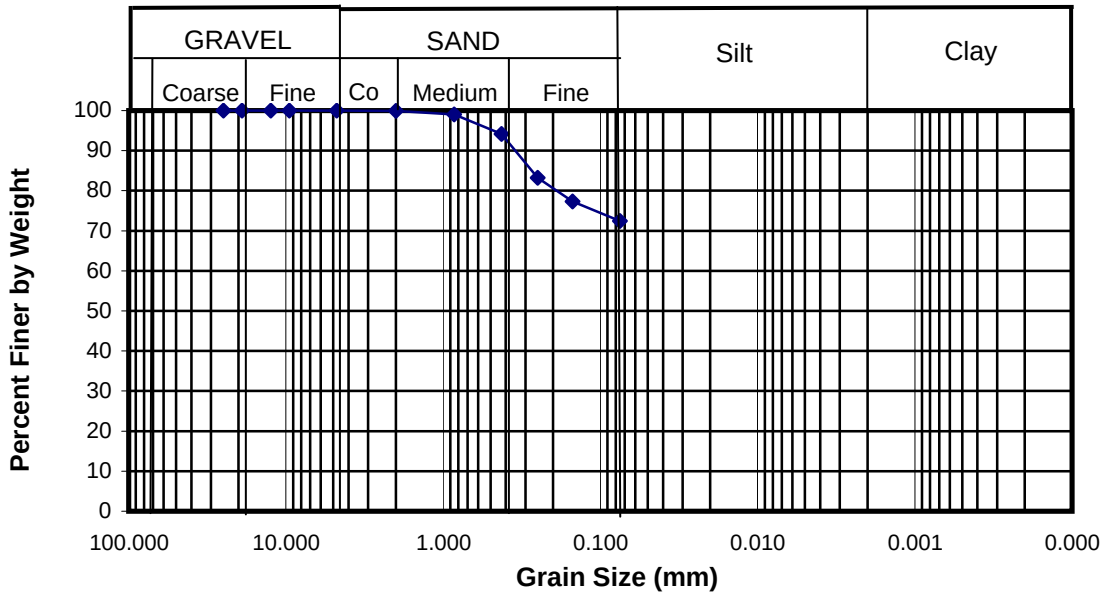
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name: **CH2M HILL - SWMUS 3, 7, & 8**
Project Number: 157234.FI.SS, CTO #: 159
Navy Clean Prime Contract N62470-95-D-6007
Number: 2649-110
Sample Number: LW07-L2-SD201-02-02C
Sample Type: Sediment
Sample Description: CLAY (CL), Grey With Fine to Medium Sand
Test Method: ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	99.9
20	99.0
40	94.2
60	83.3
100	77.4
200	72.5



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-L5-SD201-00-02 Sample Type: Sediment
Sample Description:	CLAY (CL), Grey With Fine Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.90	**Moisture Content (%):**	**143.6**
Initial Wet Sample Wt.	222.87	**Percent Fines:**	**82.0**
Initial Dry Sample Wt.	96.74		
Dry Wt. After Wash	25.47		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.00	100.0
10	2.000	0.03	100.0
20	0.850	0.12	99.9
40	0.425	0.46	99.5
60	0.250	1.74	98.0
100	0.150	4.79	94.5
200	0.075	15.78	82.0
Pan		16.58	OK

* Weigh soil only, zero scale prior to starting.

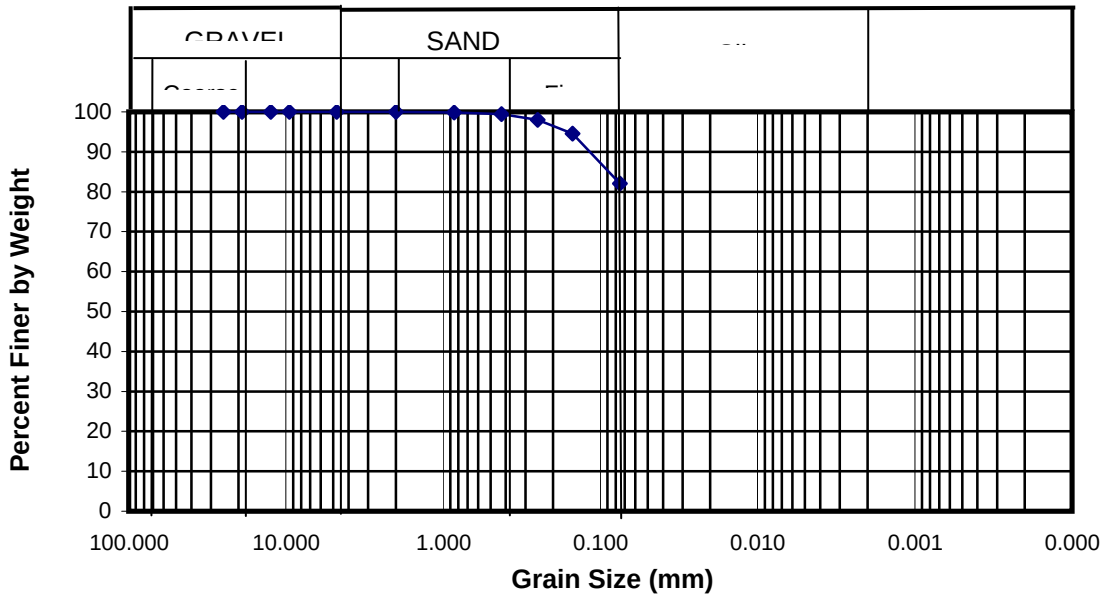
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-L5-SD201-00-02C
Sample Type:	Sediment
Sample Description:	CLAY (CL), Grey With Fine Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	100.0
20	99.9
40	99.5
60	98.0
100	94.5
200	82.0



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-L5-SD201-02-02C mple Type: Sediment
Sample Description:	Clayey SILT (CL-ML), Dark Gray, With Fine Sand and Trace Organics

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	9.04	**Moisture Content (%):**	**50.8**
Initial Wet Sample Wt.	237.95	**Percent Fines:**	**67.0**
Initial Dry Sample Wt.	160.85		
Dry Wt. After Wash	64.94		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.93	99.4
4	4.750	1.07	99.3
10	2.000	1.33	99.1
20	0.850	1.86	98.8
40	0.425	3.26	97.9
60	0.250	5.80	96.2
100	0.150	9.67	93.6
200	0.075	50.07	67.0
Pan		56.00	OK

* Weigh soil only, zero scale prior to starting.

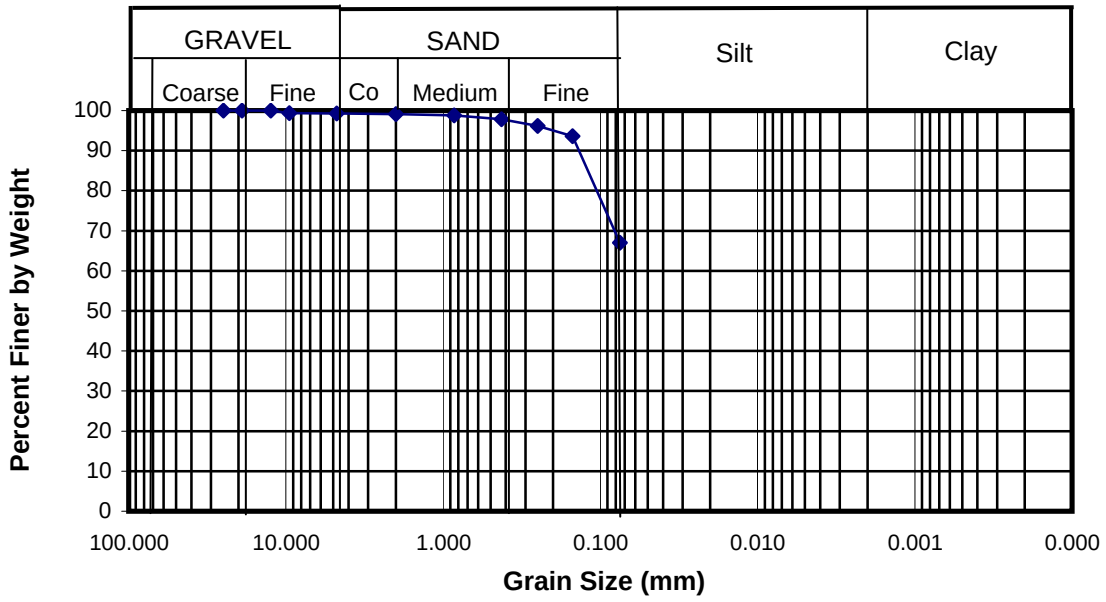
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-L5-SD201-02-02C
Sample Type:	Sediment
Sample Description:	Clayey SILT (CL-ML), Dark Gray, With Fine Sand and Trace Organics
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	99.4
4	99.3
10	99.1
20	98.8
40	97.9
60	96.2
100	93.6
200	67.0



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-L5-SD202-00-02 Sample Type: Sediment
Sample Description:	Silty CLAY (CL-ML), Olive Grey, With Fine to Medium Sand and Shell Fragments

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.88	**Moisture Content (%):**	**119.2**
Initial Wet Sample Wt.	222.62	**Percent Fines:**	**64.5**
Initial Dry Sample Wt.	106.38		
Dry Wt. After Wash	44.47		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	2.45	97.5
10	2.000	5.30	94.6
20	0.850	7.27	92.5
40	0.425	10.55	89.2
60	0.250	19.64	79.9
100	0.150	26.21	73.1
200	0.075	34.60	64.5
Pan		35.49	OK

* Weigh soil only, zero scale prior to starting.

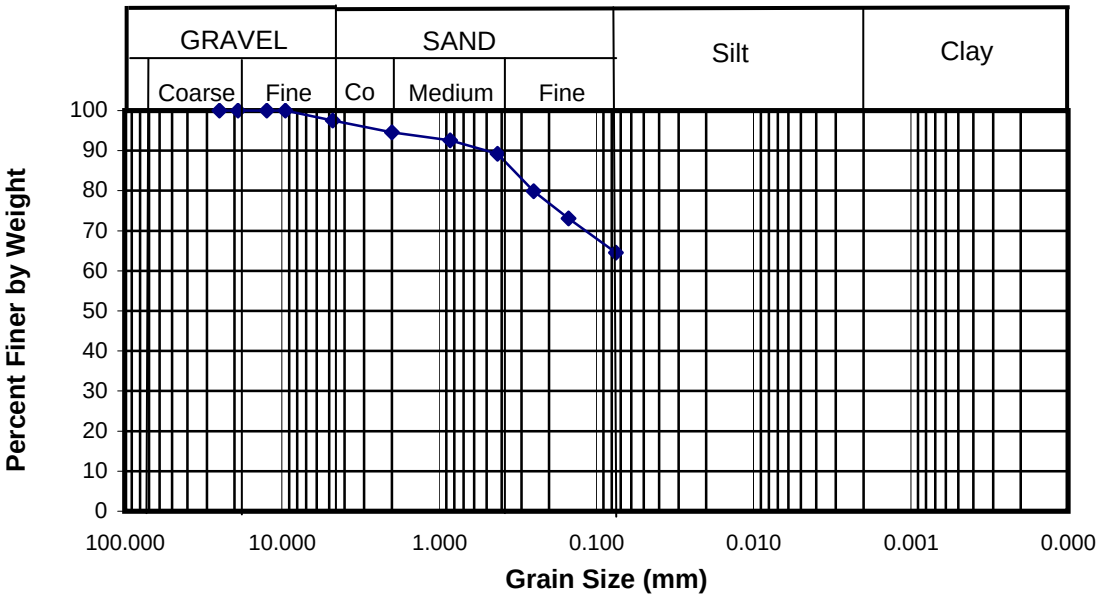
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-L5-SD202-00-02C
Sample Type:	Sediment
Sample Description:	Silty CLAY (CL-ML), Olive Grey, With Fine to Medium Sand and Shell Fragments
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	97.5
10	94.6
20	92.5
40	89.2
60	79.9
100	73.1
200	64.5



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-L6-SD201-00-02 Sample Type: Sediment
Sample Description:	Silty CLAY (CL-ML), Grey With Fine Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	9.00	**Moisture Content (%):**	**158.2**
Initial Wet Sample Wt.	212.98	**Percent Fines:**	**86.8**
Initial Dry Sample Wt.	88.00		
Dry Wt. After Wash	19.57		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.00	100.0
10	2.000	0.05	99.9
20	0.850	0.23	99.7
40	0.425	0.92	98.8
60	0.250	2.64	96.7
100	0.150	4.96	93.7
200	0.075	10.39	86.8
Pan		10.61	OK

* Weigh soil only, zero scale prior to starting.

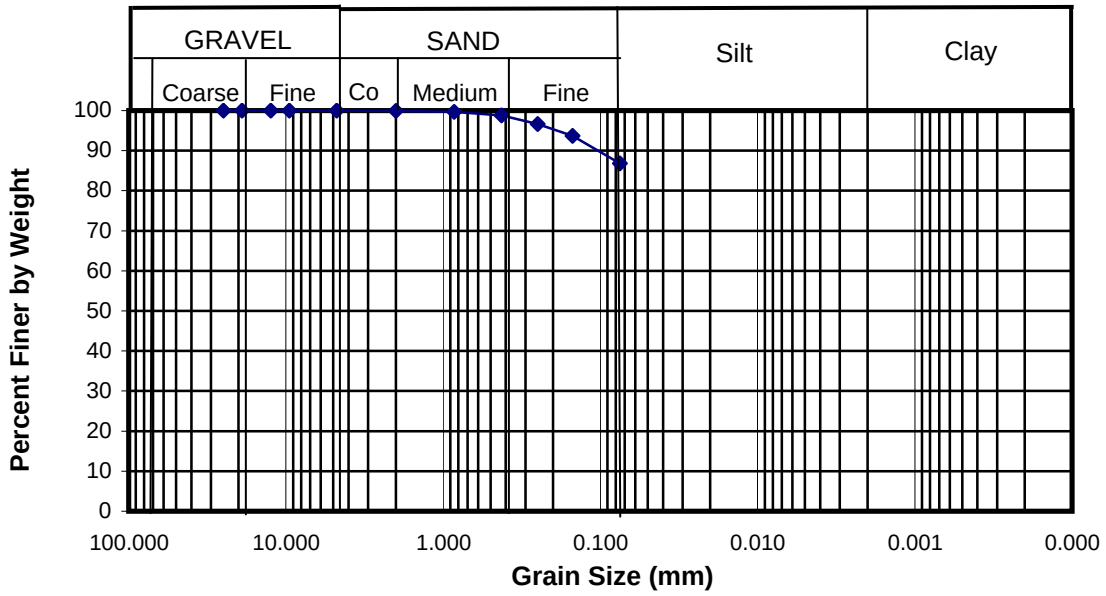
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-L6-SD201-00-02C
Sample Type:	Sediment
Sample Description:	Silty CLAY (CL-ML), Grey With Fine Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	99.9
20	99.7
40	98.8
60	96.7
100	93.7
200	86.8



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-L6-SD201-02-02 Sample Type: Sediment
Sample Description:	Silty CLAY (CL-ML), Grey With Fine Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	9.02	**Moisture Content (%):**	**126.4**
Initial Wet Sample Wt.	230.21	**Percent Fines:**	**80.4**
Initial Dry Sample Wt.	106.74		
Dry Wt. After Wash	28.82		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.00	100.0
10	2.000	0.19	99.8
20	0.850	0.91	99.1
40	0.425	3.68	96.2
60	0.250	8.89	90.9
100	0.150	13.13	86.6
200	0.075	19.15	80.4
Pan		19.69	OK

* Weigh soil only, zero scale prior to starting.

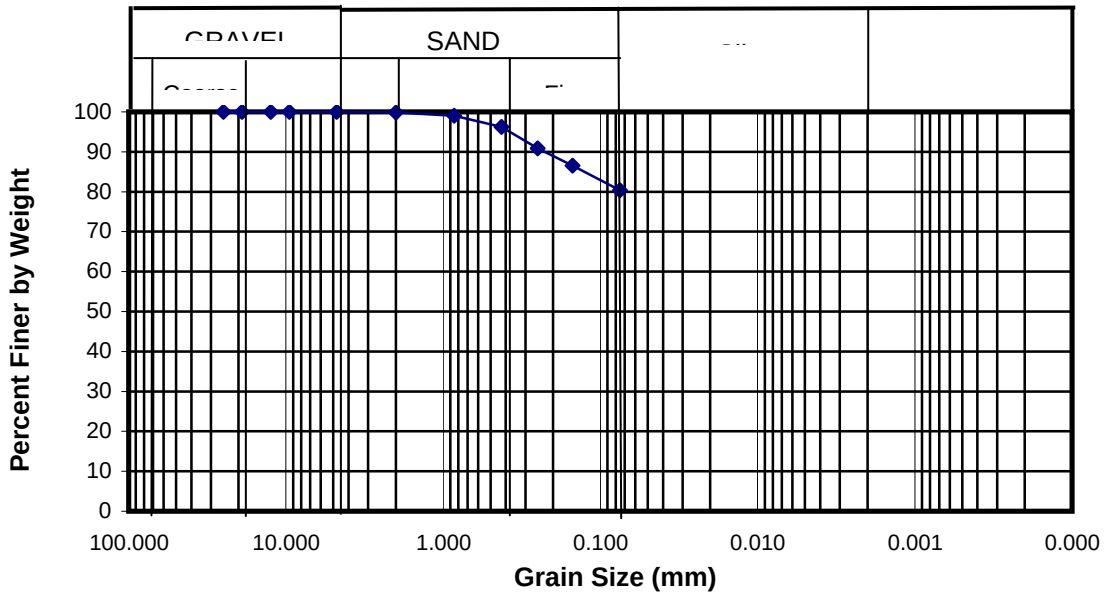
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-L6-SD201-02-02C
Sample Type:	Sediment
Sample Description:	Silty CLAY (CL-ML), Grey With Fine Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	100.0
10	99.8
20	99.1
40	96.2
60	90.9
100	86.6
200	80.4



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-M1-SD201-02-02C mple Type: Sediment
Sample Description:	Clayey SILT (CL-ML), Grey, With Fine to Medium Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.94	**Moisture Content (%):**	**99.2**
Initial Wet Sample Wt.	226.98	**Percent Fines:**	**67.6**
Initial Dry Sample Wt.	118.38		
Dry Wt. After Wash	44.51		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.28	99.7
10	2.000	1.09	99.0
20	0.850	2.44	97.8
40	0.425	5.06	95.4
60	0.250	15.18	86.1
100	0.150	25.75	76.5
200	0.075	35.51	67.6
Pan		35.67	OK

* Weigh soil only, zero scale prior to starting.

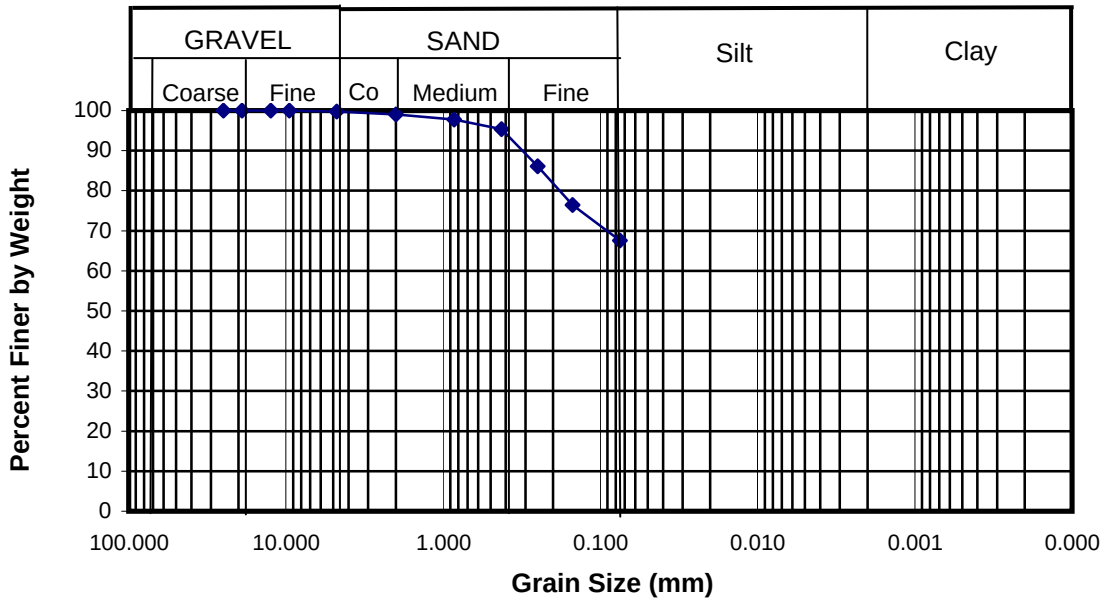
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-M1-SD201-02-02C
Sample Type:	Sediment
Sample Description:	Clayey SILT (CL-ML), Grey, With Fine to Medium Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	99.7
10	99.0
20	97.8
40	95.4
60	86.1
100	76.5
200	67.6



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-M1-SD201 Sample Type: Sediment
Sample Description:	Silty CLAY (CL-ML) Grey With Fine to Medium Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.87	**Moisture Content (%):**	**139.9**
Initial Wet Sample Wt.	218.70	**Percent Fines:**	**63.4**
Initial Dry Sample Wt.	96.34		
Dry Wt. After Wash	41.16		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	1.32	98.5
10	2.000	2.02	97.7
20	0.850	3.41	96.1
40	0.425	6.53	92.5
60	0.250	15.59	82.2
100	0.150	24.68	71.8
200	0.075	32.04	63.4
Pan		32.16	OK

* Weigh soil only, zero scale prior to starting.

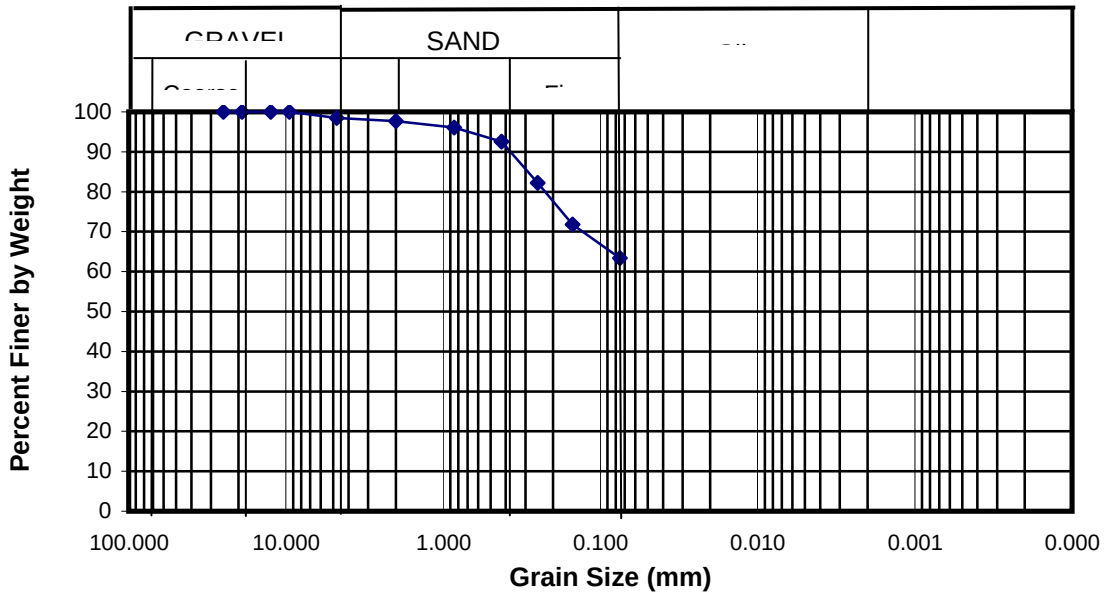
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-M1-SD201
Sample Type:	Sediment
Sample Description:	Silty CLAY (CL-ML) Grey With Fine to Medium Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	98.5
10	97.7
20	96.1
40	92.5
60	82.2
100	71.8
200	63.4



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-M3-SD201-00-0 Sample Type: Sediment
Sample Description:	Silty SAND (SM), Olive Grey, Fine to Coarse

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	8.97	**Moisture Content (%):**	**136.6**
Initial Wet Sample Wt.	235.56	**Percent Fines:**	**48.3**
Initial Dry Sample Wt.	104.72		
Dry Wt. After Wash	58.43		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	2.37	97.5
10	2.000	4.23	95.6
20	0.850	7.79	91.9
40	0.425	15.51	83.8
60	0.250	29.25	69.5
100	0.150	39.38	58.9
200	0.075	49.51	48.3
Pan		50.00	OK

* Weigh soil only, zero scale prior to starting.

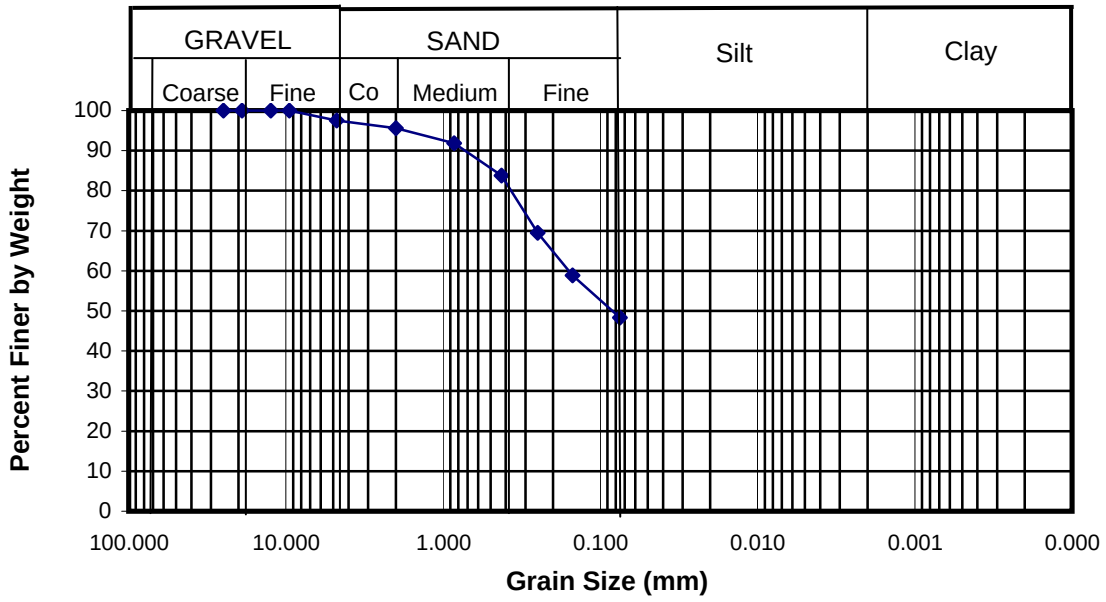
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-M3-SD201-00-02C
Sample Type:	Sediment
Sample Description:	Silty SAND (SM), Olive Grey, Fine to Coarse
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	97.5
10	95.6
20	91.9
40	83.8
60	69.5
100	58.9
200	48.3



Engineering and Testing Consultants, Inc.

Sieve Analysis
Laboratory Data
(ASTM D 422)

Project Name:	CH2M HILL - SWMUS 3, 7, & 8
CH2M HILL Project Nu	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample No.:	LW07-M3-SD202-00-0 Sample Type: Sediment
Sample Description:	Silty CLAY (CL-ML), Grey With Fine to Medium Sand

Performed By:	K. Perry
Checked By:	D. Cacace

INITIAL SAMPLE DATA

Tare Wt.	9.00	**Moisture Content (%):**	**139.8**
Initial Wet Sample Wt.	217.50	**Percent Fines:**	**69.4**
Initial Dry Sample Wt.	95.94		
Dry Wt. After Wash	35.81		

SIEVE DATA

SIEVE NO.	SIZE (mm)	SOIL WT.* (Cumulative)	PERCENT PASSING
1 Inch	25.000	0.00	100.0
3/4 Inch	19.000	0.00	100.0
1/2 Inch	12.500	0.00	100.0
3/8 Inch	9.500	0.00	100.0
4	4.750	0.16	99.8
10	2.000	1.00	98.8
20	0.850	1.83	97.9
40	0.425	5.13	94.1
60	0.250	13.09	84.9
100	0.150	19.55	77.5
200	0.075	26.58	69.4
Pan		26.80	OK

* Weigh soil only, zero scale prior to starting.

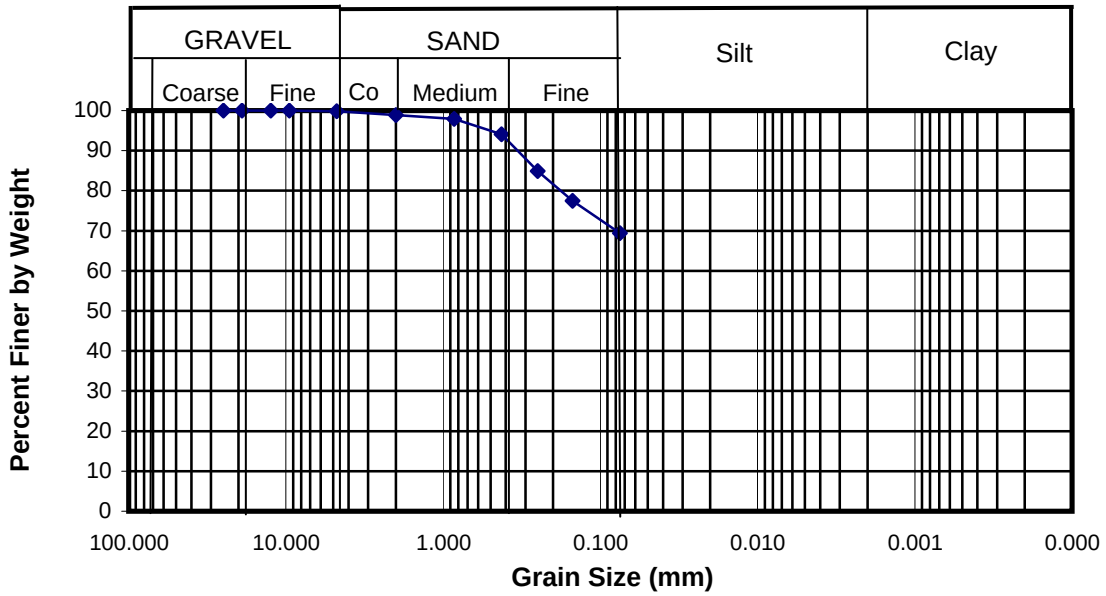
Engineering and Testing Consultants, Inc.

SIEVE ANALYSIS

Project Name:	**CH2M HILL - SWMUS 3, 7, & 8**
Project Number:	157234.FI.SS, CTO #: 159
	Navy Clean Prime Contract N62470-95-D-6007
Number:	2649-110
Sample Number:	LW07-M3-SD202-00-02C
Sample Type:	Sediment
Sample Description:	Silty CLAY (CL-ML), Grey With Fine to Medium Sand
Test Method:	ASTM D422

Sieve Analysis Data

SIEVE NO.	PERCENT PASSING
1 Inch	100.0
3/4 Inch	100.0
3/8 Inch	100.0
4	99.8
10	98.8
20	97.9
40	94.1
60	84.9
100	77.5
200	69.4



Appendix H
Human Health Risk Assessment Tables

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	Surface Sediment	Surface Sediment	Desert Cove	Other Worker	Adult	Dermal Absorption	On-site	Quant	Cove may be used for scuba diving practice and training.
						Ingestion	On-site	Quant	Cove may be used for scuba diving practice and training.
				Trespasser/Visitor	Adult	Dermal Absorption	On-site	Quant	Cove could be used for swimming by site trespasser/visitor.
						Ingestion	On-site	Quant	Cove could be used for swimming by site trespasser/visitor.
					Adolescent	Dermal Absorption	On-site	Quant	Cove could be used for swimming by site trespasser/visitor.
						Ingestion	On-site	Quant	Cove could be used for swimming by site trespasser/visitor.
	Surface Soil	Surface Soil	SWMU 7	Maintenance Worker	Adult	Dermal Absorption	On-site	Quant	Site maintenance workers could contact surface soil while mowing grass or performing other activities at site.
						Ingestion	On-site	Quant	Site maintenance workers could contact surface soil while mowing grass or performing other activities at site.
				Trespasser/Visitor	Adult	Dermal Absorption	On-site	Quant	Access to site unlimited for people on base, trespasser could contact site surface soil.
						Ingestion	On-site	Quant	Access to site unlimited for people on base, trespasser could contact site surface soil.
					Adolescent	Dermal Absorption	On-site	Quant	Access to site unlimited for people on base, trespasser could contact site surface soil.
						Ingestion	On-site	Quant	Access to site unlimited for people on base, trespasser could contact site surface soil.
		Air	Emissions from SWMU 7 Soil	Maintenance Worker	Adult	Inhalation	On-site	Quant	Site maintenance worker may inhale vapors and dust while working at site.
				Trespasser/Visitor	Adult	Inhalation	On-site	Quant	Access to site unlimited for people on base, trespasser could be exposed to dust and vapors in air from site surface soil.
					Adolescent	Inhalation	On-site	Quant	Access to site unlimited for people on base, trespasser could be exposed to dust and vaporss in air from site surface soil.
Future	Sediment*	Sediment*	Desert Cove	Trespasser/Visitor	Adult	Dermal Absorption	On-site	Quant	Cove could be used for swimming by site trespasser/visitor.
						Ingestion	On-site	Quant	Cove could be used for swimming by site trespasser/visitor.
					Adolescent	Dermal Absorption	On-site	Quant	Cove could be used for swimming by site trespasser/visitor.
						Ingestion	On-site	Quant	Cove could be used for swimming by site trespasser/visitor.
				Maintenance Worker	Adult	Dermal Absorption	On-site	Quant	Site worker may contact sediment at cove during maintenance activities.
						Ingestion	On-site	Quant	Site worker may contact sediment at cove during maintenance activities.
				Other Worker	Adult	Dermal Absorption	On-site	Quant	Cove may be used for scuba diving practice and training.
						Ingestion	On-site	Quant	Cove may be used for scuba diving practice and training.
Future	Groundwater	Groundwater	Upper Aquifer - Tap Water	Resident	Adult	Dermal Absorption	On-site	Quant	Although unlikely, groundwater could be used as a potable water supply in the future.
						Ingestion	On-site	Quant	Although unlikely, groundwater could be used as a potable water supply in the future.
					Child	Dermal Absorption	On-site	Quant	Although unlikely, groundwater could be used as a potable water supply in the future.
						Ingestion	On-site	Quant	Although unlikely, groundwater could be used as a potable water supply in the future.
					Child/Adult	Dermal Absorption	On-site	Quant	Although unlikely, groundwater could be used as a potable water supply in the future.
						Ingestion	On-site	Quant	Although unlikely, groundwater could be used as a potable water supply in the future.
				Industrial Worker	Adult	Dermal Absorption	On-site	None	Assumed site workers would not shower regularly at base even if groundwater used as a potable water supply for base.
						Ingestion	On-site	Quant	Although unlikely, groundwater could be used as a potable water supply for the base in the future.

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Groundwater	Groundwater	Upper Aquifer - Excavation Pit	Construction Worker	Adult	Dermal Absorption	On-site	Quant	Construction workers may contact groundwater during excavation activities.
						Ingestion	On-site	None	Ingestion of groundwater during construction activities expected to be minimal.
		Air	Upper Aquifer -Water Vapors at Showerhead	Resident	Adult	Inhalation	On-site	Quant	Although unlikely, groundwater could be used as a potable water supply in the future and adults may inhale volatiles while showering.
					Child	Inhalation	On-site	None	Children are assumed to take baths, not showers, resulting in minimal inhalation exposure.
					Child/Adult	Inhalation	On-site	None	Children are assumed to take baths, not showers, resulting in minimal inhalation exposure.
				Industrial Worker	Adult	Inhalation	On-site	None	Assumed site workers would not shower regularly at base even if groundwater used as a potable water supply for base.
			Upper Aquifer - Water Vapors at Excavation Pit	Construction Worker	Adult	Inhalation	On-site	Quant	Construction workers may inhale vapors from groundwater during excavation activities.
	Soil**	Soil**	SWMU 7	Construction Worker	Adult	Dermal Absorption	On-site	Quant	Exposure to soil during construction activities.
						Ingestion	On-site	Quant	Exposure to soil during construction activities.
				Industrial Worker	Adult	Dermal Absorption	On-site	Quant	If future site use is industrial, future industrial workers could contact surface and subsurface soil.
						Ingestion	On-site	Quant	If future site use is industrial, future industrial workers could contact surface and subsurface soil.
				Resident	Adult	Dermal Absorption	On-site	Quant	Although unlikely, if site used for future residential development, residents could contact soil.
						Ingestion	On-site	Quant	Although unlikely, if site used for future residential development, residents could contact soil.
					Child	Dermal Absorption	On-site	Quant	Although unlikely, if site used for future residential development, residents could contact soil.
						Ingestion	On-site	Quant	Although unlikely, if site used for future residential development, residents could contact soil.
					Child/Adult	Dermal Absorption	On-site	Quant	Although unlikely, if site used for future residential development, residents could contact soil.
						Ingestion	On-site	Quant	Although unlikely, if site used for future residential development, residents could contact soil.
		Air	Emissions from SWMU 7 Soil	Construction Worker	Adult	Inhalation	On-site	Quant	Exposure to emissions from soil during construction activities.
				Industrial Worker	Adult	Inhalation	On-site	Quant	If future site use is industrial, future industrial workers could inhale vapors and dust from soil.
				Resident	Adult	Inhalation	On-site	Quant	If site used for future residential development, residents could inhale vapors and dust from soil.
					Child	Inhalation	On-site	Quant	If site used for future residential development, residents could inhale vapors and dust from soil.
					Child/Adult	Inhalation	On-site	Quant	If site used for future residential development, residents could inhale vapors and dust from soil.

* Includes surface and subsurface sediment

**Surface and subsurface soil.

TABLE 2.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)		Maximum Concentration (Qualifier)		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (N/C) (3)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
SWMU 7	83-32-9	Acenaphthene	1.40E-02	J	1.40E-02	J	MG/KG	LW07-SS21-00	1/10	0.018 - 0.39	1.40E-02	NA	4.69E+02	N	1.00E+02	SSL	NO	BSL
	208-96-8	Acenaphthylene	1.30E-02	J	1.30E-02	J	MG/KG	LW07-SS21-00	1/10	0.036 - 0.39	1.30E-02	NA	1.56E+02	N	1.50E-01	SSL	NO	BSL
	120-12-7	Anthracene	7.90E-03	J	2.10E-02	J	MG/KG	LW07-SS21-00	3/10	0.0018 - 0.39	2.10E-02	NA	2.35E+03	N	4.70E+02	SSL	NO	BSL
	56-55-3	Benzo(a)anthracene	3.10E-03		1.40E-01	J	MG/KG	LW07-SS21-00	6/10	0.0018 - 0.39	1.40E-01	NA	8.75E-01	C	1.50E+00	SSL	NO	BSL
	50-32-8	Benzo(a)pyrene	2.70E-03		1.10E-01	J	MG/KG	LW07-SS21-00	8/10	0.0018 - 0.39	1.10E-01	NA	8.75E-02	C	3.70E-01	SSL	YES	ASL
	205-99-2	Benzo(b)fluoranthene	1.70E-02	J	1.40E-01	J	MG/KG	LW07-SS21-00	6/10	0.0036 - 0.39	1.40E-01	NA	8.75E-01	C	4.50E+00	SSL	NO	BSL
	191-24-2	Benzo(g,h,i)perylene	7.20E-03		8.60E-02	J	MG/KG	LW07-SS02-00	4/10	0.0036 - 0.39	8.60E-02	NA	2.35E+02	N	6.80E+02	SSL	NO	BSL
	207-08-9	Benzo(k)fluoranthene	2.50E-03		1.40E-01	J	MG/KG	LW07-SS21-00	6/10	0.0018 - 0.39	1.40E-01	NA	8.75E+00	C	4.50E+01	SSL	NO	BSL
	218-01-9	Chrysene	4.90E-03		2.50E-01	J	MG/KG	LW07-SS21-00	8/10	0.0018 - 0.39	2.50E-01	NA	8.75E+01	C	1.50E+02	SSL	NO	BSL
	84-74-2	Di-n-butylphthalate	6.50E-02	J	6.50E-02	J	MG/KG	LW07-SS02-00P	1/1	0.36 - 0.36	6.50E-02	NA	7.82E+02	N	5.00E+03	SSL	NO	BSL
	53-70-3	Dibenz(a,h)anthracene	1.50E-02	J	3.00E-02	J	MG/KG	LW07-SS21-00	2/10	0.0036 - 0.39	3.00E-02	NA	8.75E-02	C	1.40E+00	SSL	NO	BSL
	206-44-0	Fluoranthene	8.00E-03	J	2.40E-01	J	MG/KG	LW07-SS21-00	8/10	0.0036 - 0.39	2.40E-01	NA	3.13E+02	N	6.30E+03	SSL	NO	BSL
	86-73-7	Fluorene	1.40E-02	J	1.40E-02	J	MG/KG	LW07-SS21-00	1/10	0.0036 - 0.39	1.40E-02	NA	3.13E+02	N	1.40E+02	SSL	NO	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	3.50E-03		8.50E-02	J	MG/KG	LW07-SS21-00	7/10	0.0018 - 0.39	8.50E-02	NA	8.75E-01	C	1.30E+01	SSL	NO	BSL
	85-01-8	Phenanthrene	4.20E-03		1.90E-01	J	MG/KG	LW07-SS21-00	6/10	0.0018 - 0.39	1.90E-01	NA	2.35E+02	N	6.80E+02	SSL	NO	BSL
	129-00-0	Pyrene	7.40E-03		3.80E-01	J	MG/KG	LW07-SS21-00	7/10	0.0018 - 0.39	3.80E-01	NA	2.35E+02	N	6.80E+02	SSL	NO	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	4.90E-02	J	4.90E-02	J	MG/KG	LW07-SS02-00	1/1	0.36 - 0.36	4.90E-02	NA	4.56E+01	C	2.90E+03	SSL	NO	BSL
	7429-90-5	Aluminum	1.34E+03		8.86E+03		MG/KG	LW07-SS06-00	10/10	31 - 43.1	8.86E+03	NA	7.82E+03	N	NA	NA	YES	ASL
	7440-36-0	Antimony	3.80E-01	J	2.70E+00	J	MG/KG	LW07-SS25-00	2/10	9.3 - 12.9	2.70E+00	NA	3.13E+00	N	1.30E+01	SSL	NO	BSL
	7440-38-2	Arsenic	8.70E-01	J	4.20E+00		MG/KG	LW07-SS18-00	9/10	1.6 - 2.2	4.20E+00	NA	4.26E-01	C	2.60E-02	SSL	YES	ASL
	7440-39-3	Barium	5.70E+00	J	8.94E+01		MG/KG	LW07-SS20-00	10/10	31 - 43.1	8.94E+01	NA	5.48E+02	N	2.10E+03	SSL	NO	BSL
	7440-41-7	Beryllium	6.00E-02	J	6.00E-01	J	MG/KG	LW07-SS06-00	9/10	0.8 - 1.1	6.00E-01	NA	1.56E+01	N	1.20E+03	SSL	NO	BSL
	7440-43-9	Cadmium	8.00E-02	J	3.00E-01	J	MG/KG	LW07-SS25-00	3/10	0.8 - 1.6	3.00E-01	NA	7.80E+00	N	2.70E+01	SSL	NO	BSL
	7440-70-2	Calcium	8.00E+01	J	3.67E+04		MG/KG	LW07-SS07-00	10/10	775.2 - 1080	3.67E+04	NA	N/A		NA	NA	NO	NUT
	7440-47-3	Chromium	4.60E+00		2.76E+01		MG/KG	LW07-SS20-00	10/10	1.6 - 2.2	2.76E+01	NA	2.35E+01	N	4.20E+01	SSL	YES	ASL
	7440-48-4	Cobalt	3.10E-01	J	8.70E+00		MG/KG	LW07-SS06-00	7/10	7.8 - 10.8	8.70E+00	NA	1.60E+02	N	NA	SSL	NO	BSL

TABLE 2.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (N/C) (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
	7440-50-8	Copper	8.60E+00	1.56E+02	MG/KG	LW07-SS25-00	8/10	3.9 - 5.4	1.56E+02	NA	3.13E+02 N	1.10E+04	SSL	NO	BSL
	57-12-5	Cyanide	1.70E-01 J	1.70E-01 J		LW07-SS18-00	1/6	0.5 - 0.57	1.70E-01	NA	1.56E+02 N	1.50E+02	SSL	NO	BSL
	7439-89-6	Iron	2.79E+03	2.39E+04	MG/KG	LW07-SS20-00	10/10	15.5 - 21.5	2.39E+04	NA	2.30E+03 N	NA	NA	YES	ASL
	7439-92-1	Lead	7.90E+00	2.30E+02	MG/KG	LW07-SS25-00	10/10	0.5 - 0.65	2.30E+02	NA	4.00E+02	NA	NA	NO	BSL
	7439-95-4	Magnesium	1.76E+02 J	6.26E+03	MG/KG	LW07-SS20-00	10/10	775.2 - 1080	6.26E+03	NA	N/A	NA	NA	NO	NUT
	7439-96-5	Manganese	6.00E+00	4.60E+02	MG/KG	LW07-SS20-00	10/10	2.3 - 3.2	4.60E+02	NA	1.56E+02 N	9.50E+02	SSL	YES	ASL
	7439-97-6	Mercury	7.00E-02 J	4.00E-01	MG/KG	LW07-SS25-00	2/10	0.07 - 0.1	4.00E-01	NA	2.35E+00 N	NA	NA	NO	BSL
	7440-02-0	Nickel	1.50E+00 J	1.35E+01	MG/KG	LW07-SS20-00	7/10	6.2 - 8.6	1.35E+01	NA	1.56E+02 N	NA	NA	NO	BSL
	7440-09-7	Potassium	1.20E+02 J	5.24E+03	MG/KG	LW07-SS06-00	10/10	775.2 - 1080	5.24E+03	NA	N/A	NA	NA	NO	NUT
	7782-49-2	Selenium	4.50E-01 J	4.50E-01 J	MG/KG	LW07-SS25-00	1/10	0.8 - 1.1	4.50E-01	NA	3.91E+01 N	1.90E+01	SSL	NO	BSL
	7440-22-4	Silver	1.20E+00 J	5.20E+00	MG/KG	LW07-SS06-00	4/10	1.6 - 2.2	5.20E+00	NA	3.91E+01 N	3.10E+01	SSL	NO	BSL
	7440-23-5	Sodium	1.33E+02 J	5.01E+02 J	MG/KG	LW07-SS21-00	3/10	775.2 - 1080	5.01E+02	NA	N/A	NA	NA	NO	NUT
	7440-62-2	Vanadium	4.10E+00 J	3.21E+01	MG/KG	LW07-SS20-00	10/10	7.8 - 10.8	3.21E+01	NA	7.80E+00 N	7.30E+02	SSL	YES	ASL
	7440-66-6	Zinc	1.00E+01	3.22E+02 J	MG/KG	LW07-SS06-00	10/10	3.1 - 4.3	3.22E+02	NA	2.35E+03 N	1.40E+04	SSL	NO	BSL

[1] Maximum concentration used for screening.
[2] No background data available.
[3] Risk-Based Concentration Table for residential soil, April 14, 2004, U.S. EPA Region III, Jennifer Hubbard.
RBC value for pyrene used as surrogate for phenanthrene and benzo(g,h,i)perylene.
RBC value for napthalene used as surrogate for acenaphthylene.
RBC value for Chromium VI used for total chromium.
RBC value for manganese-nonfood used as surrogate for manganese.
RBC value for mercuric chloride used as surrogate for mercury.
Lead screening toxicity value is 400 mg/kg, the EPA residential soil screening level for lead.
[4] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
SSL = Soil Screening Levels with a DAF of 20

TABLE 2.2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Air

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier) (5)	Maximum Concentration (Qualifier) (5)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (N/C) (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
Emissions from SWMU 7 surface soil	83-32-9	Acenaphthene	6.48E-05 J	6.48E-05 J	ug/m3	LW07-SS21-00	1/10	0.018 - 0.39	6.48E-05	NA	2.19E+01 N	NA	NA	NO	BSL
	208-96-8	Acenaphthylene	9.85E-09 J	9.85E-09 J	ug/m3	LW07-SS21-00	1/10	0.036 - 0.39	9.85E-09	NA	3.29E-01 N	NA	NA	NO	BSL
	120-12-7	Anthracene	1.02E-05 J	2.72E-05 J	ug/m3	LW07-SS21-00	3/10	0.0018 - 0.39	2.72E-05	NA	1.10E+02 N	NA	NA	NO	BSL
	56-55-3	Benzo(a)anthracene	2.35E-09	1.06E-07 J	ug/m3	LW07-SS21-00	6/10	0.0018 - 0.39	1.06E-07	NA	8.58E-03 C	NA	NA	NO	BSL
	50-32-8	Benzo(a)pyrene	2.05E-09	8.33E-08 J	ug/m3	LW07-SS21-00	8/10	0.0018 - 0.39	8.33E-08	NA	2.02E-03 C	NA	NA	NO	BSL
	205-99-2	Benzo(b)fluoranthene	1.29E-08 J	1.06E-07 J	ug/m3	LW07-SS21-00	6/10	0.0036 - 0.39	1.06E-07	NA	8.58E-03 C	NA	NA	NO	BSL
	191-24-2	Benzo(g,h,i)perylene	5.45E-09	6.52E-08 J	ug/m3	LW07-SS02-00	4/10	0.0036 - 0.39	6.52E-08	NA	1.10E+01 N	NA	NA	NO	BSL
	207-08-9	Benzo(k)fluoranthene	1.89E-09	1.06E-07 J	ug/m3	LW07-SS21-00	6/10	0.0018 - 0.39	1.06E-07	NA	8.58E-02 C	NA	NA	NO	BSL
	218-01-9	Chrysene	3.71E-09	1.89E-07 J	ug/m3	LW07-SS21-00	8/10	0.0018 - 0.39	1.89E-07	NA	8.58E-01 C	NA	NA	NO	BSL
	84-74-2	Di-n-butylphthalate	4.92E-08 J	4.92E-08 J	ug/m3	LW07-SS02-00P	1/1	0.36 - 0.36	4.92E-08	NA	3.65E+01 N	NA	NA	NO	BSL
	53-70-3	Dibenz(a,h)anthracene	1.14E-08 J	2.27E-08 J	ug/m3	LW07-SS21-00	2/10	0.0036 - 0.39	2.27E-08	NA	8.58E-04 C	NA	NA	NO	BSL
	206-44-0	Fluoranthene	6.06E-09 J	1.82E-07 J	ug/m3	LW07-SS21-00	8/10	0.0036 - 0.39	1.82E-07	NA	1.46E+01 N	NA	NA	NO	BSL
	86-73-7	Fluorene	2.77E-05 J	2.77E-05 J	ug/m3	LW07-SS21-00	1/10	0.0036 - 0.39	2.77E-05	NA	1.46E+01 N	NA	NA	NO	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	2.65E-09	6.44E-08 J	ug/m3	LW07-SS21-00	7/10	0.0018 - 0.39	6.44E-08	NA	8.58E-03 C	NA	NA	NO	BSL
	85-01-8	Phenanthrene	3.18E-09	1.44E-07 J	ug/m3	LW07-SS21-00	6/10	0.0018 - 0.39	1.44E-07	NA	1.10E+01 N	NA	NA	NO	BSL
	129-00-0	Pyrene	1.97E-06	1.01E-04 J	ug/m3	LW07-SS21-00	7/10	0.0018 - 0.39	1.01E-04	NA	1.10E+01 N	NA	NA	NO	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	3.71E-08 J	3.71E-08 J	ug/m3	LW07-SS02-00	1/1	0.36 - 0.36	3.71E-08	NA	4.47E-01 C	NA	NA	NO	BSL
	7429-90-5	Aluminum	1.02E-03	6.71E-03	ug/m3	LW07-SS06-00	10/10	31 - 43.1	6.71E-03	NA	3.65E-01 N	NA	NA	NO	BSL
	7440-36-0	Antimony	2.88E-07 J	2.05E-06 J	ug/m3	LW07-SS25-00	2/10	9.3 - 12.9	2.05E-06	NA	1.46E-01 N	NA	NA	NO	BSL
	7440-38-2	Arsenic	6.59E-07 J	3.18E-06	ug/m3	LW07-SS18-00	9/10	1.6 - 2.2	3.18E-06	NA	4.15E-04 C	NA	NA	NO	BSL
	7440-39-3	Barium	4.32E-06 J	6.77E-05	ug/m3	LW07-SS20-00	10/10	31 - 43.1	6.77E-05	NA	5.11E-02 N	NA	NA	NO	BSL
	7440-41-7	Beryllium	4.55E-08 J	4.55E-07 J	ug/m3	LW07-SS06-00	9/10	0.8 - 1.1	4.55E-07	NA	7.45E-04 C	NA	NA	NO	BSL
	7440-43-9	Cadmium	6.06E-08 J	2.27E-07 J	ug/m3	LW07-SS25-00	3/10	0.8 - 1.6	2.27E-07	NA	9.94E-04 C	NA	NA	NO	BSL
	7440-70-2	Calcium	6.06E-05 J	2.78E-02	ug/m3	LW07-SS07-00	10/10	775.2 - 1080	2.78E-02	NA	N/A	NA	NA	NO	NUT
	7440-47-3	Chromium	3.48E-06	2.09E-05	ug/m3	LW07-SS20-00	10/10	1.6 - 2.2	2.09E-05	NA	1.53E-04 C	NA	NA	NO	BSL
	7440-48-4	Cobalt	2.35E-07 J	6.59E-06	ug/m3	LW07-SS06-00	7/10	7.8 - 10.8	6.59E-06	NA	6.40E-04 C	NA	NA	NO	BSL

TABLE 2.2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Air

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier) (5)	Maximum Concentration (Qualifier) (5)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (N/C) (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
	7440-50-8	Copper	6.52E-06	1.18E-04	ug/m3	LW07-SS25-00	8/10	3.9 - 5.4	1.18E-04	NA	1.46E+01 N	NA	NA	NO	BSL
	57-12-5	Cyanide	1.29E-07 J	1.29E-07 J	ug/m3	LW07-SS18-00	1/6	0.5 - 0.57	1.29E-07	NA	7.30E+00 N	NA	NA	NO	BSL
	7439-89-6	Iron	2.11E-03	1.81E-02	ug/m3	LW07-SS20-00	10/10	15.5 - 21.5	1.81E-02	NA	1.10E+02 N	NA	NA	NO	BSL
	7439-92-1	Lead	5.98E-06	1.74E-04	ug/m3	LW07-SS25-00	10/10	0.5 - 0.65	1.74E-04	NA	N/A	NA	NA	NO	NTX
	7439-95-4	Magnesium	1.33E-04 J	4.74E-03	ug/m3	LW07-SS20-00	10/10	775.2 - 1080	4.74E-03	NA	N/A	NA	NA	NO	NUT
	7439-96-5	Manganese	4.55E-06	3.48E-04	ug/m3	LW07-SS20-00	10/10	2.3 - 3.2	3.48E-04	NA	5.22E-03 N	NA	NA	NO	BSL
	7439-97-6	Mercury	5.30E-08 J	3.03E-07	ug/m3	LW07-SS25-00	2/10	0.07 - 0.1	3.03E-07	NA	3.14E-02 N	NA	NA	NO	BSL
	7440-02-0	Nickel	1.14E-06 J	1.02E-05	ug/m3	LW07-SS20-00	7/10	6.2 - 8.6	1.02E-05	NA	7.30E+00 N	NA	NA	NO	BSL
	7440-09-7	Potassium	9.09E-05 J	3.97E-03	ug/m3	LW07-SS06-00	10/10	775.2 - 1080	3.97E-03	NA	N/A	NA	NA	NO	NUT
	7782-49-2	Selenium	3.41E-07 J	3.41E-07 J	ug/m3	LW07-SS25-00	1/10	0.8 - 1.1	3.41E-07	NA	1.83E+00 N	NA	NA	NO	BSL
	7440-22-4	Silver	9.09E-07 J	3.94E-06	ug/m3	LW07-SS06-00	4/10	1.6 - 2.2	3.94E-06	NA	1.83E+00 N	NA	NA	NO	BSL
	7440-23-5	Sodium	1.01E-04 J	3.80E-04 J	ug/m3	LW07-SS21-00	3/10	775.2 - 1080	3.80E-04	NA	N/A	NA	NA	NO	NUT
	7440-62-2	Vanadium	3.11E-06 J	2.43E-05	ug/m3	LW07-SS20-00	10/10	7.8 - 10.8	2.43E-05	NA	3.70E-01 N	NA	NA	NO	BSL
	7440-66-6	Zinc	7.58E-06	2.44E-04 J	ug/m3	LW07-SS06-00	10/10	3.1 - 4.3	2.44E-04	NA	1.10E+02 N	NA	NA	NO	BSL

[1] Maximum concentration used for screening.

[2] No background data available.

[3] Risk-Based Concentration Table for ambient air, April 14, 2004, U.S. EPA Region III, Jennifer Hubbard.
RBC value for pyrene used as surrogate for phenanthrene and benzo(g,h,i)perylene.
RBC value for Chromium VI used for total chromium.
Lead screening toxicity value is 400 mg/kg, the EPA residential soil screening level for lead.
RBC value for manganese-nonfood used as surrogate for manganese.
RBC value for mercuric chloride used as surrogate for mercury.

[4] Rationale Codes

Selection Reason:	Above Screening Levels (ASL)
Deletion Reason:	No Toxicity Information (NTX)
	Essential Nutrient (NUT)
	Below Screening Level (BSL)

[5] Minimum/Maximum detected concentrations in surface soil samples multiplied by 1/PEF for nonvolatiles and 1/VF + 1/PEF (VF found in supplement t2.2A) for volatiles to get minimum and maximum concentration in air.

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic

Table 2.2.A
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
Calculation of Generic Chemical Specific VF Factors
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Chemical	Diffusivity in Air (D_i) (cm^2/s)	Henry's Law Constant (H') (unitless)	Diffusivity in Water (D_w) (cm^2/s)	Soil Organic Carbon Partition Coeff. (K_{oc}) (cm^3/g)	Soil Water Partition Coeff. ($K_d = K_{oc} \times F_{oc}$) ($g/cm^3$)	Solubility in Water (S) (mg/L)	Apparent Diffusivity (D_A) (cm^2/s)	Volatilization Factor (VF) (m^3/kg)
Volatile Organics								
Acenaphthene	4.21E-02	6.36E-03	7.69E-06	7.08E+03	4.25E+01	4.24E+00	3.36E-07	2.16E+05
Acenaphthylene	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	3.24E-02	2.67E-03	7.74E-06	2.95E+04	1.77E+02	4.34E-02	2.63E-08	7.72E+05
Fluorene	3.63E-02	2.61E-03	7.88E-06	1.38E+04	8.28E+01	1.98E+00	6.15E-08	5.05E+05
Naphthalene	5.90E-02	1.99E-02	7.50E-06	2.00E+03	1.20E+01	3.10E+01	5.17E-06	5.51E+04
Phenanthrene	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	2.72E-02	4.51E-04	7.24E-06	1.05E+05	6.30E+02	1.35E-01	1.11E-09	3.76E+06

Volatilization factor (VF) = (m^3/kg)

$$\frac{Q/C * (3.14 * D_A * T)^{1/2} * 10^{-4}\ m^2/cm^2}{2 * r_b * D_A}$$

Apparent Diffusivity (D_A) = (cm^2/s)

$$\frac{[(Q_a^{10/3} * D_i * H' + Q_w^{10/3} * D_w)/n^2]}{(r_b * K_d + Q_w + Q_a * H')}$$

Parameters	Values
Q/C - Inverse of the mean concentration at the center of a 0.5-acre-square source (g/m^2-s per kg/m^3)	68.81
T - Exposure interval(s)	9.5E+08
r_b - Soil bulk density (g/cm^3)	1.5
Q_a - Air-filled soil porosity (L_{air}/L_{water}) = n - Q_w	0.28
n - Total soil porosity (Lpore/Lsoil) = 1 - (r_b/r_s)	0.43
Q_w - Water-filled soil porosity (Lwater/Lsoil)	0.15
r_s - Soil particle density (g/cm^3)	2.65
f_{oc} - fraction organic carbon in soil (g/g)	0.006

Chemical and physical properties from USEPA, 1996, *Soil Screening Guidance: User's Guide,* EPA/540/R-96/018.

TABLE 2.3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Medium: Surface Sediment
Exposure Medium: Surface Sediment

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (N/C) (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
Desert Cove	83-32-9	Acenaphthene	1.30E-02 J	3.00E+00	MG/KG	LW07-SD05-00	18/41	0.29 - 3.5	3.00E+00	NA	4.69E+03 N	NA	NA	NO	BSL
	208-96-8	Acenaphthylene	1.60E-02 J	7.90E-01 J	MG/KG	LW07-M3-SD201-00-02C	35/41	0.41 - 6.9	7.90E-01	NA	1.56.E+03 N	NA	NA	NO	BSL
	120-12-7	Anthracene	1.10E-02 J	2.30E+00	MG/KG	LW07-SD04-00	41/41	0.029 - 0.97	2.30E+00	NA	2.35E+04 N	NA	NA	NO	BSL
	56-55-3	Benzo(a)anthracene	2.60E-02 J	7.50E+00 D	MG/KG	LW07-L5-SD202-00-02C	41/41	0.029 - 2.9	7.50E+00	NA	8.75E+00 C	NA	NA	NO	BSL
	50-32-8	Benzo(a)pyrene	2.50E-02 J	6.10E+00	MG/KG	LW07-M3-SD201-00-02C	41/41	0.029 - 0.97	6.10E+00	NA	8.75E-01 C	NA	NA	YES	ASL
	205-99-2	Benzo(b)fluoranthene	4.20E-02 J	1.20E+01 J	MG/KG	LW07-L5-SD202-00-02C	40/41	0.057 - 2.9	1.20E+01	NA	8.75E+00 C	NA	NA	YES	ASL
	191-24-2	Benzo(g,h,i)perylene	6.90E-02 J	2.50E+00	MG/KG	LW07-M3-SD201-00-02C	35/41	0.057 - 0.97	2.50E+00	NA	2.35E+03 N	NA	NA	NO	BSL
	207-08-9	Benzo(k)fluoranthene	3.70E-02 J	1.10E+01 J	MG/KG	LW07-L5-SD202-00-02C	41/41	0.029 - 2.9	1.10E+01	NA	8.75E+01 C	NA	NA	NO	BSL
	86-74-8	Carbazole	1.30E-01 J	1.30E-01 J	MG/KG	LW07-SD01-00	1/1	0.4490610542 - 0.4490610542	1.30E-01	NA	3.19.E+02 C	NA	NA	NO	BSL
	218-01-9	Chrysene	4.80E-02 J	2.10E+01 J	MG/KG	LW07-L5-SD202-00-02C	41/41	0.029 - 2.9	2.10E+01	NA	8.75E+02 C	NA	NA	NO	BSL
	84-74-2	Di-n-butylphthalate	8.30E-02 J	8.30E-02 J	MG/KG	LW07-SD01-00	1/1	0.4490610542 - 0.4490610542	8.30E-02	NA	7.82.E+03 N	NA	NA	NO	BSL
	53-70-3	Dibenz(a,h)anthracene	2.30E-02 J	1.20E+00 J	MG/KG	LW07-L5-SD202-00-02C LW07-M3-SD201-00-02C	37/41	0.057 - 0.97	1.20E+00	NA	8.75E-01 C	NA	NA	YES	ASL
	206-44-0	Fluoranthene	5.90E-02 J	2.60E+01	MG/KG	LW07-SD04-00	41/41	0.057 - 1.9	2.60E+01	NA	3.13E+03 N	NA	NA	NO	BSL
	86-73-7	Fluorene	1.60E-02 J	2.10E+00	MG/KG	LW07-SD04-00	23/41	0.057 - 0.97	2.10E+00	NA	3.13E+03 N	NA	NA	NO	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	1.80E-02 J	3.00E+00	MG/KG	LW07-M3-SD201-00-02C	41/41	0.029 - 0.97	3.00E+00	NA	8.75E+00 C	NA	NA	NO	BSL
	91-20-3	Naphthalene	1.30E-02 J	1.50E+00	MG/KG	LW07-K5-SD201-00-02C	10/41	0.29 - 3.5	1.50E+00	NA	1.56.E+03 N	NA	NA	NO	BSL
	85-01-8	Phenanthrene	2.60E-02 J	1.84E+01	MG/KG	LW07-SD04-00	40/41	0.029 - 0.97	1.84E+01	NA	2.35E+03 N	NA	NA	NO	BSL
	129-00-0	Pyrene	4.90E-02 J	2.23E+01	MG/KG	LW07-SD04-00	41/41	0.029 - 2.9	2.23E+01	NA	2.35E+03 N	NA	NA	NO	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	6.60E-02 J	6.60E-02 J	MG/KG	LW07-SD01-00	1/1	0.4490610542 - 0.4490610542	6.60E-02	NA	4.56.E+02 C	NA	NA	NO	BSL
	1031-07-8	Endosulfan sulfate	5.80E-03 J	5.80E-03 J	MG/KG	LW07-SD01-00	1/1	0.0045 - 0.0045	5.80E-03	NA	4.69E+02 N	NA	NA	NO	BSL
	7429-90-5	Aluminum	1.23E+03	1.71E+04	MG/KG	LW07-SD05-00	41/41	40.9 - 144	1.71E+04	NA	7.82E+04 N	NA	NA	NO	BSL
	7440-36-0	Antimony	3.30E-01 J	1.90E+01 J	MG/KG	LW07-K4-SD202-00-02C	15/41	12.3 - 43.2	1.90E+01	NA	3.13E+01 N	NA	NA	NO	BSL
	7440-38-2	Arsenic	1.10E+00 J	1.26E+01	MG/KG	LW07-L2-SD201-00-02C	41/41	2 - 7.2	1.26E+01	NA	4.26E+00 C	NA	NA	YES	ASL
	7440-39-3	Barium	4.20E+00 J	4.91E+01 J	MG/KG	LW07-SD05-00P	40/41	40.9 - 144	4.91E+01	NA	5.48E+03 N	NA	NA	NO	BSL
	7440-41-7	Beryllium	7.00E-02 J	7.90E-01 J	MG/KG	LW07-H1-SD201-00-02C	36/41	1 - 3.6	7.90E-01	NA	1.56E+02 N	NA	NA	NO	BSL
	7440-43-9	Cadmium	9.00E-02 J	8.80E-01 J	MG/KG	LW07-H1-SD201-00-02C	26/41	1 - 3.6	8.80E-01	NA	7.80E+01 N	NA	NA	NO	BSL
	7440-70-2	Calcium	1.14E+03 J	3.54E+04	MG/KG	LW07-SD04-00	41/41	1022.7 - 3600.7	3.54E+04	NA	N/A	NA	NA	NO	NUT
	7440-47-3	Chromium	3.90E+00	6.31E+01	MG/KG	LW07-M1-SD201-00-02C	41/41	2 - 7.2	6.31E+01	NA	2.35E+02 N	NA	NA	NO	BSL
	7440-48-4	Cobalt	6.20E-01 J	6.80E+00 J	MG/KG	LW07-L2-SD201-00-02C	36/41	10.2 - 36	6.80E+00	NA	1.60E+03 N	NA	NA	NO	BSL
	7440-50-8	Copper	9.20E+00 J	1.42E+02 J	MG/KG	LW07-SD05-00	41/41	5.1 - 18	1.42E+02	NA	3.13E+03 N	NA	NA	NO	BSL
	57-12-5	Cyanide	1.60E-01 J	2.70E-01 J	MG/KG	LW07-K5-SD201-00-02C	5/36	0.57 - 1.4	2.70E-01	NA	1.56.E+03 N	NA	NA	NO	BSL
	7439-89-6	Iron	2.36E+03	3.10E+04	MG/KG	LW07-SD05-00	41/41	20.5 - 72	3.10E+04	NA	2.30E+04 N	NA	NA	YES	ASL
	7439-92-1	Lead	5.70E+00	1.81E+03	MG/KG	LW07-SD03-00	41/41	0.6 - 2.2	1.81E+03	NA	4.00E+02	NA	NA	YES	ASL
	7439-95-4	Magnesium	7.57E+02 J	8.52E+03	MG/KG	LW07-SD05-00	41/41	1022.7 - 3600.7	8.52E+03	NA	N/A	NA	NA	NO	NUT
	7439-96-5	Manganese	2.61E+01	2.26E+02	MG/KG	LW07-SD05-00	41/41	3.1 - 10.8	2.26E+02	NA	1.56E+03 N	NA	NA	NO	BSL
	7439-97-6	Mercury	5.00E-02	4.10E+00	MG/KG	LW07-L5-SD202-00-02C	36/41	0.08 - 0.3	4.10E+00	NA	2.35E+01 N	NA	NA	NO	BSL
	7440-02-0	Nickel	1.60E+00	2.54E+01	MG/KG	LW07-M3-SD201-00-02C	37/41	8.2 - 28.8	2.54E+01	NA	1.56E+03 N	NA	NA	NO	BSL
	7440-09-7	Potassium	3.28E+02 J	4.31E+03	MG/KG	LW07-SD05-00	41/41	1022.7 - 3600.7	4.31E+03	NA	N/A	NA	NA	NO	NUT
	7782-49-2	Selenium	1.30E+00 J	2.50E+00 J	MG/KG	LW07-H3-SD202-00-02C LW07-K1-SD201-00-02C	10/41	1 - 3.6	2.50E+00	NA	3.91E+02 N	NA	NA	NO	BSL
	7440-22-4	Silver	3.20E-01 J	7.80E+00	MG/KG	LW07-SD05-00	7/41	2 - 7.2	7.80E+00	NA	3.91E+02 N	NA	NA	NO	BSL
	7440-23-5	Sodium	1.93E+03	2.05E+04	MG/KG	LW07-SD05-00P	41/41	1022.7 - 3600.7	2.05E+04	NA	N/A	NA	NA	NO	NUT
	7440-28-0	Thallium	5.50E-01 J	5.50E-01 J	MG/KG	LW07-SD01-00 LW07-B7-SD201-00-02C	1/41	2 - 7.2	5.50E-01	NA	5.48E+00 N	NA	NA	NO	BSL
	7440-31-5	Tin	1.00E+00 J	1.45E+01 J	MG/KG	LW07-M3-SD201-00-02C	35/36	11.4 - 28	1.45E+01	NA	4.69E+04 N	NA	NA	NO	BSL
	7440-62-2	Vanadium	4.20E+00 J	4.77E+01	MG/KG	LW07-SD05-00P	41/41	10.2 - 36	4.77E+01	NA	7.80E+01 N	NA	NA	NO	BSL
	7440-66-6	Zinc	3.48E+01 J	1.36E+03	MG/KG	LW07-M3-SD201-00-02C	40/41	4.1 - 14.4	1.36E+03	NA	2.35E+04 N	NA	NA	NO	BSL

TABLE 2.3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Medium: Surface Sediment
Exposure Medium: Surface Sediment

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (N/C) (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)

[1] Maximum concentration used for screening.
[2] No background data available.
[3] Risk-Based Concentration Table for residential soil multiplied by 10, April 14, 2004, U.S. EPA Region III, Jennifer Hubbard.
RBC value for pyrene used as surrogate for phenanthrene and benzo(g,h,i)perylene.
RBC value for Chromium VI used for total chromium.
Lead screening toxicity value is 400 mg/kg, the EPA residential soil screening level for lead.
RBC value for manganese-nonfood used as surrogate for manganese.
RBC value for mercuric chloride used as surrogate for mercury.
RBC value for Endosulfan used as surrogate for endosulfan sulfate.

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered

C = Carcinogenic
N = Noncarcinogenic
D = Result came from a diluted sample
J = Estimated Value
K = Biased High

[4] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

TABLE 2.4

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Sediment*
Exposure Medium: Sediment*

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (N/C) (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
Desert Cove	83-32-9	Acenaphthene	1.30E-02 J	1.10E+01 JD	MG/KG	LW07-K6-SD201-02-02C	22/60	0.29 - 11	1.10E+01	NA	4.69E+03 N	NA	NA	NO	BSL
	208-96-8	Acenaphthylene	1.50E-02 J	7.90E-01 J	MG/KG	LW07-M3-SD201-00-02C	43/60	0.39 - 6.9	7.90E-01	NA	1.56E+03 N	NA	NA	NO	BSL
	120-12-7	Anthracene	1.10E-02 J	2.30E+00	MG/KG	LW07-SD04-00	52/60	0.029 - 1	2.30E+00	NA	2.35E+04 N	NA	NA	NO	BSL
	56-55-3	Benzo(a)anthracene	1.30E-02 J	8.40E+00 JD	MG/KG	LW07-K6-SD201-02-02C	54/60	0.029 - 11	8.40E+00	NA	8.75E+00 C	NA	NA	NO	BSL
	50-32-8	Benzo(a)pyrene	1.00E-02 J	6.10E+00	MG/KG	LW07-M3-SD201-00-02C	56/60	0.029 - 1	6.10E+00	NA	8.75E-01 C	NA	NA	YES	ASL
	205-99-2	Benzo(b)fluoranthene	3.70E-02 J	1.20E+01 J	MG/KG	LW07-L5-SD202-00-02C	53/60	0.057 - 2.9	1.20E+01	NA	8.75E+00 C	NA	NA	YES	ASL
	191-24-2	Benzo(g,h,i)perylene	6.10E-02 J	2.50E+00	MG/KG	LW07-M3-SD201-00-02C	42/60	0.057 - 1	2.50E+00	NA	2.35E+03 N	NA	NA	NO	BSL
	207-08-9	Benzo(k)fluoranthene	3.10E-02 J	1.10E+01 J	MG/KG	LW07-L5-SD202-00-02C	54/60	0.029 - 2.9	1.10E+01	NA	8.75E+01 C	NA	NA	NO	BSL
	86-74-8	Carbazole	1.30E-01 J	1.30E-01 J	MG/KG	LW07-SD01-00	1/1	0.45 - 0.45	1.30E-01	NA	3.19E+02 C	NA	NA	NO	BSL
	218-01-9	Chrysene	1.10E-02 J	2.10E+01 J	MG/KG	LW07-L5-SD202-00-02C	54/60	0.029 - 2.9	2.10E+01	NA	8.75E+02 C	NA	NA	NO	BSL
	84-74-2	Di-n-butylphthalate	8.30E-02 J	8.30E-02 J	MG/KG	LW07-SD01-00	1/1	0.45 - 0.45	8.30E-02	NA	7.82E+03 N	NA	NA	NO	BSL
	53-70-3	Dibenz(a,h)anthracene	2.30E-02 J	1.20E+00 J	MG/KG	LW07-L5-SD202-00-02C LW07-M3-SD201-00-02C	44/60	0.057 - 1	1.20E+00	NA	8.75E-01 C	NA	NA	YES	ASL
	206-44-0	Fluoranthene	1.70E-02 J	5.60E+01 D	MG/KG	LW07-K6-SD201-02-02C	56/60	0.057 - 11	5.60E+01	NA	3.13E+03 N	NA	NA	NO	BSL
	86-73-7	Fluorene	1.60E-02 J	1.60E+01 D	MG/KG	LW07-K6-SD201-02-02C	27/60	0.057 - 11	1.60E+01	NA	3.13E+03 N	NA	NA	NO	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	1.80E-02 J	3.00E+00	MG/KG	LW07-M3-SD201-00-02C	54/60	0.029 - 1	3.00E+00	NA	8.75E+00 C	NA	NA	NO	BSL
	91-20-3	Naphthalene	1.30E-02 J	1.50E+00	MG/KG	LW07-K5-SD201-00-02C	13/60	0.29 - 3.5	1.50E+00	NA	1.56E+03 N	NA	NA	NO	BSL
	85-01-8	Phenanthrene	2.00E-02 J	6.20E+01 D	MG/KG	LW07-K6-SD201-02-02C	48/60	0.029 - 11	6.20E+01	NA	2.35E+03 N	NA	NA	NO	BSL
	129-00-0	Pyrene	3.10E-02 J	4.40E+01 D	MG/KG	LW07-K6-SD201-02-02C	58/60	0.029 - 11	4.40E+01	NA	2.35E+03 N	NA	NA	NO	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	6.60E-02 J	6.60E-02 J	MG/KG	LW07-SD01-00	1/1	0.45 - 0.45	6.60E-02	NA	4.56E+02 C	NA	NA	NO	BSL
	1031-07-8	Endosulfan sulfate	5.80E-03 J	5.80E-03 J	MG/KG	LW07-SD01-00	1/1	0.0045 - 0.0045	5.80E-03	NA	4.69E+02 N	NA	NA	NO	BSL
	7429-90-5	Aluminum	8.15E+02	2.87E+04 J	MG/KG	LW07-H3-SD201-02-02C	60/60	40.9 - 144	2.87E+04	NA	7.82E+04 N	NA	NA	NO	BSL
	7440-36-0	Antimony	3.30E-01 J	1.90E+01 J	MG/KG	LW07-K4-SD202-00-02C	25/60	12.3 - 43.2	1.90E+01	NA	3.13E+01 N	NA	NA	NO	BSL
	7440-38-2	Arsenic	1.10E+00 J	1.54E+01	MG/KG	LW07-M3-SD201-02-02C	59/60	2 - 7.2	1.54E+01	NA	4.26E+00 C	NA	NA	YES	ASL
	7440-39-3	Barium	2.90E+00 J	5.53E+01 J	MG/KG	LW07-M3-SD201-02-02C	59/60	40.9 - 144	5.53E+01	NA	5.48E+03 N	NA	NA	NO	BSL
	7440-41-7	Beryllium	6.00E-02 J	1.50E+00 J	MG/KG	LW07-M1-SD201-02-02C	55/60	1 - 3.6	1.50E+00	NA	1.56E+02 N	NA	NA	NO	BSL
	7440-43-9	Cadmium	9.00E-02 J	1.10E+00 J	MG/KG	LW07-M1-SD201-02-02C	33/60	1 - 3.6	1.10E+00	NA	7.80E+01 N	NA	NA	NO	BSL
	7440-70-2	Calcium	5.44E+02 J	3.54E+04	MG/KG	LW07-SD04-00	60/60	1022.7 - 3600.7	3.54E+04	NA	N/A	NA	NA	NO	NUT
	7440-47-3	Chromium	2.70E+00	6.31E+01	MG/KG	LW07-M1-SD201-00-02C	60/60	2 - 7.2	6.31E+01	NA	2.35E+02 N	NA	NA	NO	BSL
	7440-48-4	Cobalt	3.90E-01 J	1.04E+01 J	MG/KG	LW07-H3-SD201-02-02C	55/60	10.2 - 36	1.04E+01	NA	1.60E+03 N	NA	NA	NO	BSL
	7440-50-8	Copper	3.50E+00 J	2.20E+02 J	MG/KG	LW07-M1-SD201-02-02C	60/60	5.1 - 18	2.20E+02	NA	3.13E+03 N	NA	NA	NO	BSL
	57-12-5	Cyanide	1.40E-01 J	3.80E-01 J	MG/KG	LW07-M1-SD201-02-02C	11/55	0.57 - 1.6	3.80E-01	NA	1.56E+03 N	NA	NA	NO	BSL
	7439-89-6	Iron	1.56E+03	4.85E+04	MG/KG	LW07-M3-SD201-02-02C	60/60	20.5 - 72	4.85E+04	NA	2.30E+04 N	NA	NA	YES	ASL
	7439-92-1	Lead	1.60E+00	1.81E+03	MG/KG	LW07-SD03-00	60/60	0.6 - 2.2	1.81E+03	NA	4.00E+02	NA	NA	YES	ASL
	7439-95-4	Magnesium	4.44E+02 J	9.33E+03	MG/KG	LW07-H3-SD201-02-02C	60/60	1022.7 - 3600.7	9.33E+03	NA	N/A	NA	NA	NO	NUT
	7439-96-5	Manganese	9.00E+00	2.75E+02	MG/KG	LW07-M3-SD201-02-02C	60/60	3.1 - 10.8	2.75E+02	NA	1.56E+03 N	NA	NA	NO	BSL
	7439-97-6	Mercury	4.00E-02	4.10E+00	MG/KG	LW07-L5-SD202-00-02C	51/60	0.08 - 0.3	4.10E+00	NA	2.35E+01 N	NA	NA	NO	BSL
	7440-02-0	Nickel	1.60E+00	4.39E+01	MG/KG	LW07-M3-SD201-02-02C	55/60	8.2 - 28.8	4.39E+01	NA	1.56E+03 N	NA	NA	NO	BSL
	7440-09-7	Potassium	1.99E+02 J	5.21E+03 J	MG/KG	LW07-H3-SD201-02-02C	60/60	1022.7 - 3600.7	5.21E+03	NA	N/A	NA	NA	NO	NUT
	7782-49-2	Selenium	7.60E-01 J	2.50E+00 J	MG/KG	LW07-H3-SD202-00-02C LW07-K1-SD201-00-02C	20/60	1 - 3.6	2.50E+00	NA	3.91E+02 N	NA	NA	NO	BSL
	7440-22-4	Silver	3.20E-01 J	7.80E+00	MG/KG	LW07-SD05-00	7/60	2 - 7.2	7.80E+00	NA	3.91E+02 N	NA	NA	NO	BSL
	7440-23-5	Sodium	1.93E+03	2.05E+04	MG/KG	LW07-SD05-00P	60/60	1022.7 - 3600.7	2.05E+04	NA	N/A	NA	NA	NO	NUT
	7440-28-0	Thallium	5.50E-01 J	5.50E-01 J	MG/KG	LW07-SD01-00 LW07-B7-SD201-00-02C	1/60	2 - 7.2	5.50E-01	NA	5.48E+00 N	NA	NA	NO	BSL
	7440-31-5	Tin	1.00E+00 J	2.35E+01	MG/KG	LW07-M1-SD201-02-02C	49/55	11.4 - 28.8	2.35E+01	NA	4.69E+04 N	NA	NA	NO	BSL
	7440-62-2	Vanadium	3.50E+00 J	6.03E+01	MG/KG	LW07-M3-SD201-02-02C	60/60	10.2 - 36	6.03E+01	NA	7.80E+01 N	NA	NA	NO	BSL
	7440-66-6	Zinc	2.16E+01 J	1.39E+03	MG/KG	LW07-M1-SD201-02-02C	58/60	4.1 - 14.4	1.39E+03	NA	2.35E+04 N	NA	NA	NO	BSL

TABLE 2.4

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Sediment*
Exposure Medium: Sediment*

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (N/C) (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)

Sediment* - Surface and subsurface sediment combined.

[1] Maximum concentration used for screening.

[2] No background data available.

[3] Risk-Based Concentration Table for residential soil multiplied by 10, April 14, 2004, U.S. EPA Region III, Jennifer Hubbard.
RBC value for pyrene used as surrogate for phenanthrene and benzo(g,h,i)perylene.
RBC value for Chromium VI used for total chromium.
Lead screening toxicity value is 400 mg/kg, the EPA residential soil screening level for lead.
RBC value for manganese-nonfood used as surrogate for manganese.
RBC value for mercuric chloride used as surrogate for mercury.
RBC value for Endosulfan used as surrogate for endosulfan sulfate.

[4] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered

C = Carcinogenic
N = Noncarcinogenic
D = Result came from a diluted sample
J = Estimated Value
K = Biased High

TABLE 2.5

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)		Maximum Concentration (Qualifier)		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (N/C) (3)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
Upper Aquifer-Tap Water (5)	67-66-3	Chloroform	1.40E+01		1.40E+01		UG/L	LW07-MW01-00B	1/9	0.5 - 10	1.40E+01	NA	1.50E-01	C	8.00E+01	MCL	YES	ASL
	1634-04-4	Methyl-tert-butyl ether (MTBE)	9.60E-01		2.50E+01		UG/L	LW07-MW03-02C	1/6	0.5 - 0.96	2.50E+01	NA	2.60E+00	C	NA	NA	YES	ASL
	127-18-4	Tetrachloroethene	1.40E-01	J	1.40E-01	J	UG/L	LW07-MW03-02C	1/9	0.5 - 10	1.40E-01	NA	1.00E-01	C	5.00E+00	MCL	YES	ASL
	83-32-9	Acenaphthene	3.00E-01	J	3.00E-01	J	UG/L	LW07-MW01-02C	1/9	10 - 10	3.00E-01	NA	3.65E+01	N	NA	NA	NO	BSL
	105-60-2	Caprolactam	2.00E+00	J	2.00E+00	J	UG/L	LW07-MW06-02C	1/6	10 - 10	2.00E+00	NA	1.83E+03	N	NA	NA	NO	BSL
	84-74-2	Di-n-butylphthalate	3.00E-01	J	6.00E-01	J	UG/L	LW07-MW05-02C	3/9	10 - 10	6.00E-01	NA	3.65E+02	N	NA	NA	NO	BSL
	131-11-3	Dimethyl phthalate	4.00E+00	J	4.00E+00	J	UG/L	LW07-MW05-02C LW07-MW06-02C	2/9	10 - 10	4.00E+00	NA	3.65E+04	N	NA	NA	NO	BSL
	7429-90-5	Aluminum	2.35E+02		2.35E+02		UG/L	LW07-MW01-02C	1/9	200 - 200	2.35E+02	NA	3.65E+03	N	50 - 2,000	2-MCL	NO	BSL
	7440-38-2	Arsenic	6.40E+00	J	1.23E+01		UG/L	LW07-MW05-02C	3/9	10 - 10	1.23E+01	NA	4.46E-02	C	1.00E+01	MCL	YES	ASL
	7440-39-3	Barium	4.31E+01	J	1.20E+02	J	UG/L	LW07-MW01-00B	7/9	200 - 200	1.20E+02	NA	2.56E+02	N	2.00E+03	MCL	NO	BSL
	7440-70-2	Calcium	5.05E+03		1.65E+05		UG/L	LW07-MW01-02C	9/9	5000 - 5000	1.65E+05	NA	N/A		NA	NA	NO	NUT
	7440-48-4	Cobalt	3.20E+00	J	3.45E+01	J	UG/L	LW07-MW02-00B	4/9	50 - 50	3.45E+01	NA	7.30E+01	N	NA	NA	NO	BSL
	7440-50-8	Copper	1.46E+01	J	1.46E+01	J	UG/L	LW07-MW02-02C	1/9	25 - 25	1.46E+01	NA	1.46E+02	N	1.30E+03	MCL	NO	BSL
	7439-89-6	Iron	1.04E+03		5.28E+04		UG/L	LW07-MW01-02C	9/9	100 - 100	5.28E+04	NA	1.10E+03	N	NA	NA	YES	ASL
	7439-95-4	Magnesium	3.95E+03	J	1.67E+05		UG/L	LW07-MW01-02C	9/9	5000 - 5000	1.67E+05	NA	N/A		NA	NA	NO	NUT
	7439-96-5	Manganese	4.32E+01		5.91E+03		UG/L	LW07-MW01-02C	9/9	15 - 15	5.91E+03	NA	7.30E+01	N	50	2-MCL	YES	ASL
	7440-02-0	Nickel	4.50E+00	J	1.03E+01	J	UG/L	LW07-MW02-02C	2/9	40 - 40	1.03E+01	NA	7.30E+01	N	NA	NA	NO	BSL
	7440-09-7	Potassium	2.68E+03	J	6.38E+04	J	UG/L	LW07-MW01-02C	9/9	5000 - 5000	6.38E+04	NA	N/A		NA	NA	NO	NUT
	7782-49-2	Selenium	5.00E+00		5.00E+00		UG/L	LW07-MW06-02C	1/9	5 - 5	5.00E+00	NA	1.83E+01	N	5.00E+01	MCL	NO	BSL
	7440-23-5	Sodium	2.40E+04	J	1.21E+06	J	UG/L	LW07-MW01-02C	9/9	5000 - 50000	1.21E+06	NA	N/A		NA	NA	NO	NUT
	7440-62-2	Vanadium	3.40E-01	J	3.10E+00	J	UG/L	LW07-MW04-02C	2/9	50 - 50	3.10E+00	NA	3.70E+00	N	NA	NA	NO	BSL
	7440-66-6	Zinc	2.29E+01		3.70E+01		UG/L	LW07-MW01-02C	3/9	20 - 20	3.70E+01	NA	1.10E+03	N	5000	2-MCL	NO	BSL

TABLE 2.5

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (N/C) (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
Upper Aquifer-Excavation Pit (6)	67-66-3	Chloroform	1.40E+01	1.40E+01	UG/L	LW07-MW01-00B	1/9	0.5 - 10	1.40E+01	NA	1.50E-01 C	8.00E+01	MCL	YES	ASL
	1634-04-4	Methyl-tert-butyl ether (MTBE)	9.60E-01	2.50E+01	UG/L	LW07-MW03-02C	3/6	0.5 - 0.96	2.50E+01	NA	2.60E+00 C	NA	NA	YES	ASL
	127-18-4	Tetrachloroethene	1.40E-01 J	1.40E-01 J	UG/L	LW07-MW03-02C	1/9	0.5 - 10	1.40E-01	NA	1.00E-01 C	5.00E+00	MCL	YES	ASL
	83-32-9	Acenaphthene	3.00E-01 J	3.00E-01 J	UG/L	LW07-MW01-02C	1/9	10 - 10	3.00E-01	NA	3.65E+01 N	NA	NA	NO	BSL
	105-60-2	Caprolactam	2.00E+00 J	2.00E+00 J	UG/L	LW07-MW06-02C	1/6	10 - 10	2.00E+00	NA	1.83E+03 N	NA	NA	NO	BSL
	84-74-2	Di-n-butylphthalate	3.00E-01 J	6.00E-01 J	UG/L	LW07-MW05-02C	3/9	10 - 10	6.00E-01	NA	3.65E+02 N	NA	NA	NO	BSL
	131-11-3	Dimethyl phthalate	4.00E+00 J	4.00E+00 J	UG/L	LW07-MW05-02C LW07-MW06-02C	2/9	10 - 10	4.00E+00	NA	3.65E+04 N	NA	NA	NO	BSL
	7429-90-5	Aluminum	4.31E+02 J	3.38E+03	UG/L	LW07-MW02-00B	8/9	200 - 200	3.38E+03	NA	3.65E+03 N	50 - 2,000	2-MCL	NO	BSL
	7440-38-2	Arsenic	4.80E+00 J	1.84E+01	UG/L	LW07-MW05-02C	5/9	10 - 10	1.84E+01	NA	4.46E-02 C	1.00E+01	MCL	YES	ASL
	7440-39-3	Barium	6.30E+00 J	1.17E+02 J	UG/L	LW07-MW01-00B	9/9	200 - 200	1.17E+02	NA	2.56E+02 N	2.00E+03	MCL	NO	BSL
	7440-70-2	Calcium	4.82E+03 J	1.59E+05	UG/L	LW07-MW01-02C	9/9	5000 - 5000	1.59E+05	NA	N/A	NA	NA	NO	NUT
	7440-47-3	Chromium	7.30E+00 J	2.21E+01	UG/L	LW07-MW01-00B	7/9	10 - 10	2.21E+01	NA	1.10E+01 N	1.00E+02	MCL	YES	ASL
	7440-48-4	Cobalt	3.30E+00 J	4.44E+01 J	UG/L	LW07-MW02-00B	4/9	50 - 50	4.44E+01	NA	7.30E+01 N	NA	NA	NO	BSL
	7440-50-8	Copper	3.02E+01	5.00E+01	UG/L	LW07-MW02-02C	2/9	25 - 25	5.00E+01	NA	1.46E+02 N	1.30E+03	MCL	NO	BSL
	7439-89-6	Iron	1.34E+03	5.65E+04	UG/L	LW07-MW05-02C	9/9	100 - 100	5.65E+04	NA	1.10E+03 N	3.00E+02	2-MCL	YES	ASL
	7439-92-1	Lead	2.10E+00 J	4.40E+00	UG/L	LW07-MW02-02C	5/9	3 - 3	4.40E+00	NA	1.50E+01	1.50E+01	MCL	NO	BSL
	7439-95-4	Magnesium	3.89E+03 J	1.60E+05	UG/L	LW07-MW01-02C	9/9	5000 - 5000	1.60E+05	NA	N/A	NA	NA	NO	NUT
	7439-96-5	Manganese	4.32E+01	5.71E+03	UG/L	LW07-MW01-02C	9/9	15 - 15	5.71E+03	NA	7.30E+01 N	50	2-MCL	YES	ASL
	7440-02-0	Nickel	8.00E+00 J	1.47E+01 J	UG/L	LW07-MW02-02C	3/9	40 - 40	1.47E+01	NA	7.30E+01 N	NA	NA	NO	BSL
	7440-09-7	Potassium	3.12E+03 J	6.21E+04 J	UG/L	LW07-MW01-02C	9/9	5000 - 5000	6.21E+04	NA	N/A	NA	NA	NO	NUT
	7440-22-4	Silver	8.30E+00 J	8.30E+00 J	UG/L	LW07-MW03-00B	1/9	10 - 10	8.30E+00	NA	1.83E+01 N	1.00E+02	2-MCL	NO	BSL
	7440-23-5	Sodium	2.39E+04 J	1.12E+06 J	UG/L	LW07-MW01-02C	9/9	5000 - 50000	1.12E+06	NA	N/A	NA	NA	NO	NUT
	7440-62-2	Vanadium	3.60E+00 J	1.14E+01 J	UG/L	LW07-MW02-00B	9/9	50 - 50	1.14E+01	NA	3.70E+00 N	NA	NA	YES	ASL
	7440-66-6	Zinc	2.92E+01	7.03E+01	UG/L	LW07-MW01-02C	4/9	20 - 20	7.03E+01	NA	1.10E+03 N	5000	2-MCL	NO	BSL

(1) Maximum concentration used for screening.

(2) No background data available.

(3) Risk-Based Concentration Table for tap water, April 14, 2004, U.S. EPA Region III, Jennifer Hubbard.
Lead screening toxicity value is 15 ug/L, the Safe Drinking Water Act action level for lead.

(4) Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Essential Nutrient (NUT)
Below Screening Level (BSL)

(5) Filtered groundwater used to evaluate potable water scenario since notable discrepancy between filtered and unfiltered data for aluminum and iron.

(6) Total groundwater used to evaluate construction worker exposure scenario since worker would be expected to directly contact groundwater.

Definitions:
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
MCL = Safe Drinking Water Act Maximum Contaminant Level (USEPA, 2002)
2-MCL = National Secondary Drinking Water Standards (USEPA, 2002)
S = Soil Saturation
NA = Not Available
C = Carcinogenic
N = Noncarcinogenic
J = Estimated value

TABLE 2.6

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (N/C) (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
Upper Aquifer - Water Vapors at Showerhead (5)	67-66-3	Chloroform	1.40E+01	1.40E+01	UG/L	LW07-MW01-00B	1/9	0.5 - 10	1.40E+01	NA	1.50E-01 C	NA	NA	YES	ASL
	1634-04-4	Methyl-tert-butyl ether (MTBE)	9.60E-01	2.50E+01	UG/L	LW07-MW03-02C	3/6	0.5 - 0.96	2.50E+01	NA	2.60E+00 C	NA	NA	YES	ASL
	127-18-4	Tetrachloroethene	1.40E-01 J	1.40E-01 J	UG/L	LW07-MW03-02C	1/9	0.5 - 10	1.40E-01	NA	1.00E-01 C	NA	NA	YES	ASL
	83-32-9	Acenaphthene	3.00E-01 J	3.00E-01 J	UG/L	LW07-MW01-02C	1/9	10 - 10	3.00E-01	NA	3.65E+01 N	NA	NA	NO	BSL
Upper Aquifer - Water Vapors at Excavation Pit (6)	67-66-3	Chloroform	1.40E+01	1.40E+01	UG/L	LW07-MW01-00B	1/9	0.5 - 10	1.40E+01	NA	1.50E-01 C	NA	NA	YES	ASL
	1634-04-4	Methyl-tert-butyl ether (MTBE)	9.60E-01	2.50E+01	UG/L	LW07-MW03-02C	3/6	0.5 - 0.96	2.50E+01	NA	2.60E+00 C	NA	NA	YES	ASL
	127-18-4	Tetrachloroethene	1.40E-01 J	1.40E-01 J	UG/L	LW07-MW03-02C	1/9	0.5 - 10	1.40E-01	NA	1.00E-01 C	NA	NA	YES	ASL
	83-32-9	Acenaphthene	3.00E-01 J	3.00E-01 J	UG/L	LW07-MW01-02C	1/9	10 - 10	3.00E-01	NA	3.65E+01 N	NA	NA	NO	BSL

(1) Maximum concentration used for screening.
(2) No background data available.
(3) Risk-Based Concentration Table for tap water, April 14, 2004, U.S. EPA Region III, Jennifer Hubbard.
(4) Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Essential Nutrient (NUT)
Below Screening Level (BSL)
(5) Filtered groundwater used to evaluate potable water scenario since notable discrepancy between filtered and unfiltered data for aluminum and iron.
(6) Total groundwater used to evaluate construction worker exposure scenario since worker would be expected to directly contact groundwater.

Definitions:
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated value
S = Soil Saturation
NA = Not Available
C = Carcinogenic
N = Noncarcinogenic

TABLE 2.7

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (N/C) (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
SWMU 7	83-32-9	Acenaphthene	1.40E-02 J	4.90E-02 J	MG/KG	LW07-SB16P-02	3/59	0.017 - 10.96345515	4.90E-02	NA	4.69E+02 N	1.00E+02	SSL	NO	BSL
	208-96-8	Acenaphthylene	1.30E-02 J	2.70E+00 J	MG/KG	LW07-SS01-00	2/59	0.034 - 10.96345515	2.70E+00	NA	1.56E+02 N	1.50E-01	SSL	NO	BSL
	120-12-7	Anthracene	1.30E-03 J	4.70E+00 J	MG/KG	LW07-SS01-00	16/60	0.0017 - 10.96345515	4.70E+00	NA	2.35E+03 N	4.70E+02	SSL	NO	BSL
	56-55-3	Benzo(a)anthracene	9.10E-04 J	1.20E+01	MG/KG	LW07-SS01-00	35/61	0.0017 - 10.96345515	1.20E+01	NA	8.75E-01 C	1.50E+00	SSL	YES	ASL
	50-32-8	Benzo(a)pyrene	1.10E-03 J	1.40E+01	MG/KG	LW07-SS01-00	41/61	0.0017 - 10.96345515	1.40E+01	NA	8.75E-02 C	3.70E-01	SSL	YES	ASL
	205-99-2	Benzo(b)fluoranthene	1.50E-03 J	3.00E+01	MG/KG	LW07-SS01-00	38/61	0.0034 - 10.96345515	3.00E+01	NA	8.75E-01 C	4.50E+00	SSL	YES	ASL
	191-24-2	Benzo(g,h,i)perylene	7.20E-03	1.60E+01	MG/KG	LW07-SS01-00	21/61	0.0034 - 10.96345515	1.60E+01	NA	2.35E+02 N	6.80E+02	SSL	NO	BSL
	207-08-9	Benzo(k)fluoranthene	2.50E-03	2.70E+01	MG/KG	LW07-SS01-00	34/61	0.0017 - 10.96345515	2.70E+01	NA	8.75E+00 C	4.50E+01	SSL	YES	ASL
	218-01-9	Chrysene	1.40E-03 J	2.40E+01	MG/KG	LW07-SS01-00	40/61	0.0017 - 10.96345515	2.40E+01	NA	8.75E+01 C	1.50E+02	SSL	NO	BSL
	84-74-2	Di-n-butylphthalate	4.20E-02 J	6.50E-02 J	MG/KG	LW07-SS02-00P	2/6	0.3501697793 - 10.96345515	6.50E-02	NA	7.82E+02 N	5.00E+03	SSL	NO	BSL
	53-70-3	Dibenz(a,h)anthracene	1.80E-03 J	6.60E+00 J	MG/KG	LW07-SS01-00	5/59	0.0034 - 10.96345515	6.60E+00	NA	8.75E-02 C	1.40E+00	SSL	YES	ASL
	206-44-0	Fluoranthene	1.30E-03 J	9.60E+00 J	MG/KG	LW07-SS01-00	41/61	0.0034 - 10.96345515	9.60E+00	NA	3.13E+02 N	6.30E+03	SSL	NO	BSL
	86-73-7	Fluorene	2.30E-03 J	1.40E-02 J	MG/KG	LW07-SB25-01 LW07-SS21-00	4/59	0.0034 - 10.96345515	1.40E-02	NA	3.13E+02 N	1.40E+02	SSL	NO	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	2.30E-03	1.70E+01	MG/KG	LW07-SS01-00	36/61	0.0017 - 10.96345515	1.70E+01	NA	8.75E-01 C	1.30E+01	SSL	YES	ASL
	91-20-3	Naphthalene	5.50E-03 J	1.80E-02 J	MG/KG	LW07-SB24-01 LW07-SB05-01	2/59	0.017 - 10.96345515	1.80E-02	NA	1.56E+02 N	1.50E-01	SSL	NO	BSL
	85-01-8	Phenanthrene	1.00E-03 J	1.90E-01 J	MG/KG	LW07-SS21-00	31/61	0.0017 - 10.96345515	1.90E-01	NA	2.35E+02 N	6.80E+02	SSL	NO	BSL
	129-00-0	Pyrene	1.10E-03 J	2.40E+01	MG/KG	LW07-SS01-00	41/61	0.0017 - 10.96345515	2.40E+01	NA	2.35E+02 N	6.80E+02	SSL	NO	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	4.90E-02 J	1.60E+00	MG/KG	LW07-SB02-01	5/6	0.3501697793 - 10.96345515	1.60E+00	NA	4.56E+01 C	2.90E+03	SSL	NO	BSL
	72-55-9	4,4'-DDE	2.30E-02 J	2.30E-02 J	MG/KG	LW07-SS01-00	1/6	0.00334629035 - 0.0043	2.30E-02	NA	1.88E+00 C	3.50E+01	SSL	NO	BSL
	50-29-3	4,4'-DDT	1.00E-02 J	1.00E-02 J	MG/KG	LW07-SS01-00	1/6	0.00334629035 - 0.0043	1.00E-02	NA	1.88E+00 C	1.20E+00	SSL	NO	BSL
	5103-71-9	alpha-Chlordane	2.40E-02 J	2.40E-02 J	MG/KG	LW07-SS01-00	1/6	0.001723846544 - 0.0022	2.40E-02	NA	1.82E+00 C	9.20E-01	SSL	NO	BSL
	7429-90-5	Aluminum	4.67E+02	1.21E+04	MG/KG	LW07-SS09-00	61/61	29.3 - 55.5	1.21E+04	NA	7.82E+03 N	NA	NA	YES	ASL
	7440-36-0	Antimony	3.40E-01 J	2.70E+00 J	MG/KG	LW07-SS25-00	14/61	8.8 - 16.6	2.70E+00	NA	3.13E+00 N	1.30E+01	SSL	NO	BSL
	7440-38-2	Arsenic	4.90E-01 J	2.77E+01	MG/KG	LW07-SS01-00	49/61	1.5 - 2.8	2.77E+01	NA	4.26E-01 C	2.60E-02	SSL	YES	ASL
	7440-39-3	Barium	2.90E+00 J	2.63E+02	MG/KG	LW07-SS09-00	57/61	29.3 - 55.5	2.63E+02	NA	5.48E+02 N	2.10E+03	SSL	NO	BSL
	7440-41-7	Beryllium	4.00E-02 J	9.10E-01 J	MG/KG	LW07-SB23-01	44/61	0.7 - 1.4	9.10E-01	NA	1.56E+01 N	1.20E+03	SSL	NO	BSL
	7440-43-9	Cadmium	4.00E-02 J	4.90E-01 J	MG/KG	LW07-SB23-01	14/61	0.7 - 1.9	4.90E-01	NA	7.80E+00 N	2.70E+01	SSL	NO	BSL
	7440-70-2	Calcium	8.00E+01 J	3.67E+04	MG/KG	LW07-SS07-00	50/61	731.8 - 1390	3.67E+04	NA	N/A	NA	NA	NO	NUT

TABLE 2.7

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (N/C) (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
	7440-47-3	Chromium	1.80E+00	8.92E+01	MG/KG	LW07-SB16-01	60/61	1.5 - 2.8	8.92E+01	NA	2.35E+01 N	4.20E+01	SSL	YES	ASL
	7440-48-4	Cobalt	1.10E-01 J	1.32E+01	MG/KG	LW07-SS09-00	35/61	7.3 - 13.9	1.32E+01	NA	1.60E+02 N	NA	NA	NO	BSL
	7440-50-8	Copper	6.60E-01 J	5.18E+02	MG/KG	LW07-SS24-00	50/61	3.7 - 6.9	5.18E+02	NA	3.13E+02 N	1.10E+04	SSL	YES	ASL
	57-12-5	Cyanide	1.70E-01 J	1.70E-01 J	MG/KG	LW07-SS18-00	1/33	0.5 - 0.69	1.70E-01	NA	1.56E+02 N	1.50E+02	SSL	NO	BSL
	7439-89-6	Iron	7.41E+02 J	2.66E+04	MG/KG	LW07-SS09-00	61/61	14.6 - 27.7	2.66E+04	NA	2.30E+03 N	NA	NA	YES	ASL
	7439-92-1	Lead	1.30E+00	1.24E+03	MG/KG	LW07-SS24-00	61/61	0.4 - 0.83	1.24E+03	NA	4.00E+02	NA	NA	YES	ASL
	7439-95-4	Magnesium	6.44E+01 J	8.30E+03	MG/KG	LW07-SS09-00	60/61	731.8 - 1390	8.30E+03	NA	N/A	NA	NA	NO	NUT
	7439-96-5	Manganese	3.10E+00	6.17E+02	MG/KG	LW07-SS09-00	61/61	2.2 - 4.2	6.17E+02	NA	1.56E+02 N	9.50E+02	SSL	YES	ASL
	7439-97-6	Mercury	2.00E-02 L	9.90E-01	MG/KG	LW07-SS24-00	19/61	0.07 - 0.14	9.90E-01	NA	2.35E+00 N	NA	NA	NO	BSL
	7440-02-0	Nickel	2.60E-01 J	2.50E+01	MG/KG	LW07-SS09-00	42/61	5.9 - 11.1	2.50E+01	NA	1.56E+02 N	NA	NA	NO	BSL
	7440-09-7	Potassium	6.74E+01 J	8.65E+03	MG/KG	LW07-SS09-00	61/61	731.8 - 1390	8.65E+03	NA	N/A	NA	NA	NO	NUT
	7782-49-2	Selenium	4.50E-01 J	1.00E+00 J	MG/KG	LW07-SB19-02 LW07-SS04-00	4/61	0.7 - 1.9	1.00E+00	NA	3.91E+01 N	1.90E+01	SSL	NO	BSL
	7440-22-4	Silver	9.30E-01 J	6.70E+00	MG/KG	LW07-SS09-00	14/61	1.5 - 2.8	6.70E+00	NA	3.91E+01 N	3.10E+01	SSL	NO	BSL
	7440-23-5	Sodium	5.39E+01 J	5.73E+02 J	MG/KG	LW07-SB23-01	18/61	731.8 - 1390	5.73E+02	NA	N/A	NA	NA	NO	NUT
	7440-28-0	Thallium	1.30E+00 J	1.30E+00 J	MG/KG	LW07-SS17-00	1/61	1.5 - 2.8	1.30E+00	NA	5.48E-01 N	3.60E+00	SSL	YES	ASL
	7440-62-2	Vanadium	1.70E+00 L	4.32E+01	MG/KG	LW07-SS09-00	61/61	7.3 - 13.9	4.32E+01	NA	7.80E+00 N	7.30E+02	SSL	YES	ASL
	7440-66-6	Zinc	4.10E+00	7.23E+02	MG/KG	LW07-SB23-01	59/61	2.9 - 5.5	7.23E+02	NA	2.35E+03 N	5.10E+03	SSL	NO	BSL

[1] Maximum concentration used for screening.
[2] No background data available.
[3] Risk-Based Concentration Table for residential soil, April 14, 2004, U.S. EPA Region III, Jennifer Hubbard.
RBC value for naphthalene used as surrogate for acenaphthylene.
RBC value for pyrene used as surrogate for phenanthrene and benzo(g,h,i)perylene.
RBC value for cadmium-food used as surrogate for cadmium.
RBC value for Chromium VI used for total chromium.
Lead screening toxicity value is 400 mg/kg, the EPA residential soil screening level for lead.
RBC value for manganese-nonfood used as surrogate for manganese.
RBC value for mercuric chloride used as surrogate for mercury.
[4] RBC value for chlordane used as surrogate for alpha-chlordane.

Rationale Codes

Selection Reason:	Above Screening Levels (ASL)
Deletion Reason:	No Toxicity Information (NTX)
	Essential Nutrient (NUT)
	Below Screening Level (BSL)

Soil*- Surface and subsurface soil combined.

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
K = Biased High
L = Biased Low
C = Carcinogenic
N = Noncarcinogenic
SSL = Soil Screening Levels with a DAF of 20

TABLE 2.8

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Air

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier) (5)		Maximum Concentration (Qualifier) (5)		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (N/C) (3)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
SWMU 7	83-32-9	Acenaphthene	6.48E-05	J	2.27E-04		µg/m^3	LW07-SB16P-02	3/59	0.017 - 10.96345515	2.27E-04	NA	2.19E+01	N	NA	NA	NO	BSL
	208-96-8	Acenaphthylene	9.85E-09	J	2.05E-06	J	µg/m^3	LW07-SS01-00	2/59	0.034 - 10.96345515	2.05E-06	NA	3.29E-01	N	NA	NA	NO	BSL
	120-12-7	Anthracene	1.68E-06	J	6.09E-03	J	µg/m^3	LW07-SS01-00	16/60	0.0017 - 10.96345515	6.09E-03	NA	1.10E+02	N	NA	NA	NO	BSL
	56-55-3	Benzo(a)anthracene	6.89E-10	J	9.09E-06	J	µg/m^3	LW07-SS01-00	35/61	0.0017 - 10.96345515	9.09E-06	NA	8.58E-03	C	NA	NA	NO	BSL
	50-32-8	Benzo(a)pyrene	8.33E-10	J	1.06E-05	J	µg/m^3	LW07-SS01-00	41/61	0.0017 - 10.96345515	1.06E-05	NA	2.02E-03	C	NA	NA	NO	BSL
	205-99-2	Benzo(b)fluoranthene	1.14E-09	J	2.27E-05	J	µg/m^3	LW07-SS01-00	38/61	0.0034 - 10.96345515	2.27E-05	NA	8.58E-03	C	NA	NA	NO	BSL
	191-24-2	Benzo(g,h,i)perylene	5.45E-09	J	1.21E-05	J	µg/m^3	LW07-SS01-00	21/61	0.0034 - 10.96345515	1.21E-05	NA	1.10E+01	N	NA	NA	NO	BSL
	207-08-9	Benzo(k)fluoranthene	1.89E-09	J	2.05E-05	J	µg/m^3	LW07-SS01-00	34/61	0.0017 - 10.96345515	2.05E-05	NA	8.58E-02	C	NA	NA	NO	BSL
	218-01-9	Chrysene	1.06E-09	J	1.82E-05	J	µg/m^3	LW07-SS01-00	40/61	0.0017 - 10.96345515	1.82E-05	NA	8.58E-01	C	NA	NA	NO	BSL
	84-74-2	Di-n-butylphthalate	3.18E-08	J	4.92E-08	J	µg/m^3	LW07-SS02-00P	2/6	0.3501697793 - 10.9634551	4.92E-08	NA	3.65E+01	N	NA	NA	NO	BSL
	53-70-3	Dibenz(a,h)anthracene	1.36E-09	J	5.00E-06	J	µg/m^3	LW07-SS01-00	5/59	0.0034 - 10.96345515	5.00E-06	NA	8.58E-04	C	NA	NA	NO	BSL
	206-44-0	Fluoranthene	9.85E-10	J	7.27E-06	J	µg/m^3	LW07-SS01-00	41/61	0.0034 - 10.96345515	7.27E-06	NA	1.46E+01	N	NA	NA	NO	BSL
	86-73-7	Fluorene	4.55E-06	J	2.77E-05	J	µg/m^3	-SB25-01 LW07-SS	4/59	0.0034 - 10.96345515	2.77E-05	NA	1.46E+01	N	NA	NA	NO	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	1.74E-09	J	1.29E-05	J	µg/m^3	LW07-SS01-00	36/61	0.0017 - 10.96345515	1.29E-05	NA	8.58E-03	C	NA	NA	NO	BSL
	91-20-3	Naphthalene	9.98E-05	J	3.27E-04	J	µg/m^3	-SB24-01 LW07-SB	2/59	0.017 - 10.96345515	3.27E-04	NA	3.29E-01	N	NA	NA	NO	BSL
	85-01-8	Phenanthrene	7.58E-10	J	1.44E-07	J	µg/m^3	LW07-SS21-00	31/61	0.0017 - 10.96345515	1.44E-07	NA	1.10E+01	N	NA	NA	NO	BSL
	129-00-0	Pyrene	2.93E-07	J	6.40E-03	J	µg/m^3	LW07-SS01-00	41/61	0.0017 - 10.96345515	6.40E-03	NA	1.10E+01	N	NA	NA	NO	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	3.71E-08	J	1.21E-06		µg/m^3	LW07-SB02-01	5/6	0.3501697793 - 10.9634551	1.21E-06	NA	4.47E-01	C	NA	NA	NO	BSL
	72-55-9	4,4'-DDE	1.74E-08		1.74E-08		µg/m^3	LW07-SS01-00	1/6	0.00334629035 - 0.0043	1.74E-08	NA	1.84E-02	C	NA	NA	NO	BSL
	50-29-3	4,4'-DDT	7.58E-09	L	7.58E-09	J	µg/m^3	LW07-SS01-00	1/6	0.00334629035 - 0.0043	7.58E-09	NA	1.84E-02	C	NA	NA	NO	BSL
	5103-71-9	alpha-Chlordane	1.82E-08	L	1.82E-08		µg/m^3	LW07-SS01-00	1/6	0.001723846544 - 0.0022	1.82E-08	NA	1.79E-02	C	NA	NA	NO	BSL
	7429-90-5	Aluminum	3.54E-04		9.17E-03		µg/m^3	LW07-SS09-00	61/61	29.3 - 55.5	9.17E-03	NA	3.65E-01	N	NA	NA	NO	BSL
	7440-36-0	Antimony	2.58E-07	J	2.05E-06	L	µg/m^3	LW07-SS25-00	14/61	8.8 - 16.6	2.05E-06	NA	1.46E-01	N	NA	NA	NO	BSL
	7440-38-2	Arsenic	3.71E-07	J	2.10E-05		µg/m^3	LW07-SS01-00	49/61	1.5 - 2.8	2.10E-05	NA	4.15E-04	C	NA	NA	NO	BSL
	7440-39-3	Barium	2.20E-06	J	1.99E-04		µg/m^3	LW07-SS09-00	57/61	29.3 - 55.5	1.99E-04	NA	5.11E-02	N	NA	NA	NO	BSL
	7440-41-7	Beryllium	3.03E-08	J	6.89E-07		µg/m^3	LW07-SB23-01	44/61	0.7 - 1.4	6.89E-07	NA	7.45E-04	C	NA	NA	NO	BSL
	7440-43-9	Cadmium	3.03E-08	J	3.71E-07		µg/m^3	LW07-SB23-01	14/61	0.7 - 1.9	3.71E-07	NA	9.94E-04	C	NA	NA	NO	BSL
	7440-70-2	Calcium	6.06E-05	J	2.78E-02		µg/m^3	LW07-SS07-00	50/61	731.8 - 1390	2.78E-02	NA	NA		NA	NA	NO	BSL

TABLE 2.8

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Air

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier) (5)	Maximum Concentration (Qualifier) (5)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (N/C) (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
	7440-47-3	Chromium	1.36E-06 J	6.76E-05	µg/m^3	LW07-SB16-01	60/61	1.5 - 2.8	6.76E-05	NA	1.53E-04 C	NA	NA	NO	BSL
	7440-48-4	Cobalt	8.33E-08 J	1.00E-05	µg/m^3	LW07-SS09-00	35/61	7.3 - 13.9	1.00E-05	NA	6.40E-04 C	NA	NA	NO	BSL
	7440-50-8	Copper	5.00E-07 J	3.92E-04	µg/m^3	LW07-SS24-00	50/61	3.7 - 6.9	3.92E-04	NA	1.46E+01 N	NA	NA	NO	BSL
	57-12-5	Cyanide	1.29E-07 J	1.29E-07 J	µg/m^3	LW07-SS18-00	1/33	0.5 - 0.69	1.29E-07	NA	7.30E+00 N	NA	NA	NO	BSL
	7439-89-6	Iron	5.61E-04 J	2.02E-02	µg/m^3	LW07-SS09-00	61/61	14.6 - 27.7	2.02E-02	NA	1.10E+02 N	NA	NA	NO	BSL
	7439-92-1	Lead	9.85E-07 J	9.39E-04	µg/m^3	LW07-SS24-00	61/61	0.4 - 0.83	9.39E-04	NA	NA	NA	NA	NO	BSL
	7439-95-4	Magnesium	4.88E-05 J	6.29E-03	µg/m^3	LW07-SS09-00	60/61	731.8 - 1390	6.29E-03	NA	NA	NA	NA	NO	BSL
	7439-96-5	Manganese	2.35E-06 J	4.67E-04	µg/m^3	LW07-SS09-00	61/61	2.2 - 4.2	4.67E-04	NA	5.22E-03 N	NA	NA	NO	BSL
	7439-97-6	Mercury	1.52E-08 L	7.50E-07 L	µg/m^3	LW07-SS24-00	19/61	0.07 - 0.14	7.50E-07	NA	3.14E-02 N	NA	NA	NO	BSL
	7440-02-0	Nickel	1.97E-07 J	1.89E-05	µg/m^3	LW07-SS09-00	42/61	5.9 - 11.1	1.89E-05	NA	7.30E+00 N	NA	NA	NO	BSL
	7440-09-7	Potassium	5.11E-05 J	6.55E-03	µg/m^3	LW07-SS09-00	61/61	731.8 - 1390	6.55E-03	NA	NA	NA	NA	NO	BSL
	7782-49-2	Selenium	3.41E-07 J	7.58E-07 K	µg/m^3	-SB19-02 LW07-SS	4/61	0.7 - 1.9	7.58E-07	NA	1.83E+00 N	NA	NA	NO	BSL
	7440-22-4	Silver	7.05E-07 J	5.08E-06	µg/m^3	LW07-SS09-00	14/61	1.5 - 2.8	5.08E-06	NA	1.83E+00 N	NA	NA	NO	BSL
	7440-23-5	Sodium	4.08E-05 J	4.34E-04 J	µg/m^3	LW07-SB23-01	18/61	731.8 - 1390	4.34E-04	NA	NA	NA	NA	NO	BSL
	7440-28-0	Thallium	9.85E-07 J	9.85E-07	µg/m^3	LW07-SS17-00	1/61	1.5 - 2.8	9.85E-07	NA	2.56E-02 N	NA	NA	NO	BSL
	7440-62-2	Vanadium	1.29E-06 J	3.27E-05	µg/m^3	LW07-SS09-00	61/61	7.3 - 13.9	3.27E-05	NA	3.70E-01 N	NA	NA	NO	BSL
	7440-66-6	Zinc	3.11E-06 J	5.48E-04	µg/m^3	LW07-SB23-01	59/61	2.9 - 5.5	5.48E-04	NA	1.10E+02 N	NA	NA	NO	BSL

[1] Maximum concentration used for screening.

[2] No background data available.

[3] Risk-Based Concentration Table for ambient air, April 14, 2004, U.S. EPA Region III, Jennifer Hubbard.
Ambient air RBC (Cancer benchmark value = 1E-06, adjusted HQ=0.1).
RBC value for naphthalene used as surrogate for acenaphthylene.
RBC value for pyrene used as surrogate for phenanthrene and benzo(g,h,i)perylene.
RBC value for cadmium-water used as surrogate for cadmium.
RBC value for Chromium VI used for total chromium.
Lead screening toxicity value is 400 mg/kg, the EPA residential soil screening level for lead.
RBC value for manganese-nonfood used as surrogate for manganese.
RBC value for mercuric chloride used as surrogate for mercury.

[4] Rationale Co Selection Reason:
Deletion Reason: Above Screening Levels (ASL)
No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

[5] Minimum/Maximum detected concentrations in surface soil samples multiplied by 1/PEF for nonvolatiles

Soil*- Surface and subsurface soil combined.

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
K = Biased High
L = Biased Low
C = Carcinogenic
N = Noncarcinogenic

Table 2.8.A
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
Calculation of Generic Chemical Specific VF Factors
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Chemical	Diffusivity in Air (D_i) (cm^2/s)	Henry's Law Constant (H') (unitless)	Diffusivity in Water (D_w) (cm^2/s)	Soil Organic Carbon Partition Coeff. (K_{oc}) (cm^3/g)	Soil Water Partition Coeff. ($K_d = K_{oc} \times F_{oc}$) ($g/cm^3$)	Solubility in Water (S) (mg/L)	Apparent Diffusivity (D_A) (cm^2/s)	Volatilization Factor (VF) (m^3/kg)
Volatile Organics								
Acenaphthene	4.21E-02	6.36E-03	7.69E-06	7.08E+03	4.25E+01	4.24E+00	3.36E-07	2.16E+05
Acenaphthylene	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	3.24E-02	2.67E-03	7.74E-06	2.95E+04	1.77E+02	4.34E-02	2.63E-08	7.72E+05
Fluorene	3.63E-02	2.61E-03	7.88E-06	1.38E+04	8.28E+01	1.98E+00	6.15E-08	5.05E+05
Naphthalene	5.90E-02	1.99E-02	7.50E-06	2.00E+03	1.20E+01	3.10E+01	5.17E-06	5.51E+04
Phenanthrene	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	2.72E-02	4.51E-04	7.24E-06	1.05E+05	6.30E+02	1.35E-01	1.11E-09	3.76E+06

Volatilization factor (VF) = (m^3/kg)

$$\frac{Q/C * (3.14 * D_A * T)^{1/2} * 10^{-4}\ m^2/cm^2}{2 * r_b * D_A}$$

Apparent Diffusivity (D_A) = (cm^2/s)

$$\frac{[(Q_a^{10/3} * D_i * H' + Q_w^{10/3} * D_w)/n^2]}{(r_b * K_d + Q_w + Q_a * H')}$$

Parameters	Values
Q/C - Inverse of the mean concentration at the center of a 0.5-acre-square source (g/m^2-s per kg/m^3)	68.81
T - Exposure interval(s)	9.5E+08
r_b - Soil bulk density (g/cm^3)	1.5
Q_a - Air-filled soil porosity (L_{air}/L_{water}) = n - Q_w	0.28
n - Total soil porosity (Lpore/Lsoil) = 1 - (r_b/r_s)	0.43
Q_w - Water-filled soil porosity (Lwater/Lsoil)	0.15
r_s - Soil particle density (g/cm^3)	2.65
f_{oc} - fraction organic carbon in soil (g/g)	0.006

Chemical and physical properties from USEPA, 1996, *Soil Screening Guidance: User's Guide,* EPA/540/R-96/018.

TABLE 3.1.RME

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
SWMU 7	Benzo(a)pyrene	MG/KG	6.83E-02	2.43E-01	(T)	1.70E-01	J	1.70E-01	MG/KG	Max	(5)
	Aluminum	MG/KG	4.15E+03	7.17E+03	(T)	8.86E+03		7.17E+03	MG/KG	95% UCL-T	(4)
	Arsenic	MG/KG	2.12E+00	5.54E+00	(T)	4.20E+00		4.20E+00	MG/KG	Max	(5)
	Chromium	MG/KG	1.26E+01	1.94E+01	(T)	2.76E+01		1.94E+01	MG/KG	95% UCL-T	(4)
	Iron	MG/KG	9.22E+03	1.55E+04	(T)	2.39E+04		1.55E+04	MG/KG	95% UCL-T	(1)
	Manganese	MG/KG	1.57E+02	5.33E+02	(T)	4.60E+02		4.60E+02	MG/KG	Max	(5)
	Vanadium	MG/KG	1.66E+01	2.26E+01	(N)	3.21E+01		2.26E+01	MG/KG	95%UCL-N	(2)

Full statistics for data included in Appendix G.

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.

ProUCL, Version 2.1 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2002. ProUCL, Version 2.1. Prepared by Lockheed Martin Environmental Services).

Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data, H-Statistic (95% UCL-T); 95% Chebyshev (MVUE) UCL (95% Cheb); 99% Chebyshev (MVUE) UCL (99% Cheb); 95% Chebyshev (mean,std) UCL (95% Cheb-m); 97.5% Chebyshev (mean,std) UCL (97.5% Cheb-m); 99% Chebyshev (mean,std) UCL (99% Cheb-m); Mean of Log-transformed Data (Mean-T).

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test indicates data are normally distributed.
(3) Shapiro-Wilk W Test indicates data neither log-normally or normally distributed. Use non-parametric RME EPC.
(4) Shapiro-Wilk W Test indicates data fit both log-normal and normal distribution. Select distribution with higher W Test result.
(5) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.
(6) Max value used because sample size is less than 5.

N = Normal
T = Log-Transformed
NP = Non-Parametric

J - Analyte present. Reported value may or may not be accurate or precise.
L - Analyte present. Reported value may be biased low. Actual value is expected to be higher.
MG/KG - millograms per kilogram

TABLE 3.2.RME

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Medium: Surface Sediment
Exposure Medium: Surface Sediment

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
Desert Cove	Benzo(a)pyrene	MG/KG	1.02E+00	1.82E+00	(T)	6.10E+00		1.82E+00	MG/KG	95% UCL-T	(1)
	Benzo(b)fluoranthene	MG/KG	1.90E+00	3.68E+00	(T)	1.20E+01	J	3.68E+00	MG/KG	95% UCL-T	(1)
	Dibenz(a,h)anthracene	MG/KG	2.19E-01	3.29E-01	(T)	1.20E+00	J	3.29E-01	MG/KG	95% UCL-T	(1)
	Arsenic	MG/KG	8.00E+00	1.02E+01	(NP)	1.26E+01		1.02E+01	MG/KG	95% Cheb-m	(3)
	Iron	MG/KG	1.90E+04	2.38E+04	(NP)	3.10E+04		2.38E+04	MG/KG	95% Cheb-m	(3)
	Lead	MG/KG	1.09E+02	2.98E+02	(NP)	1.81E+03		2.98E+02	MG/KG	95% Cheb-m	(3)

Full statistics for data included in Appendix G.

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.

ProUCL, Version 2.1 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2002. ProUCL, Version 2.1. Prepared by Lockheed Martin Environmental Services).

Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data, H-Statistic (95% UCL-T); 95% Chebyshev (MVUE) UCL (95% Cheb); 99% Chebyshev (MVUE) UCL (99% Cheb); 95% Chebyshev (mean,std) UCL (95% Cheb-m); 97.5% Chebyshev (mean,std) UCL (97.5% Cheb-m); 99% Chebyshev (mean,std) UCL (99% Cheb-m); Mean of Log-transformed Data (Mean-T).

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test indicates data are normally distributed.
(3) Shapiro-Wilk W Test indicates data neither log-normally or normally distributed. Use non-parametric RME EPC.
(4) Shapiro-Wilk W Test indicates data fit both log-normal and normal distribution. Select distribution with higher W Test result.
(5) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.
(6) Max value used because sample size is less than 5.

N = Normal
T = Log-Transformed
NP = Non-Parametric

J - Analyte present. Reported value may or may not be accurate or precise.

MG/KG - millograms per kilogram

TABLE 3.3.RME

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Sediment*
Exposure Medium: Sediment*

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
Desert Cove	Benzo(a)pyrene	MG/KG	8.24E-01	1.82E+00	(T)	6.10E+00		1.82E+00	MG/KG	95% UCL-T	(1)
	Benzo(b)fluoranthene	MG/KG	1.48E+00	2.93E+00	(T)	1.20E+01	J	2.93E+00	MG/KG	95% UCL-T	(1)
	Dibenz(a,h)anthracene	MG/KG	2.22E-01	3.07E-01	(T)	1.20E+00	J	3.07E-01	MG/KG	95% UCL-T	(1)
	Arsenic	MG/KG	7.80E+00	8.51E+00	(N)	1.54E+01		8.51E+00	MG/KG	95% UCL-N	(2)
	Iron	MG/KG	1.96E+04	2.44E+04	(NP)	4.85E+04		2.44E+04	MG/KG	95% Cheb-m	(3)
	Lead	MG/KG	8.84E+01	1.14E+02	(T)	1.81E+03		1.14E+02	MG/KG	95% UCL-T	(1)

Sediment* - Surface and subsurface sediment combined.

Full statistics for data included in Appendix G.

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.

ProUCL, Version 2.1 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2002. ProUCL, Version 2.1. Prepared by Lockheed Martin Environmental Services).

Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data, H-Statistic (95% UCL-T); 95% Chebyshev (MVUE) UCL (95% Cheb); 99% Chebyshev (MVUE) UCL (99% Cheb); 95% Chebyshev (mean,std) UCL (95% Cheb-m); 97.5% Chebyshev (mean,std) UCL (97.5% Cheb-m); 99% Chebyshev (mean,std) UCL (99% Cheb-m); Mean of Log-transformed Data (Mean-T).

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test indicates data are normally distributed.
(3) Shapiro-Wilk W Test indicates data neither log-normally or normally distributed. Use non-parametric RME EPC.
(4) Shapiro-Wilk W Test indicates data fit both log-normal and normal distribution. Select distribution with higher W Test result.
(5) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.
(6) Max value used because sample size is less than 5.

N = Normal
T = Log-Transformed
NP = Non-Parametric

J - Analyte present. Reported value may or may not be accurate or precise.
L - Analyte present. Reported value may be biased low. Actual value is expected to be higher.
MG/KG - millograms per kilogram

Note-Lilliefors test used in place of Shapiro-Wilks W Test when greater than 50 samples.

TABLE 3.4.RME

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
Upper Aquifer - Tap Water	Chloroform	ug/L	2.83E+00	1.25E+01	(NP)	1.40E+01		1.25E+01	ug/L	97.5% Cheb-m	(3)
	Methyl-tert-butyl ether (MTBE)	ug/L	4.69E+00	3.01E+01	(NP)	2.50E+01		2.50E+01	ug/L	Max	(5)
	Tetrachloroethene	ug/L	1.82E+00	6.78E+00	(NP)	5.00E+00		5.00E+00	ug/L	Max	(5)
	Arsenic	ug/L	3.79E+00	1.41E+01	(NP)	1.23E+01		1.23E+01	ug/L	Max	(5)
	Iron	ug/L	2.42E+04	9.26E+04	(T)	5.28E+04		5.28E+04	ug/L	Max	(5)
	Manganese	ug/L	2.70E+03	2.74E+04	(T)	5.91E+03		5.91E+03	ug/L	Max	(5)
Upper Aquifer - Excavation Pit	Chloroform	ug/L	2.83E+00	1.25E+01	(NP)	1.40E+01		1.25E+01	ug/L	97.5% Cheb-m	(3)
	Methyl-tert-butyl ether (MTBE)	ug/L	4.69E+00	3.01E+01	(NP)	2.50E+01		2.50E+01	ug/L	Max	(5)
	Tetrachloroethene	ug/L	1.82E+00	6.78E+00	(NP)	5.00E+00		5.00E+00	ug/L	Max	(5)
	Arsenic	ug/L	5.80E+00	1.93E+01	(T)	1.84E+01		1.84E+01	ug/L	Max	(5)
	Chromium	ug/L	1.06E+01	2.96E+01	(T)	2.21E+01		2.21E+01	ug/L	Max	(5)
	Iron	ug/L	2.77E+04	9.45E+04	(T)	5.65E+04		5.65E+04	ug/L	Max	(5)
	Manganese	ug/L	2.59E+03	2.54E+04	(T)	5.71E+03		5.71E+03	ug/L	Max	(5)
	Vanadium	ug/L	6.98E+00	8.75E+00	(N)	1.14E+01	J	8.75E+00	ug/L	95% UCL-N	(2)

Full statistics for data included in Appendix G.

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.

ProUCL, Version 2.1 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2002. ProUCL, Version 2.1. Prepared by Lockheed Martin Environmental Services).

Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data, H-Statistic (95% UCL-T); 95% Chebyshev (MVUE) UCL (95% Cheb); 99% Chebyshev (MVUE) UCL (99% Cheb); 95% Chebyshev (mean,std) UCL (95% Cheb-m); 97.5% Chebyshev (mean,std) UCL (97.5% Cheb-m); 99% Chebyshev (mean,std) UCL (99% Cheb-m); Mean of Log-transformed Data (Mean-T).

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test indicates data are normally distributed.
(3) Shapiro-Wilk W Test indicates data neither log-normally or normally distributed. Use non-parametric RME EPC.
(4) Shapiro-Wilk W Test indicates data fit both log-normal and normal distribution. Select distribution with higher W Test result.
(5) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.
(6) Max value used because sample size is less than 5.

N = Normal
T = Log-Transformed
NP = Non-Parametric

J - Analyte present. Reported value may or may not be accurate or precise.
L - Analyte present. Reported value may be biased low. Actual value is expected to be higher.
MG/KG - millograms per kilogram

TABLE 3.5.RME

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future

Medium: Groundwater

Exposure Medium: Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution) (1)		Maximum Concentration (Qualifier)	Exposure Point Concentration			
							Value	Units	Statistic	Rationale
Upper Aquifer - Water vapors at Showerhead	Chloroform	ug/L	2.83E+00	1.25E+01	(NP)	1.40E+01	1.25E+01	ug/L	97.5% Cheb-m	(3)
	Methyl-tert-butyl ether (MTBE)	ug/L	4.69E+00	3.01E+01	(NP)	2.50E+01	2.50E+01	ug/L	Max	(5)
	Tetrachloroethene	ug/L	1.82E+00	6.78E+00	(NP)	5.00E+00	5.00E+00	ug/L	Max	(5)
Upper Aquifer - Water vapors at Excavation Pit	Chloroform	ug/L	2.83E+00	1.25E+01	(NP)	1.40E+01	1.25E+01	ug/L	97.5% Cheb-m	(3)
	Methyl-tert-butyl ether (MTBE)	ug/L	4.69E+00	3.01E+01	(NP)	2.50E+01	2.50E+01	ug/L	Max	(5)
	Tetrachloroethene	ug/L	1.82E+00	6.78E+00	(NP)	5.00E+00	5.00E+00	ug/L	Max	(5)

Full statistics for data included in Appendix G.

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.

ProUCL, Version 2.1 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2002. ProUCL, Version 2.1. Prepared by Lockheed Martin Environmental Services).

Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data, H-Statistic (95% UCL-T); 95% Chebyshev (MVUE) UCL (95% Cheb); 99% Chebyshev (MVUE) UCL (99% Cheb); 95% Chebyshev (mean,std) UCL (95% Cheb-m); 97.5% Chebyshev (mean,std) UCL (97.5% Cheb-m); 99% Chebyshev (mean,std) UCL (99% Cheb-m); Mean of Log-transformed Data (Mean-T).

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.

(2) Shapiro-Wilk W Test indicates data are normally distributed.

(3) Shapiro-Wilk W Test indicates data neither log-normally or normally distributed. Use non-parametric RME EPC.

(4) Shapiro-Wilk W Test indicates data fit both log-normal and normal distribution. Select distribution with higher W Test result.

(5) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.

(6) Max value used because sample size is less than 5.

N = Normal

T = Log-Transformed

NP = Non-Parametric

J - Analyte present. Reported value may or may not be accurate or precise.

L - Analyte present. Reported value may be biased low. Actual value is expected to be higher.

MG/KG - millograms per kilogram

TABLE 3.6.RME

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
SWMU 7	Benzo(a)anthracene	MG/KG	2.94E-01	1.51E+00	(NP)	1.20E+01		1.51E+00	MG/KG	97.5% Cheb-m	(3)
	Benzo(a)pyrene	MG/KG	3.05E-01	1.73E+00	(NP)	1.40E+01		1.73E+00	MG/KG	97.5% Cheb-m	(3)
	Benzo(b)fluoranthene	MG/KG	5.85E-01	3.64E+00	(NP)	3.00E+01		3.64E+00	MG/KG	97.5% Cheb-m	(3)
	Benzo(k)fluoranthene	MG/KG	5.31E-01	3.29E+00	(NP)	2.70E+01		3.29E+00	MG/KG	97.5% Cheb-m	(3)
	Dibenz(a,h)anthracene	MG/KG	2.23E-01	1.28E-01	(NP)	6.60E+00	J	1.28E-01	MG/KG	99% Cheb-m	(3)
	Indeno(1,2,3-cd)pyrene	MG/KG	3.62E-01	2.09E+00	(NP)	1.70E+01		2.09E+00	MG/KG	97.5% Cheb-m	(3)
	Aluminum	MG/KG	3.47E+03	4.49E+03	(T)	1.21E+04		4.49E+03	MG/KG	95% UCL-T	(1)
	Arsenic	MG/KG	2.31E+00	5.22E+00	(NP)	2.77E+01		5.22E+00	MG/KG	97.5% Cheb-m	(3)
	Chromium	MG/KG	1.27E+01	1.62E+01	(T)	8.92E+01		1.62E+01	MG/KG	95% UCL-T	(1)
	Copper	MG/KG	3.34E+01	6.39E+01	(T)	5.18E+02		6.39E+01	MG/KG	95% UCL-T	(1)
	Iron	MG/KG	7.15E+03	9.54E+03	(T)	2.66E+04		9.54E+03	MG/KG	95% UCL-T	(1)
	Lead	MG/KG	5.72E+01	5.10E+01	(T)	1.24E+03		5.10E+01	MG/KG	95% UCL-T	(1)
	Manganese	MG/KG	9.78E+01	1.63E+02	(T)	6.17E+02		1.63E+02	MG/KG	95% UCL-T	(1)
	Thallium	MG/KG	2.94E-01	3.85E-01	(NP)	1.30E+00	J	3.85E-01	MG/KG	95% Cheb-m	(3)
	Vanadium	MG/KG	1.11E+01	1.39E+01	(T)	4.32E+01		1.39E+01	MG/KG	95% UCL-T	(1)

* Surface soil & subsurface soil combined.

Full statistics for data included in Appendix G.

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.

ProUCL, Version 2.1 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2002. ProUCL, Version 2.1. Prepared by Lockheed Martin Environmental Services).

Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data, H-Statistic (95% UCL-T); 95% Chebyshev (MVUE) UCL (95% Cheb); 99% Chebyshev (MVUE) UCL (99% Cheb); 95% Chebyshev (mean,std) UCL (95% Cheb-m); 97.5% Chebyshev (mean,std) UCL (97.5% Cheb-m); 99% Chebyshev (mean,std) UCL (99% Cheb-m); Mean of Log-transformed Data (Mean-T).

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test indicates data are normally distributed.
(3) Shapiro-Wilk W Test indicates data neither log-normally or normally distributed. Use non-parametric RME EPC.
(4) Shapiro-Wilk W Test indicates data fit both log-normal and normal distribution. Select distribution with higher W Test result.
(5) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.
(6) Max value used because sample size is less than 5.

N = Normal
T = Log-Transformed
NP = Non-Parametric

J - Analyte present. Reported value may or may not be accurate or precise.
L - Analyte present. Reported value may be biased low. Actual value is expected to be higher.
MG/KG - millograms per kilogram

Note-Lilliefors test used in place of Shapiro-Wilks W Test when greater than 50 samples.

TABLE 3.1.CT

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL TENDENCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
SWMU 7	Benzo(a)pyrene	MG/KG	6.83E-02	2.43E-01	(T)	1.70E-01	J	6.83E-02	MG/KG	Mean-N	(2)
	Aluminum	MG/KG	4.15E+03	7.17E+03	(T)	8.86E+03		4.15E+03	MG/KG	Mean-N	(2)
	Arsenic	MG/KG	2.12E+00	5.54E+00	(T)	4.20E+00		2.12E+00	MG/KG	Mean-N	(2)
	Chromium	MG/KG	1.26E+01	1.94E+01	(T)	2.76E+01		1.26E+01	MG/KG	Mean-N	(2)
	Iron	MG/KG	9.22E+03	1.55E+04	(T)	2.39E+04		9.06E+03	MG/KG	Mean-T	(1)
	Manganese	MG/KG	1.57E+02	5.33E+02	(T)	4.60E+02		1.57E+02	MG/KG	Mean-N	(2)
	Vanadium	MG/KG	1.66E+01	2.26E+01	(N)	3.21E+01		1.66E+01	MG/KG	Mean-N	(2)

Full statistics for data included in Appendix G.

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.

ProUCL, Version 2.1 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2002. ProUCL, Version 2.1. Prepared by Lockheed Martin Environmental Services).

Statistics: Maximum Detected Value (Max); MVU Estimate of Mean of Log-transformed Data (Mean-T); Mean of Normal Data (Mean-N).

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test indicates data are normally distributed.
(3) Shapiro-Wilk W Test indicates data neither log-normally or normally distributed. Select distribution with higher W Test result.
(4) Shapiro-Wilk W Test indicates data fit both log-normal and normal distribution. Select distribution with higher W Test result.
(5) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.
(6) Max value used because sample size is less than 5.

N = Normal
T = Log-Transformed
NP = Non-Parametric

J - Analyte present. Reported value may or may not be accurate or precise.
MG/KG - millograms per kilogram

TABLE 3.2.CT

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL TENDENCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current

Medium: Surface Sediment

Exposure Medium: Surface Sediment

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Desert Cove	Benzo(a)pyrene	MG/KG	1.02E+00	1.82E+00 (T)	6.10E+00	1.08E+00	MG/KG	Mean-T	(1)
	Benzo(b)fluoranthene	MG/KG	1.90E+00	3.68E+00 (T)	1.20E+01 J	2.05E+00	MG/KG	Mean-T	(1)
	Dibenz(a,h)anthracene	MG/KG	2.19E-01	3.29E-01 (T)	1.20E+00 J	2.18E-01	MG/KG	Mean-T	(1)
	Arsenic	MG/KG	8.00E+00	1.02E+01 (NP)	1.26E+01	8.00E+00	MG/KG	Mean-N	(3)
	Iron	MG/KG	1.90E+04	2.38E+04 (NP)	3.10E+04	1.90E+04	MG/KG	Mean-N	(3)
	Lead	MG/KG	1.09E+02	2.98E+02 (NP)	1.81E+03	1.09E+02	MG/KG	Mean-N	(3)

Full statistics for data included in Appendix G.

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.

ProUCL, Version 2.1 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2002. ProUCL, Version 2.1. Prepared by Lockheed Martin Environmental Services).

Statistics: Maximum Detected Value (Max); MVU Estimate of Mean of Log-transformed Data (Mean-T); Mean of Normal Data (Mean-N).

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.

(2) Shapiro-Wilk W Test indicates data are normally distributed.

(3) Shapiro-Wilk W Test indicates data neither log-normally or normally distributed. Use mean based on normal distribution.

N = Normal

T = Log-Transformed

NP = Non-Parametric

J - Analyte present. Reported value may or may not be accurate or precise.

MG/KG - millograms per kilogram

TABLE 3.3.CT

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL TENDENCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future

Medium: Sediment*

Exposure Medium: Sediment*

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
Desert Cove	Benzo(a)pyrene	MG/KG	8.24E-01	1.82E+00	(T)	6.10E+00		1.02E+00	MG/KG	Mean-T	(1)
	Benzo(b)fluoranthene	MG/KG	1.48E+00	2.93E+00	(T)	1.20E+01	J	1.67E+00	MG/KG	Mean-T	(1)
	Dibenz(a,h)anthracene	MG/KG	2.22E-01	3.07E-01	(T)	1.20E+00	J	2.28E-01	MG/KG	Mean-T	(1)
	Arsenic	MG/KG	7.80E+00	8.51E+00	(N)	1.54E+01		7.80E+00	MG/KG	Mean-N	(2)
	Iron	MG/KG	1.96E+04	2.44E+04	(NP)	4.85E+04		1.96E+04	MG/KG	Mean-N	(3)
	Lead	MG/KG	8.84E+01	1.14E+02	(T)	1.81E+03		7.80E+01	MG/KG	Mean-T	(1)

Full statistics for data included in Appendix G.

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.

ProUCL, Version 2.1 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2002. ProUCL, Version 2.1. Prepared by Lockheed Martin Environmental Services).

Statistics: Maximum Detected Value (Max); MVU Estimate of Mean of Log-transformed Data (Mean-T); Mean of Normal Data (Mean-N).

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.

(2) Shapiro-Wilk W Test indicates data are normally distributed.

(3) Shapiro-Wilk W Test indicates data neither log-normally or normally distributed. Use mean based on normal distribution.

N = Normal

T = Log-Transformed

NP = Non-Parametric

J - Analyte present. Reported value may or may not be accurate or precise.

MG/KG - millograms per kilogram

Note-Lilliefors test used in place of Shapiro-Wilks W Test when greater than 50 samples.

TABLE 3.4.CT

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL TENDENCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
Upper Aquifer - Tap Water	Chloroform	ug/L	2.83E+00	1.25E+01	(NP)	1.40E+01		2.83E+00	ug/L	Mean-N	(3)
	Methyl-tert-butyl ether	ug/L	4.69E+00	3.01E+01	(NP)	2.50E+01		4.69E+00	ug/L	Mean-N	(3)
	Tetrachloroethene	ug/L	1.82E+00	6.78E+00	(NP)	5.00E+00		1.82E+00	ug/L	Mean-N	(3)
	Arsenic	ug/L	3.79E+00	1.41E+01	(NP)	1.23E+01		3.79E+00	ug/L	Mean-N	(3)
	Iron	ug/L	2.42E+04	9.26E+04	(T)	5.28E+04		2.42E+04	ug/L	Mean-N	(2)
	Manganese	ug/L	2.70E+03	2.74E+04	(T)	5.91E+03		2.70E+03	ug/L	Mean-N	(2)
Upper Aquifer - Excavation Pit	Chloroform	ug/L	2.83E+00	1.25E+01	(NP)	1.40E+01		2.83E+00	ug/L	Mean-N	(3)
	Methyl-tert-butyl ether	ug/L	4.69E+00	3.01E+01	(NP)	2.50E+01		4.69E+00	ug/L	Mean-N	(3)
	Tetrachloroethene	ug/L	1.82E+00	6.78E+00	(NP)	5.00E+00		1.82E+00	ug/L	Mean-N	(3)
	Arsenic	ug/L	5.80E+00	1.93E+01	(T)	1.84E+01		5.76E+00	ug/L	Mean-T	(1)
	Chromium	ug/L	1.06E+01	2.96E+01	(T)	2.21E+01		1.06E+01	ug/L	Mean-N	(2)
	Iron	ug/L	2.77E+04	9.45E+04	(T)	5.65E+04		2.77E+04	ug/L	Mean-N	(2)
	Manganese	ug/L	2.59E+03	2.54E+04	(T)	5.71E+03		2.59E+03	ug/L	Mean-N	(2)
	Vanadium	ug/L	6.98E+00	8.75E+00	(N)	1.14E+01	J	6.98E+00	ug/L	Mean-N	(2)

Full statistics for data included in Appendix G.

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.

ProUCL, Version 2.1 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2002. ProUCL, Version 2.1. Prepared by Lockheed Martin Environmental Services).

Statistics: Maximum Detected Value (Max); MVU Estimate of Mean of Log-transformed Data (Mean-T); Mean of Normal Data (Mean-N).

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.

(2) Shapiro-Wilk W Test indicates data are normally distributed.

(3) Shapiro-Wilk W Test indicates data neither log-normally or normally distributed. Use mean based on normal distribution.

N = Normal

T = Log-Transformed

NP = Non-Parametric

J - Analyte present. Reported value may or may not be accurate or precise.

L - Analyte present. Reported value may be biased low. Actual value is expected to be higher.

MG/KG - millograms per kilogram

TABLE 3.5.CT

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL TENDENCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution) (1)		Maximum Concentration (Qualifier)	Exposure Point Concentration			
							Value	Units	Statistic	Rationale
Upper Aquifer - Water vapors at Showerhead	Chloroform	ug/L	2.83E+00	1.25E+01	(NP)	1.40E+01	2.83E+00	ug/L	Mean-N	(3)
	Methyl-tert-butyl ether	ug/L	4.69E+00	3.01E+01	(NP)	2.50E+01	4.69E+00	ug/L	Mean-N	(3)
	Tetrachloroethene	ug/L	1.82E+00	6.78E+00	(NP)	5.00E+00	1.82E+00	ug/L	Mean-N	(3)
Upper Aquifer - Water vapors at Excavation Pit	Chloroform	ug/L	2.83E+00	1.25E+01	(NP)	1.40E+01	2.83E+00	ug/L	Mean-N	(3)
	Methyl-tert-butyl ether	ug/L	4.69E+00	3.01E+01	(NP)	2.50E+01	4.69E+00	ug/L	Mean-N	(3)
	Tetrachloroethene	ug/L	1.82E+00	6.78E+00	(NP)	5.00E+00	1.82E+00	ug/L	Mean-N	(3)

Full statistics for data included in Appendix G.

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.

ProUCL, Version 2.1 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2002. ProUCL, Version 2.1. Prepared by Lockheed Martin Environmental Services).

Statistics: Maximum Detected Value (Max); MVU Estimate of Mean of Log-transformed Data (Mean-T); Mean of Normal Data (Mean-N).

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.

(2) Shapiro-Wilk W Test indicates data are normally distributed.

(3) Shapiro-Wilk W Test indicates data neither log-normally or normally distributed. Use mean based on normal distribution.

N = Normal

T = Log-Transformed

NP = Non-Parametric

MG/KG - millograms per kilogram

TABLE 3.6.CT

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL TENDENCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
SWMU 7	Benzo(a)anthracene	MG/KG	2.94E-01	1.51E+00	(NP)	1.20E+01		2.94E-01	MG/KG	Mean-N	(3)
	Benzo(a)pyrene	MG/KG	3.05E-01	1.73E+00	(NP)	1.40E+01		3.05E-01	MG/KG	Mean-N	(3)
	Benzo(b)fluoranthene	MG/KG	5.85E-01	3.64E+00	(NP)	3.00E+01		5.85E-01	MG/KG	Mean-N	(3)
	Benzo(k)fluoranthene	MG/KG	5.31E-01	3.29E+00	(NP)	2.70E+01		5.31E-01	MG/KG	Mean-N	(3)
	Dibenz(a,h)anthracene	MG/KG	2.23E-01	1.28E-01	(NP)	6.60E+00	J	2.23E-01	MG/KG	Mean-N	(3)
	Indeno(1,2,3-cd)pyrene	MG/KG	3.62E-01	2.09E+00	(NP)	1.70E+01		3.62E-01	MG/KG	Mean-N	(3)
	Aluminum	MG/KG	3.47E+03	4.49E+03	(T)	1.21E+04		3.52E+03	MG/KG	Mean-T	(1)
	Arsenic	MG/KG	2.31E+00	5.22E+00	(NP)	2.77E+01		2.31E+00	MG/KG	Mean-N	(3)
	Chromium	MG/KG	1.27E+01	1.62E+01	(T)	8.92E+01		1.24E+01	MG/KG	Mean-T	(1)
	Copper	MG/KG	3.34E+01	6.39E+01	(T)	5.18E+02		3.41E+01	MG/KG	Mean-T	(1)
	Iron	MG/KG	7.15E+03	9.54E+03	(T)	2.66E+04		7.28E+03	MG/KG	Mean-T	(1)
	Lead	MG/KG	5.72E+01	8.39E+01	(T)	1.24E+03		5.11E+01	MG/KG	Mean-T	(1)
	Manganese	MG/KG	9.78E+01	1.63E+02	(T)	6.17E+02		1.00E+02	MG/KG	Mean-T	(1)
	Thallium	MG/KG	2.94E-01	3.85E-01	(NP)	1.30E+00	J	2.94E-01	MG/KG	Mean-N	(3)
	Vanadium	MG/KG	1.11E+01	1.39E+01	(T)	4.32E+01		1.11E+01	MG/KG	Mean-N	(2)

* Surface soil & subsurface soil combined.
Full statistics for data included in Appendix G.
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.
ProUCL, Version 2.1 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2002. ProUCL, Version 2.1. Prepared by Lockheed Martin Environmental Services).
Statistics: Maximum Detected Value (Max); MVU Estimate of Mean of Log-transformed Data (Mean-T); Mean of Normal Data (Mean-N).

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test indicates data are normally distributed.
(3) Shapiro-Wilk W Test indicates data neither log-normally or normally distributed. Use mean based on normal distribution.

N = Normal
T = Log-Transformed
NP = Non-Parametric

J - Analyte present. Reported value may or may not be accurate or precise.
MG/KG - millograms per kilogram

Note-Lilliefors test used in place of Shapiro-Wilks W Test when greater than 50 samples.

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Medium: Surface Sediment
Exposure Medium: Surface Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Other Worker	Adult	Desert Cove	CSed	Chemical Concentration in Sediment	see Table ----	mg/kg	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-Sed	Ingestion Rate of Sediment	50	mg/day	(1)	CSed x IR-Sed x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	12	days/year	(2)	
				ED	Exposure Duration	25	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Trespasser/Visitor	Adult	Desert Cove	CSed	Chemical Concentration in Sediment	see Table ----	mg/kg	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-Sed	Ingestion Rate of Sediment	50	mg/day	(1)	CSed x IR-Sed x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	26	days/year	(3)	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
	Trespasser/Visitor	Adolescent	Desert Cove	CSed	Chemical Concentration in Sediment	see Table	mg/kg	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-Sed	Ingestion Rate of Sediment	50	mg/day	(1)	CSed x IR-Sed x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	26	days/year	(3)	
				ED	Exposure Duration	9	years	(4)	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	51	kg	EPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
Dermal	Other Worker	Adult	Desert Cove	CSed	Chemical Concentration in Sediment	see Table ----	mg/kg	- -	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,170	cm^2	EPA, 1997, (8)	CSed x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA,1997, (6)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	12	days/year	(2)	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Medium: Surface Sediment
Exposure Medium: Surface Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Trespasser/Visitor	Adult	Desert Cove	CSed	Chemical Concentration in Sediment	see Table ----	mg/kg	- -	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 2001, (5)	CSed x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA,1997, (6)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	26	days/year	(3)	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
	Trespasser/Visitor	Adolescents	Desert Cove	CSed	Chemical Concentration in Sediment	see Table	mg/kg	- -	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,500	cm^2	EPA, 1997, (7)	CSed x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA,1997, (6)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	26	days/year	(3)	
				ED	Exposure Duration	9	years	(4)	
				BW	Body Weight	51	kg	EPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

Notes:

(1) Professional Judgement assuming 1/2 soil ingestion rate.

(2) Professional Judgment assuming 1 day per month per year.

(3) Professional Judgment assuming 1 day per week for one-half the year.

(4) Professional Judgment assuming adolescents from 9 to 18 years of age.

(5) RME SA is the sum of the mean surface areas (for a male) of the hands, forearms, feet, and lower legs.

(6) RME SSAF is soil adherence to hands for Gardeners No. 1 from EPA, 1997, Table 6-12.

(7) Skin surface area in contact with sediment. Assumes 30 percent of total surface area (hands, forearms, lower legs, and feet) of 12-15 year old male.

(8) RME SA is based on wet suit use.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Maintenance Worker	Adult	SWMU 7	CS	Chemical Concentration in Soil	see Table 3.1	mg/kg	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	24	days/year	(1)	
				ED	Exposure Duration	25	years	EPA, 1991	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Trespasser/Visitor	Adult	SWMU 7	CS	Chemical Concentration in Soil	see Table 3.1	mg/kg	- -	CDI (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(2)	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
	Trespasser/Visitor	Adolescent	SWMU 7	CS	Chemical Concentration in Soil	see Table 3.1	mg/kg	- -	CDI (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(2)	
				ED	Exposure Duration	9	years	(3)	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	51	kg	EPA, 1997, (4)	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

TABLE 4.2.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Maintenance Worker	Adult	SWMU 7	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.2.RME	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	3,300	cm^2	EPA, 2001, (5)	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2001, (6)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	24	days/year	(1)	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Trespasser/Visitor	Adult	SWMU 7	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.2.RME	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 2001, (5)	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2001, (7)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	52	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
	Trespasser/Visitor	Adolescents	SWMU 7	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.2.RME	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	4,600	cm^2	EPA, 1997, (8)	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2001, (9)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	52	days/year	(2)	
				ED	Exposure Duration	9	years	(3)	
				BW	Body Weight	51	kg	EPA, 1997,(4)	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name

Notes:

(1) Conservative assumption based on potential maintenance activities, including lawn mowing, at the site.

(2) Professional Judgement assuming 2 day per week for 26 weeks per year.

(3) Professional Judgement assuming adolescents from 9 to 18 years of age.

(4) Body weight is average value for the 9 year old and 18 year old male body weight.

(5) RME SA includes head, hands, forearms, and lower legs.

(6) SSAF based on maximum adherence factor for utility workers.

(7) RME SSAF is soil adherence to hands for Groundskeeper No. 1.

(8) Surface area is 25% of total surface area for 12-15 year old male. 95th percentile for total surface area is 1.85 m^2.

(9) SSAF for children.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Maintenance Worker	Adult	Emissions from SWMU 7 Soil	CS	Chemical Concentration in Soil	See Table 3.3.RME	mg/kg	See Table 3.3.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	calculated	mg/m^3	calculated	CA x IN x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.32E+09	m^3/kg	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m^3/kg	EPA, 1996	CA (mg/m^3) = CS (1/PEF + 1/VF)
				IN	Inhalation Rate	20	m^3/day	EPA, 2001	
				EF	Exposure Frequency	24	days/year	(1)	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Trespasser/Visitor	Adult	Emissions from SWMU 7 Soil	CS	Chemical Concentration in Soil	See Table 3.3.RME	mg/kg	See Table 3.3.RME	CDI (mg/kg-day) =
				CA	Chemical Concentration in Air	calculated	mg/m^3	calculated	CA x IN x ET x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.32E+09	m^3/kg	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m^3/kg	EPA, 1996	CA (mg/m^3) = CS (1/PEF + 1/VF)
				IN	Inhalation Rate	0.83	$m^3/hour$	EPA, 1991	
				ET	Exposure Time	2	hr/day	(2)	
				EF	Exposure Frequency	52	days/year	(3)	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
	Trespasser/Visitor	Adolescents	Emissions from SWMU 7 Soil	CS	Chemical Concentration in Soil	See Table 3.3.RME	mg/kg	See Table 3.3.RME	CDI (mg/kg-day) =
				CA	Chemical Concentration in Air	calculated	mg/m^3	calculated	CA x IN x ET x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.32E+09	m^3/kg	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m^3/kg	EPA, 1996	CA (mg/m^3) = CS (1/PEF + 1/VF)
				IN	Inhalation Rate	0.83	$m^3/hour$	EPA, 1991	
				ET	Exposure Time	2	hr/day	(2)	
				EF	Exposure Frequency	52	days/year	(3)	
				ED	Exposure Duration	9	years	(4)	
				BW	Body Weight	51	kg	EPA, 1997,(5)	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name

Notes:

(1) Conservative assumption based on potential maintenance activities, including lawn mowing, at the site.

(2) Professional judgement assuming trespasser would spend a maximum of 2 hours at the site.

(3) Professional Judgement assuming 2 day per week for 26 weeks per year.

(4) Professional Judgement assuming adolescents from 9 to 18 years of age.

(5) Body weight is average value for the 9 year old and 18 year old male body weight.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1996: Soil Screening Guidance: User's Guide. OSWER. EPA/540/R-96/018.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2001: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

TABLE 4.4.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Sediment*
Exposure Medium: Sediment*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Maintenance Worker	Adult	Desert Cove	CSed	Chemical Concentration in Sediment	see Table ----	mg/kg	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-Sed	Ingestion Rate of Sediment	50	mg/day	(1)	CSed x IR-Sed x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	5	days/year	(2)	
				ED	Exposure Duration	25	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Other Worker	Adult	Desert Cove	CSed	Chemical Concentration in Sediment	see Table ----	mg/kg	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-Sed	Ingestion Rate of Sediment	50	mg/day	(1)	CSed x IR-Sed x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	12	days/year	(3)	
				ED	Exposure Duration	25	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Trespasser/Visitor	Adult	Desert Cove	CSed	Chemical Concentration in Sediment	see Table ----	mg/kg	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-Sed	Ingestion Rate of Sediment	50	mg/day	(1)	CSed x IR-Sed x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	26	days/year	(4)	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
	Trespasser/Visitor	Adolescent	Desert Cove	CSed	Chemical Concentration in Sediment	see Table	mg/kg	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-Sed	Ingestion Rate of Sediment	50	mg/day	(1)	CSed x IR-Sed x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	26	days/year	(4)	
				ED	Exposure Duration	9	years	(5)	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	51	kg	EPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

TABLE 4.4.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Sediment*
Exposure Medium: Sediment*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Maintenance Worker	Adult	Desert Cove	CSed	Chemical Concentration in Sediment	see Table ----	mg/kg	- -	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,170	cm^2	EPA, 1997, (6)	CSed x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA,1997, (7)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 1995	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	5	days/year	(1)	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Other Worker	Adult	Desert Cove	CSed	Chemical Concentration in Sediment	see Table ----	mg/kg	- -	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,170	cm^2	EPA, 1997, (9)	CSed x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA,1997, (7)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	12	days/year	(3)	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Trespasser/Visitor	Adult	Desert Cove	CSed	Chemical Concentration in Sediment	see Table ----	mg/kg	- -	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 2001, (6)	CSed x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA,1997, (7)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	26	days/year	(4)	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	

TABLE 4.4.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Sediment*
Exposure Medium: Sediment*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Trespasser/Visitor	Adolescents	Desert Cove	CSed	Chemical Concentration in Sediment	see Table	mg/kg	- -	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,500	cm^2	EPA, 1997, (8)	CSed x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA,1997, (7)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	26	days/year	(4)	
				ED	Exposure Duration	9	years	(5)	
				BW	Body Weight	51	kg	EPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

Notes:

(1) Professional Judgement assuming 1/2 soil ingestion rate.

(2) Professional Judgement assuming 5 days per year.

(3) Professional Judgment assuming 1 day per month per year.

(4) Professional Judgment assuming 1 day per week for one-half the year.

(5) Professional Judgment assuming adolescents from 9 to 18 years of age.

(6) RME SA is the sum of the mean surface areas (for a male) of the hands, forearms, feet, and lower legs.

(7) RME SSAF is soil adherence to hands for Gardeners No. 1 from EPA, 1997, Table 6-12. CT SSAF is average soil adherence to hands Gardeners No. 1 and No. 2 from EPA, 1997, Table 6-12.

(8) Skin surface area in contact with sediment. Assumes 30 percent of total surface area (hands, forearms, lower legs, and feet) of 12-15 year old male.

(9) RME SA is based on wet suit use.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

Sediment*-includes surface and subsurface sediment

TABLE 4.5.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.4.RME	µg/l	See Table 3.4.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-W	Ingestion Rate of Water	2	liters/day	EPA, 1997	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
		Child	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.4.RME	µg/l	See Table 3.4.RME	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1	liters/day	EPA, 1997	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.4.RME	µg/l	See Table 3.4.RME	CDI (mg/kg-day) =
				IR-W-A	Ingestion Rate of Water, Adult	2	liters/day	EPA, 1997	CW x IR-W-Adj x EF x CF1 x 1/AT
				IR-W-C	Ingestion Rate of Water, Child	1	liters/day	EPA, 1997	
				IR-W-Adj	Ingestion Rate of Water, Age-adjusted	1.09	liter-year/kg-day	calculated	IR-W-Adj (liter-year/kd-day) =
				EF	Exposure Frequency	350	days/year	EPA, 1991	(ED-C x IR-W-C / BW-C) +
				ED-A	Exposure Duration, Adult	24	years	EPA, 1991	(ED-A x IR-W-A / BW-A)
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.5.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Industrial Worker	Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.4.RME	µg/l	See Table 3.4.RME	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1	liters/day	EPA, 1991	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
Dermal	Resident	Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.4.RME	µg/l	See Table 3.4.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2001	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2001	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2001	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2001	Organics :
				t_{event}	Event Time	0.58	hr/event	EPA, 2001	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	18,000	cm^2	EPA, 2001	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2001	x CF1 x CF2
				EF	Exposure Frequency	350	days/year	EPA, 2001	
				ED	Exposure Duration	24	years	EPA, 2001	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	
		Child	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.4.RME	µg/l	See Table 3.4.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2001	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2001	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2001	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2001	

TABLE 4.5.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Child	Upper Aquifer-Tap Water	B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2001	Organics :
				t_{event}	Event Time	1.0	hr/event		t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	6,600	cm^2	EPA, 2001	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2001	x CF1 x CF2
				EF	Exposure Frequency	350	days/year	EPA, 2001	
				ED	Exposure Duration	6	years	EPA, 2001	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	15	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + 3B^2)/(1+B)^2)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	2190	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	
	Resident	Child/Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.4.RME	µg/l	See Table 3.4.RME	CDI (mg/kg-day) = DA-Adj x EF x 1/AT
				DAevent-A	Dermally Absorbed Dose per Event, Adult	calculated	mg/cm^2-event	calculated	
				DAevent-C	Dermally Absorbed Dose per Event, Child	calculated	mg/cm^2-event	calculated	DA-Adj = (Daevent-A x SA-A x ED-A x 1/BW-A)
				DA-Adj	Dermally Absorbed Dose, Age-adjusted	calculated	mg-year/event-kg	calculated	+ (Daevent-C x SA-C x ED-C x 1/BW-C)
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2001	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2001	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2001	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2001	Organics :
				t_{event}-A	Event Time, Adult	0.58	hr/event	EPA, 2001	t_{event}<t*: DAevent (mg/cm^2-event) =
				t_{event}-C	Event Time, Child	1.0	hr/event	EPA, 2001	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				SA-A	Skin Surface Area, Adult	18,000	cm^2	EPA, 2001	x CF1 x CF2
				SA-C	Skin Surface Area, Child	6,600	cm^2	EPA, 2001	
				EV	Event Frequency	1	events/day	EPA, 2001	t_{event}>t*: DAevent (mg/cm^2-event) =
				EF	Exposure Frequency	350	days/year	EPA, 2001	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				ED-A	Exposure Duration, Adult	24	years	EPA, 2001	((1 + 3B + 3B^2)/(1+B)^2)) x CF1 x CF2
				ED-C	Exposure Duration, Child	6	years	EPA, 2001	
				BW-A	Body Weight, Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	ke	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

TABLE 4.5.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Construction Worker	Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	see Table ----	µg/l		CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2001	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2001	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2001	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2001	Organics :
				t_{event}	Event Time	8	hr/day	(1)	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	6,000	cm^2	EPA, 1997, (3)	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2001	x CF1 x CF2
				EF	Exposure Frequency	125	days/year	(2)	
				ED	Exposure Duration	1	years	EPA, 1991	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

(1) Professional Judgement based on construction activities that would occur 8 hrs per day for the RME.

(2) Assumed duration of construction project may be 1/2 a year.

(3) Skin surface area in contact with groundwater assumed to be 30 percent of total surface area (hands, forearms, lower legs, and feet).

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4.6.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Upper Aquifer- Water Vapors at showerhead	CW	Chemical Concentration in Water	See Table 3.5.RME	µg/l	See Table 3.5.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				InhExp	Inhalation Exposure per Shower	calculated	mg/kg-shower		InhExp x EF x ED x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	Foster & Chrostowski Shower Inhalation Model
				ED	Exposure Duration	24	years	EPA, 1991	for InhExp
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
	Construction Worker	Adult	Upper Aquifer- Water Vapors at Excavation Pit	CW	Chemical Concentration in Water	See Table 3.5.RME	µg/l	See Table 3.5.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	calculated	mg/m^3		CA x IN x ET x EF x ED x 1/BW x 1/AT
				IN	Inhalation Rate	2.5	m^3/hour	EPA, 1991	
				ET	Exposure Time	8	hr/day	(1)	CA calculated using two-film model
				EF	Exposure Frequency	125	days/year	(2)	
				ED	Exposure Duration	1	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	

Notes:

(1) Professional Judgement based on construction activities that would occur 8 hrs per day for the RME.

(2) Assumed duration of construction project may be 1/2 a year.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

TABLE 4.7.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current/Future
Medium: Soil**
Exposure Medium: Soil**

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Construction Worker	Adult	SWMU 7	CS	Chemical Concentration in Soil	see Table …	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	480	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	125	days/year	(1)	
				ED	Exposure Duration	1	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
	Industrial Worker	Adult	SWMU 7	CS	Chemical Concentration in Soil	see Table …	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Resident	Adult	SWMU 7	CS	Chemical Concentration in Soil	see Table …	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	

TABLE 4.7.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current/Future
Medium: Soil**
Exposure Medium: Soil**

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	SWMU 7	CS	Chemical Concentration in Soil	see Table …	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	200	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	SWMU 7	CS	Chemical Concentration in Soil	see Table …	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S-A	Ingestion Rate of Soil, Adult	100	mg/day	EPA, 1991	CS x IR-S-Adj x EF x CF3 x 1/AT
				IR-S-C	Ingestion Rate of Soil, Child	200	mg/day	EPA, 1991	
				IR-S-Adj	Ingestion Rate of Soil, Age-adjusted	114.29	mg-year/kg-day	calculated	IR-S-Adj (mg-year/kd-day) =
				EF	Exposure Frequency	350	days/year	EPA, 1991	(ED-C x IR-S-C / BW-C) + (ED-A x IR-S-A / BW-A)
				ED-A	Exposure Duration, Adult	24	years	EPA, 1991	
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
Dermal	Construction Worker	Adult	SWMU 7	CS	Chemical Concentration in Soil	see Table …	mg/kg		CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,300	cm^2	EPA, 1992, (2)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.24	mg/cm^2-day	EPA, 1997, (3)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	125	days/year	(1)	
				ED	Exposure Duration	1	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
	Industrial Worker	Adult	SWMU 7	CS	Chemical Concentration in Soil	see Table …	mg/kg		CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,300	cm^2	EPA, 1992, (2)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.32	mg/cm^2-day	EPA, 1997, (4)	ED x 1/BW x 1/AT

TABLE 4.7.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current/Future
Medium: Soil**
Exposure Medium: Soil**

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Industrial Worker	Adult	SWMU 7	DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Resident	Adult	SWMU 7	CS	Chemical Concentration in Soil	see Table …	mg/kg		CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	6,600	cm^2	EPA, 1997, (5)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 1997, (6)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
		Child	SWMU 7	CS	Chemical Concentration in Soil	see Table …	mg/kg		CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	3,400	cm^2	EPA, 1997, (5)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.11	mg/cm^2-day	EPA, 1997, (7)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	

TABLE 4.7.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current/Future
Medium: Soil**
Exposure Medium: Soil**

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal									
	Resident	Child/Adult	SWMU 7	CS	Chemical Concentration in Soil	see Table …	mg/kg		CDI (mg/kg-day) =
				SA-A	Skin Surface Area Available for Contact, Ad	6,600	cm^2	EPA, 1997	CS x DA-Adj x DABS x CF3 x EF x 1/AT
				SA-C	Skin Surface Area Available for Contact, Ch	3,400	cm^2	EPA, 1997	
				SSAF-A	Soil to Skin Adherence Factor, Adult	0.2	mg/cm^2-day	EPA, 1997	DA-Adj (mg-year/kd-day) =
				SSAF-C	Soil to Skin Adherence Factor, Child	0.11	mg/cm^2-day	EPA, 1997	
				DA-Adj	Dermal Absorption, Age-adjusted	602	mg-year/kg-day	calculated	(ED-C x SA-C x SSAF-C / BW-C) + (ED-A x SA-A / BW-A)]
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	(ED-A x SA-A x SSAF-A / BW-A)
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED-A	Exposure Duration, Adult	24	years	EPA, 1991	
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

Notes:

(1) Assumed duration of construction project may be 1/2 a year.

(2) RME SA includes head, hands, forearms, and lower legs.

(3) Soil to skin adherence factor is based on maximum adherence factor for construction workers.

(4) SSAF based on maximum adherence factor for utility workers.

(5) Surface area based on resident wearing shorts, short sleeve shirt, and shoes. RME value is 95th percentile and CT value is 50th percentile.

(6) Soil to skin adherence factor is based on maximum adherence factor for gardeners.

(7) Soil to skin adherence factor is based on maximum adherence factor for soccer players.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

Soil**-includes surface and subsurface soil

TABLE 4.8.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current/Future
Medium: Soil**
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Worker	Adult	Emissions from SWMU 7	CS	Chemical Concentration in Soil	see Table ..	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	calc	mg/m^3	EPA, 1996	CA x IN x ET x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.32E+09	m^3/kg	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m^3/kg	EPA, 1996	CA (mg/m^3) = CS (1/PEF + 1/VF)
				IN	Inhalation Rate	2.5	$m^3/hour$	EPA, 1991	
				ET	Exposure Time	8	hr/day	EPA, 1991	
				EF	Exposure Frequency	125	days/year	(1)	
				ED	Exposure Duration	1	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
	Industrial Worker	Adult	Emissions from SWMU 7	CS	Chemical Concentration in Soil	see Table ..	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	calc	mg/m^3	EPA, 1996	CA x IN x ET x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.32E+09	m^3/kg	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m^3/kg	EPA, 1996	
				IN	Inhalation Rate	0.83	$m^3/hour$	EPA, 1991	
				ET	Exposure Time	8	hr/day	EPA, 1991	CA (mg/m^3) = CS (1/PEF + 1/VF)
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Resident	Adult	Emissions from SWMU 7	CS	Chemical Concentration in Soil	see Table ..	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	calc	mg/m^3	EPA, 1996	CA x IN x ET x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.32E+09	m^3/kg	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m^3/kg	EPA, 1996	
				IN	Inhalation Rate	0.83	$m^3/hour$	EPA, 1991	CA (mg/m^3) = CS (1/PEF + 1/VF)
				ET	Exposure Time	24	hr/day	EPA, 1991	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	

TABLE 4.8.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current/Future
Medium: Soil**
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation		Child	Emissions from SWMU 7	CS	Chemical Concentration in Soil	see Table ..	mg/kg	see Table ..	Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	calc	mg/m^3	EPA, 1996	CA x IN x ET x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.32E+09	m^3/kg	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m^3/kg	EPA, 1996	
				IN	Inhalation Rate	0.5	$m^3/hour$	EPA, 1997	CA (mg/m^3) = CS (1/PEF + 1/VF)
				ET	Exposure Time	24	hr/day	EPA, 1991	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Emissions from SWMU 7	CS	Chemical Concentration in Soil	see Table 3	mg/kg	see Table 3	Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	see Table ----	mg/m^3	- -	CA x IN-Adj x EF x 1/AT
				PEF	Particulate Emission Factor	1.32E+09	kg/m^3	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m^3/kg	EPA, 1996	CA (mg/m^3) = CS (1/PEF + 1/VF)
				IN-A	Inhalation Rate, Adult	0.83	$m^3/hour$	EPA, 1991	
				IN-C	Inhalation Rate, Child	0.5	$m^3/hour$	EPA, 1997	IN-Adj (m^3-year/kd-day) =
				IN-Adj	Inhalation Rate, Age-adjusted	11.66	m^3-year/kg-day	calculated	(ED-C x IN-C x ET / BW-C) + (ED-A x IN-A x ET / BW-A)
				ET	Exposure Time	24	hours/day	(2)	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED-A	Exposure Duration, Adult	24	years	EPA, 1991	
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

Notes:

(1) Assumed duration of construction project may be 1/2 a year.

(2) Professional Judgement conservatively assumed all day.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

EPA, 2001b: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

Soil**-includes surface and subsurface soil

TABLE 4.1.CT
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDANCY
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Medium: Surface Sediment
Exposure Medium: Surface Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Other Worker	Adult	Desert Cove	CSed	Chemical Concentration in Sediment	see Table ----	mg/kg	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-Sed	Ingestion Rate of Sediment	25	mg/day	(1)	CSed x IR-Sed x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	6	days/year	(1)	
				ED	Exposure Duration	6.6	years	EPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,409	days	EPA, 1989	
	Trespasser/Visitor	Adult	Desert Cove	CSed	Chemical Concentration in Sediment	see Table ----	mg/kg	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-Sed	Ingestion Rate of Sediment	25	mg/day	(1)	CSed x IR-Sed x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	13	days/year	(1)	
				ED	Exposure Duration	9	years	EPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
	Trespasser/Visitor	Adolescent	Desert Cove	CSed	Chemical Concentration in Sediment	see Table	mg/kg	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-Sed	Ingestion Rate of Sediment	25	mg/day	(1)	CSed x IR-Sed x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	13	days/year	(1)	
				ED	Exposure Duration	9	years	(2)	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	51	kg	EPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
Dermal	Other Worker	Adult	Desert Cove	CSed	Chemical Concentration in Sediment	see Table ----	mg/kg	- -	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	1,960	cm^2	EPA, 1997, (6)	CSed x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.19	mg/cm^2-day	EPA,1997, (4)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	6	days/year	(1)	
				ED	Exposure Duration	5	years	EPA, 1993	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

TABLE 4.1.CT

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDANCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Medium: Surface Sediment
Exposure Medium: Surface Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Trespasser/Visitor	Adult	Desert Cove	CSed	Chemical Concentration in Sediment	see Table ----	mg/kg	- -	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 1997, (3)	CSed x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.19	mg/cm^2-day	EPA,1997, (4)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	13	days/year	(1)	
				ED	Exposure Duration	9	years	EPA, 1993	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
	Trespasser/Visitor	Adolescents	Desert Cove	CSed	Chemical Concentration in Sediment	see Table	mg/kg	- -	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	3,600	cm^2	EPA, 1997, (5)	CSed x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.19	mg/cm^2-day	EPA,1997, (4)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	13	days/year	(1)	
				ED	Exposure Duration	9	years	(2)	
				BW	Body Weight	51	kg	EPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

Notes:

(1) Professional Judgement assuming1/2 the RME value for the CT.

(2) Professional Judgment assuming adolescents from 9 to 18 years of age.

(3) CT SA is the sum of the mean surface areas (for a male) of the feet and hands.

(4) CT SSAF is average soil adherence to hands Gardeners No. 1 and No. 2 from EPA, 1997, Table 6-12.

(5) Skin surface area in contact with sediment. Assumes 30 percent of average total surface area (hands, forearms, lower legs, and feet) of 12-15 year old male.

(6) CT SA is based on wet suit use.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4.2.CT
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDANCY
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Maintenance Worker	Adult	SWMU 7	CS	Chemical Concentration in Soil	See Table 3.2.CT	mg/kg	See Table 3.2.CT	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	50	mg/day	EPA, 1993	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	12	days/year	(1)	
				ED	Exposure Duration	6.6	years	EPA, 1993	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,409	days	EPA, 1989	
	Trespasser/Visitor	Adult	SWMU 7	CS	Chemical Concentration in Soil	see Table 3.1	mg/kg	- -	CDI (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	50	mg/day	EPA, 1993	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	9	years	EPA, 1993	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	- -	
	Trespasser/Visitor	Adolescent	SWMU 7	CS	Chemical Concentration in Soil	See Table 3.2.CT	mg/kg	See Table 3.2.CT	CDI (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	50	mg/day	EPA, 1993	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	9	years	(2)	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	51	kg	EPA, 1997, (3)	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

TABLE 4.2.CT
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDANCY
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Maintenance Worker	Adult	SWMU 7	CS	Chemical Concentration in Soil	See Table 3.2.CT	mg/kg	See Table 3.2.CT	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	2,000	cm^2	EPA, 1992, (4)	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2001	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	12	days/year	(1)	
				ED	Exposure Duration	6.6	years	EPA, 1997	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,409	days	EPA, 1989	
	Trespasser/Visitor	Adult	SWMU 7	CS	Chemical Concentration in Soil	see Table 3.1	mg/kg	- -	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 1992, (4)	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.15	mg/cm^2-day	EPA, 1997	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	9	years	EPA, 1993	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	- -	
	Trespasser/Visitor	Adolescents	SWMU 7	CS	Chemical Concentration in Soil	See Table 3.2.CT	mg/kg	See Table 3.2.CT	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	3,700	cm^2	EPA, 1997, (5)	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2001	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	9	years	(2)	
				BW	Body Weight	51	kg	EPA, 1997, (3)	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

TABLE 4.2.CT

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDANCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current

Medium: Surface Soil

Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name

Notes:

(1) Professional Judgement assuming 1/2 the RME value for the CT.

(2) Professional Judgement assuming adolescents from 9 to 18 years of age.

(3) Body weight is average value for the 9 year old and 18 year old male body weight.

(4) SA includes head and hands.

(5) SA is 25% of total surface area for 12-15 year old male. 50th percentile for total surface area is 1.49 m^2.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4.3.CT
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDANCY
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Maintenance Worker	Adult	Emissions from SWMU 7 Soil	CS	Chemical Concentration in Soil	See Table 3.3.CT	mg/kg	See Table 3.3.CT	Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	calculated	mg/m^3	calculated	CA x IN x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.32E+09	m^3/kg	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m^3/kg	EPA, 1996	CA (mg/m^3) = CS (1/PEF + 1/VF)
				IN	Inhalation Rate	20	m^3/day	EPA, 2001	
				EF	Exposure Frequency	12	days/year	(1)	
				ED	Exposure Duration	6.6	years	EPA, 1993	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,409	days	EPA, 1989	
	Trespasser/Visitor	Adult	Emissions from SWMU 7 Soil	CS	Chemical Concentration in Soil	See Table 3.3.CT	mg/kg	See Table 3.3.CT	CDI (mg/kg-day) =
				CA	Chemical Concentration in Air	calculated	mg/m^3	calculated	CA x IN x ET x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.32E+09	m^3/kg	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m^3/kg	EPA, 1996	CA (mg/m^3) = CS (1/PEF + 1/VF)
				IN	Inhalation Rate	0.83	$m^3/hour$	EPA, 1991	
				ET	Exposure Time	2	hr/day	(2)	
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	9	years	EPA, 1993	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
	Trespasser/Visitor	Adolescents	Emissions from SWMU 7 Soil	CS	Chemical Concentration in Soil	See Table 3.3.CT	mg/kg	See Table 3.3.CT	CDI (mg/kg-day) =
				CA	Chemical Concentration in Air	calculated	mg/m^3	calculated	CA x IN x ET x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.32E+09	m^3/kg	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m^3/kg	EPA, 1996	CA (mg/m^3) = CS (1/PEF + 1/VF)
				IN	Inhalation Rate	0.83	$m^3/hour$	EPA, 1991	
				ET	Exposure Time	2	hr/day	(2)	
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	9	years	(3)	
				BW	Body Weight	51	kg	EPA, 1997,(5)	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

TABLE 4.3.CT

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDANCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name

Notes:

(1) Professional Judgement assuming 1/2 the RME value for the CT.

(2) Professional judgement assuming trespasser would spend a maximum of 2 hours at the site.

(3) Professional Judgement assuming 1 day per week for 52 weeks per year.

(3) Body weight is average value for the 9 year old and 18 year old male body weight.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1996: Soil Screening Guidance: User's Guide. OSWER. EPA/540/R-96/018.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

TABLE 4.4.CT

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDANCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Sediment*
Exposure Medium: Sediment*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Maintenance Worker	Adult	Desert Cove	CSed	Chemical Concentration in Sediment	see Table ----	mg/kg	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-Sed	Ingestion Rate of Sediment	25	mg/day	(1)	CSed x IR-Sed x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	5	days/year	(2)	
				ED	Exposure Duration	6.6	years	EPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,409	days	EPA, 1989	
	Other Worker	Adult	Desert Cove	CSed	Chemical Concentration in Sediment	see Table ----	mg/kg	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-Sed	Ingestion Rate of Sediment	25	mg/day	(1)	CSed x IR-Sed x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	6	days/year	(1)	
				ED	Exposure Duration	6.6	years	EPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,409	days	EPA, 1989	
	Trespasser/Visitor	Adult	Desert Cove	CSed	Chemical Concentration in Sediment	see Table ----	mg/kg	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-Sed	Ingestion Rate of Sediment	25	mg/day	(1)	CSed x IR-Sed x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	13	days/year	(1)	
				ED	Exposure Duration	9	years	EPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
	Trespasser/Visitor	Adolescent	Desert Cove	CSed	Chemical Concentration in Sediment	see Table	mg/kg	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-Sed	Ingestion Rate of Sediment	25	mg/day	(1)	CSed x IR-Sed x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	13	days/year	(1)	
				ED	Exposure Duration	9	years	(3)	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	51	kg	EPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

TABLE 4.4.CT

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDANCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Sediment*
Exposure Medium: Sediment*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Maintenance Worker	Adult	Desert Cove	CSed	Chemical Concentration in Sediment	see Table ----	mg/kg	- -	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	1,960	cm^2	EPA, 1997, (4)	CSed x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.19	mg/cm^2-day	EPA,1997, (5)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	6	days/year	(1)	
				ED	Exposure Duration	5	years	EPA, 1993	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
	Other Worker	Adult	Desert Cove	CSed	Chemical Concentration in Sediment	see Table ----	mg/kg	- -	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	1,960	cm^2	EPA, 1997, (7)	CSed x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.19	mg/cm^2-day	EPA,1997, (5)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	6	days/year	(1)	
				ED	Exposure Duration	5	years	EPA, 1993	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
	Trespasser/Visitor	Adult	Desert Cove	CSed	Chemical Concentration in Sediment	see Table ----	mg/kg	- -	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 1997, (4)	CSed x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.19	mg/cm^2-day	EPA,1997, (5)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	13	days/year	(1)	
				ED	Exposure Duration	9	years	EPA, 1993	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

TABLE 4.4.CT

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDANCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Sediment*
Exposure Medium: Sediment*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Trespasser/Visitor	Adolescents	Desert Cove	CSed	Chemical Concentration in Sediment	see Table	mg/kg	- -	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	3,600	cm^2	EPA, 1997, (6)	CSed x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.19	mg/cm^2-day	EPA,1997, (5)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	13	days/year	(1)	
				ED	Exposure Duration	9	years	(3)	
				BW	Body Weight	51	kg	EPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

Notes:

(1) Professional Judgement assuming 1/2 the default value for the residential soil scenario, and 1/2 the RME value for the CT.

(2) Professional Judgement assuming 5 days per year.

(3) Professional Judgment assuming adolescents from 9 to 18 years of age.

(4) CT SA is the sum of the mean surface areas (for a male) of the feet and hands.

(5) CT SSAF is average soil adherence to hands Gardeners No. 1 and No. 2 from EPA, 1997, Table 6-12.

(6) Skin surface area in contact with sediment. Assumes 30 percent of average total surface area (hands, forearms, lower legs, and feet) of 12-15 year old male.

(7) CT SA is based on wet suit use.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

Sediment*-includes surface and subsurface sediment

TABLE 4.5.CT
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDANCY
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.4.CT	µg/l	See Table 3.4.CT	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1.4	liters/day	EPA, 1993	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	9	years	EPA, 1993	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
		Child	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.4.CT	µg/l	See Table 3.4.CT	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1	liters/day	EPA, 1997	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.4.CT	µg/l	See Table 3.4.CT	CDI (mg/kg-day) =
				IR-W-A	Ingestion Rate of Water, Adult	1.4	liters/day	EPA, 1993	CW x IR-W-Adj x EF x CF1 x 1/AT
				IR-W-C	Ingestion Rate of Water, Child	1	liters/day	EPA, 1997	
				IR-W-Adj	Ingestion Rate of Water, Age-adjusted	0.58	liter-year/kg-day	calculated	IR-W-Adj (liter-year/kd-day) =
				EF	Exposure Frequency	234	days/year	EPA, 1993	(ED-C x IR-W-C / BW-C) +
				ED-A	Exposure Duration, Adult	9	years	EPA, 1993	(ED-A x IR-W-A / BW-A)
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
	Industrial Worker	Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.4.CT	µg/l	See Table 3.4.CT	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1	liters/day	EPA, 1991	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	219	days/year	EPA, 1993	
				ED	Exposure Duration	6.6	years	EPA, 1997	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,409	days	EPA, 1989	

TABLE 4.5.CT
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDANCY
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.4.CT	µg/l	See Table 3.4.CT	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2001	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2001	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2001	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2001	Organics :
				t_{event}	Event Time	0.25	hr/event	EPA, 2001	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	18,000	cm^2	EPA, 2001	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2001	x CF1 x CF2
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	9	years	EPA, 2001	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	
	Resident	Child	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.4.CT	µg/l	See Table 3.4.CT	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2001	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2001	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2001	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2001	Organics :
				t_{event}	Event Time	0.33	hr/event		t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	6,600	cm^2	EPA, 2001	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2001	x CF1 x CF2
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	6	years	EPA, 2001	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	15	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	2190	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

TABLE 4.5.CT

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDANCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Child/Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.4.CT	µg/l	See Table 3.4.CT	CDI (mg/kg-day) = DA-Adj x EF x 1/AT
				DAevent-A	Dermally Absorbed Dose per Event, Adult	calculated	mg/cm^2-event	calculated	
				DAevent-C	Dermally Absorbed Dose per Event, Child	calculated	mg/cm^2-event	calculated	DA-Adj = (Daevent-A x SA-A x ED-A x 1/BW-A)
				DA-Adj	Dermally Absorbed Dose, Age-adjusted	calculated	mg-year/event-kg	calculated	+ (Daevent-C x SA-C x ED-C x 1/BW-C)
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2001	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2001	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2001	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2001	Organics :
				t_{event}-A	Event Time, Adult	0.25	hr/event	EPA, 2001	t_{event}<t*: DAevent (mg/cm^2-event) =
				t_{event}-C	Event Time, Child	0.33	hr/event	EPA, 2001	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				SA-A	Skin Surface Area, Adult	18,000	cm^2	EPA, 2001	x CF1 x CF2
				SA-C	Skin Surface Area, Child	6,600	cm^2	EPA, 2001	
				EV	Event Frequency	1	events/day	EPA, 2001	t_{event}>t*: DAevent (mg/cm^2-event) =
				EF	Exposure Frequency	234	days/year	EPA, 1993	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				ED-A	Exposure Duration, Adult	9	years	EPA, 2001	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				ED-C	Exposure Duration, Child	6	years	EPA, 2001	
				BW-A	Body Weight, Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	ke	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	
	Construction Worker	Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	see Table ----	µg/l		CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2001	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2001	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2001	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2001	Organics :
				t_{event}	Event Time	4	hr/day	(1)	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	6,000	cm^2	EPA, 1997, (3)	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2001	x CF1 x CF2
				EF	Exposure Frequency	125	days/year	(2)	
				ED	Exposure Duration	1	years	EPA, 1991	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

TABLE 4.5.CT

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDANCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future

Medium: Groundwater

Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name

(1) Professional judgement assuming 1/2 RME value for CT.

(2) Assumed duration of construction project may be 1/2 a year.

(3) Skin surface area in contact with groundwater assumed to be 30 percent of total surface area (hands, forearms, lower legs, and feet).

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4.6.CT

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDANCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Upper Aquifer- Water Vapors at showerhead	CW	Chemical Concentration in Water	See Table 3.5.CT	µg/l	See Table 3.5.CT	Chronic Daily Intake (CDI) (mg/kg-day) =
				InhExp	Inhalation Exposure per Shower	calculated	mg/kg-shower		InhExp x EF x ED x 1/AT
				EF	Exposure Frequency	234	days/year	EPA, 1993	Foster & Chrostowski Shower Inhalation Model
				ED	Exposure Duration	9	years	EPA, 1993	for InhExp
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
	Construction Worker	Adult	Upper Aquifer- Water Vapors at Excavation Pit	CW	Chemical Concentration in Water	See Table 3.5.RME	µg/l	See Table 3.5.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	calculated	mg/m^3		CA x IN x ET x EF x ED x 1/BW x 1/AT
				IN	Inhalation Rate	2.5	m^3/hour	EPA, 1991	
				ET	Exposure Time	4	hr/day	(1)	CA calculated using two-film model
				EF	Exposure Frequency	125	days/year	(2)	
				ED	Exposure Duration	1	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	

Notes:

(1) Professional Judgement assuming 1/2 the RME value for the CT.

(2) Assumed duration of construction project may be 1/2 a year.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

TABLE 4.7.CT
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDANCY
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current/Future
Medium: Soil**
Exposure Medium: Soil**

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Construction Worker	Adult	SWMU 7	CS	Chemical Concentration in Soil	see Table …	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	200	mg/day	(2)	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	125	days/year	(1)	
				ED	Exposure Duration	1	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
	Industrial Worker	Adult	SWMU 7	CS	Chemical Concentration in Soil	see Table …	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	50	mg/day	EPA, 1993	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	219	days/year	EPA, 1993	
				ED	Exposure Duration	6.6	years	EPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,409	days	- -	
	Resident	Adult	SWMU 7	CS	Chemical Concentration in Soil	see Table …	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	50	mg/day	EPA, 1993	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	9	years	EPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
		Child	SWMU 7	CS	Chemical Concentration in Soil	see Table …	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1993	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	

TABLE 4.7.CT
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDANCY
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current/Future
Medium: Soil**
Exposure Medium: Soil**

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion		Child/Adult	SWMU 7	CS	Chemical Concentration in Soil	see Table …	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S-A	Ingestion Rate of Soil, Adult	50	mg/day	EPA, 1993	CS x IR-S-Adj x EF x CF3 x 1/AT
				IR-S-C	Ingestion Rate of Soil, Child	100	mg/day	EPA, 1993	
				IR-S-Adj	Ingestion Rate of Soil, Age-adjusted	46.43	mg-year/kg-day	calculated	IR-S-Adj (mg-year/kd-day) =
				EF	Exposure Frequency	234	days/year	EPA, 1993	(ED-C x IR-S-C / BW-C) + (ED-A x IR-S-A / BW-A)
				ED-A	Exposure Duration, Adult	9	years	EPA, 1993	
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
Dermal	Construction Worker	Adult	SWMU 7	CS	Chemical Concentration in Soil	see Table …	mg/kg		CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	2,000	cm^2	EPA, 1992, (3)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.24	mg/cm^2-day	EPA, 1997, (4)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	125	days/year	(1)	
				ED	Exposure Duration	1	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
	Industrial Worker	Adult	SWMU 7	CS	Chemical Concentration in Soil	see Table …	mg/kg		CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	2,000	cm^2	EPA, 1992, (3)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.32	mg/cm^2-day	EPA, 1997, (5)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	219	days/year	EPA, 1993	
				ED	Exposure Duration	6.6	years	EPA, 1993	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	1,825	days	- -	
	Resident	Adult	SWMU 7	CS	Chemical Concentration in Soil	see Table …	mg/kg		CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 1997, (5)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 1997, (6)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	234	days/year	EPA, 1993	

TABLE 4.7.CT

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDANCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current/Future

Medium: Soil**

Exposure Medium: Soil**

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
				ED	Exposure Duration	9	years	EPA, 1993	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	

TABLE 4.7.CT

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDANCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current/Future
Medium: Soil**
Exposure Medium: Soil**

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal		Child	SWMU 7	CS	Chemical Concentration in Soil	see Table …	mg/kg		CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	2,900	cm^2	EPA, 1997, (6)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.11	mg/cm^2-day	EPA, 1997, (7)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	SWMU 7	CS	Chemical Concentration in Soil	see Table …	mg/kg		CDI (mg/kg-day) =
				SA-A	Skin Surface Area Available for Contact, Ad	5,700	cm^2	EPA, 1997	CS x DA-Adj x DABS x CF3 x EF x 1/AT
				SA-C	Skin Surface Area Available for Contact, Ch	2,900	cm^2	EPA, 1997	
				SSAF-A	Soil to Skin Adherence Factor, Adult	0.2	mg/cm^2-day	EPA, 1997	DA-Adj (mg-year/kd-day) =
				SSAF-C	Soil to Skin Adherence Factor, Child	0.11	mg/cm^2-day	EPA, 1997	
				DA-Adj	Dermal Absorption, Age-adjusted	368.3	mg-year/kg-day	calculated	(ED-C x SA-C x SSAF-C / BW-C) + (ED-A x SA-A / BW-A)]
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	(ED-A x SA-A x SSAF-A / BW-A)
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED-A	Exposure Duration, Adult	9	years	EPA, 1993	
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

Notes:

(1) Assumed duration of construction project may be 1/2 a year.

(2) Recommendation from EPA Region III Risk Assessor.

(3) RME SA includes head, hands, forearms, and lower legs. CT surface area includes head and hands.

(4) Soil to skin adherence factor is based on maximum adherence factor for construction workers.

(5) SSAF based on maximum adherence factor for utility workers.

(6) Surface area based on resident wearing shorts and short sleever shirt. CT value is 50th percentile.

(7) Soil to skin adherence factor is based on maximum adherence factor for soccer players.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

TABLE 4.7.CT

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDANCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current/Future

Medium: Soil**

Exposure Medium: Soil**

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name

EPA, 2001b: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

Soil**-includes surface and subsurface soil

TABLE 4.8.CT
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDANCY
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current/Future
Medium: Soil**
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Worker	Adult	Emissions from SWMU 7	CS	Chemical Concentration in Soil	see Table ..	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	calc	mg/m^3	EPA, 1996	CA x IN x ET x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.32E+09	m^3/kg	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m^3/kg	EPA, 1996	CA (mg/m^3) = CS (1/PEF + 1/VF)
				IN	Inhalation Rate	2.5	$m^3/hour$	EPA, 1991	
				ET	Exposure Time	4	hr/day	(1)	
				EF	Exposure Frequency	125	days/year	(2)	
				ED	Exposure Duration	1	years	EPA., 1993	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	- -	
	Industrial Worker	Adult	Emissions from SWMU 7	CS	Chemical Concentration in Soil	see Table ..	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	calc	mg/m^3	EPA, 1996	CA x IN x ET x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.32E+09	m^3/kg	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m^3/kg	EPA, 1996	
				IN	Inhalation Rate	0.83	$m^3/hour$	EPA, 1991	
				ET	Exposure Time	4	hr/day	(3)	CA (mg/m^3) = CS (1/PEF + 1/VF)
				EF	Exposure Frequency	219	days/year	EPA, 1993	
				ED	Exposure Duration	6.6	years	EPA., 1993	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	1825	days	- -	
	Resident	Adult	Emissions from SWMU 7	CS	Chemical Concentration in Soil	see Table ..	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	calc	mg/m^3	EPA, 1996	CA x IN x ET x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.32E+09	m^3/kg	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m^3/kg	EPA, 1996	
				IN	Inhalation Rate	0.83	$m^3/hour$	EPA, 1991	CA (mg/m^3) = CS (1/PEF + 1/VF)
				ET	Exposure Time	24	hr/day	EPA, 1991	
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	9	years	EPA, 1993	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

TABLE 4.8.CT

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDANCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current/Future
Medium: Soil**
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
		Child	Emissions from SWMU 7	CS	Chemical Concentration in Soil	see Table ..	mg/kg	see Table ..	Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	calc	mg/m^3	EPA, 1996	CA x IN x ET x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.32E+09	m^3/kg	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m^3/kg	EPA, 1996	
				IN	Inhalation Rate	0.5	$m^3/hour$	EPA, 1997	CA (mg/m^3) = CS (1/PEF + 1/VF)
				ET	Exposure Time	24	hr/day	EPA, 1991	
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Emissions from SWMU 7	CS	Chemical Concentration in Soil	see Table 3	mg/kg	see Table 3	Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	see Table ---	mg/m^3	- -	CA x IN-Adj x EF x 1/AT
				PEF	Particulate Emission Factor	1.32E+09	kg/m^3	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m^3/kg	EPA, 1996	CA (mg/m^3) = CS (1/PEF + 1/VF)
				IN-A	Inhalation Rate, Adult	0.83	$m^3/hour$	EPA, 1991	
				IN-C	Inhalation Rate, Child	0.5	$m^3/hour$	EPA, 1997	IN-Adj (m^3-year/kd-day) =
				IN-Adj	Inhalation Rate, Age-adjusted	7.37	m^3-year/kg-day	calculated	(ED-C x IN-C x ET / BW-C) + (ED-A x IN-A x ET / BW-A)
				ET	Exposure Time	24	hours/day	(1)	
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED-A	Exposure Duration, Adult	9	years	EPA, 1993	
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

Notes:

(1) Professional Judgement based on construction activities that would occur 8 hrs per day for the RME and 1/2 of a day for the CT.

(2) Assumed duration of construction project may be 1/2 a year.

(3) Professional Judgement, assumed 1/2 of RME.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

EPA, 2001b: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

Soil**-includes surface and subsurface soil

TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal (1)	Absorbed RfD for Dermal (3)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Aluminum	Chronic	1.0E+00	mg/kg-day	NA	1.0E+00	mg/kg-day	CNS	100	PPRTV	4/14/2004
Arsenic*	Chronic	3.0E-04	mg/kg-day	0.95(2)	3.0E-04	mg/kg-day	Skin, Vascular	3/1	IRIS	3/26/2003
Arsenic*	Subchronic	3.0E-04	mg/kg-day	0.95(2)	3.0E-04	mg/kg-day	Skin, Vascular	3	HEAST	7/1/1997
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	Chronic	1.0E-02	mg/kg-day	NA	1.0E-02	mg/kg-day	Liver	1000/1	IRIS	3/26/2003
Chloroform	Subchronic	1.0E-02	mg/kg-day	NA	1.0E-02	mg/kg-day	Liver	1000	HEAST	7/1/1997
Chromium (VI)	Chronic	3.0E-03	mg/kg-day	0.025	7.5E-05	mg/kg-day	NOAEL	300/3	IRIS	5/12/2003
Chromium (VI)	Subchronic	2.0E-02	mg/kg-day	0.025	5.0E-04	mg/kg-day	NOAEL	100	HEAST	7/1/1997
Copper	Chronic	4.0E-02	mg/kg-day	NA	4.0E-02	mg/kg-day	Gastrointestinal	NA	HEAST	7/1/1997
Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	Chronic	3.0E-01	mg/kg-day	NA	3.0E-01	mg/kg-day	Gastrointestinal	NA	NCEA	7/23/1996
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese (non-food)	Chronic	2.0E-02	mg/kg-day	0.04	8.0E-04	mg/kg-day	CNS	1/1	IRIS	5/12/2003
Manganese (food)	Chronic	1.4E-01	mg/kg-day	0.04	5.6E-03	mg/kg-day	CNS	1/1	IRIS	5/12/2003
Methyl-tert ether (MTBE)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	Chronic	1.0E-02	mg/kg-day	NA	1.0E-02	mg/kg-day	Liver, Whole Body	1000/1	IRIS	7/7/2003
Tetrachloroethene	Subchronic	1.0E-01	mg/kg-day	NA	1.0E-01	mg/kg-day	Liver, Whole Body	100	HEAST	7/1/1997
Thallium	Chronic	7.0E-05	mg/kg-day	1	7.0E-05	mg/kg-day	Liver, Blood, Hair	3000/1	RBC	4/14/2004
Vanadium	Chronic	1.0E-03	mg/kg-day	0.026	2.6E-05	mg/kg-day	Kidney	300	NCEA	5/1/2000
Vanadium	Subchronic	7.0E-03	mg/kg-day	0.026	1.8E-04	mg/kg-day	Lifetime	100	HEAST	7/1/1997

Footnote Instructions:

(1) Source: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evalution Manual (Part E, Supplemetnal Guidance for Dermal Risk Assessment (Interim). Section 4.2 and Exhibit 4-1.

(2) If % Absorbed ABS_{GI} > 50% default value of 100% is used.

(3) See Risk Assessment text for the derivation of the "Absorbed RfD for Dermal"

Definitions:

NA = Not Available

IRIS = Integrated Risk Information System

HEAST = Health Effects Assessment Summary Tables

NCEA = National Center for Environmental Assessment

USEPA R3 = Region 3 Risk-Based Concentration Table

CNS = Central Nervous System

NOAEL = No Observed Adverse Effect Level

TABLE 5.2

NON-CANCER TOXICITY DATA -- INHALATION

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD (1)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Chloroform	Chronic	4.90E-02	mg/m3	1.4E-02	mg/kg/day	Liver, Kidney	10	NCEA	12/1/1997
Chloroform	Subchronic	4.90E-02	mg/m3	1.4E-02	mg/kg/day	Liver, Kidney	100	NCEA	12/1/1997
Methyl-tert ether (MTBE)	Chronic	3.00E+00	mg/m3	8.6E-01	mg/kg/day	NOAEL	100	IRIS	6/18/2003
Tetrachloroethene	Chronic	4.90E-01	mg/m3	1.4E-01	mg/kg/day	Liver, Whole Body	NA	NCEA	10/1/1999

(1) See Risk Assessment text for the derivation of the "Extrapolated RfD".

Definitions:

NA = Not Available

IRIS = Integrated Risk Information System

HEAST = Health Effects Assessment Summary Tables

NCEA = National Center for Environmental Assessment

NOAEL = No Observed Adverse Effect Level

TABLE 6.1

CANCER TOXICITY DATA -- ORAL/DERMAL

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal (1)	Absorbed Cancer Slope Factor for Dermal (3)		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic*	1.5E+00	1/mg/kg-day	0.95(2)	1.5E+00	1/mg/kg-day	A	IRIS	5/12/2003
Benzo(a)anthracene	7.3E-01	1/mg/kg-day	0.89(2)	7.3E-01	1/mg/kg-day	B2	NCEA	7/1/1993
Benzo(a)pyrene	7.3E+00	1/mg/kg-day	0.89(2)	7.3E+00	1/mg/kg-day	B2	IRIS	3/26/2003
Benzo(b)fluoranthene	7.3E-01	1/mg/kg-day	0.89(2)	7.3E-01	1/mg/kg-day	B2	NCEA	7/1/1993
Benzo(k)fluoranthene	7.3E-02	1/mg/kg-day	0.89(2)	7.3E-02	1/mg/kg-day	B2	NCEA	7/1/1993
Chloroform	NA	NA	NA	NA	NA	B2	IRIS	5/12/2003
Chromium (VI)	NA	NA	NA	NA	NA	D	IRIS	5/12/2003
Copper	NA	NA	NA	NA	NA	D	IRIS	5/12/2003
Dibenzo(a,h)anthracene	7.3E+00	1/mg/kg-day	0.89(2)	7.3E+00	1/mg/kg-day	B2	NCEA	7/1/1993
Indeno(1,2,3-cd)pyrene	7.3E-01	1/mg/kg-day	0.89(2)	7.3E-01	1/mg/kg-day	B2	NCEA	7/1/1993
Iron	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	B2	IRIS	5/12/2003
Manganese	NA	NA	NA	NA	NA	D	IRIS	5/12/2003
Methyl-tert ether (MTBE)	4.0E-03	1/mg/kg-day	NA	4.0E-03	1/mg/kg-day	NA	USEPA R3	4/25/2003
Tetrachloroethene	5.4E-01	1/mg/kg-day	NA	5.4E-01	1/mg/kg-day	NA	USEPA R3	4/25/2003
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA

(1) Source: Risk Assessment Guidance for Superfund: Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. 2001. Section 4.2 and Exhibit 4-1.

(2) If % Absorbed ABS_{GI} > 50% default value of 100% is used.

(3) See Risk Assessment text for derivation of the "Absorbed Cancer Slope Factor for Dermal".

* USEPA recommends that the adjustment for dermal toxicity is not performed for this constituent (USEPA 2001).

Definitions:

NA = Not Available

IRIS = Integrated Risk Information System

HEAST = Health Effects Assessment Summary Tables

NCEA = National Center for Environmental Assessment

USEPA R3 = Region 3 Risk-Based Concentration Table

Weight of Evidence definitions:

Group A chemicals (known human carcinogens) are agents for which there is sufficient evidence to support the causal association between exposure to the agents in humans and cancer.

Group B1 chemicals (probable human carcinogens) are agents for which there is limited evidence of possible carcinogenicity in humans.

Group B2 chemicals (probable human carcinogens) are agents for which there is sufficient evidence of carcinogenicity in animals but inadequate or a lack of evidence in humans.

Group C chemicals (possible human carcinogens) are agents for which there is limited evidence of carcinogenicity in animals and inadequate or a lack of human data.

Group D chemicals (not classifiable as to human carcinogenicity) are agents with inadequate human and animal evidence of carcinogenicity or for which no data are available.

TABLE 6.2

CANCER TOXICITY DATA -- INHALATION

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Chloroform	2.3E-05	1/ug/m3	8.1E-02	1/mg/kg-day	B2	IRIS	5/12/2003
Methyl-tert ether (MTBE)	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	5.7E-06	1/ug/m3	2.0E-02	1/mg/kg-day	NA	USEPA R3	4/25/2003

Definitions: NA = Not Available

IRIS = Integrated Risk Information System

USEPA R3 = Region 3 Risk-Based Concentration Table

Weight of Evidence definitions:

Group A chemicals (known human carcinogens) are agents for which there is sufficient evidence to support the causal association between exposure to the agents in humans and cancer.

Group B1 chemicals (probable human carcinogens) are agents for which there is limited evidence of possible carcinogenicity in humans.

Group B2 chemicals (probable human carcinogens) are agents for which there is sufficient evidence of carcinogenicity in animals but inadequate or a lack of evidence in humans.

Group C chemicals (possible human carcinogens) are agents for which there is limited evidence of carcinogenicity in animals and inadequate or a lack of human data.

Group D chemicals (not classifiable as to human carcinogenicity) are agents with inadequate human and animal evidence of carcinogenicity or for which no data are available.

Group E chemicals (evidence of noncarcinogenicity in humans) are agents for which there is no evidence of carcinogenicity from human or animal studies, or both.

TABLE 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Receptor Population: Other Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Sediment	Surface Sediment	Desert Cove	Ingestion	Benzo(a)pyrene	1.8E+00	MG/KG	1.5E-08	mg/kg/day	7.3E+00	1/mg/kg/day	1.1E-07	4.3E-08	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	3.7E+00	MG/KG	3.1E-08	mg/kg/day	7.3E-01	1/mg/kg/day	2.3E-08	8.6E-08	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	3.3E-01	MG/KG	2.8E-09	mg/kg/day	7.3E+00	1/mg/kg/day	2.0E-08	7.7E-09	mg/kg/day	NA	NA	NA
				Arsenic	1.0E+01	MG/KG	8.5E-08	mg/kg/day	1.5E+00	1/mg/kg/day	1.3E-07	2.4E-07	mg/kg/day	3.0E-04	mg/kg/day	7.9E-04
				Iron	2.4E+04	MG/KG	2.0E-04	mg/kg/day	NA	NA	NA	5.6E-04	mg/kg/day	3.0E-01	mg/kg/day	1.9E-03
			Exp. Route Total								2.8E-07					2.7E-03
			Dermal	Benzo(a)pyrene	1.8E+00	MG/KG	4.1E-08	mg/kg/day	7.3E+00	1/mg/kg/day	3.0E-07	1.2E-07	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	3.7E+00	MG/KG	8.3E-08	mg/kg/day	7.3E-01	1/mg/kg/day	6.1E-08	2.4E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	3.3E-01	MG/KG	7.4E-09	mg/kg/day	7.3E+00	1/mg/kg/day	5.4E-08	2.2E-08	mg/kg/day	NA	NA	NA
				Arsenic	1.0E+01	MG/KG	5.3E-08	mg/kg/day	1.5E+00	1/mg/kg/day	7.9E-08	1.5E-07	mg/kg/day	3.0E-04	mg/kg/day	5.1E-04
				Iron	2.4E+04	MG/KG	4.1E-05	mg/kg/day	NA	NA	NA	1.2E-04	mg/kg/day	3.0E-01	mg/kg/day	4.0E-04
			Exp. Route Total								4.9E-07					9.2E-04
		Exposure Point Total									7.7E-07					3.6E-03
	Exposure Medium Total										7.7E-07					3.6E-03
										Total of Receptor Risks Across All M	7.7E-07				Total of Receptor Hazards Across All	3.6E-03

TABLE 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Receptor Population: Trespasser/Visitor
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Sediment	Surface Sediment	Desert Cove	Ingestion	Benzo(a)pyrene	1.8E+00	MG/KG	3.2E-08	mg/kg/day	7.3E+00	1/mg/kg/day	2.3E-07	9.2E-08	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	3.7E+00	MG/KG	6.4E-08	mg/kg/day	7.3E-01	1/mg/kg/day	4.7E-08	1.9E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	3.3E-01	MG/KG	5.7E-09	mg/kg/day	7.3E+00	1/mg/kg/day	4.2E-08	1.7E-08	mg/kg/day	NA	NA	NA
				Arsenic	1.0E+01	MG/KG	1.8E-07	mg/kg/day	1.5E+00	1/mg/kg/day	2.7E-07	5.2E-07	mg/kg/day	3.0E-04	mg/kg/day	1.7E-03
				Iron	2.4E+04	MG/KG	4.2E-04	mg/kg/day	NA	NA	NA	1.2E-03	mg/kg/day	3.0E-01	mg/kg/day	4.0E-03
			Exp. Route Total								5.9E-07					5.8E-03
			Dermal	Benzo(a)pyrene	1.8E+00	MG/KG	8.5E-08	mg/kg/day	7.3E+00	1/mg/kg/day	6.2E-07	2.7E-07	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	3.7E+00	MG/KG	1.7E-07	mg/kg/day	7.3E-01	1/mg/kg/day	1.3E-07	5.6E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	3.3E-01	MG/KG	1.5E-08	mg/kg/day	7.3E+00	1/mg/kg/day	1.1E-07	5.0E-08	mg/kg/day	NA	NA	NA
				Arsenic	1.0E+01	MG/KG	1.1E-07	mg/kg/day	1.5E+00	1/mg/kg/day	1.6E-07	3.5E-07	mg/kg/day	3.0E-04	mg/kg/day	1.2E-03
				Iron	2.4E+04	MG/KG	8.6E-05	mg/kg/day	NA	NA	NA	2.8E-04	mg/kg/day	3.0E-01	mg/kg/day	9.2E-04
			Exp. Route Total								1.0E-06					2.1E-03
		Exposure Point Total									1.6E-06					7.9E-03
	Exposure Medium Total										1.6E-06					7.9E-03
Surface Soil	Surface Soil	SWMU 7	Ingestion	Benzo(a)pyrene	1.7E-01	MG/KG	1.2E-08	mg/kg/day	7.3E+00	1/mg/kg/day	8.7E-08	3.5E-08	mg/kg/day	NA	NA	NA
				Aluminum	7.2E+03	MG/KG	5.0E-04	mg/kg/day	NA	NA	NA	1.5E-03	mg/kg/day	1.0E+00	mg/kg/day	1.5E-03
				Arsenic	4.2E+00	MG/KG	2.9E-07	mg/kg/day	1.5E+00	1/mg/kg/day	4.4E-07	8.5E-07	mg/kg/day	3.0E-04	mg/kg/day	2.8E-03
				Chromium	1.9E+01	MG/KG	1.4E-06	mg/kg/day	NA	NA	NA	3.9E-06	mg/kg/day	3.0E-03	mg/kg/day	1.3E-03
				Iron	1.6E+04	MG/KG	1.1E-03	mg/kg/day	NA	NA	NA	3.2E-03	mg/kg/day	3.0E-01	mg/kg/day	1.1E-02
				Manganese	4.6E+02	MG/KG	3.2E-05	mg/kg/day	NA	NA	NA	9.4E-05	mg/kg/day	2.0E-02	mg/kg/day	4.7E-03
				Vanadium	2.3E+01	MG/KG	1.6E-06	mg/kg/day	NA	NA	NA	4.6E-06	mg/kg/day	1.0E-03	mg/kg/day	4.6E-03
			Exp. Route Total								5.3E-07					2.5E-02
			Dermal	Benzo(a)pyrene	1.7E-01	MG/KG	1.8E-08	mg/kg/day	7.3E+00	1/mg/kg/day	1.3E-07	5.1E-08	mg/kg/day	NA	NA	NA
				Aluminum	7.2E+03	MG/KG	5.9E-05	mg/kg/day	NA	NA	NA	1.7E-04	mg/kg/day	1.0E+00	mg/kg/day	1.7E-04
				Arsenic	4.2E+00	MG/KG	1.0E-07	mg/kg/day	1.5E+00	1/mg/kg/day	1.6E-07	2.9E-07	mg/kg/day	3.0E-04	mg/kg/day	9.7E-04
				Chromium	1.9E+01	MG/KG	1.6E-07	mg/kg/day	NA	NA	NA	4.5E-07	mg/kg/day	7.5E-05	mg/kg/day	6.0E-03
				Iron	1.6E+04	MG/KG	1.3E-04	mg/kg/day	NA	NA	NA	3.6E-04	mg/kg/day	3.0E-01	mg/kg/day	1.2E-03
				Manganese	4.6E+02	MG/KG	3.8E-06	mg/kg/day	NA	NA	NA	1.1E-05	mg/kg/day	8.0E-04	mg/kg/day	1.3E-02
				Vanadium	2.3E+01	MG/KG	1.9E-07	mg/kg/day	NA	NA	NA	5.2E-07	mg/kg/day	2.6E-05	mg/kg/day	2.0E-02
			Exp. Route Total								2.9E-07					4.2E-02
		Exposure Point Total									8.2E-07					6.7E-02
	Exposure Medium Total										8.2E-07					6.7E-02
										Total of Receptor Risks Across All M	2.4E-06				Total of Receptor Hazards Across A	7.5E-02

NA = Not applicable.

TABLE 7.3.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Receptor Population: Trespasser/Visitor
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Sediment	Surface Sediment	Desert Cove	Ingestion	Benzo(a)pyrene	1.8E+00	MG/KG	1.6E-08	mg/kg/day	7.3E+00	1/mg/kg/day	1.2E-07	1.3E-07	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	3.7E+00	MG/KG	3.3E-08	mg/kg/day	7.3E-01	1/mg/kg/day	2.4E-08	2.6E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	3.3E-01	MG/KG	3.0E-09	mg/kg/day	7.3E+00	1/mg/kg/day	2.2E-08	2.3E-08	mg/kg/day	NA	NA	NA
				Arsenic	1.0E+01	MG/KG	9.1E-08	mg/kg/day	1.5E+00	1/mg/kg/day	1.4E-07	7.1E-07	mg/kg/day	3.0E-04	mg/kg/day	2.4E-03
				Iron	2.4E+04	MG/KG	2.1E-04	mg/kg/day	NA	NA	NA	1.7E-03	mg/kg/day	3.0E-01	mg/kg/day	5.5E-03
			Exp. Route Total								3.0E-07					7.9E-03
			Dermal	Benzo(a)pyrene	1.8E+00	MG/KG	4.7E-08	mg/kg/day	7.3E+00	1/mg/kg/day	3.4E-07	3.6E-07	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	3.7E+00	MG/KG	9.5E-08	mg/kg/day	7.3E-01	1/mg/kg/day	6.9E-08	7.4E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	3.3E-01	MG/KG	8.4E-09	mg/kg/day	7.3E+00	1/mg/kg/day	6.2E-08	6.6E-08	mg/kg/day	NA	NA	NA
				Arsenic	1.0E+01	MG/KG	6.0E-08	mg/kg/day	1.5E+00	1/mg/kg/day	9.0E-08	4.7E-07	mg/kg/day	3.0E-04	mg/kg/day	1.6E-03
				Iron	2.4E+04	MG/KG	4.7E-05	mg/kg/day	NA	NA	NA	3.7E-04	mg/kg/day	3.0E-01	mg/kg/day	1.2E-03
			Exp. Route Total								5.6E-07					2.8E-03
		Exposure Point Total									8.6E-07					1.1E-02
	Exposure Medium Total										8.6E-07					1.1E-02
Surface Soil	Surface Soil	SWMU 7	Ingestion	Benzo(a)pyrene	1.7E-01	MG/KG	6.1E-09	mg/kg/day	7.3E+00	1/mg/kg/day	4.5E-08	4.7E-08	mg/kg/day	NA	NA	NA
				Aluminum	7.2E+03	MG/KG	2.6E-04	mg/kg/day	NA	NA	NA	2.0E-03	mg/kg/day	1.0E+00	mg/kg/day	2.0E-03
				Arsenic	4.2E+00	MG/KG	1.5E-07	mg/kg/day	1.5E+00	1/mg/kg/day	2.3E-07	1.2E-06	mg/kg/day	3.0E-04	mg/kg/day	3.9E-03
				Chromium	1.9E+01	MG/KG	7.0E-07	mg/kg/day	NA	NA	NA	5.4E-06	mg/kg/day	3.0E-03	mg/kg/day	1.8E-03
				Iron	1.6E+04	MG/KG	5.6E-04	mg/kg/day	NA	NA	NA	4.3E-03	mg/kg/day	3.0E-01	mg/kg/day	1.4E-02
				Manganese	4.6E+02	MG/KG	1.7E-05	mg/kg/day	NA	NA	NA	1.3E-04	mg/kg/day	2.0E-02	mg/kg/day	6.4E-03
				Vanadium	2.3E+01	MG/KG	8.1E-07	mg/kg/day	NA	NA	NA	6.3E-06	mg/kg/day	1.0E-03	mg/kg/day	6.3E-03
			Exp. Route Total								2.7E-07					3.5E-02
			Dermal	Benzo(a)pyrene	1.7E-01	MG/KG	7.3E-09	mg/kg/day	7.3E+00	1/mg/kg/day	5.3E-08	5.7E-08	mg/kg/day	NA	NA	NA
				Aluminum	7.2E+03	MG/KG	2.4E-05	mg/kg/day	NA	NA	NA	1.8E-04	mg/kg/day	1.0E+00	mg/kg/day	1.8E-04
				Arsenic	4.2E+00	MG/KG	4.2E-08	mg/kg/day	1.5E+00	1/mg/kg/day	6.2E-08	3.2E-07	mg/kg/day	3.0E-04	mg/kg/day	1.1E-03
				Chromium	1.9E+01	MG/KG	6.4E-08	mg/kg/day	NA	NA	NA	5.0E-07	mg/kg/day	7.5E-05	mg/kg/day	6.6E-03
				Iron	1.6E+04	MG/KG	5.1E-05	mg/kg/day	NA	NA	NA	4.0E-04	mg/kg/day	3.0E-01	mg/kg/day	1.3E-03
				Manganese	4.6E+02	MG/KG	1.5E-06	mg/kg/day	NA	NA	NA	1.2E-05	mg/kg/day	8.0E-04	mg/kg/day	1.5E-02
				Vanadium	2.3E+01	MG/KG	7.5E-08	mg/kg/day	NA	NA	NA	5.8E-07	mg/kg/day	2.6E-05	mg/kg/day	2.2E-02
			Exp. Route Total								1.2E-07					4.6E-02
		Exposure Point Total									3.9E-07					8.1E-02
	Exposure Medium Total										3.9E-07					8.1E-02
										Total of Receptor Risks Across All M	1.2E-06				Total of Receptor Hazards Across Al	9.2E-02

NA = Not applicable.

TABLE 7.4.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Receptor Population: Maintenance Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 7	Ingestion	Benzo(a)pyrene	1.7E-01	MG/KG	5.7E-09	mg/kg/day	7.3E+00	1/mg/kg/day	4.2E-08	1.6E-08	mg/kg/day	NA	NA	NA
				Aluminum	7.2E+03	MG/KG	2.4E-04	mg/kg/day	NA	NA	NA	6.7E-04	mg/kg/day	1.0E+00	mg/kg/day	6.7E-04
				Arsenic	4.2E+00	MG/KG	1.4E-07	mg/kg/day	1.5E+00	1/mg/kg/day	2.1E-07	3.9E-07	mg/kg/day	3.0E-04	mg/kg/day	1.3E-03
				Chromium	1.9E+01	MG/KG	6.5E-07	mg/kg/day	NA	NA	NA	1.8E-06	mg/kg/day	3.0E-03	mg/kg/day	6.1E-04
				Iron	1.6E+04	MG/KG	5.2E-04	mg/kg/day	NA	NA	NA	1.5E-03	mg/kg/day	3.0E-01	mg/kg/day	4.9E-03
				Manganese	4.6E+02	MG/KG	1.5E-05	mg/kg/day	NA	NA	NA	4.3E-05	mg/kg/day	2.0E-02	mg/kg/day	2.2E-03
				Vanadium	2.3E+01	MG/KG	7.6E-07	mg/kg/day	NA	NA	NA	2.1E-06	mg/kg/day	1.0E-03	mg/kg/day	2.1E-03
			Exp. Route Total								2.5E-07					1.2E-02
			Dermal	Benzo(a)pyrene	1.7E-01	MG/KG	4.9E-09	mg/kg/day	7.3E+00	1/mg/kg/day	3.6E-08	1.4E-08	mg/kg/day	NA	NA	NA
				Aluminum	7.2E+03	MG/KG	1.6E-05	mg/kg/day	NA	NA	NA	4.4E-05	mg/kg/day	1.0E+00	mg/kg/day	4.4E-05
				Arsenic	4.2E+00	MG/KG	2.8E-08	mg/kg/day	1.5E+00	1/mg/kg/day	4.2E-08	7.8E-08	mg/kg/day	3.0E-04	mg/kg/day	2.6E-04
				Chromium	1.9E+01	MG/KG	4.3E-08	mg/kg/day	NA	NA	NA	1.2E-07	mg/kg/day	7.5E-05	mg/kg/day	1.6E-03
				Iron	1.6E+04	MG/KG	3.4E-05	mg/kg/day	NA	NA	NA	9.6E-05	mg/kg/day	3.0E-01	mg/kg/day	3.2E-04
				Manganese	4.6E+02	MG/KG	1.0E-06	mg/kg/day	NA	NA	NA	2.9E-06	mg/kg/day	8.0E-04	mg/kg/day	3.6E-03
				Vanadium	2.3E+01	MG/KG	5.0E-08	mg/kg/day	NA	NA	NA	1.4E-07	mg/kg/day	2.6E-05	mg/kg/day	5.4E-03
			Exp. Route Total								7.8E-08					1.1E-02
		Exposure Point Total									3.3E-07					2.3E-02
	Exposure Medium Total										3.3E-07					2.3E-02
										Total of Receptor Risks Across All M	3.3E-07				Total of Receptor Hazards Across A	2.3E-02

NA = Not applicable.

TABLE 7.5.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Trespasser/Visitor
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment*	Sediment*	Desert Cove	Ingestion	Benzo(a)pyrene	1.8E+00	MG/KG	3.2E-08	mg/kg/day	7.3E+00	1/mg/kg/day	2.3E-07	9.3E-08	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	2.9E+00	MG/KG	5.1E-08	mg/kg/day	7.3E-01	1/mg/kg/day	3.7E-08	1.5E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	3.1E-01	MG/KG	5.3E-09	mg/kg/day	7.3E+00	1/mg/kg/day	3.9E-08	1.6E-08	mg/kg/day	NA	NA	NA
				Arsenic	8.5E+00	MG/KG	1.5E-07	mg/kg/day	1.5E+00	1/mg/kg/day	2.2E-07	4.3E-07	mg/kg/day	3.0E-04	mg/kg/day	1.4E-03
				Iron	2.4E+04	MG/KG	4.3E-04	mg/kg/day	NA	NA	NA	1.2E-03	mg/kg/day	3.0E-01	mg/kg/day	4.1E-03
			Exp. Route Total								5.3E-07					5.6E-03
			Dermal	Benzo(a)pyrene	1.8E+00	MG/KG	9.4E-08	mg/kg/day	7.3E+00	1/mg/kg/day	6.9E-07	2.7E-07	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	2.9E+00	MG/KG	1.5E-07	mg/kg/day	7.3E-01	1/mg/kg/day	1.1E-07	4.4E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	3.1E-01	MG/KG	1.6E-08	mg/kg/day	7.3E+00	1/mg/kg/day	1.2E-07	4.6E-08	mg/kg/day	NA	NA	NA
				Arsenic	8.5E+00	MG/KG	1.0E-07	mg/kg/day	1.5E+00	1/mg/kg/day	1.5E-07	3.0E-07	mg/kg/day	3.0E-04	mg/kg/day	9.9E-04
				Iron	2.4E+04	MG/KG	9.7E-05	mg/kg/day	NA	NA	NA	2.8E-04	mg/kg/day	3.0E-01	mg/kg/day	9.4E-04
			Exp. Route Total								1.1E-06					1.9E-03
		Exposure Point Total									1.6E-06					7.5E-03
	Exposure Medium Total										1.6E-06					7.5E-03
										Total of Receptor Risks Across All M	1.6E-06				Total of Receptor Hazards Across A	7.5E-03

NA = Not applicable.

TABLE 7.6.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Trespasser/Visitor
Receptor Age: Adolescents

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment*	Sediment*	Desert Cove	Ingestion	Benzo(a)pyrene	1.8E+00	MG/KG	1.6E-08	mg/kg/day	7.3E+00	1/mg/kg/day	1.2E-07	1.3E-07	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	2.9E+00	MG/KG	2.6E-08	mg/kg/day	7.3E-01	1/mg/kg/day	1.9E-08	2.0E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	3.1E-01	MG/KG	2.8E-09	mg/kg/day	7.3E+00	1/mg/kg/day	2.0E-08	2.1E-08	mg/kg/day	NA	NA	NA
				Arsenic	8.5E+00	MG/KG	7.6E-08	mg/kg/day	1.5E+00	1/mg/kg/day	1.1E-07	5.9E-07	mg/kg/day	3.0E-04	mg/kg/day	2.0E-03
				Iron	2.4E+04	MG/KG	2.2E-04	mg/kg/day	NA	NA	NA	1.7E-03	mg/kg/day	3.0E-01	mg/kg/day	5.7E-03
			Exp. Route Total								2.7E-07					7.7E-03
			Dermal	Benzo(a)pyrene	1.8E+00	MG/KG	4.7E-08	mg/kg/day	7.3E+00	1/mg/kg/day	3.4E-07	3.6E-07	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	2.9E+00	MG/KG	7.5E-08	mg/kg/day	7.3E-01	1/mg/kg/day	5.5E-08	5.8E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	3.1E-01	MG/KG	7.9E-09	mg/kg/day	7.3E+00	1/mg/kg/day	5.7E-08	6.1E-08	mg/kg/day	NA	NA	NA
				Arsenic	8.5E+00	MG/KG	5.0E-08	mg/kg/day	1.5E+00	1/mg/kg/day	7.6E-08	3.9E-07	mg/kg/day	3.0E-04	mg/kg/day	1.3E-03
				Iron	2.4E+04	MG/KG	4.8E-05	mg/kg/day	NA	NA	NA	3.7E-04	mg/kg/day	3.0E-01	mg/kg/day	1.2E-03
			Exp. Route Total								5.3E-07					2.6E-03
		Exposure Point Total									8.0E-07					1.0E-02
	Exposure Medium Total										8.0E-07					1.0E-02
										Total of Receptor Risks Across All M	8.0E-07				Total of Receptor Hazards Across A	1.0E-02

NA = Not applicable.

TABLE 7.7.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Maintenance Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment*	Sediment*	Desert Cove	Ingestion	Benzo(a)pyrene	1.8E+00	MG/KG	6.4E-09	mg/kg/day	7.3E+00	1/mg/kg/day	4.6E-08	1.8E-08	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	2.9E+00	MG/KG	1.0E-08	mg/kg/day	7.3E-01	1/mg/kg/day	7.5E-09	2.9E-08	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	3.1E-01	MG/KG	1.1E-09	mg/kg/day	7.3E+00	1/mg/kg/day	7.8E-09	3.0E-09	mg/kg/day	NA	NA	NA
				Arsenic	8.5E+00	MG/KG	3.0E-08	mg/kg/day	1.5E+00	1/mg/kg/day	4.5E-08	8.3E-08	mg/kg/day	3.0E-04	mg/kg/day	2.8E-04
				Iron	2.4E+04	MG/KG	8.5E-05	mg/kg/day	NA	NA	NA	2.4E-04	mg/kg/day	3.0E-01	mg/kg/day	8.0E-04
			Exp. Route Total								1.1E-07					1.1E-03
			Dermal	Benzo(a)pyrene	1.8E+00	MG/KG	1.7E-08	mg/kg/day	7.3E+00	1/mg/kg/day	1.2E-07	4.8E-08	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	2.9E+00	MG/KG	2.7E-08	mg/kg/day	7.3E-01	1/mg/kg/day	2.0E-08	7.7E-08	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	3.1E-01	MG/KG	2.9E-09	mg/kg/day	7.3E+00	1/mg/kg/day	2.1E-08	8.1E-09	mg/kg/day	NA	NA	NA
				Arsenic	8.5E+00	MG/KG	1.8E-08	mg/kg/day	1.5E+00	1/mg/kg/day	2.8E-08	5.2E-08	mg/kg/day	3.0E-04	mg/kg/day	1.7E-04
				Iron	2.4E+04	MG/KG	1.8E-05	mg/kg/day	NA	NA	NA	4.9E-05	mg/kg/day	3.0E-01	mg/kg/day	1.6E-04
			Exp. Route Total								1.9E-07					3.4E-04
		Exposure Point Total									3.0E-07					1.4E-03
	Exposure Medium Total										3.0E-07					1.4E-03
										Total of Receptor Risks Across All M	3.0E-07				Total of Receptor Hazards Across A	1.4E-03

NA = Not applicable.

TABLE 7.8.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Other Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment*	Sediment*	Desert Cove	Ingestion	Benzo(a)pyrene	1.8E+00	MG/KG	1.5E-08	mg/kg/day	7.3E+00	1/mg/kg/day	1.1E-07	4.3E-08	mg/kg/day	NA	NA	NA
				Dibenz(b)fluoranthene	2.9E+00	MG/KG	2.5E-08	mg/kg/day	7.3E-01	1/mg/kg/day	1.8E-08	6.9E-08	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	3.1E-01	MG/KG	2.6E-09	mg/kg/day	7.3E+00	1/mg/kg/day	1.9E-08	7.2E-09	mg/kg/day	NA	NA	NA
				Arsenic	8.5E+00	MG/KG	7.1E-08	mg/kg/day	1.5E+00	1/mg/kg/day	1.1E-07	2.0E-07	mg/kg/day	3.0E-04	mg/kg/day	6.7E-04
				Iron	2.4E+04	MG/KG	2.0E-04	mg/kg/day	NA	NA	NA	5.7E-04	mg/kg/day	3.0E-01	mg/kg/day	1.9E-03
			Exp. Route Total								2.6E-07					2.6E-03
			Dermal	Benzo(a)pyrene	1.8E+00	MG/KG	4.1E-08	mg/kg/day	7.3E+00	1/mg/kg/day	3.0E-07	1.1E-07	mg/kg/day	NA	NA	NA
				Dibenz(b)fluoranthene	2.9E+00	MG/KG	6.6E-08	mg/kg/day	7.3E-01	1/mg/kg/day	4.8E-08	1.8E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	3.1E-01	MG/KG	6.9E-09	mg/kg/day	7.3E+00	1/mg/kg/day	5.0E-08	1.9E-08	mg/kg/day	NA	NA	NA
				Arsenic	8.5E+00	MG/KG	4.4E-08	mg/kg/day	1.5E+00	1/mg/kg/day	6.6E-08	1.2E-07	mg/kg/day	3.0E-04	mg/kg/day	4.1E-04
				Iron	2.4E+04	MG/KG	4.2E-05	mg/kg/day	NA	NA	NA	1.2E-04	mg/kg/day	3.0E-01	mg/kg/day	3.9E-04
			Exp. Route Total								4.6E-07					8.1E-04
		Exposure Point Total									7.2E-07					3.4E-03
	Exposure Medium Total										7.2E-07					3.4E-03
										Total of Receptor Risks Across All M	7.2E-07				Total of Receptor Hazards Across A	3.4E-03

NA = Not applicable.

TABLE 7.9.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Upper Aquifer - Tap Water	Ingestion	Chloroform	1.3E+01	ug/L	NA	NA	NA	NA	NA	3.4E-04	mg/kg/day	1.0E-02	mg/kg/day	3.4E-02
				Methyl-tert-butyl ether (MTBE)	2.5E+01	ug/L	NA	NA	NA	NA	NA	6.8E-04	mg/kg/day	NA	NA	NA
				Tetrachloroethene	5.0E+00	ug/L	NA	NA	NA	NA	NA	1.4E-04	mg/kg/day	1.0E-02	mg/kg/day	1.4E-02
				Arsenic	1.2E+01	ug/L	NA	NA	NA	NA	NA	3.4E-04	mg/kg/day	3.0E-04	mg/kg/day	1.1E+00
				Iron	5.3E+04	ug/L	NA	NA	NA	NA	NA	1.4E+00	mg/kg/day	3.0E-01	mg/kg/day	4.8E+00
				Manganese	5.9E+03	ug/L	NA	NA	NA	NA	NA	1.6E-01	mg/kg/day	2.0E-02	mg/kg/day	8.1E+00
			Exp. Route Total								0.0E+00					1.4E+01
			Dermal	Chloroform	1.3E+01	ug/L	NA	NA	NA	NA	NA	3.1E-05	mg/kg/day	1.0E-02	mg/kg/day	3.1E-03
				Methyl-tert-butyl ether (MTBE)	2.5E+01	ug/L	NA	NA	NA	NA	NA	1.8E-05	mg/kg/day	NA	NA	NA
				Tetrachloroethene	5.0E+00	ug/L	NA	NA	NA	NA	NA	8.2E-05	mg/kg/day	1.0E-02	mg/kg/day	8.2E-03
				Arsenic	1.2E+01	ug/L	NA	NA	NA	NA	NA	1.8E-06	mg/kg/day	3.0E-04	mg/kg/day	5.9E-03
				Iron	5.3E+04	ug/L	NA	NA	NA	NA	NA	7.6E-03	mg/kg/day	3.0E-01	mg/kg/day	2.5E-02
				Manganese	5.9E+03	ug/L	NA	NA	NA	NA	NA	8.5E-04	mg/kg/day	8.0E-04	mg/kg/day	1.1E+00
			Exp. Route Total								0.0E+00					1.1E+00
		Exposure Point Total									0.0E+00					1.5E+01
	Exposure Medium Total										0.0E+00					1.5E+01
Groundwater	Air	Upper Aquifer - Water vapors at Showerhead	Inhalation	Chloroform	1.3E+01	ug/L	NA	NA	NA	NA	NA	6.5E-04	mg/kg/day	1.4E-02	mg/kg/day	4.6E-02
				Methyl-tert-butyl ether (MTBE)	2.5E+01	ug/L	NA	NA	NA	NA	NA	1.2E-03	mg/kg/day	8.6E-01	mg/kg/day	1.4E-03
				Tetrachloroethene	5.0E+00	ug/L	NA	NA	NA	NA	NA	2.4E-04	mg/kg/day	1.4E-01	mg/kg/day	1.7E-03
			Exp. Route Total								0.0E+00					4.9E-02
		Exposure Point Total									0.0E+00					4.9E-02
	Exposure Medium Total										0.0E+00					4.9E-02
Groundwater - Upper Aquifer Tap Water Total											0.0E+00					1.5E+01
Soil*	Soil*	SWMU 7	Ingestion	Benzo(a)anthracene	1.5E+00	MG/KG	NA	NA	NA	NA	NA	2.1E-06	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	1.7E+00	MG/KG	NA	NA	NA	NA	NA	2.4E-06	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	3.6E+00	MG/KG	NA	NA	NA	NA	NA	5.0E-06	mg/kg/day	NA	NA	NA
				Benzo(k)fluoranthene	3.3E+00	MG/KG	NA	NA	NA	NA	NA	4.5E-06	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.3E-01	MG/KG	NA	NA	NA	NA	NA	1.8E-07	mg/kg/day	NA	NA	NA
				Indeno(1,2,3-cd)pyrene	2.1E+00	MG/KG	NA	NA	NA	NA	NA	2.9E-06	mg/kg/day	NA	NA	NA
				Aluminum	4.5E+03	MG/KG	NA	NA	NA	NA	NA	6.1E-03	mg/kg/day	1.0E+00	mg/kg/day	6.1E-03
				Arsenic	5.2E+00	MG/KG	NA	NA	NA	NA	NA	7.1E-06	mg/kg/day	3.0E-04	mg/kg/day	2.4E-02
				Chromium	1.6E+01	MG/KG	NA	NA	NA	NA	NA	2.2E-05	mg/kg/day	3.0E-03	mg/kg/day	7.4E-03
				Copper	6.4E+01	MG/KG	NA	NA	NA	NA	NA	8.7E-05	mg/kg/day	4.0E-02	mg/kg/day	2.2E-03
				Iron	9.5E+03	MG/KG	NA	NA	NA	NA	NA	1.3E-02	mg/kg/day	3.0E-01	mg/kg/day	4.4E-02
				Manganese	1.6E+02	MG/KG	NA	NA	NA	NA	NA	2.2E-04	mg/kg/day	2.0E-02	mg/kg/day	1.1E-02
				Thallium	3.8E-01	MG/KG	NA	NA	NA	NA	NA	5.3E-07	mg/kg/day	7.0E-05	mg/kg/day	7.5E-03
				Vanadium	1.4E+01	MG/KG	NA	NA	NA	NA	NA	1.9E-05	mg/kg/day	1.0E-03	mg/kg/day	1.9E-02
			Exp. Route Total								0.0E+00					1.2E-01

TABLE 7.9.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal	Benzo(a)anthracene	1.5E+00	MG/KG	NA	NA	NA	NA	NA	3.6E-06	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	1.7E+00	MG/KG	NA	NA	NA	NA	NA	4.1E-06	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	3.6E+00	MG/KG	NA	NA	NA	NA	NA	8.6E-06	mg/kg/day	NA	NA	NA
				Benzo(k)fluoranthene	3.3E+00	MG/KG	NA	NA	NA	NA	NA	7.7E-06	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.3E-01	MG/KG	NA	NA	NA	NA	NA	3.0E-07	mg/kg/day	NA	NA	NA
				Indeno(1,2,3-cd)pyrene	2.1E+00	MG/KG	NA	NA	NA	NA	NA	4.9E-06	mg/kg/day	NA	NA	NA
				Aluminum	4.5E+03	MG/KG	NA	NA	NA	NA	NA	8.1E-04	mg/kg/day	1.0E+00	mg/kg/day	8.1E-04
				Arsenic	5.2E+00	MG/KG	NA	NA	NA	NA	NA	2.8E-06	mg/kg/day	3.0E-04	mg/kg/day	9.4E-03
				Chromium	1.6E+01	MG/KG	NA	NA	NA	NA	NA	2.9E-06	mg/kg/day	7.5E-05	mg/kg/day	3.9E-02
				Copper	6.4E+01	MG/KG	NA	NA	NA	NA	NA	1.2E-05	mg/kg/day	4.0E-02	mg/kg/day	2.9E-04
				Iron	9.5E+03	MG/KG	NA	NA	NA	NA	NA	1.7E-03	mg/kg/day	3.0E-01	mg/kg/day	5.8E-03
				Manganese	1.6E+02	MG/KG	NA	NA	NA	NA	NA	3.0E-05	mg/kg/day	8.0E-04	mg/kg/day	3.7E-02
				Thallium	3.8E-01	MG/KG	NA	NA	NA	NA	NA	7.0E-08	mg/kg/day	7.0E-05	mg/kg/day	9.9E-04
				Vanadium	1.4E+01	MG/KG	NA	NA	NA	NA	NA	2.5E-06	mg/kg/day	2.6E-05	mg/kg/day	9.7E-02
			Exp. Route Total								0.0E+00					1.9E-01
		Exposure Point Total									0.0E+00					3.1E-01
	Exposure Medium Total										0.0E+00					3.1E-01
Subsurface Soil Total											0.0E+00					3.1E-01
										Total of Receptor Risks Across All Media	0.0E+00				Total of Receptor Hazards Across All Media	1.6E+01

Soil* - Surface and subsurface soil combined

NA = Not applicable.

Notes-

DAevent for exposure to groundwater while bathing calculated on Table 7.9.RME Supplement A and B.

EPC for inhalation of volatiles from groundwater from shower calculated on Table 7.9.RME Supplement C.

Table 7.9.RME Supplement A
Calculation of DAevent
Adult Resident, Upper Aquifer Groundwater
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Chemical of Potential Concern	Groundwater Water Concentration (CW) (μg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
Chloroform	1.3E+01	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	0.58	1.3E-07	2
Methyl-tert-butyl ether (MTBE)	2.5E+01	NA	NA	NA	NA	NA	0.58	NA	
Tetrachloroethene	5.0E+00	3.3E-02	2.0E-01	9.1E-01	2.2E+00	1.0E+00	0.58	3.3E-07	2
Arsenic	1.2E+01	1.0E-03	NA	NA	NA	NA	0.58	7.1E-09	1
Iron	5.3E+04	1.0E-03	NA	NA	NA	NA	0.58	3.1E-05	1
Manganese	5.9E+03	1.0E-03	NA	NA	NA	NA	0.58	3.4E-06	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =
tevent<t*: DAevent (mg/cm2-event) =
2 x FA x Kp x CW x (sqrt((6 x τ_{event} x tevent)/π)) x 0.001 mg/ug x 0.001 l/cm^3 (eq 2)

tevent>t*: DAevent (mg/cm2-event) =
FA x Kp x CW x (tevent/(1+B) + 2 x τ_{event} x ((1 + 3xB + $3xB^2$)/$(1+B)^2$) x 0.001 mg/ug x 0.001 l/cm3 (eq 3)

Notes:
Permeability constants from EPA 2001, Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R/99/005.
NA - not applicable.

Table 7.9b.RME Supplement
Calculation of DAevent
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Chemical	MW	log Kow	Kow	log Kp	Kp (cm/hr)	B	log Dsc/lsc	lsc (cm)	log Dsc	Dsc (cm^2/hr)	Tau (hr)	c	b	T* (hr)	Tevent (hr/event)	Medium EPC Value, Cv?	DAevent mg/(cm^2-event)
Methyl-tert-butyl ether (MTBE)	88.15	0.94	8.71E+00	-2.59E+00	2.57E-03	8.71E-04	-3.26E+00	1.00E-03	-6.26E+00	5.52E-07	3.02E-01	3.34E-01	3.04E-01	7.24E-01	0.58	2.50E+01	7.42E-08

Equations from *Dermal Exposure Assessment: Principles and Applications*. EPA/600/8-91/011B. January 1992.

Table 7.9 RME Supplement C
Inhalation Exposure Concentrations from Foster and Chrostowski Shower Model
NAB Little Creek SWMU 7

Chemical	Exposure Point Concentration Cwo (mg/l)	Molecular weight (HH) (g/mole)	Henry's Law Constant (H) (atm-m^3/mole)	Kg (VOC) (cm/hr)	Kl(VOC) (cm/hr)	KL (cm/hr)	Kal (cm/hr)	Cwd (mg/l)	S (mg/m^3-min)	Calculated Inhalation Exposure (Einh) (mg/kg/shower)
Chloroform	1.3E+01	1.2E+02	2.87E-03	1.2E+03	1.2E+01	1.1E+01	1.5E+01	5.0E+00	3.3E+01	**6.7E-04**
Methyl-tert-butyl ether (MTBE)	2.5E+01	8.8E+01	5.84E-04	1.4E+03	1.4E+01	9.9E+00	1.3E+01	9.0E+00	6.0E+01	**1.2E-03**
Tetrachloroethene	5.0E+00	1.7E+02	1.84E-02	9.9E+02	1.0E+01	1.0E+01	1.4E+01	1.8E+00	1.2E+01	**2.5E-04**

Variables	Units	Exposure Assumptions
Kg(VOC) = gas-film mass transfer coefficient	cm/hr	Solved by Eq 1
Kl(VOC) = liquid-film mass transfer coefficient	cm/hr	Solved by Eq 2
KL = overall mass transfer coefficient	cm/hr	Solved by Eq 3
Kal = adjusted overall mass transfer coeff.	cm/hr	Solved by Eq 4
Tl = Calibration temp. of water	K (20C +273)	293
Ts = Shower water temperature	k (45C)	318
Us = water viscosity at Ts	centipoise	0.596
Ul = water viscosity at Tl	cp	1.002
Cwd = conc. leaving droplets after time sdt	ug/l	Solved by Eq 5
sdt = shower droplet drop time	sec	2
d = shower droplet diameter	mm	1
FR = shower water flow rate	l/min	20
SV = shower room air volume	m^3	3
S = indoor VOC generation rate	ug/m^3-min	Solved by Eq 6
VR = ventilation rate	l/min	13.8
Variables	**Units**	**Exposure Assumptions**
BW = body weight	kg	70
Ds = duration of shower	min	12
Dt = total duration in shower room	min	15
R = air exchange rate	min^{-1}	0.0083
Ca = indoor air concentration of VOCs	ug/m^3	Solved by Eq 7
Einh = inhalation exposure per shower	mg/kg/shower	Solved by Eq 8

Equation 1:	Kg(VOC) =	3000 * (18 / HH)$^{0.5}$	
Equation 2:	Kl(VOC) =	20 * (44 / HH)$^{0.5}$	
Equation 3:	KL =	((1 / Kl(VOC)) + (0.024 / (Kg (VOC) * H)))$^{-1}$	
Equation 4:	Kal =	(KL * (((Tl * Us) / (Ts * Ul))$^{-0.5}$))	
Equation 5:	Cwd =	(Cwo * (1-EXP((-1 * Kal * sdt)/(60 * d))))	
Equation 6:	S =	(Cwd * FR / SV)	
Equation 7:	see time series example on Table I-GW-5		
Equation 8:	**Einh =**	**If t>Ds**	(((VR * S) / (BW * R * 1000000)) * ((Ds + (EXP(-R * Dt) / R)-(EXP(R * (Ds - Dt))) / R)))

Henry's Law Constant from USEPA's *Superfund Public Health Evaluation Manual.* USEPA/540/1-86/060, October 1986.

TABLE 7.10.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Upper Aquifer - Tap Water	Ingestion	Chloroform	1.3E+01	ug/L	NA	NA	NA	NA	NA	8.0E-04	mg/kg/day	1.0E-02	mg/kg/day	8.0E-02
				Methyl-tert-butyl ether (MTBE)	2.5E+01	ug/L	NA	NA	NA	NA	NA	1.6E-03	mg/kg/day	NA	NA	NA
				Tetrachloroethene	5.0E+00	ug/L	NA	NA	NA	NA	NA	3.2E-04	mg/kg/day	1.0E-02	mg/kg/day	3.2E-02
				Arsenic	1.2E+01	ug/L	NA	NA	NA	NA	NA	7.9E-04	mg/kg/day	3.0E-04	mg/kg/day	2.6E+00
				Iron	5.3E+04	ug/L	NA	NA	NA	NA	NA	3.4E+00	mg/kg/day	3.0E-01	mg/kg/day	1.1E+01
				Manganese	5.9E+03	ug/L	NA	NA	NA	NA	NA	3.8E-01	mg/kg/day	2.0E-02	mg/kg/day	1.9E+01
			Exp. Route Total								0.0E+00					3.3E+01
			Dermal	Chloroform	1.3E+01	ug/L	NA	NA	NA	NA	NA	5.4E-05	mg/kg/day	1.0E-02	mg/kg/day	5.4E-03
				Methyl-tert-butyl ether (MTBE)	2.5E+01	ug/L	NA	NA	NA	NA	NA	4.3E-05	mg/kg/day	NA	NA	NA
				Tetrachloroethene	5.0E+00	ug/L	NA	NA	NA	NA	NA	1.4E-04	mg/kg/day	1.0E-02	mg/kg/day	1.4E-02
				Arsenic	1.2E+01	ug/L	NA	NA	NA	NA	NA	3.0E-06	mg/kg/day	3.0E-04	mg/kg/day	1.0E-02
				Iron	5.3E+04	ug/L	NA	NA	NA	NA	NA	1.3E-02	mg/kg/day	3.0E-01	mg/kg/day	4.3E-02
				Manganese	5.9E+03	ug/L	NA	NA	NA	NA	NA	1.4E-03	mg/kg/day	8.0E-04	mg/kg/day	1.8E+00
			Exp. Route Total								0.0E+00					1.9E+00
		Exposure Point Total									0.0E+00					3.5E+01
	Exposure Medium Total										0.0E+00					3.5E+01
Groundwater - Upper Aquifer Tap Water Total											0.0E+00					3.5E+01
Soil*	Soil*	SWMU 7	Ingestion	Benzo(a)anthracene	1.5E+00	MG/KG	NA	NA	NA	NA	NA	1.9E-05	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	1.7E+00	MG/KG	NA	NA	NA	NA	NA	2.2E-05	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	3.6E+00	MG/KG	NA	NA	NA	NA	NA	4.7E-05	mg/kg/day	NA	NA	NA
				Benzo(k)fluoranthene	3.3E+00	MG/KG	NA	NA	NA	NA	NA	4.2E-05	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.3E-01	MG/KG	NA	NA	NA	NA	NA	1.6E-06	mg/kg/day	NA	NA	NA
				Indeno(1,2,3-cd)pyrene	2.1E+00	MG/KG	NA	NA	NA	NA	NA	2.7E-05	mg/kg/day	NA	NA	NA
				Aluminum	4.5E+03	MG/KG	NA	NA	NA	NA	NA	5.7E-02	mg/kg/day	1.0E+00	mg/kg/day	5.7E-02
				Arsenic	5.2E+00	MG/KG	NA	NA	NA	NA	NA	6.7E-05	mg/kg/day	3.0E-04	mg/kg/day	2.2E-01
				Chromium	1.6E+01	MG/KG	NA	NA	NA	NA	NA	2.1E-04	mg/kg/day	3.0E-03	mg/kg/day	6.9E-02
				Copper	6.4E+01	MG/KG	NA	NA	NA	NA	NA	8.2E-04	mg/kg/day	4.0E-02	mg/kg/day	2.0E-02
				Iron	9.5E+03	MG/KG	NA	NA	NA	NA	NA	1.2E-01	mg/kg/day	3.0E-01	mg/kg/day	4.1E-01
				Manganese	1.6E+02	MG/KG	NA	NA	NA	NA	NA	2.1E-03	mg/kg/day	2.0E-02	mg/kg/day	1.0E-01
				Thallium	3.8E-01	MG/KG	NA	NA	NA	NA	NA	4.9E-06	mg/kg/day	7.0E-05	mg/kg/day	7.0E-02
				Vanadium	1.4E+01	MG/KG	NA	NA	NA	NA	NA	1.8E-04	mg/kg/day	1.0E-03	mg/kg/day	1.8E-01
			Exp. Route Total								0.0E+00					1.1E+00

TABLE 7.10.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal	Benzo(a)anthracene	1.5E+00	MG/KG	NA	NA	NA	NA	NA	4.7E-06	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	1.7E+00	MG/KG	NA	NA	NA	NA	NA	5.4E-06	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	3.6E+00	MG/KG	NA	NA	NA	NA	NA	1.1E-05	mg/kg/day	NA	NA	NA
				Benzo(k)fluoranthene	3.3E+00	MG/KG	NA	NA	NA	NA	NA	1.0E-05	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.3E-01	MG/KG	NA	NA	NA	NA	NA	4.0E-07	mg/kg/day	NA	NA	NA
				Indeno(1,2,3-cd)pyrene	2.1E+00	MG/KG	NA	NA	NA	NA	NA	6.5E-06	mg/kg/day	NA	NA	NA
				Aluminum	4.5E+03	MG/KG	NA	NA	NA	NA	NA	1.1E-03	mg/kg/day	1.0E+00	mg/kg/day	1.1E-03
				Arsenic	5.2E+00	MG/KG	NA	NA	NA	NA	NA	3.7E-06	mg/kg/day	3.0E-04	mg/kg/day	1.2E-02
				Chromium	1.6E+01	MG/KG	NA	NA	NA	NA	NA	3.9E-06	mg/kg/day	7.5E-05	mg/kg/day	5.2E-02
				Copper	6.4E+01	MG/KG	NA	NA	NA	NA	NA	1.5E-05	mg/kg/day	4.0E-02	mg/kg/day	3.8E-04
				Iron	9.5E+03	MG/KG	NA	NA	NA	NA	NA	2.3E-03	mg/kg/day	3.0E-01	mg/kg/day	7.6E-03
				Manganese	1.6E+02	MG/KG	NA	NA	NA	NA	NA	3.9E-05	mg/kg/day	8.0E-04	mg/kg/day	4.9E-02
				Thallium	3.8E-01	MG/KG	NA	NA	NA	NA	NA	9.2E-08	mg/kg/day	7.0E-05	mg/kg/day	1.3E-03
				Vanadium	1.4E+01	MG/KG	NA	NA	NA	NA	NA	3.3E-06	mg/kg/day	2.6E-05	mg/kg/day	1.3E-01
			Exp. Route Total								0.0E+00					2.5E-01
		Exposure Point Total									0.0E+00					1.4E+00
	Exposure Medium Total										0.0E+00					1.4E+00
Subsurface Soil Total											0.0E+00					1.4E+00
										Total of Receptor Risks Across All Media	0.0E+00				Total of Receptor Hazards Across All Media	3.6E+01

Soil* - Surface and subsurface soil combinec

NA = Not applicable.

Notes-

DAevent for exposure to groundwater while bathing calculated on Table 7.10.RME Supplement A and E

Table 7.10.RME Supplement A
Calculation of DAevent
Adult Resident, Upper Aquifer Groundwater
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Chemical of Potential Concern	Groundwater Water Concentration (CW) (μg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
Chloroform	1.3E+01	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	1	1.7E-07	2
Methyl-tert-butyl ether (MTBE)	2.5E+01	NA	NA	NA	NA	NA	1	NA	
Tetrachloroethene	5.0E+00	3.3E-02	2.0E-01	9.1E-01	2.2E+00	1.0E+00	1	4.4E-07	2
Arsenic	1.2E+01	1.0E-03	NA	NA	NA	NA	1	1.2E-08	1
Iron	5.3E+04	1.0E-03	NA	NA	NA	NA	1	5.3E-05	1
Manganese	5.9E+03	1.0E-03	NA	NA	NA	NA	1	5.9E-06	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =
tevent<t*: DAevent (mg/cm2-event) =
2 x FA x Kp x CW x (sqrt((6 x τ_{event} x tevent)/π)) x 0.001 mg/ug x 0.001 l/cm^3 (eq 2)

tevent>t*: DAevent (mg/cm2-event) =
FA x Kp x CW x (tevent/(1+B) + 2 x τ_{event} x ((1 + 3xB + $3xB^2$)/$(1+B)^2$) x 0.001 mg/ug x 0.001 l/cm3 (eq 3)

Notes:
Permeability constants from EPA 2001, Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R/99/005.
NA - not applicable.

Table 7.10b.RME Supplement
Calculation of DAevent
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Chemical	MW	log Kow	Kow	log Kp	Kp (cm/hr)	B	log Dsc/Isc	Isc (cm)	log Dsc	Dsc (cm^2/hr)	Tau (hr)	c	b	T* (hr)	Tevent (hr/event)	Medium EPC Value, Cv?	DAevent mg/(cm^2-event)
Methyl-tert-butyl ether (MTBE)	88.15	0.94	8.71E+00	-2.59E+00	2.57E-03	8.71E-04	-3.26E+00	1.00E-03	-6.26E+00	5.52E-07	3.02E-01	3.34E-01	3.04E-01	7.24E-01	1	2.50E+01	1.03E-07

Equations from *Dermal Exposure Assessment: Principles and Applications*. EPA/600/8-91/011B. January 1992.

TABLE 7.11.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Upper Aquifer - Tap Water	Ingestion	Chloroform	1.3E+01	ug/L	1.9E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Methyl-tert-butyl ether (MTBE)	2.5E+01	ug/L	3.7E-04	mg/kg/day	4.0E-03	1/mg/kg/day	1.5E-06	NA	NA	NA	NA	NA
				Tetrachloroethene	5.0E+00	ug/L	7.5E-05	mg/kg/day	5.4E-01	1/mg/kg/day	4.0E-05					
				Arsenic	1.2E+01	ug/L	1.8E-04	mg/kg/day	1.5E+00	1/mg/kg/day	2.8E-04	NA	NA	NA	NA	NA
				Iron	5.3E+04	ug/L	7.9E-01	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Manganese	5.9E+03	ug/L	8.8E-02	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								3.2E-04					0.0E+00
			Dermal	Chloroform	1.3E+01	ug/L	1.7E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Methyl-tert-butyl ether (MTBE)	2.5E+01	ug/L	1.0E-05	mg/kg/day	4.0E-03	1/mg/kg/day	4.0E-08	NA	NA	NA	NA	NA
				Tetrachloroethene	5.0E+00	ug/L	4.4E-05	mg/kg/day	5.4E-01	1/mg/kg/day	2.4E-05					
				Arsenic	1.2E+01	ug/L	1.0E-06	mg/kg/day	1.5E+00	1/mg/kg/day	1.6E-06	NA	NA	NA	NA	NA
				Iron	5.3E+04	ug/L	4.5E-03	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Manganese	5.9E+03	ug/L	5.0E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								2.5E-05					0.0E+00
		Exposure Point Total									3.4E-04					0.0E+00
	Exposure Medium Total										3.4E-04					0.0E+00
Groundwater	Air	Upper Aquifer - Water vapors at Showerhead	Inhalation	Chloroform	1.3E+01	ug/L	2.2E-04	mg/kg/day	8.1E-02	1/mg/kg/day	1.8E-05	NA	NA	NA	NA	NA
				Methyl-tert-butyl ether (MTBE)	2.5E+01	ug/L	4.0E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Tetrachloroethene	5.0E+00	ug/L	8.2E-05	mg/kg/day	2.0E-02	1/mg/kg/day	1.6E-06					
			Exp. Route Total								2.0E-05					0.0E+00
		Exposure Point Total									2.0E-05					0.0E+00
	Exposure Medium Total										2.0E-05					0.0E+00
Groundwater - Upper Aquifer Tap Water Total											3.6E-04					0.0E+00
Soil*	Soil*	SWMU 7	Ingestion	Benzo(a)anthracene	1.5E+00	MG/KG	2.4E-06	mg/kg/day	7.3E-01	1/mg/kg/day	1.7E-06	NA	NA	NA	NA	NA
				Benzo(a)pyrene	1.7E+00	MG/KG	2.7E-06	mg/kg/day	7.3E+00	1/mg/kg/day	2.0E-05	NA	NA	NA	NA	NA
				Benzo(b)fluoranthene	3.6E+00	MG/KG	5.7E-06	mg/kg/day	7.3E-01	1/mg/kg/day	4.2E-06	NA	NA	NA	NA	NA
				Benzo(k)fluoranthene	3.3E+00	MG/KG	5.1E-06	mg/kg/day	7.3E-02	1/mg/kg/day	3.8E-07	NA	NA	NA	NA	NA
				Dibenz(a,h)anthracene	1.3E-01	MG/KG	2.0E-07	mg/kg/day	7.3E+00	1/mg/kg/day	1.5E-06	NA	NA	NA	NA	NA
				Indeno(1,2,3-cd)pyrene	2.1E+00	MG/KG	3.3E-06	mg/kg/day	7.3E-01	1/mg/kg/day	2.4E-06	NA	NA	NA	NA	NA
				Aluminum	4.5E+03	MG/KG	7.0E-03	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Arsenic	5.2E+00	MG/KG	8.2E-06	mg/kg/day	1.5E+00	1/mg/kg/day	1.2E-05	NA	NA	NA	NA	NA
				Chromium	1.6E+01	MG/KG	2.5E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Copper	6.4E+01	MG/KG	1.0E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Iron	9.5E+03	MG/KG	1.5E-02	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Manganese	1.6E+02	MG/KG	2.6E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Thallium	3.8E-01	MG/KG	6.0E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Vanadium	1.4E+01	MG/KG	2.2E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								4.2E-05					0.0E+00

TABLE 7.11.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal	Benzo(a)anthracene	1.5E+00	MG/KG	1.6E-06	mg/kg/day	7.3E-01	1/mg/kg/day	1.2E-06	NA	NA	NA	NA	NA
				Benzo(a)pyrene	1.7E+00	MG/KG	1.9E-06	mg/kg/day	7.3E+00	1/mg/kg/day	1.4E-05	NA	NA	NA	NA	NA
				Benzo(b)fluoranthene	3.6E+00	MG/KG	3.9E-06	mg/kg/day	7.3E-01	1/mg/kg/day	2.9E-06	NA	NA	NA	NA	NA
				Benzo(k)fluoranthene	3.3E+00	MG/KG	3.5E-06	mg/kg/day	7.3E-02	1/mg/kg/day	2.6E-07	NA	NA	NA	NA	NA
				Dibenz(a,h)anthracene	1.3E-01	MG/KG	1.4E-07	mg/kg/day	7.3E+00	1/mg/kg/day	1.0E-06	NA	NA	NA	NA	NA
				Indeno(1,2,3-cd)pyrene	2.1E+00	MG/KG	2.2E-06	mg/kg/day	7.3E-01	1/mg/kg/day	1.6E-06	NA	NA	NA	NA	NA
				Aluminum	4.5E+03	MG/KG	3.7E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Arsenic	5.2E+00	MG/KG	1.3E-06	mg/kg/day	1.5E+00	1/mg/kg/day	1.9E-06	NA	NA	NA	NA	NA
				Chromium	1.6E+01	MG/KG	1.3E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Copper	6.4E+01	MG/KG	5.3E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Iron	9.5E+03	MG/KG	7.9E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Manganese	1.6E+02	MG/KG	1.3E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Thallium	3.8E-01	MG/KG	3.2E-08	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Vanadium	1.4E+01	MG/KG	1.1E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								2.2E-05					0.0E+00
		Exposure Point Total									6.5E-05					0.0E+00
	Exposure Medium Total										6.5E-05					0.0E+00
Subsurface Soil Total											6.5E-05					0.0E+00
										Total of Receptor Risks Across All Media	4.3E-04				Total of Receptor Hazards Across All Media	0.0E+00

Soil* - Surface and subsurface soil combined

NA = Not applicable.

Notes-

DAevent for exposure to groundwater while bathing calculated on Table 7.9.RME and 7.10.RME Supplement A and B.

EPC for inhalation of volatiles from groundwater from shower calculated on Table 7.11.RME Supplement A.

Table 7.11 RME Supplement A
Inhalation Exposure Concentrations from Foster and Chrostowski Shower Model
NAB Little Creek SWMU 7

Chemical	Exposure Point Concentration Cwo (mg/l)	Molecular weight (HH) (g/mole)	Henry's Law Constant (H) (atm-m^3/mole)	Kg (VOC) (cm/hr)	Kl(VOC) (cm/hr)	KL (cm/hr)	Kal (cm/hr)	Cwd (mg/l)	S (mg/m^3-min)	Calculated Inhalation Exposure (Einh) (mg/kg/shower)
Chloroform	1.3E+01	1.2E+02	2.87E-03	1.2E+03	1.2E+01	1.1E+01	1.5E+01	5.0E+00	3.3E+01	**6.7E-04**
Methyl-tert-butyl ether (MTBE)	2.5E+01	8.8E+01	5.84E-04	1.4E+03	1.4E+01	9.9E+00	1.3E+01	9.0E+00	6.0E+01	**1.2E-03**
Tetrachloroethene	5.0E+00	1.7E+02	1.84E-02	9.9E+02	1.0E+01	1.0E+01	1.4E+01	1.8E+00	1.2E+01	**2.5E-04**

Variables	Units	Exposure Assumptions
Kg(VOC) = gas-film mass transfer coefficient	cm/hr	Solved by Eq 1
Kl(VOC) = liquid-film mass transfer coefficient	cm/hr	Solved by Eq 2
KL = overall mass transfer coefficient	cm/hr	Solved by Eq 3
Kal = adjusted overall mass transfer coeff.	cm/hr	Solved by Eq 4
Tl = Calibration temp. of water	K (20C +273)	293
Ts = Shower water temperature	k (45C)	318
Us = water viscosity at Ts	centipoise	0.596
Ul = water viscosity at Tl	cp	1.002
Cwd = conc. leaving droplets after time sdt	ug/l	Solved by Eq 5
sdt = shower droplet drop time	sec	2
d = shower droplet diameter	mm	1
FR = shower water flow rate	l/min	20
SV = shower room air volume	m^3	3
S = indoor VOC generation rate	ug/m^3-min	Solved by Eq 6
VR = ventilation rate	l/min	13.8
Variables	**Units**	**Exposure Assumptions**
BW = body weight	kg	70
Ds = duration of shower	min	12
Dt = total duration in shower room	min	15
R = air exchange rate	min^{-1}	0.0083
Ca = indoor air concentration of VOCs	ug/m^3	Solved by Eq 7
Einh = inhalation exposure per shower	mg/kg/shower	Solved by Eq 8

Equation 1:	Kg(VOC) =	3000 * (18 / HH)$^{0.5}$	
Equation 2:	Kl(VOC) =	20 * (44 / HH)$^{0.5}$	
Equation 3:	KL =	((1 / Kl(VOC)) + (0.024 / (Kg (VOC) * H)))$^{-1}$	
Equation 4:	Kal =	(KL * (((Tl * Us) / (Ts * Ul))$^{-0.5}$))	
Equation 5:	Cwd =	(Cwo * (1-EXP((-1 * Kal * sdt)/(60 * d))))	
Equation 6:	S =	(Cwd * FR / SV)	
Equation 7:	see time series example on Table I-GW-5		
Equation 8:	**Einh =**	**If t>Ds**	(((VR * S) / (BW * R * 1000000)) * ((Ds + (EXP(-R * Dt) / R)-(EXP(R * (Ds - Dt))) / R)))

Henry's Law Constant from USEPA's *Superfund Public Health Evaluation Manual.* USEPA/540/1-86/060, October 1986.

TABLE 7.12.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Upper Aquifer - Tap Water	Ingestion	Chloroform	1.3E+01	ug/L	4.4E-05	mg/kg/day	NA	NA	NA	1.2E-04	mg/kg/day	1.0E-02	mg/kg/day	1.2E-02
				Methyl-tert-butyl ether (MTBE)	2.5E+01	ug/L	8.7E-05	mg/kg/day	4.0E-03	1/mg/kg/day	3.5E-07	2.4E-04	mg/kg/day	NA	NA	NA
				Tetrachloroethene	5.0E+00	ug/L	1.7E-05	mg/kg/day	5.4E-01	1/mg/kg/day	9.4E-06	4.9E-05	mg/kg/day	1.0E-02	mg/kg/day	4.9E-03
				Arsenic	1.2E+01	ug/L	4.3E-05	mg/kg/day	1.5E+00	1/mg/kg/day	6.4E-05	1.2E-04	mg/kg/day	3.0E-04	mg/kg/day	4.0E-01
				Iron	5.3E+04	ug/L	1.8E-01	mg/kg/day	NA	NA	NA	5.2E-01	mg/kg/day	3.0E-01	mg/kg/day	1.7E+00
				Manganese	5.9E+03	ug/L	2.1E-02	mg/kg/day	NA	NA	NA	5.8E-02	mg/kg/day	2.0E-02	mg/kg/day	2.9E+00
			Exp. Route Total								7.4E-05					5.0E+00
	Exposure Medium Total										7.4E-05					5.0E+00
Groundwater - Upper Aquifer Tap Water Total											7.4E-05					5.0E+00
Soil*	Soil*	SWMU 7	Ingestion	Benzo(a)anthracene	1.5E+00	MG/KG	5.3E-07	mg/kg/day	7.3E-01	1/mg/kg/day	3.9E-07	1.5E-06	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	1.7E+00	MG/KG	6.0E-07	mg/kg/day	7.3E+00	1/mg/kg/day	4.4E-06	1.7E-06	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	3.6E+00	MG/KG	1.3E-06	mg/kg/day	7.3E-01	1/mg/kg/day	9.3E-07	3.6E-06	mg/kg/day	NA	NA	NA
				Benzo(k)fluoranthene	3.3E+00	MG/KG	1.1E-06	mg/kg/day	7.3E-02	1/mg/kg/day	8.4E-08	3.2E-06	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.3E-01	MG/KG	4.5E-08	mg/kg/day	7.3E+00	1/mg/kg/day	3.3E-07	1.3E-07	mg/kg/day	NA	NA	NA
				Indeno(1,2,3-cd)pyrene	2.1E+00	MG/KG	7.3E-07	mg/kg/day	7.3E-01	1/mg/kg/day	5.3E-07	2.0E-06	mg/kg/day	NA	NA	NA
				Aluminum	4.5E+03	MG/KG	1.6E-03	mg/kg/day	NA	NA	NA	4.4E-03	mg/kg/day	1.0E+00	mg/kg/day	4.4E-03
				Arsenic	5.2E+00	MG/KG	1.8E-06	mg/kg/day	1.5E+00	1/mg/kg/day	2.7E-06	5.1E-06	mg/kg/day	3.0E-04	mg/kg/day	1.7E-02
				Chromium	1.6E+01	MG/KG	5.7E-06	mg/kg/day	NA	NA	NA	1.6E-05	mg/kg/day	3.0E-03	mg/kg/day	5.3E-03
				Copper	6.4E+01	MG/KG	2.2E-05	mg/kg/day	NA	NA	NA	6.2E-05	mg/kg/day	4.0E-02	mg/kg/day	1.6E-03
				Iron	9.5E+03	MG/KG	3.3E-03	mg/kg/day	NA	NA	NA	9.3E-03	mg/kg/day	3.0E-01	mg/kg/day	3.1E-02
				Manganese	1.6E+02	MG/KG	5.7E-05	mg/kg/day	NA	NA	NA	1.6E-04	mg/kg/day	2.0E-02	mg/kg/day	8.0E-03
				Thallium	3.8E-01	MG/KG	1.3E-07	mg/kg/day	NA	NA	NA	3.8E-07	mg/kg/day	7.0E-05	mg/kg/day	5.4E-03
				Vanadium	1.4E+01	MG/KG	4.9E-06	mg/kg/day	NA	NA	NA	1.4E-05	mg/kg/day	1.0E-03	mg/kg/day	1.4E-02
			Exp. Route Total								9.4E-06					8.6E-02

TABLE 7.12.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal	Benzo(a)anthracene	1.5E+00	MG/KG	1.2E-06	mg/kg/day	7.3E-01	1/mg/kg/day	8.5E-07	3.3E-06	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	1.7E+00	MG/KG	1.3E-06	mg/kg/day	7.3E+00	1/mg/kg/day	9.7E-06	3.7E-06	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	3.6E+00	MG/KG	2.8E-06	mg/kg/day	7.3E-01	1/mg/kg/day	2.0E-06	7.9E-06	mg/kg/day	NA	NA	NA
				Benzo(k)fluoranthene	3.3E+00	MG/KG	2.5E-06	mg/kg/day	7.3E-02	1/mg/kg/day	1.8E-07	7.1E-06	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.3E-01	MG/KG	9.9E-08	mg/kg/day	7.3E+00	1/mg/kg/day	7.2E-07	2.8E-07	mg/kg/day	NA	NA	NA
				Indeno(1,2,3-cd)pyrene	2.1E+00	MG/KG	1.6E-06	mg/kg/day	7.3E-01	1/mg/kg/day	1.2E-06	4.5E-06	mg/kg/day	NA	NA	NA
				Aluminum	4.5E+03	MG/KG	2.7E-04	mg/kg/day	NA	NA	NA	7.4E-04	mg/kg/day	1.0E+00	mg/kg/day	7.4E-04
				Arsenic	5.2E+00	MG/KG	9.3E-07	mg/kg/day	1.5E+00	1/mg/kg/day	1.4E-06	2.6E-06	mg/kg/day	3.0E-04	mg/kg/day	8.7E-03
				Chromium	1.6E+01	MG/KG	9.6E-07	mg/kg/day	NA	NA	NA	2.7E-06	mg/kg/day	7.5E-05	mg/kg/day	3.6E-02
				Copper	6.4E+01	MG/KG	3.8E-06	mg/kg/day	NA	NA	NA	1.1E-05	mg/kg/day	4.0E-02	mg/kg/day	2.6E-04
				Iron	9.5E+03	MG/KG	5.7E-04	mg/kg/day	NA	NA	NA	1.6E-03	mg/kg/day	3.0E-01	mg/kg/day	5.3E-03
				Manganese	1.6E+02	MG/KG	9.7E-06	mg/kg/day	NA	NA	NA	2.7E-05	mg/kg/day	8.0E-04	mg/kg/day	3.4E-02
				Thallium	3.8E-01	MG/KG	2.3E-08	mg/kg/day	NA	NA	NA	6.4E-08	mg/kg/day	7.0E-05	mg/kg/day	9.1E-04
				Vanadium	1.4E+01	MG/KG	8.2E-07	mg/kg/day	NA	NA	NA	2.3E-06	mg/kg/day	2.6E-05	mg/kg/day	8.9E-02
			Exp. Route Total								1.6E-05					1.7E-01
		Exposure Point Total									2.6E-05					2.6E-01
	Exposure Medium Total										2.6E-05					2.6E-01
Subsurface Soil Total											2.6E-05					2.6E-01
										Total of Receptor Risks Across All Media	1.0E-04				Total of Receptor Hazards Across All Media	5.3E+00

Soil* - Surface and subsurface soil combinec

NA = Not applicable.

TABLE 7.13.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Upper Aquifer - Excavation Pit	Dermal	Chloroform	1.3E+01	ug/L	2.0E-07	mg/kg/day	NA	NA	NA	1.4E-05	mg/kg/day	1.0E-02	mg/kg/day	1.4E-03
				Methyl-tert-butyl ether (MTBE)	2.5E+01	ug/L	2.3E-07	mg/kg/day	4.0E-03	1/mg/kg/day	9.3E-10	1.6E-05	mg/kg/day	NA	NA	NA
				Tetrachloroethene	5.0E+00	ug/L	5.2E-07	mg/kg/day	5.4E-01	1/mg/kg/day	2.8E-07	3.6E-05	mg/kg/day	1.0E-02	mg/kg/day	3.6E-03
				Arsenic	1.8E+01	ug/L	6.2E-08	mg/kg/day	1.5E+00	1/mg/kg/day	9.3E-08	4.3E-06	mg/kg/day	3.0E-04	mg/kg/day	1.4E-02
				Chromium	2.2E+01	ug/L	1.5E-07	mg/kg/day	NA	NA	NA	1.0E-05	mg/kg/day	3.0E-03	mg/kg/day	3.5E-03
				Iron	5.7E+04	ug/L	1.9E-04	mg/kg/day	NA	NA	NA	1.3E-02	mg/kg/day	3.0E-01	mg/kg/day	4.4E-02
				Manganese	5.7E+03	ug/L	1.9E-05	mg/kg/day	NA	NA	NA	1.3E-03	mg/kg/day	8.0E-04	mg/kg/day	1.7E+00
				Vanadium	8.8E+00	ug/L	2.9E-08	mg/kg/day	NA	NA	NA	2.1E-06	mg/kg/day	1.8E-04	mg/kg/day	1.1E-02
			Exp. Route Total								3.7E-07					1.8E+00
	Exposure Medium Total										3.7E-07					1.8E+00
	Air	Upper Aquifer - Water vapors at Excavation Pit	Inhalation	Chloroform	1.3E+01	ug/L	4.7E-07	mg/kg/day	8.1E-02	1/mg/kg/day	3.8E-08	1.1E-05	mg/kg/day	1.4E-02	mg/kg/day	8.0E-04
				Methyl-tert-butyl ether (MTBE)	2.5E+01	ug/L	1.0E-06	mg/kg/day	NA	NA	NA	2.4E-05	mg/kg/day	8.6E-01	mg/kg/day	2.8E-05
				Tetrachloroethene	5.0E+00	ug/L	1.7E-07	mg/kg/day	2.0E-02	1/mg/kg/day	3.5E-09	4.2E-06	mg/kg/day	1.4E-01	mg/kg/day	3.0E-05
			Exp. Route Total								4.1E-08					8.6E-04
		Exposure Point Total									4.1E-08					8.6E-04
	Exposure Medium Total										4.1E-08					8.6E-04
Groundwater - Upper Aquifer Tap Water Total											4.1E-07					1.8E+00
Soil*	Soil*	SWMU 7	Ingestion	Benzo(a)anthracene	1.5E+00	MG/KG	5.1E-08	mg/kg/day	7.3E-01	1/mg/kg/day	3.7E-08	3.5E-06	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	1.7E+00	MG/KG	5.8E-08	mg/kg/day	7.3E+00	1/mg/kg/day	4.2E-07	4.1E-06	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	3.6E+00	MG/KG	1.2E-07	mg/kg/day	7.3E-01	1/mg/kg/day	8.9E-08	8.6E-06	mg/kg/day	NA	NA	NA
				Benzo(k)fluoranthene	3.3E+00	MG/KG	1.1E-07	mg/kg/day	7.3E-02	1/mg/kg/day	8.0E-09	7.7E-06	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.3E-01	MG/KG	4.3E-09	mg/kg/day	7.3E+00	1/mg/kg/day	3.1E-08	3.0E-07	mg/kg/day	NA	NA	NA
				Indeno(1,2,3-cd)pyrene	2.1E+00	MG/KG	7.0E-08	mg/kg/day	7.3E-01	1/mg/kg/day	5.1E-08	4.9E-06	mg/kg/day	NA	NA	NA
				Aluminum	4.5E+03	MG/KG	1.5E-04	mg/kg/day	NA	NA	NA	1.1E-02	mg/kg/day	1.0E+00	mg/kg/day	1.1E-02
				Arsenic	5.2E+00	MG/KG	1.8E-07	mg/kg/day	1.5E+00	1/mg/kg/day	2.6E-07	1.2E-05	mg/kg/day	3.0E-04	mg/kg/day	4.1E-02
				Chromium	1.6E+01	MG/KG	5.4E-07	mg/kg/day	NA	NA	NA	3.8E-05	mg/kg/day	2.0E-02	mg/kg/day	1.9E-03
				Copper	6.4E+01	MG/KG	2.1E-06	mg/kg/day	NA	NA	NA	1.5E-04	mg/kg/day	4.0E-02	mg/kg/day	3.7E-03
				Iron	9.5E+03	MG/KG	3.2E-04	mg/kg/day	NA	NA	NA	2.2E-02	mg/kg/day	3.0E-01	mg/kg/day	7.5E-02
				Manganese	1.6E+02	MG/KG	5.5E-06	mg/kg/day	NA	NA	NA	3.8E-04	mg/kg/day	2.0E-02	mg/kg/day	1.9E-02
				Thallium	3.8E-01	MG/KG	1.3E-08	mg/kg/day	NA	NA	NA	9.0E-07	mg/kg/day	7.0E-05	mg/kg/day	1.3E-02
				Vanadium	1.4E+01	MG/KG	4.7E-07	mg/kg/day	NA	NA	NA	3.3E-05	mg/kg/day	1.0E-03	mg/kg/day	3.3E-02
			Exp. Route Total								9.0E-07					2.0E-01

TABLE 7.13.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal	Benzo(a)anthracene	1.5E+00	MG/KG	1.7E-08	mg/kg/day	7.3E-01	1/mg/kg/day	1.3E-08	1.2E-06	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	1.7E+00	MG/KG	2.0E-08	mg/kg/day	7.3E+00	1/mg/kg/day	1.5E-07	1.4E-06	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	3.6E+00	MG/KG	4.2E-08	mg/kg/day	7.3E-01	1/mg/kg/day	3.1E-08	2.9E-06	mg/kg/day	NA	NA	NA
				Benzo(k)fluoranthene	3.3E+00	MG/KG	3.8E-08	mg/kg/day	7.3E-02	1/mg/kg/day	2.8E-09	2.7E-06	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.3E-01	MG/KG	1.5E-09	mg/kg/day	7.3E+00	1/mg/kg/day	1.1E-08	1.0E-07	mg/kg/day	NA	NA	NA
				Indeno(1,2,3-cd)pyrene	2.1E+00	MG/KG	2.4E-08	mg/kg/day	7.3E-01	1/mg/kg/day	1.8E-08	1.7E-06	mg/kg/day	NA	NA	NA
				Aluminum	4.5E+03	MG/KG	4.0E-06	mg/kg/day	NA	NA	NA	2.8E-04	mg/kg/day	1.0E+00	mg/kg/day	2.8E-04
				Arsenic	5.2E+00	MG/KG	1.4E-08	mg/kg/day	1.5E+00	1/mg/kg/day	2.1E-08	9.7E-07	mg/kg/day	3.0E-04	mg/kg/day	3.2E-03
				Chromium	1.6E+01	MG/KG	1.4E-08	mg/kg/day	NA	NA	NA	1.0E-06	mg/kg/day	5.0E-04	mg/kg/day	2.0E-03
				Copper	6.4E+01	MG/KG	5.7E-08	mg/kg/day	NA	NA	NA	4.0E-06	mg/kg/day	4.0E-02	mg/kg/day	9.9E-05
				Iron	9.5E+03	MG/KG	8.5E-06	mg/kg/day	NA	NA	NA	5.9E-04	mg/kg/day	3.0E-01	mg/kg/day	2.0E-03
				Manganese	1.6E+02	MG/KG	1.5E-07	mg/kg/day	NA	NA	NA	1.0E-05	mg/kg/day	8.0E-04	mg/kg/day	1.3E-02
				Thallium	3.8E-01	MG/KG	3.4E-10	mg/kg/day	NA	NA	NA	2.4E-08	mg/kg/day	7.0E-05	mg/kg/day	3.4E-04
				Vanadium	1.4E+01	MG/KG	1.2E-08	mg/kg/day	NA	NA	NA	8.7E-07	mg/kg/day	2.6E-05	mg/kg/day	3.3E-02
			Exp. Route Total								2.4E-07					5.4E-02
		Exposure Point Total									1.1E-06					2.5E-01
	Exposure Medium Total										1.1E-06					2.5E-01
Subsurface Soil Total											1.1E-06					2.5E-01
										Total of Receptor Risks Across All Media	1.6E-06				Total of Receptor Hazards Across All Media	2.0E+00

Soil* - Surface and subsurface soil combinec

NA = Not applicable.

Notes-

DAevent for exposure to groundwater while bathing calculated on Table 7.13.RME Supplement A and E

EPC for inhalation of volatiles from groundwater from shower calculated on Table 7.13.RME Supplement C

Table 7.13.RME Supplement A
Calculation of DAevent
Construction Worker, Upper Aquifer Groundwater
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Chemical of Potential Concern	Groundwater Water Concentration (CW) (μg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
Chloroform	1.3E+01	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	8	4.7E-07	3
Methyl-tert-butyl ether (MTBE)	2.5E+01	NA	NA	NA	NA	NA	8	NA	
Tetrachloroethene	5.0E+00	3.3E-02	2.0E-01	9.1E-01	2.2E+00	1.0E+00	8	1.2E-06	3
Arsenic	1.8E+01	1.0E-03	NA	NA	NA	NA	8	1.5E-07	1
Chromium	2.2E+01	2.0E-03	NA	NA	NA	NA	8	3.5E-07	1
Iron	5.7E+04	1.0E-03	NA	NA	NA	NA	8	4.5E-04	1
Manganese	5.7E+03	1.0E-03	NA	NA	NA	NA	8	4.6E-05	1
Vanadium	8.8E+00	1.0E-03	NA	NA	NA	NA	8	7.0E-08	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =
tevent<t*: DAevent (mg/cm2-event) =
2 x FA x Kp x CW x (sqrt((6 x τ_{event} x tevent)/π)) x 0.001 mg/ug x 0.001 l/cm^3 (eq 2)

tevent>t*: DAevent (mg/cm2-event) =
FA x Kp x CW x (tevent/(1+B) + 2 x τ_{event} x ((1 + 3xB + $3xB^2$)/$(1+B)^2$) x 0.001 mg/ug x 0.001 l/cm3 (eq 3)

Notes:
Permeability constants from EPA 2001, Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R/99/005.
NA - not applicable.

Table 7.13b.RME Supplement
Calculation of DAevent
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Chemical	MW	log Kow	Kow	log Kp	Kp (cm/hr)	B	log Dsc/lsc	lsc (cm)	log Dsc	Dsc (cm^2/hr)	Tau (hr)	c	b	T* (hr)	Tevent (hr/event)	Medium EPC Value, Cv?	DAevent mg/(cm^2-event)
Methyl-tert-butyl ether (MTBE)	88.15	0.94	8.71E+00	-2.59E+00	2.57E-03	8.71E-04	-3.26E+00	1.00E-03	-6.26E+00	5.52E-07	3.02E-01	3.34E-01	3.04E-01	7.24E-01	8	2.50E+01	5.52E-07

Equations from *Dermal Exposure Assessment: Principles and Applications*. EPA/600/8-91/011B. January 1992.

Table 7.13.RME Supplement C
Inhalation of Volatiles from Groundwater During Construction
Inhalation Exposure Concentrations Calculated Using a Two-Film Volatilization Model
Future Construction Worker Senario
SWMU 7 NAB Little Creek

Chemical	Cw (μg/L)	MW (mol/gram)	K_H (unitless)	k_l (cm/hr)	k_g (cm/hr)	K_v (cm/hr)	ER (mg/hr)	ERa (g/sec-m^2)	Ca (mg/m^3)
Chloroform	1.25E+01	1.19E+02	1.50E-01	3.17E+00	1.92E+03	3.13E+00	3.93E+01	4.04E-09	1.15E-04
Methyl-tert-butyl ether (MTBE)	2.50E+01	8.82E+01	6.02E-01	3.42E+00	2.07E+03	3.41E+00	8.52E+01	8.76E-09	2.49E-04
Tetrachloroethene	5.00E+00	1.66E+02	7.54E-01	2.92E+00	1.77E+03	2.91E+00	1.45E+01	1.50E-09	4.25E-05

Equations

Equation 1 $Kv = 1/(1/k_l + 1/K_H{*}K_g)$

Equation 2 $k_g = 700(18/MW)^{1/4}V$

Equation 3 $k_l = (32/MW)^{1/4}Ka'$

Equation 4 $ER = Kv * Cw * L/1000\ cm^3 * mg/1000\ \mu g$

Equation 5 $ERa = ER * g/1000\ mg * hr/60\ min * min/60\ sec * 1/A$

Variables	Units	Exposure Assumptions
Cw = groundwater concentration	(μg/L)	chem-specific
MW = molecular weight	(mol/gram)	chem-specific
K_H - Henry's Law Constant	(unitless)	chem-specific
Kv = volatilization rate	(cm/hr)	Solved by Eq 1
k_g = gas phase transfer coefficient	(cm/hr)	Solved by Eq 2
k_l = liquid phase transfer coefficient	(cm/hr)	Solved by Eq 3
V = wind speed	(m/s)	4.4
Ka' = aeration rate	(cm/hr)	0.0633
ER = emission rate	(mg/hr)	Solved by Eq 4
A = area of excavation (utility ditch)	(m^2)	2,700
Era = area emission rate	(g/sec-m^2)	Solved by Eq 5
Ca = air concentration	(mg/m^3)	Solved using SCREEN3 model

Note: aeration rate based on aeration rate for small pond (0.1/day) multiplied by depth of water in excavation (1/2 ft)

TABLE 7.1.CT

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDANCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Upper Aquifer - Tap Water	Ingestion	Chloroform	2.8E+00	ug/L	NA	NA	NA	NA	NA	3.6E-05	mg/kg/day	1.0E-02	mg/kg/day	3.6E-03
				Methyl-tert-butyl ether (MTBE)	4.7E+00	ug/L	NA	NA	NA	NA	NA	6.0E-05	mg/kg/day	NA	NA	NA
				Tetrachloroethene	1.82E+00	ug/L	NA	NA	NA	NA	NA	2.3E-05	mg/kg/day	1.0E-02	mg/kg/day	2.3E-03
				Arsenic	3.8E+00	ug/L	NA	NA	NA	NA	NA	4.9E-05	mg/kg/day	3.0E-04	mg/kg/day	1.6E-01
				Iron	2.4E+04	ug/L	NA	NA	NA	NA	NA	3.1E-01	mg/kg/day	3.0E-01	mg/kg/day	1.0E+00
				Manganese	2.7E+03	ug/L	NA	NA	NA	NA	NA	3.5E-02	mg/kg/day	2.0E-02	mg/kg/day	1.7E+00
			Exp. Route Total								0.0E+00					2.9E+00
			Dermal	Chloroform	2.8E+00	ug/L	NA	NA	NA	NA	NA	3.1E-06	mg/kg/day	1.0E-02	mg/kg/day	3.1E-04
				Methyl-tert-butyl ether (MTBE)	4.7E+00	ug/L	NA	NA	NA	NA	NA	1.5E-06	mg/kg/day	NA	NA	NA
				Tetrachloroethene	1.8E+00	ug/L	NA	NA	NA	NA	NA	1.3E-05	mg/kg/day	1.0E-02	mg/kg/day	1.3E-03
				Arsenic	3.8E+00	ug/L	NA	NA	NA	NA	NA	1.6E-07	mg/kg/day	3.0E-04	mg/kg/day	5.2E-04
				Iron	2.4E+04	ug/L	NA	NA	NA	NA	NA	1.0E-03	mg/kg/day	3.0E-01	mg/kg/day	3.3E-03
				Manganese	2.7E+03	ug/L	NA	NA	NA	NA	NA	1.1E-04	mg/kg/day	8.0E-04	mg/kg/day	1.4E-01
			Exp. Route Total								0.0E+00					1.4E-01
		Exposure Point Total									0.0E+00					3.1E+00
	Exposure Medium Total										0.0E+00					3.1E+00
Groundwater - Upper Aquifer Tap Water Total											0.0E+00					3.1E+00
										Total of Receptor Risks Across All Media	0.0E+00				Total of Receptor Hazards Across All Media	3.1E+00

NA = Not applicable.

Notes-
DAevent for exposure to groundwater while bathing calculated on Table 7.1.CT Supplement A and E

Table 7.1.CT Supplement A
Calculation of DAevent
Adult Resident, Upper Aquifer Groundwater
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Chemical of Potential Concern	Groundwater Water Concentration (CW) (μg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
Chloroform	2.8E+00	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	0.25	1.9E-08	2
Methyl-tert-butyl ether (MTBE)	4.7E+00	NA	NA	NA	NA	NA	0.25	NA	
Tetrachloroethene	1.8E+00	3.3E-02	2.0E-01	9.1E-01	2.2E+00	1.0E+00	0.25	7.9E-08	2
Arsenic	3.8E+00	1.0E-03	NA	NA	NA	NA	0.25	9.5E-10	1
Iron	2.4E+04	1.0E-03	NA	NA	NA	NA	0.25	6.0E-06	1
Manganese	2.7E+03	1.0E-03	NA	NA	NA	NA	0.25	6.7E-07	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =
tevent<t*: DAevent (mg/cm2-event) =
2 x FA x Kp x CW x (sqrt((6 x τ_{event} x tevent)/π)) x 0.001 mg/ug x 0.001 l/cm^3 (eq 2)

tevent>t*: DAevent (mg/cm2-event) =
FA x Kp x CW x (tevent/(1+B) + 2 x τ_{event} x ((1 + 3xB + $3xB^2$)/$(1+B)^2$) x 0.001 mg/ug x 0.001 l/cm3 (eq 3)

Notes:
Permeability constants from EPA 2001, Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R/99/005.
NA - not applicable.

Table 7.1b.CT Supplement
Calculation of DAevent
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Chemical	MW	log Kow	Kow	log Kp	Kp (cm/hr)	B	log Dsc/lsc	lsc (cm)	log Dsc	Dsc (cm^2/hr)	Tau (hr)	c	b	T* (hr)	Tevent (hr/event)	Medium EPC Value, Cv?	DAevent mg/(cm^2-event)
Methyl-tert-butyl ether (MTBE)	88.15	0.94	8.71E+00	-2.59E+00	2.57E-03	8.71E-04	-3.26E+00	1.00E-03	-6.26E+00	5.52E-07	3.02E-01	3.34E-01	3.04E-01	7.24E-01	0.25	4.69E+00	9.13E-09

Equations from *Dermal Exposure Assessment: Principles and Applications*. EPA/600/8-91/011B. January 1992.

TABLE 7.2.CT

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDANCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Upper Aquifer - Tap Water	Ingestion	Chloroform	2.8E+00	ug/L	NA	NA	NA	NA	NA	1.2E-04	mg/kg/day	1.0E-02	mg/kg/day	1.2E-02
				Methyl-tert-butyl ether (MTBE)	4.7E+00	ug/L	NA	NA	NA	NA	NA	2.0E-04	mg/kg/day	NA	NA	NA
				Tetrachloroethene	1.8E+00	ug/L	NA	NA	NA	NA	NA	7.8E-05	mg/kg/day	1.0E-02	mg/kg/day	7.8E-03
				Arsenic	3.8E+00	ug/L	NA	NA	NA	NA	NA	1.6E-04	mg/kg/day	3.0E-04	mg/kg/day	5.4E-01
				Iron	2.4E+04	ug/L	NA	NA	NA	NA	NA	1.0E+00	mg/kg/day	3.0E-01	mg/kg/day	3.4E+00
				Manganese	2.7E+03	ug/L	NA	NA	NA	NA	NA	1.2E-01	mg/kg/day	2.0E-02	mg/kg/day	5.8E+00
			Exp. Route Total								0.0E+00					9.8E+00
			Dermal	Chloroform	2.8E+00	ug/L	NA	NA	NA	NA	NA	5.3E-06	mg/kg/day	1.0E-02	mg/kg/day	5.3E-04
				Methyl-tert-butyl ether (MTBE)	4.7E+00	ug/L	NA	NA	NA	NA	NA	3.0E-06	mg/kg/day	NA	NA	NA
				Tetrachloroethene	1.8E+00	ug/L	NA	NA	NA	NA	NA	2.2E-05	mg/kg/day	1.0E-02	mg/kg/day	2.2E-03
				Arsenic	3.8E+00	ug/L	NA	NA	NA	NA	NA	2.7E-07	mg/kg/day	3.0E-04	mg/kg/day	8.9E-04
				Iron	2.4E+04	ug/L	NA	NA	NA	NA	NA	1.7E-03	mg/kg/day	3.0E-01	mg/kg/day	5.7E-03
				Manganese	2.7E+03	ug/L	NA	NA	NA	NA	NA	1.9E-04	mg/kg/day	8.0E-04	mg/kg/day	2.4E-01
			Exp. Route Total								0.0E+00					2.5E-01
		Exposure Point Total									0.0E+00					1.0E+01
	Exposure Medium Total										0.0E+00					1.0E+01
Groundwater - Upper Aquifer Tap Water Total											0.0E+00					1.0E+01
										Total of Receptor Risks Across All Media	0.0E+00			Total of Receptor Hazards Across All Media		1.0E+01

Soil* - Surface and subsurface soil combinec

NA = Not applicable.

Notes-

DAevent for exposure to groundwater while bathing calculated on Table 7.2.CT Supplement A and E

Table 7.2.CT Supplement A
Calculation of DAevent
Adult Resident, Upper Aquifer Groundwater
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Chemical of Potential Concern	Groundwater Water Concentration (CW) (μg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
Chloroform	2.8E+00	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	0.33	2.2E-08	2
Methyl-tert-butyl ether (MTBE)	4.7E+00	NA	NA	NA	NA	NA	0.33	NA	
Tetrachloroethene	1.8E+00	3.3E-02	2.0E-01	9.1E-01	2.2E+00	1.0E+00	0.33	9.1E-08	2
Arsenic	3.8E+00	1.0E-03	NA	NA	NA	NA	0.33	1.3E-09	1
Iron	2.4E+04	1.0E-03	NA	NA	NA	NA	0.33	8.0E-06	1
Manganese	2.7E+03	1.0E-03	NA	NA	NA	NA	0.33	8.9E-07	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =
tevent<t*: DAevent (mg/cm2-event) =
2 x FA x Kp x CW x (sqrt((6 x τ_{event} x tevent)/π)) x 0.001 mg/ug x 0.001 l/cm^3 (eq 2)

tevent>t*: DAevent (mg/cm2-event) =
FA x Kp x CW x (tevent/(1+B) + 2 x τ_{event} x ((1 + 3xB + $3xB^2$)/$(1+B)^2$) x 0.001 mg/ug x 0.001 l/cm3 (eq 3)

Notes:
Permeability constants from EPA 2001, Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R/99/005.
NA - not applicable.

Table 7.2b.CT Supplement
Calculation of DAevent
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Chemical	MW	log Kow	Kow	log Kp	Kp (cm/hr)	B	log Dsc/lsc	lsc (cm)	log Dsc	Dsc (cm^2/hr)	Tau (hr)	c	b	T* (hr)	Tevent (hr/event)	Medium EPC Value, Cv?	DAevent mg/(cm^2-event)
Methyl-tert-butyl ether (MTBE)	88.15	0.94	8.71E+00	-2.59E+00	2.57E-03	8.71E-04	-3.26E+00	1.00E-03	-6.26E+00	5.52E-07	3.02E-01	3.34E-01	3.04E-01	7.24E-01	0.33	4.69E+00	1.05E-08

Equations from *Dermal Exposure Assessment: Principles and Applications*. EPA/600/8-91/011B. January 1992.

TABLE 7.3.CT
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDANCY
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Upper Aquifer - Tap Water	Ingestion	Chloroform	2.8E+00	ug/L	1.5E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Methyl-tert-butyl ether (MTBE)	4.7E+00	ug/L	2.5E-05	mg/kg/day	4.0E-03	1/mg/kg/day	1.0E-07	NA	NA	NA	NA	NA
				Tetrachloroethene	1.8E+00	ug/L	9.7E-06	mg/kg/day	5.4E-01	1/mg/kg/day	5.2E-06					
				Arsenic	3.8E+00	ug/L	2.0E-05	mg/kg/day	1.5E+00	1/mg/kg/day	3.0E-05	NA	NA	NA	NA	NA
				Iron	2.4E+04	ug/L	1.3E-01	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Manganese	2.7E+03	ug/L	1.4E-02	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								3.6E-05					0.0E+00
			Dermal	Chloroform	2.8E+00	ug/L	9.2E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Methyl-tert-butyl ether (MTBE)	4.7E+00	ug/L	4.5E-07	mg/kg/day	4.0E-03	1/mg/kg/day	1.8E-09	NA	NA	NA	NA	NA
				Tetrachloroethene	1.8E+00	ug/L	3.9E-06	mg/kg/day	5.4E-01	1/mg/kg/day	2.1E-06					
				Arsenic	3.8E+00	ug/L	5.0E-08	mg/kg/day	1.5E+00	1/mg/kg/day	7.5E-08	NA	NA	NA	NA	NA
				Iron	2.4E+04	ug/L	3.2E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Manganese	2.7E+03	ug/L	3.6E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								2.2E-06					0.0E+00
		Exposure Point Total									3.8E-05					0.0E+00
	Exposure Medium Total										3.8E-05					0.0E+00
Groundwater	Air	Upper Aquifer - Water vapors at Showerhead	Inhalation	Chloroform	2.8E+00	ug/L	1.3E-05	NA	8.1E-02	1/mg/kg/day	1.0E-06	NA	NA	NA	NA	NA
				Methyl-tert-butyl ether (MTBE)	4.7E+00	ug/L	1.9E-05	NA	NA	NA	NA	NA	NA	NA	NA	NA
				Tetrachloroethene	1.8E+00	ug/L	7.5E-06	NA	2.0E-02	1/mg/kg/day	1.5E-07	NA	NA	NA	NA	NA
			Exp. Route Total								1.2E-06					0.0E+00
		Exposure Point Total									1.2E-06					0.0E+00
	Exposure Medium Total										1.2E-06					0.0E+00
Groundwater - Upper Aquifer Tap Water Total											3.9E-05					0.0E+00
Soil*	Soil*	SWMU 7	Ingestion	Benzo(a)anthracene	1.0E+00	MG/KG	4.3E-07	mg/kg/day	7.3E-01	1/mg/kg/day	3.1E-07	NA	NA	NA	NA	NA
				Benzo(a)pyrene	1.0E+00	MG/KG	4.3E-07	mg/kg/day	7.3E+00	1/mg/kg/day	3.1E-06	NA	NA	NA	NA	NA
				Benzo(b)fluoranthene	1.0E+00	MG/KG	4.3E-07	mg/kg/day	7.3E-01	1/mg/kg/day	3.1E-07	NA	NA	NA	NA	NA
				Benzo(k)fluoranthene	1.0E+00	MG/KG	4.3E-07	mg/kg/day	7.3E-02	1/mg/kg/day	3.1E-08	NA	NA	NA	NA	NA
				Dibenz(a,h)anthracene	1.0E+00	MG/KG	4.3E-07	mg/kg/day	7.3E+00	1/mg/kg/day	3.1E-06	NA	NA	NA	NA	NA
				Indeno(1,2,3-cd)pyrene	1.0E+00	MG/KG	4.3E-07	mg/kg/day	7.3E-01	1/mg/kg/day	3.1E-07	NA	NA	NA	NA	NA
				Aluminum	2.5E+03	MG/KG	1.1E-03	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Arsenic	1.3E+00	MG/KG	5.6E-07	mg/kg/day	1.5E+00	1/mg/kg/day	8.3E-07	NA	NA	NA	NA	NA
				Chromium	8.3E+00	MG/KG	3.5E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Copper	1.0E+01	MG/KG	4.5E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Iron	4.8E+03	MG/KG	2.1E-03	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Manganese	4.1E+01	MG/KG	1.8E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Thallium	2.7E-01	MG/KG	1.1E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Vanadium	1.1E+01	MG/KG	4.7E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								8.0E-06					0.0E+00

TABLE 7.3.CT

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDANCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal	Benzo(a)anthracene	1.0E+00	MG/KG	4.4E-07	mg/kg/day	7.3E-01	1/mg/kg/day	3.2E-07	NA	NA	NA	NA	NA
				Benzo(a)pyrene	1.0E+00	MG/KG	4.4E-07	mg/kg/day	7.3E+00	1/mg/kg/day	3.2E-06	NA	NA	NA	NA	NA
				Benzo(b)fluoranthene	1.0E+00	MG/KG	4.4E-07	mg/kg/day	7.3E-01	1/mg/kg/day	3.2E-07	NA	NA	NA	NA	NA
				Benzo(k)fluoranthene	1.0E+00	MG/KG	4.4E-07	mg/kg/day	7.3E-02	1/mg/kg/day	3.2E-08	NA	NA	NA	NA	NA
				Dibenz(a,h)anthracene	1.0E+00	MG/KG	4.4E-07	mg/kg/day	7.3E+00	1/mg/kg/day	3.2E-06	NA	NA	NA	NA	NA
				Indeno(1,2,3-cd)pyrene	1.0E+00	MG/KG	4.4E-07	mg/kg/day	7.3E-01	1/mg/kg/day	3.2E-07	NA	NA	NA	NA	NA
				Aluminum	2.5E+03	MG/KG	8.3E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Arsenic	1.3E+00	MG/KG	1.3E-07	mg/kg/day	1.5E+00	1/mg/kg/day	2.0E-07	NA	NA	NA	NA	NA
				Chromium	8.3E+00	MG/KG	2.8E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Copper	1.0E+01	MG/KG	3.5E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Iron	4.8E+03	MG/KG	1.6E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Manganese	4.1E+01	MG/KG	1.4E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Thallium	2.7E-01	MG/KG	9.1E-09	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Vanadium	1.1E+01	MG/KG	3.7E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								7.6E-06					0.0E+00
		Exposure Point Total									1.6E-05					0.0E+00
	Exposure Medium Total										1.6E-05					0.0E+00
Subsurface Soil Total											1.6E-05					0.0E+00
										Total of Receptor Risks Across All Media	5.5E-05				Total of Receptor Hazards Across All Media	0.0E+00

Soil* - Surface and subsurface soil combined

NA = Not applicable.

Notes-

DAevent for exposure to groundwater while bathing calculated on Table 7.1.CT and 7.2.CT Supplement A and B.

Table 7.11 RME Supplement A
Inhalation Exposure Concentrations from Foster and Chrostowski Shower Model
NAB Little Creek SWMU 7

Chemical	Exposure Point Concentration Cwo (mg/l)	Molecular weight (HH) (g/mole)	Henry's Law Constant (H) (atm-m^3/mole)	Kg (VOC) (cm/hr)	Kl(VOC) (cm/hr)	KL (cm/hr)	Kal (cm/hr)	Cwd (mg/l)	S (mg/m^3-min)	Calculated Inhalation Exposure (Einh) (mg/kg/shower)
Chloroform	2.8E+00	1.2E+02	2.87E-03	1.2E+03	1.2E+01	1.1E+01	1.5E+01	1.1E+00	7.5E+00	**1.5E-04**
Methyl-tert-butyl ether (MTBE)	4.7E+00	8.8E+01	5.84E-04	1.4E+03	1.4E+01	9.9E+00	1.3E+01	1.7E+00	1.1E+01	**2.3E-04**
Tetrachloroethene	1.8E+00	1.7E+02	1.84E-02	9.9E+02	1.0E+01	1.0E+01	1.4E+01	6.7E-01	4.5E+00	**9.1E-05**

Variables	Units	Exposure Assumptions
Kg(VOC) = gas-film mass transfer coefficient	cm/hr	Solved by Eq 1
Kl(VOC) = liquid-film mass transfer coefficient	cm/hr	Solved by Eq 2
KL = overall mass transfer coefficient	cm/hr	Solved by Eq 3
Kal = adjusted overall mass transfer coeff.	cm/hr	Solved by Eq 4
Tl = Calibration temp. of water	K (20C +273)	293
Ts = Shower water temperature	k (45C)	318
Us = water viscosity at Ts	centipoise	0.596
Ul = water viscosity at Tl	cp	1.002
Cwd = conc. leaving droplets after time sdt	ug/l	Solved by Eq 5
sdt = shower droplet drop time	sec	2
d = shower droplet diameter	mm	1
FR = shower water flow rate	l/min	20
SV = shower room air volume	m^3	3
S = indoor VOC generation rate	ug/m^3-min	Solved by Eq 6
VR = ventilation rate	l/min	13.8
Variables	**Units**	**Exposure Assumptions**
BW = body weight	kg	70
Ds = duration of shower	min	12
Dt = total duration in shower room	min	15
R = air exchange rate	min^{-1}	0.0083
Ca = indoor air concentration of VOCs	ug/m^3	Solved by Eq 7
Einh = inhalation exposure per shower	mg/kg/shower	Solved by Eq 8

Equation 1:	Kg(VOC) =	3000 * (18 / HH)$^{0.5}$	
Equation 2:	Kl(VOC) =	20 * (44 / HH)$^{0.5}$	
Equation 3:	KL =	((1 / Kl(VOC)) + (0.024 / (Kg (VOC) * H)))$^{-1}$	
Equation 4:	Kal =	(KL * (((Tl * Us) / (Ts * Ul))$^{-0.5}$))	
Equation 5:	Cwd =	(Cwo * (1-EXP((-1 * Kal * sdt)/(60 * d))))	
Equation 6:	S =	(Cwd * FR / SV)	
Equation 7:	see time series example on Table I-GW-5		
Equation 8:	**Einh =**	**If t>Ds**	(((VR * S) / (BW * R * 1000000)) * ((Ds + (EXP(-R * Dt) / R)-(EXP(R * (Ds - Dt))) / R)))

Henry's Law Constant from USEPA's *Superfund Public Health Evaluation Manual.* USEPA/540/1-86/060, October 1986.

TABLE 7.4.CT

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDANCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Upper Aquifer - Tap Water	Ingestion	Chloroform	2.8E+00	ug/L	2.3E-06	mg/kg/day	NA	NA	NA	2.4E-05	mg/kg/day	1.0E-02	mg/kg/day	2.4E-03
				Methyl-tert-butyl ether (MTBE)	4.7E+00	ug/L	3.8E-06	mg/kg/day	4.0E-03	1/mg/kg/day	1.5E-08	4.0E-05	mg/kg/day	NA	NA	NA
				Tetrachloroethene	1.8E+00	ug/L	1.5E-06	mg/kg/day	5.4E-01	1/mg/kg/day	7.9E-07	1.6E-05	mg/kg/day	1.0E-02	mg/kg/day	1.6E-03
				Arsenic	3.8E+00	ug/L	3.1E-06	mg/kg/day	1.5E+00	1/mg/kg/day	4.6E-06	3.2E-05	mg/kg/day	3.0E-04	mg/kg/day	1.1E-01
				Iron	2.4E+04	ug/L	2.0E-02	mg/kg/day	NA	NA	NA	2.1E-01	mg/kg/day	3.0E-01	mg/kg/day	6.9E-01
				Manganese	2.7E+03	ug/L	2.2E-03	mg/kg/day	NA	NA	NA	2.3E-02	mg/kg/day	2.0E-02	mg/kg/day	1.2E+00
			Exp. Route Total								5.4E-06					2.0E+00
	Exposure Medium Total										5.4E-06					2.0E+00
Groundwater - Upper Aquifer Tap Water Total											5.4E-06					2.0E+00
Soil*	Soil*	SWMU 7	Ingestion	Benzo(a)anthracene	2.9E-01	MG/KG	1.2E-08	mg/kg/day	7.3E-01	1/mg/kg/day	8.7E-09	NA	NA	NA	NA	NA
				Benzo(a)pyrene	3.0E-01	MG/KG	1.2E-08	mg/kg/day	7.3E+00	1/mg/kg/day	9.0E-08	NA	NA	NA	NA	NA
				Benzo(b)fluoranthene	5.9E-01	MG/KG	2.4E-08	mg/kg/day	7.3E-01	1/mg/kg/day	1.7E-08	NA	NA	NA	NA	NA
				Benzo(k)fluoranthene	5.3E-01	MG/KG	2.1E-08	mg/kg/day	7.3E-02	1/mg/kg/day	1.6E-09	NA	NA	NA	NA	NA
				Dibenz(a,h)anthracene	2.2E-01	MG/KG	9.0E-09	mg/kg/day	7.3E+00	1/mg/kg/day	6.6E-08	NA	NA	NA	NA	NA
				Indeno(1,2,3-cd)pyrene	3.6E-01	MG/KG	1.5E-08	mg/kg/day	7.3E-01	1/mg/kg/day	1.1E-08	NA	NA	NA	NA	NA
				Aluminum	3.5E+03	MG/KG	1.4E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Arsenic	2.3E+00	MG/KG	9.3E-08	mg/kg/day	1.5E+00	1/mg/kg/day	1.4E-07	NA	NA	NA	NA	NA
				Chromium	1.3E+01	MG/KG	5.1E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Copper	3.3E+01	MG/KG	1.4E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Iron	7.1E+03	MG/KG	2.9E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Manganese	9.8E+01	MG/KG	4.0E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Thallium	2.9E-01	MG/KG	1.2E-08	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Vanadium	1.1E+01	MG/KG	4.5E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								3.3E-07					0.0E+00

TABLE 7.4.CT

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDANCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal	Benzo(a)anthracene	2.9E-01	MG/KG	2.0E-08	mg/kg/day	7.3E-01	1/mg/kg/day	1.4E-08	NA	NA	NA	NA	NA
				Benzo(a)pyrene	3.0E-01	MG/KG	2.1E-08	mg/kg/day	7.3E+00	1/mg/kg/day	1.5E-07	NA	NA	NA	NA	NA
				Benzo(b)fluoranthene	5.9E-01	MG/KG	3.9E-08	mg/kg/day	7.3E-01	1/mg/kg/day	2.9E-08	NA	NA	NA	NA	NA
				Benzo(k)fluoranthene	5.3E-01	MG/KG	3.6E-08	mg/kg/day	7.3E-02	1/mg/kg/day	2.6E-09	NA	NA	NA	NA	NA
				Dibenz(a,h)anthracene	2.2E-01	MG/KG	1.5E-08	mg/kg/day	7.3E+00	1/mg/kg/day	1.1E-07	NA	NA	NA	NA	NA
				Indeno(1,2,3-cd)pyrene	3.6E-01	MG/KG	2.4E-08	mg/kg/day	7.3E-01	1/mg/kg/day	1.8E-08	NA	NA	NA	NA	NA
				Aluminum	3.5E+03	MG/KG	1.8E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Arsenic	2.3E+00	MG/KG	3.6E-08	mg/kg/day	1.5E+00	1/mg/kg/day	5.4E-08	NA	NA	NA	NA	NA
				Chromium	1.3E+01	MG/KG	6.6E-08	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Copper	3.3E+01	MG/KG	1.7E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Iron	7.1E+03	MG/KG	3.7E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Manganese	9.8E+01	MG/KG	5.1E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Thallium	2.9E-01	MG/KG	1.5E-09	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Vanadium	1.1E+01	MG/KG	5.7E-08	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								3.8E-07					0.0E+00
		Exposure Point Total									7.1E-07					0.0E+00
	Exposure Medium Total										7.1E-07					0.0E+00
Subsurface Soil Total											7.1E-07					0.0E+00
										Total of Receptor Risks Across All Media	6.1E-06				Total of Receptor Hazards Across All Media	2.0E+00

Soil* - Surface and subsurface soil combinec

NA = Not applicable.

TABLE 7.5.CT

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDANCY

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Upper Aquifer - Excavation Pit	Dermal	Chloroform	2.8E+00	ug/L	NA	NA	NA	NA	NA	2.2E-06	mg/kg/day	1.0E-02	mg/kg/day	2.2E-04
				Methyl-tert-butyl ether (MTBE)	4.7E+00	ug/L	NA	NA	NA	NA	NA	1.6E-06	mg/kg/day	NA	NA	NA
				Tetrachloroethene	1.8E+00	ug/L	NA	NA	NA	NA	NA	9.3E-06	mg/kg/day	1.0E-02	mg/kg/day	9.3E-04
				Arsenic	5.8E+00	ug/L	NA	NA	NA	NA	NA	6.8E-07	mg/kg/day	3.0E-04	mg/kg/day	2.3E-03
				Chromium	1.1E+01	ug/L	NA	NA	NA	NA	NA	2.5E-06	mg/kg/day	5.0E-04	mg/kg/day	5.0E-03
				Iron	2.8E+04	ug/L	NA	NA	NA	NA	NA	3.2E-03	mg/kg/day	3.0E-01	mg/kg/day	1.1E-02
				Manganese	2.6E+03	ug/L	NA	NA	NA	NA	NA	3.0E-04	mg/kg/day	8.0E-04	mg/kg/day	3.8E-01
				Vanadium	7.0E+00	ug/L	NA	NA	NA	NA	NA	8.2E-07	mg/kg/day	1.8E-04	mg/kg/day	4.6E-03
			Exp. Route Total								0.0E+00					4.0E-01
	Exposure Medium Total										0.0E+00					4.0E-01
Groundwater - Upper Aquifer Tap Water Total											0.0E+00					4.0E-01
										Total of Receptor Risks Across All Media	0.0E+00				Total of Receptor Hazards Across All Media	4.0E-01

Soil* - Surface and subsurface soil combinec

NA = Not applicable.

Notes-
DAevent for exposure to groundwater while bathing calculated on Table 7.5.CT Supplement A and E

Table 7.5.CT Supplement A
Calculation of DAevent
Construction Worker, Upper Aquifer Groundwater
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Chemical of Potential Concern	Groundwater Water Concentration (CW) (μg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
Chloroform	2.8E+00	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	4	7.5E-08	3
Methyl-tert-butyl ether (MTBE)	4.7E+00	NA	NA	NA	NA	NA	4	NA	
Tetrachloroethene	1.8E+00	3.3E-02	2.0E-01	9.1E-01	2.2E+00	1.0E+00	4	3.2E-07	3
Arsenic	5.8E+00	1.0E-03	NA	NA	NA	NA	4	2.3E-08	1
Chromium	1.1E+01	2.0E-03	NA	NA	NA	NA	4	8.5E-08	1
Iron	2.8E+04	1.0E-03	NA	NA	NA	NA	4	1.1E-04	1
Manganese	2.6E+03	1.0E-03	NA	NA	NA	NA	4	1.0E-05	1
Vanadium	7.0E+00	1.0E-03	NA	NA	NA	NA	4	2.8E-08	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =
tevent<t*: DAevent (mg/cm2-event) =
2 x FA x Kp x CW x (sqrt((6 x τ_{event} x tevent)/π)) x 0.001 mg/ug x 0.001 l/cm^3 (eq 2)

tevent>t*: DAevent (mg/cm2-event) =
FA x Kp x CW x (tevent/(1+B) + 2 x τ_{event} x ((1 + 3xB + $3xB^2$)/$(1+B)^2$) x 0.001 mg/ug x 0.001 l/cm3 (eq 3)

Notes:
Permeability constants from EPA 2001, Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R/99/005.
NA - not applicable.

Table 7.5b.CT Supplement
Calculation of DAevent
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Chemical	MW	log Kow	Kow	log Kp	Kp (cm/hr)	B	log Dsc/lsc	lsc (cm)	log Dsc	Dsc (cm^2/hr)	Tau (hr)	c	b	T* (hr)	Tevent (hr/event)	Medium EPC Value, Cv?	DAevent mg/(cm^2-event)
Methyl-tert-butyl ether (MTBE)	88.15	0.94	8.71E+00	-2.59E+00	2.57E-03	8.71E-04	-3.26E+00	1.00E-03	-6.26E+00	5.52E-07	3.02E-01	3.34E-01	3.04E-01	7.24E-01	4	4.69E+00	5.54E-08

Equations from *Dermal Exposure Assessment: Principles and Applications*. EPA/600/8-91/011B. January 1992.

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Receptor Population: Other Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Sediment	Surface Sediment	Desert Cove	Benzo(a)pyrene	1.1E-07	NA	3.0E-07	4.1E-07	NA	NA	NA	NA	0.0E+00
			Benzo(b)fluoranthene	2.3E-08	NA	6.1E-08	8.3E-08	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	2.0E-08	NA	5.4E-08	7.4E-08	NA	NA	NA	NA	0.0E+00
			Arsenic	1.3E-07	NA	7.9E-08	2.1E-07	Skin, Vascular	7.9E-04	NA	5.14E-04	1.3E-03
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	1.9E-03	NA	4.02E-04	2.3E-03
			Chemical Total	2.8E-07	0.0E+00	4.9E-07	7.7E-07		2.7E-03	0.0E+00	9.2E-04	3.6E-03
		Exposure Point Total					7.7E-07					3.6E-03
	Exposure Medium Total						7.7E-07					3.6E-03
Medium Total							7.7E-07					3.6E-03
Receptor Total							7.7E-07				Receptor HI Total	3.6E-03

HI - Hazard Index

NA - Not Applicable

Total Skin HI Across All Media =	1.3E-03
Total Vascular HI Across All Media =	1.3E-03
Total Gastrointestinal HI Across All Media =	2.3E-03

TABLE 9.2.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Receptor Population: Trespasser/Visitor
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Sediment	Surface Sediment	Desert Cove	Benzo(a)pyrene	2.3E-07	NA	6.2E-07	8.5E-07	NA	NA	NA	NA	0.0E+00
			Benzo(b)fluoranthene	4.7E-08	NA	1.3E-07	1.7E-07	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	4.2E-08	NA	1.1E-07	1.5E-07	NA	NA	NA	NA	0.0E+00
			Arsenic	2.7E-07	NA	1.6E-07	4.3E-07	Skin, Vascular	1.7E-03	NA	1.18E-03	2.9E-03
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	4.0E-03	NA	9.22E-04	5.0E-03
			Chemical Total	5.9E-07	0.0E+00	1.0E-06	1.6E-06		5.8E-03	0.0E+00	2.1E-03	7.9E-03
		Exposure Point Total					1.6E-06					7.9E-03
	Exposure Medium Total						1.6E-06					7.9E-03
Medium Total							1.6E-06					7.9E-03
Surface Soil	Surface Soil	SWMU 7	Benzo(a)pyrene	8.7E-08	NA	1.3E-07	2.2E-07	NA	NA	NA	NA	0.0E+00
			Aluminum	NA	NA	NA	0.0E+00	CNS	1.5E-03	NA	1.66E-04	1.6E-03
			Arsenic	4.4E-07	NA	1.6E-07	6.0E-07	Skin, Vascular	2.8E-03	NA	9.74E-04	3.8E-03
			Chromium	NA	NA	NA	0.0E+00	NOAEL	1.3E-03	NA	6.00E-03	7.3E-03
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	1.1E-02	NA	1.20E-03	1.2E-02
			Manganese	NA	NA	NA	0.0E+00	CNS	4.7E-03	NA	1.33E-02	1.8E-02
			Vanadium	NA	NA	NA	0.0E+00	Kidney	4.6E-03	NA	2.02E-02	2.5E-02
			Chemical Total	5.3E-07	0.0E+00	2.9E-07	8.2E-07		2.5E-02	0.0E+00	4.2E-02	6.7E-02
		Exposure Point Total					8.2E-07					6.7E-02
	Exposure Medium Total						8.2E-07					6.7E-02
Receptor Total							2.4E-06				Receptor HI Total	7.5E-02

HI - Hazard Index
CNS - Central Nervous System
NA - Not Applicable
NOAEL - No Observed Adverse Effect Level

Total Skin HI Across All Media =	6.7E-03
Total Vascular HI Across All Media =	6.7E-03
Total Gastrointestinal HI Across All Media =	1.7E-02
Total CNS HI Across All Media =	2.0E-02
Total NOAEL HI Across All Media =	7.3E-03
Total Kidney HI Across All Media =	2.5E-02

TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Receptor Population: Trespasser/Visitor
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Sediment	Surface Sediment	Desert Cove	Benzo(a)pyrene	1.2E-07	NA	3.4E-07	4.6E-07	NA	NA	NA	NA	0.0E+00
			Benzo(b)fluoranthene	2.4E-08	NA	6.9E-08	9.3E-08	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	2.2E-08	NA	6.2E-08	8.3E-08	NA	NA	NA	NA	0.0E+00
			Arsenic	1.4E-07	NA	9.0E-08	2.3E-07	Skin, Vascular	2.4E-03	NA	1.56E-03	3.9E-03
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	5.5E-03	NA	1.22E-03	6.8E-03
			Chemical Total	3.0E-07	0.0E+00	5.6E-07	8.6E-07		7.9E-03	0.0E+00	2.8E-03	1.1E-02
		Exposure Point Total					8.6E-07					1.1E-02
	Exposure Medium Total						8.6E-07					1.1E-02
Medium Total							8.6E-07					1.1E-02
Surface Soil	Surface Soil	SWMU 7	Benzo(a)pyrene	4.5E-08	NA	5.3E-08	9.8E-08	NA	NA	NA	NA	0.0E+00
			Aluminum	NA	NA	NA	0.0E+00	CNS	2.0E-03	NA	1.84E-04	2.2E-03
			Arsenic	2.3E-07	NA	6.2E-08	2.9E-07	Skin, Vascular	3.9E-03	NA	1.08E-03	5.0E-03
			Chromium	NA	NA	NA	0.0E+00	NOAEL	1.8E-03	NA	6.64E-03	8.4E-03
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	1.4E-02	NA	1.33E-03	1.6E-02
			Manganese	NA	NA	NA	0.0E+00	CNS	6.4E-03	NA	1.48E-02	2.1E-02
			Vanadium	NA	NA	NA	0.0E+00	Kidney	6.3E-03	NA	2.23E-02	2.9E-02
			Chemical Total	2.7E-07	0.0E+00	1.2E-07	3.9E-07		3.5E-02	0.0E+00	4.6E-02	8.1E-02
		Exposure Point Total					3.9E-07					8.1E-02
	Exposure Medium Total						3.9E-07					8.1E-02
Receptor Total							1.2E-06				Receptor HI Total	9.2E-02

HI - Hazard Index
CNS - Central Nervous System
NA - Not Applicable
NOAEL - No Observed Adverse Effect Level

Total Skin HI Across All Media =	8.9E-03
Total Vascular HI Across All Media =	8.9E-03
Total Gastrointestinal HI Across All Media =	2.3E-02
Total CNS HI Across All Media =	2.3E-02
Total NOAEL HI Across All Media =	8.4E-03
Total Kidney Across All Media =	2.9E-02

TABLE 9.4.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Current
Receptor Population: Maintenance Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 7	Benzo(a)pyrene	4.2E-08	NA	3.6E-08	7.7E-08	NA	NA	NA	NA	0.0E+00
			Aluminum	NA	NA	NA	0.0E+00	CNS	6.7E-04	NA	4.45E-05	7.2E-04
			Arsenic	2.1E-07	NA	4.2E-08	2.5E-07	Skin, Vascular	1.3E-03	NA	2.60E-04	1.6E-03
			Chromium	NA	NA	NA	0.0E+00	NOAEL	6.1E-04	NA	1.60E-03	2.2E-03
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	4.9E-03	NA	3.21E-04	5.2E-03
			Manganese	NA	NA	NA	0.0E+00	CNS	2.2E-03	NA	3.56E-03	5.7E-03
			Vanadium	NA	NA	NA	0.0E+00	Kidney	2.1E-03	NA	5.39E-03	7.5E-03
			Chemical Total	2.5E-07	0.0E+00	7.8E-08	3.3E-07		1.2E-02	0.0E+00	1.1E-02	2.3E-02
		Exposure Point Total					3.3E-07					2.3E-02
	Exposure Medium Total						3.3E-07					2.3E-02
Receptor Total							3.3E-07				Receptor HI Total	2.3E-02

HI - Hazard Index
CNS - Central Nervous System
NA - Not Applicable
NOAEL - No Observed Adverse Effect Level

Total Skin HI Across All Media =	1.6E-03
Total Vascular HI Across All Media =	1.6E-03
Total Gastrointestinal HI Across All Media =	5.2E-03
Total CNS HI Across All Media =	6.4E-03
Total NOAEL HI Across All Media =	2.2E-03
Total Kidney HI Across All Media =	7.5E-03

TABLE 9.5.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Trespasser/Visitor
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment*	Sediment*	Desert Cove	Benzo(a)pyrene	2.3E-07	NA	6.9E-07	9.2E-07	NA	NA	NA	NA	0.0E+00
			Dibenz(b)fluoranthene	3.7E-08	NA	1.1E-07	1.5E-07	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	3.9E-08	NA	1.2E-07	1.5E-07	NA	NA	NA	NA	0.0E+00
			Arsenic	2.2E-07	NA	1.5E-07	3.8E-07	Skin, Vascular	1.4E-03	NA	9.88E-04	2.4E-03
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	4.1E-03	NA	9.43E-04	5.1E-03
			Chemical Total	5.3E-07	0.0E+00	1.1E-06	1.6E-06		5.6E-03	0.0E+00	1.9E-03	7.5E-03
		Exposure Point Total					1.6E-06					7.5E-03
	Exposure Medium Total						1.6E-06					7.5E-03
Medium Total							1.6E-06					7.5E-03
Receptor Total							1.6E-06				Receptor HI Total	7.5E-03

HI - Hazard Index

NA - Not Applicable

Sediment*- Surface and subsurface sediment combined.

Total Skin HI Across All Media =	2.4E-03
Total Vascular HI Across All Media =	2.4E-03
Total Gastrointestinal HI Across All Media =	5.1E-03

TABLE 9.6.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Trespasser/Visitor
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment*	Sediment*	Desert Cove	Benzo(a)pyrene	1.2E-07	NA	3.4E-07	4.6E-07	NA	NA	NA	NA	0.0E+00
			Dibenz(b)fluoranthene	1.9E-08	NA	5.5E-08	7.4E-08	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	2.0E-08	NA	5.7E-08	7.8E-08	NA	NA	NA	NA	0.0E+00
			Arsenic	1.1E-07	NA	7.6E-08	1.9E-07	Skin, Vascular	2.0E-03	NA	1.31E-03	3.3E-03
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	5.7E-03	NA	1.25E-03	6.9E-03
			Chemical Total	2.7E-07	0.0E+00	5.3E-07	8.0E-07		7.7E-03	0.0E+00	2.6E-03	1.0E-02
		Exposure Point Total					8.0E-07					1.0E-02
	Exposure Medium Total						8.0E-07					1.0E-02
Medium Total							8.0E-07					1.0E-02
Receptor Total							8.0E-07				Receptor HI Total	1.0E-02

HI - Hazard Index

NA - Not Applicable

Sediment*- Surface and subsurface sediment combined.

Total Skin HI Across All Media =	3.3E-03
Total Vascular HI Across All Media =	3.3E-03
Total Gastrointestinal HI Across All Media =	6.9E-03

TABLE 9.7.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Maintenance Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment*	Sediment*	Desert Cove	Benzo(a)pyrene	4.6E-08	NA	1.2E-07	1.7E-07	NA	NA	NA	NA	0.0E+00
			Dibenz(b)fluoranthene	7.5E-09	NA	2.0E-08	2.8E-08	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	7.8E-09	NA	2.1E-08	2.9E-08	NA	NA	NA	NA	0.0E+00
			Arsenic	4.5E-08	NA	2.8E-08	7.2E-08	Skin, Vascular	2.8E-04	NA	1.72E-04	4.5E-04
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	8.0E-04	NA	1.64E-04	9.6E-04
			Chemical Total	1.1E-07	0.0E+00	1.9E-07	3.0E-07		1.1E-03	0.0E+00	3.4E-04	1.4E-03
		Exposure Point Total					3.0E-07					1.4E-03
	Exposure Medium Total						3.0E-07					1.4E-03
Medium Total							3.0E-07					1.4E-03
Receptor Total							3.0E-07				Receptor HI Total	1.4E-03

HI - Hazard Index

NA - Not Applicable

Sediment*- Surface and subsurface sediment combined.

Total Skin HI Across All Media =	4.5E-04
Total Vascular HI Across All Media =	4.5E-04
Total Gastrointestinal HI Across All Media =	9.6E-04

TABLE 9.8.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Other Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment*	Sediment*	Desert Cove	Benzo(a)pyrene	1.1E-07	NA	3.0E-07	4.1E-07	NA	NA	NA	NA	0.0E+00
			Dibenz(b)fluoranthene	1.8E-08	NA	4.8E-08	6.6E-08	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	1.9E-08	NA	5.0E-08	6.9E-08	NA	NA	NA	NA	0.0E+00
			Arsenic	1.1E-07	NA	6.6E-08	1.7E-07	Skin, Vascular	6.7E-04	NA	4.13E-04	1.1E-03
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	1.9E-03	NA	3.95E-04	2.3E-03
			Chemical Total	2.6E-07	0.0E+00	4.6E-07	7.2E-07		2.6E-03	0.0E+00	8.1E-04	3.4E-03
		Exposure Point Total					7.2E-07					3.4E-03
	Exposure Medium Total						7.2E-07					3.4E-03
Medium Total							7.2E-07					3.4E-03
Receptor Total							7.2E-07				Receptor HI Total	3.4E-03

HI - Hazard Index
NA - Not Applicable
Sediment*- Surface and subsurface sediment combined.

Total Skin HI Across All Media =	1.1E-03
Total Vascular HI Across All Media =	1.1E-03
Total Gastrointestinal HI Across All Media =	2.3E-03

TABLE 9.9.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Upper Aquifer - Tap Water	Chloroform	NA	NA	NA	0.0E+00	Liver	3.4E-02	NA	3.1E-03	3.8E-02
			Methyl-tert-butyl ether (MTBE)	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Tetrachloroethene	NA	NA	NA	0.0E+00	Liver, Whole Body	1.4E-02	NA	8.2E-03	2.2E-02
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	1.1E+00	NA	5.9E-03	1.1E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	4.8E+00	NA	2.5E-02	4.8E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	8.1E+00	NA	1.1E+00	9.2E+00
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		1.4E+01	0.0E+00	1.1E+00	1.5E+01
		Exposure Point Total					0.0E+00					1.5E+01
	Exposure Medium Total						0.0E+00					1.5E+01
	Air	Upper Aquifer - Water vapors at Showerhead	Chloroform	NA	NA	NA	0.0E+00	Liver, Kidney	NA	4.6E-02	NA	4.6E-02
			Methyl-tert-butyl ether (MTBE)	NA	NA	NA	0.0E+00	NOAEL	NA	1.4E-03	NA	1.4E-03
			Tetrachloroethene	NA	NA	NA	0.0E+00	Liver, Whole Body	NA	1.7E-03	NA	1.7E-03
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	4.9E-02	0.0E+00	4.9E-02
		Exposure Point Total					0.0E+00					4.9E-02
	Exposure Medium Total						0.0E+00					4.9E-02
Medium Total							0.0E+00					1.5E+01
Soil*	Soil*	SWMU 7	Benzo(a)anthracene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Benzo(a)pyrene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Benzo(b)fluoranthene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Benzo(k)fluoranthene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Indeno(1,2,3-cd)pyrene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Aluminum	NA	NA	NA	0.0E+00	CNS	6.1E-03	NA	8.1E-04	7.0E-03
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	2.4E-02	NA	9.4E-03	3.3E-02
			Chromium	NA	NA	NA	0.0E+00	NOAEL	7.4E-03	NA	3.9E-02	4.6E-02
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	2.2E-03	NA	2.9E-04	2.5E-03
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	4.4E-02	NA	5.8E-03	4.9E-02
			Manganese	NA	NA	NA	0.0E+00	CNS	1.1E-02	NA	3.7E-02	4.8E-02
			Thallium	NA	NA	NA	0.0E+00	Liver, Blood, Hair	7.5E-03	NA	9.9E-04	8.5E-03
			Vanadium	NA	NA	NA	0.0E+00	Kidney	1.9E-02	NA	9.7E-02	1.2E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		1.2E-01	0.0E+00	1.9E-01	3.1E-01
		Exposure Point Total					0.0E+00					3.1E-01

TABLE 9.9.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Exposure Medium Total						0.0E+00					3.1E-01
Medium Total							0.0E+00					3.1E-01
Receptor Total							0.0E+00				Receptor HI Total	1.6E+01

Soil* - Surface and subsurface soil combined

HI - Hazard Index

CNS - Central Nervous System

NA - Not Applicable

NOAEL - No Observed Adverse Effect Level

Total CNS HI Across All Media =	9.2E+00
Total Skin HI Across All Media =	1.2E+00
Total Vascular HI Across All Media =	1.2E+00
Total Blood HI Across All Media =	8.5E-03
Total Liver HI Across All Media =	1.2E-01
Total Hair HI Across All Media =	8.5E-03
Total NOAEL Across All Media =	4.8E-02
Total Gastrointestinal HI Across All Media =	4.9E+00
Total Kidney HI Across All Media =	1.6E-01
Total Whole Body HI Across All Media =	2.4E-02

TABLE 9.10.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Upper Aquifer - Tap Water	Chloroform	NA	NA	NA	0.0E+00	Liver	8.0E-02	NA	5.4E-03	8.6E-02
			Methyl-tert-butyl ether (MTBE)	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Tetrachloroethene	NA	NA	NA	0.0E+00	Liver, Whole Body	3.2E-02	NA	1.4E-02	4.6E-02
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	2.6E+00	NA	1.0E-02	2.6E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	1.1E+01	NA	4.3E-02	1.1E+01
			Manganese	NA	NA	NA	0.0E+00	CNS	1.9E+01	NA	1.8E+00	2.1E+01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		3.3E+01	0.0E+00	1.9E+00	3.5E+01
		Exposure Point Total					0.0E+00					3.5E+01
	Exposure Medium Total						0.0E+00					3.5E+01
Medium Total							0.0E+00					3.5E+01
Soil*	Soil*	SWMU 7	Benzo(a)anthracene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Benzo(a)pyrene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Benzo(b)fluoranthene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Benzo(k)fluoranthene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Indeno(1,2,3-cd)pyrene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Aluminum	NA	NA	NA	0.0E+00	CNS	5.7E-02	NA	1.1E-03	5.8E-02
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	2.2E-01	NA	1.2E-02	2.3E-01
			Chromium	NA	NA	NA	0.0E+00	NOAEL	6.9E-02	NA	5.2E-02	1.2E-01
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	2.0E-02	NA	3.8E-04	2.1E-02
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	4.1E-01	NA	7.6E-03	4.1E-01
			Manganese	NA	NA	NA	0.0E+00	CNS	1.0E-01	NA	4.9E-02	1.5E-01
			Thallium	NA	NA	NA	0.0E+00	Liver, Blood, Hair	7.0E-02	NA	1.3E-03	7.2E-02
			Vanadium	NA	NA	NA	0.0E+00	Kidney	1.8E-01	NA	1.3E-01	3.1E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		1.1E+00	0.0E+00	2.5E-01	1.4E+00
		Exposure Point Total					0.0E+00					1.4E+00
	Exposure Medium Total						0.0E+00					1.4E+00
Medium Total							0.0E+00					1.4E+00
Receptor Total							0.0E+00				Receptor HI Total	3.6E+01

Soil* - Surface and subsurface soil combined
HI - Hazard Index
CNS - Central Nervous System
NA - Not Applicable

Total CNS HI Across All Media =	2.1E+01
Total Skin HI Across All Media =	2.9E+00
Total Vascular HI Across All Media =	2.9E+00

TABLE 9.10.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total

NOAEL - No Observed Adverse Effect Level

Total Blood HI Across All Media =	7.2E-02
Total Liver HI Across All Media =	2.0E-01
Total Hair HI Across All Media =	7.2E-02
Total NOAEL Across All Media =	1.2E-01
Total Gastrointestinal HI Across All Media =	1.2E+01

TABLE 9.11.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Upper Aquifer - Tap Water	Chloroform	NA	NA	NA	0.0E+00	Liver	NA	NA	NA	0.0E+00
			Methyl-tert-butyl ether (MTBE)	1.5E-06	NA	4.0E-08	1.5E-06	NA	NA	NA	NA	0.0E+00
			Tetrachloroethene	4.0E-05	NA	2.4E-05	6.4E-05	Liver, Whole Body	NA	NA	NA	0.0E+00
			Arsenic	2.8E-04	NA	1.6E-06	2.8E-04	Skin, Vascular	NA	NA	NA	0.0E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	NA	0.0E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	NA	NA	NA	0.0E+00
			Chemical Total	3.2E-04	0.0E+00	2.5E-05	3.4E-04		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					3.4E-04					0.0E+00
	Exposure Medium Total						3.4E-04					0.0E+00
	Air	Upper Aquifer - Water vapors at Showerhead	Chloroform	NA	1.8E-05	NA	1.8E-05	Liver, Kidney	NA	NA	NA	0.0E+00
			Methyl-tert-butyl ether (MTBE)	NA	NA	NA	0.0E+00	NOAEL	NA	NA	NA	0.0E+00
			Tetrachloroethene	NA	1.6E-06	NA	1.6E-06	Liver, Whole Body	NA	NA	NA	0.0E+00
			Chemical Total	0.0E+00	2.0E-05	0.0E+00	2.0E-05		0.0E+00	NA	0.0E+00	0.0E+00
		Exposure Point Total					2.0E-05					0.0E+00
	Exposure Medium Total						2.0E-05					0.0E+00
Medium Total							3.6E-04					0.0E+00
Soil*	Soil*	SWMU 7	Benzo(a)anthracene	1.7E-06	NA	1.2E-06	2.9E-06	NA	NA	NA	NA	0.0E+00
			Benzo(a)pyrene	2.0E-05	NA	1.4E-05	3.3E-05	NA	NA	NA	NA	0.0E+00
			Benzo(b)fluoranthene	4.2E-06	NA	2.9E-06	7.0E-06	NA	NA	NA	NA	0.0E+00
			Benzo(k)fluoranthene	3.8E-07	NA	2.6E-07	6.3E-07	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	1.5E-06	NA	1.0E-06	2.5E-06	NA	NA	NA	NA	0.0E+00
			Indeno(1,2,3-cd)pyrene	2.4E-06	NA	1.6E-06	4.0E-06	NA	NA	NA	NA	0.0E+00
			Aluminum	NA	NA	NA	0.0E+00	CNS	NA	NA	NA	0.0E+00
			Arsenic	1.2E-05	NA	1.9E-06	1.4E-05	Skin, Vascular	NA	NA	NA	0.0E+00
			Chromium	NA	NA	NA	0.0E+00	NOAEL	NA	NA	NA	0.0E+00
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	NA	0.0E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	NA	0.0E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	NA	NA	NA	0.0E+00
			Thallium	NA	NA	NA	0.0E+00	Liver, Blood, Hair	NA	NA	NA	0.0E+00
			Vanadium	NA	NA	NA	0.0E+00	Kidney	NA	NA	NA	0.0E+00
			Chemical Total	4.2E-05	0.0E+00	2.2E-05	6.5E-05		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					6.5E-05					0.0E+00

TABLE 9.11.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Exposure Medium Total						6.5E-05					0.0E+00
Medium Total							6.5E-05					0.0E+00
Receptor Total							4.3E-04				Receptor HI Total	0.0E+00

Soil* - Surface and subsurface soil combined

HI - Hazard Index

CNS - Central Nervous System

NA - Not Applicable

NOAEL - No Observed Adverse Effect Level

TABLE 10.1.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Upper Aquifer - Tap Water	Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	1.1E+00	NA	3.1E-03	1.1E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	4.8E+00	NA	3.1E-03	4.8E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	8.1E+00	NA	3.1E-03	8.1E+00
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		1.4E+01	0.0E+00	9.4E-03	1.4E+01
		Exposure Point Total					0.0E+00					1.4E+01
	Exposure Medium Total						0.0E+00					1.4E+01
Medium Total							0.0E+00					1.4E+01
Receptor Total							0.0E+00				Receptor HI Total	1.4E+01

HI - Hazard Index
CNS - Central Nervous System
NA - Not Applicable
NOAEL - No Observed Adverse Effect Level

Total CNS HI Across All Media =	8.1E+00
Total Skin HI Across All Media =	1.1E+00
Total Vascular HI Across All Media =	1.1E+00
Total Gastrointestinal HI Across All Media =	4.8E+00

TABLE 10.2.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Upper Aquifer - Tap Water	Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	2.6E+00	NA	1.0E-02	2.6E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	1.1E+01	NA	4.3E-02	1.1E+01
			Manganese	NA	NA	NA	0.0E+00	CNS	1.9E+01	NA	1.8E+00	2.1E+01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		3.3E+01	0.0E+00	1.9E+00	3.5E+01
		Exposure Point Total					0.0E+00					3.5E+01
	Exposure Medium Total						0.0E+00					3.5E+01
Medium Total							0.0E+00					3.5E+01
Soil*	Soil*	SWMU 7	Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	2.2E-01	NA	1.2E-02	2.3E-01
			Chromium	NA	NA	NA	0.0E+00	NOAEL	6.9E-02	NA	5.2E-02	1.2E-01
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	4.1E-01	NA	7.6E-03	4.1E-01
			Manganese	NA	NA	NA	0.0E+00	CNS	1.0E-01	NA	4.9E-02	1.5E-01
			Vanadium	NA	NA	NA	0.0E+00	Kidney	1.8E-01	NA	1.3E-01	3.1E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		9.8E-01	0.0E+00	2.5E-01	1.2E+00
		Exposure Point Total					0.0E+00					1.2E+00
	Exposure Medium Total						0.0E+00					1.2E+00
Medium Total							0.0E+00					1.2E+00
Receptor Total							0.0E+00				Receptor HI Total	3.6E+01

Soil* - Surface and subsurface soil combined
HI - Hazard Index
CNS - Central Nervous System
NA - Not Applicable
NOAEL - No Observed Adverse Effect Level

Total CNS HI Across All Media =	2.1E+01
Total Skin HI Across All Media =	2.9E+00
Total Vascular HI Across All Media =	2.9E+00
Total NOAEL Across All Media =	1.2E-01
Total Gastrointestinal HI Across All Media =	1.2E+01
Total Kidney HI Across All Media =	3.1E-01

TABLE 10.3.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Upper Aquifer - Tap Water	Methyl-tert-butyl ether (MTBE)	1.5E-06	NA	4.0E-08	1.5E-06	NA	NA	NA	NA	0.0E+00
			Tetrachloroethene	4.0E-05	NA	2.4E-05	6.4E-05	Liver, Whole Body	NA	NA	NA	0.0E+00
			Arsenic	2.8E-04	NA	1.6E-06	2.8E-04	Skin, Vascular	NA	NA	NA	0.0E+00
			Chemical Total	3.2E-04	NA	2.5E-05	3.4E-04		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					3.4E-04					0.0E+00
	Exposure Medium Total						3.4E-04					0.0E+00
	Air	Upper Aquifer - Water vapors at Showerhead	Chloroform	NA	1.8E-05	NA	1.8E-05	Liver, Kidney	NA	NA	NA	0.0E+00
			Tetrachloroethene	NA	1.6E-06	NA	1.6E-06	Liver, Whole Body	NA	NA	NA	0.0E+00
			Chemical Total	0.0E+00	2.0E-05	0.0E+00	2.0E-05		0.0E+00	NA	0.0E+00	0.0E+00
		Exposure Point Total					2.0E-05					0.0E+00
	Exposure Medium Total						2.0E-05					0.0E+00
Medium Total							3.6E-04					0.0E+00
Soil*	Soil*	SWMU 7	Benzo(a)anthracene	1.7E-06	NA	1.2E-06	2.9E-06	NA	NA	NA	NA	0.0E+00
			Benzo(a)pyrene	2.0E-05	NA	1.4E-05	3.3E-05	NA	NA	NA	NA	0.0E+00
			Benzo(b)fluoranthene	4.2E-06	NA	2.9E-06	7.0E-06	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	1.5E-06	NA	1.0E-06	2.5E-06	NA	NA	NA	NA	0.0E+00
			Indeno(1,2,3-cd)pyrene	2.4E-06	NA	1.6E-06	4.0E-06	NA	NA	NA	NA	0.0E+00
			Arsenic	1.2E-05	NA	1.9E-06	1.4E-05	Skin, Vascular	NA	NA	NA	0.0E+00
			Chemical Total	4.2E-05	0.0E+00	2.2E-05	6.4E-05		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					6.4E-05					0.0E+00
	Exposure Medium Total						6.4E-05					0.0E+00
Medium Total							6.4E-05					0.0E+00
Receptor Total							4.3E-04				Receptor HI Total	0.0E+00

Soil* - Surface and subsurface soil combined
HI - Hazard Index
CNS - Central Nervous System
NA - Not Applicable
NOAEL - No Observed Adverse Effect Level

TABLE 10.4.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Upper Aquifer - Tap Water	Tetrachloroethene	9.4E-06	NA	NA	9.4E-06	Liver, Whole Body	NA	NA	NA	0.0E+00
			Arsenic	6.4E-05	NA	NA	6.4E-05	Skin, Vascular	4.0E-01	NA	NA	4.0E-01
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	1.7E+00	NA	NA	1.7E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	2.9E+00	NA	NA	2.9E+00
			Chemical Total	6.4E-05	0.0E+00	0.0E+00	6.4E-05		5.0E+00	0.0E+00	0.0E+00	5.0E+00
		Exposure Point Total					6.4E-05					5.0E+00
	Exposure Medium Total						6.4E-05					5.0E+00
Medium Total							6.4E-05					5.0E+00
Soil*	Soil*	SWMU 7	Benzo(a)anthracene	3.9E-07	NA	8.5E-07	1.2E-06	NA	NA	NA	NA	0.0E+00
			Benzo(a)pyrene	4.4E-06	NA	9.7E-06	1.4E-05	NA	NA	NA	NA	0.0E+00
			Benzo(b)fluoranthene	9.3E-07	NA	2.0E-06	3.0E-06	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	3.3E-07	NA	7.2E-07	1.0E-06	NA	NA	NA	NA	0.0E+00
			Indeno(1,2,3-cd)pyrene	5.3E-07	NA	1.2E-06	1.7E-06	NA	NA	NA	NA	0.0E+00
			Arsenic	2.7E-06	NA	1.4E-06	4.1E-06	NA	NA	NA	NA	0.0E+00
			Vanadium	NA	NA	NA	0.0E+00	Kidney	1.4E-02	NA	8.9E-02	1.0E-01
			Chemical Total	9.3E-06	0.0E+00	1.6E-05	2.5E-05		1.4E-02	0.0E+00	8.9E-02	1.0E-01
		Exposure Point Total					2.5E-05					1.0E-01
	Exposure Medium Total						2.5E-05					1.0E-01
Medium Total							2.5E-05					1.0E-01
Receptor Total							9.0E-05				Receptor HI Total	5.1E+00

Soil* - Surface and subsurface soil combined
HI - Hazard Index
CNS - Central Nervous System
NA - Not Applicable
NOAEL - No Observed Adverse Effect Level

Total CNS HI Across All Media =	2.9E+00
Total Skin HI Across All Media =	4.0E-01
Total Vascular HI Across All Media =	4.0E-01
Total Gastrointestinal HI Across All Media =	1.7E+00
Total Kidney HI Across All Media =	1.0E-01

TABLE 10.5.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Upper Aquifer - Excavation Pit	Manganese	NA	NA	NA	0.0E+00	CNS	NA	NA	1.7E+00	1.7E+00
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00	1.7E+00	1.7E+00
		Exposure Point Total					0.0E+00					1.7E+00
	Exposure Medium Total						0.0E+00					1.7E+00
Medium Total							0.0E+00					1.7E+00
Receptor Total							0.0E+00				Receptor HI Total	1.7E+00

HI - Hazard Index
CNS - Central Nervous System
NA - Not Applicable
NOAEL - No Observed Adverse Effect Level

Total CNS HI Across All Media = 1.7E+00

TABLE 10.1.CT
RISK SUMMARY
CENTRAL TENDENCY
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Upper Aquifer - Tap Water	Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	1.6E-01	NA	5.2E-04	1.6E-01
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	5.5E-01	NA	1.8E-03	5.5E-01
			Manganese	NA	NA	NA	0.0E+00	CNS	8.1E-01	NA	6.5E-02	8.8E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		1.5E+00	0.0E+00	6.8E-02	1.6E+00
		Exposure Point Total					0.0E+00					1.6E+00
	Exposure Medium Total						0.0E+00					1.6E+00
Receptor Total							0.0E+00				Receptor HI Total	1.6E+00

HI - Hazard Index
CNS - Central Nervous System
NA - Not Applicable

Total CNS HI Across All Media =	8.8E-01
Total Skin HI Across All Media =	1.6E-01
Total Vascular HI Across All Media =	1.6E-01
Total Gastrointestinal HI Across All Media =	5.5E-01

TABLE 10.2.CT
RISK SUMMARY
CENTRAL TENDENCY
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Upper Aquifer - Tap Water	Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	5.4E-01	NA	8.9E-04	5.4E-01
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	1.8E+00	NA	3.0E-03	1.8E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	2.7E+00	NA	1.1E-01	2.8E+00
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		5.1E+00	0.0E+00	1.2E-01	5.2E+00
		Exposure Point Total					0.0E+00					5.2E+00
	Exposure Medium Total						0.0E+00					5.2E+00
Medium Total							0.0E+00					5.2E+00
Receptor Total							0.0E+00				Receptor HI Total	5.2E+00

HI - Hazard Index
CNS - Central Nervous System
NA - Not Applicable

Total CNS HI Across All Media =	2.8E+00
Total Skin HI Across All Media =	5.4E-01
Total Vascular HI Across All Media =	5.4E-01
Total Gastrointestinal HI Across All Media =	1.8E+00

TABLE 10.3.CT
RISK SUMMARY
CENTRAL TENDENCY
SWMU 7
NAB Little Creek, Virginia Beach, Virginia

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Upper Aquifer - Tap Water	Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	1.1E-01	NA	NA	1.1E-01
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	3.7E-01	NA	NA	3.7E-01
			Manganese	NA	NA	NA	0.0E+00	CNS	5.4E-01	NA	NA	5.4E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		1.0E+00	0.0E+00	0.0E+00	1.0E+00
		Exposure Point Total					0.0E+00					1.0E+00
	Exposure Medium Total						0.0E+00					1.0E+00
Medium Total							0.0E+00					1.0E+00
Receptor Total							0.0E+00				Receptor HI Total	1.0E+00

HI - Hazard Index
CNS - Central Nervous System
NA - Not Applicable

Total CNS HI Across All Media =	5.4E-01
Total Skin HI Across All Media =	1.1E-01
Total Vascular HI Across All Media =	1.1E-01
Total Gastrointestinal HI Across All Media =	3.7E-01

Table 9 - Calculations of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 05/19/03

Exposure Variable	PbB Equation[1] 1*	PbB Equation[1] 2**	Description of Exposure Variable	Units	Values for Non-Residential Exposure Scenario: Using Equation 1, GSDi = Hom	Using Equation 1, GSDi = Het	Using Equation 2, GSDi = Hom	Using Equation 2, GSDi = Het
PbS	X	X	Soil lead concentration	ug/g or ppm	51	51	750	750
$R_{fetal/maternal}$	X	X	Fetal/maternal PbB ratio	--	0.9	0.9	0.9	0.9
BKSF	X	X	Biokinetic Slope Factor	ug/dL per ug/day	0.4	0.4	0.4	0.4
GSD_i	X	X	Geometric standard deviation PbB	--	2.1	2.3	2.1	2.3
PbB_0	X	X	Baseline PbB	ug/dL	1.5	1.7	1.5	1.7
IR_S	X		Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050	0.050	--	--
IR_{S+D}		X	Total ingestion rate of outdoor soil and indoor dust	g/day	--	--	0.050	0.050
W_S		X	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--	--	1.0	1.0
K_{SD}		X	Mass fraction of soil in dust	--	--	--	0.7	0.7
$AF_{S,D}$	X	X	Absorption fraction (same for soil and dust)	--	0.12	0.12	0.12	0.12
$EF_{S,D}$	X	X	Exposure frequency (same for soil and dust)	days/yr	219	219	219	219
$AT_{S,D}$	X	X	Averaging time (same for soil and dust)	days/yr	365	365	365	365
PbB_{adult}	**PbB of adult worker, geometric mean**			**ug/dL**	**1.6**	**1.8**	**2.6**	**2.8**
$PbB_{fetal,0.95}$	**95th percentile PbB among fetuses of adult workers**			**ug/dL**	**4.8**	**6.3**	**7.9**	**9.8**
PbB_t	**Target PbB level of concern (e.g., 10 ug/dL)**			**ug/dL**	**10.0**	**10.0**	**10.0**	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**			**%**	**0.4%**	**1.4%**	**2.5%**	**4.8%**

[1] Equation 1 does not apportion exposure between soil and dust ingestion (excludes W_S, K_{SD}).
When $IR_S = IR_{S+D}$ and $W_S = 1.0$, the equations yield the same $PbB_{fetal,0.95}$.

***Equation 1, based on Eq. 1, 2 in USEPA (1996).**

PbB_{adult} =	$(PbS*BKSF*IR_{S+D}*AF_{S,D}*EF_S/AT_{S,D}) + PbB_0$
$PbB_{fetal,0.95}$ =	$PbB_{adult} * (GSD_i^{1.645} * R)$

****Equation 2, alternate approach based on Eq. 1, 2, and A-19 in USEPA (1996).**

PbB_{adult} =	$PbS*BKSF*([(IR_{S+D})*AF_S*EF_S*W_S]+[K_{SD}*(IR_{S+D})*(1-W_S)*AF_D*EF_D])/365+PbB_0$
$PbB_{fetal,0.95}$ =	$PbB_{adult} * (GSD_i^{1.645} * R)$

Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil

Table 11.1

COPCs Comparison to Background - Filtered Groundwater, Upper Aquifer

SWMU 7

NAB Little Creek, Virginia Beach, Virginia

CAS Number	Chemical	Maximum [1] Concentration (ug/L)	Maximum Qualifier	Distribution of SWMU 7 Data	Background [2] Value (ug/L)	Distribution of Background Data	Max. Site Conc. greater than Background UTL?	Site greater than Background (MWU)
Filtered - Potable Use								
7440-38-2	Arsenic	1.23E+01		NP	6.90E+01	NP	NO	NO
7439-89-6	Iron	5.28E+04		Lognormal	2.98E+04	NP	YES	YES
7439-96-5	Manganese	5.91E+03		Lognormal	1.51E+03	NP	YES	YES
Unfiltered - Construction Worker								
7439-96-5	Manganese	5.71E+03		Lognormal	1.50E+03	NP	YES	YES

Notes

[1] Maximum detected concentration.

[2] Background values are UTL from Final Background Investigation for Naval Amphibiuous Base Little Creek, Virginia Beach, Virginia (CH2M Hill, December 2000)

Definitions

COPC = Chemical of Potential Concern

NP = Nonparametric

MWU = Mann-Whitney U test (Table 11.2a)

Table 11.1a
Comparison of Filtered Groundwater Sample Concentrations to Background Concentration
Using Mann-Whitney U Test
SWMU7
NAB Little Creek, Virginia Beach, Virginia

	Number of Samples	Concentration (ug/l)	Rank	Sum Ranks (R and R')	U and U'	z	p	Decision	
Arsenic - filtered									
Site	9	1.55	5	69	66	1.71	0.0436	accept	site < background
		6.4	15						
		1.55	5						
		1.25	2						
		1.55	5						
		7	16						
		1.25	2						
		12.3	17						
		1.25	2						
Background	10	1.9	10	121	24				
		1.9	10						
		1.9	10						
		1.9	10						
		5.4	14						
		1.9	10						
		69.4	19						
		1.9	10						
		1.9	10						
		13.9	18						
Iron - filtered									
Site	9	44800	17	111	24	-1.71	0.0436	reject	site > background
		52800	19						
		8790	11						
		4420	7						
		20200	14						
		33500	16						
		1040	4						
		49000	18						
		3000	5						
Background	10	10100	12	64	81				
		4690	8						
		11.55	1						
		13.6	2						
		14000	13						
		15.2	3						
		29800	15						
		6980	10						
		3810	6						
		4780	9						
Manganese - filtered									
Site	9	5690	18	118	17	-2.29	0.011	reject	site > background
		5910	19						
		4980	17						
		3630	16						
		959	11						
		1190	12						
		43.2	3						
		169	7						
		1690	15						
Background	10	598	9	72	73				
		163	6						
		140	4						
		17.2	1						
		384	8						
		24.6	2						
		1220	13						
		820	10						
		142	5						
		1510	14						

Table 11.1a
Comparison of Filtered Groundwater Sample Concentrations to Background Concentration
Using Mann-Whitney U Test
SWMU7
NAB Little Creek, Virginia Beach, Virginia

	Number of Samples	Concentration (ug/l)	Rank	Sum Ranks (R and R')	U and U'	z	p	Decision	
Manganese - unfiltered									
Site	9	4860	17	117	18	-2.20	0.0139	reject	site > background
		5710	19						
		4900	18						
		3730	16						
		983	11						
		1170	12						
		43.2	3						
		202	6						
		1680	15						
Background	10	613	9	73	72				
		159	5						
		143	4						
		16.3	1						
		386	8						
		25	2						
		1300	13						
		792	10						
		224	7						
		1500	14						

Mann-Whitney U Test

U = n1*n2 + n1 (n1 +1)/2 - R1
U' = n1*n2 + n2 (n2 +1)/2 - R2
z = (U - n1*n2/2)/((n1*n2*(n1+n2+1)/12)$^{1/2}$)

n1 = number of samples in data group 1 R1 = sum of ranks for data group 1
n2 = number of samples in data group 2 R2 = sum of ranks for data group 2

p = from area under the standard normal curve look-up table

Decision:
H_o: site data and background statistically similar
if $p < 0.05$ reject H_o, therefore, site data greater than background
Based on one-tailed test

Appendix I
SWMU 7 and SWMU 8 Construction Completion Report