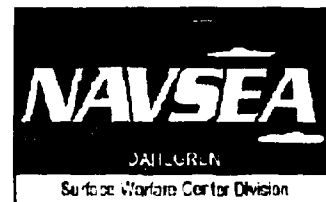
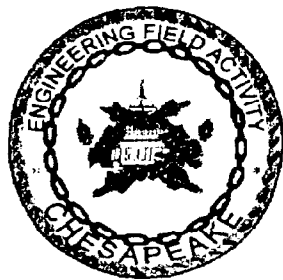


Five-Year Review Report
For
**Site 2 – Fenced Ordnance Burial
Area**

Naval Surface Warfare Center
Dahlgren Site

Dahlgren, Virginia



Engineering Field Activity Chesapeake
Naval Facilities Engineering Command

Contract Number N62467-94-D-0888

Contract Task Order 0810

September 2003

FIVE-YEAR REVIEW REPORT
FOR
SITE 2 - FENCED ORDNANCE BURIAL AREA
NAVAL SURFACE WARFARE CENTER
DAHLGREN SITE
DAHLGREN, VIRGINIA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Engineering Field Activity Chesapeake
1314 Harwood St., S.E.
Washington Navy Yard, D.C. 20374-5018

Submitted by:
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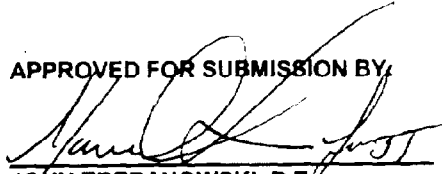
CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0810

SEPTEMBER 2003

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

September 30, 2003

CAPT. Lyal B. Davidson, USN
Commander
Attn: Billie Weedon
Naval Surface Warfare Center
Dahlgren, Virginia 22448-5100

Re: Five Year Review Report, Site 2 NSWC Dahlgren


Dear Captain Davidson:

The U.S. Environmental Protection Agency (EPA) Region III has reviewed the report entitled "Five-Year Review Report For Site 2 - Fenced Ordnance Burial Area Naval Surface Warfare Center Dahlgren Site". The report was prepared to address the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Section 121 (c) five-year review requirements. EPA has reviewed this five-year review report and has compared it to the OSWER Directive 9355.7-03B-P, *Comprehensive Five-Year Review Guidance* (EPA, June 2001). EPA concurs with the Navy's determination that the remedy in place is protective of human health and the environment.

EPA's Region 3 would like to congratulate the Navy in preparing a five-year review report that meets the intent of EPA's Five-Year Review Guidance Document.

If you have any questions, please contact Bruce Beach at (215) 814-3364.

Sincerely,


Abraham Ferdas, Director
Hazardous Site Cleanup Division

cc: Mr. Eric Salopek, Virginia Dept of Environmental Quality
Mr. Ryan Mayer, EFA Chesapeake



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LIST OF ACRONYMS

BTAG	Biological Technical Assistance Group
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-term Environmental Action Navy
COC	Contaminant of Concern
CTO	Contact Task Order
EEQ	Environmental Effects Quotients
ERA	Ecological Risk Assessment
FS	Feasibility Study
GPS	Groundwater Protection Standards
IR	Installation Restoration
MCL	Maximum Contaminant Limit
msl	mean sea level
NCP	National Oil and Hazardous Contingency Plan
NSWCDL	Naval Surface Warfare Center Dahlgren Site
O&M	Operation and Maintenance
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
PCOC	Preliminary Contaminants of Concern
PRG	Preliminary Remediation Goal
RA	Remedial Action
RAO	Remedial Action Objectives
RBC	Risk-Based Concentration
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RI	Remedial Investigation
ROD	Record of Decision
RPM	Remedial Project Manager
SDWA	Safe Drinking Water Act
SVOC	Semivolatile Organic Compound
TBC	to be considered
TtNUS	Tetra Tech NUS, Inc.
USEPA	U. S. Environmental Protection Agency
VDEQ	Virginia Department of Environmental Quality
VOC	Volatile Organic Compound

Navy Five-Year Review Signature Cover

Key Review Information

SITE IDENTIFICATION		
Site name: Site Name: Naval Surface Warfare Center, Dahlgren, VA(Site 2 - Fenced Ordnance Burial Area)		
EPA ID: VA7170024684		
Region: 3	State: VA	City/County: King George County
SITE STATUS		
NPL status: Final		
Remediation status (choose all that apply): <input checked="" type="checkbox"/> Under Construction <input checked="" type="checkbox"/> Operating <input type="checkbox"/> Complete (Final Remedy for Site 2)		
Multiple Operable Units (OUs)*? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Number of Sites/OUs: 1/NA		
Construction Completion Date: October 1998		
Fund/PRP/Federal Facility Lead: Federal Facility	Lead Agency: Department of the Navy Engineering Field Activity Chesapeake	
Has site been put into reuse? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
REVIEW STATUS		
Who conducted the review (EPA Region, State, Federal Agency): Engineering Field Activity Chesapeake		
Author name: Ryan Mayer		
Author title: Remedial Project Manager	Author Affiliation: Department of the Navy, Engineering Field Activity Chesapeake	
Review period: May 2003		
Date(s) of site inspection: April 29,2003		
Highlight: <u>Statutory Policy</u>	Policy Type (name): 1. Pre-SARA 2. Ongoing 3. Removal Only 4. Regional Discretion	
Review number: <input type="checkbox"/> first <input checked="" type="checkbox"/> second <input checked="" type="checkbox"/> third <input checked="" type="checkbox"/> other (specify)_____		
Triggering action Event: Initiation of the remedial action for Site 2 - Fenced Ordnance Burial Area		
Triggering action date: April 1998		
Due date: April 2003		

EXECUTIVE SUMMARY

The final remedy for Site 2 - Fenced Ordnance Burial Area at the Naval Surface Warfare Center, Dahlgren Site, Dahlgren, Virginia included removal of several debris piles, debris filled trenches, and soil hotspots; consolidation of removed debris, capping of the fenced area and removal debris and soils with a Resource Conservation and Recovery Act (RCRA) Subtitle C cap; and institutional controls with monitoring. The site achieved construction completion with the issuance of the Final Construction Report in February 1999. The trigger for this Five-Year Review was the actual start of construction on April 1, 1998.

The assessment of this Five-Year Review found that the remedy was constructed in accordance with the requirements of the Record of Decision (ROD). The remedy is functioning as designed and is protective of human health and the environment. Several issues, including the delay in implementing several administrative institutional controls, the lack of a formal operation and maintenance plan, and the delay in implementing a groundwater monitoring program, have been identified and will be addressed by the Navy.

This Five-Year Review only applies to the final remedial action implemented at Site 2 - Fenced Ordnance Burial Area.

Issues:

The lack of a formal operation and maintenance plan, the delay in implementation a long-term monitoring program, and the delay in finalizing several administrative institutional controls were outstanding issues identified during the review of this Five-Year Review. These outstanding issues, however, do not affect the potential for release of contaminants from the site and do not affect the current or future protectiveness of the final remedy.

Recommendations and Required Actions:

NSWCDL and the Navy have been advised of the above issues and plan to address each item to comply with the ROD.

Protectiveness Statement(s):

The final remedial action for Site 2 is protective of human health and the environment. The remedy is functioning as intended. This Five-Year Review shows that the Navy has not prepared and implemented ROD requirements in accordance with the schedule presented in the ROD.

Other Comments:

None.

Next Review:

The next Five-Year Review of will be completed in April 2008.

Signature of U.S. Department of the Navy and Date

1.0 INTRODUCTION

The purpose of this Five-Year Review is to determine whether the final remedy at Site 2, the Fenced Ordnance Burial Area, at the Naval Surface Warfare Center, Dahlgren Site (NSWC DL) in Dahlgren, Virginia, is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review reports. In addition, Five-Year Review reports identify issues found during the review, if any, and identify recommendations to address them.

The Navy is preparing this Five-Year Review report pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA §121 states the following:

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

The Navy interpreted this requirement further in the NCP; 40 Code of Federal Regulations (CFA) § 300.430(f)(4)(ii) states:

If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such actions no less often than every five years after the initiation of the selected remedial action.

Tetra Tech NUS, Inc. (TtNUS) conducted an analysis of the available information in support of the Five-Year Review in April 2003 in response to Contract Task Order (CTO) 0810 under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Number N62467-94-D-0888. Representatives of TtNUS conducted a site inspection on April 29, 2003. This report documents the results of the review.

This is the first Five-Year Review for Site 2 at NSWC Dahlgren. The triggering action for this statutory review is the initiation of the remedial action on April 1, 1998. The Five-Year Review is required because hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure.

This is the first Five-Year Review performed at any site at NSWC DL.

2.0 SITE CHRONOLOGY

Site activities are believed to have started in 1943. However, the exact activities that occurred from this initial time to the early 1970's are largely unknown. In the early 1970s a fenced landfill was excavated and used for disposal of metal ordnance and miscellaneous machine parts. From 1976 through 1980 trenching operations outside of the fenced area occurred. These trenches were filled with aircraft scrap and non-explosive missile materials.

Various site investigations were performed and decision, documents produced during the 1990s. In 1994 a remedial investigation (RI) was initiated at Site 2, which included a geophysical survey, surface soil and sediment sampling, groundwater monitoring well installation and groundwater sampling and analysis. A draft final RI report was produced (B&R Environmental,

1995). The RI was completed in 1997 (B&R Environmental, 1997a). Additional sampling and analysis of surface soil, subsurface soil, surface water, sediment, and groundwater, and the installation of several test pits were completed in 1996-1997. A human health and ecological risk assessment was prepared as part of the RI. Based on the results of the RI, a Feasibility Study (FS) was prepared (B&R Environmental, 1997b). A Record of Decision (ROD) was produced and signed in 1997 (U. S. Navy, 1997).

The ROD stipulated that the remedy consisted of the removal of soils exceeding remediation goals, removal of the western and southern trenches and debris piles, backfilling with clean fill, consolidation of all removed wastes onsite, disposal of recyclable materials offsite, surface capping of the fenced area and consolidated soils, and institutional controls with monitoring.

The remedial design (RD) was completed in March 1998 (B&R Environmental, 1998), and the remedial action (RA) was completed in October 1998 (TtNUS, 2000; OHM, 1999). As part of the remedy, institutional controls with long-term monitoring were stipulated. A Long-Term Monitoring Plan was produced (TtNUS, 2001), and surface water and sediment sampling was conducted in September 2002, (TtNUS, 2003a); groundwater sampling and analysis was conducted in November 2001 (TtNUS, 2002) and January 2003 (TtNUS, 2003b). Table 2-1 summarizes the site chronology.

**TABLE 2-1
CHRONOLOGY OF SITE EVENTS
SITE 2, FENCED AREA ORDNANCE
NSWCDL, DAHLGREN, VIRGINIA**

Event	Date
Site Activity Begins	1943
Fenced Landfill Excavated; area used for metal ordnance and miscellaneous machine waste	1970's
Trenching operations outside fenced area - aircraft scrap materials and non-explosive missile materials deposited	1976-1980
Final listing on USEPA National Priority List	1994
Remedial Investigation (RI)	1994
Feasibility Study	1997
Addition Remedial investigation	1997
Proposed Plan released to the public; start of public comment period	1997
Record of Decision (ROD)	1997
Remedial Design (RD) completed	1998
Remedial Action	1998
Long-Term Monitoring Plan Prepared	2001
Round 1 Groundwater Monitoring	2001
Round 1 Biennial Surface Water and Sediment Sampling	2002
Round 2 Groundwater Monitoring	2003

3.0 BACKGROUND

3.1 PHYSICAL CHARACTERISTICS

Site 2, formerly used for disposal of various natal ordnance items, is located close to the eastern shore of Gambo Creek and southeast of Site 12, the Chemical Bum Area (Figure 3-1). Site 2 consisted of a small fenced area, five trenches south and west of the fenced area, and two surface debris piles. Access to Site 2 is from Bagby Road, which in conjunction with Stump Dump Road forms the northern edge of the site. Gambo Creek and associated marsh areas form the western and southern site boundaries. The eastern border of Site 2 is defined by the limits of the geophysical survey conducted during the RI (Figure 3-2). The geophysical survey did not, however, investigate the fenced area of the site due to the potential dangers associated with ordnance.

The site is located on a relatively flat parcel of land, with elevations ranging between 15 and 20 feet above mean sea level (msl). Waste materials were disposed of in trenches in areas within and outside of the fenced area. There was no surface expression of trenching, with the possible exception of piles of excess soil remaining from the excavation and filling operations. The northeastern portion of the site is sparsely vegetated; the remainder of the site is wooded with mature deciduous trees and small pine trees indicating growth after landfill operations ended.

Two drainage swales located along the western portion of the site direct sulfate flow toward Gambo Creek and the surrounding marsh west of the site. Gambo Creek flows south from the site, joining a tributary east of the site further downstream. Based on the topographic features at this location, site drainage is principally to the south-southwest, toward a marshy area adjacent to Gambo Creek. There is also a drainage component to the eastern tributary of Gambo Creek.

3.2 LAND AND RESOURCE USE

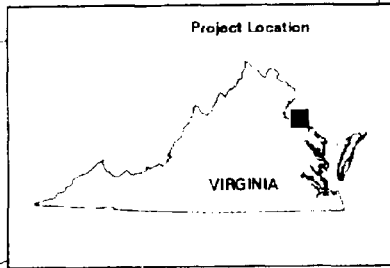
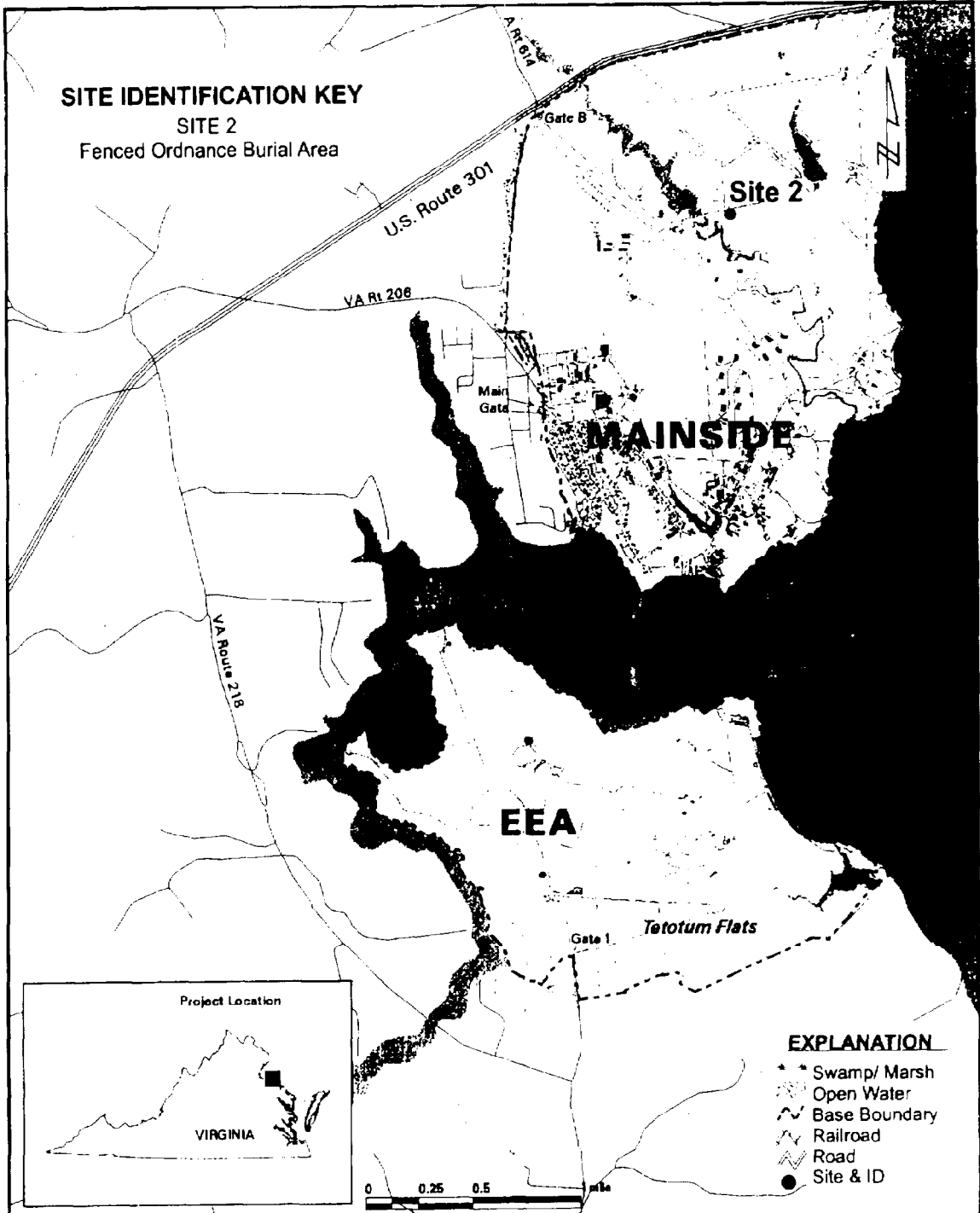
Evidence based on a study of aerial photography by the US Environmental Protection Agency (USEPA) in 1992 shows that activity at Site 2 began around 1943, as observed on photos by a small cleared area appearing approximately 100 feet south of Bagby Road. In a 1952 photo, a large cleared, square, fenced area south of Bagby Road was apparent. A pile of dark-colored dirt was present in the northwest corner of the site.

In the early 1970s a fenced landfill area was excavated in the northeast corner of the site. This area was reportedly used for the disposal of metal ordnance materials that may have contained explosive residue. The fenced area was approximately 150 feet by 150 feet and was surrounded by an 8-foot-high chain link fence. In addition, asbestos pipe wrappings, rinsed pesticide containers, ordnance hardware, and machine pans were buried in this area. Additional wastes that may have been buried at Site 2 within the previous fenced area include an unknown quantity of "cut up gun barrels," residue from small arms ammunition, and potentially explosive ordnance. "Misch" metal, which may be composed of radioactive thorium and rare earth metals alloyed with magnesium or nickel, may have been buried at Site 2, although ultimate disposal details were not recorded (Fred C. Hart Associates, Inc., 1983). According to facility personnel, drums were filled with "Misch" metal immersed in waste oil prior to placement in the trenches. Records of disposal activities at Site 2 have revealed that some of the buried materials were wastes recovered from burning activities at nearby Site 12. Records do not mention the burial of drums or waste oils, but do report the burial of a large quantity of ordnance materials, scrap metal, and machinery parts primarily on the southern portion of the fenced area.

Two additional trenches within the previously fenced area appeared on aerial photographs in the early to mid-1980s. In the early 1980s areas to the east and west the fence were cleared of vegetation.

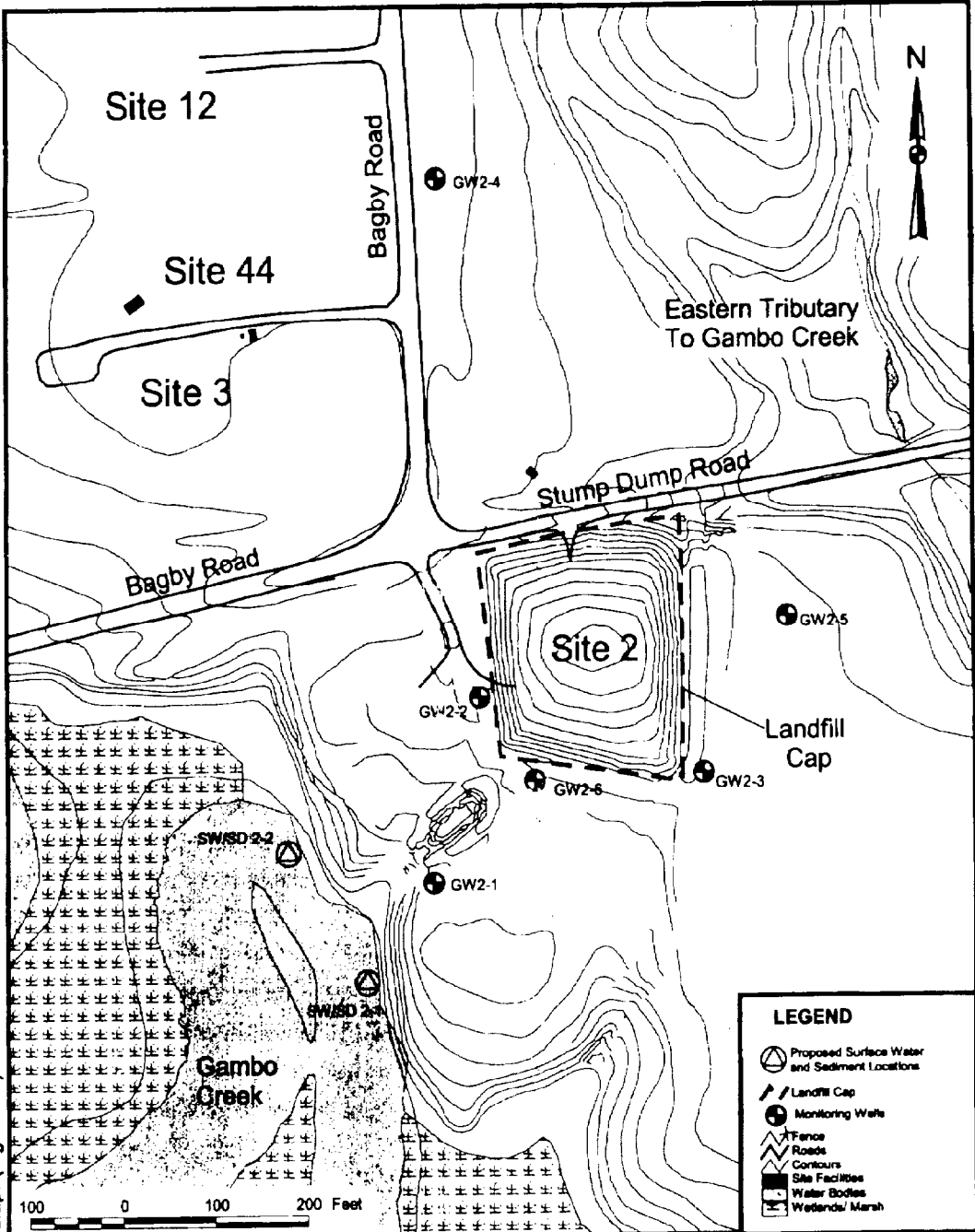
Trenching operations outside the currently fenced area occurred between 1976 and 1988. Four

SITE IDENTIFICATION KEY
SITE 2
Fenced Ordnance Burial Area



- EXPLANATION**
- Swamp/ Marsh
 - Open Water
 - Base Boundary
 - Railroad
 - Road
 - Site & ID

DRAWN BY LR	DATE 05/06/03	Tetra Tech NUS, Inc.	CONTRACT NO 462467-949D90688	OWNER NO 0810
CHECKED BY DMW	DATE 05/06/03		APPROVED BY D.M.W.	DATE 5/6/03
SCALE AS SHOWN		SITE LOCATION MAP SITE 2 NSWCDL DAHLGREN, VIRGINIA	APPROVED BY	DATE
			DRAWING NO. Figure 3-1	REV. 0



k:\project\ah\site2.apr (Figure 3-1)

DRAWN BY LR	DATE 5/06/03	Tetra Tech NUS, Inc.	CONTRACT NUMBER N62467-94-D-0888	OWNER NO CTO 810
CHECKED BY DMW	DATE 5/06/03		APPROVED BY DMW	DATE 5/16/03
COST/SCHEDULE AREA		SITE MAP SITE 2 NSWCDL, DAHLGREN, VIRGINIA	APPROVED BY	DATE
SCALE AS NOTED			DRAWING NO Figure 3-2	REV 0

trenches outside and immediately south of the previously fenced area reportedly received aircraft scrap, sonar buoys, NiCad sonar batteries, and non-explosive missile materials. These trenches were each approximately 100 feet long by 20 feet wide. An additional trench west of the fenced area (and approximately the same dimensions) reportedly received seawater batteries and NiCad batteries, but during test pit operations conducted as part of the RI, only seawater batteries and magnesium wet cell batteries were found.

The site is currently a partially open, grass-covered field at the landfill), a partial wooded area with thick underbrush, and a marsh at the shoreline of Gambo Creek. The landfill portion of the site is currently capped, and the landfill and consolidated waste are contained beneath this surface cap. The current land use for the surrounding area is military. The future land use for the foreseeable future for the surrounding area is expected to be military.

The lithology of Site 2 consists of channel- fill deposits (predominately sands with some fines) overlying a clay unit. Depth to the shallow aquifer ranges from approximately 10 to 15 feet bgs across the site. Groundwater in the shallow aquifer flows and discharges primarily south and west to Gambo Creek. There is also a flow component to the east and southeast toward the eastern tributary of Gambo Creek.

Groundwater production wells, which are located more than 4,000 feet south of Site 2, supply potable water to NSWCDD.

The closest residences, on-base Navy housing consisting of over 150 homes, are within 6,000 feet southwest of Site 2.

3.3 BASIS FOR REMEDIAL ACTION

The need for a remedial action at Site 2 was based on the history of site activities and the resulting multimedia contamination, nature and extent of the multimedia contamination, a human health and ecological risk assessment to determine the effects, if any, of contamination on human and ecological receptors, and the comparison of contaminants of concern to calculated, or literature, preliminary remediation goals. These items are discussed in the following paragraphs.

3.3.1 History of Contamination

As mentioned previously, disposal activities at Site 2 are thought to have been initiated in 1943. A fenced landfill was built in the early 1970s and accepted metals ordnance materials. In addition, several trenches were excavated, both inside and outside of the fenced area. These trenches received multiple types of wastes, including scrap metals and batteries.

The RI at Site 2 was completed in phases. Geophysical and radiologic investigations were initiated in 1993. Sampling activities consisting of soil, surface water, and sediment sampling of Gambo Creek adjacent to Site 2 and the installation and sampling of groundwater monitoring wells were completed in 1994. Additional RI sampling, consisting of additional surface and subsurface soil sampling and test pitting activities, were completed in 1996 and early 1997.

Prior to the completion of the Record of Decision, no CERCLA or non-CERCLA removal/responses or closures had occurred.

3.3.2 Sources of Contamination

Geophysical investigations at Site 2 included magnetic and surface radiological surveys. The surveys were used to determine locations of buried ferromagnetic materials outside of the fenced area and to evaluate the potential presence of thorium- contaminated surface soils. The results of the survey outlined areas of buried metallic objects at Site 2 and identified four potential source areas in addition to the fenced ordnance burial area. These included

the two trench disposal areas (Western and Southern Trenches) and the two surface debris piles (Western and Southern Debris Piles) located on the site.

Wastes in the fenced area of the site have never been sampled or analyzed due to the presence of ordnance and the potential dangers associated with their sampling. During the initial RI and subsequent RI events, groundwater, sediment, surface water, and surface and subsurface soil samples were collected at Site 2 and analyzed for volatile organic compounds (VOCs), semivolatile organic contaminants (SVOCs), pesticides, polychlorinated biphenyls PCBs, inorganics, explosives, thorium, radioactive gross alpha and beta activity, phenol, and cyanide. The results of these investigations are summarized in the following paragraphs. The draft final RI (B&R Environmental, 1995) and RI addendum (B&R Environmental, 1997) should be consulted for further information.

Groundwater

A total of five monitoring wells were installed at Site 2 (Figure 3-2). The wells were sampled to provide a comprehensive picture of groundwater quality at the site and analyzed for VOCs, SVOCs, explosives, thorium, radioactive gross alpha and beta activity, pesticides, PCBs, and inorganics (metals and cyanide). Table 3-1 summarizes the RI groundwater data.

Although low levels of VOCs, SVOCs and radioactive gross alpha and beta activity were detected in groundwater samples collected, their detection at low levels was not indicative of significant (action or maximum contaminant) levels of groundwater. No explosives were detected in monitoring wells GW2-1 and GW2-3, and no pesticides, or PCBs were detected in any of the groundwater samples.

To fully characterize the occurrence and distribution of inorganics, both unfiltered (representing total) and filtered (representing dissolved) samples were collected and analyzed. Both are necessary to evaluate contaminant mobility and bioavailability. The sample results indicated that iron, manganese, and aluminum exceeded secondary maximum contaminant limits (MCLs) in unfiltered samples, and the action level (15 mg/kg, from the Safe Drinking Water Act) for lead was exceeded in one well (GW2-3). In addition, Virginia Groundwater Standards, which are based on drinking water criteria, were exceeded for zinc and cadmium.

Surface Soils

VOCs were detected infrequently in the 12 surface soil samples collected. Acetone was detected at its highest concentration of 130.0 ug/kg, and styrene was detected at 35.0 ug/kg in one sample (SS2-5). Similarly, SVOCs were detected infrequently, with the majority of polynuclear aromatic hydrocarbon (PAH) compounds being detected in a single sample (SS2-10). The pesticides 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were also detected in some samples at low levels, with 4,4'-DDT detected at the highest concentration at SS2-8 (60 ug/kg) in the debris piles on the west side of the site. These pesticide concentrations were all below the corresponding risk-based concentrations (RBCs). With respect to the protection of human health and ecological receptors, no VOCs and only one SVOCs (2-methylnaphthalene) was identified as contaminants of concern in surface soils at Site 2.

Surface Water

Surface water samples were analyzed for VOCs, SVOCs, pesticides/PCBs, inorganics (metals and cyanide), radioactive parameters (including thorium isotopes), and hardness. A trace concentration (1 ug/L) of trichloroethene was the only VOC detected in the eight samples collected from Gambo Creek adjacent to Site 2. Similarly, trace concentrations of di-n-butyl phthalate (4 ug/L) and Fenuron TCA (0.44 ug/L) were detected at very low levels. Sixteen inorganics were detected in the surface water samples, thirteen of which contained concentrations above reported maximum background levels.

The RI identified gross beta radioactivity sample results were above maximum background

TABLE 3-1

**COMPARISON OF GROUNDWATER DATA
SITE 2, FENCED ORDNANCE BURIAL AREA
NSWCDL, DAHLGREN, VIRGINIA
PAGE 1 OF 3**

Chemical	1994 Data				1996 Data				Risk-Based COC Screening Level Tap Water (mg/L)	Federal MCL (mg/L)
	Frequency of Detection	Range of Detection (mg/L)	Mean of detected Values (mg/L)	Location of Maximum	Frequency of Detection	Range of Detection (mg/L)	Mean of Detected Values (mg/L)	Location of Maximum		
VOCs										
Chloromethane	0/3	NA	NA	NA	1/5	6	6	GW2-5	1.4 *	NA
Methylene chloride	0/3	NA	NA	NA	2/5	49-51	50	GW2-4	4.1 *	5 *
SVOCs										
1,2-Dichlorobenzene	1/3	7.5	7.5	GW2-4	0/5	NA	NA	NA	27	600
1,3-Dichlorobenzene	1/3	7.5	7.5	GW2-4	0/5	NA	NA	NA	54	600
1,4-Dichlorobenzene	1/3	7.5	7.5	GW2-4	0/5	NA	NA	NA	0.44 *	75
2-Chlorophenol	1/3	7.5	7.5	GW2-4	0/5	NA	NA	NA	18	NA
2-Methylphenol	1/3	7.5	7.5	GW2-4	0/5	NA	NA	NA	180	NA
4-Methylphenol	1/3	7.5	7.5	GW2-4	0/5	NA	NA	NA	18	NA
Bis(2-chloroethyl) ether	1/3	7.5	7.5	GW2-4	0/5	NA	NA	NA	0.0092 *	NA
Bis(2-chloroisopropyl) ether	1/3	7.5	7.5	GW2-4	0/5	NA	NA	NA	0.26 *	NA
Bis(2-ethylhexyl)phthalate	0/3	NA	NA	NA	2/5	0.65 - 1	0.83	GW2-4	4.8	6
Di-n-butylphthalate	2/3	0.6 - 0.7	0.65	GW2-3	0/5	NA	NA	NA	370	NA
Diethyl phthalate	1/3	1	1	GW2-1	2/5	0.5	0.5	GW2-2 GW2-4	2900	NA
Fluorene	0/3	NA	NA	NA	1/5	0.6	0.6	GW2-2	150	NA
N-Nitroso-di-n-propylamine	1/3	7.5	7.5	GW2-4	0/5	NA	NA	NA	0.0096 *	NA
Phenol	1/3	7.5	7.5	GW2-4	0/5	NA	NA	NA	2200	NA
INORGANICS										
Aluminum	3/3	834.5 - 3170	1861.5	GW2-3	5/5	729 - 10720	3829.8	GW2-2	3700 *	50 - 200 * ⁽¹⁾
Aluminum, Filtered	3/3	56.5 - 143	89.6	GW2-4-F	4/5	22.1 - 1630	474	GW2-5-F	3700	50 - 200 * ⁽¹⁾
Arsenic	0/3	NA	NA	NA	1/5	5.75	5.75	GW2-2	0.045 *	50
Barium	3/3	71.15 - 175	110.5	GW2-3	5/5	45.9 - 148	89.8	GW2-3	260	2000
Barium, Filtered	3/3	59.75 - 129	83.9	GW2-1-F	5/5	27.9 - 127	63.1	GW2-3-F	260	2000
Cadmium	0/3	NA	NA	NA	2/5	1.0 - 1.1	1.05	GW2-2	1.8	5

TABLE 3-1

**COMPARISON OF GROUNDWATER DATA
SITE 2, FENCED ORDNANCE BURIAL AREA
NSWCDL, DAHLGREN, VIRGINIA
PAGE 2 OF 3**

Chemical	1994 Data				1996 Data				Risk-Based COC Screening Level Tap Water (mg/L)	Federal MCL (mg/L)
	Frequency of Detection	Range of Detection (mg/L)	Mean of detected Values (mg/L)	Location of Maximum	Frequency of Detection	Range of Detection (mg/L)	Mean of Detected Values (mg/L)	Location of Maximum		
Calcium	3/3	2900 - 6770	5036.7	GW2-3	5/5	2000 - 7930	3946	GW2-5	NA	NA
Calcium, Filtered	3/3	2945 - 6030	4615	GW2-3-F	5/5	1330 - 7660	3228	GW2-5-F	NA	NA
Chromium	2/3	4.9 - 5.3	5.1	GW2-3	4/5	3.5 - 16.4	7.5	GW2-2	18 ^(b)	100
Chromium, Filtered	0/3	NA	NA	NA	1/5	2.4	2.4	GW2-5-F	18 ^(b)	100
Cobalt	3/3	10.0 - 24.7	16.7	GW2-4	4/5	5.55 - 29.4	13.4	GW2-4	220	NA
Cobalt, Filtered	3/3	9.4 - 24.05	15.9	GW2-4-F	4/5	1.85 - 22.0	9.8	GW2-4-F	220	NA
Copper	2/3	6.6 - 19.5	13.1	GW2-3	5/5	4.2 - 13.1	7.5	GW2-2	150	1300 ^(b)
Copper, Filtered	2/3	2.1	2.1	GW2-1-F GW2-3-F	2/5	3.75 - 5.9	4.8	GW2-5-F	150	1300 ^(b)
Cyanide	0/3	NA	NA	NA	0/5	4.3	4.3	GW2-2	73	200
Iron	3/3	929.5 - 2780	1873.2	GW2-3	5/5	686 - 7155	3062.2	GW2-2	1100 *	300 * ^(b)
Iron, Filtered	3/3	142 - 446	243.3	GW2-4-F	4/5	40.9 - 1540	449.8	GW2-5-F	1100 *	300 * ^(b)
Lead	2/3	2.3 - 16.0	9.2	GW2-3	0/5	NA	NA	NA	15 * ^(b)	15 * ^(b)
Lead, Filtered	0/3	NA	NA	NA	1/5	5.725	5.7	GW2-2	15 ^(b)	15 ^(b)
Magnesium	3/3	3330 - 7370	4760	GW2-3	5/5	1800 - 5030	3269	GW2-3	NA	NA
Magnesium, Filtered	3/3	3190 - 6710	4413.3	GW2-3-F	5/5	1185 - 4600	2773	GW2-3-F	NA	NA
Manganese	3/3	39.05 - 153	98.1	GW2-3	5/5	32.4 - 157	70.7	GW2-5	84 *	50 * ^(b)
Manganese, Filtered	3/3	38.55 - 146	93.2	GW2-3-F	5/5	25.3 - 154	61.3	GW2-5-F	84 *	50 * ^(b)
Nickel	3/3	12.7 - 30.95	21.6	GW2-4	5/5	4.6 - 39.1	16.4	GW2-4	73	100
Nickel, Filtered	3/3	11.8 - 31.8	21.2	GW2-4-F	5/5	3.6 - 28.8	12.4	GW2-4-F	73	100
Potassium	3/3	1070 - 2400	1741.7	GW2-3	5/5	923 - 2290	1651.6	GW2-3	NA	NA
Potassium, Filtered	3/3	1210 - 2310	1700	GW2-3-F	5/5	803 - 2660	1546.7	GW2-3-F	NA	NA
Sodium	3/3	4965 - 7930	6721.7	GW2-1	5/5	7680 - 12800	9345	GW2-1	NA	NA
Sodium, Filtered	3/3	4965 - 6860	5941.7	GW2-1-F	5/5	7015 - 11400	8805	GW2-1-F	NA	NA
Vanadium	0/3	NA	NA	NA	4/5	3.1 - 18.8	8.3	GW2-2	26	NA

TABLE 3-1

**COMPARISON OF GROUNDWATER DATA
SITE 2, FENCED ORDNANCE BURIAL AREA
NSWCDL, DAHLGREN, VIRGINIA
PAGE 3 OF 3**

Chemical	1994 Data				1996 Data				Risk-Based COC Screening Level Tap Water (mg/L)	Federal MCL (mg/L)
	Frequency of Detection	Range of Detection (mg/L)	Mean of detected Values (mg/L)	Location of Maximum	Frequency of Detection	Range of Detection (mg/L)	Mean of Detected Values (mg/L)	Location of Maximum		
Vanadium, Filtered	0/3	NA	NA	NA	1/5	2.5	2.5	GW2-5-F	26	NA
Zinc	3/3	50.1 - 75.05	64.5	GW2-4	4/5	45.1 - 108	63.1	GW2-4	1100	5000 ⁽¹⁾
Zinc, Filtered	3/3	39.5 - 74.75	56.3	GW2-4-F	5/5	19.85 - 97.5	53.2	GW2-5-F	1100	5000 ⁽¹⁾
RADIONUCLIDES										
Gross alpha (pCi/g)	3/3	2.14 - 18.4	8.2	GW2-3					NA	15 *
Gross beta (pCi/g)	3/3	5.355 - 19.2	10.3	GW2-3					NA	NA
Thorium-230 (pCi/g)	1/3	2.67	2.7	GW2-4					NA	NA
Miscellaneous										
Hardness as CaCO ₃	3/3	21 - 42	30.3	GW2-3					NA	NA

1 Secondary MCL.

2 Hexavalent chromium.

3 Action level.

* Indicates the value is exceeded by the maximum site concentration.

Blank space indicates no analyses was performed

NA Not applicable

levels (8.53 pCi/l) in seven of eight surface water samples ranging from 29.3 to 80.75 pCi/l. Two additional surface water samples were obtained in Gambo Creek, near the disposal trenches to evaluate the potential for the leaching of radioactive materials from the wastes into the stream. Thorium Isotopes and gross alpha activity were not detected in these two samples. Both of these samples detected gross beta radioactivity below the federal MCL of 15 pCi/l.

Sediments

VOCs and SVOCs were detected in sediments at the maximum in only two out of eight samples and at low concentrations at isolated locations. Five VOCs were detected at four different sampling locations in Gambo Creek adjacent to Site 2. The highest concentration (380 ug/kg) was for acetone, which was reported as biased high. Six SVOCs were detected from three locations with the highest concentration (380 ug/kg) reported for benzo(a)pyrene. A total of 6 PAHs were detected for a combined maximum concentration of 1,005 ug/kg. The debris pile present on the west side of the site may represent the source of some of the SVOC compounds detected. Nine pesticides/PCBs were detected in sediments, with concentrations ranging from 3.3 ug/kg to 1,910 ug/kg. Most of the highest concentrations were detected in one sample west of the site. However, pesticides are known to be present at low levels (7.6 to 29 ug/kg) in environmental media throughout the NSWCDL facility, and Site 2 is not believed to be a source.

Explosive constituents were not detected in any of the sediment samples collected. Inorganics, several of which were detected above background levels, were detected in sediment samples. They include antimony, arsenic, beryllium, chromium, iron, lead, magnesium, and manganese.

3.3.3 Summary of Site Risks

The human health and ecological risks associated with exposure to contaminated media at Site 2 were evaluated in the RI Report Addendum. The human health baseline risk assessment evaluated the potential health risks that might result under current and future industrial land use scenarios. The residential use scenario was not evaluated and institutional controls will be implemented to limit the site to future industrial use and to exclude shallow groundwater use. Under the industrial land use scenario for Site 2, COCs were selected by comparing the contaminants detected to industrial risk-based concentrations. Due to its brackish quality and productivity constraints, groundwater in the shallow aquifer is not a current source of drinking water and will not be used as one in the future. Exposure to surface water is expected to be limited to fisherman in boats in Gambo Creek.

An ecological evaluation was also performed to evaluate potential threats to ecological receptors. A summary of the human health and ecological risks associated with the site is presented below.

Human Health Risks

Exposure Pathways and Potential Receptors

Base workers, recreational users (adults and children, at the site and on Gambo Creek adjacent to Site 2), and construction workers (future conditions only) were evaluated as potential receptors in the quantitative risk assessment. The remaining receptors were considered for current and future conditions. Ingestion of fin fish was evaluated for adult recreational users only. Construction workers were evaluated for exposure to surface/subsurface soil (0 to 12 feet), while all other receptors were considered for surface soil (0 to 2 feet) exposure. Inhalation of volatile emissions and fugitive dust was evaluated. Direct contact with surface water and sediment is not anticipated at the site and therefore were not evaluated.

Exposure Assessment

No VOCs were identified as contaminants of concern (COCs) in the surface or subsurface soil at Site 2. Arsenic at a maximum concentration of 18.7 mg/kg was evaluated in surface and subsurface soils. All the other inorganics identified as COCs in surface and subsurface soils are listed because of environmental risks. These inorganic COCs all had concentrations below the human health risk-based concentrations (RBCs). Antimony and iron were identified as COCs for the exposure assessment from fish ingestion. The results of the human health risk characterization are discussed in the following paragraphs.

Current and Future Base Worker. The cumulative hazard indices for ingestion of and dermal contact with soils for Site 2 under industrial land use conditions are less than 1, which indicates that there are no significant hazards associated with soils at Site 2. The cumulative ingestion and dermal contact cancer risk is 1.3×10^{-7} under a "reasonable maximum exposure" scenario, well below USEPA's target risk range of 1×10^{-6} to 1×10^{-4} .

Adult Recreational User. The cumulative non-cancer hazard index from exposure via ingestion of and dermal contact with Site 2 soils under industrial land use conditions are less than 1, as is the risk associated with the potential ingestion of fish. The summation of ingestion and dermal contact cancer risk is 6.4×10^{-7} under a reasonable maximum exposure scenario, well below USEPA's target risk range of 1×10^{-6} to 1×10^{-4} . Under the industrial land use scenario, ingestion and dermal contact were evaluated just for arsenic.

Child Recreational User. The cumulative hazard index and cancer risk associated with ingestion and dermal contact exposure to surface and subsurface soil at Site 2 under the industrial land use scenario are 2.4×10^{-2} and 1.4×10^{-6} respectively under a reasonable maximum exposure scenario. Under the industrial land use scenario, ingestion and dermal contact were evaluated only for arsenic.

Construction Worker. The cumulative hazard index and cancer risk associated with ingestion and dermal contact exposure to Site 2 soil under industrial land use conditions are 8.4×10^{-2} and 5.4×10^{-7} respectively under a reasonable maximum exposure scenario.

Ecological Risk Assessment

The intent of the baseline ecological risk assessment (ERA) was to characterize potential receptors and to estimate the potential hazard or risk to environmental receptors. Contaminant pathways were identified to evaluate receptors potentially at risk. The ERA followed USEPA guidance for performing ecological risk assessments and was approved by Region III, USEPA's Biological Technical Assistance Group (BTAG). The baseline ERA is described fully in the RI Report and is summarized here.

Analytical data compiled from the RIs were analyzed using USEPA Region III guidance for screening-level risk assessments determine environmental effects quotients (EEQs). EEQs were determined by comparison with standard guidelines such as USEPA Region III and BTAG guidelines. Table 3-2 summarizes the analysis. Data were reviewed for surface water, sediment, and surface soil; preliminary COCs (PCOCs) were selected for each of these exposure media by comparing maximum site concentrations to screening values, which typically are conservative. COCs were selected by comparing maximum site concentrations to PRGs. Those chemicals exceeding PRGs and potentially posing an actual risk to receptor populations living on or near Site 2 were selected as COCs. Decisions regarding whether or not to remediate a contaminant and how to manage the potential risk were made by comparing maximum site concentrations to background levels, and by considering the frequency of detection, the likelihood that a source exists on the site, and bioavailability.

The PCOCs for surface water were di-n-butyl phthalate, aluminum, copper, iron, manganese, and nickel. Because all of the metals were detected at levels above PRGs, they were retained as COCs for surface water.

Of the 22 PCOCs identified in sediment, nine had maximum concentrations above their PRG (or no PRG) and were retained as COCs for sediment. The nine COCs were acetone, methylene chloride, styrene, endrin aldehyde, heptachlor, monuron, aluminum, antimony, and iron.

TABLE 3-2

**ECOLOGICAL RISK MANAGEMENT
SITE 2, FENCED ORDNANCE BURIAL AREA
NSWCDL DAHLGREN, VIRGINIA
PAGE 1 OF 2**

CHEMICAL	DETECTION FREQUENCY	BTAG SCREENING LEVEL	MODEL NOAEL PRG	MODEL LOAEL PRG	PREFERRED PRG ¹	RANGE OF DETECTIONS	MEAN	MEAN / MAXIMUM BACKGROUND	NOTES*
Surface Water (µg/L)									
Aluminum	6/8	25.0	NP	NP	87.0	77-2590	713	417/668	COC; Unlikely toxicant under normal pH conditions
Copper	5/8	2.9	NP	NP	2.9	2.8-10.1	3.58	3.7/2.7	COC; Not of concern in sediment
Iron	8/8	320	NP	NP	1000	278-6840	1577	1162/1800	COC; Unlikely toxicant under normal pH conditions
Manganese	8/8	10	NP	NP	120	56.9-226	104	421/657	COC; Max. < mean background
Nickel	1/8	8.3	NP	NP	8.3	10.2	5.8	ND	COC; 1 of 8 detected, slightly above BTAG level
Di-n-butylphthalate	1/8	0.3	NP	NP	33	4	4	ND	1 of 8 detected; max. < PRG
Sediment (mg/kg)									
Aluminum	8/8	NA	560	5600	15000	3880-18900	14169	22000/24000J	COC; Max. < mean background
Antimony	3/8	150	NA	NA	25	5.1-73.5	31	ND	COC; Max. < BTAG screening level
Arsenic	6/8	8.2	2	17	70	6-18.9	9.2	8.7-9.7	Maximum less than ER-M
Iron	8/8	NA	510	5105	29000	12100-36100	25103	32150/35200	COC; Max. approx. equal to maximum background
Lead	8/8	46.7	2	15	218	12.6-106	45	37.1-39.8J	Max. approx. one-half of ER-M
Acetone	3/8	NA	NA	NA	0.022	0.17-12	1.6	0.05/0.11B	COC; Common laboratory contaminant
Methylene Chloride	2/8	NA	NA	NA	1.875	0.068-5.6	0.723	0.042/0.084	COC; Common laboratory contaminant
Styrene	1/8	NA	NA	NA	NA	0.045	0.045	ND	COC; 1 of 8 detected
Endrin aldehyde	3/8	NA	0.1	1	0.038	0.0041-0.17	0.015	ND	COC; Max. near NOAEL PRG; mean < PRG
Heptachlor	1/8	NA	NA	NA	0.0067	0.0185	0.0185	0.008/0.008J	COC; 1 of 8 detected
Monuron	5/8	NA	NA	NA	0.004	0.007-1.91	0.272	ND	COC; PRG for algae; other tox. data are scarce
Surface Soil (mg/kg)									
Aluminum	12/12	1	32	323	50	6560-15700	10842	9016/18800	COC; Max. < max. background
Antimony	2/12	0.48	2	21	5	12.8-21.45	4.64	ND	COC; 2 of 12 detected, max. near LOAEL PRG

TABLE 3-2

**ECOLOGICAL RISK MANAGEMENT
SITE 2, FENCED ORDINANCE BURIAL AREA
NSWCDL DAHLGREN, VIRGINIA
PAGE 2 OF 2**

CHEMICAL	DETECTION FREQUENCY	BTAG SCREENING LEVEL	MODEL NOAEL PRG	MODEL LOAEL PRG	PREFERRED PRG ¹	RANGE OF DETECTIONS	MEAN	MEAN / MAXIMUM BACKGROUND	NOTES*
Arsenic	12/12	328	0.2	2.0	2.7	1.3-5.1	3.69	1.7/2.6	COC; Regional background max. = 7.1 mg/kg; max. < BTAG screening level
Chromium	12/12	0.02	0.30	3.00	0.40	7.8-19.2	13.82	8.8/16	COC; Regional background max. = 20 mg/kg
Copper	11/12	15.00	1.50	15.00	50.00	3.7-19.9	8.44	ND	Max. < PRG
Iron	12/12	12	259	2593	200	7990-21600	13913	6457/10600	COC; Unlikely toxicant under normal pH conditions
Lead	12/12	0.01	0.20	2	50	5.8-43.5	25	15.0/18.8	Max. < PRG
Mercury	1/12	0.058	0.010	0.015	0.019	0.77	0.29	ND	COC; 1 of 12 detected
Thallium	2/12	0.001	0.100	1.000	1	0.43-1.075	0.55	0.22/0.35	COC; 2 of 12 detected, max. near PRG
Vanadium	12/12	0.5	3.0	33.0	2	13.2-31.8	23.1	15.0/23.8	COC; Max. < Model LOAEL
Zinc	12/12	10	38	82	50	9.7-50	25.4	17.1/39.1	COC; Max. = PRG
Dibenzofuran	1/11	NA	NA	NA	0.23	0.055	0.055	ND	1 of 11 detected, < PRG
2-Methylnapthalene	1/11	NA	NA	NA	NA	0.11	0.11	ND	COC; 1 of 11 detected, near screening level for other PAHs (0.1)

¹"PREFERRED PRG" includes surface water: VA WQ stds., SCVs (ORNL); sediment: ER-Ms, equilibrium partitioning of VA chronic WQ stds. and SCVs; soil: values from Elroyson, et al. 1996 (ORNL)

* If maximum > Preferred PRG, then the contaminant is a COC

NP = Not performed; for terrestrials, it is usually safe to assume that drinking water contributes little to risk compared to food; for aquatics, WQC cover this pathway

ND = Not detected; NA = Toxicity data not found for applicable pathway

There were 33 PCOCs in surface soil, including 15 PAHs and 14 metals. Nine metals and one PAH had maximum concentrations above PRGs (or no PRG) and were carried forward as COCs. These were 2-methylnaphthalene, aluminum, antimony, arsenic, chromium, iron, mercury, thallium, vanadium, and zinc.

Exposure Pathways

The terrestrial exposure pathways include dermal absorption of chemicals from soil, ingestion of soil, absorption of chemicals from soil by plants, and ingestion of chemicals through the food chain. Exposure to contaminants for aquatic receptors in Gambo Creek m& y occur via ingestion of contaminated surface water, sediment, and food, or through direct contact with surface water and sediments.

Exposure Assessment

Surface soil contaminants at Site 2 that had EEQs greater than one, or no PRG included 2-methyl naphthalene, aluminum, antimony, arsenic, chromium, iron, mercury, thallium, and vanadium. The EEQs related to other chemicals were all less than or equal to 1, indicating that the risks for those chemicals were near or within acceptable ranges.

Potential Receptors

Terrestrial organisms most likely to be receptors include soil microorganisms, soil invertebrates, mammals, and birds. In addition, due to the proximity of Gambo Creek to Site 2, a variety of freshwater and estuarine organisms are potential receptors. Because of the natural setting of Site 2 and the variety of nearby habitats, Site 2 is likely to have a diversity of wildlife.

Risk Characterization

Based on risk management factors as well as hazard potential, antimony in surface soils, copper in surface water, pesticides, and the herbicide monuron in sediment are of concern for risks to ecological receptors at Site 2. Risk management factors include the maximum site concentrations compared to background levels, the frequency of detection, the likelihood that a source exists on the site, and bioavailability of the contaminant. Based on this analysis, pesticides and herbicides were found not to be site related and therefore were not analyzed further.

Development of Preliminary Remediation Goals for Cross Media Contamination

Because many contaminants have the ability to migrate from one medium to another (e.g., soil to groundwater), assessing risks from observed levels of contaminants is insufficient to evaluate all the potential risks at a site. Fate and transport modeling was therefore completed to determine if levels of COCs might migrate to other media and present unacceptable future risks to potential receptors. PRG's were developed for COCs in all media to establish concentrations that would not produce unacceptable risks.

Contaminant fate and transport modeling was used to evaluate the potential for COCs, as Identified by the human health and ecological risk assessment to migrate to other media and present unacceptable risks. For example, contaminants present in soils could migrate to groundwater or be carried with precipitation to surface water or sediments at a site, PRGs were developed by modeling for the following COC's:

- Antimony
- Arsenic
- Beryllium
- Chromium
- Copper
- Lead
- Manganese

- Nickel
- Vanadium

This list includes all of the COCs identified by the human health risk assessment and most of the metals identified as COCs in the ecological risk assessment. The COCs that were either not modeled were not attributable to Site 2 as a current source, or had borderline toxicity potential, were common laboratory contaminants, or had concentrations no different from background levels, Copper was identified by the modeling to be present in surface soils at levels slightly above the PRG for the protection of surface water (via groundwater) at one location. Vanadium In subsurface soils was identified at levels exceeding the PRG for the protection of sediment at 3 locations. Concentrations of the contaminants of concern in each medium of exposure are found in Tables 3-3, 3-4, and 3-5. Figure 3-3 depicts the location of the soil hotspots.

Assessment of Site 2 Risk

In summary, human health risks were evaluated to be within acceptable ranges. Ecological risks were identified for antimony, copper, pesticides, and monuron. Based on the analysis Performed in the FS (TtNUS, 1997b) for Site 2, antimony was identified at levels above PRGs for protection of ecological receptors at two locations, and copper at one location in surface soils. In addition, vanadium was identified above PRGs at three locations in subsurface soils. Figure 3-3 depicts the locations, or "hot spots," that required remediation, based on the comparison of the COCs (antimony, copper, and vanadium) to the literature and/or modeled cross-media PRGs.

TABLE 3-3
SUMMARY OF SURFACE SOIL PRGs (mg/kg)
SITE 2, FENCED ORDNANCE BURIAL AREA
NSWCDL, DAHLGREN, VIRGINIA

Chemical of Concern	Soil Sampling Results	Preliminary Remediation Goals	
	Range of Detected Values	Protection of Surface Water	Protection of Sediment
Inorganics - total metals			
Antimony	12.8 - 21.45	375	27.6
Arsenic	1.3 - 5.1	307	77.4
Beryllium	0.35 - 0.81	71.1	1.26
Chromium	7.8 - 19.2	46.6	409
Copper	3.7 - 19.9	15.5	298
Lead	5.8 - 43.5	313	241
Manganese	6.4 - 191.5	1,500	475
Nickel	2.5 - 8.25	104	57.0
Vanadium	13.2 - 31.8	2,730	40.9

Shaded: COC which exceeds PRGs

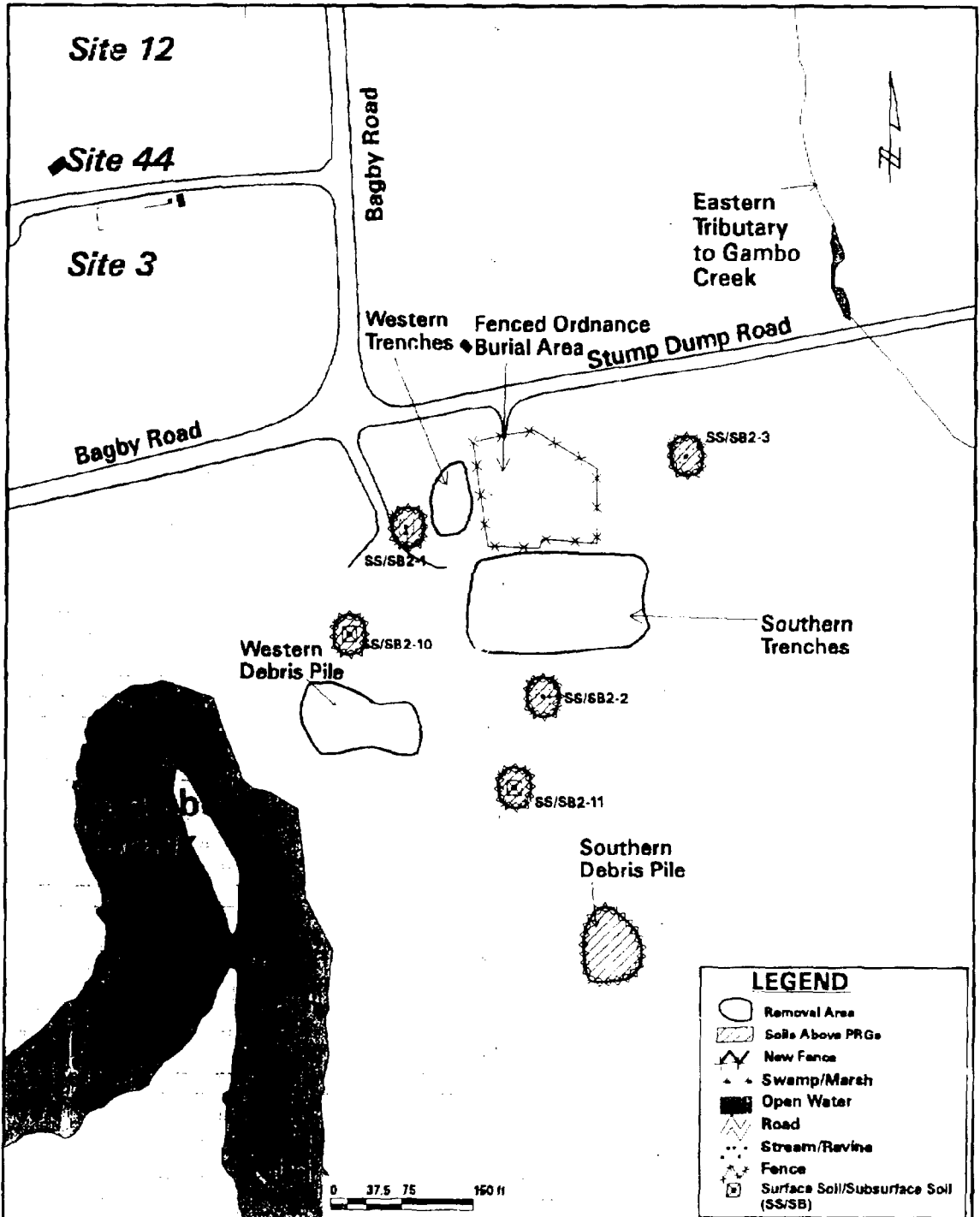
TABLE 3-4
SUMMARY OF SUBSURFACE SOIL PRGs (mg/kg)
SITE 2, FENCED ORDNANCE BURIAL AREA
NSWCDL, DAHLGREN, VIRGINIA

Chemical of Concern	Soil Sampling Results	Preliminary Remediation Goals	
	Range of Detected Values	Protection of Surface Water	Protection of Sediment
Inorganics - total metals			
Antimony	0.052 - 21.45	6,340	53.1
Arsenic	0.93 - 18.7	3,180	149
Beryllium	0.18 - 0.85	42,400	2.4
Chromium	3.0 - 61.3	422	793
Copper	2.8 - 27.1	372	574
Lead	0.08 - 43.5	63,900	460
Manganese	2.9 - 191.5	31,300	912
Nickel	1.2 - 11.8	3,640	109
Vanadium	3.9 - 118	>1,000,000	77.0

Shaded: COC which exceeds PRGs

TABLE 3-5
SUMMARY OF GROUNDWATER PRGs (ug/L)
SITE 2, FENCED ORDNANCE BURIAL AREA
NSWCDL, DAHLGREN, VIRGINIA

Chemical of Concern	Soil Sampling Results	Preliminary Remediation Goals	
	Range of Detected Values	Protection of Surface Water	Protection of Sediment
Inorganics (total and dissolved metals)			
Arsenic	5.75	65,500	3,030
Chromium	2.4 - 16.4	13,200	24,700
Copper	2.1 - 19.5	6,340	9,830
Lead	2.3 - 16.0	143,000	1,020
Manganese	25.3 - 157	378,000	10,200
Nickel	3.6 - 39.1	33,800	1,000
Vanadium	2.5 - 18.8	>1,000,000	40.5



LEGEND	
	Removal Area
	Soils Above PRGs
	New Fence
	Swamp/Marsh
	Open Water
	Road
	Stream/Ravine
	Fence
	Surface Soil/Subsurface Soil (SS/SB)

DRAWN BY LR	DATE 05/06/03	Tetra Tech NUS, Inc. ESTIMATED AREA OF SOIL CONTAMINATION ABOVE PRGS (mg/kg) FENCED ORDNANCE BURIAL AREA SITE 2 DAHLGREN, VIRGINIA	CONTRACT NO. N62467-949D90888	OWNER NO. 0810
CHECKED BY DMW	DATE 05/06/03		APPROVED BY DMW	DATE 5/16/03
COST/SCHED AREA	SCALE AS SHOWN		APPROVED BY	DATE
		DRAWING NO. Figure 3-3	REV. 0	

4.0 REMEDIAL ACTIONS

4.1 REMEDY SELECTION

The Site 2 Remedial Action Objectives (RAOs), as presented in the ROD, include the following:

- Comply with contaminant-specific, location-specific, and action-specific Federal and Commonwealth of Virginia Applicable or Relevant and Appropriate Requirements (ARARs) and to be considers (TBCs) at Site 2.
- Protect human receptors from contact with ordnance material which is suspected to be buried in the southern half of the fenced area.
- Prevent antimony at concentrations greater than 5 mg/kg in surface soils from contacting terrestrial ecological receptors and causing adverse effects.
- Prevent copper at concentrations greater than 15.5 mg/kg in surface soils from migrating to surface water and vanadium at concentrations greater than 77 mg/kg in subsurface soils from migrating to sediments, causing adverse effects in ecological receptors.

A detailed analysis of the possible remedial alternatives for Site 2 is included in the Site 2 Feasibility Study report. The detailed analysis was conducted in accordance with the USEPA document entitled "Guidance for conducting Remedial Investigations and Feasibility Studies under CERCLA" and the NCP.

The selected remedy for Site 2 involved the removal 01 soils exceeding remediation goals, removal of western and southern trenches and debris piles and backfilling all with clean fill, consolidation of all removed wastes onsite; recycling recyclable materials from debris piles offsite; capping the fenced area and consolidated waste and soils with a RCRA Subtitle C cap; and providing institutional controls to limit the site to future industrial use and to exclude shallow groundwater use. Finally, surface water, sediment and groundwater has been monitored.

4.2 REMEDY IMPLEMENTATION

The Navy performed the remedial design and implemented the remedial action. The RD was completed in March 1998. Site preparation activities for the RA began in April 1998. The RA was completed in October 1998. The major components of the RA were as follows:

- A total of 5,540 cubic yards of material were excavated horn several hotspots, disposal trenches, and debris piles as follows:

<u>Location</u>	<u>Volume (cv)</u>
Western Debris Pile	670
Southern Debris Pile	45
Western Disposal Trench	825 (380 used as select fill, 445 debris)
Southern Disposal Trench	2,280 (920 used as select fill, 1360 debris)
Soil Hot Spots (Copper, Antimony, vanadium)	475

- The excavated materials were consolidated and placed in the onsite landfill (Note: no soil, waste or debris was disposed of offsite). Upon completion of waste consolidation, a RCRA Subtitle C cap was installed on the landfill. Major components of the cover system consisted of, in ascending order

- > A 12-inch thick buffer of select fill material
- > A geosynthetic clay liner
- > A 60-mil low-density polyethylene geomembrane
- > A nonwoven geotextile (16 oz/sy)
- > An 18-inch thick select cover material layer
- > A 6-inch thick topsoil layer

- Stormwater management items, including runoff channel, culverts, rip-rap drainage channels, and a collection basin with an overflow outlet control were installed.
- A groundwater monitoring well was installed to comply with RCRA groundwater monitoring standards of one upgradient of the capped landfill and three downgradient.

The remediation contractor issued the final RA report in February 1999 (OHM, 1999). The Navy, USEPA, and Virginia Department of Environmental Quality (DEQ) have determined that all RA construction activities were performed according to specifications.

4.3 SYSTEM OPERATION/OPERATION AND MAINTENANCE

The ROD for the RA states that operation and maintenance (O&M) will be performed in accordance with an operation and maintenance plan developed upon completion of remedial activities. This O&M plan was never formally produced for Site 2.

However, although no formal O&M requirements or documentation exist for Site 2, informal site inspections have been performed during the groundwater and surface water/sediment monitoring events. These informal inspections included inspection of the cover, drainage items, and fencing. Any gross, observable problems were not noted during the sampling events.

O&M costs currently consist of both groundwater and surface water/sediment monitoring and reporting. Table 4-1 summarizes the monitoring costs to date.

TABLE 4-1
ANNUAL O&M COSTS
SITE 2, FENCED AREA ORDNANCE
NSWCDL, DAHLGREN, VIRGINIA

Year	Total Cost Rounded to nearest \$1,000
2000	\$30,000
2001	\$10,000
2002	\$10,000

5.0 PROGRESS SINCE THE LAST REVIEW

This was the first Five-Year Review for the site.

6.0 FIVE YEAR REVIEW PROCESS

6.1 ADMINISTRATIVE COMPONENTS

The USEPA and Virginia DEQ were notified of the initiation of the Five-Year Review in May. 2003. The Site 2 Five-Year Review team was led by Ryan Mayer, the Remedial Project Manager (RPM) for the Navy. TtNUS assisted in the review under contract to the Navy. Ann Swope, the NSWCDC RPM, assisted in the review as the representative of the base. Bruce Beach, the USEPA RPM, and Eric Salopek, the Virginia DEQ RPM, assisted in the review as the representatives of the support agencies.

On May 7, 2003, the review team established the review schedule at a Dahlgren partnering meeting. The components included the following:

- Community involvement
- Document review
- Data review
- Site inspection
- Five-Year Review report development and review

The Five-Year Review schedule was extended through the end of May 2003.

6.2 COMMUNITY INVOLVEMENT

A notice was sent to the *Free-Lance Star*, the *King George Journal*, and the *Westmoreland News* that a Five-Year Review was conducted in March 2003.

Upon completion of the Report, a notice will be sent to the same local newspapers that reported the completion of that the Five-Year Review report for Site 2 was complete, and that the results of the review and the report were available to the public at the Chinn Smoot Memorial Library at King George, Dahlgren Site General Library, and Dahlgren Site Public Record Room.

6.3 DOCUMENT REVIEW

The Five-Year Review consisted of a review of relevant documents including monitoring data. The documents reviewed include the following:

- B&R Environmental (Brown & Root Environmental), 1995. Draft Final Remedial Investigation Report for the Naval Surface Warfare Center, Dahlgren Laboratory, Dahlgren, Virginia. Prepared for Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Washington Navy Yard, Washington, DC, September.
- B&R Environmental (Brown & Root Environmental), 1997a. Addendum Remedial Investigation Report Site 2 for The Naval Surface Warfare Center Dahlgren Laboratory Dahlgren, VA. Prepared for Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Washington Navy Yard, Washington, DC, July.
- B&R Environmental (Brown & Root Environmental), 1997b. Feasibility Study Site 2 for The Naval Surface Warfare Center, Dahlgren Laboratory, Dahlgren, VA. Prepared for Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Washington Navy Yard, Washington, DC, February.
- B&R Environmental (Brown & Root Environmental), 1998. RCRA Cap Design Submittal for Site 2 - Fenced Ordnance Burial Area, Prepared for Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Washington Navy Yard, Washington, DC, March.

- OHM Remediation Services Corporation (OHM), 1999. Final Report for Site 2 - Fenced Ordnance Burial Area. Dahlgren NSWC, Dahlgren, VA, February.
- TtNUS (Tetra Tech NUS, Inc.), 2000. Post-Remedial Action Report for Site 2 - Fenced Ordnance Burial Area, Naval Surface Warfare Center, Dahlgren Laboratory, Dahlgren, VA. Prepared for Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Washington Navy Yard, Washington, DC, June.
- TtNUS (Tetra Tech NUS, Inc.), 2001. Monitoring Plan for Naval Surface Warfare Center, Dahlgren Laboratory, Dahlgren, VA. Prepared for Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Washington Navy Yard, Washington, DC, April.
- TtNUS (Tetra Tech NUS, Inc.), 2002. Periodic Groundwater Monitoring Report for Site 2 - Round 1, Naval Surface Warfare Center, Dahlgren Laboratory, Dahlgren, VA. Prepared for Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Washington Navy Yard, Washington, DC, July.
- TtNUS (Tetra Tech NUS, Inc.) 2003a. Periodic Biennial Surface Water and Sediment Monitoring Report for Site 2 - Round 1, Naval Surface Warfare Center, Dahlgren Laboratory, Dahlgren, VA, Prepared for Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Washington Navy Yard, Washington, DC, March.
- TtNUS (Tetra Tech NUS, Inc.), 2003b. Periodic Groundwater Monitoring Report for Site 2 - Round 2, Naval Surface Warfare Center, Dahlgren Laboratory, Dahlgren, VA. Prepared for Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Washington Navy Yard, Washington, DC, May.
- U. S. Navy, 1997. Record of Decision Site, 2 Fenced Ordnance Burial Area for The Naval Surface Warfare Center, Dahlgren Site, Dahlgren, VA. September.

6.4 DATA REVIEW

6.4.1 Background

Hazardous materials, as defined under the Resource Conservation and Recovery Act (RCRA), were disposed at Site 2. A landfill cap was constructed and institutional controls have been implemented as a remedial action to limit the migration of constituents to receptors. Since RCRA regulated waste is present at Site 2 and remedial action (or corrective action as defined under RCRA) has been performed, a Monitoring Plan was developed to comply with the groundwater monitoring requirements of a RCRA Corrective Action Program. The primary purpose of the Monitoring Plan is to ensure that corrective action performed at Site 2 is protective of potential receptors in the surface water, and sediments of Gambo Creek, which may potentially be exposed to discharging groundwater in the vicinity of Site 2.

The monitoring program for Site 2 was designed to substantially comply with applicable portions of 40 CFR Part 264 and the Virginia Hazardous Waste Management regulations (9 VAC 20-60) and to ensure that RAOs specified in the ROD are being achieved and/or maintained. To achieve this, the monitoring program included a groundwater, surface water, and sediment sampling and analysis program. Table 6-1 summarizes the monitoring requirements.

Groundwater monitoring will be performed every nine months for the first four rounds of sampling. Subsequent monitoring events will be completed on a fifteen month cycle throughout the post-closure care period of 30 years as specified in 40 CFR 269.117. The nine-month and fifteen-month sampling frequencies account for seasonal variation in the groundwater system. Surface water and sediment samples will be collected at a rate of every two years.

TABLE 6-1

LONG-TERM MONITORING REQUIREMENTS
 SITE 2, FENCED ORDNANCE BURIAL AREA
 NSWCDL, DAHLGREN, VIRGINIA

Sample Number	Field Parameters ⁽¹⁾	Explosives Method 8330	TAL Metals CLP SOW ILM04.0	TPH SW846 8015	TOC USEPA 415.1	PERCHLORATE	TOX SW-846 9020	TCL SVOCs CLP SOW OLM 04.2	TAL Metals & CN CLP SOW ILM04.1	TCL Pesticides CLP SOW OLM04.2
Groundwater										
GW2-1-MMY ²	X	X	X	X	X	X	X			
GW2-2-MMY	X	X	X	X	X	X	X			
GW2-3-MMY	X	X	X	X	X	X	X			
GW2-4-MMY	X	X	X	X	X	X	X			
GW2-6-MMY	X	X	X	X	X	X	X			
Surface Water/Sediment										
SW/SD2-1			X					X	X	X
SW/SD2-2			X					X	X	X

1 pH and specific conductivity

2 Month/Year

TAL = Target Analyte List

CLP = Contract Laboratory Program

SOW = Statement of Work

ILM 04.0 = Inorganic Laboratory Method 4.0

TPH = Total Petroleum Hydrocarbons

TOC = Total Organic Carbon

TOX = Total Organic Halogens

6.4.2 Surface Water/Sediment

The data review conducted for the Five-Year Review included a comparison of the first round of surface water and sediment sampling results. These samples were collected on September 9, 2002 in accordance with the Site 2 Monitoring Plan (TtNUS, 2001). Tables 6-2 and 6-3 summarize the surface water and sediment data, respectively.

Bis(2-ethylhexyl) phthalate, and 11 inorganics were detected in the two surface water samples obtained during the 2002 sampling event. Of the 12 constituents detected, only aluminum and Iron were observed to exceed their AWQC but were less than historical concentrations.

Four phthalate compounds, eight PAHs, and 17 inorganic constituents were detected in the two sediment samples collected during the 2002 monitoring event. The highest concentration for each detected constituent was observed in sediment sample SD2-1, which is downgradient of the site. Pesticides were not detected in either sediment sample. The detected values were within the range of historical values obtained from the RI events. Finally, since no sediment PRGs have been developed for the site, a direct comparison to set limits is not applicable.

Based on one round of data, however, it is difficult to discern any trends in contamination, whether positive or negative over time. As stated in the Long-Term Monitoring Plan, after one additional round of sampling, scheduled for September 2004, the surface water and sediment data will be evaluated to determine whether additional monitoring of the Gambo Creek surface water and sediments adjacent to Site 2 is warranted.

6.4.3 Groundwater

A groundwater monitoring program has been initiated to comply with requirements specified within the RCRA corrective action program. As stated in the Site 2 Long-Term Monitoring Plan, groundwater is monitored every 9 months at 1 upgradient and 3 downgradient wells. To date, two sampling rounds have been performed (11/2001 and 1/2003). Table 6-4 summarizes the analytical data. For the purposes of this discussion, only historical and current analytical results for inorganics (e.g. metals) have been included (unfiltered).

Groundwater monitoring data indicates that all detected metals are below their respective groundwater PRGs for the protection of surface water and sediment, as developed in the Site 2 FS. It should be noted that these metals include copper and vanadium - 2 metals which had ROD specified requirements for remedial action, Lead was slightly above its MCL at 2 wells, although on an intermittent basis. No other groundwater concentration trends were evident from the data.

Table 6-5 summarizes a comparison of the past 2 rounds of groundwater monitoring data with their respective Groundwater Protection Standards (GPS), which are based on the most stringent Ambient Water Quality Standards, BTAG values, or Gambo Creek background concentrations. As per methodology presented in the Long Term Monitoring Plan, a dilution factor of 50 is applied to the groundwater data to account for dilution/ mixing that occurs when the Site 2 groundwater enters Gambo Creek. Analysis of the data indicates that all groundwater metals data, notably copper and vanadium, are below their respective GPS values.

6.5 SITE INSPECTION

An inspection of the site was conducted on April 30, 2003 by representatives of TtNUS, including an engineer and a geologist. The purpose of the inspection was to assess the protectiveness of the remedy, including the presence of fencing to restrict access, the integrity of the landfill cap, the condition of the stormwater management/erosion control devices, and the integrity/condition of the gas vents and groundwater monitoring wells. Appendix A contains the site inspection checklist. Photographs taken during the site inspection are included in Appendix B.

Inspection of the perimeter fence and locked entrance gate indicated that both were in good

TABLE 6-2

**SUMMARY OF SURFACE WATER POSITIVE RESULTS
SITE 2, FENCED ORDNANCE BURIAL AREA
NSWCDL, DAHLGREN, VIRGINIA**

SAMPLE ID: LABORATORY ID: SAMPLE DATE:	1994 and 1996 RI Analytical Range of Detected Values ⁽¹⁾	AWQC ⁽²⁾	SW2-1 WS3623-005 9/9/2002	SW2-2 WS3623-006 9/9/2002
SEMIVOLATILES (µg/l)				
BIS(2-ETHYLHEXYL)PHTHALATE	--	NA	29 J	0.9 J
INORGANICS (µg/l)				
ALUMINUM	77.0 - 2590	87	1660 J	2050 J
BARIUM	39.0 - 63.1	NA	70.1	72.1
CALCIUM	2090 - 76050	NA	140000	138000
CHROMIUM	--	11 ⁽³⁾	--	3.6 K
COPPER	2.8 - 10.1	3.1	13.2 B	11.7 B
IRON	278 - 6840	1000	2040 J	2680 J
MAGNESIUM	1770 - 20400	NA	426000	409000
MANGANESE	56.9 - 226	NA	204	220
MERCURY	--	0.77	0.03 B	0.08 B
POTASSIUM	1500 - 75350	NA	142000	132000
SODIUM	5570 - 176500	NA	3460000	3370000
VANADIUM	5.7	NA	4.8 J	5 J
ZINC	6.4 - 59.3	81	10.2 K	11.1 K

(1) B&R Environmental, 1997a (Table 1-6)

(2) Most stringent (freshwater or aquatic) criteria value presented as specified in EPA-822-R-02-047 (2002)

(3) AWQC for chromium VI presented.

AWQC = Federal Ambient Water Quality Criteria

NA = Not Applicable

-- = Not Detected

TABLE 6-3

**SUMMARY OF SEDIMENT POSITIVE RESULTS
SITE 2, FENCED ORDNANCE BURIAL AREA
NSWCDL, DAHLGREN, VIRGINIA**

SAMPLE ID: LABORATORY ID: SAMPLE DATE:	Historical Range of Detected Values ⁽¹⁾	SD2-1 WS3623-012 9/9/2002	SD2-2 WS3623-013 9/9/2002
TCL SEMIVOLATILE SOIL (µg/kg)			
BENZALDEHYDE	--	42 J	37 J
BENZO(A)ANTHRACENE	--	41 J	21 J
BENZO(A)PYRENE	73 - 380	29 J	--
BENZO(B)FLUORANTHENE	46	50 J	23 J
BIS(2-ETHYLHEXYL)PHTHALATE	--	140 J	110 J
BUTYL BENZYL PHTHALATE	--	1000 J	--
CHRYSENE	67	33 J	23 J
DIETHYL PHTHALATE	--	170 J	--
DI-N-BUTYL PHTHALATE	240	2000 J	33 J
FLUORANTHENE	92	62 J	30 J
PHENANTHRENE	--	32 J	--
PYRENE	120 - 180	63 J	31 J
TAL METAL SOILS (mg/kg)			
ALUMINUM	3880 - 18900	14600	10200
ARSENIC	6 - 18.9	4.6	3 K
BARIUM	33.8 - 76.8	42.4	29
BERYLLIUM	0.5 - 5	1.1 B	0.8 B
CADMIUM	--	0.31 K	0.25 K
CALCIUM	405 - 8600	2000	1860
CHROMIUM	11.2 - 32	23.7	16.8
COBALT	14.4 - 48.2	11.9 K	7.3 K
COPPER	4.7 - 31.3	22.1	14.8
IRON	12100 - 36100	26500	14300
LEAD	12.6 - 106	24.6	16.3
MAGNESIUM	442 - 7320	4000	2650
MANGANESE	17.8 - 999	176 J	150 J
MERCURY	--	0.14 B	0.11 B
NICKEL	15.4 - 29.9	17.7	12.3 K
POTASSIUM	485 - 2850	2330	1460
SODIUM	5190 - 17500	9140	5880
VANADIUM	17.4 - 40.7	33.9	23.9
ZINC	18.6 - 139	89.6	58.3

(1) B&R Environmental, 1997a (Table 1.7)

-- = Not Detected

µg/kg = micrograms per kilogram

mg/kg = milligrams per kilogram

TABLE 6-4

**GROUNDWATER TREND ANALYSIS
SITE 2, FENCED ORDNANCE BURIAL AREA
NSWCDC, DAHLGREN, VIRGINIA
PAGE 1 OF 2**

SAMPLE ID: SAMPLE DATE:	Preliminary Remediation Goals (ug/l) ⁽¹⁾		Federal MCLs ⁽²⁾	GW2-1(94)	GW2-1(96)	GW2-1(01)	GW2-1(03)	GW2-2(96)	GW2-2(01)	GW2-2(03)
	Protection of Surface Water	Protection of Sediment		3/4/1994	8/19/1996	11/14/2001	1/15/2003	8/19/1996	11/14/2001	1/21/2003
INORGANICS (ug/l)										
ALUMINUM	NA	NA	NA	1580.00 J	1880.00	1250.00	648.00	11600.00	377.00	110.00 B
ARSENIC	65500	3033	10	--	--	3.00	--	4.80 J	--	--
BERYLLIUM	NA	NA	4	--	--	--	1.40 B	--	--	--
CADMIUM	NA	NA	5	--	--	1.60 B	1.50 B	1.10	0.59 B	--
CALCIUM	NA	NA	NA	5440.00	3780.00	18000.00	14700.00	3770.00	1190.00	1280.00
CHROMIUM	13200	24700	100	4.90	3.50	0.69 B	--	17.20	1.60 B	2.50
COBALT	NA	NA	NA	10.00	8.00	19.80	16.30 B	5.50	3.60 B	3.80
IRON	NA	NA	NA	1910.00 L	2200.00	891.00	1240.00	7330.00	515.00	196.00
LEAD	143000	1020	15 ⁽³⁾	2.30 J	1.80 B		1.50 K	8.80 B	12.90	--
MAGNESIUM	NA	NA	NA	3580.00	3980.00	11400.00	10200.00 L	2160.00	1460.00	1570.00
MANGANESE	378000	10200	NA	102.00	69.00	436.00	233.00	58.40	47.20	23.300
MERCURY	NA	NA	2	--	--	--	--	--	--	--
NICKEL	33800	1000	100	12.70	13.20	93.80	83.00	10.80	11.20 B	7.800
POTASSIUM	NA	NA	NA	1070.00 L	503.00	3710.00	2860.00 B	1880.00	881.00	1150.00 B
SELENIUM	NA	NA	50	--	--	--	--	--	2.90 L	--
SODIUM	NA	NA	160000	7930.00	12800.00	5300.00 J	6950.00	7930.00	4480.00 J	7230.00
THALLIUM	NA	NA	2	--	--	--	--	--	--	7.80 B
VANADIUM	2000000	200000	NA	200.00	200.00	200.00	200.00	200.00	200.00	200.00
ZINC	NA	NA	NA	50.10 L	47.00	260.00	117.00	70.70	19.80	36.80

Footnotes:

- As presented in the Site 2 Record of Decision (B&R Environmental, 1997b)
- EPA 822-R-02-038 (USEPA, 2002)
- Action Level

MCLs = Maximum Contaminant Levels

mg/L = Milligram per liter

ug/L = Microgram per liter

-- = Not detected or considered an artifact of blank contamination.

B = Positive result is considered to be an artifact of blank contamination and should not be considered present

L = Positive result is considered bias low, "L", as a result of technical noncompliances

K = Inductively Coupled Plasma Interference

J = Positive result is considered estimated, "J", as a result of technical noncompliances.

NA = Not Applicable.

Lead was above MCL at 2 locations, as indicated by black shading

Copper and vanadium had ROD specified requirements, as indicated by the grey shading.

TABLE 6-4

GROUNDWATER TREND ANALYSIS
 SITE 2, FENCED ORDNANCE BURIAL AREA
 NSWCDL, DAHLGREN, VIRGINIA
 PAGE 2 OF 2

SAMPLE ID:	Preliminary Remediation Goals (ug/l) ¹⁾		Federal MCLs ¹⁾	GW2-3(94)	GW2-3(96)	GW2-3(01)	GW2-3(03)	GW2-4(94)	GW2-4(96)	GW2-5(96)	GW2-6(01)	GW2-6(03)
	Protection of Surface Water	Protection of Sediment		3/4/1994	8/19/1996	11/15/2001	1/17/2003	3/1/1994	8/19/1996	8/19/1996	11/15/2001	1/21/2003
ALUMINIUM	NA	NA	NA	3170.00 J	729.00	79.20	47.30	798.00 J	1320.00	4500.00	1560.00	1090
ARSENIC	65500	3033	10	--	--	--	--	--	--	--	--	--
BERYLLIUM	NA	NA	4	--	--	--	--	--	--	--	--	0.34 B
CADMIUM	NA	NA	5	--	--	--	1.80 B	--	1.00	--	0.47 B	--
CALCIUM	NA	NA	NA	6770.00	2000.00	3370.00	2060.00	3150.00	2240.00	7930.00	8510.00	5690
CHROMIUM	13200	24700	100	5.30	--	0.92 B	--	--	3.70	6.30	3.80	3.2
COBALT	NA	NA	NA	15.30	10.60	4.60 B	10.30 B	25.40	29.40	--	31.20	23.3
COPPER	8340	1700	2	--	--	--	--	--	--	--	--	--
IRON	NA	NA	NA	2780.00 L	686.00	4210.00	783.00	968.00	2380.00	2890.00	2530.00	2290
LEAD	143000	1020	15 ²⁾	J	1.30 B	--	--	2.10 B	2.10 B	2.20 B	5.80 B	--
MAGNESIUM	NA	NA	NA	7370.00	5030.00	1880.00	2840.00	3330.00	3420.00	1800.00	2110.00	2040
MANGANESE	378000	10200	NA	153.00	39.30	156.00	83.40	39.20	32.40	157.00	475.00	323
MERCURY	NA	NA	2	--	--	--	--	--	--	--	--	--
NICKEL	33800	1000	100	21.00	14.40	34.80	10.30 B	31.90	39.10	4.60	33.20	27.2
POTASSIUM	NA	NA	NA	2400.00 L	2290.00	1650.00	2780.00 B	1650.00	1730.00	1510.00	1440.00	1890 B
SELENIUM	NA	NA	50	--	--	--	--	--	--	--	3.90 L	--
SODIUM	NA	NA	160000	7270.00	9420.00	4040.00 J	8380.00	5340.00	8860.00	7680.00	5470.00 J	6740
THALLIUM	NA	NA	2	--	--	--	--	--	--	--	--	--
VANADIUM	1000000 ³⁾	7000	NA	--	--	--	--	--	--	--	--	--
ZINC	NA	NA	NA	68.40 L	45.10	18.90	38.60	74.70 J	108.00	15.20 B	83.30	94.7

Footnotes:

- As presented in the Site 2 Record of Decision (B&R Environmental, 1997b)
- EPA 822-R-02-038 (USEPA, 2002)
- Action Level

MCLs = Maximum Contaminant Levels

mg/L = Milligram per liter

ug/L = Microgram per liter

-- = Not detected or considered an artifact of blank contamination.

B = Positive result is considered to be an artifact of blank contamination and sho

L = Positive result is considered bias low, "L", as a result of technical noncompl

K = Inductively Coupled Plasma Interference

J = Positive result is considered estimated, "J", as a result of technical noncompl

NA = Not Applicable.

Lead was above MCL at 2 locations, as indicated by black shading.

Copper and vanadium had ROD specified requirements, as indicated by the grey

TABLE 6-5

**GROUNDWATER GPS EVALUATION
SITE 2, FENCED ORDNANCE BURIAL AREA
NSWCDL, DAHLGREN, VIRGINIA**

Sample ID: Location: Sample Date:	GW2-1-1101 ⁽¹⁾ GW2-1 11/14/2001	GW2-1-0103 ⁽³⁾ GW2-1 1/15/2003	GW2-2-1101 ⁽⁵⁾ GW2-2 11/14/2001	GW2-2-0103 ⁽⁵⁾ GW2-2 1/21/2003	GW2-3-1101 ⁽⁵⁾ GW2-3 11/15/2001	GW2-3-0103 GW2-3 1/17/2003	GW2-6-1101 ⁽⁵⁾ GW2-6 11/15/2001	GW2-6-0103 GW2-6 1/21/2003	
Metals (ug/L)									
ALUMINUM	658 ⁽¹⁾	25	12.96	7.54	--	1.58	0.95	31.2	21.8
ARSENIC	36 ⁽²⁾	0.06	--	--	--	--	--	--	--
BARIUM	10000 ⁽³⁾	0.70 J	0.44	0.95 J	1.04	0.73 J	0.91	1.39 J	1.09
CALCIUM	92000 ⁽⁴⁾	360	294	23.8	25.6	67.4	41.2	130.2	113.8
CHROMIUM	11 ⁽⁵⁾	--	--	--	0.05	--	--	0.08	0.064
COBALT	35000 ⁽⁵⁾	0.4	--	--	0.078	--	--	0.62	0.47
IRON	1000 ⁽⁵⁾	17.82	24.8	10.3	3.92	84.2	15.66	50.6	45.8
LEAD	2.5 ⁽⁵⁾	0.35	0.03 K	0.26	--	0.44	--	--	--
MAGNESIUM	277000 ⁽⁴⁾	228	204 L	29.2	31.4	37.6	56.8	42.2	40.9
MANGANESE	10 ⁽⁵⁾	8.72	4.68	0.94	0.47	3.12	1.67	9.5	6.46
MERCURY	0.512 ⁽⁵⁾	--	--	--	--	--	--	--	--
NICKEL	8.2 ⁽⁵⁾	1.88	1.56	--	0.152	0.69	--	0.66	0.54
POTASSIUM	86200 ⁽⁴⁾	74.2	--	17.62	--	33	--	28.8	--
SELENIUM	5 ⁽⁵⁾	--	--	0.06 L	--	--	--	0.08 L	--
SODIUM	2350000 ⁽⁴⁾	106 J	139	89.6 J	144.6	80.8 J	167.6	109.4 J	134.8
ZINC	81 ⁽⁵⁾	5.2	2.34	0.4	0.74	0.38	0.77	1.67	1.89

Footnotes:

- 1 Groundwater Protection Standards based on the most stringent AWQC, BTAG, or Gambo Creek surface water data.
- 2 GPS value based on the most stringent AWQC freshwater/saltwater value.
- 3 GPS value based on the most stringent BTAG freshwater/saltwater value.
- 4 GPS value based on Gambo Creek background concentrations (B&R Environmental, 1997).
- 5 Dilution factor/mixing ratio of 50 applied to groundwater analytical data.

GPS = Groundwater Protection Standard

ug/L = Microgram per liter

TOC = Total Organic Carbon

TOX = Total Organic Halides

AWQC = Federal Ambient Water Quality Criteria.

BTAG = USEPA Biological Technical Assistance Group.

-- = Not detected or considered an artifact of blank contamination

L = Positive result is considered bias low, 'L', as a result of technical noncompliances

K = Inductively Coupled Plasma Interference

J = Positive result is considered estimated, 'J', as a result of technical noncompliances

NA = Not Applicable

Copper and vanadium had ROD specified requirements, as indicated by the gray shading

working condition and had no breaches or damaged areas. The access road that surrounds the landfill was also in good condition with no erosion or rutting evident.

The landfill cover was heavily vegetated, with grass height ranging up to 1-ft. The surface vegetation was in good condition with no gross signs of stress. The landfill cover was in good condition, with no evidence of mounding, slope failure, settlement, surface cracking, or erosion. No significant issues were identified at any time regarding the soil barrier layer, shoreline protection, or fence.

The surface water diversion and erosion control devices were all in excellent condition with no obvious signs of problems. The drainage channel surrounding the landfill did not exhibit surface erosion. The drainage channels did not show any signs of vegetative growth impeding water flow, and the lining of the channels (e.g. rip-rap) was still in place and showed no signs of movement due to high water velocity. The stormwater collection basin did not show any signs of excessive siltation or erosion, and the overflow control device and overflow channel were in good condition with no signs of heavy erosion.

The groundwater monitoring wells were all locked and in good condition. The landfill gas vent, located on the top of the landfill, was in working order and did not show signs of settlement.

The site specific institutional controls that have been put in place by NSWCDL include restrictions on breaching of the barrier layer, access from unauthorized personnel, and any other activities or actions that might interfere with the implemented final remedy. No invasive development of the landfill is allowed. During the site visit, no activities were observed that would have violated the institutional controls. The soil barrier layer was undisturbed, and no uses of groundwater were observed. In summary, no significant site issues were identified.

Review of on-site documentation indicated that all relevant Site 2 reports are kept on-site, either in a hardcopy or electronic format (Building 189). The relevant Occupational Safety and Health Administration SHA documents, including the site-specific health and safety plan and employee training records, are kept in the TtNUS job trailer located on-base.

6.6 INTERVIEWS

Interviews were conducted by TtNUS personnel in August 2003. The interview sheets are contained in Appendix D.

It should be noted that the parties most familiar with the site are the Navy, the NSWCDL, the USEPA, and the Virginia DEQ RPMs, and TtNUS personnel. These personnel meet regularly to discuss issues with the CERCLA sites at NSWC Dahlgren, including Site 2. Their knowledge regarding Site 2 has been incorporated in this Five-Year Review report.

7.0 TECHNICAL ASSESSMENT

7.1 QUESTION A: IS THE REMEDY FUNCTIONING AS INTENDED BY THE DECISION DOCUMENTS?

The review of documents, ARARs, and risk assumptions and the results of the site inspection indicate that the final remedy is functioning as intended by the ROD. The removal of contaminated soil from multiple hotspots, the removal of waste from multiple burial trenches and debris piles, the consolidation of removed soil and wastes at the landfill, and the installation of the RCRA landfill cap and associated stormwater management items have achieved the RAOs both to minimize the ecological risk associated with direct contact of surface soil (antimony) and to reduce and/or eliminate migration of contaminants to groundwater and ultimately surface water and sediment (copper and vanadium). The effective implementation of institutional controls has also helped to achieve the RAO to minimize human

receptor contact with suspected ordnance material.

Formal inspection and maintenance of the site security controls and soil barrier layer have been lacking. However, informal inspection of the cover, drainage items, and fencing were performed. No deficiencies were observed during the site visit, as noted on the site inspection checklist. There are no indications of any difficulties with the final remedy.

There were no opportunities to improve the performance and/or to reduce costs of monitoring and sampling due to the overall lack of groundwater and surface water/sediment monitoring data. Analysis of the monitoring program will be conducted after two and four rounds of monitoring for surface water/sediment and groundwater, respectively.

The institutional controls that are in place include restrictions on breaching the barrier layer, access restrictions for unauthorized personnel, and any restrictions on other activities or actions that might interfere with the implemented final remedy. No invasive development of the landfill is allowed. No activities were observed that would have violated the institutional controls. The soil barrier layer is undisturbed. The fence around the site is intact and in good repair.

7.2 QUESTION B: ARE THE EXPOSURE ASSUMPTIONS, TOXICITY DATA, CLEAN-UP LEVELS, AND RAOS USED AT THE TIME OF THE REMEDY SELECTION STILL VALID?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the final remedy.

7.2.1 Changes in Standards and To Be Considered (TBCs)

As the remedial work was completed, all location and action specific ARARs and TBCs, as cited in the ROD, were satisfied. A list of the ARARs and TBCs from the ROD is included in Appendix C. Additionally, all ARARs and TBCs pertaining to air have been met by the remedial work. Several ARARs and TBCs pertaining to water are still applicable. The long-term monitoring plan, including data collection and analysis, addresses these items.

7.2.2 Changes In Exposure Pathways, Toxicity, and Other Contaminant Characteristics

The exposure assumptions used to develop the human health risk assessment for Site 2 included both current exposures (base worker), recreational users (adults and children) and potential future exposures (construction worker). The risk assessment also included exposure of an adult recreational user who ingests fish. Currently, there has been no change in the land use, nor are there any projected changes in land use in the near future. Therefore, the exposure assumptions are still considered valid.

As stated in the ROD, there were no human health COGS that required a remedial action. Therefore, changes in toxicity or contaminant characteristics in relation to the site are not valid.

The ecological risk assessment indicated that direct exposure to antimony in surface soil was a risk. As part of the remedial action, two "hot spots" where antimony exceeded its ecological PRG were excavated and placed under a landfill cap therefore any contaminant or toxicity changes in antimony are not relevant at this time.

Cross-media modeling of soil COCs indicated a requirement to remediate Copper in surface soils to 15.5 mg/kg in order to be protective of surface water, and Vanadium to 77 mg/kg in order to be protective of sediment. These requirements resulted in the excavation of four soil "hot spots" during site remedial activities. The cross-media PRGs were based on surface water (copper) and sediment (vanadium) criteria as presented in the FS. The sediment vanadium criterion (37 mg/kg) was based on Gambo Creek non-toxic data and is still valid. The Mace water copper criterion (2.9 ug/L) was based on the Virginia State surface wafer standard for

tidal waters (freshwater and marine) as of July 1996. The current standard (9 VAC 25-260-40) for saltwater chronic is 3.8 ug/L, and the current USEPA saltwater aquatic protection standard is 3.1 ug/L. Therefore, the initial criterion initially used in the cross-media PRG analysis is more conservative than current copper surface water criteria.

In summary, there have been no changes in exposure assumptions, toxicity, or contaminant characteristics that have negatively impacted the remedial action or monitoring activities.

7.3 QUESTION C: HAS ANY OTHER INFORMATION COME TO LIGHT THAT CALLS INTO QUESTION THE PROTECTIVENESS OF THE REMEDY?

No other information calls into question the protectiveness of the final remedy. No on-site ecological targets were evaluated during the baseline risk assessment or identified during the Five-Year Review. Therefore, monitoring of on-site ecological targets is not necessary. Long-term groundwater monitoring has indicated that site-specific PRGs and GPS values have not been exceeded. One metal slightly exceeded its Safe Drinking Water Act (SDWA) Action Level, but on an intermittent basis. Additionally, no weather-related events have affected the protectiveness of the final remedy.

7.4 TECHNICAL ASSESSMENT SUMMARY

According to the data reviewed and the site inspection, the final remedy is functioning as intended by the ROD. There have been no changes in the physical conditions of the site that would affect the protectiveness of the final remedy. All ARARs for soil contamination cited in the ROD have been met. Several ARARs, specifically for water (49 CFR 257.3-3(a), 49 CFR 257.3-4 and Appendix 1, 40 CFR 121, VR 680-15-02, and 9 VAC 25.210-10), have not been initiated accordance with the schedule specified in the AOD. However, groundwater concentrations have not exceeded derived PRGs, and only lead has been slightly exceeded SDWA Action Level, and only intermittently. GPS standards, as applied to metals, have not been exceeded in Gambo Creek surface water. There is no other information that calls into question the protectiveness of the final remedy.

8.0 ISSUES

There are several issues that were identified related to site operations, conditions, or activities. The first issue is the lack of a formal, written operation and maintenance plan. Informal site inspections, however, have been performed since remedy implementation. These have included informal inspections of the cap, drainage structures, and fencing. However, barring unforeseen circumstances (i.e. total landfill cover failure); the lack of a formal O&M plan does not affect the potential for release of contaminants from the site and does not affect current or future protectiveness of the final remedy.

Several administrative institutional control requirements, as stipulated in the ROD, are in progress. These items include updating the Base Master Plan with notations indicating Site 2 is an area in which construction changes cannot occur, residential development cannot occur, shallow groundwater cannot be used. and site access shall be limited. Also, several administrative filings, including a notation in the real property file maintained by EFACHES for the site indicated the extent of the area where hazardous wastes are present, and a record of the type, location, and quantity of hazardous wastes disposed of at the site (with the County Board of Supervisors) are all in progress.

Groundwater monitoring has been initiated in accordance with the schedule provided in the ROD. To date, there have been no significant exceedances of the site-specific PRGs for groundwater, federal MCLs, or calculated GPS. The existing data gaps have not likely impacted the current or future protectiveness of the final remedy.

9.0 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Recommendations and follow-up actions for several issues were identified during this Five-Year Review. These included the lack of a formal, written O&M plan, the delay in initiating the groundwater monitoring program, and the delay in finalizing several administrative institutional control items. The Navy and NSWCDL will be responsible for these actions. The milestone for this follow-up action is tentatively scheduled for September 2003. However, it should be noted these outstanding issues do not affect the current or future protectiveness of the final remedy.

10.0 PROTECTIVENESS STATEMENT

The RA for Site 2 is protective of human health and the environment. The final remedy is functioning as intended. The exposure assumptions, toxicity data, clean-up levels, and RAOs used at the time of the final remedy selection are still valid. No other information has come to light that could call into question the protectiveness of the final remedy.

11.0 NEXT REVIEW

The next Five-Year Review for Site 2 is required by May 2008, five years from the date of this review.

REFERENCES

- B&R Environmental (Brown & Root Environmental), 1995. Draft Final Remedial Investigation Report for the Naval Surface Warfare Center, Dahlgren Laboratory, Dahlgren, Virginia. Prepared for Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Washington Navy Yard, Washington, DC, September.
- B&R Environmental (Brown & Root Environmental), 1997a. Addendum Remedial Investigation Report Site 2 for The Naval Surface Warfare Center, Dahlgren Laboratory, Dahlgren, VA. Prepared for Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Washington Navy Yard, Washington, DC, July.
- B&R Environmental (Brown & Root Environmental), 1997b. Feasibility Study Site 2 for The Naval Surface Warfare Center, Dahlgren Laboratory, Dahlgren, VA. Prepared for Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Washington Navy Yard, Washington, DC, February.
- B&R Environmental (Brown & Root Environmental), 1998. RCRA Cap Design Submittal for Site 2 - Fenced Ordnance Burial Area. Prepared for Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Washington Navy Yard, Washington, DC, March.
- Fred C. Hart Associates, Inc., 1983. Initial Assessment Study of Naval Surface Weapons Center Dahlgren Laboratory. Prepared for the Naval Energy and Environmental Support Activity, Port Hueneme, CA, May.
- OHM Remediation Services Corporation (OHM), 1998. Workplan for Site 2 RCRA Cap Construction. Dahlgren NSWC, Dahlgren, VA, March.
- OHM Remediation Services Corporation (OHM), 1999. Final Report for Site 2 - Fenced Ordnance Burial Area. Dahlgren NSWC, Dahlgren, VA, February.
- TtNUS (Tetra Tech NUS, Inc.), 2000. Post-Remedial Action Report for Site 2 - Fenced Ordnance Burial Area, Naval Surface Warfare Center, Dahlgren Laboratory, Dahlgren, VA. Prepared for Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Washington Navy Yard, Washington, DC, June.
- TtNUS (Tetra Tech NUS, Inc.), 2001. Monitoring Plan for Naval Surface Warfare Center, Dahlgren Laboratory, Dahlgren, VA. Prepared for Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Washington Navy Yard, Washington, DC, April.
- TtNUS (Tetra Tech NUS, inc.), 2002. Periodic Groundwater Monitoring Report for Site 2 - Round 1, Naval Surface Warfare Center, Dahlgren Laboratory, Dahlgren, VA. Prepared for Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Washington Navy Yard, Washington, DC, July.
- TtNUS (Tetra Tech NUS, Inc.) 2003a. Periodic Biennial Surface Water and Sediment Monitoring Report for Site 2 - Round 1, Naval Surface Warfare Center, Dahlgren Laboratory, Dahlgren, VA. Prepared for Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Washington Navy Yard, Washington, DC, March.
- TtNUS (Tetra Tech NUS, Inc.), 2003b. Periodic Groundwater Monitoring Report for Site 2 - Round 2, Naval Surface Warfare Center, Dahlgren Laboratory, Dahlgren, VA. Prepared for Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Washington Navy Yard, Washington, DC, May.
- U. S. Navy, 1997. Record of Decision Site 2 Fenced Ordnance Burial Area for The Naval Surface Warfare Center, Dahlgren Site, Dahlgren, VA. September.

I. SITE INFORMATION

Site name: <u>Site 2 - Dahlgren</u>	Date of inspection: <u>4/29/83</u>
Location and Region: <u>EPA Region 3</u>	EPA ID: <u>VA 717 0024684</u>
Agency, office, or company leading the five-year review: <u>EPA / Navy</u>	Weather/temperature: <u>Clear, 70°</u>

Remedy Includes: (Check all that apply)

<input checked="" type="checkbox"/> Landfill cover/containment	<input type="checkbox"/> Monitored natural attenuation
<input type="checkbox"/> Access controls	<input type="checkbox"/> Groundwater containment
<input checked="" type="checkbox"/> Institutional controls	<input type="checkbox"/> Vertical barrier walls
<input type="checkbox"/> Groundwater pump and treatment	
<input type="checkbox"/> Surface water collection and treatment	
<input checked="" type="checkbox"/> Other <u>long term monitoring of groundwater, surface water, and sediment</u>	

Attachments: Inspection team roster attached Site map attached N/A

II. INTERVIEWS (Check all that apply)

1. O&M site manager N/A

Name	Title	Date
------	-------	------

Interviewed at site at office by phone Phone no. _____

Problems, suggestions; Report attached _____

2. O&M staff N/A

Name	Title	Date
------	-------	------

Interviewed at site at office by phone Phone no. _____

Problems, suggestions; Report attached _____

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency _____

Contact _____

Name

Title

Date Phone no.

Problems; suggestions; Report attached _____

Agency _____

Contact _____

Name

Title

Date Phone no.

Problems; suggestions; Report attached _____

Agency _____

Contact _____

Name

Title

Date Phone no.

Problems; suggestions; Report attached _____

Agency _____

Contact _____

Name

Title

Date Phone no.

Problems; suggestions; Report attached _____

4. **Other interviews** (optional) Report attached.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

O&M manual (LTM manual)

Readily available

Up to date

N/A

As-built drawings

Readily available

Up to date

N/A

Maintenance logs

Readily available

Up to date

N/A

Remarks NO O&M MANUAL

2.	Site-Specific Health and Safety Plan <input type="checkbox"/> Contingency plan/emergency response plan Remarks _____	<input checked="" type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date	<input type="checkbox"/> N/A <input type="checkbox"/> N/A	
3.	O&M and OSHA Training Records Remarks _____	<input checked="" type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input type="checkbox"/> N/A	
4.	Permits and Service Agreements <input type="checkbox"/> Air discharge permit <input type="checkbox"/> Effluent discharge <input type="checkbox"/> Waste disposal, POTW <input type="checkbox"/> Other permits _____ Remarks _____	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A	
5.	Gas Generation Records Remarks _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A	
6.	Settlement Monument Records Remarks _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A	
7.	Groundwater Monitoring Records Remarks _____	<input checked="" type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input type="checkbox"/> N/A	
8.	Leachate Extraction Records Remarks _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A	
9.	Discharge Compliance Records <input type="checkbox"/> Air <input type="checkbox"/> Water (effluent) Remarks _____	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A	
10.	Daily Access/Security Logs Remarks _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A	
IV. O&M COSTS					
1.	O&M Organization <input type="checkbox"/> State in-house <input checked="" type="checkbox"/> PRP in-house <input type="checkbox"/> Federal Facility in-house <input type="checkbox"/> Other _____	<input type="checkbox"/> Contractor for State <input type="checkbox"/> Contractor for PRP <input type="checkbox"/> Contractor for Federal Facility			

2. **O&M Cost Records**

Readily available Up to date
 Funding mechanism/agreement in place
Original O&M cost estimate N/A Breakdown attached

Total annual cost by year for review period if available

From _____	To <u>2000</u>	<u>\$ 30,000</u>	<input type="checkbox"/> Breakdown attached
Date	Date	Total cost	
From _____	To <u>2001</u>	<u>\$ 10,000</u>	<input type="checkbox"/> Breakdown attached
Date	Date	Total cost	
From _____	To <u>2002</u>	<u>\$ 10,000</u>	<input type="checkbox"/> Breakdown attached
Date	Date	Total cost	
From _____	To _____	_____	<input type="checkbox"/> Breakdown attached
Date	Date	Total cost	
From _____	To _____	_____	<input type="checkbox"/> Breakdown attached
Date	Date	Total cost	

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: None

V. ACCESS AND INSTITUTIONAL CONTROLS Applicable N/A

A. Fencing

1. **Fencing damaged** Location shown on site map Gates secured N/A
Remarks Good condition

B. Other Access Restrictions

1. **Signs and other security measures** Location shown on site map N/A
Remarks Gate locked

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented

Yes No N/A

Site conditions imply ICs not being fully enforced

Yes No N/A

Type of monitoring (e.g., self-reporting, drive by) multi-media

Frequency 9 MONTH FOR GW; BIENNALLY FOR SWISED

Responsible party/agency EPA/NAVY

Contact RYAN MAYER RPM
Name Title Date Phone no.

Reporting is up-to-date

Yes No N/A

Reports are verified by the lead agency

Yes No N/A

Specific requirements in deed or decision documents have been met

Yes No N/A

Violations have been reported

Yes No N/A

Other problems or suggestions: Report attached

SEVERAL Administrative ICS incomplete

2. **Adequacy**

ICs are adequate

ICs are inadequate

N/A

Remarks incomplete

D. General

1. **Vandalism/trespassing**

Location shown on site map

No vandalism evident

Remarks _____

2. **Land use changes on site** N/A

NONE

Remarks _____

3. **Land use changes off site** N/A

NONE

Remarks _____

VI. GENERAL SITE CONDITIONS

A. Roads

Applicable

N/A

1. **Roads damaged**

Location shown on site map

Roads adequate

N/A

Remarks Adequate

B. Other Site Conditions

Remarks NONE

VII. LANDFILL COVERS Applicable N/A

A. Landfill Surface

1. **Settlement (Low spots)** Location shown on site map Settlement not evident
 Areal extent _____ Depth _____
 Remarks _____

2. **Cracks** Location shown on site map Cracking not evident
 Lengths _____ Widths _____ Depths _____
 Remarks _____

3. **Erosion** Location shown on site map Erosion not evident
 Areal extent _____ Depth _____
 Remarks _____

4. **Holes** Location shown on site map Holes not evident
 Areal extent _____ Depth _____
 Remarks _____

5. **Vegetative Cover** Grass Cover properly established No signs of stress
 Trees/Shrubs (indicate size and locations on a diagram)
 Remarks _____

6. **Alternative Cover (armored rock, concrete, etc.)** N/A
 Remarks _____

7. **Bulges** Location shown on site map Bulges not evident
 Areal extent _____ Height _____
 Remarks _____

8. **Wet Areas/Water Damage** Wet areas/water damage not evident
 Wet areas Location shown on site map Areal extent _____
 Ponding Location shown on site map Areal extent _____
 Seeps Location shown on site map Areal extent _____
 Soft subgrade Location shown on site map Areal extent _____
 Remarks _____

9. **Slope Instability** Slides Location shown on site map No evidence of slope instability
 Areal extent _____
 Remarks _____

B. Benches Applicable N/A
 (Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

1.	Flows Bypass Bench Remarks _____	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> N/A or okay
2.	Bench Breached Remarks _____	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> N/A or okay
3.	Bench Overtopped Remarks _____	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> N/A or okay
C. Letdown Channels <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A (Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)			
1.	Settlement Areal extent _____ Depth _____ Remarks _____	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> No evidence of settlement
2.	Material Degradation Material type _____ Areal extent _____ Remarks _____	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> No evidence of degradation
3.	Erosion Areal extent _____ Depth _____ Remarks _____	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> No evidence of erosion
4.	Undercutting Areal extent _____ Depth _____ Remarks _____	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> No evidence of undercutting
5.	Obstructions Type _____ <input type="checkbox"/> Location shown on site map Areal extent _____ Size _____ Remarks _____		<input checked="" type="checkbox"/> No obstructions
6.	Excessive Vegetative Growth Type _____ <input checked="" type="checkbox"/> No evidence of excessive growth <input checked="" type="checkbox"/> Vegetation in channels does not obstruct flow <input type="checkbox"/> Location shown on site map Areal extent _____ Remarks _____		
D. Cover Penetrations <input type="checkbox"/> Applicable <input type="checkbox"/> N/A			
1.	Gas Vents Remarks _____	<input checked="" type="checkbox"/> Active <input type="checkbox"/> Passive	<input checked="" type="checkbox"/> Good condition
	<input checked="" type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled	<input type="checkbox"/> Evidence of leakage at penetration <input type="checkbox"/> Needs Maintenance	<input type="checkbox"/> N/A

2.	Gas Monitoring Probes	<input type="checkbox"/> Properly secured/locked	<input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled	<input type="checkbox"/> Good condition
		<input type="checkbox"/> Evidence of leakage at penetration		<input type="checkbox"/> Needs Maintenance	<input checked="" type="checkbox"/> N/A
Remarks _____					
3.	Monitoring Wells (within surface area of landfill)	<input type="checkbox"/> Properly secured/locked	<input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled	<input type="checkbox"/> Good condition
		<input type="checkbox"/> Evidence of leakage at penetration		<input type="checkbox"/> Needs Maintenance	<input checked="" type="checkbox"/> N/A
Remarks _____					
4.	Leachate Extraction Wells	<input type="checkbox"/> Properly secured/locked	<input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled	<input type="checkbox"/> Good condition
		<input type="checkbox"/> Evidence of leakage at penetration		<input type="checkbox"/> Needs Maintenance	<input checked="" type="checkbox"/> N/A
Remarks _____					
5.	Settlement Monuments	<input type="checkbox"/> Located	<input type="checkbox"/> Routinely surveyed	<input checked="" type="checkbox"/> N/A	
Remarks _____					
E. Gas Collection and Treatment		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A		
1.	Gas Treatment Facilities	<input type="checkbox"/> Flaring	<input type="checkbox"/> Thermal destruction	<input type="checkbox"/> Collection for reuse	
		<input type="checkbox"/> Good condition	<input type="checkbox"/> Needs Maintenance		
Remarks _____					
2.	Gas Collection Wells, Manifolds and Piping	<input type="checkbox"/> Good condition	<input type="checkbox"/> Needs Maintenance		
Remarks _____					
3.	Gas Monitoring Facilities (e.g., gas monitoring of adjacent homes or buildings)	<input type="checkbox"/> Good condition	<input type="checkbox"/> Needs Maintenance	<input type="checkbox"/> N/A	
Remarks _____					
F. Cover Drainage Layer		<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A		
1.	Outlet Pipes Inspected	<input checked="" type="checkbox"/> Functioning	<input type="checkbox"/> N/A		
Remarks _____					
2.	Outlet Rock Inspected	<input checked="" type="checkbox"/> Functioning	<input type="checkbox"/> N/A		
Remarks _____					
G. Detention/Sedimentation Ponds		<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A		
1.	Siltation	Areal extent _____	Depth _____	<input type="checkbox"/> N/A	
	<input checked="" type="checkbox"/> Siltation not evident				
Remarks _____					

2.	Erosion	Areal extent _____	Depth _____
	<input checked="" type="checkbox"/> Erosion not evident		
	Remarks _____		

3.	Outlet Works	<input checked="" type="checkbox"/> Functioning	<input type="checkbox"/> N/A
	Remarks _____		

4.	Dam	<input checked="" type="checkbox"/> Functioning	<input type="checkbox"/> N/A
	Remarks _____		

H. Retaining Walls			
		<input type="checkbox"/> Applicable	<input type="checkbox"/> N/A
1.	Deformations	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Deformation not evident
	Horizontal displacement _____	Vertical displacement _____	
	Rotational displacement _____		
	Remarks _____		

2.	Degradation	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Degradation not evident
	Remarks _____		

I. Perimeter Ditches/Off-Site Discharge			
		<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A
1.	Siltation	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Siltation not evident
	Areal extent _____	Depth _____	
	Remarks _____		

2.	Vegetative Growth	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> N/A
	<input checked="" type="checkbox"/> Vegetation does not impede flow		
	Areal extent _____	Type _____	
	Remarks _____		

3.	Erosion	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Erosion not evident
	Areal extent _____	Depth _____	
	Remarks _____		

4.	Discharge Structure	<input checked="" type="checkbox"/> Functioning	<input type="checkbox"/> N/A
	Remarks _____		

VIII. VERTICAL BARRIER WALLS			
		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
1.	Settlement	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Settlement not evident
	Areal extent _____	Depth _____	
	Remarks _____		

2.	Performance Monitoring	Type of monitoring _____	
	<input type="checkbox"/> Performance not monitored		
	Frequency _____	<input type="checkbox"/> Evidence of breaching	
	Head differential _____		
	Remarks _____		

IX. GROUNDWATER/SURFACE WATER REMEDIES <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	
A. Groundwater Extraction Wells, Pumps, and Pipelines <input type="checkbox"/> Applicable <input type="checkbox"/> N/A	
1.	Pumps, Wellhead Plumbing, and Electrical <input type="checkbox"/> Good condition <input type="checkbox"/> All required wells properly operating <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A Remarks _____ _____
2.	Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____
3.	Spare Parts and Equipment <input type="checkbox"/> Readily available <input type="checkbox"/> Good condition <input type="checkbox"/> Requires upgrade <input type="checkbox"/> Needs to be provided Remarks _____ _____
B. Surface Water Collection Structures, Pumps, and Pipelines <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	
1.	Collection Structures, Pumps, and Electrical <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____
2.	Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____
3.	Spare Parts and Equipment <input type="checkbox"/> Readily available <input type="checkbox"/> Good condition <input type="checkbox"/> Requires upgrade <input type="checkbox"/> Needs to be provided Remarks _____ _____
C. Treatment System <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	
1.	Treatment Train (Check components that apply) <input type="checkbox"/> Metals removal <input type="checkbox"/> Oil/water separation <input type="checkbox"/> Bioremediation <input type="checkbox"/> Air stripping <input type="checkbox"/> Carbon adsorbers <input type="checkbox"/> Filters <input type="checkbox"/> Additive (e.g., chelation agent, flocculent) <input type="checkbox"/> Others _____ <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> Sampling ports properly marked and functional <input type="checkbox"/> Sampling/maintenance log displayed and up to date <input type="checkbox"/> Equipment properly identified <input type="checkbox"/> Quantity of groundwater treated annually _____ <input type="checkbox"/> Quantity of surface water treated annually _____ Remarks _____ _____
2.	Electrical Enclosures and Panels (properly rated and functional) <input type="checkbox"/> N/A <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____

3.	Tanks, Vaults, Storage Vessels <input checked="" type="checkbox"/> N/A <input type="checkbox"/> Good condition <input type="checkbox"/> Proper secondary containment <input type="checkbox"/> Needs Maintenance Remarks _____
4.	Discharge Structure and Appurtenances <input checked="" type="checkbox"/> N/A <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____
5.	Treatment Building(s) <input type="checkbox"/> N/A <input type="checkbox"/> Good condition (esp. roof and doorways) <input type="checkbox"/> Needs repair <input type="checkbox"/> Chemicals and equipment properly stored Remarks _____
6.	Monitoring Wells (pump and treatment remedy) <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> All required wells located <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A Remarks _____
D. Monitoring Data	
1.	Monitoring Data <input checked="" type="checkbox"/> Is routinely submitted on time <input type="checkbox"/> Is of acceptable quality
2.	Monitoring data suggests: N/A <input type="checkbox"/> Groundwater plume is effectively contained <input type="checkbox"/> Contaminant concentrations are declining
D. Monitored Natural Attenuation	
1.	Monitoring Wells (natural attenuation remedy) <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> All required wells located <input type="checkbox"/> Needs Maintenance <input checked="" type="checkbox"/> N/A Remarks _____

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

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

Remedy was designed to consolidate and cover waste in order to eliminate direct exposure. As a secondary benefit, the cover minimizes chemical leaching into the groundwater. Based on site visit and review of the long-term monitoring data indicate that the remedy is effective and functioning as designed.

B. Adequacy of O&M

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

No formal, written O&M manual exists and no written documentation of O&M has occurred. However, the lack of formal O&M procedures has not effected the current and long-term protectiveness of the remedy.

C. Early Indicators of Potential Remedy Problems

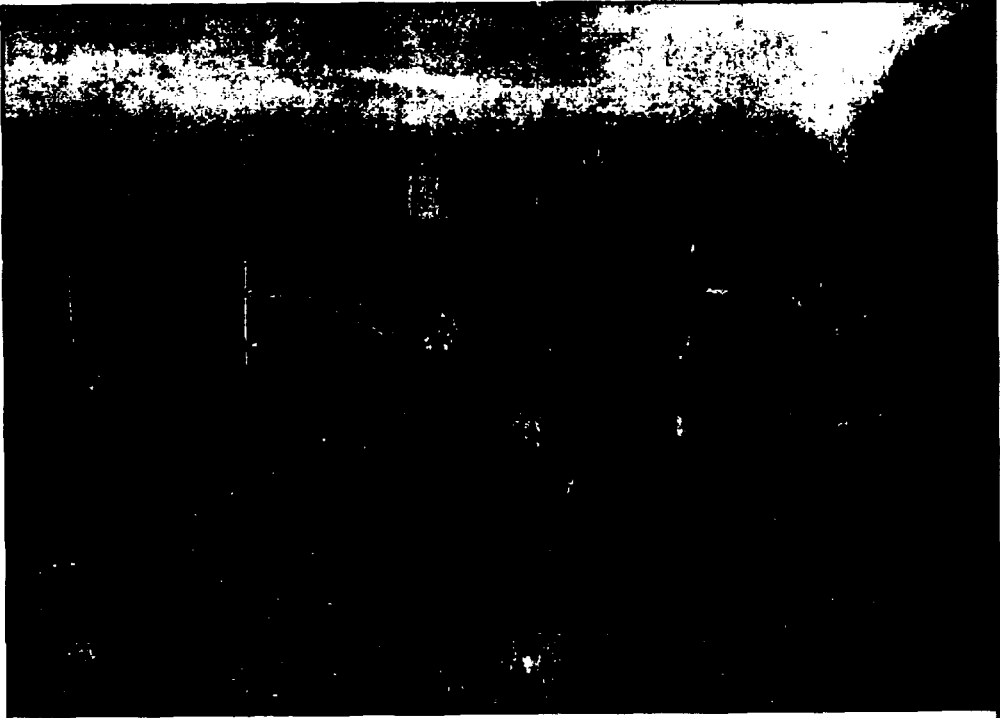
Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.

NO ISSUES OR OBSERVATIONS INDICATE THAT THE PROTECTIVENESS OF THE REMEDY MAY BE COMPROMISED IN THE FUTURE.

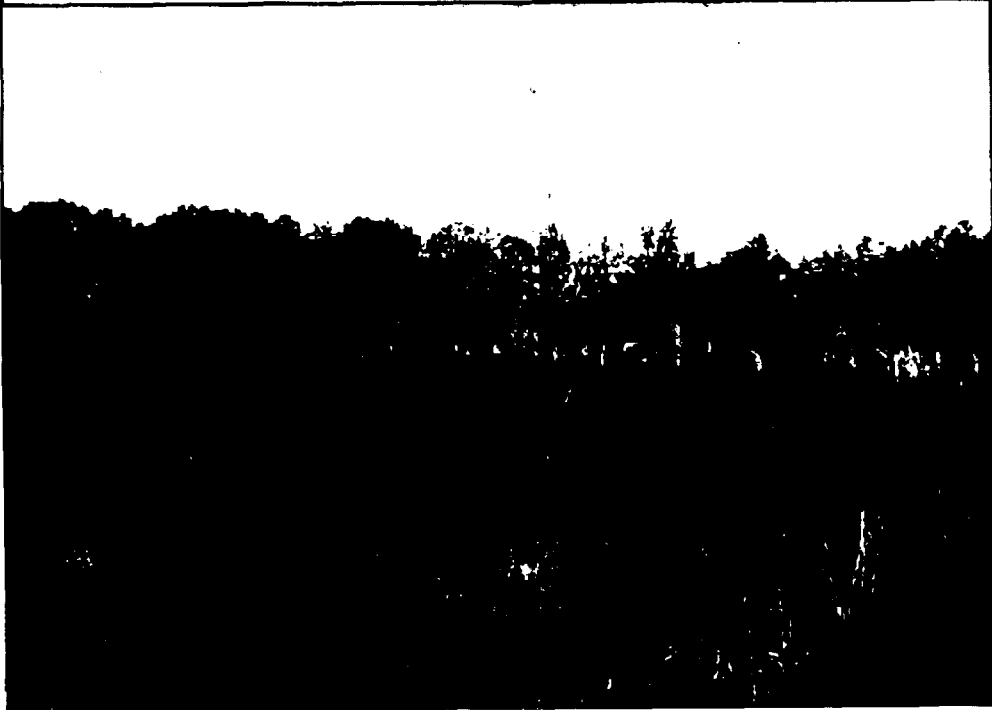
D. Opportunities for Optimization

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

AN INSUFFICIENT AMOUNT OF GUISWISED DATA HAS BEEN COLLECTED, THEREFORE THERE ARE NO OPPORTUNITIES FOR OPTIMIZATION.



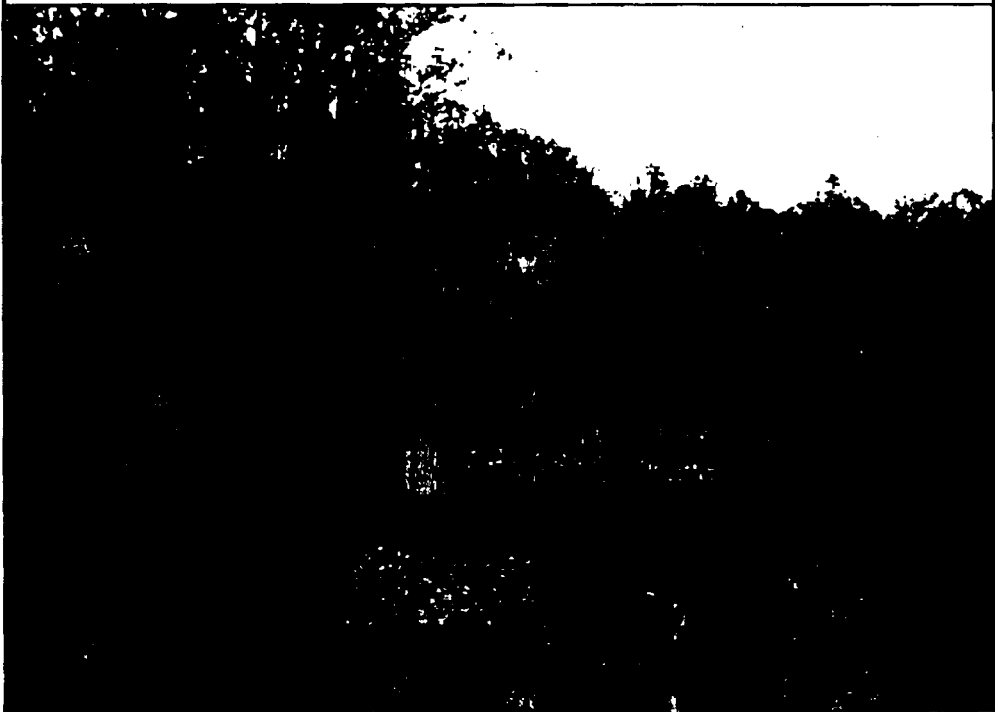
Gated Access



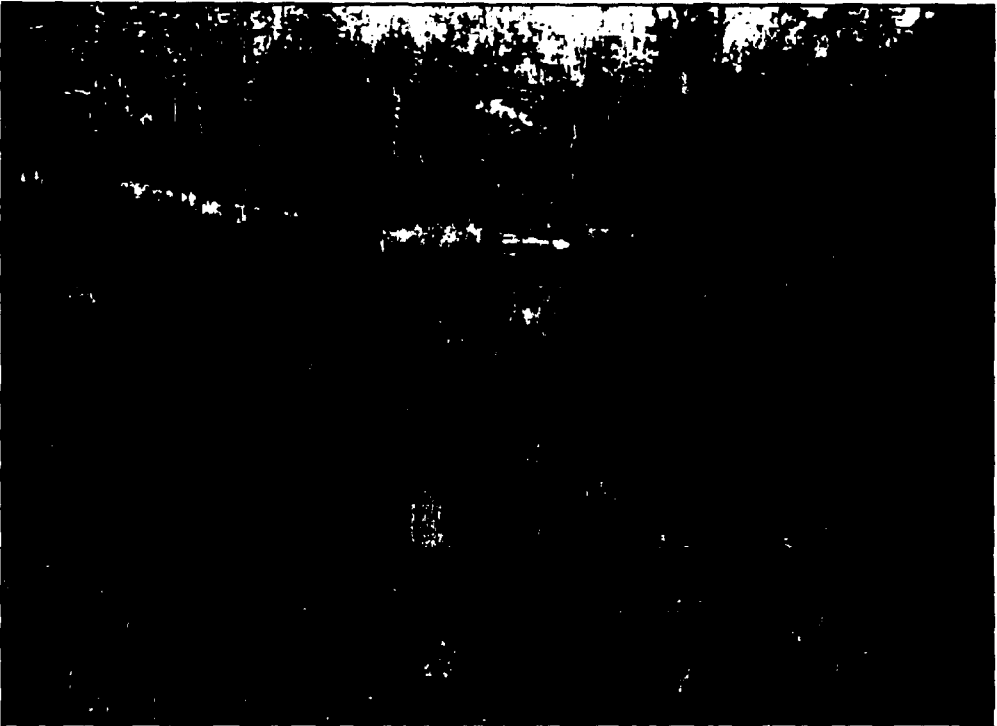
Northwest Corner of Site Looking Southeast



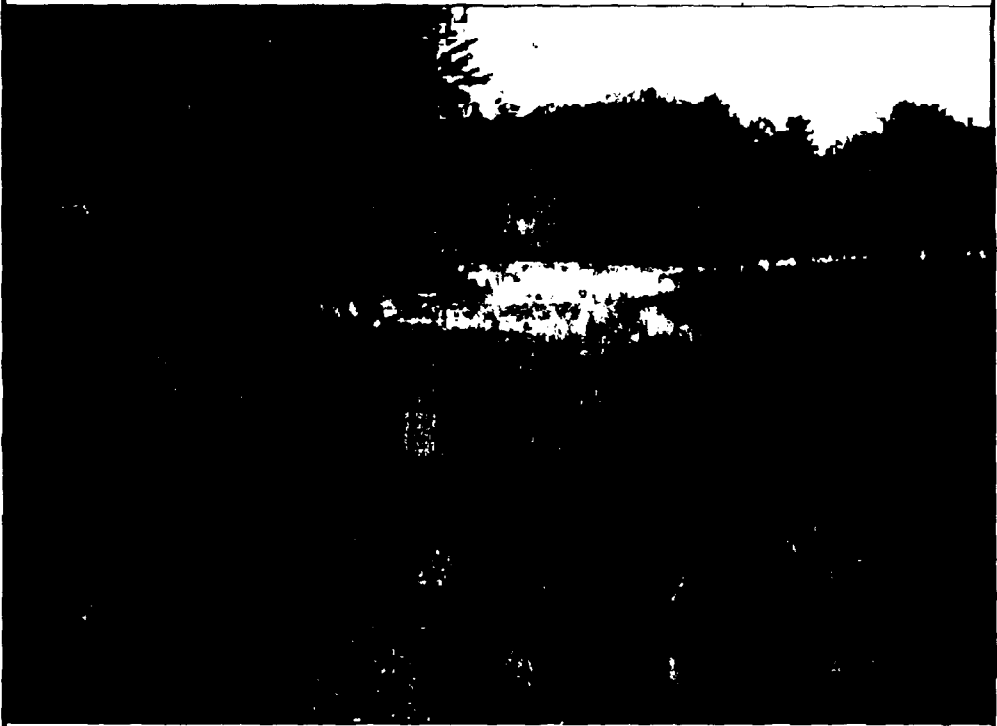
Northeast Corner Looking West



East Access Road



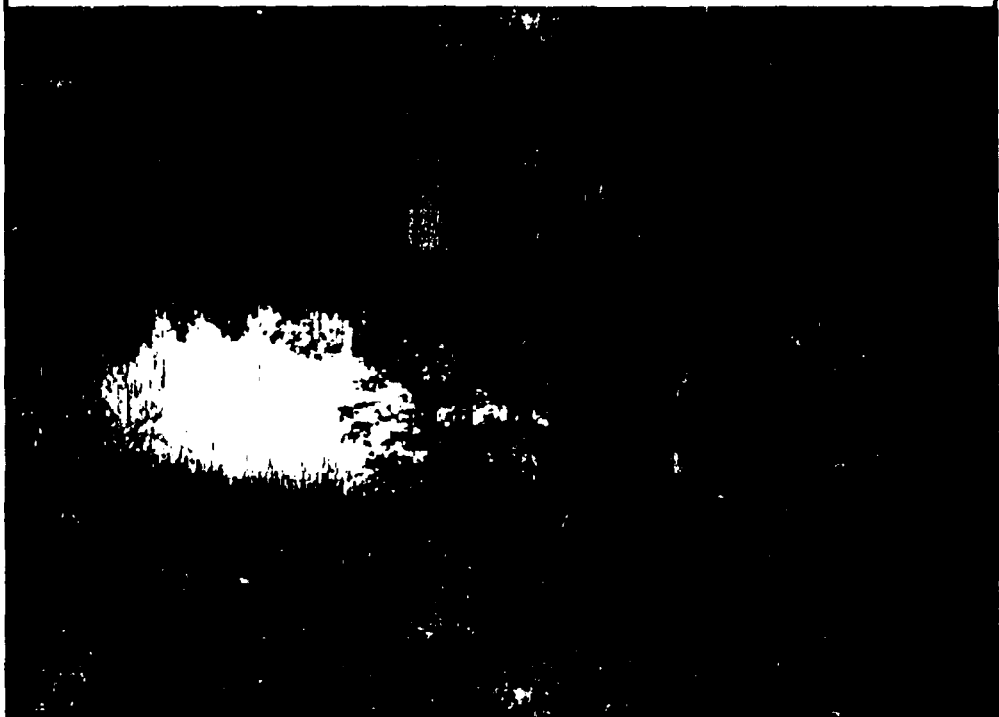
Southern Access Road



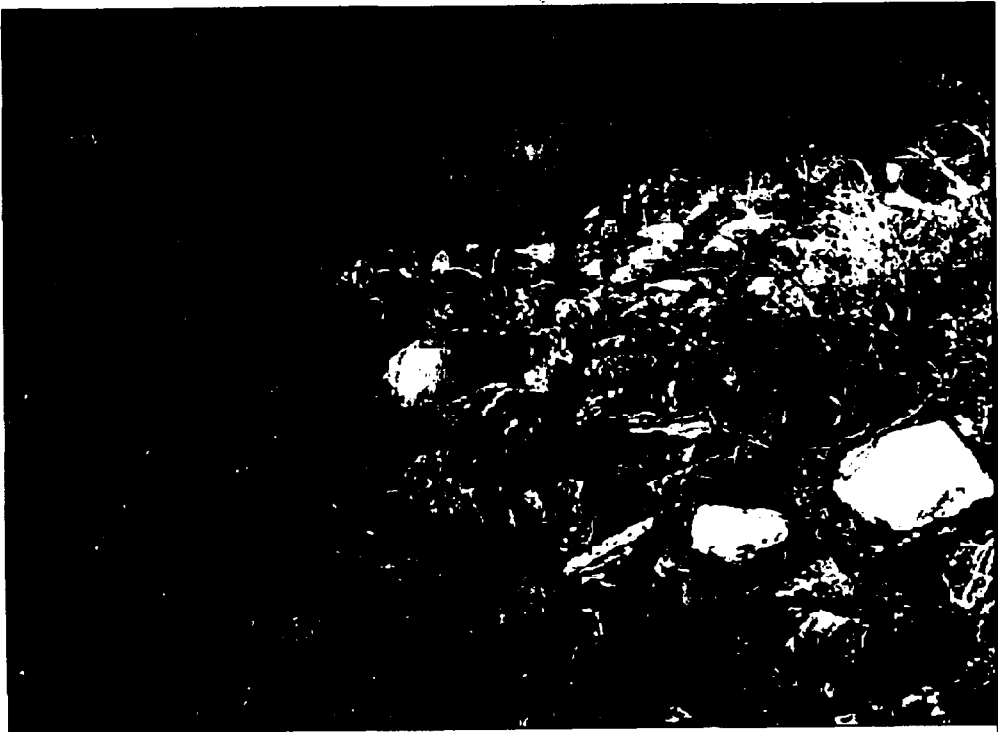
Southern Access Road Looking Toward GW2-6



Southern Access Road Looking North



Detention Basin



Detention Basin Outlet Channel



Downslope of Detention Basin Outlet Channel

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ARAR or TBC	Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
I. LOCATION SPECIFIC				
<p>Endangered Species Act of 1978</p> <p>Virginia Endangered Species Regulations</p>	<p>16 USC 1531 50 C.F.R. Part 402</p> <p>VR 325-01-1 4 VAC 15-20-130</p>	<p>Applicable</p>	<p>Act requires federal agencies to ensure that any action authorized by an agency is not likely to jeopardize the continued existence of any endangered or threatened species or adversely affect its critical habitat. Similar Virginia requirements for submittal and review of environmental assessments.</p>	<p>Potentially affected endangered species have not been identified at NSWCDL Dahlgren. The remedial action will be implemented so resources are not adversely affected should such resources be identified in the future.</p>
<p>Virginia Board of Game and Inland Fisheries: Virginia Endangered Plant and Insect Species Regulations</p>	<p>Code of Virginia Sections 29.1-100 and 29.1-563</p> <p>VR 115-04-01 2 VAC 5-320-10</p>	<p>Applicable</p>	<p>The Department of Game and Inland Fisheries (DGIF) determines if rare, threatened or endangered animal species or their habitats are threatened by remediation of the site. Certain species of fish and wildlife are afforded special preservation and protection measures. The Department of Conservation and Recreation (DCR) determines if any ecologically significant areas are threatened by the remediation of the site.</p>	<p>Potentially affected endangered species have not been identified at NSWCDL Dahlgren. The remedial action will be implemented so resources are not adversely affected should such resources be identified in the future.</p>
<p>The Archaeological and Historical Preservation Act of 1974</p> <p>Virginia Historic Resources Law</p>	<p>16 U.S.C § 469</p> <p>VR 10.1-2200-2214</p>	<p>Applicable</p>	<p>Requires actions to avoid potential loss or destruction of significant scientific, historical, or archaeological data</p>	<p>Site is not known to be within a historically significant area. If future resources are identified actions will be taken to ensure compliance.</p>
<p>Migratory Bird Area</p>	<p>16 USC Section 703</p>	<p>Applicable</p>	<p>Protects almost all species of native birds in the U.S. from unregulated "take" which can include poisoning at hazardous waste sites.</p>	<p>Remedy will be implemented to ensure that hazardous wastes have no impacts to native birds.</p>

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ARAR or TBC	Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
Chesapeake Bay Preservation Act	VR 173-02-01 9 VAC 10-20-10	Applicable	Requires certain locally designated tidal and non-tidal wetlands and other sensitive areas be subject to limitations regarding land-disturbing activities, removal of vegetation, use of impervious cover, erosion and sediment control, and stormwater management.	Remedy implementation will require construction activities. Actions will meet the regulatory requirements.
Resource Conservation and Recovery Act Virginia Hazardous Waste Management Regulations	40 C.F.R. 264.18 (b) VR 672-20-10 9 VAC 20-80-10	Applicable	Applies to treatment, storage, or disposal of hazardous waste.	Remedy implementation may produce incidental hazardous wastes which will be managed consistent with federal and Virginia requirements.
Virginia Water Control Board Regulations	VR 680-21-04 9 VAC 25-260-10	Relevant and Appropriate	Facility or activity design must adequately address the issues arising from locating in wetlands, delineated (wellhead protection areas determined vulnerable.)	Remedy implementation is not expected to involve wetland or wellhead protection areas. If identified, actions will address the regulation.
Executive Order 11988, Protection of Floodplains	40 C.F.R. 6, Appendix A; excluding Sections 6(a)(2), 6(a)(4), 6(a)(6); 40 C.F.R. 6.302	Applicable	Facilities or activities located within the floodplain must comply with this order.	Site is adjacent to Gambo Creek and is therefore partially in the 100 year floodplain. Remedy will not be installed in the floodplain and will be constructed to avoid impacts to floodplain resources.

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ARAR or TBC	Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
<p>Executive Order 11990, Protection of Wetlands</p> <p>Virginia Wetlands Mitigation Compensation Policy</p>	<p>40 C.F.R. 6, Appendix A</p> <p>Clean Water Act of 1972 (CWA) Section 404</p> <p>VR 450-01-0051 4 VAC 20-390-10</p>	<p>Applicable</p>	<p>Action to minimize the destruction, loss, or degradation of wetlands.</p> <p>Any activity to take place in, or impact on, a tidal wetland must meet the provisions of Virginia Wetlands Mitigation Compensation Policy and regulations as applicable.</p>	<p>Portions of the site adjacent to Gambo Creek are characterized as wetlands. Remedy implementation will be completed to avoid wetland impacts.</p>
<p>Virginia Water Permit Regulations</p>	<p>VR680-15-02 9 VAC 25-210-10</p>	<p>Relevant and appropriate</p>	<p>Procedures and requirements in connection with dredging, filling, or discharging any pollutant into or adjacent to surface waters, or any activity which impacts the physical, chemical, or biological properties of surface waters.</p>	<p>Construction of landfill could potentially involve discharge of contaminants to Gambo Creek. Any potential discharges will meet requirements.</p>
II. ACTION SPECIFIC				
<p>Capping /Closure and Post Closure</p>	<p>40 CFR 259.60-61</p>	<p>Applicable</p>	<p>Requirements for final cover systems to minimize infiltration and erosion. Requirements for 30 year post closure care including maintaining integrity and effectiveness of final cover. Maintenance of groundwater monitoring and landfill gas monitoring systems.</p>	<p>Installation of RCRA Subtitle C cap requires adherence to these regulations at Site 2.</p>
<p>Military Munitions Rules</p>	<p>(40 CFR 260-266 and 270)</p>	<p>To Be Considered</p>	<p>Recently promulgated regulations in response to Section 107 of the Federal Facilities Compliance Act of 1992, identifying when conventional and chemical military munitions become hazardous waste.</p>	<p>Ordnance-related wastes buried in the fenced area of Site 2 will be managed in compliance with the rules.</p>

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ARAR or TBC	Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
DoD Guidance on Property Contaminated with Ammunition, Explosives or Chemical Agents	DoD 6055.9-STD	To Be Considered	DoD guidance document stipulating policy and procedure to provide protection of personnel resulting from DoD ammunition, explosives or chemical agent contamination. Includes property currently or formerly owned, leased or used by DoD, and calls for identification and control at active installations, and provides guidance for potential land disposal.	Capping of the fenced area will be completed to be consistent with DoD policy and procedures to meet safety issues.
Erosion and Sediment Control	VR 625-02-00 4 VAC 50-30-10	Applicable	Erosion and sediment control plans are to be prepared for land-disturbing activities.	Construction activities will disturb the land in the vicinity of the site. Activities will address Virginia erosion and sediment control requirements.
Resource Conservation and Recovery Act	40 C.F.R. 265.19	Applicable	Construction Quality Assurance Program.	Installation of RCRA Subtitle C cap will address construction quality requirements under RCRA.
Virginia Hazardous Waste Management Regulations (VHWMR) Resource Conservation and Recovery Act (RCRA)	9 VAC 20-60-12 to 1505 40 C.F.R. 265.111	Applicable	For a closing facility, owner must minimize need for further maintenance; control, minimize, or eliminate post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere; and comply with other closure requirements.	VHWMR/RCRA requirements will be met with the installation of the cap at Site 2. Designs for capping, and construction of the containment unit and appurtenances will conform with engineering practice and RCRA requirements.

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ARAR or TBC	Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
Virginia Hazardous Waste Management Regulations (VHWMR) Resource Conservation and Recovery Act (RCRA)	9 VAC 20-60-12 to 1505 40 C.F.R. 265.114	Applicable	During final closure, all contaminated equipment, structures, and soil must be properly disposed of, or decontaminated.	VHWMR/RCRA requirements will be met with the installation of the cap at Site 2. Work Plans addressing these requirements will be submitted for review and approval by the Navy, EPA and VDEQ.
Virginia Hazardous Waste Management Regulations (VHWMR) Resource Conservation and Recovery Act (RCRA)	9 VAC 20-60-12 to 1505 40 C.F.R. 265.115	Relevant and Appropriate	Within 60 days of completion of closure, the owner or operator must submit to the Regional Administrator, by registered mail, a certification that the unit has been closed in accordance with approved plans and specifications.	VHWMR/RCRA requirements will be met with the installation of the cap at Site 2. Documentation of completion of construction activities at Site 2 will be submitted within required time frames.
Virginia Hazardous Waste Management Regulations (VHWMR) Resource Conservation and Recovery Act (RCRA)	9 VAC 20-60-12 to 1505 40 C.F.R. 265.116	Relevant and Appropriate	No later than the submission of the certification of closure, an owner or operator must submit to the local zoning authority and to the Regional Administrator, a survey plat indicating the location and dimensions of the landfill with respect to permanently surveyed benchmarks.	VHWMR/RCRA requirements will be met with the installation of the cap at Site 2. Surveys providing vertical and horizontal control will be prepared and submitted to appropriate authorities upon completion.

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ARAR or TBC	Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
Virginia Hazardous Waste Management Regulations (VHWMR) Resource Conservation and Recovery Act (RCRA)	9 VAC 20-60-12 to 1505 40 C.F.R. 265.117	Relevant and Appropriate	Post-closure care for each hazardous waste management unit must begin after completion of closure and continue for 30 years after that date. It must consist of monitoring and reporting under requirements RCRA Subpart N and for maintenance and monitoring of waste containment systems.	VHWMR/RCRA requirements will be met with the installation of the cap at Site 2. Monitoring requirements will be negotiated between the Navy, VDEQ, and EPA, consistent with post-closure requirements under RCRA.
Virginia Hazardous Waste Management Regulations (VHWMR) Resource Conservation and Recovery Act (RCRA)	9 VAC 20-60-12 to 1505 40 C.F.R. 265.118	Applicable	The owner or operator must develop a written post-closure plan. The post-closure plan must identify activities to be carried on after closure and the frequency of these activities. The activities include a description of the planned monitoring activities and frequencies to be performed; a description of the planned maintenance activities and frequencies to be performed to ensure the integrity of the cap and final cover and the function of the monitoring equipment. The post-closure plan must also include the name, address, and phone number of the person to contact during the post-closure care period.	VHWMR/RCRA requirements will be met with respect to the installation of the cap at Site 2. Appropriate post-closure plans will be developed and implemented consistent with RCRA requirements.

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ARAR or TBC	Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
Virginia Hazardous Waste Management Regulations (VHWMR) Resource Conservation and Recovery Act (RCRA)	9 VAC 20-60-12 to 1505 40 C.F.R. 265.119	Relevant and Appropriate	The owner or operator must, within 60 days after certification of closure of each hazardous waste disposal unit, submit to the local zoning authority and to the Regional Administrator a record of the type, location, and quantity of hazardous waste disposed of within the disposal unit. The owner or operator must record a notation on the deed, or other legal instrument to the facility property that will perpetuity notify any potential purchaser of the property that the land has been used to manage hazardous waste, its use is restricted under 40 C.F.R. Subpart G regulations and that a survey plat is included. The owner or operator must submit a certification that he has recorded the notation on the deed.	VHWMR/RCRA requirements will be met with the installation of the cap at Site 2. Appropriate deed notations will be prepared by the Navy to address notification requirements under RCRA regarding the presence of wastes at Site 2.
Virginia Hazardous Waste Management Regulations (VHWMR) Resource Conservation and Recovery Act (RCRA)	9 VAC 20-60-12 to 1505 40 C.F.R. 265.120	Applicable	The owner or operator, within 60 days after completion of the post-closure care period, must submit to the Regional Administrator, by registered mail, a certification that the post-closure care period was performed in accordance with the specifications in the approved post-closure plan.	VHWMR/RCRA requirements will be met with the installation of the cap at Site 2. The required notifications will be completed to address RCRA requirements at Site 2.

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ARAR or TBC	Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
Virginia Hazardous Waste Management Regulations (VHWMR) Resource Conservation and Recovery Act (RCRA)	9 VAC 20-60-12 to 1505 40 C.F.R. 265.310	Applicable	Final cover to provide long-term minimization of infiltration. Restrict post-closure use of property to prevent damage to the cover. Prevent run-on and run-off from damaging the cap. 30-year post-closure care to ensure site is maintained and monitored.	VHWMR/RCRA requirements will be met with the installation of the cap at Site 2. Access to the site will be restricted by fencing, and monitoring and inspection activities will be conducted.
Solid Waste Management Regulations	VR 672-20-10 9 VAC 20-80-10	Applicable	Permanent Closure Criteria governing: Access Restriction, Closure and Post Closure Care, Gas Management, Drainage Layer, Final Cover, Run-on Run-off controls, Site Monitoring, and compliance with other permanent closure requirements .	Virginia Solid Waste Management requirements will be addressed with the installation of the cap at Site 2. Overlapping with RCRA, the additional requirements under solid waste rules will be addressed.
Virginia Regulations Governing Transportation of Hazardous Materials (VRGTHM)	VR 672-30-01 9 VAC 20-110-10	Applicable	The VRGTHM designates the manner and method by which hazardous materials are loaded, packed, identified, marked, placarded, stored and transported.	Transportation of hazardous waste must be conducted in compliance with VRGTHM.

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ARAR or TBC	Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
AIR				
Gas Collection and Vents	CAA Section 101 and 40 C.F.R. 52	Relevant and Appropriate	File an Air Pollution Emission Notice (APEN) with the State to include estimation of emission rates for each pollutant expected. Design system to provide an odor-free operation.	Design of capped area anticipated to include venting to ensure cap functions as intended.
Gas Collection and Vents	40 C.F.R. 52	Relevant and Appropriate	Predict total emission of volatile organic compounds (VOCs) to demonstrate emissions do not exceed 450 lb/hr, 3,000 lb/day, 10 gal/day or allowable emission levels from similar sources using Reasonably Available Control Technology (RACT).	Design of capped area to demonstrate that decomposition gases address regulatory requirements.
Gas Collection and Vents	40 C.F.R. 60 Subpart WWW and CC	To Be Considered	New Source Performance Standard (NSPS) for municipal landfills: Landfill Emission Rule; deals with non-methane organic compounds.	NSPS requirements include calculations for gas emission rates, limitations on non-methane emissions, monitoring and recordkeeping. Rules are a TBC since Site 2 is not to receive MSW, and emissions of non-methane gases should be insignificant.
Gas Collection and Vents	CAA Section 112(D)	Relevant and Appropriate	Emission Standards for new stationary sources.	NSPS for venting. Confirmation that standards not exceeded will be addressed.
Gas Collection and Vents	CAA Section 118	Relevant and Appropriate	Control of pollution from Federal Facilities.	NSWCDL is a Federal Facility to meet CAA requirements.

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ARAR or TBC	Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
Virginia Ambient Air Quality Standards	VR 120-03-01 9 VAC 5-30-10	Relevant and Appropriate	Stipulates requirements for compliance with emissions of toxic pollutants in attainment and non-attainment areas; permitting procedures and monitoring requirements for processes emitting pollutants: any emission from the disturbance of soil must meet Virginia air emission standards for toxic pollutants particulates and VOC's.	Remedy implementation will potentially involve discharges of VOCs to the atmosphere. Emissions will be consistent with federal and state regulations.
WATER				
Criteria for Classification of Solid Waste Disposal Facilities and Practices ¹	49 C.F.R. 257.3-3(a)	Applicable	A facility shall not cause a discharge of pollutants into the waters of the U. S. that is in violation of the substantive requirements of the NPDES under CWA Section 402, as amended.	No discharges under the remedy are planned. The NPDES program is delegated to Virginia (VPDES). Potentially applicable for situations potentially not covered by VPDES.
Criteria for Classification of Solid Waste Disposal Facilities and Practices ¹	49 C.F.R. 257.3-3(a)	Applicable	A facility or practice shall not cause nonpoint source pollution of the waters of the U. S. that violates applicable legal substantive requirements implementing an area wide or Statewide water quality management plan approved by the Administrator under CWA Section 208, as amended.	Potential future releases to groundwater could migrate to the stream. Ongoing monitoring will address the requirement.
Criteria for Classification of Solid Waste Disposal Facilities and Practices ¹	49 C.F.R. 257.3-4 and Appendix I	Applicable	A facility or practice shall not contaminate an underground drinking water source beyond the solid waste boundary or a court- or State-established alternative.	Potential future releases to groundwater could contaminate groundwater over risk-based criteria. Ongoing monitoring will meet the requirement.

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ARAR or TBC	Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
Clean Water Act ' Water Quality 'Standards	33 U.S.C. §1251 et. seq. 40 CFR 121 VR 680-15-02 9 VAC 25-25-260-5 to 550	Relevant and Appropriate	Criteria and standards for groundwater quality. Virginia regulation provides basis for risk-based remediation and discharge limitations.	Provides basis for risk-based decision making, establishes standards for groundwater quality. Ongoing monitoring at Site 2 will address the requirement.
Water Quality Standards	VR 680-15-02 9 VAC 25-25-260-5 to 550	Relevant and Appropriate	Subsurface borings of all types shall be constructed, operated and closed in a manner which protects groundwater.	Completion of additional soil borings, monitoring wells and subsurface investigations will be consistent with regulatory requirements.
Pollution Discharge Elimination System (VPDES); Virginia Pollution Abatement (VPA) Permit Program	9 VAC 25-31-10 to 946 9 VAC 25-32-10 to 300	Applicable	Procedures and requirements for discharging pollutants into surface waters, or any activity which impacts physical, chemical or biological properties of surface waters.	Capping of Site 2 is not expected to produce waste liquids that would be discharged to surface waters. Any future activities or groundwater monitoring (e.g. generation of purge water) will meet regulatory requirements.
Water Quality Standards	VR 672-10-01	Relevant and Appropriate	Monitoring well design Standards.	Completion of additional soil borings, monitoring wells and subsurface investigations will be consistent with regulatory requirements.
Water Quality Standards	VR 672-10-01	Relevant and Appropriate	Monitoring well Drillers certification.	Completion of additional soil borings, monitoring wells and subsurface investigations will be consistent with regulatory requirements.

**APPENDIX C
 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
 SITE 2, FENCED ORDNANCE BURIAL AREA
 NSWCDL, DAHLGREN, VIRGINIA
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ARAR or TBC	Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
Virginia Standards for Surface Water	VR 680-21-01.14 9 VAC 25-260-140	Relevant and Appropriate	Soil Cleanup levels will be developed by using risk assessment or soil modeling techniques to determine concentrations of contaminants that can remain in soil such that water in equilibrium with the soil will not lead to natural discharge to surface water resulting in an in stream contaminant concentration greater than the surface water standard.	Cleanup criteria developed in the Feasibility Study completed for the site used risk assessment and modeling techniques that meet the requirements.
Virginia Stormwater Regulations	VR 215-02-00 4 VAC 3-20-10	Applicable	All land disturbing activities must be in compliance with local stormwater management programs, where they exist.	Remediation activities must meet requirements.

¹ On-going long-term monitoring addresses these concerns

APPENDIX D SUMMARY OF FIVE-YEAR REVIEW INTERVIEWS

To support the Five-Year Review Process for Site 2, eight people were interviewed, including two Restoration Advisory Board (RAB) members, the Naval Surface Warfare Center Dahlgren Site (NSWCDC) Fire Captain, and Dahlgren Installation Restoration Team members, including representatives from the U.S. Environmental Protection Agency (USEPA), Virginia Department of Environmental Quality (VDEQ), the Navy, and TtNUS. Interviewees were selected based upon whether they were familiar with the Site 2 remedial activities. The interviews were conducted in August and September 2003.

The Five-Year Review Process interview questions are divided into several sections. Section A contains general questions that each interviewee was asked. Section B contains questions that were applicable to Federal and State Regulators and Local Authorities. Section C contains questions relating to the Construction of the Site 2 remedy. Section D contains questions relating to the performance, operation, and maintenance of the Site 2 remedy. Section E contains questions directed toward neighbors or community representatives. A copy of the interview questions is presented at the end of this Appendix.

The interviewees felt that the Site 2 remedy was adequate and working as it was designed. One person felt the remedy was more extensive than it needed to be. No community members appeared to be concerned about the remedy for Site 2. Members of the Dahlgren Installation Restoration Team agreed that the Navy should develop a formal Operations and Maintenance Plan and should finalize the Institutional Controls for the site. The regulators felt well informed and no violations were identified for the site. No problems were identified with the construction and the Navy was encouraged to maintain the Subtitle "C" Landfill Cap and its Institutional Controls. Although one of the regulators was not aware that the site visits were occurring regularly, a Navy representative mentioned that the site is visited several times a month and cited the recent discovering of a groundhog nest at the site and the plans for capture and relocation of the animal. When asked for comments, suggestions, or recommendations, one of the local community commented that local Dahlgren residents think that cancer is coming from Dahlgren. A community representative also requested that NSWCDC keep the King George County Engineer informed about site cleanup activities.

**Five-Year Review Questionnaire - 2003
Addendum to Community Involvement Questionnaire
Naval Surface Warfare Center Dahlgren Laboratory (NSWCDL)**

Site Name: _____

Interviewee Name: _____

Title and Organization: _____

Mailing Address: _____

City: _____ **State:** _____ **Zip Code:** _____

Telephone: _____ **Date:** _____ **Time:** _____

Email Address: _____ **Location of Interview:** _____

Type of Interview: Visit Telephone Other _____

INTERVIEWER: Explain location of Site 2, Fenced Ordnance Burial Area, within the NSWCDL site and the purpose of this portion of the interview.

Section A – General

1. What is your overall impression or general sentiment of the Site 2 remedy?

2. Do you have any comments, suggestions, or recommendations regarding Site 2's management or operation?

Section B – Federal and State Regulators, Local Authorities

1. Do you feel well informed about Site 2 activities and progress?

2. Have there been routine communications or activities (Site visits, inspections, reporting activities, etc.) conducted by your office regarding Site 2? If so, please give purpose and results.

Site Visits:

Inspections:

Reporting Activities:

3. Have there been any complaints, violations, or other incidents related to Site 2 requiring a response by your office? If so, please give details of the events and results of the responses.

Complaints:

Violations:

Other Incidents:

Five-Year Review Questionnaire - 2003
Addendum to Community Involvement Questionnaire
Naval Surface Warfare Center Dahlgren Laboratory (NSWC DL)

Section C – Construction

1. What is the current status of construction (e.g., budget and schedule)?

Budget:

Schedule:

2. Have any problems been encountered which required, or will require, changes to this remedial design or this ROD?

3. Have any problems or difficulties been encountered which have impacted construction progress or implementability?

4. Do you have any comments, suggestions, or recommendations regarding this project (i.e., design, construction documents, constructability, management, regulatory agencies, etc.)?

Section D – Performance, Operation, and Maintenance

1. Is the Site remedy functioning as expected? How well is the remedy performing?

2. What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?

3. Is there a continuous on-site O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.

4. Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines since start-up or in the last five years? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.

5. Have there been unexpected O&M difficulties or costs at the Site since start-up or in the last five years? If so, please give details.

6. Have there been opportunities to optimize O&M, or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.

