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Final

Action Memorandum for Contaminated Soil and Sediment Site 8 and SSA 14 Naval Weapons Station Yorktown Yorktown, Virginia

Prepared For

Department of the Navy

Atlantic Division
Naval Facilities Engineering Command

Norfolk, Virginia

Contract No. N62470-02-D-3052
CTO-046

December 2005

Prepared by

CH2MHILL

Federal Group, Ltd.

Baker
Environmental, Inc.

ACTION MEMORANDUM
SITE 8 AND SSA 14
NAVAL WEAPONS STATION YORKTOWN

DATE: December 12, 2005

SUBJECT: Removal Action at Site 8, Naval Explosives Development Engineering Department (NEDED) Explosives-Contaminated Wastewater Discharge Area, and Site Screening Area (SSA) 14, Building 537 Discharge to Felgates Creek, Naval Weapons Station Yorktown

FROM: Commander, Mid-Atlantic Division, Naval Facilities Engineering Command

TO: Gerard O'Regan, CAPT, USN
Commanding Officer
Naval Weapons Station Yorktown

This Action Memorandum documents approval for the removal action as described herein for Site 8, NEDED Explosives-Contaminated Wastewater Discharge Area, and SSA 14, Building 537 Discharge to Felgates Creek, at Naval Weapons Station (WPNSTA) Yorktown, Yorktown, Virginia. This Action Memorandum serves as the Decision Document for the Engineering Evaluation/Cost Analysis for Site 8 and SSA 14.

This decision document was developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 as amended, and is consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record for the site.

Conditions at Site 8 and SSA 14 meet the NCP Section 300.415(b)(2) criteria for removal. The Naval Facilities Engineering Command, Mid-Atlantic, recommends approval of the proposed removal action. The total project ceiling is estimated to be $600,000. Response actions should commence as soon as practical due to the potential threat to human health and the environment from Site 8 and SSA 14.

Approved by:

Gerard O'Regan, CAPT, USN
Commanding Officer
Naval Weapons Station Yorktown

21 Dec 05
Date

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ACRONYMS AND ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Requirement
BEHP	Bis(2-ethylhexyl)phthalate
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
cy	cubic yard
EE/CA	Engineering Evaluation/Cost Analysis
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEDED	Naval Explosives Development Engineering Department
RI	Remedial Investigation
SSA	Site Screening Area
SVOC	Semivolatile Organic Compound
TNT	Trinitrotoluene
USEPA	United States Environmental Protection Agency
WPNSTA	Naval Weapons Station

I. PURPOSE

This Action Memorandum documents approval for the removal action as described herein for Site 8, NEDED Explosives-Contaminated Wastewater Discharge Area, and SSA 14, Building 537 Discharge to Felgates Creek, at WPNSTA Yorktown, Yorktown, Virginia. This Action Memorandum serves as the Decision Document for the Final Engineering Evaluation/Cost Analysis (EE/CA) for Site 8 and SSA 14 (Baker, 2005) included as Appendix A.

This Action Memorandum has been completed in accordance with the removal program requirements defined by the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended, the NCP, and the U.S. Environmental Protection Agency's (USEPA) Superfund Removal Procedures Action Memorandum Guidance (USEPA, 1990).

The Department of the Navy has broad authority under CERCLA Section 104 and Executive Order 12580 to carry out removal actions when the release is on, or the sole source of the release is from, the Navy installation. The Navy/Marine Corps Environmental Restoration Program was initiated to identify, assess, characterize, and clean up or control contamination from past hazardous waste disposal operations and hazardous material spills at Navy and Marine Corps installations. This Action Memorandum follows the guidelines published in the Navy/Marine Corps Installation Restoration Manual updated in 2001 (Naval Facilities Engineering Service Center, 2001). This document addresses a non-time-critical removal action for removing soil and sediment contaminated with bis(2-ethylhexyl)phthalate (BEHP), Aroclor-1260, explosives, and inorganics.

II. SITE CONDITIONS AND BACKGROUND

In 1992, WPNSTA Yorktown was placed on USEPA's National Priorities List of Superfund sites and is identified in USEPA's Comprehensive Environmental Response, Compensation and Liability Information System as VA8170024170. The following sections describe the features and history of Site 8 and SSA 14. This section also discusses previous site investigations, the current site investigation, and the detected contaminants that necessitated the preparation of the EE/CA.

A. Site Description

WPNSTA Yorktown is a 10,624-acre installation located on the Virginia Peninsula in York and James City Counties and the City of Newport News (Figure 1). WPNSTA Yorktown is bounded on the northwest by WPNSTA Yorktown Cheatham Annex and the King's Creek Commerce Center; on the northeast by the York River and the Colonial National Historic Parkway; on the southwest by Route 143 and Interstate 64; and on the southeast by Route 238 and the town of Lackey.

Originally named the U.S. Navy Mine Depot, WPNSTA Yorktown was established in 1918 to support the laying of mines in the North Sea during World War I. For 20 years after World War I, the depot received, reclaimed, stored, and issued mines, depth charges, and related materials. During World War II, the facility was expanded to include three 2,4,6-trinitrotoluene (TNT) loading plants and new torpedo overhaul facilities. A research and development laboratory for experimentation with high explosives was established in 1944. In 1947, a quality evaluation laboratory was developed to monitor special tasks assigned to the facility, which included the design and development of depth charges and advanced underwater weapons. On August 7, 1959, the depot was renamed the U.S. Naval Weapons Station. Today, the primary mission of WPNSTA Yorktown is to provide ordnance, technical support, and related services to sustain the war-fighting capability of the Armed Forces in support of national military strategy.

Site 8 is a 100-foot drainageway located along the eastern branch of Felgates Creek, approximately 1.5 miles from the confluence of the creek and the York River (Figure 2). This area received wastewater from the NEDED complex (Building 456) from 1940 to 1975. The wastewater reportedly contained unspecified solvents, spent/neutralized acids, and nitramine compounds. In 1974, a carbon adsorption tower was installed to treat the contaminated wastewater prior to discharge into the drainage area. A National Pollutant Discharge Elimination System permit was granted by USEPA Region III to allow this discharge. In 1986, the effluent from the tower was diverted to the sanitary sewer and ultimately to Hampton Roads Sanitation District. Currently, the site has reverted to a natural drainage area.

SSA 14 occupies an area of approximately 0.4 acres, and is located outside of Building 537 and upstream of Site 8 in the north central portion of the facility (Figure 2). This SSA consists of a pipe leading from the building, through which nitramine-contaminated wastewater was reportedly discharged to Felgates Creek.

1. Removal Site Evaluation

Site 8 was identified as a potential area of concern in an Initial Assessment Study conducted in 1984 (C.C. Johnson & Associates, Inc. and CH2M Hill, 1984). A Round One Remedial Investigation (RI) (Baker and Weston, 1993) was also conducted for Site 8. A Final Relative Risk Ranking Data Collection Investigation Report for WPNSTA Yorktown (Baker, 1995) included the first sampling data from SSA 14. A Round Two RI (Baker, 2004) and a Pre-Removal Characterization have been performed at Site 8 and SSA 14. Results of the Pre-Removal Characterization are presented in the EE/CA for Site 8 and SSA 14. The EE/CA was made available to the public on November 6, 2005 (Baker, 2005). These documents contain information concerning the nature and extent of contamination in the soil and sediment, as well as a description of the objectives of the non-time-critical removal action and analysis of various removal alternatives that were considered for these sites.

2. Physical Location

WPNSTA Yorktown is located on the south bank of the York River within York County, Virginia (Figure 1). WPNSTA Yorktown is situated northeast of Interstate 64, approximately 1 to 2 miles southeast of Williamsburg, Virginia. Site 8 and SSA 14 are located along Felgates Creek in the central portion of WPNSTA Yorktown. Figure 2 shows the location of Site 8 and SSA 14.

3. Site Characteristics

The topography of Site 8 is best described as a drainage basin. The drainage basin measures approximately 30 feet wide by 100 feet long and is at least 14 feet lower in elevation than the surrounding areas. East of the drainage basin, a small paved parking area is bordered to the north by a steep sloping hillside and a building set on a hillside to the south. This drainage basin flows toward a marsh area that merges with the east branch of Felgates Creek. The drainage basin receives surface water runoff from the surrounding topography in addition to the stormwater collection system that drains the area around Building 456.

SSA 14 is very small, covering less than half of an acre, and consists of a stormwater discharge line and the associated discharge area. The investigation centers around a former discharge pipe that empties at the top of a slope and flows downward to a marsh area (approximately 15 feet lower in elevation), which extends to the east branch of Felgates Creek. Above the discharge pipe is an asphalt road and underground concrete bunkers set into the hillside. The level area contains a one-lane paved road which circles around the side of the hill and allows access to the concrete bunkers. Surface water runoff drains from the higher hillside, which drains onto the level area, which in turn drains over the site.

Although the Navy still conducts testing and research on explosives at the NEDED complex and Building 537, there are no process wastewater discharges from these buildings to Site 8 and SSA 14. Exposure to any contamination at the sites is limited to research and development facility employees; however, the drainage basin at Site 8 and drainageway at SSA 14 are generally inaccessible because of their steep topographic relief.

4. Release or Threatened Release Into The Environment of a Hazardous Substance, Pollutant, or Contaminant

The media of concern at these sites are soil and sediment contaminated with BEHP, Aroclor-1260, explosives, and inorganics. This Action Memorandum addresses soil/sediment with concentrations exceeding remediation levels. The following table provides the remediation goals for the contaminants of concern. These remediation goals are based on the results of the risk assessments conducted as part of the RI and were agreed to by the Yorktown Partnering Team on August 17, 2005. Approximately 740 cubic yards (cy) of soil/sediment at Site 8 and 730 cy of soil/sediment at SSA 14 will be removed.

Summary of Risk-Based Remediation Goals		
Media	**COC**	**Goal (mg/kg)**
Site 8 Soil	BEHP	10
	Aroclor-1260	0.1
	amino-DNTs	1.3
	HMX	6.3
	RDX	21.1
	2,4,6-TNT	1.3
	Chromium	16.27
	Iron	11,276
	Mercury	0.1
	Vanadium	23.07
	Zinc	50
Site 8 Sediment	BEHP	0.18
	Aroclor-1260	0.023
SSA 14 Soil	BEHP	10
	HMX	6.3
	Chromium	16.27
	Iron	11,276
	Mercury	0.1
	Vanadium	23.07
	Zinc	50
SSA 14 Sediment	BEHP	0.18
	Selenium	1

5. National Priorities List Status

In 1992, WPNSTA Yorktown was placed on USEPA's National Priorities List of Superfund sites. Remedial activities are in progress at WPNSTA Yorktown and include examining contamination to soils, sediments, surface water, and groundwater.

6. Maps, Pictures, and Other Graphic Representations

Figures 1 and 2 show a location map and layout of Site 8 and SSA 14, respectively. Figures 3 and 4 present the proposed removal areas to be addressed during the non-time-critical removal action.

B. Other Actions to Date

1. Previous Actions

Investigations and studies related to Site 8 and SSA 14 are listed below:

- Initial Assessment Study
- Confirmation Study and RI Interim Report
- Focused Biological Sampling and Preliminary Risk Evaluation Report
- Round One RI
- Habitat Evaluation
- Relative Risk Ranking for SSA 14
- Round Two RI
- Pre-Removal Characterization of Soil at Site 2, Site 8, and SSA 14

The EE/CA provides an in-depth discussion of the previous investigations at Site 8 and SSA 14.

2. Current Actions

Although the Navy still conducts testing and research on explosives at the NEDED complex and Building 537, there are no process wastewater discharges from these buildings to Site 8 and SSA 14. This Action Memorandum addresses only contaminated soil and sediment at Site 8 and SSA 14, which are potential sources of contamination. Groundwater will be addressed as part of a separate investigation for Groundwater Operable Unit IV.

C. State and Local Authorities' Roles

1. State and Local Actions to Date

As previously stated, Executive Order 12580 delegates to the Department of Defense the President's authority to undertake CERCLA response actions. Congress further outlined this authority in the Defense Environmental Restoration Program Amendments, under 10 United States Code Sections 2701 through 2705. CERCLA Section 120 requires the Navy to apply State removal and remedial action law requirements at its facilities.

2. Potential for Continued State/Local Response

It is expected that the Navy will continue to be the lead agency, and that the Navy's environmental restoration program will continue to be the exclusive source of funding for this removal action. The USEPA and the Virginia Department of Environmental Quality will continue to be consulted during and until actions addressing the contaminated soil/sediment are determined complete.

III. THREATS TO PUBLIC HEALTH OR WELFARE OR THE ENVIRONMENT, AND STATUTORY AND REGULATORY AUTHORITIES

Section 300.415 of the NCP lists the factors to be considered in determining the appropriateness of a non-time-critical removal action. Paragraphs (b)(2)(i), (ii), (iv), and (v) of Section 300.415 apply to the conditions as follows:

300.415(b)(2)(i) "Actual or potential exposures to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants."

BEHP, Aroclor-1260, explosives, and inorganics are present in the soil/sediment at levels above the site remediation goals. Based on the Screening-Level Ecological Risk Assessment and Step 3a conducted as part of the Round Two RI (Baker, 2004), there is unacceptable risk to ecological receptors from the contaminants in soil/sediment at both Site 8 and SSA 14.

300.415(b)(2)(iv) "High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate."

High levels of Aroclor-1260 have been detected in Site 8 surface and subsurface soils. The site is along Felgates Creek, increasing contaminant migration potential via stormwater runoff.

IV. ENDANGERMENT DETERMINATION

Actual or threatened releases of hazardous substances from these sites, if not addressed by implementing the response action discussed in this Action Memorandum, may present an imminent and substantial endangerment to public health, welfare, or the environment.

V. PROPOSED ACTIONS AND ESTIMATED COSTS

A. Proposed Actions

1. Proposed Action Description

The proposed removal action at Site 8 and SSA 14 will include the removal and disposal of contaminated soil and sediment, transportation of contaminated soil and sediment to an approved disposal facility, backfilling and grading the area to the approximate original elevations of the sites prior to excavation, placement of riprap as erosion control in steep areas, placement of six inches of topsoil over the remaining disturbed areas, and vegetation with native grasses and wetland plants. Approximately 740 cy of soil/sediment at Site 8 and 730 cy of soil/sediment at SSA 14 will be removed and disposed off-site.

Institutional controls and five-year reviews will not be required since there will be no contaminated material left on-site.

2. Contribution to Remedial Performance

The removal action will mitigate the potential direct contact threat posed by soil/sediment contaminated with BEHP, Aroclor-1260, explosives, and inorganics and will mitigate the threat of contaminant release and migration. A long-term remedial action for all environmental media has not yet been evaluated. The action will immediately address soil/sediment contamination and the potential human health and ecological risks and will not impede future responses groundwater contamination. The proposed removal

action is compatible with the planned future uses of the sites, is consistent with accepted removal practices, and meets the NCP removal criteria.

3. Description of Alternative Technologies

Two alternatives were qualitatively assessed and compared based on their effectiveness, implementability, and cost. The preferred soil/sediment removal option was selected to provide a high level of protection by removing contaminated soil/sediment from the sites. The proposed removal action provides a permanent and effective remedial action because contaminated soil/sediment will be removed, thus reducing exposure to human health and ecological receptors. The other alternative technology evaluated included excavation and off-site incineration. The EE/CA provides an in-depth discussion and comparison of the alternative removal options considered for contaminated soil/sediment at Site 8 and SSA 14.

4. Engineering Evaluation/Cost Analysis

As described above, an EE/CA was completed to address the non-time-critical removal action at Site 8 and SSA 14. The EE/CA was made available to the public for comment on November 6, 2005. No comments were received from the public during the comment period, which ended on December 6, 2005.

5. Applicable or Relevant and Appropriate Requirements

The NCP requires that removal actions attain applicable or relevant and appropriate Federal and State requirements (ARARs) with limited exception, to the extent practicable. ARARs are divided into three categories: chemical-specific, location-specific, and action-specific. Chemical-specific ARARs are particular to individual contaminants. Location-specific ARARs depend upon the location of the contamination and potential restrictions on activities conducted in these areas (i.e., wetlands, floodplains, etc.). Action-specific ARARs govern the remedial actions and are usually technology or activity-based directions or limitations that control actions taken at CERCLA sites.

The analysis of removal alternatives was performed and is presented in the Final EE/CA for Site 8 and SSA 14. The removal action set forth in this Action Memorandum will comply with all applicable, relevant, and appropriate environmental and human health requirements, to the extent practicable considering the requirements of the situation.

6. Project Schedule

The proposed project schedule is shown in the following table.

Task	Proposed Schedule
Approval of Action Memorandum	December 2005
Preparation of Work Plans and Related Shop Drawings	December 2005
Removal Action	January 2006 – June 2006

B. Estimated Costs

The estimated costs associated with the removal action are itemized below:

		Site 8	SSA 14
Direct Capital Costs			
General		$80,000	$80,000
Site Preparation		$5,500	$6,000
Contaminated Soil/Sediment Removal		$147,000	$137,000
Site Restoration		$17,500	$20,000
	Subtotal	**$250,000**	**$243,000**
Indirect Capital Costs		$53,000	$51,000
	Total	**$303,000**	**$294,000**

VI. EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN

If no action is taken or the action is delayed, the potential for direct contact with the contaminants and the threat of migration of contaminants from the sites will remain.

VII. OUTSTANDING POLICY ISSUES

There are no outstanding policy issues regarding this action.

VIII. ENFORCEMENT

The Navy can and will perform the proposed response promptly and properly.

IX. RECOMMENDATION

This decision document represents the selected removal action for Site 8 and SSA 14, developed in accordance with CERCLA as amended, and is consistent with the NCP. This decision is based on the administrative record for this site.

Conditions at the site meet the NCP Section 300.415(b)(2) criteria for removal. The Naval Facilities Engineering Command, Mid-Atlantic, recommends approval of the proposed remedial action. The total project ceiling is estimated to be $600,000. Response actions should commence as soon as practical due to the potential threat to human health and the environment from Site 8 and SSA 14.

X. REFERENCES

Baker, 2005. Final Engineering Evaluation/Cost Analysis for Contaminated Soil and Sediment, Site 8 and SSA 14, Naval Weapons Station Yorktown, Yorktown, Virginia. December 2005.

Baker, 2004. Final Round Two Remedial Investigation Report Sites 2, 8, 18 and SSA 14, Naval Weapons Station Yorktown, Yorktown, Virginia. June 2004.

Baker, 1995. Relative Risk Ranking System Data Collection Investigation, Naval Weapons Station Yorktown, Yorktown, Virginia. November 1995.

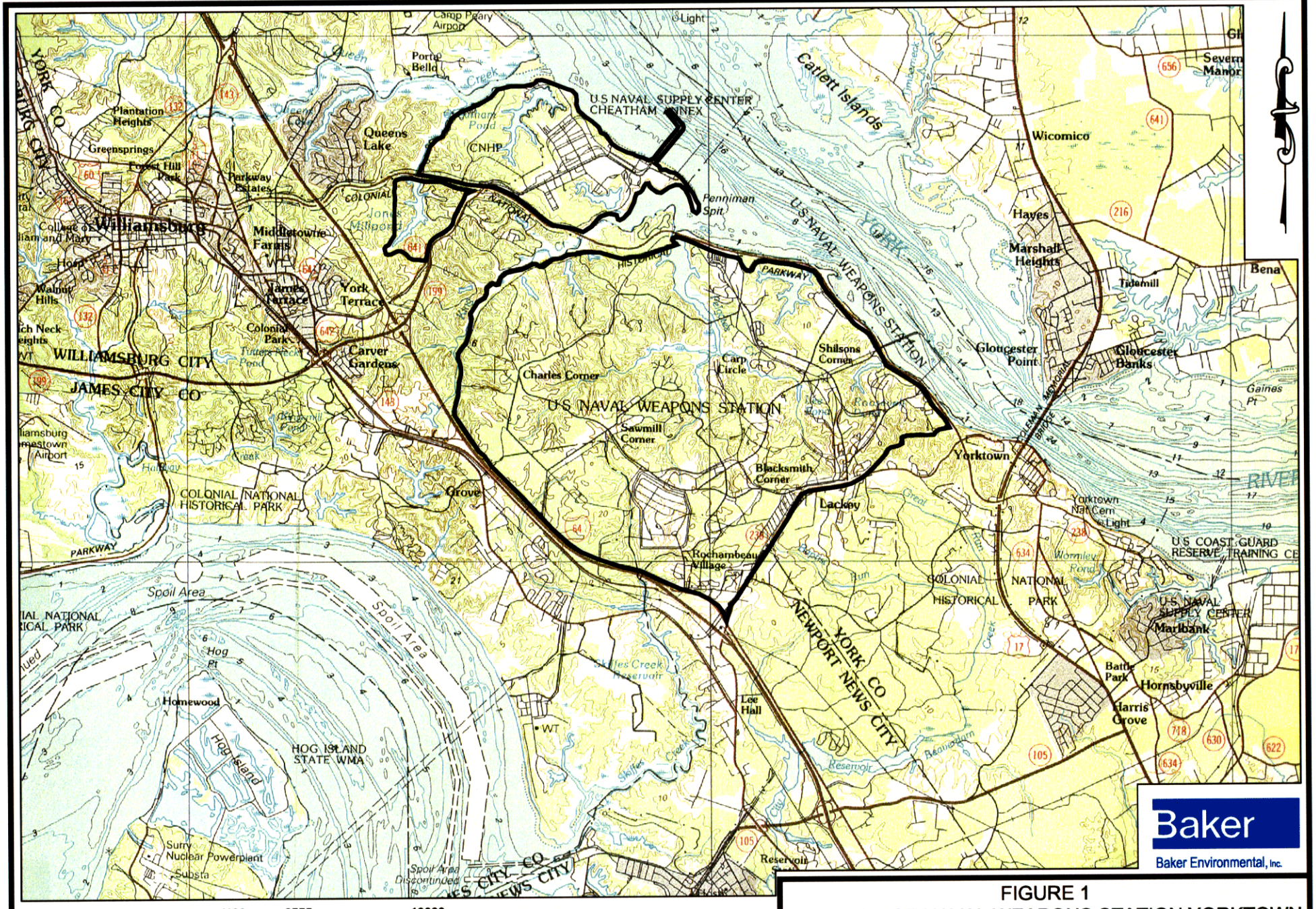
Baker and Roy F. Weston, Inc. 1993. Final Round One Remedial Investigation Report for Sites 1-9, 11, 12, 16-19 and 21, Naval Weapons Station Yorktown, Yorktown, Virginia. July 1993.

C.C. Johnson & Associates, Inc. and CH2M Hill, 1984. Initial Assessment Study of Naval Weapons Station Yorktown, Yorktown, Virginia. July 1984.

Naval Facilities Engineering Service Center, 2001. Navy/Marine Corps Installation Restoration Manual. 324 pp.

USEPA, 1990. Superfund Removal Procedures Action Memorandum Guidance. OSWER Directive 9360.3-01. EPA/540/P-90/004.

FIGURES

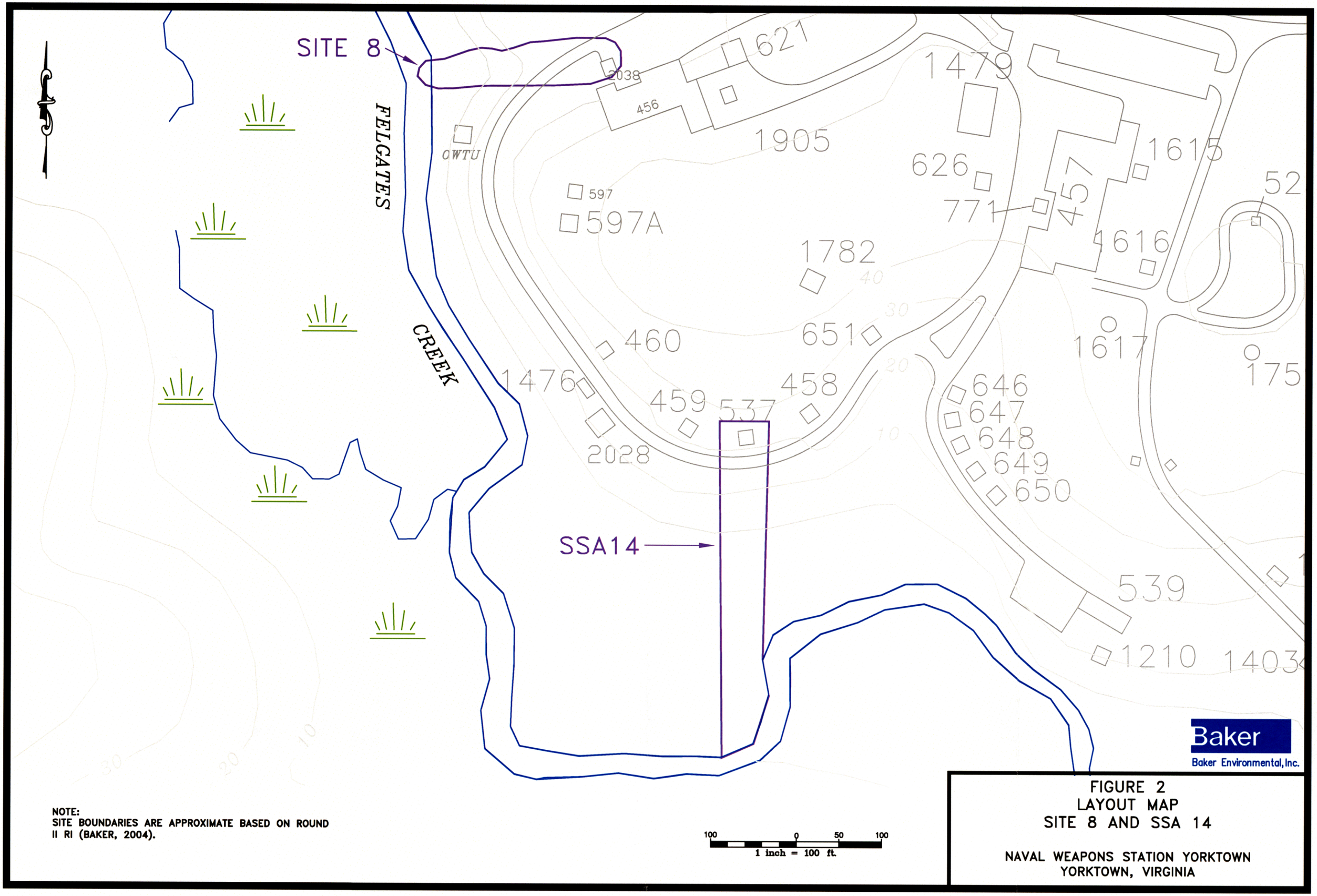


SOURCE: U.S.G.S. 1:100,000–SCALE PLANIMETRIC MAP, WILLIAMSBURG, VIRGINIA, 1984.

Baker

Baker Environmental, Inc.

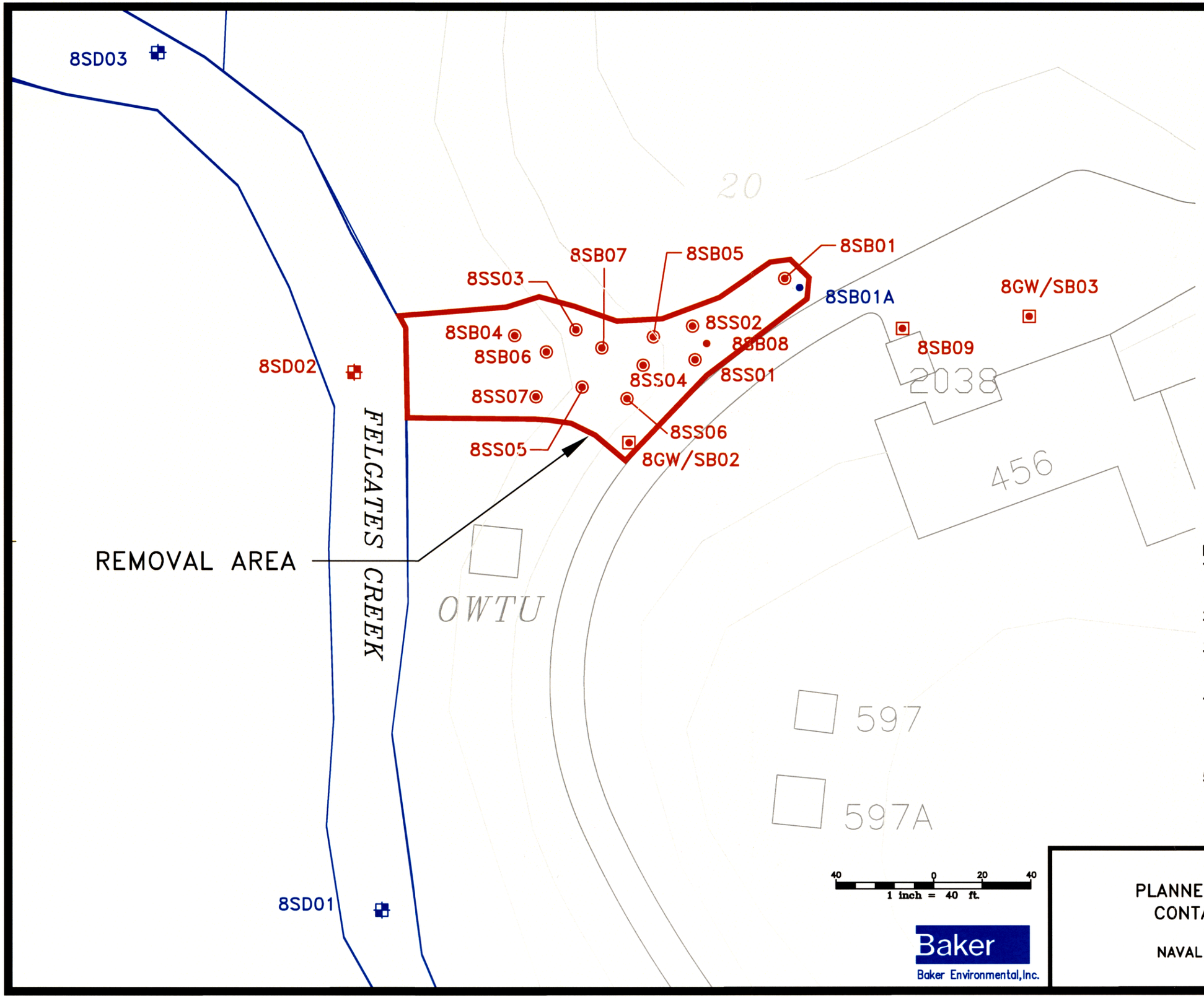
FIGURE 1
LOCATION OF NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA AND CHEATHAM ANNEX
WILLIAMSBURG, VIRGINIA



NOTE:
SITE BOUNDARIES ARE APPROXIMATE BASED ON ROUND II RI (BAKER, 2004).

FIGURE 2
LAYOUT MAP
SITE 8 AND SSA 14

NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA



REMEDIATION GOALS		
MEDIA	COC	GOAL (MG/KIG)
SOIL	BEHP	10
	AROCLOR-1260	0.1
	AMINO-DNTS	1.3
	HMX	6.3
	RDX	21.1
	TNT	1.3
	CHROMIUM	16.27
	IRON	11276
	MERCURY	0.1
	VANADIUM	23.07
	ZINC	50
SEDIMENT	BEHP	0.18
	AROCLOR-1260	0.023

NOTES:
1. BLUE SAMPLES INDICATE NON-EXCEEDANCES OF REMEDIATION GOALS.
2. RED SAMPLES INDICATE EXCEEDANCES OF REMEDIATION GOALS.
3. 2-AMINO-4,6-DNT AND 4-AMINO-2,6-DNT WERE ADDED TO DETERMINE AMINO-DNT EXCEEDANCES.
4. 8GW/SB03 SLIGHTLY EXCEEDS IRON (11400 MG/KG) AND VANADIUM (23.8 MG/KG). THIS IS AN UPGRADIENT SAMPLE AND IS WITHIN BACKGROUND LEVELS.
5. 8SB09 EXCEEDS REMEDIATION GOALS FOR INORGANICS. UPGRADIENT SAMPLE WAS COLLECTED AT 5-7 FT AND IS NOT PART OF EXPOSURE PATHWAY.

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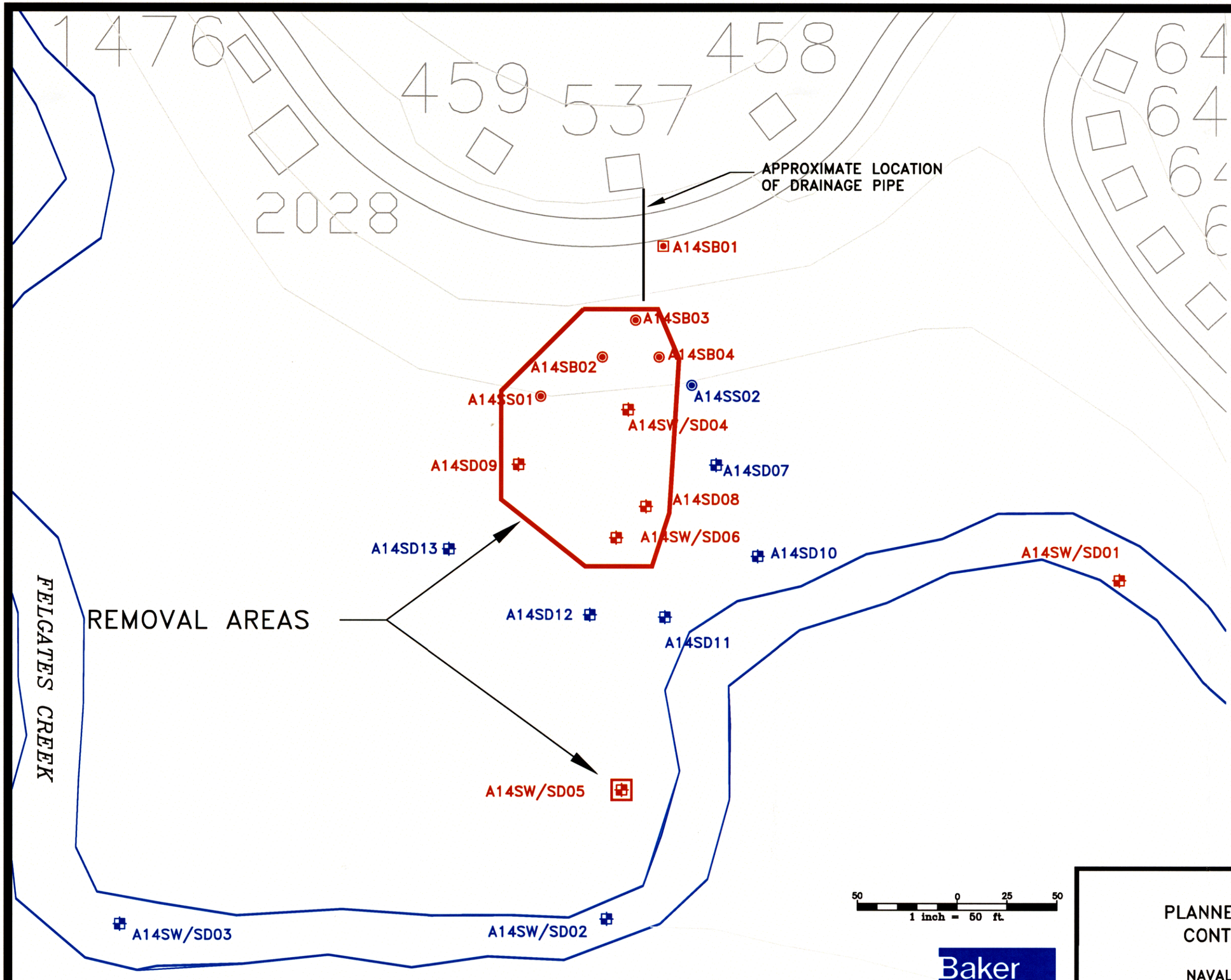
FIGURE 3
PLANNED EXTENT OF REMOVAL OF CONTAMINATED SOIL/SEDIMENT
SITE 8
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA



REMEDIATION GOALS		
MEDIA	COC	GOAL (MG/KIG)
SOIL	BEHP	10
	HMX	6.3
	IRON	11276
	MERCURY	0.1
	VANADIUM	23.07
	ZINC	50
SEDIMENT	BEHP	0.18
	SELENIUM	1

NOTES:
1. BLUE SAMPLES INDICATE NON-EXCEEDANCES OF REMEDIATION GOALS.
2. RED SAMPLES INDICATE EXCEEDANCES OF REMEDIATION GOALS.
3. A14SB01 EXCEEDS IRON (22800 MG/KG)
4. AND VANADIUM (35.9 MG/KG). THIS IS AN UPGRADIENT SAMPLE AND IS NOT INDICATIVE OF PAST SITE ACTIVITIES. A14SW/SW01 EXCEEDS REMEDIATION GOAL FOR BEHP. SEDIMENT CONTAMINATION WITHIN FELGATES CREEK WILL BE ADDRESSED AS PART OF SEPARATE INVESTIGATION.

50 0 25 50
1 inch = 50 ft.

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Baker Environmental, Inc.

FIGURE 4
PLANNED EXTENT OF REMOVAL OF CONTAMINATED SOIL/SEDIMENT
SSA 14
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

FINAL

ENGINEERING EVALUATION/COST ANALYSIS FOR CONTAMINATED SOIL AND SEDIMENT SITE 8 AND SSA 14

NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

CONTRACT TASK ORDER 046

DECEMBER 2005

Prepared for:

Norfolk, Virginia

Under the:

NAVFAC ATLANTIC CLEAN PROGRAM
CONTRACT N62470-02-D-3052

Prepared by:

Virginia Beach, Virginia

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ACRONYMS AND ABBREVIATIONS

µg/kg	Microgram per kilogram
ARAR	Applicable or Relevant and Appropriate Requirement
BEHP	Bis(2-ethylhexyl)phthalate
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COC	Contaminant of Concern
COPC	Contaminant of Potential Concern
CT	Central Tendency
cy	Cubic Yard
DNT	Dinitrotoluene
EE/CA	Engineering Evaluation/Cost Analysis
ERA	Ecological Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IAS	Initial Assessment Study
ILCR	Incremental Lifetime Cancer Risk
IR	Installation Restoration
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEDED	Naval Explosives Development Engineering Department
NFESC	Naval Facilities Engineering Services Center
NTCRA	Non-Time-Critical Removal Action
ODUSD(I&E)	Office of the Deputy Under Secretary of Defense (Installations and the Environment)
PCB	Polychlorinated Biphenyl
ppm	Parts per Million
PRG	Preliminary Remediation Goal
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
SSA	Site Screening Area
SVOC	Semivolatile Organic Compound
TBC	To Be Considered
TCLP	Toxicity Characteristic Leachate Procedure
TNT	Trinitrotoluene
TSCA	Toxic Substances Control Act

ACRONYMS AND ABBREVIATIONS
(Continued)

USEPA	United States Environmental Protection Agency
VHWMR	Virginia Hazardous Waste Management Regulations
VOC	Volatile Organic Compound
VSWMR	Virginia Solid Waste Management Regulations
WPNSTA	Naval Weapons Station

EXECUTIVE SUMMARY

This Engineering Evaluation/Cost Analysis (EE/CA) provides the basis for a non-time-critical removal action (NTCRA) for contaminated soil and sediment at two environmental restoration (ER) sites at Naval Weapons Station (WPNSTA) Yorktown:

- Site 8, Naval Explosives Development Engineering Department (NEDED) Explosives-Contaminated Wastewater Discharge Area

- Site Screening Area (SSA) 14, Building 537 Discharge to Felgates Creek

Work conducted at these sites includes two Remedial Investigation (RI) Reports, one in 1993 and the other in 2004, and additional soil and sediment sampling in 2005 to identify the boundaries of the contamination. Results of the additional soil and sediment sampling completed in 2005 are presented in this EE/CA. This EE/CA addresses the remediation of soil and sediment contaminated with the semivolatile organic compound (SVOC), bis(2-ethylhexyl)phthalate (BEHP), and with Aroclor-1260 (a PBC), explosives such as TNT, and inorganics such as chromium, iron, and zinc.

The Navy identified the need for a NTCRA at Site 8 and SSA 14 following the completion of the second RI. The Navy plans to initiate this removal action to minimize the threat for human health and ecological exposure to contaminated soil and sediment. The WPNSTA Yorktown Partnering Team agreed to proceed with this EE/CA for Site 8 and SSA 14 in June 2004.

Removal action alternatives evaluated for Site 8 and SSA 14 in this EE/CA include: (1) excavation with off-site incineration; and (2) excavation with off-site disposal. In accordance with United States Environmental Protection Agency (USEPA) guidance from 1993, the No Action alternative has not been evaluated because it is not protective of human health and the environment.

The two alternatives were evaluated based on effectiveness, implementability, and cost. The Navy recommends the implementation of Alternative 2, excavation with off-site disposal.

1.0 INTRODUCTION

This report presents the EE/CA of removal action options for contaminated soil and sediment at Site 8, NEDED Explosives-Contaminated Wastewater Discharge Area, and SSA 14, Building 537 Discharge to Felgates Creek, at WPNSTA Yorktown, Yorktown, Virginia. An EE/CA serves an analogous function to the Remedial Investigation and Feasibility Study (RI/FS) but is more streamlined and allows for an accelerated cleanup. Baker Environmental, Inc. has prepared this EE/CA under contract to the Naval Facilities Engineering Command, Atlantic Division. This EE/CA has been prepared under Comprehensive Long-Term Environmental Action, Navy Contract N62470-02-D-3052, Contract Task Order 046.

This EE/CA has been conducted in accordance with the removal program requirements defined by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, as amended, , the Superfund Amendments and Reauthorization Act of 1986, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and the USEPA's *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (USEPA, 1993a). This EE/CA also follows the guidelines published in the Navy/Marine Corps IR Manual updated in 2001 (Naval Facilities Engineering Services Center [NFESC], 2001).

The Department of the Navy has broad authority under CERCLA Section 104 and Executive Order 12580 to carry out removal actions when the release is on, or the sole source of the release is from, the Department of the Navy installation. The Navy/Marine Corps Environmental Restoration Program (NERP) was initiated to identify, assess, characterize, and clean up or control contamination from past hazardous waste disposal operations and hazardous material spills at Navy and Marine Corps installations.

A NTCRA is conducted when the Navy determines, based on the site evaluation, that a removal action is appropriate , and a planning period of at least six months exists prior to initiation of the on-site removal activities. Because a NTCRA can address priority risks, they provide an important method of moving sites more quickly through the CERCLA process. Potential remediation alternatives are evaluated for effectiveness in minimizing or stabilizing the threat to public health, consistency with anticipated final remedial actions, consistency with applicable or relevant and appropriate requirements (ARARs), and cost effectiveness. NTCRAs may be interim or final actions, may be the first and only action at a site, or one of a series of planned response actions. The NCP recognizes many appropriate removal action options, including site control measures, stabilization, drainage controls, capping, excavation, treatment, and disposal (40 CFR 300.415(e)).

This NTCRA will only address contaminated soil and sediment at Site 8 and SSA 14. Groundwater will be addressed as part of Groundwater Operable Unit IV. This EE/CA is based on data presented in the Round One Remedial Investigation Report (Baker/Weston, 1993b), the Round Two Remedial Investigation Report (Baker, 2004) and additional soil and sediment sampling data presented in this EE/CA.

2.0 SITE CHARACTERIZATION

The following sections describe the features and history of Site 8, NEDED Explosives-Contaminated Wastewater Discharge Area, and SSA 14, Building 537 Discharge to Felgates Creek, within WPNSTA Yorktown. These sections also discuss previous investigations and the identified contaminants that necessitated the preparation of this EE/CA.

2.1 WPNSTA Yorktown Description and History

WPNSTA Yorktown is a 10,624-acre installation located on the Virginia Peninsula in York and James City Counties and the City of Newport News (Figure 2-1). WPNSTA Yorktown is bounded on the northwest by WPNSTA Yorktown Cheatham Annex and the King's Creek Commerce Center; on the northeast by the York River and the Colonial National Historic Parkway; on the southwest by Route 143 and Interstate 64; and on the southeast by Route 238 and the town of Lackey, Virginia.

Originally named the U.S. Navy Mine Depot, WPNSTA Yorktown was established in 1918 to support the laying of mines in the North Sea during World War I. For 20 years after World War I, the depot received, reclaimed, stored, and issued mines, depth charges, and related materials. During World War II, the facility was expanded to include three 2,4,6-trinitrotoluene (TNT) loading plants and new torpedo overhaul facilities. A research and development laboratory for experimentation with high explosives was established in 1944. In 1947, a quality evaluation laboratory was developed to monitor special tasks assigned to the facility, which included the design and development of depth charges and advanced underwater weapons. On August 7, 1959, the depot was renamed the U.S. Naval Weapons Station. Today, the primary mission of WPNSTA Yorktown is to provide ordnance, technical support, and related services to sustain the war-fighting capability of the Armed Forces in support of national military strategy.

2.2 Site 8, NEDED Explosives-Contaminated Wastewater Discharge Area

Site 8 is a 100-foot drainageway located along the eastern branch of Felgates Creek, approximately 1.5 miles from the confluence of the creek and the York River (Figure 2-2). Site 8 is located at latitude 37 degrees, 5 minutes, 08.05327 seconds and longitude 76 degrees, 34 minutes, 10.52396 seconds. This area received wastewater from the NEDED complex (Building 456) from 1940 to 1975. The wastewater reportedly contained unspecified solvents, spent/neutralized acids, and nitramine compounds. In 1974, a carbon adsorption tower was installed to treat the contaminated wastewater prior to discharge into the drainage area. A National Pollutant Discharge Elimination System permit was granted by USEPA Region III to allow this discharge. In 1986, the effluent from the tower was diverted to the sanitary sewer and ultimately to Hampton Roads Sanitation District. Currently, the site has reverted to a natural drainage area.

2.3 SSA 14, Building 537 Discharge to Felgates Creek

SSA 14 occupies an area of approximately 0.4 acres, and is located outside of Building 537 and upstream of Site 8 in the north central portion of the facility (Figure 2-2). SSA 14 8 is located at latitude 37 degrees, 15minutes, 01.91898 seconds and longitude 76 degrees, 34 minutes, 7.38908 seconds. Building 537 is one of several small buildings used by the Indian Head Detachment for explosives research, development and testing. This SSA consists of a pipe leading from the building, through which nitramine-contaminated wastewater was reportedly discharged to Felgates Creek.

2.3.1 Physiography

The topography of Site 8 is best described as a drainage basin. The drainage basin measures approximately 30 feet wide by 100 feet long and is at least 14 feet lower in elevation than the surrounding areas. East of the drainage basin, a small paved parking area is bordered to the north by a steep sloping hillside and a building set on a hillside to the south. This drainage basin flows toward a marsh area that merges with the east branch of Felgates Creek. The drainage basin receives surface water runoff from the surrounding topography in addition to the stormwater collection system that drains the area around Building 456.

SSA 14 is very small, covering less than half of an acre, and consists of a stormwater discharge line and the associated discharge area. The investigation centers around a discharge or drainage pipe from Building 537 that empties at the top of a slope and flows downward to a marsh area (approximately 15 feet lower in elevation), which extends to the east branch of Felgates Creek. The discharge pipe is located under an asphalt road that passes in front of Building 537, an underground concrete bunker set into the hillside. The one-lane paved road circles around the side of the hill and allows access to Building 537 and other concrete bunkers (See Figure 2-2). Surface water runoff drains from the higher hillside above Building 537, which drains onto the paved level area, which in turn drains over the site.

2.3.2 Geology

In general, Site 8 is underlain by unconsolidated deposits of silt, little clay, and trace amounts of fine-grained sand. These deposits range in depth from approximately 6- to 30- feet below ground surface (bgs) where the lithology becomes granular with the introduction of medium- to fine-grained sand and marine shell fragments.

The subsurface geology at SSA 14 is described as tan silt, with little clay and trace fine-grained sand and marine shell fragments. This lithology becomes more coarsely grained at 14-feet bgs where fine-grained sand becomes the major constituent, with silt and marine shell fragments as minor constituents.

2.3.3 Land Use and Demography

Explosive research and development is conducted within Building 465, which is adjacent to Site 8. SSA 14 is also within an area where explosive research and development is currently conducted. Exposure to contaminants is limited to research and development facility employees; however, the drainage basin at Site 8 and drainageway at SSA 14 are generally inaccessible because of their steep topographic relief.

2.3.4 Ecology

2.3.4.1 Site 8, NEDED Explosives-Contaminated Wastewater Discharge Area

Site 8 is located in an industrialized area of WPNSTA Yorktown, and is relatively open in nature. Surrounding the site on higher ground is deciduous upland forest characterized by a diverse assemblage of upland deciduous trees, including American beech (*Fagus grandifolia*), white oak (*Quercus alba*), yellow poplar (*Liriodendron tulipifera*), southern red oak (*Quercus falcata*) and sugar maple (*Acer saccharum*) with an understory of American holly (*Ilex opaca*) and mountain laurel (*Kalmia latifolia*) and groundcover comprised of partridgeberry (*Mitchella repens*) and Christmas fern (*Polystichum acrostichoides*). A mixed hardwood-pine forest comprised of beech,

sycamore, loblolly pine (*Pinus taeda*), sweet gum (*Liguidambar styraciflua*), silktree (*Albizia julibrissin*), sourwood (*Oxydendrum arboreum*), red maple (*Acer rubrum*), and Virginia pine (*Pinus virginiana*) is present in the vicinity of the drainageway. Understory species include holly, juniper (*Juniperus* sp.), redbud (*Cercis canadensis*), pawpaw (*Asimina triloba*), bayberry (*Myrica cerifera*), groundsel-tree (*Baccharis glomeruliflora*), blueberry (*Vaccinium vacillans*), and swamp rose mallow (*Hibiscus palustris*) and several woody vine species, including poison ivy (*Rhus radicans*), Virginia creeper (*Parthenocissus quinquifo*), bullbriar (*Smilax* sp.), trumpet creeper (*Campsis radicans*), sand grape (*Vitis rupestris*), and wild grape (*Vitus* spp.).

Although the drainageway to Felgates Creek is not officially classified as a wetland on the National Wetland Inventory maps, wetland vegetation is present. Three wetland forbs dominate the area, sensitive fern (*Onoclea sensibilis*), water pennywort (*Hydrocotyle americana*), and clearweed (*Pilea pumila*). The drainageway leads to an estuarine, intertidal, emergent wetland along Felgates Creek dominated by smooth cordgrass (*Spartina alterniflora*). Felgates Creek flows due north in the vicinity of Site 8; approximately 125 feet downstream the creek turns westward. The surrounding marsh and creek receive storm and groundwater influences from upland areas, including those from both Site 8 and SSA 14. Salt-tolerant marshes edge Felgates Creek in the vicinity of both sites.

Felgates Creek and the surrounding salt marshes likely support a diverse community of estuarine fish and invertebrate species as well as a wide range of avian and mammalian upper trophic level consumer species. No reptiles or amphibians were noted at Site 8 during the habitat evaluation, though they would be expected given the habitat available. Though not optimal due to salinity, marsh surface waters may serve as a drinking water source for semi-aquatic and aquatic receptors utilizing the site.

2.3.4.2 SSA 14, Building 537 Discharge to Felgates Creek

SSA 14 is located in an industrial area containing buildings, roadways and paved parking areas. Excluding these man-made features, the terrestrial habitat upgradient of SSA 14 includes grass-covered, landscaped land surrounded by a mixed hardwood-pine woodland, characterized by many individuals but few dominant woodland species common at WPNSTA Yorktown, including yellow poplar (*Liriodendron tulipifera*), sycamore (*Platanus occidentalis*), American beech (*Fagus grandifolia*), and loblolly pine (*Pinus taeda*). Understory species include holly (*Ilex opaca*) and mountain laurel (*Kalmia latifolia*).

The downgradient portions of the SSA 14 discharge area are inundated from Felgates Creek at high tide. Felgates Creek flows due west in the vicinity of SSA 14; approximately 250 feet downstream the creek abruptly turns northward towards downgradient Site 8. The surrounding marsh and creek receive storm and groundwater influences from upland areas, including those from both SSA 14 and Site 8. Salt-tolerant marshes edge Felgates Creek in the vicinity of both sites. The vegetative community supported downgradient of the SSA 14 discharge pipe and downgradient of Site 8 is characteristic of estuarine creeks, dominated by smooth cordgrass (*Spartina alterniflora),* edged by bayberry (*Myrica cerifera*).

Invertebrate species observed and expected to be utilizing the brackish aquatic habitat offered by the marsh include mussels, marsh periwinkles, mud crabs, fiddler crabs, oysters, amphipods, and worms. Small fish, including minnows, anchovy, and mosquito fish are likely abundant in the channels networking the marshes, and are probably found throughout the habitat at higher tidal levels. Felgates Creek and the surrounding marshes additionally have the potential to support a wide range of avian, mammalian, and reptilian upper trophic level consumer species. Though not optimal due to salinity,

marsh surface waters may serve as a drinking water source for semi-aquatic and aquatic receptors utilizing the site.

2.4 Previous Investigations and Actions

There have been no remedial actions or removal actions at Site 8 and SSA 14. Investigations and studies related to Site 8 and SSA 14 are listed below.

- Initial Assessment Study (IAS)
- Confirmation Study and RI Interim Report
- Focused Biological Sampling and Preliminary Risk Evaluation Report
- Round One RI
- Habitat Evaluation
- Relative Risk Ranking for SSA 14
- Round Two RI
- Pre-Removal Characterization of Soil at Site 2, Site 8, and SSA 14

The following sections provide a brief discussion on investigations relevant to this EE/CA.

2.4.1 Initial Assessment Study

The purpose of the IAS (C.C. Johnson & Associates, Inc. and CH2M Hill, 1984) was to identify and assess sites on WPNSTA Yorktown that posed a potential threat to human health and/or the environment due to contamination from past operations. A total of 19 potentially contaminated sites were identified based on information from historical records, aerial photographs, field inspections, and personnel interviews. Each site was evaluated for the type of contamination, migration pathways, and pollutant receptors. The IAS concluded that 15 of the 19 sites, including Site 8, were of sufficient potential threat to human health or the environment to warrant Confirmation Studies. SSAs were not identified in the IAS.

2.4.2 Confirmation Study and RI Interim Report

Two rounds of data were obtained during the Confirmation Study effort. The first round of sampling and analysis was documented in the "Confirmation Study Step IA (Verification), Round One" (Dames & Moore, 1986). The results of the second round of sampling and comparisons with appropriate regulatory standards were presented in the "Confirmation Study Step IA (Verification), Round Two" (Dames & Moore, 1988). The results of these field efforts were combined and summarized in the Draft RI Interim Report (Dames & Moore, 1989). Versar, Inc. subsequently revised this report in 1991 to incorporate comments from the former Technical Review Committee (now know as the Restoration Advisory Board). The revised report is referred to as the RI Interim Report (Versar, 1991). The RI Interim Report recommended that further RI activities be completed at Site 8.

2.4.3 Focused Biological Sampling and Preliminary Risk Evaluation Report

The Focused Biological Sampling and Preliminary Risk Evaluation Report (Baker and Weston, 1993b) summarized the results of a limited biological tissue, surface water, and sediment sampling effort conducted in October 1992. The primary objective of the sampling program was to evaluate the potential human health risk associated with consumption of fish and shellfish taken from select waters within WPNSTA Yorktown, including Lee Pond, Roosevelt Pond, Felgates Creek, and Indian Field Creek. Site 8 and SSA 14 are each located along the banks of Felgates Creek.

2.4.4 Round One RI

The results of the Final Round One RI (Baker and Weston, 1993a) indicated that further investigation was needed at Site 8 to better define the nature and extent of contamination associated with each site. The Round One investigation at Site 8 consisted of surface soil, groundwater, surface water, and sediment investigations. Based on the results of the Round One RI, further soil sampling for explosives and volatile organic compounds (VOCs) was recommended to delineate the extent of contamination in soils at Site 8. Installation of monitoring wells and collection of VOC, explosive, and inorganic samples to confirm the Round One results and delineate the extent of contamination was also recommended.

2.4.5 Habitat Evaluation

The Final Habitat Evaluation Report (Baker, 1995a) included a characterization of the aquatic and terrestrial habitats supported at WPNSTA Yorktown, including Site 8. SSA 14 was not included in the Habitat Evaluation; however, it is located immediately upstream of Site 8. The evaluation included a description and areal characterization of major habitat types on or surrounding each site, an inventory of vegetative species supported, and a record of any animal species encountered or suspected to be present or using IR site habitats.

2.4.6 Relative Risk Ranking for SSA 14

A Relative Risk Ranking Data Collection Investigation was conducted at SSA 14 during late October 1995 (Baker, 1995b). The objective of this effort was to gather contaminant, pathway, and receptor information to be used in the Navy's Relative Risk Ranking System. Prior to this investigation, no samples had been collected at SSA 14. Surface soil, surface water, and sediment samples were collected, and all samples were analyzed for nitramine compounds. Explosives were detected in one surface soil (HMX and RDX), one surface water sample (HMX, RDX, and amino-dinitrotoluenes [amino-DNTs]), and in one sediment sample (HMX).

2.4.7 Round Two RI

The results of the previous investigations at Site 8 and SSA 14 indicated that further investigation was needed to better define the nature and extent of contamination associated with each site. The objectives of the Final Round Two RI Report (Baker, 2004) were to: (1) conduct a Round Two remedial investigation based on the results of the Round One RI, (2) assess the nature and extent of contamination at each site and/or to address data gaps observed after the Round One RI that prevented an adequate understanding of site conditions, and (3) assess potential human health and ecological risks associated with any contamination at Site 8 and SSA 14 and identify any potential remaining data gaps. To address data gaps from the Round One investigation, a second round of field investigation activities was conducted. These activities included the installation of additional monitoring wells at all sites and the collection of surface and subsurface soil, surface water, sediment, biota, and groundwater samples at Site 8 and SSA 14. Contaminants of concern (COCs) were detected in a number of these samples. At Site 8 detected COCs included explosives (amino-DNTs, HMX, RDX and 2,4,6-TNT) in surface soil samples, and amino-DNTs and HMX in subsurface soil samples. Inorganic COCs including chromium, iron, mercury, vanadium, and zinc were detected in both surface and subsurface soil samples at Site 8. The only COCs detected in sediment samples at Site 8 were BEHP and selenium. At SSA 14 detected COCs included in BEHP, HMX, iron, mercury, vanadium and zinc in surface soil samples. In the two subsurface soil samples at SSA 14 the only COCs detected were iron, vanadium and zinc. BEHP and selenium were detected in sediment samples at SSA 14. Analytical results of the Round Two RI samples are discussed in Section 2.5.

2.4.8 Pre-Removal Characterization of Soil at Site 2, Site 8, and SSA 14

The purpose of the Pre-Removal Characterization investigation was to characterize soil and sediment in support of planned removal actions. The approach for this investigation is detailed in the Site 2, 8, SSA 14 Pre-Removal Characterization Work Plan (Baker, 2005). Soil and sediment samples were collected to determine the extent of chemicals identified as either human health or ecological COCs at Site 8 and SSA 14. COCs were detected in a number of these samples. At Site 8 seven surface soil and 7 subsurface soil samples were collected. At SSA 14, two surface soil, two subsurface soil, seven surface sediment and seven subsurface sediment samples were collected. Detected COCs at Site 8 included explosives (amino-DNTs, HMX, RDX and 2,4,6-TNT), BEHP, Aroclor-1260, chromium, mercury and zinc in both surface and subsurface soil samples. At SSA 14 detected COCs in both surface and subsurface soil samples included in BEHP, HMX, mercury, selenium and zinc. In the seven surface and subsurface sediment samples at SSA 14 the COCs detected BEHP, mercury and zinc. Selenium was detected in only one surface sediment sample, and was not detected in any subsurface sediment samples. No explosives were detected in sediment samples at SSA 14. The results of the Pre-Removal Characterization are discussed in the following section.

2.5 Source, Nature, and Extent of Contamination

Based on site history and the results of previous investigations, contamination from prior disposal practices and operating procedures at Site 8 and SSA 14 have, to various degrees, impacted soil and sediment. Detailed findings and data evaluation of the nature and extent of contamination are presented in Sections 4.0 and 5.0 of the Round Two RI Report (Baker, 2004). The following COCs have been identified:

- Site 8 Soil: BEHP, Aroclor-1260, amino-DNTs, HMX, RDX, 2,4,6-TNT, chromium, iron, mercury, vanadium, zinc
- Site 8 Sediment: BEHP, Aroclor-1260
- SSA 14 Soil: BEHP, HMX, iron, mercury, vanadium, zinc
- SSA 14 Sediment: BEHP, selenium

The following paragraphs summarize the analytical results of soil and sediment sampling conducted for the Pre-Removal Characterization and previous sampling conducted as part of the Round Two RI. Tables 2-1 through 2-6 present the positive detection summaries for the Pre-Removal Characterization samples. Positive detection summaries for the Round Two RI are presented in Section 4.0 of the RI Report and have been included as Attachment A. It should be noted that the data collected from the investigations completed prior to the Round Two RI (1984 IAS, 1991 RI Interim Report, 1993 Focused Biological Sampling and Preliminary Risk Evaluation Report, 1993 Round One RI, 1995 Relative Risk Ranking Data Collection Investigation) support the COCs listed above. However, soil and sediment samples from the Round Two RI and Pre-Removal Characterization provide the most current data, and were collected over a larger area at both sites. Therefore, the following discussions on the nature and extent of contamination are based on the most recent data collected.

2.5.1 Site 8, NEDED Explosives-Contaminated Wastewater Discharge Area

2.5.1.1 Surface Soil

Round Two RI

Eight surface soil samples (and one duplicate) were collected from locations shown in Figure 2-3. The sampling depths varied from 0-1 foot. Samples were analyzed for VOCs, SVOCs, pesticides, polychlorinated biphenyls (PCBs), explosives, and inorganics. Of the chemicals of concern, there

were positive detections of BEHP (three of eight locations [3/8]), Aroclor-1260 (1/8), amino-DNTs (4/8), HMX (2/8), RDX (1/8), 2,4,6-TNT (3/8), chromium (8/8), iron (8/8), mercury (4/8), vanadium (8/8), and zinc (8/8).

Pre-Removal Characterization
A total of seven surface soil samples (0-6 inches deep) were collected from locations shown in Figure 2-3 during the Pre-Removal Characterization. These samples were analyzed for BEHP, Aroclor-1260, select explosives (amino-DNTs, HMX, RDX, 2,4,6-TNT), and select inorganics (chromium, mercury, and zinc). Table 2-1 presents the Site 8 positive detection data for surface soil.

All seven surface soil sample locations had positive detections of Aroclor-1260, 2,4,6-TNT, amino-DNTs, chromium, mercury, and zinc. Positive detections of Aroclor-1260 ranged from 4500 J microgram per kilogram (µg/kg) to 24,000 µg/kg. BEHP was detected at six of the seven locations. HMX and RDX were detected at three of the seven locations.

2.5.1.2 Subsurface Soil

Round Two RI
Five subsurface soil samples (and one duplicate) were collected from locations shown in Figure 2-3. The sampling depths varied from 0-9 feet. Samples were analyzed for VOCs, SVOCs, pesticides, PCBs, explosives, and inorganics. Of the chemicals of concern, there were positive detections of BEHP (1/5), amino-DNTs (1/5), HMX (2/5), chromium (5/5), iron (5/5), mercury (1/5), vanadium (5/5), and zinc (5/5). Aroclor-1260, 2,4,6-TNT, and RDX were not detected in the subsurface soil samples.

Pre-Removal Characterization
A total of seven subsurface soil samples (6-24 inches deep) were collected from locations shown in Figure 2-3. These samples were analyzed for the same constituents as the surface soil samples. All seven subsurface soil locations had positive detections of Aroclor-1260, chromium, mercury, and zinc. Positive detections of Aroclor-1260 ranged from 1500 J µg/kg to 160,000 µg/kg. BEHP was detected at two of the seven locations. Explosives were also detected at several locations: amino-DNTs (5/7), HMX (1/7), RDX (1/7), and 2,4,6-TNT (2/7). Table 2-2 presents the Site 8 positive detection data for subsurface soil.

2.5.1.3 Surface Sediment

Round Two RI
During the Round Two RI, 6 surface sediment samples (and one duplicate) were collected from 0-4 inches deep at locations shown in Figure 2-3. Samples were analyzed for VOCs, SVOCs, explosives, and inorganics. BEHP and Aroclor-1260 are the only COCs in sediment at Site 8. Of the six samples, only three samples had positive detections of BEHP. Aroclor-1260 was not detected in the Round Two RI sediment samples.

Pre-Removal Characterization
Sediment samples were not collected as part of the Pre-Removal Characterization.

2.5.1.4 Subsurface Sediment

Round Two RI
Six subsurface sediment samples (and one duplicate) were collected from 4-8 inches deep at locations shown in Figure 2-3. Samples were analyzed for VOCs, SVOCs, explosives, and inorganics. Of the

six samples, only four samples had positive detections of BEHP. Aroclor-1260 was not detected in the Round Two RI sediment samples.

Pre-Removal Characterization
Sediment samples were not collected as part of the Pre-Removal Characterization.

2.5.2 SSA 14, Building 537 Discharge to Felgates Creek

2.5.2.1 Surface Soil

Round Two RI
Four surface soil samples (and one duplicate) were collected from locations shown in Figure 2-4. The sampling depths varied from 0-1 foot. Samples were analyzed for VOCs, SVOCs, pesticides, PCBs, explosives, and inorganics. Of the chemicals of concern, there were positive detections of BEHP (3/4), HMX (3/4), iron (4/4), mercury (2/4), vanadium (4/4), and zinc (4/4).

Pre-Removal Characterization
Two surface soil samples (0-6 inches deep) were collected from locations shown in Figure 2-4 during the Pre-Removal Characterization. These samples were analyzed for BEHP, HMX, and select inorganics (mercury, selenium, and zinc). BEHP and selenium were not detected in the surface soil samples. HMX was detected at one location, while mercury and zinc were detected at both locations. Table 2-3 presents the SSA 14 positive detection data for surface soil.

2.5.2.2 Subsurface Soil

Round Two RI
Two subsurface soil samples (and one duplicate) were collected from locations shown in Figure 2-4. The sampling depths varied from 3-11 feet. Samples were analyzed for VOCs, SVOCs, pesticides, PCBs, explosives, and inorganics. There were no positive detections of organics. Of the inorganics of concern, there were positive detections of iron (2/2), vanadium (2/2), and zinc (2/2). Mercury was not detected in the subsurface soil samples.

Pre-Removal Characterization
Two subsurface soil samples (6-24 inches deep) were collected from locations shown in Figure 2-4. These samples were analyzed for the same constituents as the surface soil samples. Of the COCs, there were positive detections of BEHP (1/2), HMX (1/2), mercury (2/2), and zinc (2/2). Table 2-4 presents the SSA 14 positive detection data for subsurface soil.

2.5.2.3 Surface Sediment

Round Two RI
During the Round Two RI, 6 surface sediment samples (and 2 duplicates) were collected from 0-4 inches deep at locations shown in Figure 2-4. Samples were analyzed for VOCs, SVOCs, explosives, and inorganics. BEHP and selenium are the only COCs in sediment at SSA 14. Of the six samples, only four had positive detections of BEHP and three samples had positive detections of selenium.

Pre-Removal Characterization
A total of seven surface sediment samples (0-4 inches deep) were collected from locations shown in Figure 2-4. Samples were analyzed for BEHP, HMX, mercury, selenium, and zinc. Of the COCs, BEHP was positively detected in one sample and selenium was detected in one sample. Table 2-5 presents the SSA 14 positive detection data for surface sediment.

2.5.2.4 Subsurface Sediment

Round Two RI

Six subsurface sediment samples (4-8 inches deep) were collected from locations shown in Figure 2-4. Samples were analyzed for VOCs, SVOCs, explosives, and inorganics. Of the six samples, only two samples had positive detections of BEHP and three samples had positive detections of selenium.

Pre-Removal Characterization

Seven subsurface sediment samples (4-8 inches deep) were collected from locations shown in Figure 2-4. Samples were analyzed for BEHP, HMX, mercury, selenium, and zinc. Of the COCs, BEHP was positively detected in two samples and selenium was not detected. Table 2-6 presents the SSA 14 positive detection data for subsurface sediment.

3.0 STREAMLINED RISK EVALUATION

USEPA's guidance document on conducting NTCRAs (USEPA, 1993a) requires that, as part of the EE/CA, a streamlined risk evaluation be performed. The goals of the streamlined risk evaluation are to (1) identify contaminants of potential concern at the site, (2) identify potential current and future human exposures that should be prevented, (3) identify ecological exposures that should be prevented, and (4) estimate potential human health and ecological risks associated with exposures to the contaminants of potential concern if no remedial action is taken.

3.1 Overview

USEPA's guidance document indicates that a separate risk assessment is not required if a quantitative risk assessment (such as that performed in an RI) is available that "identifies pathways of concern and concentration of contaminants above standards" (USEPA, 1993a). This type of quantitative risk assessment and documentation is available for Site 8 and SSA 14 in the Round Two RI (Baker, 2004). The human health risk evaluation was performed following USEPA's Risk Assessment Guidance for Superfund, Part A, Human Health Evaluation Manual (USEPA, 1989). The ecological risk assessment (ERA) was conducted in accordance with the Navy Tier II ERA approach developed with EPA Region III, which is based on the USEPA ERA Guidance (USEPA, 1997) and the Chief of Naval Operations Policy (Chief of Naval Operations, 1999). Both risk assessments were conducted as part of the Round Two RI (Baker, 2004).

3.2 Summary of Streamlined Risk Evaluation

3.2.1 Human Health Risk Assessment

Based on information available regarding the physical features, site setting, site historical activities, and current and expected land uses, seven potential human receptors were selected for evaluation at Site 8 and SSA 14. These receptors include:

- Current Adult Maintenance Workers
- Current On-Station Adolescent Recreational Users and Trespassers (7-15 years)
- Current On-Station Adult Recreational Users and Trespassers
- Future Adult Construction Workers
- Future Adult Industrial/Commercial Workers
- Future On-site Young Child Residents (1-6 years)
- Future On-site Adult Residents

Estimated Incremental Lifetime Cancer Risk (ILCR) values were compared to $1x10^{-6}$ to $1x10^{-4}$ which represents the target risk range of ILCR values considered by the USEPA to represent an acceptable (i.e., de minimis) risk (USEPA, 1990). A hazard index (HI) less than 1.0 indicates that adverse noncarcinogenic health effects are unlikely. An HI greater than 1.0 indicates the potential for adverse noncarcinogenic health effects to occur at that exposure level and caution should be exercised. Table 3-1 summarizes the total site ILCRs and HIs for potential current and future human exposures to contaminants of potential concern (COPCs) identified in environmental media at Site 8 and SSA 14.

3.2.1.1 Site 8

There are no carcinogenic risks that exceeded USEPA's acceptable criteria for the receptors at Site 8. There are also no adverse health hazards for current adult trespassers and future adult industrial/commercial workers. However, there were noncarcinogenic hazards to current adult

maintenance workers, current adolescent trespassers, future adult construction workers, and future on-site child and adult residents exposed to contaminants at Site 8.

Current Adult Maintenance Workers

Current adult maintenance workers were evaluated for exposures to surface soil, surface water, and sediment COPCs at Site 8. The total site HI (3.52) exceeded the target value of 1.0 due to accidental ingestion and dermal exposures to amino-DNTs in surface water. The sum of the HQs (Hazard Quotients) of the ingestion and dermal contact pathways for these nitramine compounds were greater than unity.

Current On-Station Adolescent Recreational Users and Trespassers

Current adolescent recreational users and trespassers were evaluated for exposures to surface soil, surface water, and sediment at Site 8. The total site HI (1.52) calculated for the adolescent recreational user and trespasser exceeded the target value of 1.0 primarily due to accidental ingestion of amino-DNTs in surface water. However, it should be noted that none of the individual HQs for the adolescent exceed unity. Summing the HQs for amino-DNTs over both the ingestion and dermal pathways results in acceptable HI values. Therefore, it can be concluded that no potentially unacceptable risks to current adolescent recreational users and trespassers are associated with the environmental media at Site 8.

Future Adult Construction Workers

Future construction workers were evaluated for exposures to subsurface soil at Site 8. The total site HI of 1.15 was primarily due to accidental ingestion of iron and arsenic in the subsurface soil. However, none of the individual HQs exceeded unity. Summing the HQs for iron over both the ingestion and dermal pathways results in an acceptable HI for iron. Likewise, summing the HQs for arsenic over both the ingestion and dermal pathways results in an acceptable HI for arsenic. Also, since all HQs estimated for iron and arsenic are less than 1.0, and since iron and arsenic target different organs, it can be summarized that although the total site HI exceeds 1.0, no real adverse health effects are expected for this receptor subsequent to exposure. Therefore, it can be concluded that no potentially unacceptable risks are associated with the environmental media investigated at Site 8.

Future On-Site Young Child Residents

Future young child residents were evaluated for exposures to surface soil at Site 8 as well as exposures to shallow groundwater under a beneficial use scenario. The total site HI (4.38) exceeded USEPA's acceptable target value of 1.0. The exceedance was primarily due to accidental ingestion of amino-DNTs, iron, and arsenic and dermal exposures to chromium and amino-DNTs in the surface soil. The accidental ingestion of amino-DNTs in the shallow groundwater also contributed to the total site risk. It should be noted that the individual HQ for amino-DNTs in the shallow groundwater exceeded unity. It should also be noted that none of the individual HQs in the surface soil for the child exceeded unity. In evaluating the central tendency (CT), the total site HI still exceeded unity, and the individual HQ for amino-DNTs in the shallow groundwater still exceeded unity. Based on the results of the baseline risk assessment, exposure to the surface soil and shallow groundwater at Site 8 may cause adverse human health effects to this receptor.

Future On-Site Adult Residents

Future adult residents were evaluated for exposures to surface soil at Site 8 as well as exposures to shallow groundwater under a beneficial use scenario. The total site HI (1.02) exceeded the corresponding USEPA acceptable target risk criteria. This exceedance was primarily due to accidental ingestion of amino-DNTs, iron, and arsenic and dermal exposures to chromium and amino-DNTs in the surface soil. It should be noted that all individual HQs estimated for this receptor are

less than unity. In addition, it should be noted that an evaluation of the same scenarios under CT exposure assumptions yielded a total site HI less than USEPA's acceptable target value of 1.0. It is unlikely that exposure to media at Site 8 would cause adverse human health effects to this receptor.

3.2.1.2 SSA 14

There are no carcinogenic risks that exceeded USEPA's acceptable criteria for the receptors at SSA 14. There are also no adverse health hazards for current adolescent and adult trespassers, future adult construction workers, and future adult industrial/commercial workers. However, there were noncarcinogenic hazards to current adult maintenance workers and future on-site child and adult residents exposed to contaminants at SSA 14.

Current Adult Maintenance Workers

Current adult maintenance workers were evaluated for exposures to surface soil, surface water, and sediment at SSA 14. The total site HI (1.11) exceeded the target value of 1.0 due to dermal exposures to HMX, chromium, and vanadium in the surface soil; accidental ingestion of HMX, iron, and arsenic in the surface soil; and accidental ingestion of antimony and thallium in the surface water. However, since all HQs are less than 1.0 and are not additive since they target different organs, no real adverse health effects are expected for this receptor subsequent to exposure although the total site HI exceeds 1.0. It can therefore be concluded that, based on the exposure scenarios evaluated in the baseline risk assessment, no potentially unacceptable risks can be associated with any environmental media investigated at SSA 14, for this receptor.

Future On-Site Young Child Residents

Future young child residents were evaluated for exposures to surface soil at SSA 14 as well as exposures to shallow groundwater under a beneficial use scenario. The total site HI (6.69) exceeds USEPA's acceptable target value of 1.0. This exceedance was primarily due to accidental ingestion of HMX, iron, and arsenic, and dermal exposures to HMX and chromium in the surface soil. It should be noted that the individual HQs for HMX (accidental ingestion and dermal exposures) exceeded unity. In evaluating the CT, the total site HI exceeded unity. However, the individual HQ for HMX in the accidental ingestion of surface soil exposure scenario was below the acceptable value of 1.0.

Future On-Site Adult Residents

Future adult residents were evaluated for exposures to surface soil at SSA 14 as well as exposures to shallow groundwater under a beneficial use scenario. The total site HI (1.42) exceeds USEPA's acceptable target value of 1.0. This exceedance was due primarily to accidental ingestion of HMX, iron, and arsenic and dermal exposures to HMX and chromium in the surface soil. It should be noted that the individual HQs did not exceed 1.0 for this receptor. It should be noted that an evaluation of the same scenarios under CT exposure assumptions yielded a total site HI less than USEPA's acceptable value of 1.0. Therefore, it is unlikely that adverse health effects would occur for this receptor from exposure to media at SSA 14.

3.2.2 Ecological Risk Assessment

A Screening-Level ERA and Step 3a of the Navy's ERA approach was conducted for Site 8 and SSA 14. The Navy ERA process consists of eight steps organized into three tiers and represents a clarification and interpretation of the eight-step ERA process outlined in the USEPA ERA guidance for the Superfund program (USEPA, 1997). The ERA for Site 8 and SSA 14 included Tier 1 and the first step of Tier 2 of the Navy ERA process, representing the Screening-Level ERA:

- Screening-level problem formulation and ecological effects evaluation (Step 1)

- Screening-level exposure estimate and risk calculation (Step 2)
- Refinement of exposure estimation and risk calculation (Step 3a)

The general objectives of the Screening-Level ERA were to screen media to determine if additional ERA is warranted (beyond Steps 1 and 2) and to identify any data gaps that may require the collection of additional data. In Step 3a, the conservative exposure assumptions applied in the Screening-Level ERA were refined and risk estimates were recalculated using the same conceptual site model. The evaluation of risks in Step 3a also included consideration of background data, chemical bioavailability, and the frequency of detection. In general, if the re-evaluation of the conservative exposure assumptions does not support an acceptable risk determination, the site continues in the baseline ERA process (Step 3b, baseline ERA problem formulation).

3.2.2.1 Site 8

Amino-DNTs, HMX, RDX, Aroclor-1260, chromium, iron, mercury, vanadium, and zinc were identified as risk drivers for terrestrial lower trophic level populations and communities. Aroclor-1260 was additionally identified as a risk driver for mammalian insectivores, mammalian omnivores, and avian omnivores in the terrestrial habitat. 2,4,6-TNT and 4-amino-2,6-dinitrotoluene were identified as potential risk drivers for lower trophic level aquatic receptors based on the evaluation of chemicals detected in surface waters. In addition, although it is unlikely that 2,4,6-TNT is impacting terrestrial invertebrates and plants at Site 8, the evaluation indicates that this explosive may be migrating with surface soil to downgradient surface water at ecologically significant concentrations. For this reason, 2,4,6-TNT was also identified as a potential risk driver for surface soil. Furthermore, additional evaluation was recommended for aquatic lower trophic level exposures to the SVOC BEHP based on significant analytical uncertainty in the current dataset. Given the tidal nature of Felgates Creek, it was also noted that selenium was identified as a risk driver for aquatic lower trophic level populations and communities from upgradient SSA 14.

3.2.2.2 SSA 14

HMX, chromium, iron, mercury, vanadium, and zinc are identified as risk drivers for terrestrial lower trophic level populations and communities. Selenium is additionally identified as a risk driver for aquatic lower trophic level populations and communities. Additional evaluation is also recommended for terrestrial and aquatic lower trophic level exposures to BEHP based on significant analytical uncertainty in the current dataset. Given the tidal nature of Felgates Creek, it is noted that 2,4,6-TNT and 4-amino-2,6-dinitrotoluene were additionally identified as potential risk drivers for lower trophic level aquatic receptors from downgradient Site 8 based on the evaluation of chemicals detected in surface waters. No risk drivers were identified for upper trophic level terrestrial or aquatic receptors.

3.3 Risk-Based Remediation Goals

The results of this risk evaluation confirmed the need for a NTCRA, thereby prompting the need for soil and sediment remediation goals protective of human health and environmental receptors.

Human health remediation goals were developed for amino-DNTs in Site 8 soil and HMX in SSA 14 soil. There were no other human health COCs. Table 3-2 presents the human health preliminary remediation goals (PRGs).

Remediation goals for each ecological contaminant of concern are presented in Tables 3-3 through 3-6. Ecological remediation goals were based on documented levels from accepted sources, or were

based on background concentrations from Yorktown data. Attachment B provides the rationale in determining the ecological remediation goals.

Human health and ecological remediation goals were compared to background concentrations, and the lower remediation goal was selected as the final remediation goal for soil and sediment. Table 3-7 summarizes the remediation levels for the media at Site 8 and SSA 14.

3.4 Conclusion

A removal action at Site 8 and SSA 14 will be conducted in accordance with the NCP. The following factors, which are listed in the NCP as appropriate for consideration to determine the appropriateness of removal actions, exist at Site 8 and SSA 14:

- Actual or potential exposures to nearby human populations, animals, or the food chain from hazardous substances, pollutants, or contaminants (40 CFR 300.415(b)(2)(i))
- High levels of hazardous substances, pollutants, or contaminants in soils largely at or near the surface, that may migrate (40 CFR 300.415(b)(2)(iv))

Based on the risk characterization results, further action is warranted at Site 8 and SSA 14 to prevent or lessen the potential impact to human health and the environment from contaminants in soil and sediment. To be protective of human health and the environment, these contaminants should be remediated to levels within the risk-based remediation goals presented in Table 3-7, which will achieve regulatory requirements for cleanup under 40 CFR 300.430(e)(2).

4.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

Previous and current investigations have identified BEHP, Aroclor-1260, explosives, and inorganics in soil and sediment at Site 8 and SSA 14. Therefore, the objective of the removal action for these sites is to minimize the potential risks to the environment from contaminated soil and sediment.

4.1 Regulatory Limits on Removal Actions

The NCP at 40 CFR Part 300.415(b)(5) dictates limits of $2 million and 12 months on CERCLA fund-financed removal actions, with statutory exemptions for emergencies and actions consistent with the remedial action to be taken. This removal action will not be CERCLA fund-financed. The Management Guidance for the Defense Environmental Restoration Program (Office of the Deputy Under Secretary of Defense (Installations and the Environment) [ODUSD (I&E)], 2001) recommends that "all response alternatives must meet the threshold requirement of protectiveness of human health and the environment." A time limit is not specified. The Navy/Marine Corps IR Manual (NFESC, 2001) does not limit the cost or duration of a removal action; however, cost effectiveness is a recommended criterion for evaluation of removal action alternatives.

4.2 Determination of Removal Scope

The scope of the removal action to be initiated at Site 8 and SSA 14 will address contaminated soil and sediment. Based on the human health and ecological risk assessments, soil and sediment at Site 8 and SSA 14 may present unacceptable risks to both human health and the environment. The action will include the removal or remediation of approximately 740 cubic yards (cy) of soil/sediment at Site 8 and 730 cy of soil/sediment at SSA 14.

4.3 Determination of Removal Schedule

The removal action is scheduled to be completed within 12 months of the approved and signed Action Memorandum.

The schedule for undertaking the removal will follow this general outline:

Activity	Time Required
Mobilization	January 2006
Removal action	January-May 2006
Demobilization	June 2006

4.4 Applicable or Relevant and Appropriate Requirements

One of the main considerations during the development of remedial action alternatives for hazardous waste sites under CERCLA is the degree of human health and environmental protection provided by a given remedy. Section 121 of CERCLA requires that primary consideration be given to remedial alternatives that attain or exceed ARARs so CERCLA response actions will be consistent with other pertinent Federal and State environmental requirements.

ARARs may include the following:

- Any standard, requirement, criterion, or limitation under Federal environmental law
- Any promulgated standard, requirement, criterion, or limitation under a State environmental or facility-siting law that is more stringent than the associated Federal standard, requirement, criterion, or limitation

A requirement may be either "applicable" or "relevant and appropriate," but not both. Definitions of the two types of ARARs, as well as other "to be considered" (TBC) criteria, are given below:

- Applicable Requirements are cleanup standards, standards of control, or other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.
- Relevant and Appropriate Requirements are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site address problems or situations sufficiently similar (relevant) to those encountered at the CERCLA site, that their use is well suited (appropriate) to the particular site. Requirements must be relevant and appropriate to be an ARAR.
- "To be considered" criteria are non-promulgated, non-enforceable guidelines or criteria that may be useful for establishing a cleanup level or designing the remedial action, especially when no ARARs exist or they are not sufficiently protective. Examples of TBC criteria include USEPA Drinking Water Health Advisories and Secondary Maximum Contaminant Levels.

ARARs are categorized by the manner in which they are applied, and many ARARs may logically fit into more than one category. These categories are as follows:

Chemical-Specific: Health or risk-based numerical values or methodologies that establish concentration or discharge limits for particular contaminants. Examples of chemical-specific ARARs include Maximum Contaminant Levels and Clean Water Act water quality criteria.

Location-Specific: Restrictions based on the concentration of hazardous substances or the conduct of activities in specific locations. These requirements may restrict or preclude certain remedial actions or may apply only to certain portions of a site. Examples of location-specific ARARs include Federal and State siting laws for hazardous waste facilities and sites on the National Register of Historic Places.

Action-Specific: Technology- or activity-based controls or restrictions on activities related to management of hazardous waste.

4.4.1 Chemical-Specific ARARs

The potential chemical-specific ARARs and TBC criteria are shown in Table 4-1. Based on the streamlined risk evaluation, the media of concern are soil and sediment with contaminants that do not have specific regulatory limits (ARARs) or contaminant levels. However, regulations promulgated to Section 6(b) of the Toxic Substances Control Act (TSCA) may be an ARAR for Site 8 because PCBs were detected in the soil. Analytical results show PCB concentrations above 50 parts per million (ppm) which exceed criteria for consideration under TSCA rules for transport and disposal. If soils greater than or equal to 50 ppm are excavated, that soil would be considered a TSCA waste with respect to transport and disposal.

Virginia Hazardous Waste Management regulations may be applicable to Site 8 and SSA 14 if hazardous waste is generated during remedial activities. Grab samples will need to be collected and toxicity characteristic leachate procedure (TCLP) analyses performed according to USEPA Method

SW846 to determine if the soil/sediment is hazardous or non-hazardous. Based on these results, the waste could be segregated into hazardous and non-hazardous waste streams.

TBC criteria include USEPA Region III residential screening values for human health and USEPA Region III Biological Technical Assistance Group surface soil screening levels for ecological resources. These TBC criteria were used in the RI to develop the COCs. Contaminant concentrations that exceeded these screening levels were identified as potential COCs (Baker, 2004).

4.4.2 Location-Specific ARARs

Potential location-specific ARARs identified for Site 8 and SSA 14 are listed in Table 4-2. An evaluation determining the applicability of these location-specific ARARs is also presented in the table. Based on this evaluation, specific sections of the following acts and standards could be considered as ARARs and/or TBC criteria for these sites:

- National Historic Preservation Act
- Executive Order 1988, Protection of Floodplains
- Executive Order 11990, Protection of Wetlands
- Clean Water Act
- Virginia Wetlands Regulations

4.4.3 Action-Specific ARARs

Action-specific ARARs are most efficiently evaluated following the development of alternatives since they are dependent on the type of action being considered. Therefore, at this step in the EE/CA process, potential action-specific ARARs have been identified but not evaluated for Site 8 and SSA 14. Potential action-specific ARARs are listed in Table 4-3. These ARARs are based on U.S. Department of Transportation, Virginia solid waste, Virginia hazardous waste, and Virginia stormwater management regulations.

Excavation and off-site disposal of soil and sediment is regulated under Virginia Waste Management Act, Code of Virginia Sections 10.1-1400 et seq.; Virginia Hazardous Waste Management Regulations (VHWMR), 9 VAC 20-60-124 to 1505; Virginia Solid Waste Management Regulations (VSWMR), 9 VAC 20-80; Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6901, and the applicable regulations contained in 40 CFR 260 through 268; and the U.S. Department of Transportation Rules for Transportation of Hazardous Materials, 49 CFR Parts 107 and 171.1-172.558.

If the removal contemplated involves storage, treatment, or disposal of a Federal or State hazardous waste, various VHWMR and/or RCRA requirements may apply. Because Virginia administers an authorized State RCRA program, the VHWMR will serve as the governing ARAR in place of the RCRA regulations, except for Federal Land Disposal Restrictions at 40 CFR Part 268. The transportation of hazardous waste must be conducted in compliance with VHWMR, 9 VAC 20-110, Regulations Governing the Transportation of Hazardous Materials, and 49 CFR Parts 107 and 171.1 through 172.558. The disposal of any soil, debris, sludge, or any other solid waste from a site must be undertaken in compliance with VSWMR, 9 VAC 20-80-260 through 270. Contaminated material from the sites that are not classified as hazardous may be classified as a special waste under Part VIII of VSWMR, and will be disposed in accordance with State requirements.

5.0 IDENTIFICATION OF REMOVAL ACTION ALTERNATIVES

The following section presents a discussion of potential removal action technologies for Site 8 and SSA 14. Current EE/CA guidance does not require initial screening of alternatives, but a brief evaluation of a focused list of potential technologies is presented to provide a cost-effective evaluation of the remediation alternatives. A summary of the identification and screening of the general response actions for Site 8 and SSA 14 is presented in Table 5-1.

5.1 No Action

The No Action alternative does not meet the removal action objectives presented in Section 4 for Site 8 and SSA 14 because soil and sediment will continue to pose an unacceptable risk to human health and the environment at Site 8 and SSA 14. Therefore, in accordance with current EE/CA guidance, the No Action alternative will not be evaluated. The response actions that are applicable to soil and sediment at Site 8 and SSA 14 are discussed in the following paragraphs.

5.2 Alternative 1: Excavation with Off-Site Incineration

Under this treatment response scenario, the threat to human health and the environment would be removed through excavation of contaminated soil and sediment with treatment and disposal at an approved off-site incineration facility. Incineration of soil and sediment is effective in reducing the concentrations of contaminants including SVOCs, PCBs, explosives, and inorganics (USEPA, 1993b). Soil ash residue as a byproduct of the incineration process would be properly disposed at the disposal/incineration facility.

Alternative 1 for Site 8 and SSA 14 includes the removal of contaminated soil and sediment exceeding remediation goals, followed by off-site incineration and disposal at an approved disposal facility. Figures 5-1 and 5-2 depict the planned removal areas for Site 8 and SSA 14, respectively. Based on the concentrations of Aroclor-1260 in the Site 8 surface and subsurface soil samples, the removal action at Site 8 would require an initial excavation depth to 3 feet, which would result in the excavation of approximately 740 cubic yards (cy) of soil. At SSA 14, the removal action would require an initial excavation depth to 2 feet, which would result in the excavation of approximately 730 cy of material. Removal activities will not extend into Felgates Creek at either Site 8 or SSA 14.

Following the excavation of the removal area boundaries shown in Figures 5-1 and 5-2, confirmation samples will be collected and analyzed for the COCs listed in Table 3-7. Analytical results of the samples will be compared to remediation goals to determine if additional excavation is required. At Site 8, samples will be collected and initially analyzed for Aroclor-1260. Any locations exceeding the remediation goal will be further excavated. Once the site meets the remediation goal for Aroclor-1260, additional confirmation samples will be collected and analyzed for the remaining COCs listed in Table 3-7.

Site restoration activities would include backfilling and grading the excavation areas to the approximate original elevations of the sites prior to excavation, placement of riprap as erosion control in steep areas, placement of six inches of topsoil over the remaining disturbed areas, and vegetation with native grasses and wetland plants.

Institutional controls and five-year reviews will not be required since there will be no contaminated material left on-site.

5.3 Alternative 2: Excavation with Off-Site Disposal

This alternative includes the removal and disposal of contaminated soil and sediment, transportation of contaminated soil and sediment to an approved disposal facility. Alternative 2 for Site 8 and SSA 14 includes the removal of contaminated soil and sediment exceeding remediation goals, off-site disposal at an approved disposal facility, and site restoration. Figures 5-1 and 5-2 depict the removal areas for Site 8 and SSA 14, respectively. As previously stated for Alternative 1, based on the concentrations of Aroclor-1260 in the Site 8 surface and subsurface soil samples, the removal action at Site 8 would require an initial excavation depth to 3 feet, which would result in the excavation of approximately 740 cubic yards (cy) of material. At SSA 14, the removal action would require an initial excavation depth to 2 feet, which would result in the excavation of approximately 730 cy of material. Removal activities will not extend into Felgates Creek at either Site 8 or SSA 14.

Following the excavation of the removal area boundaries shown in Figures 5-1 and 5-2, confirmation samples will be collected and analyzed for the COCs listed in Table 3-7. Analytical results of the samples will be compared to remediation goals to determine if additional excavation is required. At Site 8, samples will be collected and initially analyzed for Aroclor-1260. Any locations exceeding the remediation goal will be further excavated. Once the site meets the remediation goal for Aroclor-1260, additional confirmation samples will be collected and analyzed for the remaining COCs listed in Table 3-7.

Contaminated soil/sediment removed from the sites will be transported to an off-site disposal facility. At Site 8, Aroclor-1260 concentrations in the surface and subsurface soil exceed the TSCA level of 50 ppm. Contaminated soil/sediment at Site 8 will be segregated as TSCA or non-TSCA material. Disposal of non-TSCA material will be in a solid waste or hazardous waste landfill, depending on the results of characterization analyses (by TCLP).

The excavated areas will be backfilled with material from an off-Station borrow pit and graded to approximate original elevations of the sites prior to excavation. Site restoration will also include the placement of six inches of topsoil over the disturbed areas and vegetation with native grasses and wetland plants. Riprap will be placed in steep areas as erosion control.

Institutional controls and five-year reviews will not be required since there will be no contaminated material left on-site.

6.0 ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section provides a detailed analysis of the response actions from Section 5.0. This analysis compares the alternatives; recommends an appropriate removal action for the sites; and illustrates how removal selection requirements, as provided in the NCP at 40 CFR 300.415, will be met by the alternative recommended. Each alternative was evaluated individually based on the following criteria listed in the EPA guidance (USEPA, 1993a):

- Effectiveness
    - Overall Protection of Human Health and the Environment
    - Compliance with ARARs
    - Long-Term Effectiveness and Permanence
    - Reduction of Toxicity, Mobility, or Volume Through Treatment
    - Short-Term Effectiveness
- Implementability
    - Technical Feasibility and Availability
    - Administrative Feasibility
- Cost
    - Capital Cost
    - Operation and Maintenance Cost
    - Net Present Worth Cost

Paralleling the EPA guidance, the Defense Environmental Restoration Program Guidance (ODUSD (I&E), 2001) and the Navy/Marine Corps IR Manual (NFESC, 2001) recommend that criteria for evaluating removal alternatives include effectiveness to minimize the threat to public health, consistency with the anticipated final remedial action, consistency with ARARs, and cost effectiveness. These guidance documents formed the basis for this evaluation.

6.1 Alternative 1: Excavation with Off-Site Incineration

6.1.1 Effectiveness

6.1.1.1 Overall Protection of Human Health and the Environment

Since this alternative includes removal and disposal of the contaminated soil and sediment, it will provide a significant reduction in risks to human health and the environment. The source of contamination will be removed and disposed in an approved facility. This alternative will provide protectiveness to human health and the environment.

6.1.1.2 Compliance with ARARs

Chemical-specific ARARs have not been promulgated for the soil and sediment COCs with the exception of TSCA rules for PCBs. PCB-contaminated soil exceeding 50 ppm will be removed. Otherwise, because the contaminated soil and sediment will be transported to a landfill disposal facility, TCLP analysis will be required to determine if the waste can be disposed of in a Subtitle D (non-hazardous) or Subtitle C (hazardous) RCRA landfill.

Alternative 1 will be implemented such that location-specific ARARs will be met. Specifically, location-specific ARARs regarding wetlands apply to this alternative because excavation activities may disturb existing wetlands at both Site 8 and SSA 14.

This alternative will comply with action-specific ARARs and will require erosion and sediment controls to be in place during earthmoving activities. In addition, the off-site incineration facility would have to be permitted to accept contaminated soil/sediment from Site 8 and SSA 14. Action-specific ARARs regarding transportation of hazardous waste may apply to this alternative.

6.1.1.3 Long-Term Effectiveness and Permanence

Alternative 1 will be an effective and permanent solution because contaminated soil/sediment will be removed from Site 8 and SSA 14. No annual inspections, five-year reviews, or monitoring will be required for the sites.

6.1.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative 1 includes the reduction of toxicity, mobility, or volume of contaminants through treatment. The primary component of Alternative 1 is treatment via incineration. As such, contaminated soil and sediment exceeding the remediation goals will be excavated from Site 8 and SSA 14 and treated off-site.

6.1.1.5 Short-Term Effectiveness

Since this alternative includes earthmoving, the risk to the surrounding community and construction workers may increase due to increased potential for direct contact with contaminated soil and sediment during the excavation and transportation activities. Alternative 1 will be implemented such that these risks will be minimized. The potential for migration of contaminants due to erosion during earthmoving will be minimized through proper use of erosion and sediment controls. Also, there will be an increased risk to the community during the off-site transport of the contaminated soil. This risk can be reduced by selection of transport routes that would minimize exposure in the event of an accident.

6.1.2 Implementability

6.1.2.1 Technical Feasibility and Availability

Soil excavation is a routine construction operation that requires standard construction equipment. Incineration is a proven technology, however, it may be difficult to find a facility that is permitted for all of the COCs or that is available at the time of remediation. Restoration of the sites requires clean backfill and topsoil which is readily available. The transport and disposal of contaminated material is routinely done but requires proper tracking and the availability of an approved landfill facility.

6.1.2.2 Administrative Feasibility

The Navy will commit the necessary administrative resources to ensure the implementation of Alternative 1.

6.1.3 Cost

The cost estimate for this alternative is presented in Tables 6-1 and 6-2 for Site 8 and SSA 14, respectively. The estimated capital cost for Alternative 1 is approximately $693,000 for Site 8 and $671,000 for SSA 14. Annual operation and maintenance costs are not anticipated for this alternative. Therefore, the net present worth for Alternative 1 is approximately $693,000 for Site 8 and $671,000 for SSA 14.

6.2 Alternative 2: Excavation with Off-Site Disposal

6.2.1 Effectiveness

6.2.1.1 Overall Protection of Human Health and the Environment

Since this alternative includes removal and disposal of the contaminated soil and sediment, it will provide a significant reduction in risks to human health and the environment. The source of contamination will be removed and disposed in an approved facility. This alternative will provide protectiveness to human health and the environment.

6.2.1.2 Compliance with ARARs

Chemical-specific ARARs have not been promulgated for the soil and sediment COCs with the exception of TSCA rules for PCBs. PCB-contaminated soil exceeding 50 ppm will be removed. Otherwise, because the contaminated soil and sediment will be transported to a landfill disposal facility, TCLP analysis will be required to determine if the waste can be disposed of in a Subtitle D (non-hazardous) or Subtitle C (hazardous) RCRA landfill.

Alternative 2 will be implemented such that location-specific ARARs will be met. Specifically, location-specific ARARs regarding wetlands apply to this alternative because excavation activities may disturb existing wetlands at both Site 8 and SSA 14.

This alternative will comply with action-specific ARARs and will require erosion and sediment controls to be in place during earthmoving activities. Action-specific ARARs regarding transportation of hazardous waste may apply to this alternative.

6.2.1.3 Long-Term Effectiveness and Permanence

Alternative 2 will be an effective and permanent solution because contaminated soil/sediment will be removed from Site 8 and SSA 14. No annual inspections, five-year reviews, or monitoring will be required for the sites.

6.2.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

No treatment is proposed under this alternative. Contaminated material will be removed from the sites and disposed at a permitted facility. Disposal will not permanently and significantly reduce the toxicity, mobility, or volume through treatment, but contaminated material will be isolated from receptors.

6.2.1.5 Short-Term Effectiveness

Since this alternative includes earthmoving, the risk to the surrounding community and construction workers may increase due to increased potential for direct contact with contaminated soil and sediment during the excavation and transportation activities. Alternative 2 will be implemented such that these risks will be minimized. The potential for migration of contaminants due to erosion during earthmoving will be minimized through proper use of erosion and sediment controls. Also, there will be an increased risk to the community during the off-site transport of the contaminated soil. This risk can be reduced by selection of transport routes that would minimize exposure in the event of an accident.

6.2.2 Implementability

6.2.2.1 Technical Feasibility and Availability

Soil excavation is a routine construction operation that requires standard construction equipment. Restoration of the sites requires clean backfill and topsoil which is readily available. The transport and disposal of contaminated material is routinely done but requires proper tracking and the availability of an approved landfill facility.

6.2.2.2 Administrative Feasibility

The Navy will commit the necessary administrative resources to ensure the implementation of Alternative 2.

6.2.3 Cost

Tables 6-3 and 6-4 contain the cost estimate for this alternative for Site 8 and SSA 14, respectively. The estimated capital cost for Alternative 2 is approximately $303,000 for Site 8 and $294,000 for SSA 14. Annual operation and maintenance costs are not anticipated for this alternative. Therefore, the net present worth for Alternative 2 is approximately $303,000 for Site 8 and $294,000 for SSA 14.

7.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

Two alternatives were qualitatively assessed and compared based on the criteria described in Section 6.0. A summary of the comparative analysis is shown in Table 7-1.

7.1 Effectiveness

7.1.1 Overall Protection of Human Health and the Environment

Both alternatives provide a significant reduction in risks to human health and the environment since both alternatives include removal of contaminated material.

7.1.2 Compliance with ARARs

Alternatives 1 and 2 for Site 1 would comply with all chemical-, location-, and action-specific ARARs.

7.1.3 Long-Term Effectiveness and Permanence

Both alternatives will be an effective and permanent solution because contaminated soil/sediment will be removed from the sites.

7.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative 1 will reduce the toxicity, mobility, or volume of contaminated material through treatment via incineration. Both alternatives include removal of contaminated material, which will eliminate the threat of long-term exposure at Site 8 and SSA 14.

7.1.5 Short-Term Effectiveness

Both alternatives may increase risks to the community and construction workers due to increased potential for direct contact with contaminated soil and sediment during the excavation and transportation activities.

7.2 Implementability

7.2.1 Technical Feasibility and Availability

Both Alternatives 1 and 2 will require an extensive design effort, administrative effort, and heavy equipment. Alternative 1 will require additional coordination for the incineration.

7.2.2 Administrative Feasibility

Both alternatives will require Navy administration and oversight.

7.3 Cost

In terms of net present worth, at $303,000 and $294,000 for Site 8 and SSA 14, respectively, Alternative 2 would be least expensive to implement than Alternative 1 at $693,000 for Site 8 and $671,000 for SSA 14. The cost estimating spreadsheets are located in Tables 6-1 through 6-4.

8.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

The Navy recommends the implementation of Alternative 2, Excavation with Off-Site Disposal, for a NTCRA at Site 8 and SSA 14. The main features of this alternative include:

- Excavation of approximately 740 cy of contaminated soil/sediment at Site 8
- Excavation of approximately 730 cy of contaminated soil/sediment at SSA 14
- Transportation of contaminated soil/sediment to an approved disposal facility
- Backfilling and grading to approximate original elevations
- Placement of riprap in steep areas as erosion control
- Placement of topsoil and vegetation with native grasses and wetland plants

The preferred removal option, Alternative 2, was selected to provide a high level of protection by removing contaminated soil and sediment from Site 8 and SSA 14. Although Alternative 1 also provides a high level of protection, Alternative 2 is less expensive than Alternative 1 and is more technically feasible.

9.0 REFERENCES

Baker, 2005. Final Work Plan for the Pre-Removal Characterization of Soil, Site 2, Site 8, SSA 14, Naval Weapons Station Yorktown, Yorktown, Virginia. June 2005.

Baker, 2004. Final Round Two Remedial Investigation Report Sites 2, 8, 18 and SSA 14, Naval Weapons Station Yorktown, Yorktown, Virginia. June 2004.

Baker, 1995a. Final Habitat Evaluation Report, Sites 1, 2, 3, 4, 6, 7, 8, 9, 11, 12, 16, 17, 18, 19, and 21, Naval Weapons Station Yorktown, Yorktown, Virginia. July 1995.

Baker, 1995b. Relative Risk Ranking System Data Collection Investigation, Naval Weapons Station Yorktown, Yorktown, Virginia. November 1995.

Baker and Weston, 1993a. Final Round One Remedial Investigation Report for Sites 1-9, 11, 12, 16-19, and 21, Naval Weapons Station Yorktown, Yorktown, Virginia. July 1993.

Baker and Weston, 1993b. Focused Biological Sampling and Preliminary Risk Evaluation, Naval Weapons Station Yorktown, Yorktown, Virginia. April 1993.

C.C. Johnson & Associates, Inc. and CH2M Hill, 1984. Initial Assessment Study of Naval Weapons Station Yorktown, Yorktown, Virginia. July 1984.

Chief of Naval Operations, 1999. Navy Policy for Conducting Ecological Risk Assessments. Memorandum from Chief of Naval Operations to Commander, Naval Facilities Engineering Command. Ser N453E/9U595355. April 1999.

Dames & Moore, 1989. Draft Remedial Investigation Interim Report, Naval Weapons Station Yorktown, Yorktown, Virginia. February 1989.

Dames & Moore, 1988. Confirmation Study Step 1A (Verification), Round Two, Naval Weapons Station Yorktown, Yorktown, Virginia. June 1988.

Dames & Moore, 1986. Confirmation Study Step 1A (Verification), Round One, Naval Weapons Station Yorktown, Yorktown, Virginia. June 1986.

NFESC, 2001. Navy/Marine Corps IR Manual. 324pp.

ODUSD (I&E), 2001. Management Guidance for the Defense Environmental Restoration Program. September 2001.

USEPA, 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (Interim Final). Environmental Response Team, EPA/540/R-97-006. June 1997.

USEPA, 1993a. Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA. EPA540-R-93-057. August 1993.

USEPA, 1993b. Technology Alternatives for the Remediation of PCB-Contaminated Soil and Sediment. EPA/540/S-93/506. October 1993.

USEPA, 1990. National Oil and Hazardous Substances Pollution Contingency Plan; Final Rule. Federal Register, 40 CFR 300, March 1990.

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

Versar, 1991. Remedial Investigation Interim Report, Naval Weapons Station Yorktown, Yorktown, Virginia. July 1991.

TABLE 2-1

PRE-REMOVAL CHARACTERIZATION ANALYTICAL RESULTS
SITE 8 SURFACE SOIL
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

SAMPLE ID	8SS01-00	8SS02-00	8SS03-00	8SS04-00	8SS05-00	8SS06-00	8SS07-00
DATE SAMPLED	06-20-2005	06-20-2005	06-20-2005	06-20-2005	06-20-2005	06-20-2005	06-20-2005
DEPTH	0-6"	0-6"	0-6"	0-6"	0-6"	0-6"	0-6"
SVOCs (ug/kg)							
Bis(2-ethylhexyl) Phthalate (BEHP)	110 J	480	140 J	310 U	330 J	150 J	1500
PCBs (ug/kg)							
Aroclor-1260	12000	5200 J	4500 J	16000	24000	6100	9600
EXPLOSIVES (ug/kg)							
2-Amino-4,6-dinitrotoluene	600	220 U	150 J	160 JP	370	180 J	120 J
4-Amino-2,6-dinitrotoluene	1200	160 JP	320	410 P	1000	220	240
HMX	1800 J	870 U	450 J	950 U	880 J	830 U	870 U
RDX (Cyclonite)	660 J	870 U	770 U	950 U	470 J	130 J	870 U
2,4,6-Trinitrotoluene (TNT)	4000	180 J	350	380	1100	260 J	240
INORGANICS (mg/kg)							
Chromium	41.1	29.6	15.5	37.6	45.7	33.1	18.2
Mercury	0.98 J	0.17 J	0.13 J	0.73 J	0.33 J	0.16 J	1.4 J
Zinc	145	187	127	169	342	100	90

TABLE 2-1 (Continued)

PRE-REMOVAL CHARACTERIZATION ANALYTICAL RESULTS
SITE 8 SURFACE SOIL
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

	Minimum Non-Detect	Maximum Non-Detect	Minimum Detected	Maximum Detected	Location of Maximum Detect	Frequency of Detection	Upper 95% Confidence Level
SVOCs (ug/kg)							
Bis(2-ethylhexyl) Phthalate (BEHP)	310 U	310 U	110 J	1500	8SS07-00	6/7	775.8901
PCBs (ug/kg)							
Aroclor-1260	ND	ND	4500 J	24000	8SS05-00	7/7	16223.0616
EXPLOSIVES (ug/kg)							
2-Amino-4,6-dinitrotoluene	220 U	220 U	120 J	600	8SS01-00	6/7	374.1344
4-Amino-2,6-dinitrotoluene	ND	ND	160 JP	1200	8SS01-00	7/7	813.1762
HMX	830 U	950 U	450 J	1800 J	8SS01-00	3/7	1075.1276
RDX (Cyclonite)	770 U	950 U	130 J	660 J	8SS01-00	3/7	542.7047
2,4,6-Trinitrotoluene (TNT)	ND	ND	180 J	4000	8SS01-00	7/7	1950.3437
INORGANICS (mg/kg)							
Chromium	ND	ND	15.5	45.7	8SS05-00	7/7	39.8634
Mercury	ND	ND	0.13 J	1.4 J	8SS07-00	7/7	0.9195
Zinc	ND	ND	90	342	8SS05-00	7/7	228.2647

TABLE 2-2

PRE-REMOVAL CHARACTERIZATION ANALYTICAL RESULTS
SITE 8 SUBSURFACE SOIL
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

SAMPLE ID	8SS01-01	8SS02-01	8SS03-01	8SS04-01	8SS05-01	8SS06-01	8SS07-01
DATE SAMPLED	06-20-2005	06-20-2005	06-20-2005	06-20-2005	06-20-2005	06-20-2005	06-20-2005
DEPTH	6-24"	6-24"	6-24"	6-24"	6-24"	6-24"	6-24"
SVOCs (ug/kg)							
Bis(2-ethylhexyl) Phthalate (BEHP)	170 J	540	330 U	2700 U	140 U	140 U	290 U
PCBs (ug/kg)							
Aroclor-1260	7800	1500 J	3100 J	160000	25000	2300 J	64000
EXPLOSIVES (ug/kg)							
2-Amino-4,6-dinitrotoluene	2600	240 U	200 U	250 U	190 J	220 U	230 U
4-Amino-2,6-dinitrotoluene	1700	240 U	380	310	370	220 U	200 J
HMX	810 J	950 U	800 U	1000 U	1000 U	870 U	910 U
RDX (Cyclonite)	300 J	950 U	800 U	1000 U	1000 U	870 U	910 U
2,4,6-Trinitrotoluene (TNT)	9200 J	240 U	300 J	300	250 U	220 U	110 J
INORGANICS (mg/kg)							
Chromium	35.4	16	15.2	19.8	16.9	28.3	22.5
Mercury	0.85 J	0.095 J	0.13 J	0.21 J	0.088 J	0.14 J	0.13 J
Zinc	135	27.4	92.8	132	155	69.6	48.5

TABLE 2-2 (Continued)

PRE-REMOVAL CHARACTERIZATION ANALYTICAL RESULTS
SITE 8 SUBSURFACE SOIL
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

	Minimum Non-Detect	Maximum Non-Detect	Minimum Detected	Maximum Detected	Location of Maximum Detect	Frequency of Detection	Upper 95% Confidence Level
SVOCs (ug/kg)							
Bis(2-ethylhexyl) Phthalate (BEHP)	140 U	2700 U	170 J	540	8SS02-01	2/7	700.5769
PCBs (ug/kg)							
Aroclor-1260	ND	ND	1500 J	160000	8SS04-01	7/7	80565.2448
EXPLOSIVES (ug/kg)							
2-Amino-4,6-dinitrotoluene	200 U	250 U	190 J	2600	8SS01-01	2/7	1166.9297
4-Amino-2,6-dinitrotoluene	220 U	240 U	200 J	1700	8SS01-01	5/7	866.8519
HMX	800 U	1000 U	810 J	810 J	8SS01-01	1/7	611.1364
RDX (Cyclonite)	800 U	1000 U	300 J	300 J	8SS01-01	1/7	489.6546
2,4,6-Trinitrotoluene (TNT)	220 U	250 U	110 J	9200 J	8SS01-01	4/7	3971.86
INORGANICS (mg/kg)							
Chromium	ND	ND	15.2	35.4	8SS01-01	7/7	27.4825
Mercury	ND	ND	0.088 J	0.85 J	8SS01-01	7/7	0.4361
Zinc	ND	ND	27.4	155	8SS05-01	7/7	129.7399

TABLE 2-3

PRE-REMOVAL CHARACTERIZATION ANALYTICAL RESULTS
SSA 14 SURFACE SOIL
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

SAMPLE ID	A14SS01-00	A14SS02-00
DATE SAMPLED	06-20-2005	06-20-2005
DEPTH	0-6"	0-6"
SVOCs (ug/kg)		
Bis(2-ethylhexyl) Phthalate (BEHP)	350 U	170 UJ
EXPLOSIVES (ug/kg)		
HMX	9200	770 U
INORGANICS (mg/kg)		
Mercury	0.091 J	0.05 J
Selenium	3.7 U	1.6 U
Zinc	149	34.8

TABLE 2-3 (Continued)

PRE-REMOVAL CHARACTERIZATION ANALYTICAL RESULTS
SSA 14 SURFACE SOIL
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

	Minimum Non-Detect	Maximum Non-Detect	Minimum Detected	Maximum Detected	Location of Maximum Detect	Frequency of Detection	Upper 95% Confidence Level
SVOCs (ug/kg)							
Bis(2-ethylhexyl) Phthalate (BEHP)	170 UJ	350 U	ND	ND		0/2	414.1188
EXPLOSIVES (ug/kg)							
HMX	770 U	770 U	9200	9200	A14SS01-00	1/2	32620.3599
INORGANICS (mg/kg)							
Mercury	ND	ND	0.05 J	0.091 J	A14SS01-00	2/2	0.2
Selenium	1.6 U	3.7 U	ND	ND		0/2	4.6399
Zinc	ND	ND	34.8	149	A14SS01-00	2/2	452.4152

TABLE 2-4

PRE-REMOVAL CHARACTERIZATION ANALYTICAL RESULTS
SSA 14 SUBSURFACE SOIL
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

SAMPLE ID	A14SS01-01	A14SS02-01
DATE SAMPLED	06-20-2005	06-20-2005
DEPTH	6-24"	6-24"
SVOCs (ug/kg)		
Bis(2-ethylhexyl) Phthalate (BEHP)	310	170 U
EXPLOSIVES (ug/kg)		
HMX	910 U	280 J
INORGANICS (mg/kg)		
Mercury	0.036 J	0.04 J
Selenium	1.5 U	0.92 J
Zinc	62.4	35.8

TABLE 2-4 (Continued)

PRE-REMOVAL CHARACTERIZATION ANALYTICAL RESULTS
SSA 14 SUBSURFACE SOIL
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

	Minimum Non-Detect	Maximum Non-Detect	Minimum Detected	Maximum Detected	Location of Maximum Detect	Frequency of Detection	Upper 95% Confidence Level
SVOCs (ug/kg)							
Bis(2-ethylhexyl) Phthalate (BEHP)	170 U	170 U	310	310	A14SS01-01	1/2	907.7969
EXPLOSIVES (ug/kg)							
HMX	910 U	910 U	280 J	280 J	A14SS02-01	1/2	919.9533
INORGANICS (mg/kg)							
Mercury	ND	ND	0.036 J	0.04 J	A14SS02-01	2/2	0.0505
Selenium	1.5 U	1.5 U	0.92 J	0.92 J	A14SS02-01	1/2	1.3716
Zinc	ND	ND	35.8	62.4	A14SS01-01	2/2	133.0727

TABLE 2-5

PRE-REMOVAL CHARACTERIZATION ANALYTICAL RESULTS
SSA 14 SURFACE SEDIMENT
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

SAMPLE ID	A14SD07-00	A14SD08-00	A14SD09-00	A14SD10-00	A14SD11-00	A14SD12-00	A14SD13-00
DATE SAMPLED	06-21-2005	06-21-2005	06-21-2005	06-21-2005	06-21-2005	06-21-2005	06-21-2005
DEPTH	0-6"	0-6"	0-6"	0-6"	0-6"	0-6"	0-6"
SVOCs (ug/kg)							
Bis(2-ethylhexyl) Phthalate (BEHP)	660 U	930 U	480	310 U	710 U	390 U	370 U
EXPLOSIVES (ug/kg)							
HMX	950 U	950 U	1000 U	800 U	910 U	1000 U	870 U
INORGANICS (mg/kg)							
Mercury	0.098 J	0.079 J	0.11 J	0.1	0.11	0.12 J	0.11 J
Selenium	3.7 U	4.8 U	4.6 U	0.8 J	3.7 U	3.7 U	3.5 U
Zinc	123	119	135	191	115	121	112

TABLE 2-5 (Continued)

PRE-REMOVAL CHARACTERIZATION ANALYTICAL RESULTS
SSA 14 SURFACE SEDIMENT
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

	Minimum Non-Detect	Maximum Non-Detect	Minimum Detected	Maximum Detected	Location of Maximum Detect	Frequency of Detection	Upper 95% Confidence Level
SVOCs (ug/kg)							
Bis(2-ethylhexyl) Phthalate (BEHP)	310 U	930 U	480	480	A14SD09-00	1/7	407.9239
EXPLOSIVES (ug/kg)							
HMX	800 U	1000 U	ND	ND		0/7	489.4108
INORGANICS (mg/kg)							
Mercury	ND	ND	0.079 J	0.12 J	A14SD12-00	7/7	0.1136
Selenium	3.5 U	4.8 U	0.8 J	0.8 J	A14SD10-00	1/7	2.2096
Zinc	ND	ND	112	191	A14SD10-00	7/7	151.0621

TABLE 2-6

PRE-REMOVAL CHARACTERIZATION ANALYTICAL RESULTS
SSA 14 SUBSURFACE SEDIMENT
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

SAMPLE ID	A14SD07-01	A14SD08-01	A14SD09-01	A14SD10-01	A14SD11-01	A14SD12-01	A14SD13-01
DATE SAMPLED	06-21-2005	06-21-2005	06-21-2005	06-21-2005	06-21-2005	06-21-2005	06-21-2005
DEPTH	6-24"	6-24"	6-24"	6-24"	6-24"	6-24"	6-24"
SVOCs (ug/kg)							
Bis(2-ethylhexyl) Phthalate (BEHP)	360 U	220 J	310 J	350 U	310 UL	350 U	410 U
EXPLOSIVES (ug/kg)							
HMX	950 U	910 U	950 U	870 U	770 U	800 U	830 U
INORGANICS (mg/kg)							
Mercury	0.2	0.15	0.098 J	0.2	0.13	0.14	0.25
Selenium	3.3 U	3.8 U	4.7 U	3.4 U	2.9 U	3.3 U	4.3 U
Zinc	145	156	126	196	125	135	106

TABLE 2-6 (Continued)

PRE-REMOVAL CHARACTERIZATION ANALYTICAL RESULTS
SSA 14 SUBSURFACE SEDIMENT
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

	Minimum Non-Detect	Maximum Non-Detect	Minimum Detected	Maximum Detected	Location of Maximum Detect	Frequency of Detection	Upper 95% Confidence Level
SVOCs (ug/kg)							
Bis(2-ethylhexyl) Phthalate (BEHP)	310 UL	410 U	220 J	310 J	A14SD09-01	2/7	240.953
EXPLOSIVES (ug/kg)							
HMX	770 U	950 U	ND	ND		0/7	460.6331
INORGANICS (mg/kg)							
Mercury	ND	ND	0.098 J	0.25	A14SD13-01	7/7	0.2051
Selenium	2.9 U	4.7 U	ND	ND		0/7	2.0687
Zinc	ND	ND	106	196	A14SD10-01	7/7	162.5032

TABLE 3-1

SUMMARY OF CARCINOGENIC AND NONCARCINOGENIC RISK
SITE 8 AND SSA 14
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Receptors	Site 8		SSA 14	
	Total ILCR	Total HI	Total ILCR	Total HI
Current Adult Maintenance Workers	3.7E-05	3.52	2.1E-05	1.11
Current On-Station Adolescent Recreational Users and Trespassers	4.2E-06	1.52	1.8E-06	0.30
Current On-Station Adult Recreational Users and Trespassers	1.1E-05	0.91	6.1E-06	0.21
Future Adult Construction Workers	1.7E-06	1.15	1.8E-06	0.56
Future Adult Industrial/Commercial Workers	7.6E-06	0.25	5.9E-06	0.53
Future On-Site Young Child Residents - RME	3.3E-05	4.38	7.1E-05	6.69
Future On-Site Young Child Residents - CT	1.2E-05	2.47	3.6E-05	2.69
Future On-Site Adult Residents - RME	2.2E-05	1.02	7.9E-05	1.42
Future On-Site Adult Residents - CT	8.9E-06	0.58	2.8E-05	0.65

Notes:
Shading indicates exceedances of USEPA acceptable target risk criteria
ILCR - Incremental Lifetime Cancer Risk
HI - Hazard Index
RME - Reasonable Maximum Exposure
CT - Central Tendency

TABLE 3-2

HUMAN HEALTH PRELIMINARY REMEDIATION GOALS
SITE 8 AND SSA 14
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Site	COCs	Surface Soil (mg/kg)									Soil PRG Value (mg/kg)
		Future Residents[1]			Future Commercial/Industrial Worker			Future Construction Worker[2]			
		HI	1×10^{-04}	1×10^{-06}	HI	1×10^{-04}	1×10^{-06}	HI	1×10^{-04}	1×10^{-06}	
8	Amino-DNTs	13	NA	NA	155	NA	NA	34	NA	NA	13
8	Aroclor-1260	0.3	NA	NA	NE	NE	NE	NE	NE	NE	0.3
SSA 14	HMX	3,257	NA	NA	38,712	NA	NA	8,574	NA	NA	3,257

Notes:

All PRGS were calculated using original exposure parameters from the HHRA in the Final Round Two RI Report (Baker, 2004).
However, toxicity criteria used in the calculations were taken from the most recent USEPA Region III RBC Table (October, 2004).

(1) Most conservative value for either an adult or child receptor.

(2) Future construction workers were not evaluated for exposure to surface soil in the HHRA.
However, PRGs were calculated for this receptor because contact with surface soil could occur during excavation activities.

COCs - Chemicals of concern (risk drivers).
PRG - Preliminary Remediation Goal
HI - Hazard Index
NA - Not Applicable
NE - Not Evaluated

TABLE 3-3

ECOLOGICAL PRELIMINARY REMEDIATION GOALS
SITE 8 SOIL
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

COC	RI Data Max Detected	2005 Data Max Detected	95% UCL Background [1]	Human Health PRG	Ecological PRG	PRGs From Other Sites	Proposed Final PRG
SVOCs (mg/kg)							
BEHP	0.13J	1.5	5	NA	10	(2)	10
PCBs (mg/kg)							
Aroclor-1260	10	160	ND	0.3	0.1 (lower trophic level) 0.2 (upper trophic level)	0.1[3]	0.1
Explosives (mg/kg)							
amino-DNTs (mixture)	4.9	4.1	ND	13	1.3	6[4]	1.3
HMX	14	1.8	ND	NA	6.3	5.7[5]	6.3
RDX	30	0.66	ND	NA	21.1	2[4]	21.1
2,4,6-TNT	2	9.2	ND	NA	1.3	8[4]	1.3
Metals (mg/kg)							
Chromium	61.5	45.7	16.27	NA	0.0075	33.5[6]	16.27
Iron	31,700	---	11,276	NA	200	(2)	11,276
Mercury	0.91	1.4J	0.1	NA	0.1	0.24[7]	0.1
Vanadium	44.8	---	23.07	NA	2	(2)	23.07
Zinc	249	342	38.42	NA	50	(8)	50

Notes:
BEHP - bis(2-ethylhexyl)phthalate
NA - not applicable; not a contaminant of concern for this pathway
ND - not detected
--- - not analyzed in 2005, limits identified in RI dataset
(1) 95 % Upper Confidence Limit (UCL) for Soil Group 1 Background (Baker, 1995 and 2003)
(2) Has not been a contaminant of concern at other sites
(3) Cleanup goal for total PCBs in soil at CAX Site 1
(4) Site 6 human health residential goal, revised January 2005
(5) Soil value was used at Site 22 based on Site 6 Toxicity Study. Same value was used at Site 6 for sediment
(6) Site 4
(7) Sites 4 and 23
(8) Cleanup goal varies from site to site: 410 at Sites 4 and 21, 200 at Site 23, 50 at CAX Site 1 - all dependent on background

Explanation of Qualifiers:
J - analyte present, reported value is estimated

TABLE 3-4

ECOLOGICAL PRELIMINARY REMEDIATION GOALS
SITE 8 SEDIMENT
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

COC	RI Data Max Detected	2005 Data Max Detected	95% UCL Background [2]	Human Health PRG	Ecological PRG	PRGs From Other Sites	Proposed Final PRG
SVOCs (mg/kg)							
BEHP	34D	(1)	ND	NA	0.18	(3)	0.18
PCBs (mg/kg)							
Aroclor-1260	ND	(1)	ND	NA	0.023	1[4]	0.023

Notes:
BEHP - bis(2-ethylhexyl)phthalate
NA - not applicable; not a contaminant of concern for this pathway
ND - not detected
(1) Site 8 sediment not included in 2005 field investigation
(2) Background for Tidal Streams
(3) Has not been a contaminant of concern at other sites
(4) Interim goal for CAX Site 1

Explanation of Qualifiers:
D - reported value is based on diluted analysis

TABLE 3-5

ECOLOGICAL PRELIMINARY REMEDIATION GOALS
SSA 14 SOIL
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

COC	RI Data Max Detected	2005 Data Max Detected	95% UCL Background [1]	Human Health PRG	Ecological PRG	PRGs From Other Sites	Proposed Final PRG
SVOCs (mg/kg)							
BEHP	2.4J	0.31	5	NA	10	(2)	10
Explosives (mg/kg)							
HMX	17000	9.2	ND	3257	6.3	5.7[3]	6.3
Metals (mg/kg)							
Chromium	39.4	NA	16.27	NA	0.0075	33.5[4]	16.27
Iron	28,600	---	11,276	NA	200	(2)	11,276
Mercury	0.29	0.09J	0.05J	NA	0.1	0.24[5]	0.1
Vanadium	85.3	---	23.07	NA	2	(2)	23.07
Zinc	318J	149	24.1	NA	50	(6)	50

Notes:
BEHP - bis(2-ethylhexyl)phthalate
NA - not applicable; not a contaminant of concern for this pathway
--- - not analyzed in 2005, limits identified in RI dataset
(1) 95 % Upper Confidence Limit (UCL) for Soil Group 1 Background (Baker, 1995 and 2003)
(2) Has not been a contaminant of concern at other sites
(3) Soil value was used at Site 22 based on Site 6 Toxicity Study. Same value was used at Site 6 for sediment
(4) Site 4
(5) Sites 4 and 23
(6) Cleanup goal varies from site to site: 410 at Sites 4 and 21, 200 at Site 23, 50 at CAX Site 1

Explanation of Qualifiers:
J - analyte present, reported value is estimated

TABLE 3-6

ECOLOGICAL PRELIMINARY REMEDIATION GOALS
SSA 14 SEDIMENT
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

COC	RI Data Max Detected	2005 Data Max Detected	95% UCL Background [1]	Human Health PRG	Ecological PRG	PRGs From Other Sites	Proposed Final PRG
SVOCs (mg/kg)							
BEHP	6.2	0.48	ND	NA	0.18	(2)	0.18
Metals (mg/kg)							
Selenium	3.4L	0.8J	0.92	NA	1	(2)	1

Notes:
BEHP = bis(2-ethylhexyl)phthalate
NA - not applicable; not a contaminant of concern for this pathway
ND - not detected
(1) 95 % Upper Confidence Limit (UCL) for Tidal Streams (Baker, 1995 and 2003)
(2) Has not been a contaminant of concern at other sites

Explanation of Qualifiers:
J - analyte present, reported value is estimated
L - analyte present, reported value is biased low

TABLE 3-7

SUMMARY OF RISK-BASED REMEDATION GOALS
SITE 8 AND SSA 14
VAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINI

Media	COC	Goal (mg/kg)
Site 8 Soil	BEHP	10
	Aroclor-1260	0.1
	amino-DNTs	1.3
	HMX	6.3
	RDX	21.1
	2,4,6-TNT	1.3
	Chromium	16.27
	Iron	11,276
	Mercury	0.1
	Vanadium	23.07
	Zinc	50
Site 8 Sediment	BEHP	0.18
	Aroclor-1260	0.023
SSA 14 Soil	BEHP	10
	HMX	6.3
	Chromium	16.27
	Iron	11,276
	Mercury	0.1
	Vanadium	23.07
	Zinc	50
SSA 14 Sediment	BEHP	0.18
	Selenium	1

TABLE 4-1

POTENTIAL CHEMICAL-SPECIFIC ARARs AND TBC CRITERIA
SITE 8 AND SSA 14
NAVAL WEAPONS STATION YORKTOWN, VIRGINIA

Citation	Requirement	ARAR/TBC Criteria Determination	Comments
Toxic Substances Control Act (40 CFR Part 761.60)	Regulates the storage and disposal of PCB wastes.	ARAR. Applicable to sites where PCBs are detected in excavated waste.	High levels of PCBs were detected in the soil at Site 8. The concentration of PCBs in the soil would determine how the soil can be disposed.
Virginia Hazardous Waste Management Regulations (9 VAC 20-60)	Regulates the treatment, storage, and disposal of hazardous waste.	ARAR. Applicable to remedial actions involving treatment, storage, or disposal of hazardous waste.	TCLP analysis would be required if wastes are excavated for off-site disposal.
USEPA Region III Soil Screening Values for Human Health	Applicable for screening contaminant levels in soils at levels that are protective of residential or industrial users on land.	TBC.	Contaminants of concern were identified for Site 8 and SSA 14 partly through the use of these soil screening levels.
USEPA Region III BTAG Soil Screening Levels for Ecological Resources	Applicable for screening contaminant levels in soils at levels that are protective of ecological receptors.	TBC.	Ecological contaminants of concern were identified for Site 8 and SSA 14 partly through the use of these soil screening levels.

TABLE 4-2

POTENTIAL LOCATION-SPECIFIC ARARs AND TBC CRITERIA
SITE 8 AND SSA 14
NAVAL WEAPONS STATION YORKTOWN, VIRGINIA

Citation	Requirement	ARAR/TBC Criteria Determination	Comments
The Endangered Species Act of 1973 (16 USC 1531) (40 CFR Part 502)	Requires action to conserve endangered and threatened species and their critical habitats.	Not applicable.	There are no known endangered species at Site 8 or SSA 14.
National Historic Preservation Act (32 CFR Parts 229 and 229.4; 43 CFR Part 171; and 36 CFR Part 800)	Develops procedures for the protection of archaeological and historical resources.	ARAR.	If archaeological resources are encountered during soil excavation, they must be reviewed by Federal and Commonwealth archaeologists. Also applicable to historical buildings.
Executive Order 1988; Protection of Floodplains; 40 CFR 6, Appendix A; excluding Sections 6(a)(2), 6(a)(4), 6(a)(6); 40 CFR 6.302	Actions taken should avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial values.	ARAR.	Site 8 and SSA 14 are located within a floodplain.
Executive Order 11990, Protection of Wetlands; 40 CFR 6, Appendix A; excluding Sections 6(a)(2), 6(a)(4), 6(a)(6); 40 CFR 6.302	Action to minimize the destruction, loss or degradation of wetlands.	ARAR.	Wetlands are adjacent to the sites and could potentially be impacted by remedial response actions.
Clean Water Act, Section 404; 40 CFR 230.10; 40 CFR 231 (231.1, 231.2, 231.7, 231.8)	Action to prohibit discharge of dredged or fill material into wetland without permit.	ARAR.	Applicable if discharge of dredged or fill material to a wetland is planned as part of remedial response action.
Virginia Wetlands Regulations (4 VAC 20-390)	Regulates activities that impact wetlands.	ARAR.	Activities that could impact wetlands will comply with regulations.
Virginia Endangered Species Act and Virginia Board of Game and Inland Fisheries; Code of Virginia Sections 29.1-563 et seq. and 29-100 et seq.	Action to conserve endangered species or threatened species, including consultation with the Board of Game and Inland Fisheries.	Not applicable.	No known endangered species are found at Site 8 or SSA 14.

TABLE 4-3

POTENTIAL ACTION-SPECIFIC ARARs AND TBC CRITERIA
SITE 8 AND SSA 14
NAVAL WEAPONS STATION YORKTOWN, VIRGINIA

Citation	Requirement	ARAR/TBC Criteria Determination	Comments
DOT Rules for Hazardous Materials Transport (49 CFR Parts 107 and 171.1-500)	Regulates the transport of hazardous waste materials including packaging, shipping, and placarding.	ARAR. Applicable for any action requiring off-site transportation of hazardous materials.	Remedial actions may include off-site disposal.
Resource Conservation and Recovery Act Subtitle C (40 CFR Part 260-268)	Regulates the treatment, storage, and disposal of hazardous waste.	ARAR. Applicable to remedial actions involving treatment, storage, or disposal of hazardous waste.	Remedial actions could include treatment, storage, or disposal of hazardous waste.
Virginia Solid Waste Management Regulations (9 VAC 20-80)	Regulates the identification, management, and disposal of solid wastes.	ARAR. Applicable for solid (non-hazardous) waste.	Remedial actions could include off-site disposal of non-hazardous waste.
Virginia Regulations Governing the Transportation of Hazardous Materials (9 VAC 20-110)	Regulates the transport of hazardous waste materials including packaging, shipping, and placarding.	ARAR. Applicable for any action requiring off-site transportation of hazardous materials.	Remedial actions may include off-site disposal of hazardous waste.
Virginia Hazardous Waste Management Regulations (9 VAC 20-60)	Regulates the treatment, storage, and disposal of hazardous waste.	ARAR. Applicable to remedial actions involving treatment, storage, or disposal of hazardous waste.	Remediation may include disposal of hazardous waste.
Identification and Listing of Hazardous Waste (9 VAC 20-60, Part III)	Regulations concerning determination of whether or not a waste is hazardous based on characteristics or listing.	ARAR. Applicable in determining waste classification.	Wastes excavated at the sites could be classified as hazardous.
Manifest Systems, Recordkeeping, and Reporting (9 VAC 20-60, Part VII)	Regulates manifest systems related to hazardous waste treatment, storage, and disposal.	ARAR. Applicable to remedial actions where hazardous waste is generated or transported.	Remedial actions may include off-site disposal of hazardous waste.
Virginia Stormwater Management Regulations (4 VAC 50-60) and Virginia Erosion and Sediment Control Regulations (4 VAC 50-30)	Regulates stormwater management and erosion/sedimentation control practices that must be followed during land disturbing activities.	ARAR. Applicable for remedial actions involving land disturbing activities.	Activities during construction will comply with the Virginia Storm Water Management Program. A sediment and erosion control plan will be submitted to NAVFAC MIDLANT for approval.

TABLE 5-1

PRELIMINARY SCREENING OF REMOVAL ALTERNATIVES
SITE 8 AND SSA 14
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Response Action	Technology	Screening Comment
No Action	None	Not retained. Does not meet action objectives.
Treatment	Incineration	Retained
Removal	Excavation	Retained

TABLE 6-1

COST ESTIMATE FOR ALTERNATIVE 1 - EXCAVATION WITH OFF-SITE INCINERATION
SITE 8
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Cost Component	Unit	Quantity	Unit Cost	Subtotal Cost	Total Cost	Source	Basis/Comments
DIRECT CAPITAL COSTS							
General							
Pre-construction Submittals	LS	1	$20,000	$20,000		Engr. Est.	Work, E&S, & QC Plans
Mobilization/Demobilization	LS	1	$20,000	$20,000		Engr. Est.	Includes mob/demob for equipment
Equipment Wash Pad	LS	1	$10,000	$10,000		Engr. Est.	To prevent contaminated soil from leaving the site
Contract Administration	LS	1	$20,000	$20,000		Engr. Est.	Invoicing, project management, field supervision, H&S, etc.
Post-Construction Submittals	LS	1	$10,000	$10,000		Engr. Est.	Record drawings, etc.
General - Subtotal					$80,000		
Site Preparation							
Clearing and Grubbing	LS	1	$5,000	$5,000		Engr. Est., Means Site Work	
Temporary Safety Fencing	LF	120	$3.55	$426		Engr. Est., Means Site Work	Temporary safety fencing will be placed to prevent access to construction area
Temporary Silt Fencing	LF	150	$0.92	$138		Engr. Est., Means Site Work	Silt fencing downgradient of excavation area
Site Preparation - Subtotal					$5,564		
Excavation and Off-Site Incineration							
Excavation of Contaminated Soil/Sediment	CY	825	$7.90	$6,518		Engr. Est.	740 cy of soil/sediment will be excavated to 3 ft depth; assume 10% additional
Confirmatory Sampling Analyses							
BEHP	Sample	30	$123	$3,690		Baker BOAs	72 hour turnaround; add 75% to $70/sample
PCBs	Sample	30	$166	$4,980		Baker BOAs	72 hour turnaround; add 75% to $95/sample
Explosives	Sample	30	$280	$8,400		Baker BOAs	72 hour turnaround; add 75% to $160/sample
Inorganics	Sample	30	$245	$7,350		Baker BOAs	72 hour turnaround; add 75% to $140/sample
Incineration Fees	Tons	1350	$325	$438,750		Engr. Est.	Includes disposal costs; assumes 120 pcf
Contaminated Soil/Sediment Removal - Subtotal					$469,688		

TABLE 6-1 (Continued)

COST ESTIMATE FOR ALTERNATIVE 1 - EXCAVATION WITH OFF-SITE INCINERATION

SITE 8

NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Cost Component	Unit	Quantity	Unit Cost	Subtotal Cost	Total Cost	Source	Basis/Comments
Site Restoration							
Backfill	CY	825	$11.20	$9,240		Engr. Est., Means Site Work	Off-site source, assume 85% compaction
Topsoil	CY	125	$34.00	$4,250		Engr. Est., Means Site Work	Off-site source; placed 6" deep over all disturbed areas
Riprap	CY	100	$20.00	$2,000		Engr. Est.	Erosion Control
Fine Grading/Seeding (Revegetation)	SY	375	$4.38	$1,643		Engr. Est.	Grading and revegetation over disturbed areas
Wetland Planting	SF	75	$0.50	$38		Engr. Est.	Assume 10% of area
Site Restoration - Subtotal					$17,170		
DIRECT CAPITAL COSTS - TOTAL					$572,422		
INDIRECT CAPITAL COSTS							
Engineering and Design	LS	1	$34,345	$34,345		Engr. Est.	Assume 6% of Total Direct Capital Costs
Contingency Allowance	LS	1	$85,863	$85,863		Engr. Est.	Assume 15% of Total Direct Capital Costs
INDIRECT CAPITAL COSTS - TOTAL					$120,209		
CAPITAL COSTS (DIRECT AND INDIRECT)					**$692,630**		
TOTAL NET PRESENT WORTH: ALTERNATIVE 2					**$692,630**		

TABLE 6-2

COST ESTIMATE FOR ALTERNATIVE 1 - EXCAVATION WITH OFF-SITE INCINERATION
SSA 14
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Cost Component	Unit	Quantity	Unit Cost	Subtotal Cost	Total Cost	Source	Basis/Comments
DIRECT CAPITAL COSTS							
General							
Pre-construction Submittals	LS	1	$20,000	$20,000		Engr. Est.	Work, E&S, & QC Plans
Mobilization/Demobilization	LS	1	$20,000	$20,000		Engr. Est.	Includes mob/demob for equipment
Equipment Wash Pad	LS	1	$10,000	$10,000		Engr. Est.	To prevent contaminated soil from leaving the site
Contract Administration	LS	1	$20,000	$20,000		Engr. Est.	Invoicing, project management, field supervision, H&S, etc.
Post-Construction Submittals	LS	1	$10,000	$10,000		Engr. Est.	Record drawings, etc.
General - Subtotal					$80,000		
Site Preparation							
Clearing and Grubbing	LS	1	$5,000	$5,000		Engr. Est., Means Site Work	
Temporary Safety Fencing	LF	250	$3.55	$888		Engr. Est., Means Site Work	Temporary safety fencing will be placed to prevent access to construction area
Temporary Silt Fencing	LF	300	$0.92	$276		Engr. Est., Means Site Work	Silt fencing downgradient of excavation area
Site Preparation - Subtotal					$6,164		
Excavation and Off-Site Incineration							
Excavation of Contaminated Soil/Sediment	CY	800	$7.90	$6,320		Engr. Est.	730 cy of soil/sediment will be excavated to 2 ft depth; assume 10% additional
Confirmatory Sampling Analyses							
BEHP	Sample	30	$123	$3,690		Baker BOAs	72 hour turnaround; add 75% to $70/sample
Explosives	Sample	30	$280	$8,400		Baker BOAs	72 hour turnaround; add 75% to $160/sample
Inorganics	Sample	30	$245	$7,350		Baker BOAs	72 hour turnaround; add 75% to $140/sample
Incineration Fees	Tons	1300	$325	$422,500		Engr. Est.	Includes disposal costs; assumes 120 pcf
Contaminated Soil/Sediment Removal - Subtotal					$448,260		

TABLE 6-2 (Continued)

COST ESTIMATE FOR ALTERNATIVE 1 - EXCAVATION WITH OFF-SITE INCINERATION

SSA 14

NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Cost Component	Unit	Quantity	Unit Cost	Subtotal Cost	Total Cost	Source	Basis/Comments
Site Restoration							
Backfill	CY	700	$11.20	$7,840		Engr. Est., Means Site Work	Off-site source, assume 85% compaction
Topsoil	CY	190	$34.00	$6,460		Engr. Est., Means Site Work	Off-site source; placed 6" deep over all disturbed areas
Riprap	CY	100	$20.00	$2,000		Engr. Est.	Erosion Control
Fine Grading/Seeding (Revegetation)	SY	800	$4.38	$3,504		Engr. Est.	Grading and revegetation over disturbed areas
Wetland Planting	SF	490	$0.50	$245		Engr. Est.	Assume 10% of area
Site Restoration - Subtotal					$20,049		
DIRECT CAPITAL COSTS - TOTAL					$554,473		
INDIRECT CAPITAL COSTS							
Engineering and Design	LS	1	$33,268	$33,268		Engr. Est.	Assume 6% of Total Direct Capital Costs
Contingency Allowance	LS	1	$83,171	$83,171		Engr. Est.	Assume 15% of Total Direct Capital Costs
INDIRECT CAPITAL COSTS - TOTAL					$116,439		
CAPITAL COSTS (DIRECT AND INDIRECT)					**$670,912**		
TOTAL NET PRESENT WORTH: ALTERNATIVE 2					**$670,912**		

TABLE 6-3

COST ESTIMATE FOR ALTERNATIVE 2 - EXCAVATION WITH OFF-SITE DISPOSAL
SITE 8
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Cost Component	Unit	Quantity	Unit Cost	Subtotal Cost	Total Cost	Source	Basis/Comments
DIRECT CAPITAL COSTS							
General							
Pre-construction Submittals	LS	1	$20,000	$20,000		Engr. Est.	Work, E&S, & QC Plans
Mobilization/Demobilization	LS	1	$20,000	$20,000		Engr. Est.	Large construction equipment
Equipment Wash Pad	LS	1	$10,000	$10,000		Engr. Est.	To prevent contaminated soil from leaving the site
Contract Administration	LS	1	$20,000	$20,000		Engr. Est.	Invoicing, project management, field supervision, H&S, etc.
Post-Construction Submittals	LS	1	$10,000	$10,000		Engr. Est.	Record drawings, etc.
General - Subtotal					$80,000		
Site Preparation							
Clearing and Grubbing	LS	1	$5,000	$5,000		Engr. Est., Means Site Work	
Temporary Safety Fencing	LF	120	$3.55	$426		Engr. Est., Means Site Work	Temporary safety fencing will be placed to prevent access to construction area
Temporary Silt Fencing	LF	150	$0.92	$138		Engr. Est., Means Site Work	Silt fencing downgradient of excavation area
Site Preparation - Subtotal					$5,564		
Excavation and Off-Site Disposal							
Excavation of Contaminated Soil/Sediment	CY	825	$7.90	$6,518		Engr. Est.	740 cy of soil/sediment will be excavated to 3 ft depth; assume 10% additional
Confirmatory Sampling Analyses							
BEHP	Sample	30	$123	$3,690		Baker BOAs	72 hour turnaround; add 75% to $70/sample
PCBs	Sample	30	$166	$4,980		Baker BOAs	72 hour turnaround; add 75% to $95/sample
Explosives	Sample	30	$280	$8,400		Baker BOAs	72 hour turnaround; add 75% to $160/sample
Inorganics	Sample	30	$245	$7,350		Baker BOAs	72 hour turnaround; add 75% to $140/sample
TCLP	Sample	10	$690	$6,900		Baker BOAs	Confirmatory sampling of contaminated soil; total profile TCLP
Non-TSCA Soil/Sediment							
Transport and Disposal	Tons	1070	$50	$53,500		Engr. Est.	Assume 80% is non-TSCA @ 120 pcf
TSCA Soil/Sediment							
Transport and Disposal	Tons	280	$200	$56,000		Engr. Est.	Assume 20% is TSCA @ 120 pcf
Contaminated Soil/Sediment Removal - Subtotal					$147,338		

TABLE 6-3 (Continued)

COST ESTIMATE FOR ALTERNATIVE 2 - EXCAVATION WITH OFF-SITE DISPOSAL
SITE 8
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Cost Component	Unit	Quantity	Unit Cost	Subtotal Cost	Total Cost	Source	Basis/Comments
Site Restoration							
Backfill	CY	825	$11.20	$9,240		Engr. Est., Means Site Work	Off-site source, assume 85% compaction
Topsoil	CY	125	$34.00	$4,250		Engr. Est.; Means Site Work	Off-site source; placed 6" deep over all disturved areas
Riprap	CY	100	$20.00	$2,000		Engr. Est.	Erosion Control
Fine Grading/Seeding (Revegetation)	SY	375	$4.38	$1,643		Engr. Est.	Grading and revegetation over disturbed areas
Wetland Planting	SF	75	$0.50	$38		Engr. Est.	Assume 10% of area
Site Restoration - Subtotal					$17,170		
DIRECT CAPITAL COSTS - TOTAL					$250,072		
INDIRECT CAPITAL COSTS							
Engineering and Design	LS	1	$15,004	$15,004		Engr. Est.	Assume 6% of Total Direct Capital Costs
Contingency Allowance	LS	1	$37,511	$37,511		Engr. Est.	Assume 15% of Total Direct Capital Costs
INDIRECT CAPITAL COSTS - TOTAL					$52,515		
CAPITAL COSTS (DIRECT AND INDIRECT)					**$302,587**		
TOTAL NET PRESENT WORTH: ALTERNATIVE 2					**$302,587**		

TABLE 6-4

COST ESTIMATE FOR ALTERNATIVE 2 - EXCAVATION WITH OFF-SITE DISPOSAL
SSA 14
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Cost Component	Unit	Quantity	Unit Cost	Subtotal Cost	Total Cost	Source	Basis/Comments
DIRECT CAPITAL COSTS							
General							
Pre-construction Submittals	LS	1	$20,000	$20,000		Engr. Est.	Work, E&S, & QC Plans
Mobilization/Demobilization	LS	1	$20,000	$20,000		Engr. Est.	Large construction equipment
Equipment Wash Pad	LS	1	$10,000	$10,000		Engr. Est.	To prevent contaminated soil from leaving the site
Contract Administration	LS	1	$20,000	$20,000		Engr. Est.	Invoicing, project management, field supervision, H&S, etc.
Post-Construction Submittals	LS	1	$10,000	$10,000		Engr. Est.	Record drawings, etc.
General - Subtotal					$80,000		
Site Preparation							
Clearing and Grubbing	LS	1	$5,000	$5,000		Engr. Est., Means Site Work	
Temporary Safety Fencing	LF	250	$3.55	$888		Engr. Est., Means Site Work	Temporary safety fencing will be placed to prevent access to construction area
Temporary Silt Fencing	LF	300	$0.92	$276		Engr. Est., Means Site Work	Silt fencing downgradient of excavation area
Site Preparation - Subtotal					$6,164		
Excavation and Off-Site Disposal							
Excavation of Contaminated Soil/Sediment	CY	800	$7.90	$6,320		Engr. Est.	730 cy of soil/sediment will be excavated to 2 ft depth; assume 10% additional
Confirmatory Sampling Analyses							
BEHP	Sample	30	$123	$3,690		Baker BOAs	72 hour turnaround; add 75% to $70/sample
Explosives	Sample	30	$280	$8,400		Baker BOAs	72 hour turnaround; add 75% to $160/sample
Inorganics	Sample	30	$245	$7,350		Baker BOAs	72 hour turnaround; add 75% to $140/sample
TCLP	Sample	10	$690	$6,900		Baker BOAs	Confirmatory sampling of contaminated soil; total profile TCLP
Non-Hazardous Soil/Sediment							
Transport and Disposal	Tons	1040	$50	$52,000		Engr. Est.	Assume 80% is non-hazardous @ 120 pcf
Hazardous Soil/Sediment							
Transport and Disposal	Tons	260	$200	$52,000		Engr. Est.	Assume 20% is hazardous @ 120 pcf
Contaminated Soil/Sediment Removal - Subtotal					$136,660		

TABLE 6-4 (Continued)

COST ESTIMATE FOR ALTERNATIVE 2 - EXCAVATION WITH OFF-SITE DISPOSAL

SSA 14

NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

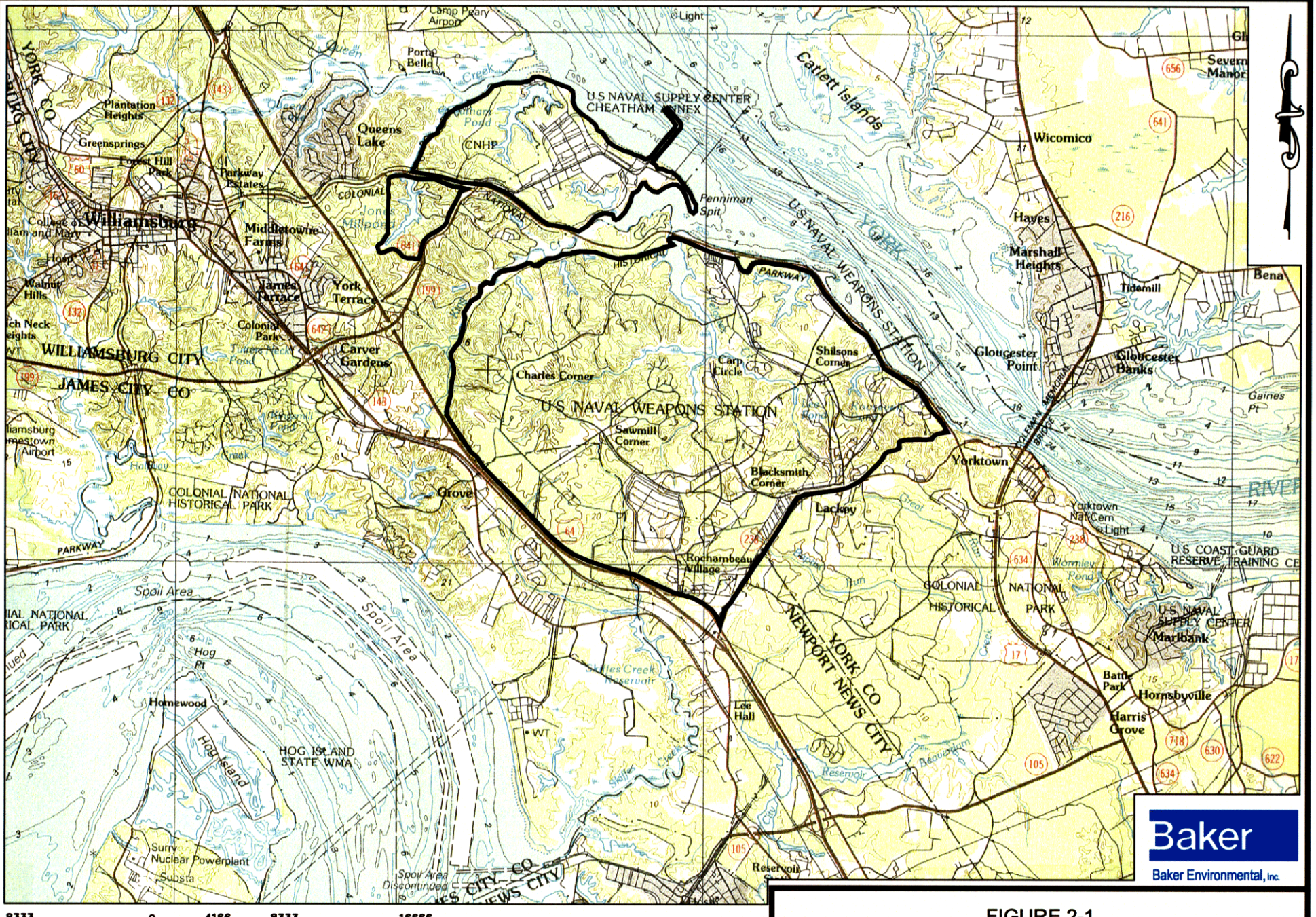
Cost Component	Unit	Quantity	Unit Cost	Subtotal Cost	Total Cost	Source	Basis/Comments
Site Restoration							
Backfill	CY	700	$11.20	$7,840		Engr. Est.; Means Site Work	Off-site source, assume 85% compaction
Topsoil	CY	190	$34.00	$6,460		Engr. Est.; Means Site Work	Off-site source; placed 6" deep over all disturved areas
Riprap	CY	100	$20.00	$2,000		Engr. Est.	Erosion Control
Fine Grading/Seeding (Revegetation)	SY	800	$4.38	$3,504		Engr. Est.	Grading and revegetation over disturbed areas
Wetland Planting	SF	490	$0.50	$245		Engr. Est.	Assume 10% of area
Site Restoration - Subtotal					$20,049		
DIRECT CAPITAL COSTS - TOTAL					$242,873		
INDIRECT CAPITAL COSTS							
Engineering and Design	LS	1	$14,572	$14,572		Engr. Est.	Assume 6% of Total Direct Capital Costs
Contingency Allowance	LS	1	$36,431	$36,431		Engr. Est.	Assume 15% of Total Direct Capital Costs
INDIRECT CAPITAL COSTS - TOTAL					$51,003		
CAPITAL COSTS (DIRECT AND INDIRECT)					**$293,876**		
TOTAL NET PRESENT WORTH: ALTERNATIVE 2					**$293,876**		

TABLE 7-1

SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES
SITE 8 AND SSA 14
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Evaluation Criteria	Alternative 1: Excavation with Off-Site Incineration	Alternative 2: Excavation with Off-Site Disposal
Effectiveness		
• Overall Protection of Human Health and the Environment	• Alternative would provide the highest degree of protection to the environment. • Provides immediate elimination in exposures via direct contact with soil and sediment. • Possibility of short-term exposure to construction workers from direct contact with material.	• Alternative would provide the highest degree of protection to the environment. • Provides immediate elimination in exposures via direct contact with soil and sediment. • Possibility of short-term exposure to construction workers from direct contact with contaminated material.
• Compliance with ARARs	• Alternative will comply with ARARs	• Alternative will comply with ARARs
• Long-Term Effectiveness and Permanence	• Alternative will be an effective and permanent solution since contaminated soil/sediment will be removed.	• Alternative will be an effective and permanent solution since contaminated soil/sediment will be removed.
• Reduction of Toxicity, Mobility, or Volume Through Treatment	• Alternative will significantly reduce the toxicity, mobility, or volume since treatment through incineration is involved.	• Disposal will not permanently and significantly reduce the toxicity, mobility, or volume but contaminated material will be isolated from receptors.
• Short-Term Effectiveness	• Potential risk to surrounding community and construction workers due to direct contact with contaminated material.	• Potential risk to surrounding community and construction workers due to direct contact with contaminated material.
Implementability		
• Technical Feasibility and Availability	• May be difficult to find incineration facility. • Implementation would require extensive site activities that would disturb soils, increasing the potential for migration.	• Excavation and disposal are common construction activities and are easily implemented. • Implementation would require extensive site activities that would disturb soils, increasing the potential for migration.
• Administrative Feasibility	• This alternative will require that the Navy commit the necessary administrative resources.	• This alternative will require that the Navy commit the necessary administrative resources.
Cost		
• Capital Cost	• $693,000 (Site 8) $671,000 (SSA 14)	• $303,000 (Site 8) $294,000 (SSA 14)
• O&M Costs	• $0	• $0
• Net Present Worth	• $693,000 (Site 8) $671,000 (SSA 14)	• $303,000 (Site 8) $294,000 (SSA 14)

FIGURES



8333 0 4166 8333 16666

1 inch = 8333 ft.

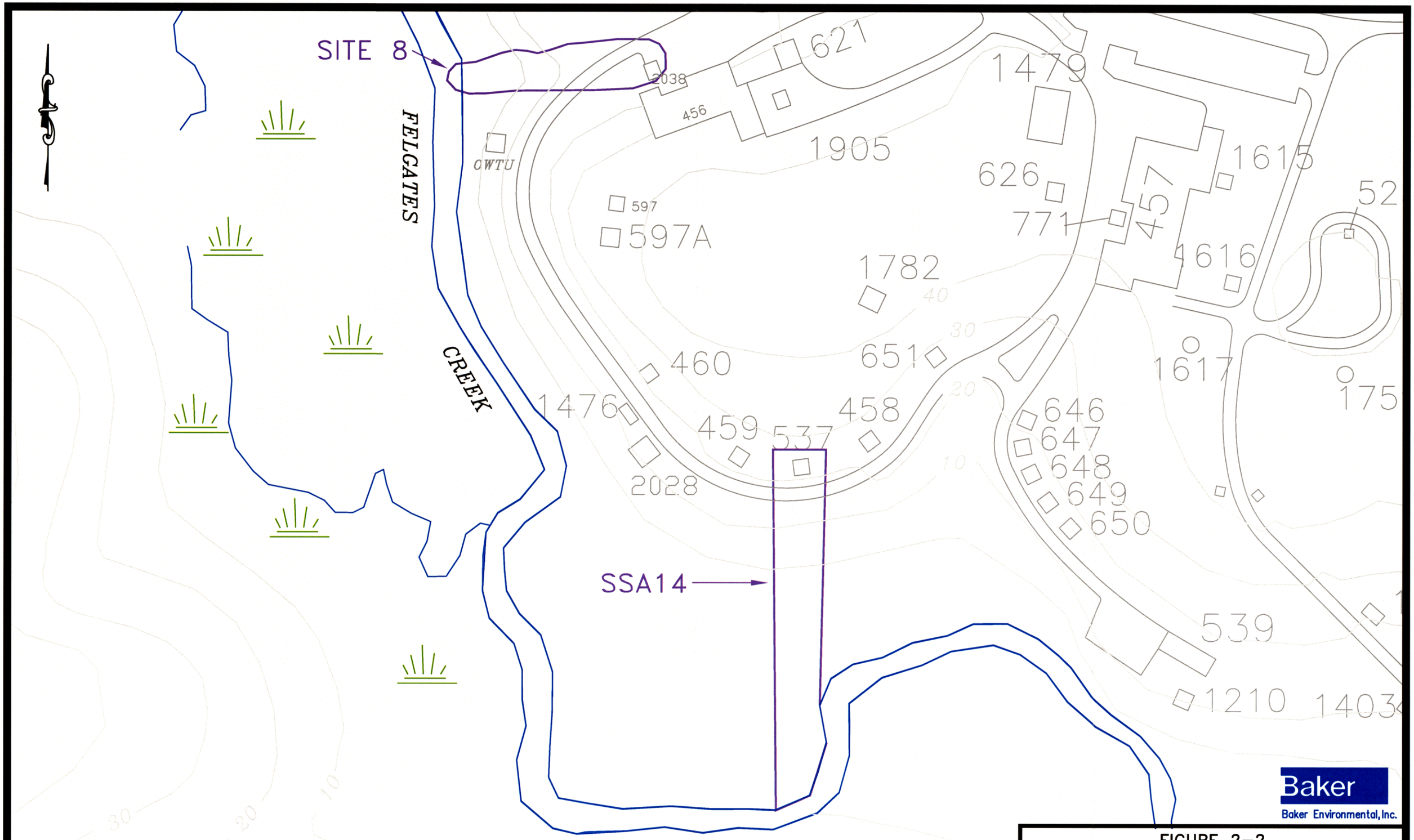
2195500W

SOURCE: U.S.G.S. 1:100,000–SCALE PLANIMETRIC MAP, WILLIAMSBURG, VIRGINIA, 1984.

Baker

Baker Environmental, Inc.

FIGURE 2-1
LOCATION OF NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA



NOTE:
SITE BOUNDARIES ARE APPROXIMATE BASED ON ROUND II RI (BAKER, 2004).

100 0 50 100
1 inch = 100 ft.

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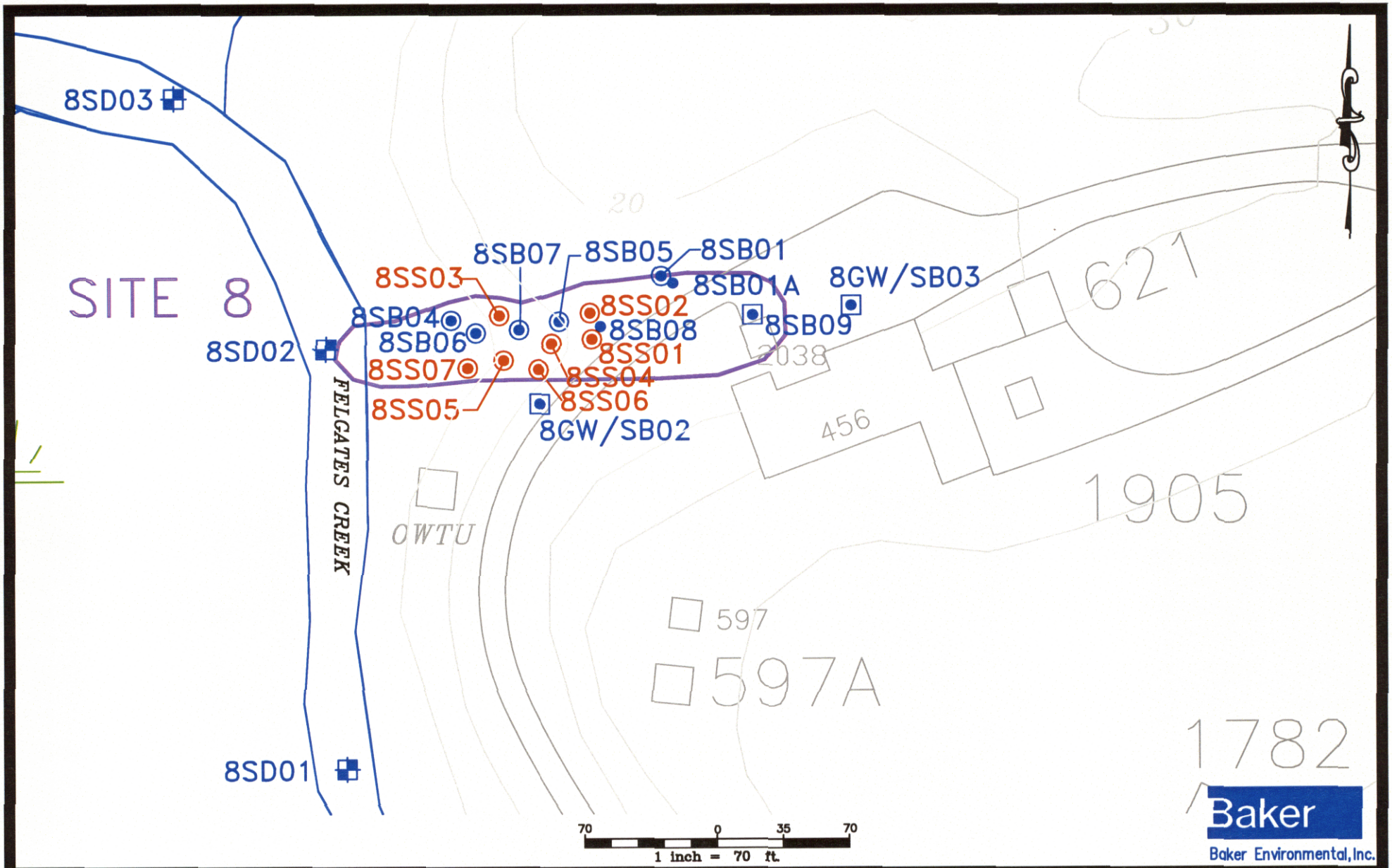
FIGURE 2-2
LAYOUT MAP
SITE 8 AND SSA 14

NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA



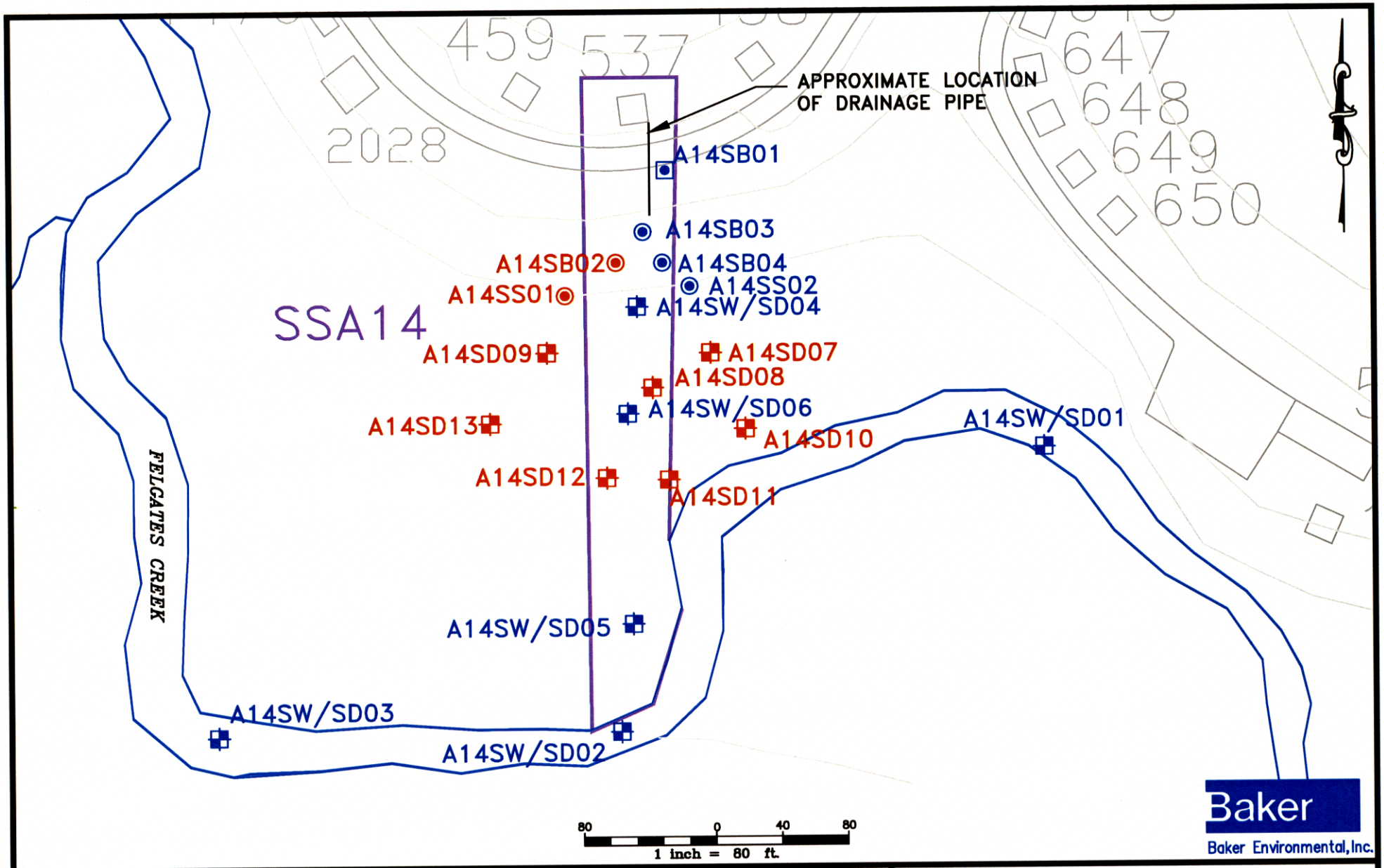
LEGEND

- ROUND TWO RI SURFACE SOIL LOCATION
- ROUND TWO RI SURFACE/SUBSURFACE SOIL LOCATION
- ROUND TWO SUBSURFACE SOIL LOCATION
- ROUND TWO RI SURFACE/SUBSURFACE SEDIMENT LOCATION
- PRE-CHARACTERIZATION SURFACE/SUBSURFACE SOIL LOCATION

NOTES:
1. 8SD04 IS IN LOCATION 8SS07
2. 8SD05 IS IN LOCATION 8SS05
3. 8SD06 IS IN LOCATION 8SS06

FIGURE 2-3
SITE 8 SAMPLE LOCATIONS

NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

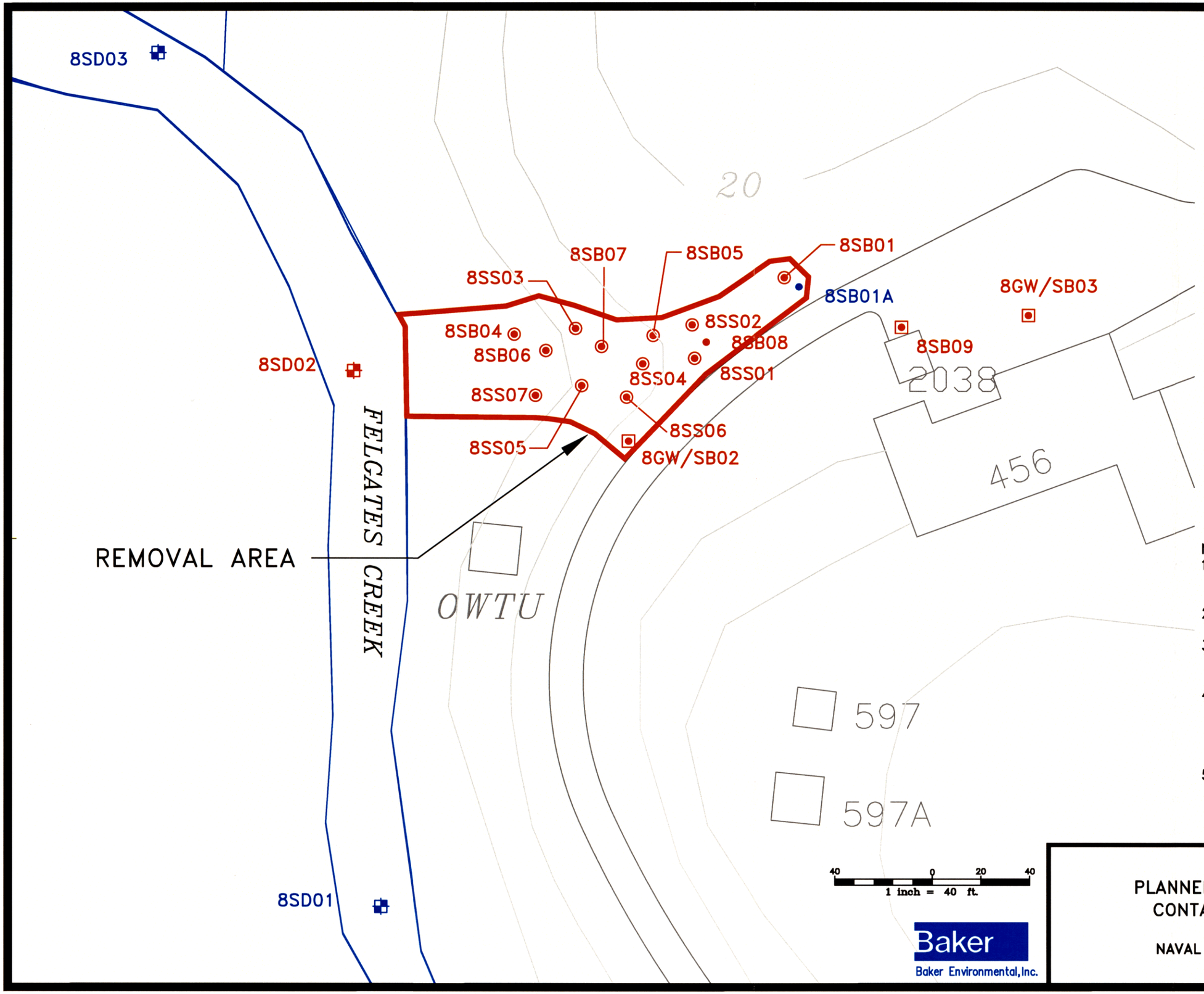


LEGEND

- ROUND TWO RI SURFACE SOIL LOCATION
- ROUND TWO RI SURFACE/SUBSURFACE SOIL LOCATION
- ROUND TWO RI SURFACE/SUBSURFACE SEDIMENT LOCATION
- PRE-CHARACTERIZATION SURFACE/SUBSURFACE SOIL LOCATION
- PRE-CHARACTERIZATION SURFACE/SUBSURFACE SEDIMENT LOCATION

FIGURE 2-4
SSA 14 SAMPLE LOCATIONS

NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA



REMEDIATION GOALS		
MEDIA	COC	GOAL (MG/KIG)
SOIL	BEHP	10
	AROCLOR-1260	0.1
	AMINO-DNTS	1.3
	HMX	6.3
	RDX	21.1
	TNT	1.3
	CHROMIUM	16.27
	IRON	11276
	MERCURY	0.1
	VANADIUM	23.07
	ZINC	50
SEDIMENT	BEHP	0.18
	AROCLOR-1260	0.023

NOTES:
1. BLUE SAMPLES INDICATE NON-EXCEEDANCES OF REMEDIATION GOALS.
2. RED SAMPLES INDICATE EXCEEDANCES OF REMEDIATION GOALS.
3. 2-AMINO-4,6-DNT AND 4-AMINO-2,6-DNT WERE ADDED TO DETERMINE AMINO-DNT EXCEEDANCES.
4. 8GW/SB03 SLIGHTLY EXCEEDS IRON (11400 MG/KG) AND VANADIUM (23.8 MG/KG). THIS IS AN UPGRADIENT SAMPLE AND IS WITHIN BACKGROUND LEVELS.
5. 8SB09 EXCEEDS REMEDIATION GOALS FOR INORGANICS. UPGRADIENT SAMPLE WAS COLLECTED AT 5-7 FT AND IS NOT PART OF EXPOSURE PATHWAY.

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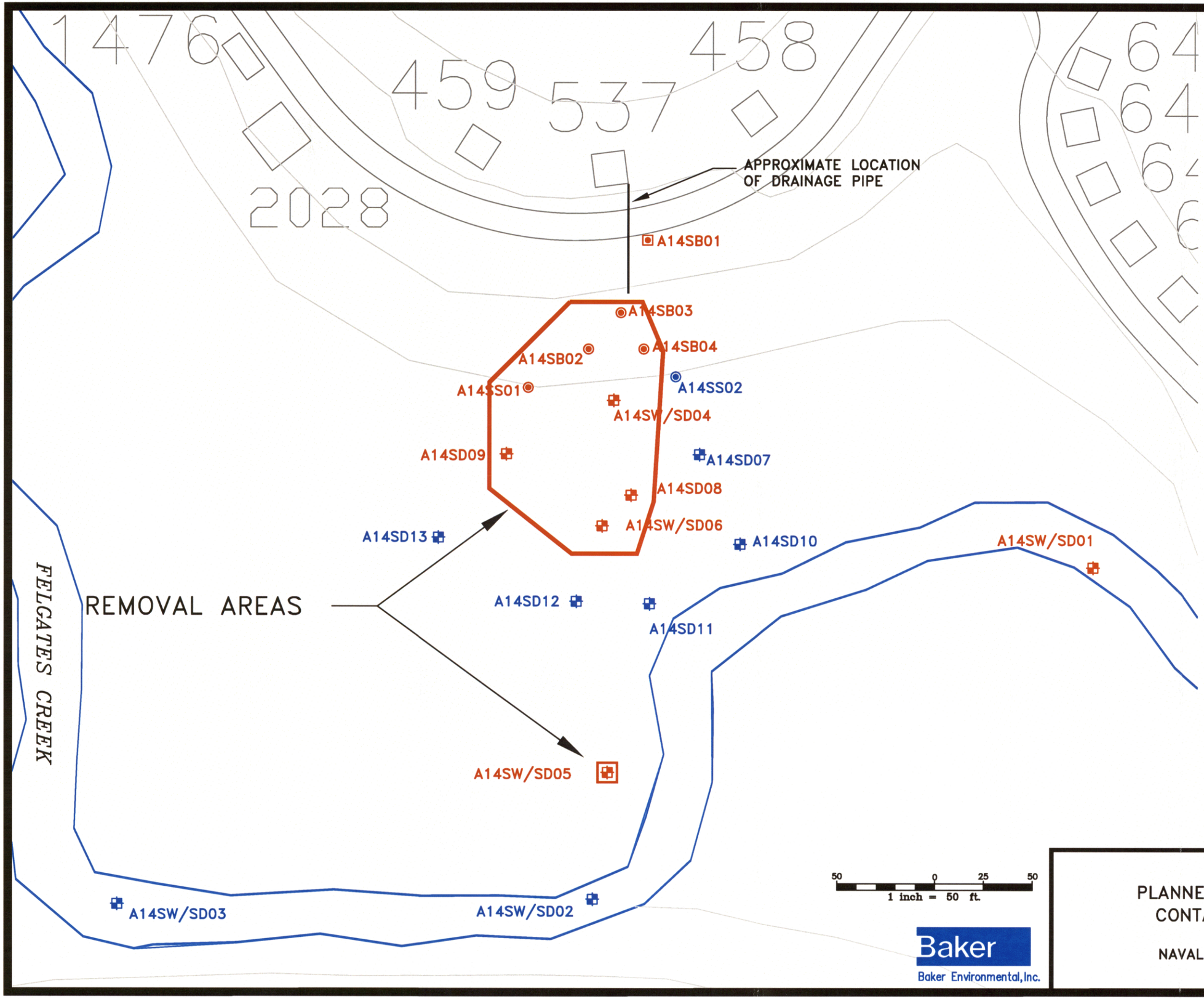
FIGURE 5-1
PLANNED EXTENT OF REMOVAL OF CONTAMINATED SOIL/SEDIMENT
SITE 8
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA



REMEDIATION GOALS		
MEDIA	COC	GOAL (MG/KIG)
SOIL	BEHP	10
	HMX	6.3
	IRON	11276
	MERCURY	0.1
	VANADIUM	23.07
	ZINC	50
SEDIMENT	BEHP	0.18
	SELENIUM	1

NOTES:
1. BLUE SAMPLES INDICATE NON-EXCEEDANCES OF REMEDIATION GOALS.
2. RED SAMPLES INDICATE EXCEEDANCES OF REMEDIATION GOALS.
3. A14SB01 EXCEEDS IRON (22800 MG/KG)
4. AND VANADIUM (35.9 MG/KG). THIS IS AN UPGRADIENT SAMPLE AND IS NOT INDICATIVE OF PAST SITE ACTIVITIES. A14SW/SW01 EXCEEDS REMEDIATION GOAL FOR BEHP. SEDIMENT CONTAMINATION WITHIN FELGATES CREEK WILL BE ADDRESSED AS PART OF SEPARATE INVESTIGATION.

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FIGURE 5-2
PLANNED EXTENT OF REMOVAL OF CONTAMINATED SOIL/SEDIMENT
SSA 14
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

ATTACHMENT A
ROUND TWO REMEDIAL INVESTIGATION POSITIVE DETECTION SUMMARIES

TABLE A-1

SURFACE SOIL - POSITIVE DETECTION SUMMARY
ORGANIC COMPOUNDS
SITE 8
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

SAMPLE ID	8SB01-00	8SB02-00	8SB03-00	8SB04-00	8SB05-00	8SB06-00	8SB07-00	8SB07-00D	8SB09-00
DATE SAMPLED	01/18/97	01/18/97	01/18/97	01/18/97	01/14/97	01/18/97	01/18/97	01/18/97	01/18/97
DEPTH	0-6"	0-6"	0-6"	0-5"	0-1'	0-5"	0-10"	0-10"	0-6"
VOLATILES (ug/kg)									
1,2-Dichloroethene (total)	13 U	13 U	11 U	7 J	3 J	6 J	14 U	15 U	12 U
Toluene	13 UJ	13 UJ	2 J	17 UJ	16 UJ	18 UJ	14 UJ	15 UJ	12 UJ
Trichloroethene (TCE)	13 UJ	13 UJ	54 J	8 J	11 J	18 UJ	14 UJ	15 U	12 U
SEMIVOLATILES (ug/kg)									
2-Methylnaphthalene	430 U	420 U	75 J	570 U	520 U	580 U	480 U	490 U	390 U
Acenaphthene	430 U	420 U	360 U	570 U	520 U	580 U	480 U	75 J	390 U
Anthracene	430 U	420 U	360 U	570 U	520 U	580 U	480 U	230 J	390 U
Benzo(a)anthracene	430 U	420 U	360 U	570 U	76 J	92 J	480 UJ	550 J	390 U
Benzo(a)pyrene	430 U	420 U	360 U	570 U	79 J	94 J	480 U	470 J	390 UJ
Benzo(b)fluoranthene	430 U	420 U	360 U	76 J	200 J	180 J	86 J	690 J	390 UJ
Benzo(g,h,i)perylene	430 U	420 U	360 U	570 U	75 J	100 J	480 U	240 J	390 UJ
Benzo(k)fluoranthene	430 U	420 U	360 U	570 U	520 U	580 U	480 U	230 J	390 UJ
Bis(2-ethylhexyl)phthalate	430 U	98 J	360 U	570 U	110 B	130 J	62 J	69 J	390 U
Carbazole	430 U	420 U	360 U	570 U	520 U	580 U	480 U	180 J	390 U
Chrysene	430 U	420 U	360 U	570 U	93 J	120 J	52 J	600 J	390 U
Dibenz(a,h)anthracene	430 U	420 U	360 U	570 U	520 U	580 U	480 U	75 J	390 UJ
Dibenzofuran	430 U	420 U	360 U	570 U	520 U	580 U	480 U	69 J	390 U
Dimethyl Phthalate	430 U	420 U	360 U	570 U	520 U	110 J	480 U	490 U	390 U
Fluoranthene	430 U	420 U	360 U	570 U	150 J	230 J	62 J	1400 J	390 U
Fluorene	430 U	420 U	360 U	570 U	520 U	580 U	480 U	120 J	390 U
Indeno(1,2,3-cd)pyrene	430 U	420 U	360 U	570 U	68 J	100 J	480 U	280 J	390 UJ
Phenanthrene	430 U	420 U	360 U	570 U	84 J	130 J	480 UJ	1200 J	390 U
Pyrene	430 U	420 U	360 U	570 U	140 J	200 J	74 J	980 J	390 U
PESTICIDES/PCBS (ug/kg)									
4,4'-DDE	22 U	4.2 U	3.6 U	120 U	12 J	590 U	240 U	240 U	0.54 J
Chlordane, alpha-	11 U	2.1 U	1.8 U	58 U	10	290 U	120 U	120 U	2 U
Chlordane, gamma-	11 U	2.1 U	1.8 U	58 U	1.1 J	290 U	120 U	120 U	2 U
Endrin Aldehyde	22 U	4.2 U	3.6 U	120 U	75 J	590 U	240 U	240 U	4 U
Endrin Ketone	22 U	4.2 U	0.41 J	120 U	10 U	590 U	240 U	240 U	0.22 J
Heptachlor Epoxide	11 U	2.1 U	1.8 U	58 U	6.3 J	290 U	120 U	120 U	2 U
Aroclor-1260	220 U	42 U	36 U	1200 U	10000	5900 U	2400 U	2400 U	40 U

TABLE A-1 (Continued)

SURFACE SOIL - POSITIVE DETECTION SUMMARY
ORGANIC COMPOUNDS
SITE 8
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

SAMPLE ID	8SB01-00	8SB02-00	8SB03-00	8SB04-00	8SB05-00	8SB06-00	8SB07-00	8SB07-00D	8SB09-00
DATE SAMPLED	01/18/97	01/18/97	01/18/97	01/18/97	01/14/97	01/18/97	01/18/97	01/18/97	01/18/97
DEPTH	0-6"	0-6"	0-6"	0-5"	0-1'	0-5"	0-10"	0-10"	0-6"
EXPLOSIVES (ug/kg)									
2,4,6-Trinitrotoluene	250 U	250 U	250 U	250	1300	2500 U	920 J	2000	250 U
2-Nitrotoluene	250 U	250 U	250 U	250 U	400 NJ	2500 U	250 U	250 U	250 U
3-Nitrotoluene	300 NJ	250 U	250 U	250 U	250 U	2500 U	250 U	1000 NJ	250 U
Amino Dinitrotoluenes (mixture)	250 U	250 U	250 U	350	3400	4900	2600	2200	250 U
HMX	500 U	500 U	500 U	500 U	570 U	14000	740	610	500 U
RDX	500 U	500 U	500 U	500 U	500 U	30000	500 U	500 U	500 U

TABLE A-1 (Continued)

SURFACE SOIL - POSITIVE DETECTION SUMMARY
ORGANIC COMPOUNDS
SITE 8
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

	MINIMUM NONDETECT	MAXIMUM NONDETECT	MINIMUM DETECT	MAXIMUM DETECT	LOCATION OF MAXIMUM DETECTION	FREQUENCY OF DETECTION	AVERAGE OF POSITIVE DETECTIONS	MEDIAN OF POSITIVE DETECTIONS
VOLATILES (ug/kg)								
1,2-Dichloroethene (total)	11 U	15 U	3 J	7 J	8SB04-00	3/9	5.33	6
Toluene	12 UJ	18 UJ	2 J	2 J	8SB03-00	1/9	2	2
Trichloroethene (TCE)	12 U	18 UJ	8 J	54 J	8SB03-00	3/9	24.33	11
SEMIVOLATILES (ug/kg)								
2-Methylnaphthalene	390 U	580 U	75 J	75 J	8SB03-00	1/9	75	75
Acenaphthene	360 U	580 U	75 J	75 J	8SB07-00D	1/9	75	75
Anthracene	360 U	580 U	230 J	230 J	8SB07-00D	1/9	230	230
Benzo(a)anthracene	360 U	570 U	76 J	550 J	8SB07-00D	3/9	239.33	92
Benzo(a)pyrene	360 U	570 U	79 J	470 J	8SB07-00D	3/9	214.33	94
Benzo(b)fluoranthene	360 U	430 U	76 J	690 J	8SB07-00D	5/9	246.4	180
Benzo(g,h,i)perylene	360 U	570 U	75 J	240 J	8SB07-00D	3/9	138.33	100
Benzo(k)fluoranthene	360 U	580 U	230 J	230 J	8SB07-00D	1/9	230	230
Bis(2-ethylhexyl)phthalate	110 B	570 U	62 J	130 J	8SB06-00	4/9	89.75	83.5
Carbazole	360 U	580 U	180 J	180 J	8SB07-00D	1/9	180	180
Chrysene	360 U	570 U	52 J	600 J	8SB07-00D	4/9	216.25	106.5
Dibenz(a,h)anthracene	360 U	580 U	75 J	75 J	8SB07-00D	1/9	75	75
Dibenzofuran	360 U	580 U	69 J	69 J	8SB07-00D	1/9	69	69
Dimethyl Phthalate	360 U	570 U	110 J	110 J	8SB06-00	1/9	110	110
Fluoranthene	360 U	570 U	62 J	1400 J	8SB07-00D	4/9	460.5	190
Fluorene	360 U	580 U	120 J	120 J	8SB07-00D	1/9	120	120
Indeno(1,2,3-cd)pyrene	360 U	570 U	68 J	280 J	8SB07-00D	3/9	149.33	100
Phenanthrene	360 U	570 U	84 J	1200 J	8SB07-00D	3/9	471.33	130
Pyrene	360 U	570 U	74 J	980 J	8SB07-00D	4/9	348.5	170
PESTICIDES/PCBS (ug/kg)								
4,4'-DDE	3.6 U	590 U	0.54 J	12 J	8SB05-00	2/9	6.27	6.27
Chlordane, alpha-	1.8 U	290 U	10	10	8SB05-00	1/9	10	10
Chlordane, gamma-	1.8 U	290 U	1.1 J	1.1 J	8SB05-00	1/9	1.1	1.1
Endrin Aldehyde	3.6 U	590 U	75 J	75 J	8SB05-00	1/9	75	75
Endrin Ketone	4.2 U	590 U	0.22 J	0.41 J	8SB03-00	2/9	0.32	0.32
Heptachlor Epoxide	1.8 U	290 U	6.3 J	6.3 J	8SB05-00	1/9	6.3	6.3
Aroclor-1260	36 U	5900 U	10000	10000	8SB05-00	1/9	10000	10000

TABLE A-1 (Continued)

SURFACE SOIL - POSITIVE DETECTION SUMMARY
ORGANIC COMPOUNDS
SITE 8
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

	MINIMUM NONDETECT	MAXIMUM NONDETECT	MINIMUM DETECT	MAXIMUM DETECT	LOCATION OF MAXIMUM DETECTION	FREQUENCY OF DETECTION	AVERAGE OF POSITIVE DETECTIONS	MEDIAN OF POSITIVE DETECTIONS
EXPLOSIVES (ug/kg)								
2,4,6-Trinitrotoluene	250 U	2500 U	250	2000	8SB07-00D	4/9	1117.5	1110
2-Nitrotoluene	250 U	2500 U	400 NJ	400 NJ	8SB05-00	1/9	400	400
3-Nitrotoluene	250 U	2500 U	300 NJ	1000 NJ	8SB07-00D	2/9	650	650
Amino Dinitrotoluenes (mixture)	250 U	250 U	350	4900	8SB06-00	5/9	2690	2600
HMX	500 U	570 U	610	14000	8SB06-00	3/9	5116.67	740
RDX	500 U	500 U	30000	30000	8SB06-00	1/9	30000	30000

TABLE A-2

SURFACE SOIL - POSITIVE DETECTION SUMMARY
TOTAL INORGANICS
SITE 8
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

SAMPLE ID	8SB01-00	8SB02-00	8SB03-00	8SB04-00	8SB05-00	8SB06-00	8SB07-00	8SB07-00D	8SB09-00
DATE SAMPLED	01/18/97	01/18/97	01/18/97	01/18/97	01/14/97	01/18/97	01/18/97	01/18/97	01/18/97
DEPTH	0-6"	0-6"	0-6"	0-5"	0-1'	0-5"	0-10"	0-10"	0-6"
TOTAL INORGANICS (mg/kg)									
Aluminum	12300	12000	6560	9090	26300	9220	11500	9820	12700
Antimony	0.82 L	0.76 UL	0.91 L	1.5 L	0.95 U	2.6 L	2.6 L	2.1 L	0.72 UL
Arsenic	13.8 J	11.1 J	1.3 J	5.9 J	5.9	5.9 J	5 J	5.4 J	7.4 J
Barium	25.8	35	24.6	123	67.6	371	187	210	23.8
Beryllium	0.72	0.55	0.32	0.41	0.32 U	0.35 U	0.29 U	0.29 U	0.67
Cadmium	0.26 U	0.25 U	0.22 U	0.35 U	2.1	0.98	0.71	0.7	0.24 U
Calcium	2710 J	2670 J	8490 J	3980 J	3510	3050 J	1740 B	1740 J	27200 J
Chromium	36.6	32.2	9.4	26.4	61.5	28	28.4	29.7	27.4
Cobalt	6.1	5.5	3.9	4.1	20.6	8.5	5.2	5.1	5.7
Copper	8.3	8.6	5.7	12.6	61.9	68.4	41.3	40.1	6.5
Cyanide	0.13	0.11	0.06 U	0.1 U	0.15 B	3.1	0.14	0.34	0.07 U
Iron	31700	31200	11400	16200	16500	14900	11700	11400	24600
Lead	15.9	15.5	7.9	35.5	129	78.9	50.6	52.1	10.3
Magnesium	1780	1360	2680	1300	1000	1010	740	682	1840
Manganese	100 J	121 J	317 J	154 J	227	137 J	115 J	105 J	99.9 J
Mercury	0.07 UL	0.06 UL	0.05 UL	0.1 L	0.91	0.75 L	0.66 L	0.68 L	0.06 UL
Nickel	11.6	10.5	4.7	8.3	12	12.7	8.3	7.3	12.1
Potassium	1640	1400	1220	1070	505	572	428	335	1530
Thallium	0.78 U	0.82 K	0.65 U	1 U	0.95 U	1.1 U	0.87 U	1.2 K	0.72 U
Vanadium	44.3	44.8	23.8	31.5	38.5	32.8	27	24.5	36.5
Zinc	46.4 J	49.8 J	27.1 J	103 J	249	179 J	104 J	94.8 J	30.4 J

TABLE A-2 (Continued)

SURFACE SOIL - POSITIVE DETECTION SUMMARY
TOTAL INORGANICS
SITE 8
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

	MINIMUM NONDETECT	MAXIMUM NONDETECT	MINIMUM DETECT	MAXIMUM DETECT	LOCATION OF MAXIMUM DETECTION	FREQUENCY OF DETECTION	AVERAGE OF POSITIVE DETECTIONS	MEDIAN OF POSITIVE DETECTIONS
TOTAL INORGANICS (mg/kg)								
Aluminum	ND	ND	6560	26300	8SB05-00	9/9	12165.56	11500
Antimony	0.72 UL	0.95 U	0.82 L	2.6 L	8SB06-00,8SB07-00	6/9	1.76	1.8
Arsenic	ND	ND	1.3 J	13.8 J	8SB01-00	9/9	6.86	5.9
Barium	ND	ND	23.8	371	8SB06-00	9/9	118.64	67.6
Beryllium	0.29 U	0.35 U	0.32	0.72	8SB01-00	5/9	0.53	0.55
Cadmium	0.22 U	0.35 U	0.7	2.1	8SB05-00	4/9	1.12	0.85
Calcium	1740 B	1740 B	1740 J	27200 J	8SB09-00	8/9	6668.75	3280
Chromium	ND	ND	9.4	61.5	8SB05-00	9/9	31.07	28.4
Cobalt	ND	ND	3.9	20.6	8SB05-00	9/9	7.19	5.5
Copper	ND	ND	5.7	68.4	8SB06-00	9/9	28.16	12.6
Cyanide	0.06 U	0.15 B	0.11	3.1	8SB06-00	5/9	0.76	0.14
Iron	ND	ND	11400	31700	8SB01-00	9/9	18844.44	16200
Lead	ND	ND	7.9	129	8SB05-00	9/9	43.97	35.5
Magnesium	ND	ND	682	2680	8SB03-00	9/9	1376.89	1300
Manganese	ND	ND	99.9 J	317 J	8SB03-00	9/9	152.88	121
Mercury	0.05 UL	0.07 UL	0.1 L	0.91	8SB05-00	5/9	0.62	0.68
Nickel	ND	ND	4.7	12.7	8SB06-00	9/9	9.72	10.5
Potassium	ND	ND	335	1640	8SB01-00	9/9	966.67	1070
Thallium	0.65 U	1.1 U	0.82 K	1.2 K	8SB07-00D	2/9	1.01	1.01
Vanadium	ND	ND	23.8	44.8	8SB02-00	9/9	33.74	32.8
Zinc	ND	ND	27.1 J	249	8SB05-00	9/9	98.17	94.8

TABLE A-3

SUBSURFACE SOIL - POSITIVE DETECTION SUMMARY
ORGANIC COMPOUNDS
SITE 8
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

SAMPLE ID	8SB01A-03	8SB02-04	8SB03-03	8SB03-03D	8SB08-00	8SB09-03
DATE SAMPLED	01/14/97	01/18/97	01/18/97	01/18/97	01/14/97	01/18/97
DEPTH	4-6'	5-9'	3-6'	3-6'	0-2'	5-7'
SEMIVOLATILES (ug/kg)						
Benzo(a)anthracene	420 U	450 U	420 U	420 U	55 J	420 U
Benzo(a)pyrene	420 U	450 U	420 U	420 U	48 J	420 U
Benzo(b)fluoranthene	420 U	450 U	420 U	420 U	66 J	420 U
Bis(2-ethylhexyl)phthalate	56 B	75 B	420 U	420 U	51 B	63 J
Chrysene	420 U	450 U	420 U	420 U	59 J	420 U
Fluoranthene	420 U	450 U	420 U	420 U	140 J	420 U
Phenanthrene	420 U	450 U	420 U	420 U	130 J	420 U
Pyrene	420 U	450 U	420 U	420 U	110 J	420 U
PESTICIDES/PCBS (ug/kg)						
Endrin Aldehyde	4.3 U	4.5 U	4.2 U	4.2 U	5.2 J	4.2 U
Methoxychlor	21 U	23 U	0.98 J	21 U	210 U	21 U
EXPLOSIVES (ug/kg)						
Amino dinitrotoluenes (mixture)	250 U	250 U	250 U	250 U	360	250 U
HMX	2600	500 U	500 U	500 U	730	500 U

TABLE A-3 (Continued)

SUBSURFACE SOIL - POSITIVE DETECTION SUMMARY
ORGANIC COMPOUNDS
SITE 8
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

	MINIMUM NONDETECT	MAXIMUM NONDETECT	MINIMUM DETECT	MAXIMUM DETECT	LOCATION OF MAXIMUM DETECTION	FREQUENCY OF DETECTION	AVERAGE OF POSITIVE DETECTIONS	MEDIAN OF POSITIVE DETECTIONS
SEMIVOLATILES (ug/kg)								
Benzo(a)anthracene	420 U	450 U	55 J	55 J	8SB08-00	1/6	55	55
Benzo(a)pyrene	420 U	450 U	48 J	48 J	8SB08-00	1/6	48	48
Benzo(b)fluoranthene	420 U	450 U	66 J	66 J	8SB08-00	1/6	66	66
Bis(2-ethylhexyl)phthalate	51 B	420 U	63 J	63 J	8SB09-03	1/6	63	63
Chrysene	420 U	450 U	59 J	59 J	8SB08-00	1/6	59	59
Fluoranthene	420 U	450 U	140 J	140 J	8SB08-00	1/6	140	140
Phenanthrene	420 U	450 U	130 J	130 J	8SB08-00	1/6	130	130
Pyrene	420 U	450 U	110 J	110 J	8SB08-00	1/6	110	110
PESTICIDES/PCBS (ug/kg)								
Endrin Aldehyde	4.2 U	4.5 U	5.2 J	5.2 J	8SB08-00	1/6	5.2	5.2
Methoxychlor	21 U	210 U	0.98 J	0.98 J	8SB03-03	1/6	0.98	0.98
EXPLOSIVES (ug/kg)								
Amino dinitrotoluenes (mixture)	250 U	250 U	360	360	8SB08-00	1/6	360	360
HMX	500 U	500 U	730	2600	8SB01A-03	2/6	75	1665

TABLE A-4

SUBSURFACE SOIL - POSITIVE DETECTION SUMMARY
TOTAL INORGANICS
SITE 8
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

SAMPLE ID	8SB01A-03	8SB02-04	8SB03-03	8SB03-03D	8SB08-00	8SB09-03
DATE SAMPLED	01/14/97	01/18/97	01/18/97	01/18/97	01/14/97	01/18/97
DEPTH	4-6'	5-9'	3-6'	3-6'	0-2'	5-7'
TOTAL INORGANICS (mg/kg)						
Aluminum	9600	24300	14500	6130	8790	8240
Arsenic	9.5	21.3 J	11.4 J	9.6 J	7.5	10.1 J
Barium	24.5	35	21.5	11.3	34.3	18.2
Beryllium	0.84	1.1	0.31	0.25 U	0.52	0.61
Cadmium	0.26	0.27 U	0.25 U	0.25 U	0.25 U	0.25 U
Calcium	64900	903 J	513 J	612 J	1710	5710 J
Chromium	28.6	57.7	40.5	23.3	21.7	23.2
Cobalt	8.8	7.3	3.7	3.4	4.1	9.1
Copper	7.2	9.1	6.8	5.8	8.9	7.4
Iron	23000	58500	30000	25300	19300	26600
Lead	10.9	17.4	9.5	7.9	18.3	9.1
Magnesium	2200	1930	2060	1160	946	1530
Manganese	167	77.9 J	62.2 J	51.3 J	66.9	141 J
Mercury	0.06 U	0.07 UL	0.06 UL	0.06 UL	0.07	0.06 UL
Nickel	15.3	15.3	8.6	5.8	7.6	13.3
Potassium	1910	2340	1890	991	947	1240
Sodium	313	245 B	162 B	166 B	86.1 B	242 B
Thallium	0.93	1.6 K	0.96 K	0.76 U	0.76 U	0.76 U
Vanadium	29.6	79.9	43.7	25.7	25.6	28.5
Zinc	39.3	53.6 J	30.4 J	22.7 J	46.6	41.3 J

TABLE A-4 (Continued)

SUBSURFACE SOIL - POSITIVE DETECTION SUMMARY
TOTAL INORGANICS
SITE 8
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

	MINIMUM NONDETECT	MAXIMUM NONDETECT	MINIMUM DETECT	MAXIMUM DETECT	LOCATION OF MAXIMUM DETECTION	FREQUENCY OF DETECTION	AVERAGE OF POSITIVE DETECTIONS	MEDIAN OF POSITIVE DETECTIONS
TOTAL INORGANICS (mg/kg)								
Aluminum	ND	ND	6130	24300	8SB02-04	6/6	11926.67	9195
Arsenic	ND	ND	7.5	21.3 J	8SB02-04	6/6	11.57	9.85
Barium	ND	ND	11.3	35	8SB02-04	6/6	24.13	23
Beryllium	0.25 U	0.25 U	0.31	1.1	8SB02-04	5/6	0.68	0.61
Cadmium	0.25 U	0.27 U	0.26	0.26	8SB01A-03	1/6	0.26	0.26
Calcium	ND	ND	513 J	64900	8SB01A-03	6/6	12391.33	1306.5
Chromium	ND	ND	21.7	57.7	8SB02-04	6/6	32.5	25.95
Cobalt	ND	ND	3.4	9.1	8SB09-03	6/6	6.07	5.7
Copper	ND	ND	5.8	9.1	8SB02-04	6/6	7.53	7.3
Iron	ND	ND	19300	58500	8SB02-04	6/6	30450	25950
Lead	ND	ND	7.9	18.3	8SB08-00	6/6	12.18	10.2
Magnesium	ND	ND	946	2200	8SB01A-03	6/6	1637.67	1730
Manganese	ND	ND	51.3 J	167	8SB01A-03	6/6	94.38	72.4
Mercury	0.06 UL	0.07 UL	0.07	0.07	8SB08-00	1/6	0.07	0.07
Nickel	ND	ND	5.8	15.3	8SB01A-03,8SB02-04	6/6	10.98	10.95
Potassium	ND	ND	947	2340	8SB02-04	6/6	1553	1565
Sodium	86.1 B	245 B	313	313	8SB01A-03	1/6	313	313
Thallium	0.76 U	0.76 U	0.93	1.6 K	8SB02-04	3/6	1.16	0.96
Vanadium	ND	ND	25.6	79.9	8SB02-04	6/6	38.83	29.05
Zinc	ND	ND	22.7 J	53.6 J	8SB02-04	6/6	38.98	40.3

TABLE A-5

SEDIMENT - POSITIVE DETECTION SUMMARY
ORGANIC COMPOUNDS
SITE 8
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

SAMPLE ID	8SD01-01	8SD01-01D	8SD01-02	8SD02-01	8SD02-02	8SD03-01	8SD03-02	8SD04-01	8SD04-02	8SD05-01	8SD05-02	8SD06-01	8SD06-02	8SD06-02D
DATE SAMPLED	08/27/96	08/27/96	08/27/96	08/27/96	08/27/96	08/27/96	08/27/96	5/13/2000	5/13/2000	5/13/2000	5/13/2000	5/13/2000	5/13/2000	5/13/2000
DEPTH	0-4"	0-4"	4-8"	0-4"	4-8"	0-4"	4-8"							
VOLATILES (ug/kg)														
Acetone	25 U	26 U	48 B	130 B	74 B	34 U	22 U	29 B	9 J	29 BJ	6 J	19	13 R	15 J
Vinyl Chloride	25 U	26 U	24 U	33 U	28 U	34 U	22 U	17 U	15 U	6 J	13 U	17 U	13 U	18 UJ
SEMIVOLATILES (ug/kg)														
Benzo(a)anthracene	830 U	850 U	800 U	1100 U	930 U	1100 U	730 U	99 J	83 J	510 UJ	440 UJ	120 J	430 UJ	410 UJ
Benzo(a)pyrene	830 U	850 U	800 U	1100 U	930 U	1100 U	730 U	100 J	89 J	510 UJ	440 UJ	130 J	430 UJ	410 UJ
Benzo(b)fluoranthene	830 U	850 U	800 U	1100 U	930 U	1100 U	730 U	130 J	100 J	510 UJ	440 UJ	200 NJ	430 UJ	410 UJ
Benzo(g,h,i)perylene	830 U	850 U	800 U	1100 U	930 U	1100 U	730 U	77 J	69 J	510 UJ	440 UJ	550 UJ	430 UJ	410 UJ
Benzo(k)fluoranthene	830 U	850 U	800 U	1100 U	930 U	1100 U	730 U	110 J	150 J	510 UJ	440 UJ	230 NJ	430 UJ	410 UJ
Bis(2-ethylhexyl)phthalate	830 U	850 U	800 U	1100 U	1200	1100 U	730 U	34000 D	160 J	2900 J	95 J	540 J	210 J	410 UJ
Chrysene	830 U	850 U	800 U	1100 U	930 U	1100 U	730 U	130 J	150 J	510 UJ	440 UJ	140 J	430 UJ	410 UJ
Di-n-octyl Phthalate	830 U	850 U	800 U	1100 U	930 U	1100 U	730 U	560 UJ	500 UJ	65 J	440 UJ	550 UJ	430 UJ	410 UJ
Fluoranthene	830 U	850 U	800 U	1100 U	930 U	1100 U	730 U	290 J	290 J	57 J	440 UJ	230 J	430 UJ	410 UJ
Indeno(1,2,3-cd)pyrene	830 U	850 U	800 U	1100 U	930 U	1100 U	730 U	81 J	76 J	510 UJ	440 UJ	78 J	430 UJ	410 UJ
Phenanthrene	830 U	850 U	800 U	1100 U	930 U	1100 U	730 U	210 J	500 UJ	510 UJ	440 UJ	130 J	430 UJ	410 UJ
Pyrene	830 U	850 U	800 U	1100 U	930 U	1100 U	730 U	240 J	240 J	55 J	440 UJ	230 J	45 J	410 UJ
EXPLOSIVES (ug/kg)														
2,4,6-Trinitrotoluene	120 U	120 U	120 U	120 U	120 U	120 U	120 U	12.11 J	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
2-Amino-4,6-dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	3.366 J	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
4-Amino-2,6-dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	2.738 J	0.48 U	0.48 U	0.48 U	0.48 U	0.48 U	0.48 U

TABLE A-5 (Continued)

SEDIMENT - POSITIVE DETECTION SUMMARY
ORGANIC COMPOUNDS
SITE 8
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

	MINIMUM NONDETECT	MAXIMUM NONDETECT	MINIMUM DETECT	MAXIMUM DETECT	LOCATION OF MAXIMUM DETECTION	FREQUENCY OF DETECTION	AVERAGE OF POSITIVE DETECTIONS	MEDIAN OF POSITIVE DETECTIONS
VOLATILES (ug/kg)								
Acetone	22 U	130 B	6 J	19	8SD06-01	4/13	12.25	12
Vinyl Chloride	13 U	34 U	6 J	6 J	8SD05-01	1/14	6	6
SEMIVOLATILES (ug/kg)								
Benzo(a)anthracene	410 UJ	1100 U	83 J	120 J	8SD06-01	3/14	100.67	99
Benzo(a)pyrene	410 UJ	1100 U	89 J	130 J	8SD06-01	3/14	106.33	100
Benzo(b)fluoranthene	410 UJ	1100 U	100 J	200 NJ	8SD06-01	3/14	143.33	130
Benzo(g,h,i)perylene	410 UJ	1100 U	69 J	77 J	8SD04-01	2/14	73	73
Benzo(k)fluoranthene	410 UJ	1100 U	110 J	230 NJ	8SD06-01	3/14	163.33	150
Bis(2-ethylhexyl)phthalate	410 UJ	1100 U	95 J	34000 D	8SD04-01	7/14	5586.43	540
Chrysene	410 UJ	1100 U	130 J	150 J	8SD04-02	3/14	140	140
Di-n-octyl Phthalate	410 UJ	1100 U	65 J	65 J	8SD05-01	1/14	65	65
Fluoranthene	410 UJ	1100 U	57 J	290 J	8SD04-01,8SD04-02	4/14	216.75	260
Indeno(1,2,3-cd)pyrene	410 UJ	1100 U	76 J	81 J	8SD04-01	3/14	78.33	78
Phenanthrene	410 UJ	1100 U	130 J	210 J	8SD04-01	2/14	75	170
Pyrene	410 UJ	1100 U	45 J	240 J	8SD04-01,8SD04-02	5/14	162	230
EXPLOSIVES (ug/kg)								
2,4,6-Trinitrotoluene	1.5 U	120 U	12.11 J	12.11 J	8SD04-01	1/14	12.11	12.11
2-Amino-4,6-dinitrotoluene	1.5 U	1.5 U	3.366 J	3.366 J	8SD04-01	1/7	3.37	3.37
4-Amino-2,6-dinitrotoluene	0.48 U	0.48 U	2.738 J	2.738 J	8SD04-01	1/7	2.74	2.74

TABLE A-6

SEDIMENT - POSITIVE DETECTION SUMMARY
TOTAL INORGANICS
SITE 8
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

SAMPLE ID	8SD01-01	8SD01-01D	8SD01-02	8SD02-01	8SD02-02	8SD03-01	8SD03-02	8SD04-01	8SD04-02	8SD05-01	8SD05-02	8SD06-01	8SD06-02	8SD06-02D
DATE SAMPLED	08/27/96	08/27/96	08/27/96	08/27/96	08/27/96	08/27/96	08/27/96	5/13/2000	5/13/2000	5/13/2000	5/13/2000	5/13/2000	5/13/2000	5/13/2000
DEPTH	0-4"	0-4"	4-8"	0-4"	4-8"	0-4"	4-8"							
TOTAL INORGANICS (mg/kg)														
Aluminum	21700	19100	22300	18400	12500	22300	19900	3520	3810	3340	3030	9370	6340	3360
Antimony	7 UL	5.9 UL	6.6 UL	7.4 UL	6.8 UL	7.9 UL	5.1 UL	0.65 U	0.67 J	0.65 U	0.63 J	0.91 J	0.55 U	0.7 J
Arsenic	8	8.2	10.9	9.7	10.8	12.3	9.3	1.3 J	1.7 J	1.6 J	1.3 J	4.6	4.1	3.3
Barium	41.3	36.6	43.1	39.7	29.2	42.9	35.7	155	61.4	77	29.7 J	101	58.2	25 J
Beryllium	1.5	1.5	1.7	0.99	0.97	1.4	1.3	0.17 J	0.24 J	0.21 J	0.14 J	0.34 J	0.33 J	0.23 J
Cadmium	1.3 U	1.1 U	1.2 U	1.3 U	1.2 U	1.6 K	0.93 U	0.17 J	0.29 J	0.15 J	0.16 J	0.39 J	0.11 J	0.05 U
Calcium	6510	3320	3650	3040	3320	5310	2380	2390	2710	1780	1360	1960	901 J	392 J
Chromium	46.7	42.9	49	39.2	30.3	47.7	47	8.7 J	12.8 J	11.7 J	7.3 J	25.2 J	14.2 J	9.8 J
Cobalt	8.3	7.9	9.5	6.7	5.2	8.8	8	2.2 J	1.9 J	1.5 J	1 J	3.3 J	4.1 J	1.4 J
Copper	10 J	8.6 J	9.1 J	16.2 J	13.7 J	15 J	9 J	49.4	60.5	24.6 J	14.2	36.1	15.9	3 J
Iron	36000	34600	38700	34100	29900	40800	38200	6850 J	7770 J	9120 J	4110 J	12700 J	10800 J	7950 J
Lead	12.7 L	19.4 L	18 L	23.6 L	19.8 L	19.7 L	11.1 L	15.4 J	19.5 J	20.3 J	14.8 J	51.4 J	13.8 J	9.9 J
Magnesium	7010	6590	7610	5740	4660	7190	7440	1080 J	628 J	552 J	566 J	830 J	482 J	303 J
Manganese	326	345	358	224	214	292	263	48.4	36.9	51.1	35.6	43.2	21.1	14.3
Mercury	0.11 U	0.09 U	0.11 U	0.14 U	0.11 U	0.12 U	0.08 U	0.1 J	0.12 J	0.13 J	0.09 J	0.57	0.14	0.05 J
Nickel	16.2	17.4	19.9	16.6	12.7	20.4	20.6	9.1 J	4.9 J	3.8 J	2.7 J	6.7 J	4.2 J	2.3 J
Potassium	4120	3940	4800	3370	2680	4110	4460	288 J	326 J	228 J	159 J	471 J	478 J	306 J
Sodium	5750	5830	6460	7310	6250	8360	5140	250 B	197 B	245 B	185 B	269 B	183 B	189 B
Thallium	0.75 UL	0.59 UL	0.51 UL	0.87 U	0.77 UL	0.95 UL	0.55 U	1 U	1.7 J	2.5 J	1.4 J	2.6 J	2.8	1.9 J
Vanadium	45.2	41.8	46.6	44.1	37	51.6	44.3	13 J	16.3	13.6 J	11	25.4	20.6	19.4
Zinc	66	61	66.9	104	86.9	101	64.2	66.9	90	56.7	43.4	87.7	29.9	12.5

TABLE A-6 (Continued)

SEDIMENT - POSITIVE DETECTION SUMMARY
TOTAL INORGANICS
SITE 8
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

	MINIMUM NONDETECT	MAXIMUM NONDETECT	MINIMUM DETECT	MAXIMUM DETECT	LOCATION OF MAXIMUM DETECTION	FREQUENCY OF DETECTION	AVERAGE OF POSITIVE DETECTIONS	MEDIAN OF POSITIVE DETECTIONS
TOTAL INORGANICS (mg/kg)								
Aluminum	ND	ND	3030	22300	8SD01-02,8SD03-01	14/14	12069.29	10935
Antimony	0.55 U	7.9 UL	0.63 J	0.91 J	8SD06-01	4/14	0.73	0.69
Arsenic	ND	ND	1.3 J	12.3	8SD03-01	14/14	6.22	6.3
Barium	ND	ND	25 J	155	8SD04-01	14/14	55.41	42.1
Beryllium	ND	ND	0.14 J	1.7	8SD01-02	14/14	0.79	0.66
Cadmium	0.05 U	1.3 U	0.11 J	1.6 K	8SD03-01	7/14	0.41	0.17
Calcium	ND	ND	392 J	6510	8SD01-01	14/14	2787.36	2550
Chromium	ND	ND	7.3 J	49	8SD01-02	14/14	28.04	27.75
Cobalt	ND	ND	1 J	9.5	8SD01-02	14/14	4.99	4.65
Copper	ND	ND	3 J	60.5	8SD04-02	14/14	20.38	14.6
Iron	ND	ND	4110 J	40800	8SD03-01	14/14	22257.14	21300
Lead	ND	ND	9.9 J	51.4 J	8SD06-01	14/14	19.24	18.7
Magnesium	ND	ND	303 J	7610	8SD01-02	14/14	3620.07	2870
Manganese	ND	ND	14.3	358	8SD01-02	14/14	162.33	132.55
Mercury	0.08 U	0.14 U	0.05 J	0.57	8SD06-01	7/14	0.17	0.12
Nickel	ND	ND	2.3 J	20.6	8SD03-02	14/14	11.25	10.9
Potassium	ND	ND	159 J	4800	8SD01-02	14/14	2124	1579
Sodium	183 B	269 B	5140	8360	8SD03-01	7/14	6442.86	6250
Thallium	0.51 UL	1 U	1.4 J	2.8	8SD06-02	6/14	2.15	2.2
Vanadium	ND	ND	11	51.6	8SD03-01	14/14	30.71	31.2
Zinc	ND	ND	12.5	104	8SD02-01	14/14	66.94	66.45

TABLE A-7

SURFACE SOIL - POSITIVE DETECTION SUMMARY
ORGANIC COMPOUNDS
SSA 14
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

SAMPLE ID	A14SB01-00	A14SB01-00D	A14SB02-00	A14SB03-00	A14SB04-00
DATE SAMPLED	01/19/97	01/19/97	01/19/97	01/19/97	01/19/97
DEPTH	0-5"	0-6"	0-5"	1-0"	0-5"
VOLATILES (ug/kg)					
1,1-Dichloroethane	13 U	12 U	18 U	18 U	20 J
1,1-Dichloroethene	13 U	12 U	18 U	18 U	14 J
1,2-Dichloroethene (total)	13 U	12 U	18 U	18 U	91
2-Hexanone (MBK)	13 U	3 J	18 U	18 UJ	43 U
4-Methyl-2-pentanone (MIBK)	13 U	6 J	18 U	18 UJ	43 U
Trichloroethene (TCE)	13 U	12 U	18 U	18 U	20 J
SEMIVOLATILES (ug/kg)					
Acenaphthene	120 J	410 U	580 U	2400 U	1500 U
Anthracene	170 J	410 U	580 U	2400 U	1500 U
Benzo(a)anthracene	340 J	410 U	580 U	510 J	1500 U
Benzo(a)pyrene	300 J	410 U	580 U	510 J	1500 U
Benzo(b)fluoranthene	350 J	410 U	580 U	2400 U	1500 U
Benzo(g,h,i)perylene	150 J	410 U	580 U	480 J	1500 U
Benzo(k)fluoranthene	130 J	410 U	580 U	2400 U	1500 U
Bis(2-ethylhexyl)phthalate	420 U	350 J	63 J	2400 J	1500 U
Carbazole	140 J	410 U	580 U	2400 U	1500 U
Chrysene	340 J	410 U	580 U	570 J	1500 U
Dibenz(a,h)anthracene	53 J	410 U	580 U	2400 U	1500 U
Dibenzofuran	54 J	410 U	580 U	2400 U	1500 U
Fluoranthene	870 J	410 UJ	580 U	1200 J	1500 U
Fluorene	100 J	410 U	580 U	2400 U	1500 U
Indeno(1,2,3-cd)pyrene	200 J	410 U	580 U	350 J	1500 U
Phenanthrene	850 J	410 UJ	580 U	1000 J	1500 U
Pyrene	880 J	410 UJ	580 U	1300 J	1500 U
PESTICIDES/PCBS (ug/kg)					
Chlordane, alpha-	2.1 U	2.1 U	2.9 U	3.8 J	37 U
Chlordane, gamma-	0.074 J	2.1 U	2.9 U	5.4 J	37 U
Dieldrin	0.34 J	4.2 U	0.54 J	12 U	73 U
Endosulfan I	0.26 J	2.1 U	2.9 U	0.84 J	37 U
Endrin Ketone	4.2 U	4.2 U	5.8 U	1.7 J	73 U
EXPLOSIVES (mg/kg)					
2,6-Dinitrotoluene	0.26	0.44	0.25 U	1200 U	0.25 U
HMX	0.5 U	0.5 U	4	17000	0.81

TABLE A-7 (Continued)

SURFACE SOIL - POSITIVE DETECTION SUMMARY
ORGANIC COMPOUNDS
SSA 14
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

	MINIMUM NONDETECT	MAXIMUM NONDETECT	MINIMUM DETECT	MAXIMUM DETECT	LOCATION OF MAXIMUM DETECTION	FREQUENCY OF DETECTION	AVERAGE OF POSITIVE DETECTIONS	MEDIAN OF POSITIVE DETECTIONS
VOLATILES (ug/kg)								
1,1-Dichloroethane	12 U	18 U	20 J	20 J	A14SB04-00	1/5	20	20
1,1-Dichloroethene	12 U	18 U	14 J	14 J	A14SB04-00	1/5	14	14
1,2-Dichloroethene (total)	12 U	18 U	91	91	A14SB04-00	1/5	91	91
2-Hexanone (MBK)	13 U	43 U	3 J	3 J	A14SB01-00D	1/5	3	3
4-Methyl-2-pentanone (MIBK)	13 U	43 U	6 J	6 J	A14SB01-00D	1/5	6	6
Trichloroethene (TCE)	12 U	18 U	20 J	20 J	A14SB04-00	1/5	20	20
SEMIVOLATILES (ug/kg)								
Acenaphthene	410 U	2400 U	120 J	120 J	A14SB01-00	1/5	120	120
Anthracene	410 U	2400 U	170 J	170 J	A14SB01-00	1/5	170	170
Benzo(a)anthracene	410 U	1500 U	340 J	510 J	A14SB03-00	2/5	425	425
Benzo(a)pyrene	410 U	1500 U	300 J	510 J	A14SB03-00	2/5	405	405
Benzo(b)fluoranthene	410 U	2400 U	350 J	350 J	A14SB01-00	1/5	350	350
Benzo(g,h,i)perylene	410 U	1500 U	150 J	480 J	A14SB03-00	2/5	315	315
Benzo(k)fluoranthene	410 U	2400 U	130 J	130 J	A14SB01-00	1/5	130	130
Bis(2-ethylhexyl)phthalate	420 U	1500 U	63 J	2400 J	A14SB03-00	3/5	937.67	350
Carbazole	410 U	2400 U	140 J	140 J	A14SB01-00	1/5	140	140
Chrysene	410 U	1500 U	340 J	570 J	A14SB03-00	2/5	455	455
Dibenz(a,h)anthracene	410 U	2400 U	53 J	53 J	A14SB01-00	1/5	53	53
Dibenzofuran	410 U	2400 U	54 J	54 J	A14SB01-00	1/5	54	54
Fluoranthene	410 UJ	1500 U	870 J	1200 J	A14SB03-00	2/5	1035	1035
Fluorene	410 U	2400 U	100 J	100 J	A14SB01-00	1/5	100	100
Indeno(1,2,3-cd)pyrene	410 U	1500 U	200 J	350 J	A14SB03-00	2/5	275	275
Phenanthrene	410 UJ	1500 U	850 J	1000 J	A14SB03-00	2/5	925	925
Pyrene	410 UJ	1500 U	880 J	1300 J	A14SB03-00	2/5	1090	1090
PESTICIDES/PCBS (ug/kg)								
Chlordane, alpha-	2.1 U	37 U	3.8 J	3.8 J	A14SB03-00	1/5	3.8	3.8
Chlordane, gamma-	2.1 U	37 U	0.074 J	5.4 J	A14SB03-00	2/5	2.74	2.74
Dieldrin	4.2 U	73 U	0.34 J	0.54 J	A14SB02-00	2/5	0.44	0.44
Endosulfan I	2.1 U	37 U	0.26 J	0.84 J	A14SB03-00	2/5	0.55	0.55
Endrin Ketone	4.2 U	73 U	1.7 J	1.7 J	A14SB03-00	1/5	1.7	1.7
EXPLOSIVES (mg/kg)								
2,6-Dinitrotoluene	0.25 U	1200 U	0.26	0.44	A14SB01-00D	2/5	0.35	0.35
HMX	0.5 U	0.5 U	0.81	17000	A14SB03-00	3/5	5668.27	4

TABLE A-8

SURFACE SOIL - POSITIVE DETECTION SUMMARY
TOTAL INORGANICS
SSA 14
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

SAMPLE ID	A14SB01-00	A14SB01-00D	A14SB02-00	A14SB03-00	A14SB04-00
DATE SAMPLED	01/19/97	01/19/97	01/19/97	01/19/97	01/19/97
DEPTH	0-5"	0-6"	0-5"	1-0"	0-5"
TOTAL INORGANICS (mg/kg)					
Aluminum	11000	12600	9520	9980	18200
Antimony	0.76 U	0.75 UL	1.1 L	1.1 UL	2.7 UL
Arsenic	7.6	9.1	8.3 J	3.2 J	14.5
Barium	29.9	39.3	14.2	2460	36.9
Beryllium	0.34	0.46	0.38	0.37 U	0.88 U
Calcium	1450	1380	844 J	1530 J	4010
Chromium	29.5	30.9	22.3	30.8	39.4
Cobalt	3.5	4.2	2.8	2	9.9
Copper	6.4 K	7 K	8.5	113	20.5 K
Cyanide, total	0.07 U	0.07 U	0.1 U	2.8	0.25 U
Iron	20900	22800	18300	14600	28600
Lead	11.7	16.2	12.4	124	39.3
Magnesium	2160	2080	1500	2470	5980
Manganese	58.1	58.8	44.1 J	115 J	269
Mercury	0.06 U	0.06 U	0.09 UL	0.28 L	0.29
Nickel	6.1	8.3	6.2	20.2	21.5
Potassium	2080	2070	1310	1260	3290
Silver	2.5 U	0.25 U	0.35 U	0.37 U	2
Sodium	34.2	53	1980	402	6880
Thallium	0.76 U	1.2 K	1 U	1.8 K	2.7 U
Vanadium	28.6	35.9	36.1	64	85.3
Zinc	41.7 J	49.9 J	30.8 J	318 J	141 J

TABLE A-8 (Continued)

SURFACE SOIL - POSITIVE DETECTION SUMMARY
TOTAL INORGANICS
SSA 14
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

	MINIMUM NONDETECT	MAXIMUM NONDETECT	MINIMUM DETECT	MAXIMUM DETECT	LOCATION OF MAXIMUM DETECTION	FREQUENCY OF DETECTION	AVERAGE OF POSITIVE DETECTIONS	MEDIAN OF POSITIVE DETECTIONS
TOTAL INORGANICS (mg/kg)								
Aluminum	ND	ND	9520	18200	A14SB04-00	5/5	12260	11000
Antimony	0.75 UL	2.7 UL	1.1 L	1.1 L	A14SB02-00	1/5	1.1	1.1
Arsenic	ND	ND	3.2 J	14.5	A14SB04-00	5/5	8.54	8.3
Barium	ND	ND	14.2	2460	A14SB03-00	5/5	516.06	36.9
Beryllium	0.37 U	0.88 U	0.34	0.46	A14SB01-00D	3/5	0.39	0.38
Calcium	ND	ND	844 J	4010	A14SB04-00	5/5	1842.8	1450
Chromium	ND	ND	22.3	39.4	A14SB04-00	5/5	30.58	30.8
Cobalt	ND	ND	2	9.9	A14SB04-00	5/5	4.48	3.5
Copper	ND	ND	6.4 K	113	A14SB03-00	5/5	31.08	8.5
Cyanide, total	0.07 U	0.25 U	2.8	2.8	A14SB03-00	1/5	2.8	2.8
Iron	ND	ND	14600	28600	A14SB04-00	5/5	21040	20900
Lead	ND	ND	11.7	124	A14SB03-00	5/5	40.72	16.2
Magnesium	ND	ND	1500	5980	A14SB04-00	5/5	2838	2160
Manganese	ND	ND	44.1 J	269	A14SB04-00	5/5	109	58.8
Mercury	0.06 U	0.09 UL	0.28 L	0.29	A14SB04-00	2/5	0.29	0.29
Nickel	ND	ND	6.1	21.5	A14SB04-00	5/5	12.46	8.3
Potassium	ND	ND	1260	3290	A14SB04-00	5/5	2002	2070
Silver	0.25 U	2.5 U	2	2	A14SB04-00	1/5	2	2
Sodium	ND	ND	34.2	6880	A14SB04-00	5/5	1869.84	402
Thallium	0.76 U	2.7 U	1.2 K	1.8 K	A14SB03-00	2/5	1.5	1.5
Vanadium	ND	ND	28.6	85.3	A14SB04-00	5/5	49.98	36.1
Zinc	ND	ND	30.8 J	318 J	A14SB03-00	5/5	116.28	49.9

TABLE A-9

SUBSURFACE SOIL - POSITIVE DETECTION SUMMARY
ORGANIC COMPOUNDS
SSA 14
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

SAMPLE ID	A14SB01-03	A14SB01-03D	A14SB01-06
DATE SAMPLED	01/18/97	01/18/97	01/18/97
DEPTH	3-6'	3-6'	8-11'

NO ORGANIC COMPOUNDS WERE DETECTI
IN THE SUBSURFACE SOIL

TABLE A-10

SUBSURFACE SOIL - POSITIVE DETECTION SUMMARY
TOTAL INORGANICS
SSA 14
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

SAMPLE ID	A14SB01-03	A14SB01-03D	A14SB01-06
DATE SAMPLED	01/18/97	01/18/97	01/18/97
DEPTH	3-6'	3-6'	8-11'
TOTAL METALS (mg/kg)			
Aluminum	9670	11000	4760
Antimony	0.79 L	0.74 UL	0.75 UL
Arsenic	16.7 J	12.7 J	6.2 J
Barium	20	18.8	17.6
Beryllium	1	0.99	0.3
Calcium	18300 J	21200 J	181000 J
Chromium	19.7	17	16.3
Cobalt	11.5	12.4	3.6
Copper	5.9	5.8	3.4
Iron	19700	15800	12600
Lead	13.5	11.9	3.4
Magnesium	1950	1790	2860
Manganese	87.8 J	91.8 J	104 J
Nickel	34.2	35.9	6.3
Potassium	1840	1410	1730
Sodium	290 B	297 B	1140
Thallium	0.81 K	0.87 K	0.82 K
Vanadium	18.4	13.7	14.2
Zinc	86.3 J	86.8 J	21.8 J

TABLE A-10 (Continued)

SUBSURFACE SOIL - POSITIVE DETECTION SUMMARY
TOTAL INORGANICS
SSA 14
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

	MINIMUM NONDETECT	MAXIMUM NONDETECT	MINIMUM DETECT	MAXIMUM DETECT	LOCATION OF MAXIMUM DETECTION	FREQUENCY OF DETECTION	AVERAGE OF POSITIVE DETECTIONS	MEDIAN OF POSITIVE DETECTIONS
TOTAL METALS (mg/kg)								
Aluminum	ND	ND	4760	11000	A14SB01-03D	3/3	8476.67	9670
Antimony	0.74 UL	0.75 UL	0.79 L	0.79 L	A14SB01-03	1/3	0.79	0.79
Arsenic	ND	ND	6.2 J	16.7 J	A14SB01-03	3/3	11.87	12.7
Barium	ND	ND	17.6	20	A14SB01-03	3/3	18.8	18.8
Beryllium	ND	ND	0.3	1	A14SB01-03	3/3	0.76	0.99
Calcium	ND	ND	18300 J	181000 J	A14SB01-06	3/3	73500	21200
Chromium	ND	ND	16.3	19.7	A14SB01-03	3/3	17.67	17
Cobalt	ND	ND	3.6	12.4	A14SB01-03D	3/3	9.17	11.5
Copper	ND	ND	3.4	5.9	A14SB01-03	3/3	5.03	5.8
Iron	ND	ND	12600	19700	A14SB01-03	3/3	16033.33	15800
Lead	ND	ND	3.4	13.5	A14SB01-03	3/3	9.6	11.9
Magnesium	ND	ND	1790	2860	A14SB01-06	3/3	2200	1950
Manganese	ND	ND	87.8 J	104 J	A14SB01-06	3/3	94.53	91.8
Nickel	ND	ND	6.3	35.9	A14SB01-03D	3/3	25.47	34.2
Potassium	ND	ND	1410	1840	A14SB01-03	3/3	1660	1730
Sodium	290 B	297 B	1140	1140	A14SB01-06	1/3	1140	1140
Thallium	ND	ND	0.81 K	0.87 K	A14SB01-03D	3/3	0.83	0.82
Vanadium	ND	ND	13.7	18.4	A14SB01-03	3/3	15.43	14.2
Zinc	ND	ND	21.8 J	86.8 J	A14SB01-03D	3/3	64.97	86.3

TABLE A-11

SEDIMENT - POSITIVE DETECTION SUMMARY
ORGANIC COMPOUNDS
SSA 14
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

SAMPLE ID	A14SD01-01	A14SD01-01D	A14SD01-02	A14SD02-01	A14SD02-02	A14SD03-01	A14SD03-02	A14SD04-01	A14SD04D-01	A14SD04-02
DATE SAMPLED	08/28/96	08/28/96	08/28/96	08/28/96	08/28/96	08/28/96	08/28/96	05-13-2000	05-13-2000	05-13-2000
DEPTH	0-4"	0-4"	4-8"	0-4"	4-8"	0-4"	4-8"			
VOLATILES (ug/kg)										
2-Butanone (MEK)	30 U	33 U	23 U	25 U	30 U	30 U	24 U	19 J	380 J	820
Acetone	96 B	200 B	47 B	25 U	71 B	36 B	24 U	99 B	85 B	87 U
Carbon Disulfide	12 J	38	22 J	10 J	35	30 U	24 U	18 J	10 J	87 U
SEMIVOLATILES (ug/kg)										
Benzo(a)anthracene	1000 U	1100 U	96 J	820 U	1000 U	1000 U	790 U	1300 UJ	1300 UJ	1400 UJ
Benzo(b)fluoranthene	1000 U	1100 U	120 J	820 U	1000 U	1000 U	790 U	1300 UJ	1300 UJ	1400 UJ
Bis(2-ethylhexyl)phthalate	6200	1100	160 J	820 U	1000 U	1000 U	790 U	240 J	1300 UJ	150 J
Chrysene	1000 U	1100 U	100 J	820 U	1000 U	1000 U	790 U	1300 UJ	1300 UJ	1400 UJ
Di-n-octyl Phthalate	1000 U	1100 U	750 U	820 U	1000 U	1000 U	790 U	1300 UJ	1300 UJ	480 J
Fluoranthene	1000 U	1100 U	240 J	820 U	1000 U	200 J	790 U	1300 UJ	1300 UJ	1400 UJ
Phenanthrene	1000 U	1100 U	170 J	820 U	1000 U	110 J	790 U	1300 UJ	1300 UJ	1400 UJ
Pyrene	1000 U	1100 U	290 J	820 U	1000 U	220 J	790 U	1300 UJ	1300 UJ	1400 UJ
EXPLOSIVES (ug/kg)										
RDX	540 U	540 U	540 U	540 U	540 U	540 U	540 U	627 J	2500 U	2500 U

TABLE A-11 (Continued)

SEDIMENT - POSITIVE DETECTION SUMMARY
ORGANIC COMPOUNDS
SSA 14
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

SAMPLE ID	A14SD05-01	A14SD05-02	A14SD06-01	A14SD06-02
DATE SAMPLED	05-14-2000	05-13-2000	05-14-2000	05-13-2000
DEPTH				
VOLATILES (ug/kg)				
2-Butanone (MEK)	34 U	40 U	34 U	33 U
Acetone	34 J	39 J	41	37
Carbon Disulfide	34 U	40 U	6 J	8 J
SEMIVOLATILES (ug/kg)				
Benzo(a)anthracene	1100 U	1300 U	1100 U	1100 U
Benzo(b)fluoranthene	1100 U	1300 U	1100 U	1100 U
Bis(2-ethylhexyl)phthalate	1500	1300 U	260 J	1100 U
Chrysene	1100 U	1300 U	1100 U	1100 U
Di-n-octyl Phthalate	1100 U	1300 U	1100 U	1100 U
Fluoranthene	1100 U	1300 U	1100 U	1100 U
Phenanthrene	1100 U	1300 U	1100 U	1100 U
Pyrene	1100 U	1300 U	1100 U	1100 U
EXPLOSIVES (ug/kg)				
RDX	2500 U	496.7 U	2500 U	2500 U

TABLE A-11 (Continued)

SEDIMENT - POSITIVE DETECTION SUMMARY
ORGANIC COMPOUNDS
SSA 14
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

	MINIMUM NONDETECT	MAXIMUM NONDETECT	MINIMUM DETECT	MAXIMUM DETECT	LOCATION OF MAXIMUM DETECTION	FREQUENCY OF DETECTION	AVERAGE OF POSITIVE DETECTIONS	MEDIAN OF POSITIVE DETECTIONS
VOLATILES (ug/kg)								
2-Butanone (MEK)	23 U	40 U	19 J	820	A14SD04-02	3/14	406.33	380
Acetone	24 U	200 B	34 J	41	A14SD06-01	4/14	37.75	38
Carbon Disulfide	24 U	87 U	6 J	38	A14SD01-01D	9/14	17.67	12
SEMIVOLATILES (ug/kg)								
Benzo(a)anthracene	790 U	1400 UJ	96 J	96 J	A14SD01-02	1/14	96	96
Benzo(b)fluoranthene	790 U	1400 UJ	120 J	120 J	A14SD01-02	1/14	120	120
Bis(2-ethylhexyl)phthalate	790 U	1300 U	150 J	6200	A14SD01-01	7/14	1372.86	260
Chrysene	790 U	1400 UJ	100 J	100 J	A14SD01-02	1/14	100	100
Di-n-octyl Phthalate	750 U	1300 U	480 J	480 J	A14SD04-02	1/14	480	480
Fluoranthene	790 U	1400 UJ	200 J	240 J	A14SD01-02	2/14	220	220
Phenanthrene	790 U	1400 UJ	110 J	170 J	A14SD01-02	2/14	140	140
Pyrene	790 U	1400 UJ	220 J	290 J	A14SD01-02	2/14	255	255
EXPLOSIVES (ug/kg)								
RDX	496.7 U	2500 U	627 J	627 J	A14SD04-01	1/14	627	627

TABLE A-12

SEDIMENT - POSITIVE DETECTION SUMMARY
TOTAL INORGANICS
SSA 14
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

SAMPLE ID	A14SD01-01	A14SD01-01D	A14SD01-02	A14SD02-01	A14SD02-02	A14SD03-01	A14SD03-02	A14SD04-01	A14SD04D-01	A14SD04-02
DATE SAMPLED	08/28/96	08/28/96	08/28/96	08/28/96	08/28/96	08/28/96	08/28/96	05-13-2000	05-13-2000	05-13-2000
DEPTH	0-4"	0-4"	4-8"	0-4"	4-8"	0-4"	4-8"			
TOTAL INORGANICS (mg/kg)										
Aluminum	15400	18200	16900	29300	20500	23400	24500	23400	18900	19900
Antimony	6.3 UL	7.7 UL	4.5 UL	7.1 L	6.5 UL	7.8 UL	4.8 UL	1.2 UL	1.2 UL	1.3 UL
Arsenic	10.3	10.7	7.8	9.8	10.7	13	11.1	13.2	12.9	13.5
Barium	32.6	38.3	34.2	52.3	39.3	48.5	44.6	44.2 J	36.2 J	38.3 J
Beryllium	0.81	1.1	1	1.6	1.3	1.2	1.2	1.1 J	0.79 J	0.76 J
Cadmium	1.1 U	1.4 U	0.81 U	1.1 U	1.2 U	1.4 U	0.86 U	0.35 J	0.23 U	0.26 U
Calcium	5660	3380	3590	2590	2910	24000	2940	2810 J	2270 J	2440 J
Chromium	32.6	37.8	37.4	57.6	43.9	44.1	48.2	45.6	38.2	40.3
Cobalt	5.5	6.8	7.3	9.9	8	7.2	8.9	10 J	7.9 J	8.4 J
Copper	45.7 J	15.2 J	12.4 J	10.2 J	11.5 J	16 J	12.3 J	24.9	20	20.2 J
Cyanide	1.2 U	0.94 U	0.83 U	0.94 U	1.4 U	0.84 U	0.85 U	0.34 J	0.17 U	0.19 U
Iron	29800	34100	30500	42500	36200	34400	36700	39600	32700	34700
Lead	26.7 L		12.5 L	15.5 L	16.2 L	25.9 L	25.7 L	36.5	31.5	32.2
Magnesium	4680	5470	5280	7920	6250	6120	6030	6510	5380	5680
Manganese	226	279	319	450	335	269	331	434	372	376
Mercury	0.11 U	0.14	0.1 U	0.11 U	0.12 U	0.15 U	0.1 U	0.22 L	0.22 L	0.21 L
Nickel	15.7	19.3	13.8	21.7	18.3	18.3	18.3	20.6 J	16.7 J	17.2 J
Potassium	2790	3300	3460	5180	3670	3680	3910	3950 J	3120 J	3370 J
Selenium	0.84 U	0.92 U	0.78 U	0.76 U	0.91 U	0.73 U	0.62 U	3.4 L	3 L	3.3 L
Silver	1.4	1.7 U	0.97 U	1.3 U	1.4 U	3.7	1 U	4 J	4.5 J	4.8 J
Sodium	5280	6920	4850	5490	6130	6800	3920	6870 J	7000 J	7560 J
Vanadium	40.1	46.1	39.6	56.1	46.4	50.4	50.5	68.6	59.5	61.8
Zinc	83.3	102	66.7	78.1	84	106	71.3	142	109	110

TABLE A-12 (Continued)

SEDIMENT - POSITIVE DETECTION SUMMARY
TOTAL INORGANICS
SSA 14
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

SAMPLE ID	A14SD05-01	A14SD05-02	A14SD06-01	A14SD06-02
DATE SAMPLED	05-14-2000	05-13-2000	05-14-2000	05-13-2000
DEPTH				
TOTAL INORGANICS (mg/kg)				
Aluminum	23800	7830	23500	21600
Antimony	1 UL	0.39 UL	1 UL	0.92 UL
Arsenic	11.5	3.9	12	14.8
Barium	44.9 J	14.6 J	42.8 J	39.5 J
Beryllium	1.1 J	0.35 J	0.99 J	0.84 J
Cadmium	0.2 U	0.08 U	0.21 U	0.18 U
Calcium	2720 J	869 J	2880 J	2580 J
Chromium	46.4	15.4	45	41.2
Cobalt	9.2 J	3 J	9.2 J	8.3 J
Copper	24.6	8	24.6	23.5
Cyanide	0.15 U	0.06 U	0.15 U	0.15 U
Iron	35700	13200	40600	36100
Lead	32.3	11.5	33.2	31.1
Magnesium	6690	2290	6670	6040
Manganese	360	167	426	433
Mercury	0.17 L	0.07 L	0.2 L	0.25 L
Nickel	19.5 J	6.7 J	20.1 J	18.1 J
Potassium	3900 J	1390 J	3960 J	3690 J
Selenium	2.4 L	0.89 L	2.9 L	2.9 L
Silver	2.5 J	1.2 J	3.6 J	5 J
Sodium	7660 J	2860 J	7730 J	7580 J
Vanadium	60.7	21.4	62.1	57.4
Zinc	123	42.2	133	119

TABLE A-12 (Continued)

SEDIMENT - POSITIVE DETECTION SUMMARY
TOTAL INORGANICS
SSA 14
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

	MINIMUM NONDETECT	MAXIMUM NONDETECT	MINIMUM DETECT	MAXIMUM DETECT	LOCATION OF MAXIMUM DETECTION	FREQUENCY OF DETECTION	AVERAGE OF POSITIVE DETECTIONS	MEDIAN OF POSITIVE DETECTIONS
TOTAL INORGANICS (mg/kg)								
Aluminum	ND	ND	7830	29300	A14SD02-01	14/14	20509.29	21050
Antimony	0.39 UL	7.8 UL	7.1 L	7.1 L	A14SD02-01	1/14	7.1	7.1
Arsenic	ND	ND	3.9	14.8	A14SD06-02	14/14	11.09	11.3
Barium	ND	ND	14.6 J	52.3	A14SD02-01	14/14	39.31	39.4
Beryllium	ND	ND	0.35 J	1.6	A14SD02-01	14/14	1.01	1.05
Cadmium	0.08 U	1.4 U	0.35 J	0.35 J	A14SD04-01	1/14	0.35	0.35
Calcium	ND	ND	869 J	24000	A14SD03-01	14/14	4402.79	2845
Chromium	ND	ND	15.4	57.6	A14SD02-01	14/14	40.98	42.55
Cobalt	ND	ND	3 J	10 J	A14SD04-01	14/14	7.83	8.15
Copper	ND	ND	8	45.7 J	A14SD01-01	14/14	19.22	18
Cyanide	0.06 U	1.4 U	0.34 J	0.34 J	A14SD04-01	1/14	0.34	0.34
Iron	ND	ND	13200	42500	A14SD02-01	14/14	34057.14	35200
Lead	ND	ND	11.5	36.5	A14SD04-01	13/13	25.45	26.7
Magnesium	ND	ND	2290	7920	A14SD02-01	14/14	5786.43	6035
Manganese	ND	ND	167	450	A14SD02-01	14/14	341.21	347.5
Mercury	0.1 U	0.15 U	0.07 L	0.25 L	A14SD06-02	8/14	0.19	0.21
Nickel	ND	ND	6.7 J	21.7	A14SD02-01	14/14	17.45	18.3
Potassium	ND	ND	1390 J	5180	A14SD02-01	14/14	3526.43	3675
Selenium	0.62 U	0.92 U	0.89 L	3.4 L	A14SD04-01	7/14	2.68	2.9
Silver	0.97 U	1.7 U	1.2 J	5 J	A14SD06-02	9/14	3.41	3.7
Sodium	ND	ND	2860 J	7730 J	A14SD06-01	14/14	6189.29	6835
Vanadium	ND	ND	21.4	68.6	A14SD04-01	14/14	51.48	53.3
Zinc	ND	ND	42.2	142	A14SD04-01	14/14	97.83	104

ATTACHMENT B
PROPOSED ECOLOGICAL PRELIMINARY REMEDIATION GOALS

Proposed Ecological Preliminary Remediation Goals
Site 8 and SSA 14
Naval Weapons Station Yorktown, Yorktown, Virginia

Background

The Remedial Investigation (RI) report for Site 8 and Site Screening Area (SSA 14) was finalized on June 30, 2004 (Baker, 2004). The RI recommended further ecological investigation of both sites based on the potential for unacceptable risks from the following chemicals:

Site 8		SSA 14	
Soil	Sediment	Soil	Sediment
2,4,6-Trinitrotoluene[1] Amino-Dinitrotoluenes (mixture) HMX RDX Aroclor-1260[2] Chromium Iron Mercury Vanadium Zinc	Bis(2-ethylhexyl) phthalate	Bis(2-ethylhexyl) phthalate[3] HMX Chromium Iron Mercury Vanadium Zinc	Bis(2-ethylhexyl) phthalate[3] Selenium

Notes:

[1] 2,4,6-TNT in soils did not pose unacceptable risks to terrestrial receptors but had the potential to migrate to downgradient aquatic habitats.
[2] Potential impacts identified to both upper and lower trophic level ecological receptors.
[3] Analytical uncertainties associated with bis(2-ethylhexyl)phthalate required further investigation.

Based on the results and recommendations of the RI, the Yorktown Partnering Team agreed during the June 2004 meeting to perform a pre-removal characterization of soils and sediments at Site 8 and SSA 14. As outlined in Consensus Statement 6-24-04-40, a removal action is planned at both sites if the characterization indicates that the extent of contamination is well defined. The work plan outlining the objectives and approach of the investigation supporting this effort was finalized on June 1, 2005 (Baker, 2005); the field investigation was conducted from June 20 to June 22, 2005. The following discussion presents proposed ecological preliminary remediation goals for soil and sediment to be used to determine the extent of potentially impacted areas at Site 8 and SSA 14 requiring further investigation and/or remedial action.

Proposed Ecological Preliminary Remediation Goals

The limits of the removal action planned for Site 8 and SSA 14 will not be based on the collection of the site-specific ecological data of the type usually included in a baseline ecological risk assessment (BERA). Because of this, conservative ecological screening benchmarks will be used as ecological cleanup goals to ensure the protectiveness of the remedy. In cases where no established ecological screening value exists, a literature review of available effects levels was performed and a cleanup goal recommendation is presented based upon that review.

Soil

Bis(2-ethylhexyl)phthalate (BEHP) – The recommended ecological cleanup goal for BEHP in soil is 10 mg/kg. No USEPA Region III screening value is available for BEHP in soils. Only USEPA Region V has established a benchmark (USEPA, 2003). The Region V Ecological Screening Level (ESL) is 0.925 mg/kg; a value based on exposures to the masked shrew (*Sorex cinerus*). A search of the primary literature was performed as the Region V value is not indicative of impacts to terrestrial lower trophic level receptors, the receptors identified as potentially impacted in the RI Report. Two papers by Hulzebos et al. (1991 and 1993) and a PhD dissertation by Jensen (2004) were identified. Jensen (2004) provided a review of chronic threshold effects studies and presented new data (as published in Jensen et al., 2001) for impacts to springtails (*Folsomia candida*). The table below presents a summary of these No Observed Effects Concentration (NOEC), Lowest Observed Effect Concentration (LOEC), the tenth percentile effects concentration (EC_{10}) results. Jensen (2004) concluded that BEHP does not impact terrestrial receptors below 1,000 mg/kg. The 10 mg/kg proposed cleanup goal represents the minimum EC_{50} converted to a NOEC by the application of an uncertainty factor of 100, following Wentzel et al. (1994). The 95th percentile upper confidence limit (95% UCL) of BEHP in Soil Group 1 background soils is 0.231J mg/kg (Baker, 1995 and 2003). Use of the 95% UCL instead of the maximum recorded background value for comparisons was discussed and recommended to the team by the ecological subgroup during the August 17, 2005 partnering meeting. In addition, use of the Soil Group 1 background values was discussed and agreed to by the ecological subgroup, based on the saturated soils present at both Site 8 and SSA 14.

Receptor	Endpoint	Concentration	Reference
Springtail (*Folsomia candida*)	Juvenile survival EC_{10}	>1,000 mg/kg (10 mg/kg NOEC with /100 uncertainty factor)	Jensen et al., 2001
Springtail (*Folsomia candida*)	Growth EC_{10}	>1,000 mg/kg (10 mg/kg NOEC with /100 uncertainty factor)	Jensen et al., 2001
Springtail (*Folsomia candida*)	Adult survival EC_{10}	>5,000 mg/kg (50 mg/kg NOEC with /100 uncertainty factor)	Jensen et al., 2001
Springtail (*Folsomia candida*)	Reproduction EC_{10}	>5,000 mg/kg (50 mg/kg NOEC with /100 uncertainty factor)	Jensen et al., 2001
Lettuce (*Lactuca sativa*)	Growth EC_{50}	1,000 mg/kg (100 mg/kg NOEC with /100 uncertainty factor)	Hulzebos et. Al., 1991
Microorganisms	Respiration/ Nitrification NOEC	250 mg/kg	Kirchman and Tesgsved, 1991
Spinach and Peas	Growth NOEC	1,000 mg/kg	Herring and Bering, 1988
Oats (*Avena sativa*)	Growth LOEC	1,000 mg/kg (200 mg/kg NOEC with /5 uncertainty factor)	Stanley and Tapp, 1982, as reported in KEMI, 1994
Japanese Red Giant Mustard Lettuce (*Brassica rapus*)	Growth NOEC	1,000 mg/kg	Stanley and Tapp, 1982, as reported in KEMI, 1994
Lettuce (*Lactuca sativa*)	Growth NOEC	1,000,000 mg/kg	Hulzebos et. Al., 1993

Aroclor-1260 – The recommended ecological cleanup goal for Aroclor-1260 in soil is 0.1 mg/kg. Potentially unacceptable impacts to Aroclor-1260 exposures were identified at Site 8 for both lower trophic level and upper trophic level ecological receptors. The recommended cleanup goal of 0.1 mg/kg represents the lower of the screening values protective of these two receptor groups (0.1 mg/kg, BTAG

screening value protective of plants and invertebrates [USEPA, 1995], and 0.2 mg/kg, foodweb model NOAEL-based screening value protective of most sensitive receptor, short-tailed shrew).

Amino-Dinitrotoluenes – The recommended ecological cleanup goal for amino-dinitrotoluenes in soil is 1.3 mg/kg. No regulatory benchmarks were identified for either 2-amino-4,6-dinitrotolune (2-ADNT) or 4-amino-2,6-dinitrotolune (4-ADNT) in soils and no investigations were identified which studied the effects of either compound on soil invertebrates and/or plants. In the Ecological Soil Screening Level (Eco-SSL) development performed by Kuperman (2003), greater toxicity to 2,6-dinitrotolune was identified in weathered, versus freshly amended soils. This effect was suggested to be from the influence of parent compound degradation into amino-dinitrotoluenes. However, no amino-dinitrotoluene concentrations were reported and no thresholds effect value can be determined from the data presented by Kuperman (2003).

One document summarizing the current state of knowledge of the ecological impacts of amino-dinitrotoluenes on wildlife (mammals, birds, amphibians, and reptiles) was identified (USACHPPM, 2000). USACHPPM (2000) did not identify any studies on either birds or amphibians. USACHPPM (2000) did report one investigation into acute oral exposures from 2-ADNT and 4-ADNT to the mouse and rat (Ellis et al., 1980). The lowest median lethal dose concentrations (LD_{50}) reported were 1,394 mg/kg 2-ADNT and 959 mg/kg 4-ADNT, both for female rats. One study investigating the impacts of amino-DNTs on tiger salamanders was also identified by USACHPPM (2000). Johnson et al. (2000) exposed tiger salamanders (*Ambystoma tigrinum*) to spiked soil and earthworms over 14-days and recorded immunological, histopathological, and blood impacts. The initial concentrations of 2-ADT and 4-ADNT in soil were 39 mg/kg and 62 mg/kg, while initial earthworm concentrations were 2.1 to 2.6 ug/g 2-ADNT and 2.1 to 2.5 ug/g 4-ADNT. No adverse effects were reported. Based on this work, USACHPPM (2000) developed an acute NOAEL of 39 mg/kg for amino-dinitrotoluenes (lowest measured initial concentration). Application of a safety factor of 30 (acute NOAEL to chronic NOAEL, as outlined in Wentzel et al., 1994), yields a chronic NOAEL of 1.3 mg/kg. This value is the recommended ecological cleanup goal for amino-DNTs in soils. Confidence in this value as a level protective of invertebrates and plants is not high, as it is based on a single study to an amphibian species and included both direct contact (soil) and ingestion (earthworm) exposures. However, it represents the only available estimate of a threshold effect of amino-DNTs on ecological receptors. As amino-DNTs are present in the environment only as the degradation products of other nitroaromatic compounds (TNT, 2,4-dinitrotoluene and 2,6-dinitrotolune), remediation of TNT and amino-DNTs together may serve to mitigate some of the uncertainty associated with the 1.3 mg/kg amino-DNT cleanup level. Examination of the lowest NOEC of 25 mg/kg for TNT in the chronic nature of the studies outlined below indicates concentrations of total nitrotoluenes (TNT + 2-ADNT + 4-ADNT) below 25 mg/kg do not impact terrestrial receptors as degradation of TNT would have occurred during the experimental period, and the effects thresholds reported would have integrated the total parent and daughter product effect.

HMX – The recommended ecological cleanup goal for HMX in soil is 6.3 mg/kg. No regulatory benchmarks were identified for HMX in soils. Though several investigations into the chronic impacts of HMX to soil receptors were identified (Pennington et al. 1999, Robidoux et al., 2001, Robidoux et al., 2002, and Robidoux et al., 2003), the 6.3 mg/kg cleanup goal is based on the work performed by Kuperman (2003). Kuperman (2003) developed Ecological Soil Screening Values (Eco-SSLs) for RDX, HMX, 2,4-DNT, 2,6-DNT, and 1,3,5-trinitrobenzene for three species of terrestrial plants (alfalfa [*Medicago sativa*], Japanese millet [*Echinochloa crusgalli*], and perennial ryegrass [*Lolium perenne*]) and soil invertebrates (earthworms [*Eisenia fetida*], potworms [*Enchytraeus crypticus*], and springtails [*Folsomia candida*]) in freshly amended and weathered soil with physical and chemical parameters favoring high bioavailability. Eco-SSLs, representing the lowest chronic effects based concentration recorded for each of the six species, were recommended for each explosive chemical. No adverse impacts were measured for plant species at the highest concentration of HMX tested, indicating that HMX in soils

is not toxic to plants at concentrations below 10,000 mg/kg. The Eco-SSL for invertebrate exposures to HMX was 6.3 mg/kg. This value is lower than all those reported in the literature outlined above and is the recommended cleanup goal for soils at Site 8 and SSA 14.

RDX – The recommended ecological cleanup goal for RDX in soil is 21.1 mg/kg. No regulatory benchmarks were identified for RDX in soils. Investigations into the chronic impacts of RMX to soil microbes, plants, and invertebrate include Gong et al., 2001, Pennington et al. 1999, Robidoux et al., 2000, Robidoux et al., 2002, Robidoux et al., 2003, and Schafer and Achazi, 1999. Like HMX, the 21.1 mg/kg cleanup goal is based on the Eco-SSL work performed by Kuperman (2003). RDX was also not toxic to plants at the highest concentrations measured (10,000 mg/kg). The Eco-SSL for invertebrate exposures to HMX was 21.1 mg/kg. This value is lower than all those reported in the literature outlined above and is the recommended cleanup goal for soils at Site 8 and SSA 14.

2,4,6-Trinitrotoluene (TNT) – The recommended ecological cleanup goal for TNT in soil is 1.3 mg/kg. Concentrations of TNT were not identified in the RI datasets for either Site 8 or SSA 14 at levels with the potential to impact terrestrial ecological receptors. However, TNT was identified as a potential risk driver in Site 8 surface water and the daughter products of TNT (amino-DNTs) were identified as Site 8 risk drivers in soil. Based on the potential for migration and leaching of TNT present in source soils to surface water, as well as the fact that TNT is the parent compound of the two amino-dinitrotoluene compound soil risk drivers, the cleanup goal for TNT is conservatively set at the 1.3 mg/kg identified for amino-DNTs. The following paragraphs discuss toxicological data available for TNT in soils, which indicate that TNT is not toxic to terrestrial receptors at concentrations below 25 mg/kg. It is noted that there is uncertainty in the level of protectiveness associated with applying a screening value developed for terrestrial plants and invertebrates to aquatic lower trophic level receptors (i.e., utilizing terrestrial cleanup goals for TNT in soils to address their identification of risk drivers in surface water). However, performing sampling of surface water and sediments at Site 8 and in the branch of Felgates Creek adjacent to the site post-removal, once the source material in soils is removed, will mitigate the uncertainty and address the potential for continued ecological impacts.

No regulatory benchmarks were identified for TNT in soils. Efroymson et al. (1997b) identified only one study, examining the chronic impacts of TNT on soil nematodes and microarthropods (Parmalee et al. 1993), but declined to recommend the reported NOEC of 100 mg/kg as a benchmark. Several more recent investigations have been identified, however, which examined the chronic effects of TNT on the survival, growth, and/or reproduction of terrestrial plants and invertebrates. The table below presents these threshold effect concentrations. A 25 mg/kg value represents the lowest available NOEC, No Observed Effects Level (NOEL) or No Observed Adverse Effects Level (NOAEL) identified. However, based on the uncertainty associated with the available toxicological data for amino-dinitrotoluenes (described below), the most conservative value identified for TNT and the amino-DNTs (1.3 mg/kg) was identified as the preliminary ecological cleanup level for TNT in soils. This issue was discussed during the August 17, 2005 partnering meeting and the 1.3 mg/kg value was agreed to and recommended to the team by the ecological subgroup.

Receptor	Endpoint	Test	Concentration	Reference
Field mustard (*Brassica rapa*)	Growth NOEC	14-day study in natural soil	25 mg/kg	Gong et al., 1999
Garden cress (*Lepidum sativum*)	Growth NOEC	14-day study in natural soil	25 mg/kg	Gong et al., 1999
Earthworm (*Eisenia fetida*)	Growth NOAEL	56-day study in soil	50 mg/kg	Pennington et al., 1999

Receptor	Endpoint	Test	Concentration	Reference
Earthworm (*Eisenia andrei*)	Reproduction NOEC	56-day study in artificial soil	55 mg/kg	Robidoux et al., 2000
Earthworm (*Eisenia fetida*)	Reproduction NOAEL	56-day study in soil	100 mg/kg	Pennington et al., 1999
Earthworm (*Eisenia fetida*)	Growth NOEL	14-day study in artificial soil	110 mg/kg	Phillips et al., 1993
Earthworm (*Eisenia andrei*)	Survival NOEC	56-day study in sandy forest soil	136 mg/kg	Robidoux et al., 2002

Chromium – The recommended ecological cleanup goal for chromium in soil is 0.0075 mg/kg. Potentially unacceptable impacts to chromium exposures were identified for only lower trophic level ecological receptors. The recommended cleanup goal of 0.0075 mg/kg represents the USEPA Region III screening value (USEPA, 1995). The 95% UCL of chromium in Soil Group 1 background soils is 16.27 mg/kg (Baker, 1995 and 2003).

Iron – The recommended ecological cleanup goal for iron in soil is 200 mg/kg. Potentially unacceptable impacts to iron exposures were identified for only lower trophic level ecological receptors. The recommended cleanup goal of 200 mg/kg represents the screening value developed by Efroymson et al. (1997b). This value was used in the RI Report in place of the BTAG value, which is based on unadjusted oral ingestion exposure to rabbits (USEPA, 1995). The 95% UCL of iron in Soil Group 1 background soils is 11,276 mg/kg (Baker, 1995 and 2003).

Mercury – The recommended ecological cleanup goal for mercury in soil is 0.1 mg/kg. Potentially unacceptable impacts to mercury exposures were identified for only lower trophic level ecological receptors. The recommended cleanup goal of 0.1 mg/kg represents the screening value developed by Efroymson et al. (1997b). This value was used in the RI Report in place of the BTAG value, which is based on US Geological Survey background (USEPA, 1995). The 95% UCL of mercury in Soil Group 1 background soils is 0.1 mg/kg (Baker, 1995 and 2003).

Vanadium – The recommended ecological cleanup goal for vanadium in soil is 2 mg/kg. Potentially unacceptable impacts to vanadium exposures were identified for only lower trophic level ecological receptors. The recommended cleanup goal of 2 mg/kg represents the BTAG screening value (USEPA, 1995). The 95% UCL of vanadium in Soil Group 1 background soils is 23.07 mg/kg (Baker, 1995 and 2003).

Zinc – The recommended ecological cleanup goal for zinc in soil is 50 mg/kg. Potentially unacceptable impacts to zinc exposures were identified for only lower trophic level ecological receptors. The recommended cleanup goal of 50 mg/kg represents the screening value developed by Efroymson et al. (1997b). This value was used in the RI Report in place of the BTAG value, whose basis is unknown (USEPA, 1995). The 95% UCL of zinc in Soil Group 1 background soils is 38.42 mg/kg (Baker, 1995 and 2003).

Sediment

BEHP – The recommended ecological cleanup goal for BEHP in sediment is 0.18 mg/kg. Potentially unacceptable impacts to BEHP exposures were identified for lower trophic level ecological receptors and a considerable amount of analytical uncertainty was noted at both of the Site 8 and SSA 14 datasets. The recommended cleanup goal of 0.18 mg/kg represents the recently lowered USEPA Region III BTAG (USEPA, 2005) screening value for freshwater sediments (1.3 mg/kg BTAG 1995 value used in the RI report). BEHP was not detected in background tidal stream sediments (Baker, 1995). Pre-removal

sampling of tidally influenced sediments between Site 8 and Felgates Creek and in the branch of Felgates Creek itself adjacent to both Site 8 and SSA 14 has not been performed. As such, the sediment cleanup goal for BEHP presently applies only to marsh area contiguous to SSA 14.

Aroclor-1260 – The recommended ecological cleanup goal for Aroclor-1260 in sediment is 0.023 mg/kg. Aroclor-1260 was not identified as a risk driver in sediment at either Site 8 or SSA 14. However, a larger and more significant area of contamination was identified in Site 8 soils during the pre-removal field investigation than was known from the RI dataset alone. Because of this, the limit of the PCB contamination is not delineated and may extend into the adjacent tidally influenced wetland between the Site 8 drainage way and Felgates Creek. In the event that removal activities in this area would capture the extent of this contamination, an additional cleanup goal has been developed for Aroclor-1260 in sediment. The recommended 0.023 mg/kg ecological cleanup goal represents the BTAG screening value for marine sediment, which is based on the Effects Range Low (ER-L) values reported by Long et al. (1995). This value was used in place of the newly established BTAG sediment screening value protective of freshwater receptors (0.0598 mg/kg, USEPA 2005) as a conservative measure, based on the tidally brackish nature of the habitat in question. This issue was discussed during the August 17, 2005 partnering meeting and the 0.023 mg/kg value was agreed to and recommended to the team by the ecological subgroup.

Selenium – The recommended ecological cleanup goal for selenium in sediment is 1 mg/kg. Potentially unacceptable impacts to selenium exposures were identified for only lower trophic level ecological receptors at SSA 14. The recommended cleanup goal of 1 mg/kg represents the screening value developed by Buchman (1999) for marine sediment. This value is more conservative than the USEPA Region III BTAG value of 2.0 mg/kg for freshwater sediments. The more conservative value was chosen based on the tidally brackish nature of the habitat supported downgradient of SSA 14. The 95% UCL of selenium in is 0.92 mg/kg for tidal stream surface sediments and is 1.00 mg/kg in tidal stream subsurface sediments (Baker, 1995).

Summary

The following ecological preliminary cleanup goals are recommended for remedial activities at Site 8 and SSA 14. Human health preliminary cleanup goals and background concentrations will also be considered in the development of final cleanup goals.

Soil		Sediment	
BEHP	10 mg/kg	BEHP	0.18 mg/kg
Aroclor-1260	0.1 mg/kg	Aroclor-1260	0.023 mg/kg
Amino-Dinitrotoluenes (mixture)	1.3 mg/kg	Selenium	1 mg/kg
HMX	6.3 mg/kg		
RDX	21.1 mg/kg		
TNT	1.3 mg/kg		
Chromium	0.0075 mg/kg		
Iron	200 mg/kg		
Mercury	0.1 mg/kg		
Vanadium	2 mg/kg		
Zinc	50 mg/kg		

References

Baker. 2005. *Final Work Plan for the Pre-Removal Characterization of Soil. Site 2, Site 8, and Site Screening Area 14.* Naval Weapons Station Yorktown, Yorktown, Virginia. June 2005.

Baker. 2004. *Final Round II Remedial Investigation Report. Sites 2, 8, 18, and Site Screening Area 14.* Naval Weapons Station Yorktown, Yorktown, Virginia. June 2004.

Baker. 2003. *Final Background Study.* Naval Weapons Station Yorktown and Cheatham Annex Site. April 2003.

Baker. 1995. *Final Summary of Background Constituent Concentrations and Characterization of the Biotic Community from the York River Drainage Basin, Naval Weapons Station Yorktown, Yorktown, Virginia.* March 1995.

Buchman, M.F. 1999. *NOAA Screening Quick Reference Tables.* NOAA HAZMAT Report 99-1, Seattle, WA. 12 pp.

Ellis III, H.V., C.B. Hong, and C.C. Lee. 1980. Mammalian toxicity of munitions compounds. *Summary of Toxicity of Nitrotoluenes.* AD A080146. Prepared by the Midwest Research Institute, Kansas City, MO for the US Army Medical Research and Development Command, Fort Detrick, Frederick, MD.

Efroymson, R.A., Will, M.E., Suter II, G.W., and Wooten, A.C. 1997a. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 revision.* Oak Ridge National Laboratory. Oak Ridge, TN. (ES/ER/TM-85/R3).

Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997b. *Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrate and Heterotrophic Process: 1997 Revision.* US Department of Energy, Office of Environmental Management. ES/ER/TM-126-R2.

Gong, P, J. Hawari, S. Thiboutot, G. Ampleman, and G. Sunahara. 2001. Ecotoxicological Effects of Hexahydro-1,3,5-trinitro-1,3,5-triazine on Soil Microbial Activities. *Environmental Toxicology and Chemistry.* 20(5):947-951.

Gong, P., B.M. Wilke, and S. Fleischmann. 1999. Soil-based phytotoxicity of 2,4,6-trinitrotoluene (TNT) to terrestrial higher plants. *Arch. Environ. Contam. Toxicol.* 36(2): 152-158.

Herring R. and C.L. Bering. 1988. Effects of phthalate-esters on plant seedlings and reversal by a soil microorganism. *Bulletin of Environmental Contamination and Toxicology.* 40: 626-632.

Hulzebos, E.M., D.M.M. Adema, E.M. Dirven-Van Breemen, L. Henzen, W.A. Van Dis, H.A. Herbold, J.A. Hoekstra, and R. Baerselman. 1993. Phytotoxicity studies with *Lactuca sativa* in soil and nutrient solution. *Environmental Toxicology and Chemistry.* 12(6):1079-1094.

Hulzebos. E.M., D.M.M. Adema, D. Van Breemen, L. Henzen, C.A.M. Van Gestel. 1991. QSARs in phytotoxicity. *The Science of the Total Environment.* 109/110: 493-497.

Jensen, J. 2004. *Ecotoxicological Effect Assessment and Risk Characterization of Selected Contaminants in Sewage Sludge.* PhD Thesis. National Environmental Research Institute. Department of Terrestrial Ecology. ISBN 87-7834-611-8.

Jensen. J., J. Van Langevelde, G. Pritzl, and P.H. Krogh. 2001. Effects of di(2-ethylhexyl)phthalate and dibutyl phthalate on the collembolan *Folsomia fimetaria. Environmental Toxicology and Chemistry.* 20(5): 1085-1091.

Johnson, M.S., J.K. Vodela, G. Reddy, and S.D. Holladay. 2000. Fate and the biochemical effects of 2,4,6-Trinitrotoluene (TNT) exposure to tiger salamanders: (*Ambystoma tigrinum*). *Ecotoxicology and Environmental Safety*. 46:186-191.

KEMI. 1994. Phthalate acid esters used as plastic additives. *Ecological Risk Assessment (part 1) and Comparisons of Toxicological Effects (part 2).* Report no. 12/94 from The Swedish National Chemicals Inspectorate. 290 pp.

Kirchman. H. and A. Tesgsved. 1991. Organic pollutants in sewage sludge. *Swed. J. Agric. Res.* 21:115-119.

Kuperman, R. 2003. *Development of Ecological Toxicity and Biomagnification Data for Explosives Contaminants in Soils.* Final Technical Report, Project CU-1211. US Army Edgewood Chemical Biological Center.

Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. *Environ. Management.* 19(1):81-97.

Parmalee, R.W., R.S. Wentsel, C.T. Phillips, M. Simini, and R.T. Checkai. 1993. Soil microcosm for testing the effects of chemical pollutants on soil fauna communities and trophic structure. *Environmental Toxicology and Chemistry.* 12:1477-1486.

Pennington, J.C., K.A. Thorn, L.S. Inouye, V.A. McFarland, A.S. Jarvis, C.H, Lutz, C.A. Hayes, and B.E. Porter. 1999. *Explosives Conjugation Products in Remediation Matrices: Final Report.* US Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS.

Philips, C.T., R.T. Checkai, and R.S. Wentzel. 1993. *Toxicity of Selected Munitions and Munition-Contaminated Soil on the Earthworm* (Eisenia Foetida). Edgewood Research, Development and Engineering Center, Aberdeen Proving Ground. U.S. NTIS AD-A264408.

Robidoux PY, Bardai G, Paquet L, Ampleman G, Thiboutot S, Hawari J, Sunahara GI. 2003. Phytotoxicity of 2,4,6-trinitrotoluene (TNT) and octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) in spiked artificial and natural forest soils. *Arch Environ Contam Toxicol.* 44(2):198-209.

Robidoux PY, Hawari J, Bardai G, Paquet L, Ampleman G, Thiboutot S, Sunahara GI. 2002. TNT, RDX, and HMX decrease earthworm (*Eisenia andrei*) life-cycle responses in a spiked natural forest soil. *Arch Environ Contam Toxicol.* 43(4):379-88.

Robidoux PY, Hawari J, Thiboutot S, Ampleman G, Sunahara GI. 2001. Chronic toxicity of octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) in soil determined using the earthworm (*Eisenia andrei*) reproduction test. *Environ Pollut.* 111(2):283-92.

Robidoux, P.Y., C. Svendsen, J. Caumartin, J. Hawari, G. Ampleman, S. Thiboutot, J.M. Weeks, G.I. Sunahara. 2000. Chronic toxicity of energetic compounds in soil determination using the earthworm (*Eisenia andrei*) reproduction test. *Environ. Toxicol. Chem.* 19(7):1764-1773.

Schafer R, Achazi RK. 1999. The toxicity of soil samples containing TNT and other ammunition derived compounds in the Enchytraeid and Collembola-biotest. *Environ. Sc.i Pollut. Res. Int.* 6:213–219.

U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM). 2000. *Wildlife Toxicity Assessment for 2-Amino-4,6-Dinitrotoluene and 4-Amino-2,6-Dinitrotoluene.* Project Number 39-EJ1138-01C, Aberdeen Proving Ground, Maryland, October 2000.

U.S. Environmental Protection Agency (USEPA). 2005. *Region III - Biological Technical Assistance Group Screening Levels (Revised Freshwater Sediment Values).* Region III, Philadelphia, Pennsylvania. April, 2005. http://www.epa.gov/reg3hwmd/risk/eco/btag/sbv/fwsed/screenbench.htm.

USEPA. 2003. *USEPA Region V RCRA Corrective Action Ecological Screening Levels.* August 22, 2003 Update. http://www.epa.gov/Region5/rcraca/edql.htm.

USEPA. 1995. *Region III - Biological Technical Assistance Group Screening Levels (Revised).* Region III, Philadelphia, Pennsylvania. August, 1995.

Wentsel, R.S., T.W. LaPoint, M. Simini, R.T. Checkai, D. Ludwig, and L.W. Brewer, 1994. *Tri-Service Procedural Guidelines for Ecological Risk Assessments.* ADA297968. US Army ERDEC, Aberdeen Proving Ground, MD.