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EPA Superfund
Record of Decision:

NAVAL SURFACE WARFARE CENTER - DAHLGREN
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1.0 THE DECLARATION

1.1 SITE NAME AND LOCATION

Site 2 Fenced Ordnance Burial Area
Naval Surface Warfare Center
Dahlgren Virginia

1.2 STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for Site 2 Fenced Ordnance Burial Area the Naval Surface Warfare Center, Dahlgren Site (NSWCDL) Dahlgren, Virginia. This document focuses on remedial decisions for Site 2 at NSWCDL and the term "site" in this document refers to Site 2. This determination has been made in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record for this site.

The Commonwealth of Virginia concurs with the selected remedy (see Appendix A).

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

1.3 PESCRIPTION OF THE SELECTED REMEDY

The Navy will manage the remediation of the landfill in two phases. The remedial action selected in this Record of Decision (ROD) addresses contamination associated with Site 2 landfill contents, surface and subsurface soils and groundwater. Possible contaminated surface water and sediments in Gambo Creek near Site 2 will undergo further remedial evaluation as part of the Gambo Creek Ecological Assessment and a separate ROD will be issued for Gambo Creek, as appropriate.

The selected-remedy for Site 2 is Alternative 4 which involves the removal of soils exceeding remediation goals; removal of the western and southern trenches and debris piles; backfilling with clean fill; consolidating all removed wastes onsite, recycling recyclable materials from debris piles offsite; capping the fenced area and consolidated-waste and soils; and providing institutional controls to limit the site to future industrial use and to exclude shallow groundwater use. Surface water and groundwater shall continue to be monitored.

The major components of the selected remedy are:

The Navy shall remove soils which are above the Remedial Action Objectives (RAOs) in selected areas on the site. These soils shall be consolidated underneath the fenced area landfill cap.

The Navy shall remove the southern and western debris piles. The Navy shall recycle the recyclable material in the debris piles and consolidate the remaining wastes underneath the fenced area landfill cap.

The Navy shall excavate the wastes from the southern and western trenches and backfill with clean fill. The Navy shall consolidate the excavated wastes underneath the fenced area landfill cap.

The Navy shall construct a multi-layer cap over the fenced area and the area over the excavated trenches. The cap shall be consistent with RCRA Subtitle C requirements and shall consist of a minimum of 24 inches of topsoil and vegetative cover underlain by a filter layer and 12 inches of drainage (minimum 10 -2 cm/sec), a minimum 20 mil geomembrane, and 24 inches of compacted soil or clay, or equivalent design achieving a maximum hydraulic conductivity of 10 -7 cm/sec. The cap shall include a passive gas collection system and a perimeter drainage system.

The Navy shall develop and implement an operating and maintenance plan for the landfill. The Navy shall also implement all post-closure requirements for the landfill, including the certification of closure to the Regional Administrator within 60 days of completion of the cap.

The Navy shall institute the following institutional controls within 60 days of completion of the cap: a real property description notation, Base Master Plan notations, and limited site access. Fencing shall be erected around the landfill area and signs shall be posted which state that hazardous wastes are present. The Base Master Plan shall note the area as one in which construction changes can not occur, residential development can not occur, shallow groundwater can not be used, and site access shall be limited. A notation shall be filed in the real property file maintained at Engineering Field Activity, Chesapeake (EFA Ches) (US Navy) for this site indicating the extent of the area and the fact that hazardous wastes are present. Institutional controls shall also include the following: Within 60 days of closure (capping), the Navy shall produce a survey plat indicating the location and dimensions of landfill cells or other hazardous waste disposal units with respect to permanently surveyed benchmarks. This plat shall be prepared and certified by a professional land surveyor. The plat shall contain a note, prominently displayed, which states the owners obligation to restrict disturbance of the hazardous waste disposal unit; post-closure use shall prohibit residential use, shall prohibit access or use of groundwater underlying the property for any purpose except monitoring, and shall never be allowed to disturb the integrity of the final cover, liners, or any other components of the containment system, or the function of the facility's monitoring systems. No later than 60 days after closure, the Navy shall submit to the county board of supervisors a record of the type, location, and quantity of hazardous wastes disposed of within each cell or other disposal unit of the facility. As soon as practicable, the owner shall record, in accordance with state and local law, a notation on the deed to the property - or on some other instrument which is normally examined during title search - that will in perpetuity notify any potential purchaser of the property that the land has been used to manage hazardous wastes, that its use is restricted as described above, and that a survey plat and a record of the type, location, and quantity of hazardous wastes disposed of have been filed with the local government. If and when the property is transferred out of the federal government, the deed shall contain the survey plat, the notation that the property was previously used to manage hazardous wastes and that its future use is restricted, and other deed restrictions as appropriate.

The Navy shall institute groundwater monitoring at the perimeter of the landfill cap and shall continue monitoring for 30 years, the post-closure time period as required by the Resource Conservation and Recovery Act (RCRA).

The Navy shall monitor the drainage system, surrounding the cap, surface waters, and sediments in Gambo Creek adjacent to Site 2. The frequency of analysis and the length of time for monitoring shall be developed in the Operation and Management Plan.

Implementation of the selected remedy will address the principal threats at the site by reducing the potential risk to human health and the environment associated with the surface soils and landfill contents. Additionally, this action should reduce the risk associated with potential leaching of landfill contents to the groundwater beneath the site. The selected remedy will meet the substantive requirements for the proper closure of a RCRA subtitle C landfill.

1.4 STATUTORY DETERMINATIONS

The selected remedy for Site 2 is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to this action, and is cost-effective.

The selected remedy for Site 2 addresses the containment of surface soils and landfill wastes at Site 2. The selected remedy will provide for the long-term reduction of leachate generation and possible contamination of the groundwater beneath the landfill.

This remedy fulfills the RCRA Subtitle C regulations for closure by using a design for the cap which follows EPA guidance and VDEQ requirements. The installation of a RCRA Subtitle C cap will eliminate direct contact, ingestion, and inhalation threats from contaminated soils and will reduce the leaching of contaminants to groundwater by controlling precipitation entering the landfill and minimizing eachate generation. Also, the permanent RCRA Subtitle C cap will stabilize existing conditions at the landfill.

The selected remedy for Site 2 will be constructed to meet all applicable or relevant and appropriate requirements (ARARs) whether chemical-, action-, or location-specific. No waivers of any ARARs are requested. Capping is a permanent solution and is a common remedy for land-filled wastes. Containment in the form of capping is applicable and appropriate for a site with buried ordnance.

This remedy utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. However, because treatment of the principal threats was not found to be practicable, this remedy does not satisfy the statutory preference for treatment as a principal element.

Because this remedy will result in hazardous substances remaining on-site above health based levels, a review will be conducted within five years after commencement of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

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2.0 DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND DESCRIPTION

This Record of Decision (ROD) is issued to describe the Department of the Navy's (Navy) selected remedial actions for Site 2, Fenced Ordnance Burial Area, at the Naval Surface Warfare Center, Dahlgren Site (NSWCDL), Dahlgren, Virginia (Figure 2-1). The Fenced Ordnance Burial Area is one of several Installation Restoration (IR) sites (Figure 2-2) located at the NSWCDL facility. Site 2 is situated on the "Mainside" of the base and is bounded on its western side by Gambo Creek (Figure 2-3).

Site 2, formerly used for disposal of various metal ordnance items, is located close to the eastern shore of Gambo Creek and southeast of Site 12, the Chemical Burn Area (Figure 2-2). Site 2 consists 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 Remedial Investigation (RI) (Figure 2-3). The geophysical survey did not, however, investigate the fenced area of the site due to the potential dangers associated with ordnance.

Adjacent land has been used for open burning of explosive waste, as an aerial bombing range, and as a natural habitat for native plant and animal species. Laboratory and office spaces are located within 1500 feet to the northeast of Site 2, and within 1000 feet to the southwest of the Site.

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 in trenches in areas within and outside of the fenced area. There is 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 or small pine trees indicating growth after landfill operations ended.

Groundwater production wells, which are located over 4,000 feet south of Site 2 supply potable water to NSWCDL.

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

Two drainage swales located along the western portion of the site direct surface 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.

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.2.1 History of Site Activities

Evidence based on a study of aerial photography by the USEPA in 1992 shows that activity at Site 2 began around 1943, as observed by a small cleared area on photos 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.

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In the early 1970s a fenced landfill area was excavated in the northeast corner of the site and was reportedly used for the disposal of metal ordnance materials that may have contained explosive residue. The fenced area is approximately 150 feet by 150 feet, and is surrounded by an 8-foot-high chain link fence. In addition, asbestos pipe wrappings, rinsed pesticide containers, ordnance hardware, and machine parts were buried in this area. Additional wastes that may have been buried at Site 2 within the current 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 current fenced area appeared on aerial photographs in the early to mid- 1980s. In the early 1980s, areas of the site to the east and west side of the fence were cleared of vegetation.

Trenching operations outside the current fenced area occurred between 1976 and 1988. Four trenches outside and immediately south of the current 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. This information has been updated based on the field investigation of the site, and is discussed in more detail in the Remedial Investigation (RI) report.

A surface debris pile approximately 100 feet by 50 feet containing wood, scrap metal, and rubber is located in the west side of the site. A second, smaller, debris pile containing partially melted aircraft rocket launchers is present in the southern portion of the site. (Figure 2-3).

2.2.2 Previous Investigations

Prior to the Remedial Investigation (RI), no environmental sampling and analysis was conducted at Site 2. An Initial Assessment Study (IAS) for NSWCDL, conducted in 1981, concluded that a Confirmation Study consisting of radiological monitoring should be completed to determine the presence of thorium-contaminated wastes and to determine whether a threat to human health existed at Site 2. However, Site 2 was not investigated as part of the Confirmation Study, due to the potential presence of low-level radioactive waste. Other studies that were completed at NSWCOL of relevance to Site 2 included the completion of aerial photography, a hydrogeologic survey, and ecological surveys completed in 1991-1992.

2.2.3 Enforcement Actions

There have been no enforcement actions taken at Site 2. The Navy has owned this property since the early 1900's and is identified as the responsible party.

2.2.4 Highlights of Community Participation

In accordance with Section 113 and 117 of CERCLA, the Navy held a public comment period from July 30, 1997 through August 29, 1997 for the proposed remedial action described in the Feasibility Study for Site 2 and in the Proposed Plan.

These documents, as well as the RI reports, were available to the public in the Administrative Record and information repositories maintained at the Smoot Memorial Library, King George, Virginia; the Dahlgren Laboratory General Library, Dahlgren, Virginia; and the Dahlgren Laboratory Public Record Room, Dahlgren, Virginia. Public notice of document availability and of the public meeting was provided in The Freelance Star newspaper on July 29, 1997 and a Public Meeting was held in the King George Administration Building on August 6, 1997. No written comments were received during the comment period and the copy of the certified transcript of the Public Meeting is presented in Appendix B.

2.3 SCOPE AND ROLE OF RESPONSE ACTION AT SITE 2

Past disposal operations at Site 2 have contaminated surface and subsurface soils. The NCP (40 CFR 300.430(a)(1)(ii)(A)) states "Sites should generally be remediated in operable units when early actions are necessary or appropriate to achieve significant risk reduction quickly, when phased analysis and response is necessary or appropriate given the size or complexity of total site cleanup."

The selected remedy identified in this ROD addresses contamination associated with Site 2 as identified in the RI Report, the Addendum RI Report, and the Feasibility Study (FS) Report for Site 2. The recommended response actions (or preferred alternatives) for these media are identified and the rationale for their selection is described in Section 2.7.

The selected remedy will reduce the potential risk to human health and the environment associated with the surface and subsurface soils. The remedy consists of the removal of wastes located in trenches and debris piles outside of the fenced area, and consolidating these materials into a single on-site disposal area. Soil containing elevated levels of contaminants from other areas of the site (i.e., "hot spots") will also be excavated and incorporated there. Recyclable materials from the surface debris piles will be recovered. An impermeable cap consistent with RCRA Subtitle C requirements will be installed over the ordnance area and consolidated wastes. The cap will reduce any possible exposure to contaminants in the waste disposal area and will reduce infiltration of precipitation into the wastes.

This remedy is consistent with long-term remedial goals for Site 2. The remedial action will help to contain the waste on-site, thereby reducing the principal threat from potential contact with ordnance materials. The remedy will also address direct contact and ecological risks posed from exposure to soils and surface debris and ordnance-contaminated materials. The remedy will not address surface water and sediment in Gambo Creek adjacent to Site 2. Remediation of these media will be deferred to the Gambo Creek Ecological Study.

2.4 SUMMARY OF SITE CHARACTERISTICS

The RI at Site 2 was completed in phases. Geophysical investigations and radiologic investigations were initiated in 1993. Sampling activities, consisting of soil sampling, 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. The results of the RI are summarized below.

2.4.1 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 (Figure 2-3). 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. Figure 2-4 indicates the estimated area of soil contamination above Preliminary Remediation Goals (PRGs).

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2.4.2 Description of Contamination

Wastes in the fenced area of the site have never been sampled and analyzed due to presence of ordnance and the potential dangers associated with their sampling. Based on historical records and dimensions of the filled ordnance area, approximately 6,700 cubic yards of ordnance-contaminated wastes are present in the fenced area of Site 2.

During the RI, surface and subsurface soil samples were collected at Site 2 and analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, PCBs, inorganics, explosives, thorium, radioactive gross alpha and beta activity, phenol and cyanide.

Surface Soils

VOCs were detected infrequently in the 12 surface soil samples collected. Acetone was detected at its highest concentration of 130.0 Ig/kg, and styrene was detected at 35.0 Ig/kg in one sample (SS2-5). Similarly, SVOCs were detected infrequently, with the majority of 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 Ig/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 SVOC (2-methylnaphthalene) were identified as contaminants of concern in surface soils at Site 2.

No explosives were detected in any of the surface soil samples. The radioactive parameter analyses, for gross alpha and beta activity, detected a single sample that exceeded background levels for Thorium-230. However the exceedance was slight (less than 3 times background). Aluminum, antimony, arsenic, chromium, iron, mercury, thallium, vanadium, and zinc were the only inorganics selected as contaminants of concern (COCs) in surface soils due to their potential impact to ecological receptors. Antimony was included even though the highest concentration detected was below the PRG, because the analytical result was reported as biased low and was close to the PRG for the protection of sediments.

Subsurface Soils

Subsurface soil samples were collected from the waste disposal trenches, debris piles, and other areas of the site. In addition, four test pits were completed through the trench disposal areas and samples were collected for chemical analysis.

Similar to the results for surface soils, VOCs, SVOCs and pesticides/PCBs were typically detected infrequently in the 62 samples and then at low concentration. No organic COCs were identified in subsurface soils. Elevated levels of inorganics were, however, detected at Site 2 and antimony (20.8 Ig/kg maximum), arsenic (18.7 Ig/kg maximum), manganese (177 Ig/kg maximum), selenium, (4 Ig/kg maximum) and vanadium (118 Ig/kg maximum) were selected as potential COCs in subsurface soils due to the Potential for these constituents to migrate to surface water and sediment.

Groundwater

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

Groundwater analytical data, both historical (1993) and most recent (1996), is presented in Table 2-1. 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 contamination.

TABLE 2-1

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

	Historical Data				1996 Data					
Chemical	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	Risk-Based COC Screening Level Tap Water (ug/L)	Federal MCL(Ig/L)
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 - 1127*	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
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 (2)	100
Chromium, Filtered	0/3	NA	NA	NA	1/5	2.4	2.4	GW2-5-F	18 (2)	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 - 220	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 (3)
Copper, Filtered	2/3	2.1	2.1	GW2-1-F	2/5	3 75 - 5.9	4.8	GW2-5-F	150	1300 (3)

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Chemical	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	Risk-Based COC Screening Level Tap Water (ug/L)	Federal MCL(Ig/L)
Cyanide	0/3	NA	NA	GW2-3-F 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* (1)
Iron, Filtered	3/3	142 - 446	243.3	GW2-4-F	4/5	40.9 - 1540	449.8	GW2-5-F	1100*	300* (1)
Lead	2/3	2.3 - 16.0	9.2	GW2-3	0/5	NA	NA	NA	15* (3)	15* (3)
Lead, Filtered	0/3	NA	NA	NA	1/5	5.725	5.7	GW2-2	15* (3)	15* (3)
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 (1)
Manganese, Filtered	3/3	38.55 - 146	93.2	GW2-3-F	5/5	253 - 154	61.3	GW2-5-F	84*	50 (1)
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
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		GW2-4	4/5	45.1 -108	63.1	GW2-4	1100	5000 (1)
Zinc, Filtered	3/3	39.5 - 74.75		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 CaCO3	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

No explosives were detected in monitoring wells GW2-1 and GW2-3, and no pesticide, 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 MCLs in unfiltered samples, and the action level (15 Ig/kg, from the Safe Drinking Water Act) for lead was exceeded in one well (GW2-3). The most recent sample of all monitoring wells, including GW2-3, did not detect lead. In addition, Virginia Groundwater Standards, which are based on drinking water criteria, were exceeded for zinc and cadmium.

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 (1 Ig/L) concentration 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-butylphthalate (4 Ig/L) and Fenuron TCA (0.44 Ig/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 above maximum background levels (8,53 pCi/l) in seven of eight surface water samples ranging from 29.3 to 80.75 pCi/l. However, 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. Thonium 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 at a maximum of only two out of eight samples and then at low concentrations at isolated locations in sediments. Five VOCs were detected at four different sampling locations in Gambo Creek adjacent to Site 2. The highest concentration (380 Ig/kg) was for acetone, which was reported as biased high. Six SVOCs were detected from three locations with the highest concentration (380 Ig/kg) reported for benzo(a)pyrene. A total of 6 Polynuclear Aromatic Hydrocarbons (PAHS) were detected for a combined maximum concentration of 1005 Ig/kg. The debris pile present on the west side of the site may represent a possible source of some of the SVOC compounds detected. Nine pesticides/PCBs were detected in sediments, with concentrations ranging from 3.3 Ig/kg to 1,910 Ig/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 Ig/kg) in environmental media throughout the NSWCDL facility, and Site 2 is not believed to be a source. The Gambo Creek Ecological Study, currently being performed, will determine the extent to which surface water and sediments are impacted by facility operations and will make recommendations for addressing sediments and surface water throughout the Gambo Creek watershed on the base.

Explosive constituents were not detected in any of the sediment samples collected. Inorganics were detected in sediment samples, several of which were detected above background levels, including antimony, arsenic, beryllium, chromium, iron, lead, magnesium, and manganese. Potential remedial actions to address contributions from other sources at NSWCDL are being evaluated separately under the Gambo Creek Ecological Assessment Study.

2.4.3 Contaminant Migration

Access to the ordnance burial area of the site is currently restricted by fences. Base workers visit Site 2 infrequently, and do not enter the ordnance disposal area. The trench disposal area and the surface debris piles may be accessed, however, potential exposure is expected to be minimal. The migration of contaminants associated with the ordnance burial area has been shown in the different phases of the RI to be minimal, and potential exposure would be similarly minimal.

COCs identified at Site 2 consist of inorganics in surface and subsurface soil that may present risks to ecological receptors. These contaminants are expected to migrate via surface runoff or

through soils by dissolution to groundwater, and transport by groundwater to receptors in surface water and sediment. Migration pathways were considered in detail in the modeling effort completed for the FS.

2.5 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 which 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 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 fishermen 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.

Because many contaminants have the ability to migrate from on medium to another (e.g, soil to aroundwater), assessing risks from observed levels of contaminants is insufficient to evaluate all the risks that may be presented 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. Preliminary Remediation Goals (PRG's) were developed for COCs in all media to establish concentrations that would not produce unacceptable risks.

2.5.1 Human Health Risks

Exposure Pathways and Potential Receptors

Base workers, recreational users (adults and children, on the site and on Gambo Creek adjacent to Site 2), and construction workers were evaluated as potential receptors in the quantitative risk assessment. Construction workers were evaluated for future conditions only. The remaining receptors are considered for current and future conditions. Ingestion of finish was evaluated for adult recreational users only. Construction workers were evaluated for exposure to surface/subsurface soil (0 to 12 feet), while surface soil (0 to 2 feet) exposure was considered for all other receptors. Inhalation of volatile emissions and fugitive dust was evaluated qualitatively via a comparison of site data to EPA Generic Soil Screening levels for transfers from soil to air. Inhalation exposure was considered to be relatively insignificant since all detected soil concentrations were less than the screening levels. Direct contact with surface water and sediment is not anticipated at the site. Fishermen will be in boats and have very limited exposure and duration of exposures to surface waters. Therefore, pathways associated with these media were not quantitatively evaluated.

Exposure Assessment

No VOCs were identified as 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.

Toxicity Assessment

Cancer potency factors (CPFs) have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. CPFs, which are expressed in units of (mg/kg-day) -1, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the CPFs. Use of this approach

makes underestimation of the actual cancer risk highly unlikely. Cancer potency factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied.

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs, which are expressed in units mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur.

Risk Characterization

Excess lifetime cancer risks are determined by multiplying the intake level with the cancer potency factor. These risks are probabilities that are generally expressed in scientific notation (e.g., lxl0 -6). An excess lifetime cancer risk of 1 x 10 -6 indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of site related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ) (or the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose). By adding the HQs for all contaminants within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) can be generated. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media.

Current and Future Bass 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 x 10 -7 under a "reasonable maximum exposure" scenario, well below EPA's target risk range of 1 x 10 -6 to 1 x 10 -4.

Adult Recreational User. The cumulative noncancer 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 fin fish. The cumulative ingestion and dermal contact cancer risk is 6.4 x 10 -7 under a reasonable maximum exposure scenario, well below EPA's target risk range of 1 x 10 -6 to 1 x 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 industrial land use scenario are 2.4 x 10 -2 and 1.4 x 10 -6 respectively under a reasonable maximum exposure scenario. Under the industrial land use scenario, ingestion and dermal contact were evaluated just 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 x 10 -2 and 5.4 x 10 -7 respectively under a reasonable maximum exposure scenario.

Although the incremental cancer risk (ICR) for the child recreational user slightly exceeded 1 x10 -5, it is well within EPA's target risk range of 1 x 10 -4 to 1 x 10 -6. Since the ICR to all other receptors is less than 1 x 10 -6, and the hazard indices for receptors are less than 1.0, human health risks under industrial land use conditions are within acceptable risk ranges at Site 2. Human health baseline risks are not greater than the risk range, however action is being taken at Site 2 to protect potential environmental receptors.

There are several aspects of uncertainty associated with the risk assessment conducted at Site 2. The major issues of uncertainty specific to Site 2 are as follows:

While the USEPA recognizes lead as a B2 carcinogen, no cancer slope factor has been assigned to this chemical. Currently, risks associated with lead are estimated in terms of predicted blood lead levels in small children (ages 7 and under) by using the Integrated Uptake Biokinetic Model. Typically, lead does not become a significant risk factor unless concentrations exceed 400 mg/kg in soil (USEPA, 1994b) and 15 Ig/L in drinking water. Lead is not considered to be a COC for soil at the site since the maximum detected concentration of lead is less than 400 mg/kg. Although the maximum site concentration of lead in groundwater exceeds 15 Ig/L, groundwater is not expected to be used as a potable water supply. No USEPA Region III COC screening level is available for exposure to lead in fish. However, the maximum surface water concentration for this chemical (7.0 Ig/L; sample SW2-7) was well below the 50 Ig/L Federal AWQC for the protection of human health (consumption of water and organisms). Therefore, even though lead was not evaluated quantitatively in the human health risk assessment, the potential risks associated with exposure to this chemical are considered to be minimal.

Because of the lack of toxicity criteria, USEPA Region III COC screening levels could not be calculated for a few chemicals detected in the soil and surface water at the site (benzo(g,h,i)perylene, calcium, magnesium, sodium, and potassium). This may lead to a slight underestimation of potential risks. However, the underestimation is expected to be minimal since overall exposure to PAHs is adequately addressed by the evaluation of other PAHs, and the remaining inorganics are essential nutrients, commonly detected in environmental media.

Because of the relatively small data set of five samples, the maximum surface water concentration was used to assess potential RME risks for recreational users via fish ingestion. Consequently, the human health risks, associated with this exposure route may be overestimated since it is highly unlikely that the true exposure concentration for surface water, to which a receptor is hypothetically exposed over the entire exposure period, is equal to the maximum detection.

Analytical results for unfiltered surface water samples were used to estimate potential human health risks for fish ingestion. Unfiltered results are typically greater than filtered results because of suspendel sediment. The use of unfiltered data is considered to be conservative since data for filtered samples are more likely to approximate the bioavailable fraction of inorganics in surface water. Therefore, estimates of fish uptake based on unfiltered sample data for inorganics may result in overestimates of fish tissue concentrations and the human health risks for fish consumption.

The calculated risks for the fish ingestion pathway are based on estimates of uptake from surface water and do not account for the uptake of contaminants from sediment. Thus, the risks for the fish ingestion pathway may be underestimated. Chemicals present in the sediment, as opposed to the surface water, may be of greater concern for bioaccumulation in fish. Chemicals commonly detected in the sediment at Site 2 consist of PAHs and metals. Styrene was detected in one sediment sample. A presentation of the sediment results for the site is provided in the Draft RI Report, Volume I.

2.5.2 Environmental Evaluation

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 EPA followed EPA guidance for performing ecological risk assessments and was approved by Region III, EPA's Biological Technical Assistance Group (BTAG). The baseline ERA is described fully in the RI Report, and is briefly summarized here.

Analytical data compiled from the RI were analyzed using EPA Region III guidance for screening-level risk assessments and to determine environmental effects quotients (EEQs). EEQs were determined by comparison with standard guidelines such as EPA Region III and Biological Technical Assistance Group (BTAG) guidelines. 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 preliminary remediation goals (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 or how to manage the potential risk were made by comparling 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 twenty-two PCOCs identified in sediment, nine had maximum concentrations above their PRG (or had 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.

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

Table 2-2 summarizes the list of COCs developed for the ecological risk assessment.

2.5.3 Development of Preliminary Remediation Goals (PRGs)

Contaminant fate and transport modeling is used to evaluate the potential for COCs 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. In order to evaluate this potential, fate and transport modeling was conducted for Site 2 using the ECTran model.

The model uses contaminant properties such as solubility, and site specific characteristics such as depth to groundwater, to predict acceptable levels of COCs in soil and groundwater that would be protective of surface water and sediment. Using regulatory criteria for surface water and similarly protective sediment, values for the concentrations developed by the modeling, PRGs, are used to determine if existing levels of COCs are acceptable. A complete discussion of the use of modeling and assumptions is presented in the Site 2 FS.

<IMG SRC 97179FA>Potential migration of COC's evaluated for Site 2 by the ECTran model included:

- Surface soil to surface water via runoff
- Surface soil to sediment via runoff
- Surface soil to surface water via groundwater
- Subsurface soil to surface water via groundwater
- Subsurface soil to sediment via groundwater
- Groundwater to surface water
- Groundwater to sediment

PRGs were developed by modeling for the following COC's:

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

This list includes 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 not modeled were; not attributable to Site 2 as a current source, or had borderline toxicity potential, or were common laboratory contaminants, or had ooncentrations 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 was identified at levels in subsurface soils 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 2-3, 2-4, and 2-5.

TABLE 2-3

SUMMARY OF SURFACE SOIL PRGs - SITE 2 - (mg/kg)
NSWCDL DAHLGREN, VIRGINIA

	Soil Sampling Results	Preliminary Remediation Goals	
Chemical of Concern	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	409	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 2-4

SUMMARY OF SUBSURFACE SOIL PRGs - SITE 2 - (mg/kg)
NSWCDL DAHLGREN, VIRGINIA

	Soil Sampling Results	Preliminary Remediation Goals	
Chemical of Concern	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 2-5

SUMMARY OF GROUNDWATER PRGs - SITE - (Ig/L)
NSWCDL DAHLGREN, VIRGINIA

Chemical of Concern	Range of Detected Values	Preliminary Remediation Goals: Protection of Surface Water	Preliminary Remediation Goals: 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. -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

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 Crook may occur via ingestion of contaminated surface water, sediment, and food, and through direct contact with surface water and sediments.

Exposure Assessment

Surface soil contaminants at Site 2 that had EEQs greater than 1, or had no PRG, included 2-methyl napthalene, 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 microrganisms, 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, and pesticides and the herbicide monuron in sediment are of concern for risks to ecological receptors at Site 2. Risk management factors include comparing maximum site concentrations to background levels, considering the frequency of detection, the likelihood that a source exists on the site, and bioavailability of the contaminant.

2.5.4 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 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. Pesticides and monuron in sediments of Gambo Creek adjacent to Site 2 will be evaluated further in the Gambo Creek Ecological Study and any necessary remedy selected thereafter.

Viewed within the context of the full range and distribution of sample results throughout the site, these exceedances were considered isolated "hot spots" (see Figure 2-4) that would be addressed as part of the remedial altenatives considered for Site 2.

2.6 DESCRIPTION OF ALTERNATIVES

Based on an evaluation of site conditions, potential risks, and legal requirements for Site 2, four remediation goals were identified to protect the public from potential current and future health risks, as well as to protect the environment:

- Compliance at Site 2 with contaminant-specific, location-specific, and action-specific Federal and Commonwealth of Virginia ARARS, and to be considereds (TBCS).
- 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 5mg/kg in surface soils from contact with 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, and causing adverse effects in ecological receptors.

A detailed analysis of the possible remedial atternatives for Site 2 is included in the Site 2 Feasibility Study (FS) report. The detailed analysis was conducted in accordance with the EPA document entitled "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" and the National Oil and Hazardous Substances Contingency Plan (NCP).

Institutional controls, including a real property description notation. Base Master Plan notations, and limited site access would be implemented for each alternative except the No Action Alternative.

Limited site access would be achieved by using fencing and by posting signs that say hazardous wastes are present. The Base Master Plan will note the area as one in which construction changes can not occur, residential development can not occur, shallow groundwater can not be used, and site access will be limited. A notation will be filed in the real property file maintained by EFA Ches for this site indicating the extent of the area and the fact that hazardous wastes are present. Institutional controls shall also include the following: Within 60 days of closure (capping), the Navy shall produce a survey plat indicating the location and dimensions of landfill cells or other hazardous waste disposal units with respect to permanently surveyed benchmarks. This plat shall be prepared and certified by a professional land surveyor. The plat shall contain a note, prominently displayed, which states the owner's obligation to restrict disturbance of the hazardous waste disposal unit: post-closure use shall prohibit residential use, shall prohibit access or use of groundwater underlying the property for any purpose except monitoring, and shall never be allowed to disturb the integrity of the final cover, liners, or any other components of the containment system, or the function of the facility's monitoring systems. No later than 60 days after closure, the Navy shall submit to the county board of supervisors a record of the type, location, and quantity of hazardous wastes disposed of within each cell or other disposal unit of the facility. As soon as practicable, the owner shall record, in accordance with state and local law, a notation on the deed to the property - or on some other instrument which is normally examined during title search - that will in perpetuity notify any potential purchaser of the property that the land has been used to manage hazardous wastes, that its use is restricted as described above, and that a survey plat and a record of the type, location, and quantity of hazardous wastes disposed of have been filed with the local government. If and when the property is transferred out of the federal government, the deed shall contain the survey plat, the notation that the property was previously used to manage hazardous wastes and that its future use is restricted, and other deed restrictions as appropriate. Reviews of groundwater, surface water, sediment and drainage system monitoring would be conducted every 5 years for each alternative. Due to Navy security concerns with the nature of the material in the disposal trenches at Site 2, the FS did not consider any offsite treatment or disposal alternatives for waste buried in these trenches. Similarly, due to safety concerns for ordnance-related waste in the fenced ordnance area, the FS did not consider any alternatives that would require the excavation of this portion of the site.

A summary of the remedial alternatives which were developed to address contamination associated with Site 2 is presented below.

ALTERNATIVE 1 - No Action

Description: Under this alternative no further effort or resources would be expended at Site 2. Alternative 1 serves as the baseline against which the effectiveness of the other alternatives is judged.

ALTERNATIVE 2 - Remove Soils Exceeding Remediation Goals and Dispose Offsite; Characterize and Take Appropriate Action on Western Debris Pile; Backrill with Clean Fill; Institutional Controls

Description: Waste materials would be excavated from the areas where remediation goals are exceeded, including the southern debris pile, and disposed at an offsite industrial landfill. Although wastes present in the western debris pile have not been characterized as exceeding remediation goals, the basis of the characterization is a single sample. Additional sampling of the western debris pile would be completed to more completely characterize the materials disposed in this area of the site, and to take appropriate action. No actions would be taken for the western debris pile unless further characterization indicated that remediation goals were exceeded. If remediation goals are determined to be exceeded, the quantity of soils that exceeded remediation goals would be disposed in an industrial waste landfill (Alternative 2A). Costs developed for Alternative 2A assume that if excavation proved to be necessary that all soils in the western debris pile would require disposal. All areas of the site excavated to achieve remediation goals would be backfilled with clean fill, regraded, and revegetated. No additional actions are proposed for the fenced ordnance burial area under Alternative 2. During excavation, the potential for erosion will be minimized by following erosion and sediment control best management practices. Habitat alteration will be minimal.

Institutional controls including limiting site access and future land use would be implemented to eliminate or reduce potential exposure to ordnance materials at the site. In addition, groundwater, surface water, and sediment monitoring would be conducted over at least the next five years to determine if contaminants were migrating at significant rates and concentrations.

The costs for this alternative are:

Capital costs*	$396,000
Annual costs	$26,800
30-year present worth*	$876,000
Months to implement	4

*Note: Costs indicated assume that western debris pile characterization does not result in exceeding remediation goals. If remediation goals are exceeded, capital costs for the alternative (offsite disposal, Alternative 2A) are estimated to be $818,000 (present worth of $1,298,000).

ALTERNATIVE 3 - Remove Soils Exceeding Remediation Goals and Dispose Offsite or Beneath Cap Onsite; Characterize and Take Appropriate Action on Western Debris Pile; Backfill with Clean Fill; Cap Fenced Area and Western and Southern Trenches; Institutional Controls

Description: Alternative 3 is identical to Alternative 2, with the exception that the fenced area and the western and southern disposal trenches would be capped resulting in a RCRA Subtitle C Landfill Closure. No actions would be taken on the western debris pile unless further characterization indicated that remediation goals were exceeded. If remediation goals were determined to be exceeded, the quantity of soils that exceeded remediation goals would be removed and either disposed in an industrial landifill (Alternative 3A) or removed and placed beneath the cap covering the fenced area and the western and southern disposal trenches (Alternative 3B). A multi-layer cap installed over the fenced area and trenches would minimize the potential for human contact, and reduce the potential migration of contaminants through the ordnance and trench disposal areas. Consistent with RCRA Subtitle C requirements, the cap would consist of a minimum of 24 inches of topsoil and vegetative cover underlain by a filter layer and 12 inches of drainage (minimum 10 -2 cm/sec), a 20 mil geomembrane, and 24 inches of compacted soil or clay achieving a maximum hydraulic conductivity of 10 -7 cm/sec. The vegetative and protective layers provide stability and erosion control and protect underlying layers. The drainage layer allows infiltrating surface water to flow away from the cap areas. The geomembrane is a protective layer overlying the low permeability soil/clay cap. (See Section 2.8.1 for a more thorough discussion of the function and composition of the cap layers).

During excavation and construction of the cap, the potential for erosion will be minimized by following erosion and sediment control best management practices. Less than one acre of forest habitat will be converted to grassland habitat.

Institutional controls including limiting site access and future land use would be implemented to eliminate or reduce potential exposure to ordnance materials at the site. In addition, groundwater, surface water, and sediment monitoring over the next 30 years would be conducted to determine if contaminants from either the ordnance area or the disposal trenches were migrating at significant rates and concentrations. Because the elevation of the groundwater table is not known relative to the buried materials in the fenced area, groundwater monitoring would also be used to evaluate whether further actions were necessary to depress the groundwater table to avoid communication with fenced area wastes.

The estimated costs for this alternative are:

Estimated capital costs*	$1,065,000
Estimated annual costs	$26,000
Estimated 30-year present worth*	$1,545,000
Months to Implement	12

*Note: Costs indicated assume that western debris pile characterization does not result in exceeding remediation goals. If remediation goals are exceeded, capital costs for the alternative (offsite disposal; Alternative 3A) are estimated to be $1,550,000 (present worth of $2,030,000).

If the materials can be consolidated beneath the onsite cap (Alternative 3B), capital costs are estimated to be $1,140,000 (present worth of $1,620,000).

ALTERNATIVE 4 - Remove Soils Exceeding Remediation Goals; Remove Western and Southern Trenches and Debris Piles; Backfill with Clean Fill; Consolidate All Removed Wastes Onsite, Dispose of Recyclable Materials from Debris Piles Offsite; Cap Fenced Area and Consolidated Soils; Institutional Controls

Description: Alternative 4 is identical to Alternative 3 (more specifically Alternative 3B) with the exception that wastes are removed from the western and southern trenches and consolidated beneath an impermeable cap, rather than left in place and capped. The intent of Alternative 4 is to minimize the possibility of future groundwater communication with the trenched wastes and potential subsequent leaching of associated contaminants. This would be accomplished by moving the wastes to ground surface for disposal and subsequent capping. The capping area and requirements would be identical to that indicated by Altemative 3.

During excavation and construction of the cap, the potential for erosion will be minimized by following erosion and sediment control best management practices. Less than one acre of forest habitat will be converted to grassland habitat.

Institutional controls including limiting site access and future land use would be implemented to eliminate or reduce potential exposure to ordnance materials at the site. Monitoring of groundwater, surface water, and sediment would be performed as described in Alternative 3.

The estimated costs for this alternative are:

Estimated capital costs	$1,510,000
Estimated annual costs	$26,000
Estimated 30-year present worth	$1,990,000
Months to Implement	12

2.7 SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

The remedial alternatives presented on 2.6 were evaluated in the FS against nine criteria identified in the NCP. The comparison alternative to the nine criteria is presented below.

2.7.1 Threshold Criteria

Overall Protection of Human Health and the Environment

The Site 2 Remedial Action Objectives (RAOs) include:

Compliance at Site 2 with contaminant-specific, location-specific, and action-specific Federal and Commonwealth of Virginia ARARs, and TBCs.

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 5mg/kg in surface soils from contact with 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, and causing adverse effects in ecological receptors.

Alternative 4 provides the highest level of protection because wastes in the western and southern disposal trenches, including batteries known to contain lead, zinc, and manganes would be excavated and brought to ground surface and capped, further reducing the potential for contaminants to migrate to ecological receptors. Institutional controls, including deed restrictions and fencing, would prevent direct contact risks to ordnance materials in the fenced area. Alternatives 3, 3A, and 3B would provide a measure of protectiveness by installing a cap over the fenced area and disposal trenches, thereby reducing potential infiltration of precipitation to the buried wastes and potential migration of contaminants. Alternative 2 would be protective. Soils exceeding remediation goals and posing risks to ecological receptors would be excavated and removed from the site, if soils in the western debris pile were determined to exceed remediation goals (Alternative 2A), these soils would similarly be excavated and removed from the site for appropriate disposal. Institutional controls under Alternatives 2, 3, 3A, 3B, and 4, including deed restrictions and long-term monitoring of groundwater, surface water, and sediments, would limit the use of groundwater and any future use of the site to ensure overall protection of human health and the environment. Alternative 1 would not be protective of ecological receptors, because no action would be undertaken to address soil contamination posing risks to ecological receptors at Site 2.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Alternative 4 would comply with all ARARs and TBCs and in addition would follow the policy for landfill closures to keep a minimum distance between wastes and the groundwater. Alternatives 3, 3A, 3B would comply wdh all ARARs and TBCs identified. Alternative 2 (and 2A) would comply with remediation goals for the protection of ecological receptors, however, it would not address the recently promulgated Military Munitions Rule (40 CFR 260) or DoD guidance (6055.9.STD) regarding disposition of property containing explosives or ordnance wastes. Generally, the Military Munitions Rule provides a clarification of RCRA requiring consideration of ordnance wastes as hazardous. DoD guidance supports the removal of ordnance wastes, if practical, and its safe disposal otherwise. Alternative 1 will not achieve remediation goals for the protection of ecological receptors, nor meet all ARARs and TBCs.

2.7.2 Primary Ballancina Criteria

Long-Term Effectiveness and Permanence

Alternative 4 provides the most effective and permanent - protection because it provides for the excavation of the wastes present in the western and southern trenches, including batteries, and their disposal well above the groundwater table. With the implementation of a RCRA Subtitle C cap, Alternatives 3, 3A, 3B, and 4 would greatly reduce the potential for migration of contaminants from the fenced ordnance burial area and the trench disposal areas, and would therefore provide an effective and permanent protection of human health and the environment. Alternative 2 (and 2A) does not provide for the installation of an impermeable cap, and would therefore not provide the same degree of effectiveness. In addition, inorganics, including batteries known to contain lead, zinc, and manganese, would remain on site under Alternative 2 (and 2A). Alternative 1 would not be effective in the long term because there would be no means available to evaluate effectiveness over time.

Reduction of Toxicity, Mobility, and Volume

Alternative 4 has the greatest potential to reduce the mobility of contaminants. Excavation of the wastes in the disposal trenches and bringing the wastes to the ground surface prior to capping, thereby removing them from contact with the water table and increasing the buffer between the wastes and the groundwater, and provides the additional reduction in the potential mobility of the contaminants into the groundwater. Alternative 4 would reduce the volume of wastes by removal and consolidation of some wastes. Alternatives 3, and 3A would reduce the mobility and volume of soil contaminants at the site, however, offsite disposal would merely relocate the wastes. Similarly, Alternative 3 would not reduce the volume or toxicity of the wastes, but would reduce their mobility through the installation of a RCRA Subtitle C cap over the fenced area and disposal trenches. Alternatives 2 and 2A would reduce the mobility and volume of soil contaminants at the site, however, offsite disposal would merely relocate the wastes. Alternatives 2, 3, 3A, 3B, and 4 would provide the potential for recycling or reclaiming materials present in the western, and southern debris piles which would reduce the volume of materials that would otherwise require disposal. Alternative 1 would not achieve any reduction of toxicity, mobility, or volume of contaminants at Site 2.

Short-Term Effectiveness

Alternative 4 would have the best potential for short-term effectiveness to address RAOs. Alternative 4, while having some additional concerns relative to potential worker exposures during excavation of the disposal trenches, would address these concerns with appropriate personal protective equipment and site monitoring, and will be accomplished within a relatively short time frame. Alternative 4 would provide a more permanent remedy upon completion that would address all RAOs. The potential risk from explosion during capping of the landfill will be reduced by providing an additional soil layer to reduce the load during construction. Alternatives 2, 2A, 3 and 3A would have additional concerns associated with potential exposures during offsite transport of contaminated soils. To reduce this potential exposure transport vehicles will be covered. Alternative 3B would not address the batteries and other wastes present in the western and southern disposal trenches. Alternative 1 would not be effective in the short-term because soils exceeding remediation goals are left in place.

Implementability

Alternative 4 is the best choice for implementation and site remediation. The installation of a RCRA Subtitle C cap under Alternatives 3, 3A, 3B and 4 would have some implementation concerns related to construction of the cap over the fenced ordnance area of the site. The construction of the cap will require special construction techniques or methods to cap the fenced area safely and effectively. Safety concerns provide for a somewhat more complex remedy under Alternatives 3, 3A, 3B, and 4. However, these concerns can be easily addressed by applying prudent health, safety, and construction measures, and capping is a well demonstrated technology that has been shown to be reliable and readily implementable using conventional, commercially available materials and equipment. The excavation of wastes under Alternative 4 would also add some concern due to increased excavation and waste handling requirements, however, these concerns would be addressed through the implementation of appropriate health and safety measures, and would be easily implemented.

Alternatives 3, 3A, and 3B involve off-site removal of wastes which will require additional testing, logistical support, and will increase local street traffic. Alternatives 2 and 2A would have the fewest implementability concerns, however, this is because relatively little would be necessary to be performed under either alternative. Alternative 1 requires no implementation.

Cost

Alternative 4 provides the most cost-effective remedy for Site 2. Alternative 4 provides the highest level of protectiveness and addresses all ARARs and TBCs for the site. Although not the least costly alternative, the increased environmental benefits associated with removing the batteries from the trenches for disposal at higher elevation compensates for the additional cost of approximately $445,000 over Alternative 3. Based on estimated net present worth, of the alternatives that employ active remediation Alternative 2 is the least expensive remedy ($876,000), followed by Alternative 2A ($1,298,000). However, as mentioned previously, these alternatives may not address all ARARs and TBCs for Site 2. Alternative 3 is the next most

expensive remedy ($1,545,000) followed by Alternative 3B ($1,620,000). While these alternatives would address ARARs and TBCS for Site 2, they would not provide the additional environmental benefit of removing the trenched wastes that include batteries known to contain lead, zinc, and manganese and other wastes from the westem and southern trench disposal areas.

The capital, operating, and 30-year net present-worth costs of the alternatives are presented in the following table including 30-year net present-worth cost.

Alternative	Capital($)	Operating($/yr)	Present-Worth ($)
1	$0	$0	$0
2	$396,000	$26,000	$876,000
2A	$818,000	$26,000	$1,298,000
3	$1,065,000	$26,000	$1,545,000
3A	$1,550,000	$26,000	$2,030,000
3B	$1,140,000	$26,000	$1,620,000
4	$1,510,000	$26,000	$1,990,000

Note: Baseline (numbered) alternatives assume no action is performed on the western debris pile. 'A' alternatives assume offsite disposal of western debris pile materials. 'B' alternatives assume western debris pile materials are consolidated beneath the cap for the alternative indicated.

Note that the operating cost in each alternative is attributable to monitoring of groundwater, sediments and surface water.

2.7.3 Modifying Criteria

State Acceptance

The Virginia Department of Environmental Quality on behalf of the Commonwealth of Virginia, has reviewed the information available for this site and concurs with this ROD and the selected remedy identified below.

Community Acceptance

Community Acceptance summarizes the public's general response to the afternatives, described in the Proposed Plan and the Feasibility Study. No written comments were received during the thirty-day comment period, which began on July 30 and ended on August 29, 1997. There were no comments or questions received at the Proposed Plan Public Meeting held August 6, 1997, Background on Community involvement at NSWDL is included in the Responsiveness Summary, Section 3.0 of the ROD.

2.8 THE SELECTED REMEDY

The selected remedy for Site 2 is Alternative 4 which involves the removal of soils exceeding remediation goals; removal of the western and southern trenches and debris piles, backfilling with clean fill; consolidating all removed wastes onsite, recycling recyclable materials from debris piles offsite; capping the fenced area and consolidated waste and soils; and providing institutional controls to limit the site to future industrial use and to exclude shallow groundwater use. Surface water and groundwater shall continue to be monitored.

The major components of the selected remedy are:

The Navy shall remove soils which are above the RAOs in selected areas on the site. These areas are identied on Figure 2-4 as areas with soil above PRGs. These soils shall be consolidated underneath the fenced area landfill cap.

The Navy shall remove the southern and western debris piles. The Navy shall recycle the recyclable material in the debris piles and consolidate the remaining wastes underneath the fenced area landfill cap.

The Navy shall excavate the wastes from the southern and western trenches and backfill with

clean fill. The Navy shall consolidate the excavated wastes underneath the fenced area landfill cap.

The Navy shall construct a multi-layer cap over the fenced area and the area over the excavated trenches. The cap shall be consistent with RCRA Subtitle C requirements and the Virginia Hazardous Waste Management Regulations (VFHWMR). It shall consist of a minimum of 24 inches of topsoil and vegetative cover underlain by a filter layer and 12 inches of drainage (minimum 10 -2 cm/sec), a minimum 20 mil geomembrane, and 24 inches of compacted soil or clay or equivalent design achieving a maximum hydraulic conductivity of 10 -7 cm/sec. The cap shall include a passive gas collection system and a perimeter drainage system.

The Navy shall develop and implement an operating and maintenance plan for the landfill. The Navy shall also implement all post-closure requirements for the landfill, including the certification of closure to the Regional Administrator within 60 days of completion of the cap.

The Navy shall institute the following institutional controls within 60 days of completion of the cap: a real property description notation, Base Master Plan notations, and limited site access. Fendng shall be erected around the landfill area and signs shall be posted which state that hazardous wastes are present. The Base Master Plan shall note the area as one in which construction changes can not occur, residential development can not occur, shallow groundwater can not be used, and site access shall be limited. A notation shall be filed in the real property file maintained at EFA Chas for this sde indicating the extent of the area and the fact that hazardous wastes are present. Institutional controls shall also include the following: Within 60 days of closure (capping), the Navy shall produce a survey plat indicating the location and dimensions of landfill calls or other hazardous waste disposal units with respect to permanently surveyed benchmarks. This plat shall be prepared and certified by a professional land surveyor. The plat shall contain a note, prominently displayed, which states the owner's obligation to restrict disturbance of the hazardous waste disposal unit, post-closure use shall prohibit residential use, shall prohibit access or use of groundwater underlying the property for any purpose except monitoring, and shall never be allowed to disturb the integrity of the final cover, liners, or any other components of the containment system, or the function of the facility's monitoring systems. No later than 60 days after closure, the Navy shall submit to the county board of supervisors a record of the type, location, and quantity of hazardous wastes disposed of within each cell or other disposal unit of the facility.

As soon as practicable, the owner shall record, in accordance with state and local law, a notation an the deed to the property - or on some other instrument which is normally examined during title search - that will in perpetuity notify any potential purchaser of the property that the land has been used to manage hazardous wages, that its use is restricted as described above, and that a survey plat and a record of the type, location, and quantity of hazardous wastes disposed of have been filed with the local government. If and when the property is transferred out of the federal govemment, the deed shall contain the survey plat, the notation that the property was previously used to manage hazardous wastes and that its future use is restricted, and other deed restrictions as-appropriate.

The Navy shall institute groundwater monitoring at the perimeter of the landfill cap and shall continue monitoring for 30 years, the post-closure time period as required by RCRA and VHWMR.

The Navy shall monitor the drainage system surrounding the cap, surface waters, and sediments in Gambo Creek adjacent to Site 2. The frequency of analysis and the length of time for monitoring shall be developed in the Operation and Management Plan.

Based on available information and the current understanding of site conditions, Alternative 4 appears to provide the best balance with respect to the nine NCP evaluation criteria. In addition, the selected alternative is anticipated to meet the following statutory requirements:

- Protection of human health and the environment.
- Compliance with ARARs.
- Cost-effectiveness.

The selected alternative provides for the removal and containment of surface soil, trench, and debris pile wastes at Site 2, and prevents direct contact with ordnance-contaminated materials inside the fenced area of the site. The selected alternative will provide for the long-term reduction of leachate generation and reduce potential future contamination of the groundwater

beneath the disposal area. This alternative addresses Virginia DEC and EPA solid and hazardous waste regulations by using a RCRA Subtitle C cap design. As discussed previously in this ROD, a separate study will be prepared which addresses possible surface water and sediment contamination in Gambo Creek.

2.8.1 Performance Standards

Soils and Trench-Contents Removal

All soil above RAOs in the areas identified on Figure 2-4 shall be removed and consolidated underneath the fenced area landfill. The southern and western trenches (Figure 2-4) shall be excavated and consolidated underneath the fenced area landfill. The southern and western debns piles (Figure 2-4) shall be removed, recyclable materials recycled, and the remaining material consolidated underneath the fenced area landfill cap.

Landfill Cap

The landfill cap shall be designed, constructed, operated, and maintained to meet the performance requirements of RCRA Subtitle C, regulations specified in 40 C.F.R. °°265.19, 265.111 and 265.310 and VHWMR.

The cap shall also be designed to meet the requirements of the following EPA technical guidance documents: "Final Covers on Hazardous Waste Landfills and Surface Impoundments" (EPA/530-SW-89-047, July 1989); and "Construction Quality Management for Remedial Action and Remedial Design Waste Containment Systems" (EPA/540/R-92/073, October 1992).

The cap design shall minimize infiltration, and control surface water run onlrunoff. The landfill cap shall be constructed, at a minimum to the following performance standards:

Compacted soil or clay Layer - 24 inches of material or equivalent design achieving a maximum hydraulic conductivity of 1x10 -7 cm/sec.

Geomembrane Layer - Minimum 20 mil thick low permeability membrane.

Drainage Layer - Composed of a minimum 12 inches of sand or soil having a minimum hydraulic conductivity of 1x10 -2 cm/sec.

Soil Cover Layer - Minimum 24 inches in thickness.

Surface water drainage controls shall be constructed to prevent erosion of the cap. As determined by the final Site 2 Cap Design, drainage channels shall be installed in certain areas on the top and perimeter of the landfill cap to channel runoff away from the landfill.

The cap shall be capable of managing residuals and achieving all RAOs within the boundaries of Site 2, and shall meet all ARARs and TBCs for the site. Managing residuals shall include the monitoring and collection and treatment of any leachate and generated gases, as required.

RCRA Groundwater Monitoring Wells

A groundwater mondoring network shall be implemented in accordance with RCRA and VHWMR. It shall be installed at the perimeter of the unit to evaluate any future contaminant transport. The location and number of monitoring wells, the frequency of analyses, and the types of analyses shall be determined in the site design and operation and management documents. These documents must be approved by the EPA and the Commonwealth of Virginia. Groundwater monitoring shall continue for 30 years, the post-closure time period as required by RCRA. The wells shall be installed according to RCRA and Commonwealth of Virginia construction requirements.

Surface Water, Sediment, and Drainage System Monitoring

A surface water, sediment and drainage system sampling and monitoring plan shall be developed as part of the Operation and Management (0 & M) Plan. The location and number of sampling locations, the frequency of analyses, the types of analyses, and the duration of

monitoring shall be determined in the 0 & M Plan. This plan must be approved by the EPA and the Commonwealth of Virginia.

Institutional Controls

Fencing shall be installed and signs shall be posted indicating hazardous materials are present. The Base Master Plan shall be updated with notations indicating Site 2 is an area in which construction changes can not occur, residential development can not occur, shallow groundwater can not be used, and site access shall be limited. A notation shall be filed in the real property file maintained by EFA Ches for this site indicating the extent of the area and the fact that hazardous wastes are present.

Within 60 days of closure (capping), the Navy shall produce a survey plat indicating the location and dimensions of landfill cells or other hazardous waste disposal units with respect to permanently surveyed benchmarks. This plat shall be prepared and certified by a professional land surveyor. The plat shall contain a note, prominently displayed, which states the owners obligation to restrict disturbance of the hazardous waste disposal unit; post-closure use shall prohibit residential use, shall prohibit access or use of groundwater underlying the property for any purpose except monitoring, and shall never be allowed to disturb the integrity of the final cover, liners, or any other components of the containment system, or the function of the facility's monitoring systems. No later than 60 days after closure, the Navy shall submit to the county board of supervisors a record of the type, location, and quantity of hazardous wastes disposed of within each cell or other disposal unit of the facility.

If and when the the property is transferred out of the federal government, the deed shall contain the survey plat, the notation that the property was previously used to manage hazardous wastes and other deed restrictions as appropriate.

In the yearly 0 & M Report, the Navy shall certify that the institutional controls as outlined above are still in-place and effective. The Navy shall notify USEPA and VADEQ 60 days before changing any of the use restrictions in the Base Master Plan related to Site 2.

2.9 STATUTORY DETERMINATIONS

Remedial actions must meet the statutory requirements of Section 121 of CERCLA as discussed below. Remedial actions undertaken at NPL sites must achieve adequate protection of human health and the environment, comply with applicable or relevant and appropriate requirements of both Federal and State laws and regulations, be cost effective, and utilize, to the maximum extent practicable, permanent solutions and alternative treatment or resource recovery technologies. Also, remedial alternatives that reduce the volume, toxicity, and/or mobility of hazardous waste as the principal element are preferred. The following discussion summarizes the statutory requirements that are met by the selected remedy.

2.9.1 Protection of Human Health and tho Environment

The selected remedy will protect human health and the environment. The installation of a RCRA Subtitle C cap consistent with the Commonwealth of Virginia and EPA solid and hazardous waste regulations will eliminate direct contact wfth ordnance-contaminated materials, eliminate direct contact, ingestion, and inhalation threats from contaminated soils, and will reduce the leaching of contaminants to groundwater by controlling precipitation entering the landfill and minimizing leachate generation. There will be limited short term risks as with any construction activity at the site. However, the short-term risk should be minimal because fenced area wastes will not be removed during construction activities. Also, the permanent cap will effectively stabilize existing conditions at the landfill.

2.9.2 Compliance with ARARs

The selected remedy will be constructed to meet all applicable or relevant and appropriate requirements (ARARs) whether chemical-, action-, or location-specific. No waivers of any ARARs are requested. ARARs that have been identified for Site 2 are presented in Appendix C.

Location- and action-specific ARARS and TBCs that will be addressed by the selected remedy include Federal and Commonwealth of Virginia hazardous waste regulations related to the

installation of the cap (40 CFR 260-279, 9 VAC 20-80), landfill closure requirements and performance standards (40 CFR 264, 9 VAC 20-60-870), regulations and guidance regarding ordnance wastes (40 CFR 260, DoD 6055.9-STD), endangered species protection (50 CFR Part 402) and wetlands protection (10 CFR 1021). In addition, related Commonwealth of Virginia regulations pertaining to storm water management (9 VAC 25-180), sediment and erosion control (4 VAC 50-30), and air emissions (VAC 5-50) during contruction will be addressed.

The low permeabilfty RCRA Subtitle C cap will be designed to meet the performance standards in section 2.8.1.

The cap will achieve all RAOs within the boundaries of Site 2, and will meet all ARARs and TCBs for the site.

Regular inspections of the cap shall be conducted to ensure that its integrity is maintained and that it is functioning as designed. The O&M plan will include procedures to repair and/or replace components of the cap as necessary, to maintain its grade and vegetative cover in order to control sedimentation and erosion. The operation and maintenance program shall state that a yearly evaluation of the vegetative cover will be made by a qualified individual.

New monitoring wells will be installed in accordance with Commonwealth of Virginia requirements. The specific analytical methods, procedures and sampling frequency will be specified in the O&M plan. Substantive permit and licensing requirements shall be followed. Land-use and access restrictions will limd the use and development of the property, These restrictions will ensure the long-term effectiveness and integrity of the cap.

2.9.3 Cost-Effectiveness

The selected remedy is cost-effective because it provides overall effectiveness proportional to the cost. Although more costly than the alternative that removes soils exceeding remediation goals (Alternative 2), the alternative provides for the removal and containment of hazardous wastes, and the recovery of recycleable metals and therefore provides greater long-term protection of human heafth and/or the environment than other alternatives, and meets all required ARARs.

2.9.4 Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable ("MEP")

Capping is a permanent solution and is a common remedy for land filled wastes of high volume and low contaminant concentration. Containment in the form of capping is typical and appropriate for a site of this type. In addition, this alternative provides for additional protectiveness provided by a RCRA Subtitle C cap and the recovery of recycleable metals to the maximum extent practicable, and therefore addresses this goal.

2.9.5 Preference for Treatment as a Principal Element

The selected remedy does not utilize permanent treatment technologies for this site due to cost and other considerations. Although this action does not fully address the statutory mandate for treatment, this action provides for a permanent remedy and thus partially satisfies this mandate.

3.0 RESPONSIVENESS SUMMARY

The selected remedy for Site 2 is a composite cap comprised of a geosynthetic clay liner (GCL) and a minimum 20 mil flexible membrane cap (FMC). No written comments, concerns, or questions were received by the Navy, EPA, or the Commonwealth of Virginia during the public comment period from July 30, 1997 to August 29, 1997. A public meeting was held on August 6, 1997 to present the Proposed Plan for Site 2 and to answer any questions on the Proposed Plan and on the documents in the information repositories. No formal questions were asked during the meeting. Based on the limited comments, the Public appears to support the selected remedy.

A copy of the certified transcript of the formal Public Meeting is attached as Appendix B.

Both the EPA and the Virginia Department of Environmental Quality, representing the Commonwealth of Virginia, concur that the selected remedy is protective of human health and

the environment.

3.1 BACKGROUND ON COMMUNITY INVOLVEMENT

The Navy and NSWCDL has had a comprehensive public involvement program for several years. Starting in 1993, a Technical Review Committee (TRC) would meet on average twice a year to discuss issues related to investigative activities at NSWCDL. The TRC was comprised of mostly governmental personnel, however a few private citizens attended the meetings.

In early 1996, the Navy converted the TRC into a Restoration Advisory Broad (RAB) and 8 - 10 community representatives joined. The RAB is co-chaired by a community member and has held meetings approximately every four to six months since. The Feasibility Study for Site 2 and the Proposed Plan were both discussed at the RAS meetings and a Site 2 tour was undertaken during a special RAS meeting.

Community relations activities for the final selected remedy include:

The documents concerning the investigation and analysis at Site 2, as well as a copy of the Proposed Plan were placed in the information repository at the NSWCDL Library and King George Public Library.

Copies of the documents, including the Proposed Plan in were sent to the members of the RAB.

Newspaper announcements on the availability of the documents and the public comment period/meeting date was placed in the Freelance Star Newspaper on July 29, 1997.

The Navy established a 30-day public comment period starting July 30, 1997 and ending August 29, 1997 to present the Proposed Plan. No written comments were received during the 30-day public comment period.

A Public Meeting was held August 6, 1997 to answer any questions concerning the Site 2 Proposed Plan. Approximately 20 people, including Federal, State and local government representatives attended the meeting.

APPENDIX A

VIRGINIA CONCURRENCE LETTER

COMMONWEALTH of VIRGINIA

George Allen
Governor

DEPARTMENT OF ENVIRONMENTAL QUALITY

Street address: 629 East Main Street Richmond, Virginia 23219
Mailing address: P.O. Box 10009, Richmond, Virginia 23240

Fax (804) 698-4500 TDD (804) 698-4021
http://www.deq.state.va.us

Thomas L. Hopkins
Director

(804) 698-4000
1-800-592-5482

Becky Norton Dunlop
Secretary of Natural Resources

September 25, 1997

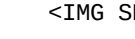
CAPT. Vaughn E. Mahaffey, USN
Commanding Officer
Naval Surface Warfare Center
Dahlgren, Virginia

Re: Record of Decision for Site 2 (Fenced Ordnance Burial Area), Naval Surface Warfare Center, Dahlgren, VA

Dear Captain Mahaffey:

The Virginia Department of Environmental Quality has reviewed the final Record of Decision for Site 2, the Fenced Ordnance Burial Area at the Naval Surface Warfare Center, Dahlgren, VA. On the behalf of the Commonwealth of Virginia, the Virginia Department of Environmental Quality hereby concurs with this Record of Decision and the selected remedy for Site 2, Alternative 4 as specified therein. This involves the removal of soils exceeding remediation goals; removal of the western and southern trenches and debris piles; backfilling with clean fill; consolidating all removed wastes onsite, recycling recyclable materials from debris piles offsite; capping the fenced area and consolidated waste and soils; and providing institutional controls to limit the site to future industrial use and to exclude shallow groundwater use. Surface water and groundwater shall continue to be monitored.

Please let me know if there are any questions, or if I can be of additional assistance.



APPENDIX B

RESPONSIVENESS SUMMARY

NAVAL SEA SYSTEMS COMMAND

NAVAL SURFACE WARFARE CENTER
DAHLGREN DIVISION

PUBLIC MEETING

WEDNESDAY, AUGUST 6, 1997, 7:00 P.M.
KING GEORGE COUNTY ADMINISTRATION BUILDING
KING GEORGE, VIRGINIA

PROPOSED REMEDIAL ACTION PLAN
Site 2, Fenced Ordnance Burial Area

USEPA Region III
Hazardous Waste Management Division
Federal Facilities Section
Mr. Bruce Beach
841 Chestnut Building, Philadelphia, Pennsylvania 19107

Virginia Department of Environmental Quality
Mr. David Gillispie
629 East Main Street, Richmond, Virginia 23225

Public Affairs Office
Commander, Naval Surface Warfare Center
Ms. Jennifer Wilkins
17320 Dahlgren Road, Dahlgren, Virginia 22448

Reported by: Paula J. Evans

FRANCES K. HALEY & ASSOCIATES, Court Reporters
10500 Wakeman Drive, Suite 300, Fredericksburg, VA 22407
PHONE: (540)898-1527 FAX: (540)898-6154

August 6, 1997:

There were no formal questions on the floor at this Meeting.

FRANCES K. HALEY & ASSOCIATES, Court Reporters
10500 Wakeman Drive, Suite 300, Fredericksburg, VA 22407
PHONE: (540)898-1527 FAX: (540)898-6154

CERTIFICATE OF COURT REPORTER

I, Paula J. Evans, hereby certify that I was the Court Reporter at the Public Meeting held at King George County Administration Building, King George, Virginia, on August 6, 1997, at the time of the meeting herein.

I further certify that the foregoing transcript is a true and accurate record of the proceeding herein.

Given under my hand this 19th day of August, 1997.

<IMG SRC 97179I>

FRANCES K. HALEY & ASSOCIATES, Court Reporters
10500 Wakeman Drive, Suite 300, Fredericksburg, VA 22407
PHONE: (540)898-1527 FAX: (540)898-6154

APPENDIX C
Applicable or Relevant and Appropriate Requirements
Site 2 Fenced Ordnance Burial Area
NSWCDL, Dahlgren, Virginia

	Regulation	Classification	Requirement Synopsis Alternatives	Applicability to Remedial ARAR or TBC
1. LOCATION SPECIFIC				
Endangered Species Act of 1978	16 USC 1531-1544 50 CFR Pan 402	Applicable	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.	Potentially affected endangered species have not been identified at NSWC Dahlgren. The remedial action will be implemented so resources are not adversely affected, should such resources be identified in the future.
Virginia Endangered Species Regulations	VR 325-01-1 4 VAC 15-20-130			
Virginia Board of Game and Inland Fisheries: Virginia Endangered Plant and Insect Species Regulations	Code of Virginia Sections 29.1-100 and 29.1-563 VR 115-04-01 2 VAC 5-320-10	Applicable	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.	Potentially affected endangered species have been identified at NSWC Dahlgren. The remedial action will be implemented so resources are not adversely affected should any be identified in the future.

APPENDIX C
Applicable or Relevant and Appropriate Requirements
Site 2 Fenced Ordnance Burial Area
NSWCDL, Dahlgren, Virginia

The Archaeological and Historical Preservation Act of 1974	16 U.S.C º 469	Applicable	Requires actions to avoid potential loss or destruction of significant scientific, historical, or archaeological data	Site is not known to be within a historically significant area. If future resources are identified actions will be taken to ensure compliance
Virginia Historic Resources Law	VR 10.1-2200-2214			
Migratory Bird Area	16 USC Section 703	Applicable	Protects almost all species of native birds in the U.S. from unregulated "take" which can include poisoning at hazardous waste sites.	Remedy will be implemented to ensure that hazardous wastes have no impacts to native birds.
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 address the regulatory requirements
Resource Conservation and Recovery Act	40 C.F.R. 264.18 (b)	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 Hazardous Waste Management Regulations	VR 672-20-10 9 VAC 20-80-10			

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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.
Executive Order 11990, Protection of Wetlands	40 C.F.R. 6, Appendix A Clean Water Act of 1972 (CWA) Section 404	Applicable	Action to minimize the destruction, loss, or degradation of wetlands.	Portions of the site adjacent to Gambo Creek are characterized as wetlands. Remedy implementation will be completed to avoid wetland impacts.
Virginia Wetlands Regulations	VR 450-01-0051 4 VAC 20-390-10		Any activity to take place in, or impact on, a tidal wetland must meet the provisions of Virginia Wetlands Act and regulations as applicable	
Virginia Water Permit Regulations	VR680-15-02 9 VAC 25-210-10	Relevant and appropriate	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	Construction of landfill could potentially involve discharge of contaminants to Gambo Creek Any potential discharges will meet requirements

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II. ACTION SPECIFIC

Capping /Closure and Post Closure	40 CFR 258.60-61	Applicable	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.	Installation of RCRA Subtitle C cap requires adherence to these regulations at Site 2.
Military Munitions Rules	(40 CFR 260-266 and 270)	To Be Considered	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.	Ordnance-related wastes buried in the fenced area of Site 2 will be managed in compliance with the rules.
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 address safety issues.

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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 20-60-580 B 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 engineening practice and RCRA requirements.

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Virginia Hazardous Waste Management Regulations (VHWMR) Resource Conservation and Recovery Act (RCRA)	9 VAC 20-60-580 E 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 20-60-580 F 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.

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Virginia Hazardous Waste Management Regulations (VHWMR)	9 VAC 20-60-580 G	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.
Resource Conservation and Recovery Act (RCRA)	40 C.F.R. 265.116			
Virginia Hazardous Waste Management Regulations (VHWMR)	9 VAC 20-60-580 H	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 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.
Resource Conservation and Recovery Act (RCRA)	40 C.F.R. 265.117			

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Virginia Hazardous Waste Management Regulations (VHWMR)	9 VAC 20-60-580 I	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 the installation of the cap at Site 2. Appropriate post-closure plans will be developed and implemented consistent with RCRA requirements.
Resource Conservation and Recovery Act (RCRA)	40 C.F.R. 265.118			

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Virginia Hazardous Waste Management Regulations (VHWMR) Resource Conservation and Recovery Act (RCRA)	9 VAC 20-60-580 J 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 20-60-580 K 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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Virginia Hazardous Waste Management Regulations (VHWMR)	9 VAC 20-60-650	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.
Resource Conservation and Recovery Act (RCRA)	40 C.F.R. 265.310			
Solid Waste Management Act	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 need to 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 a hazardous waste must be conducted in compliance with VRGTHM.

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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, 3,00 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 address CAA requirements.

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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: anu 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 VOC's to the atmosphere Emissions will be consistent with federal and state regulations.
WATER				
Criteria for Classification of Solid Waste Disposal Facilities and Practices	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 Wage Disposal Facilities and Practices	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 areawide 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.

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Criteria for Classification of Solid Waste Disposal Facilities and Practices	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 address the requirement.
Water Quality Standards	VR 680-15-02 9 VAC 25-210-10	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 25-210-10	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.
Water Quality Standards	VR 680-21-00 9 VAC25-260-10	Applicable	Groundwater monitoring stations shall be located and constructed in a manner that allows accurate determination of groundwater quality and levels, and prevents contamination of groundwater through the finished well hole or casing. All groundwater monitoring stations shall be accurately located utilizing latitude and longitude by surveying, or other acceptable means, and coordinates shall be included with all data collected.	Completion of additional soil borings, monitoring wells and subsurface investigations will be consistent with regulatory requirements.

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Pollution Discharge Elimination System (VPDES), Virginia Pollution Abatement (VPA) Permit Program	VR 680-14-01 9 VAC 25-30-10	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 address 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.
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 instream contaminant concentration greater than the surface water standard.	Cleanup criteria developed in the Feasibility Study completed for the site used risk assesment and modeling techniques that meet the requirements.

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Water Quality Standards	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.